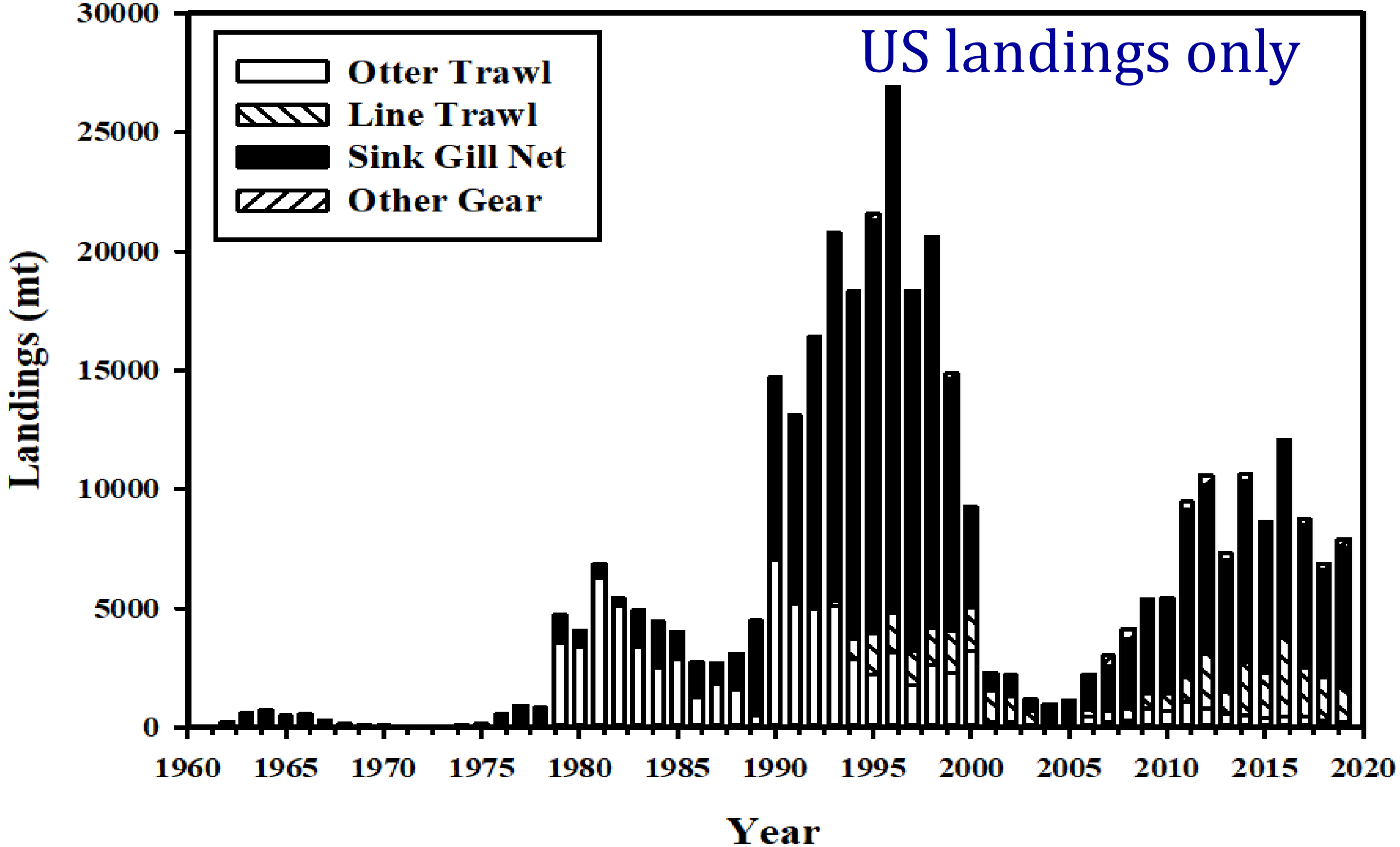
Spiny dogfish research track assessment, 2022

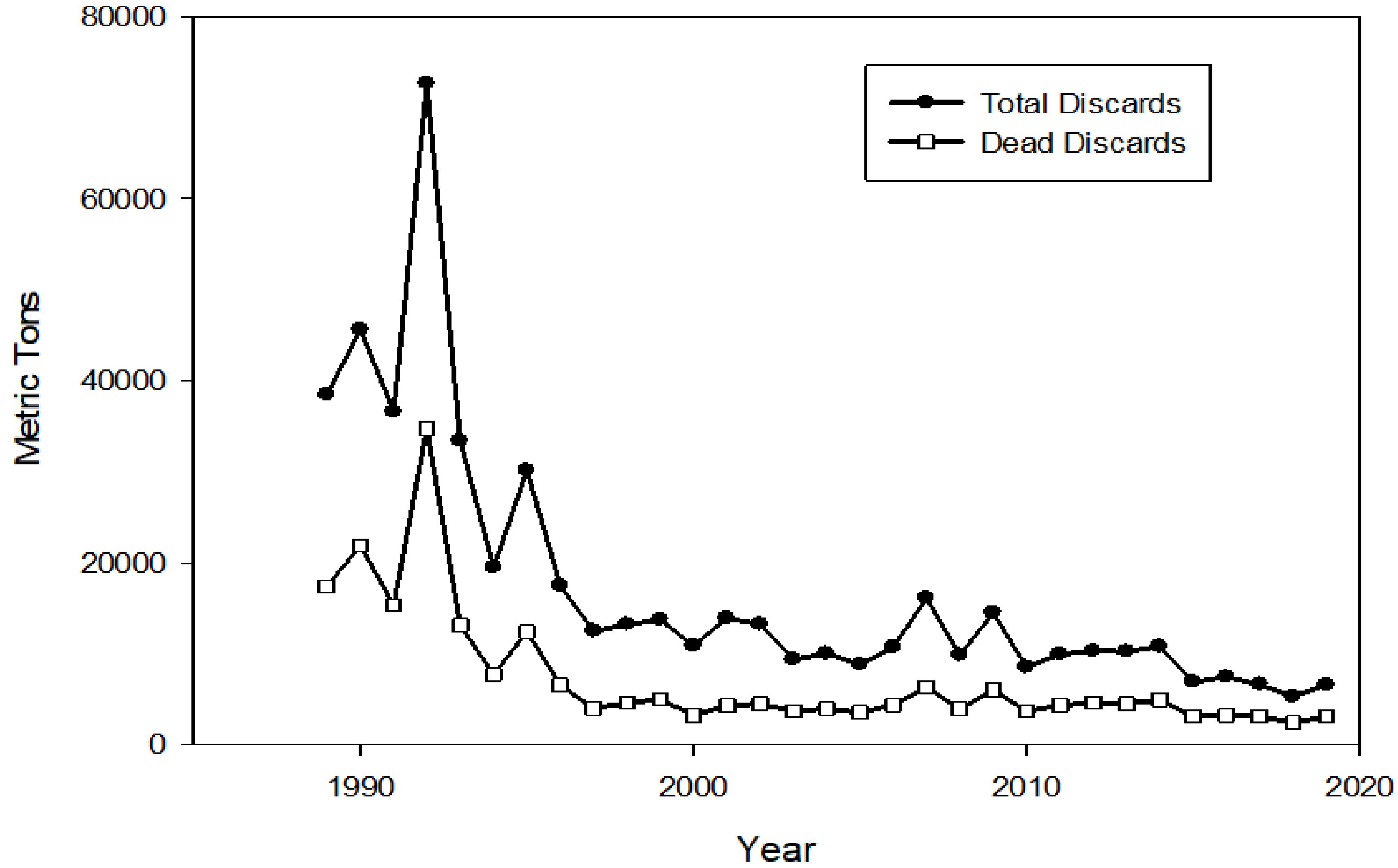
Landings

Gillnets have been the primary gear since 1989
Earlier landings were dominated by otter trawls, and in the 1960s and 70s, foreign trawlers



Discards

Discards have declined since the early 1990s but still comprise a substantial portion of the catch



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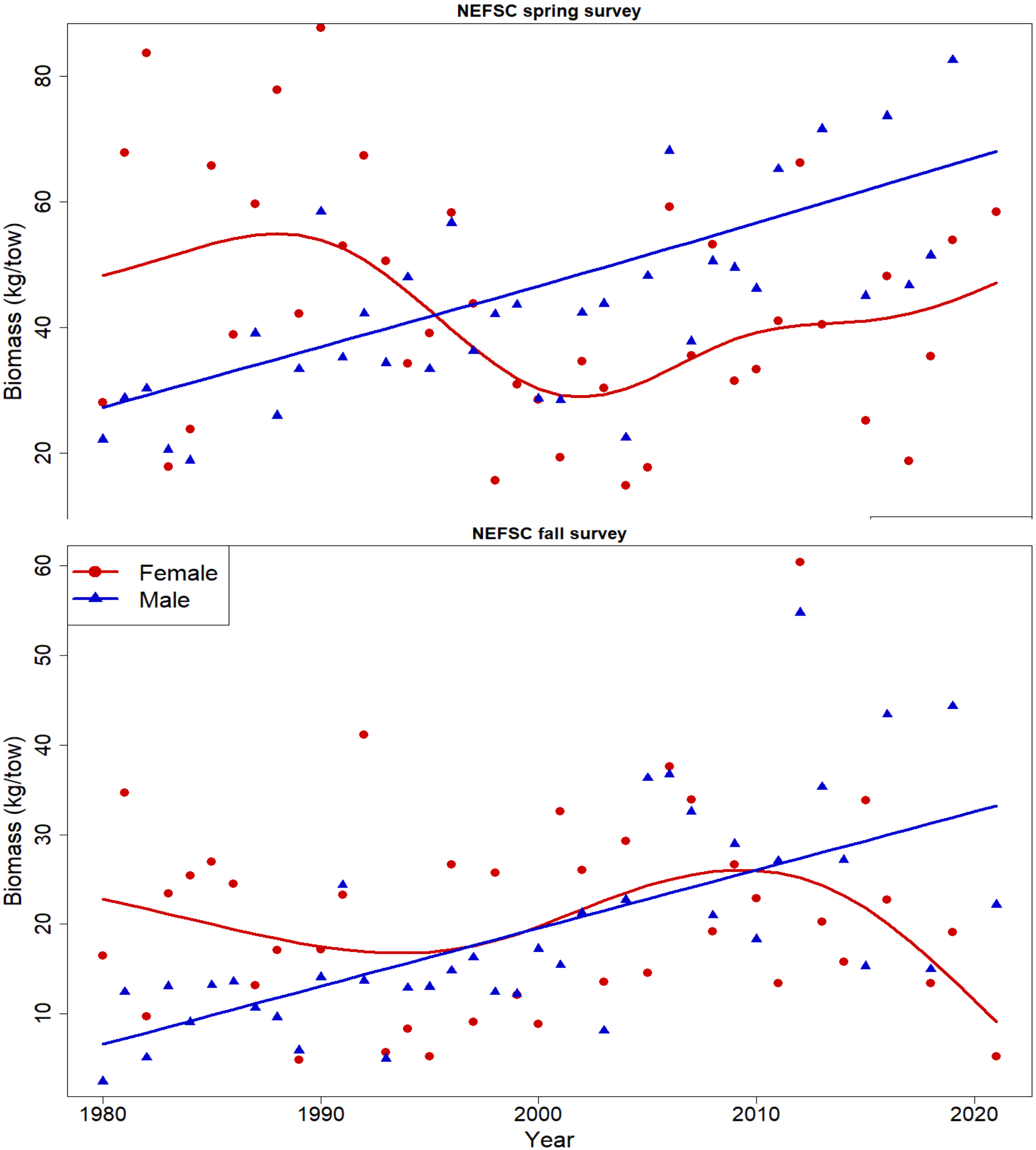

Surveys

Males increasing. Recent trend for females slightly increasing in the spring survey, decreasing in the fall survey.

However, SSB has been decreasing; 2022 spring SSB was lowest in time series.

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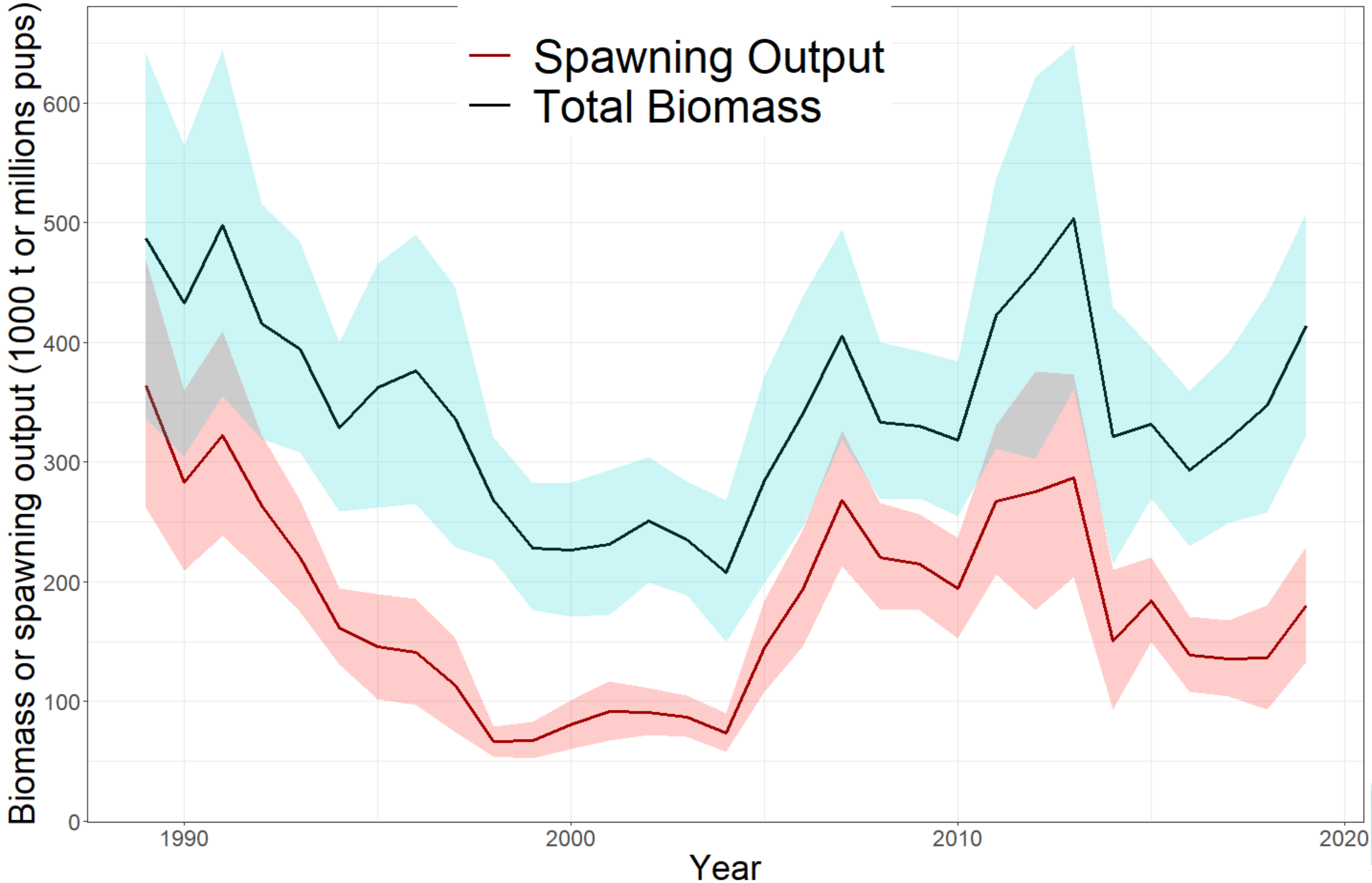
Surveys

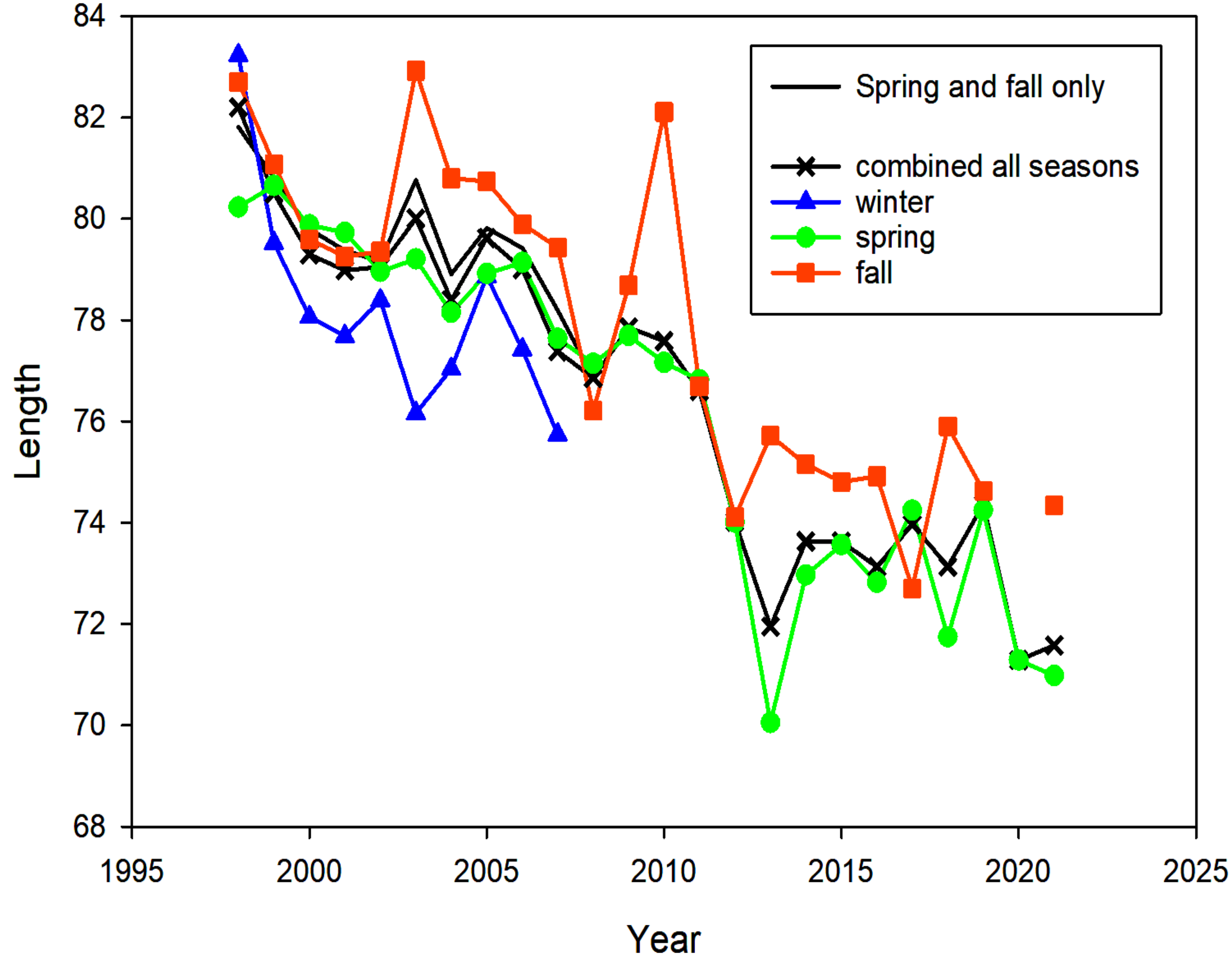
Spawning output (calculated pup production, similar to spawning stock biomass) has been low in recent years, based on the spring survey, due to the limited number of mature females. Consistent with this, recent recruitment has also been low.



Expanded spring survey trends, using a 3-year moving average smoother (Stochastic Estimator)

Life History

Decreasing length at maturity



Female spiny dogfish are maturing at smaller lengths in recent years and are not growing as large

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Stock Synthesis 3

Stock assessment model commonly used on the US west coast. It was recently successfully used to assess Pacific spiny dogfish

Does not require age data (not available for spiny dogfish) – can directly use length data instead (but still requires accurate growth information)

Can model sexes separately – important for spiny dogfish, which is sexually dimorphic and where only females are targeted

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Stock Synthesis 3 - Fleets

Separate “fleets” were used to account for the multiple gears that catch spiny dogfish, and for the differential selectivity of landings vs discards. The only survey used was the spring bottom trawl, which is also considered a fleet.

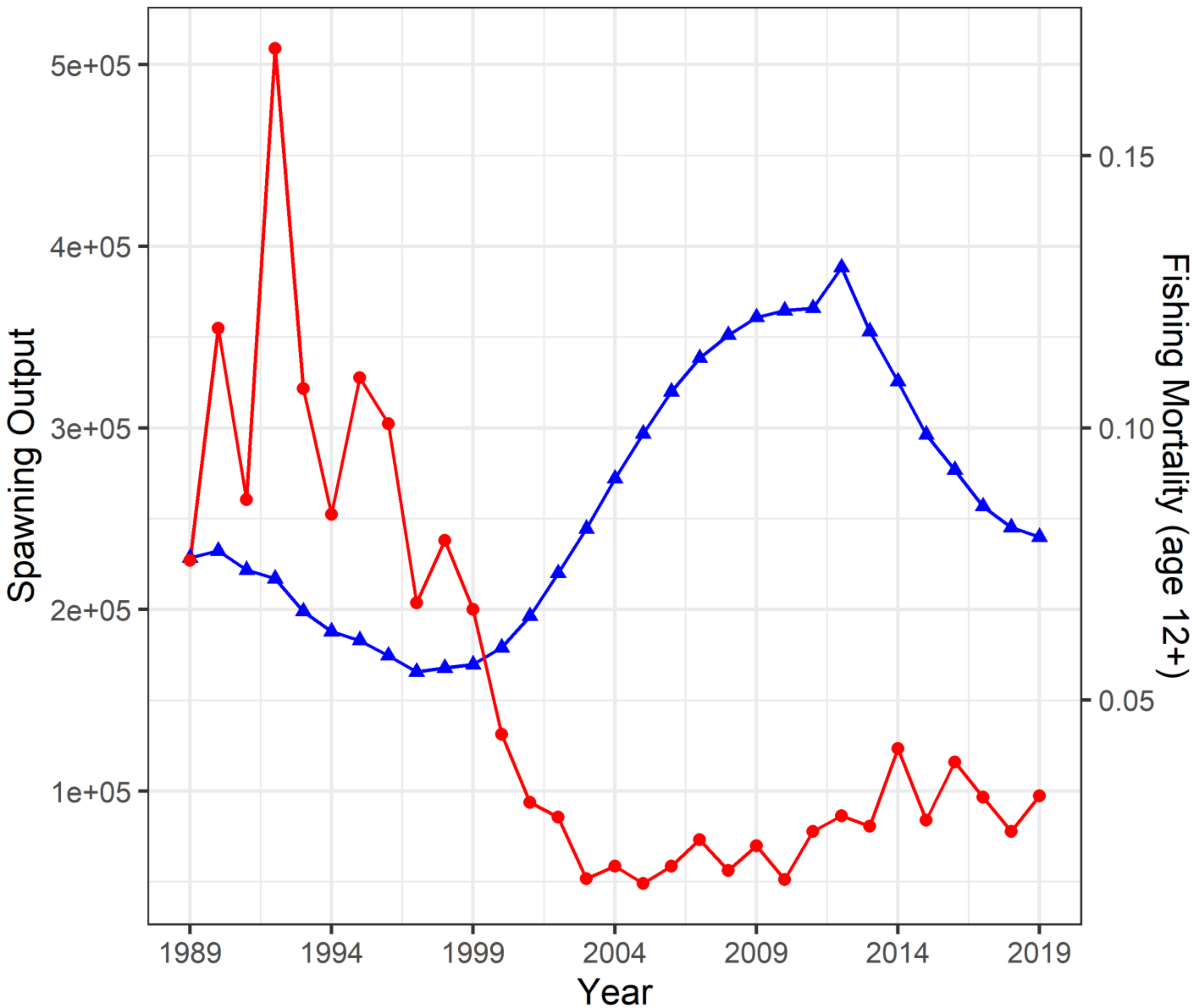
Type	Gear	Fleet	Label
Landings	• Sink Gill Net + Others • Recreational	1	Landings_SGN_Rec_Others
Landings	• Longline • Otter Trawl + Foreign	2	Landings_LL_OT_Foreign
Discard	• Sink Gill Net • Scallop Dredge	3	Discard_SGN_SD
Discard	• Longline • Large Mesh Otter Trawl • Recreational	4	Discard_LMOT_LL_Rec
Discard	Small Mesh Otter Trawl	5	Discard_SMOT
Survey	NEFSC Spring Bottom Trawl	6	NEFSC_Spring_BTS

Stock Synthesis 3 – Time Blocks

Biology blocks: As previously mentioned, spiny dogfish appear to be maturing earlier with a reduced asymptotic size in recent years. For that reason, the time series was blocked into 1989-2010 and 2011-2019, with separate maturity, fecundity and growth. Growth was fixed in 1989-2010 based on Nammack et al. (1985), but estimated for the second block (female L_{∞}=100.5 in first period compared to 89.24 cm in second).

Survey blocks: Survey selectivity was split into two blocks to reflect the different selectivity of the *Albatross IV* (and other vessels) compared to the *Bigelow*.

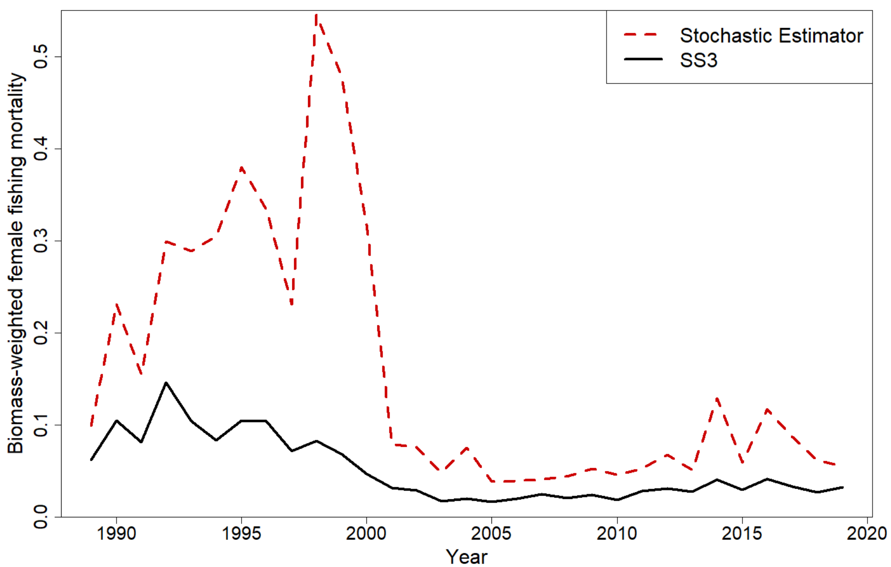
Stock Synthesis 3 - results



Estimated fishery selectivity is to the left of the old assumption of L_{50} = 80 cm

Spawning output has rapidly decreased since its peak in 2012.

Stock Synthesis 3 – Comparison with the Stochastic Estimator (previous method)



SS3 typically estimates higher biomass, spawning output, and lower *F*, since it is not assuming 100% catchability

Trends during 2000-2019 are similar for the two models.

However, spawning output and biomass declined much faster in the survey/stochastic estimator than in SS3 during 1989-1999. This indicates some misspecification during that time (e.g., underestimated catch, changes in growth, problems with initial conditions).

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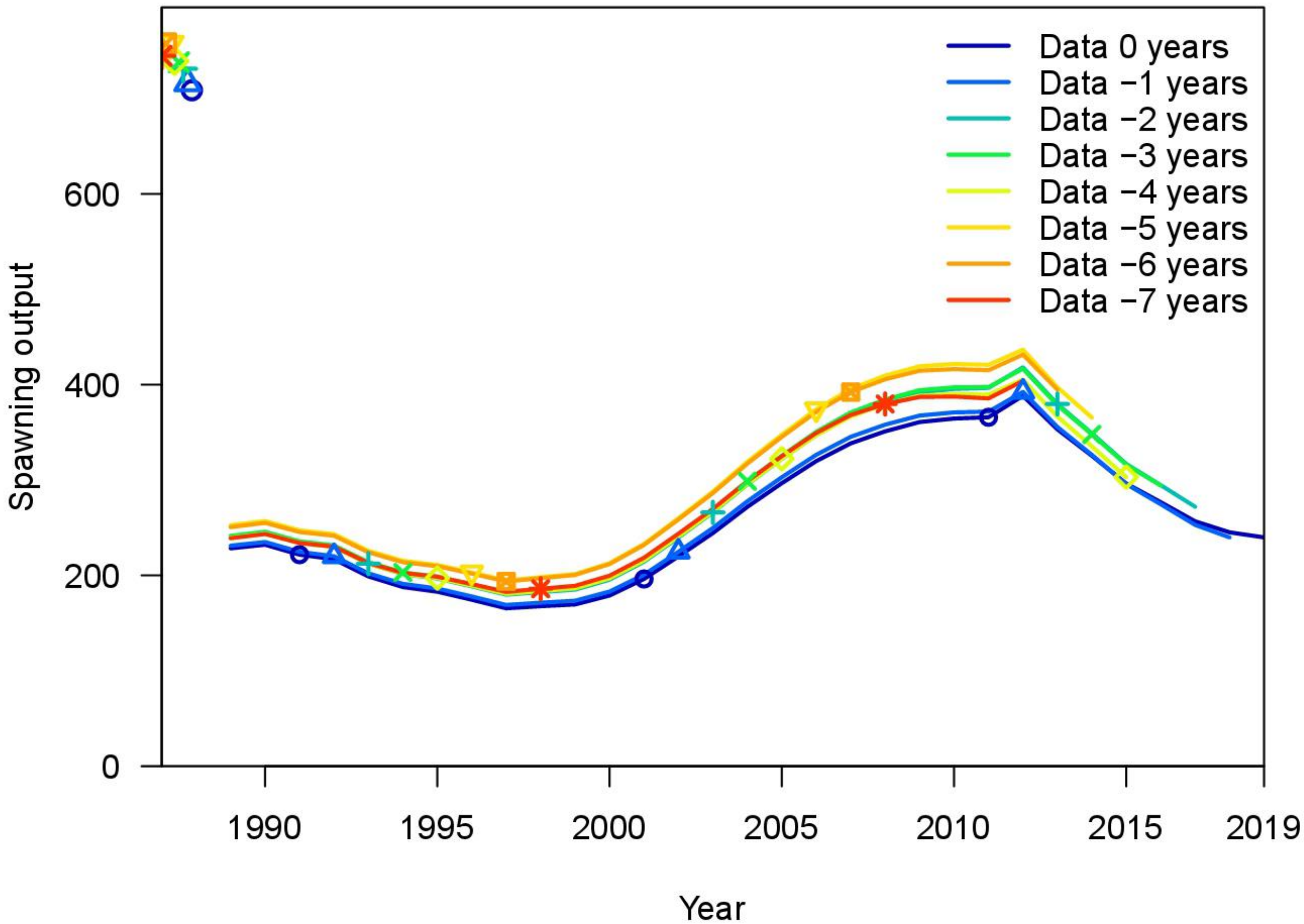
Stock Synthesis 3 – retrospective pattern

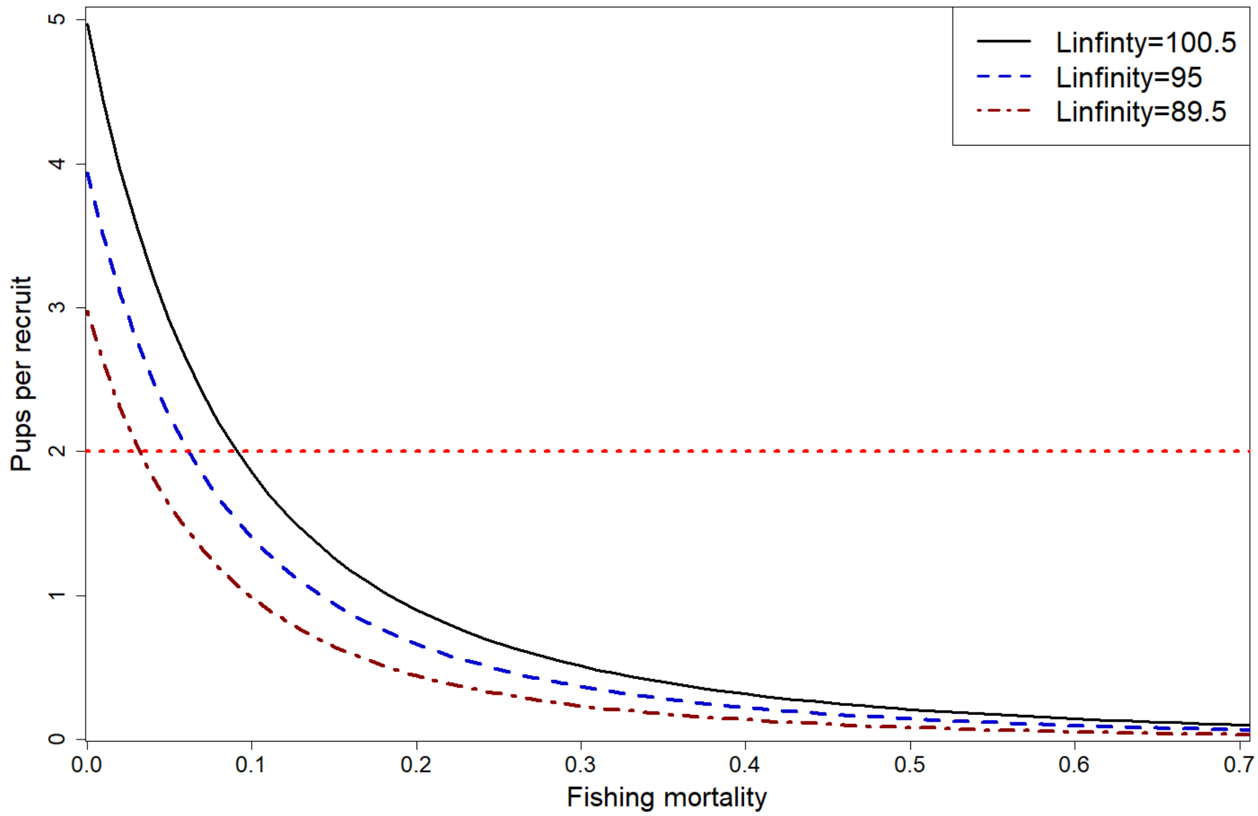


Model is stable, with very little retrospective pattern

(Mohn's ρ= 0.06)

Reference Points – Pups per recruit

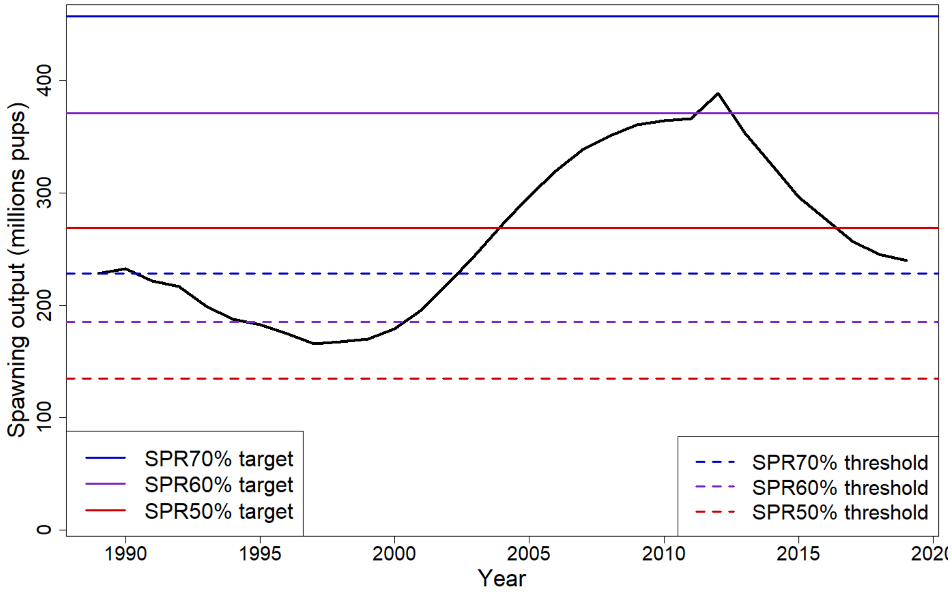
Must have more than two pups per female recruit for sustainability. At current growth, this means $F < 0.03$

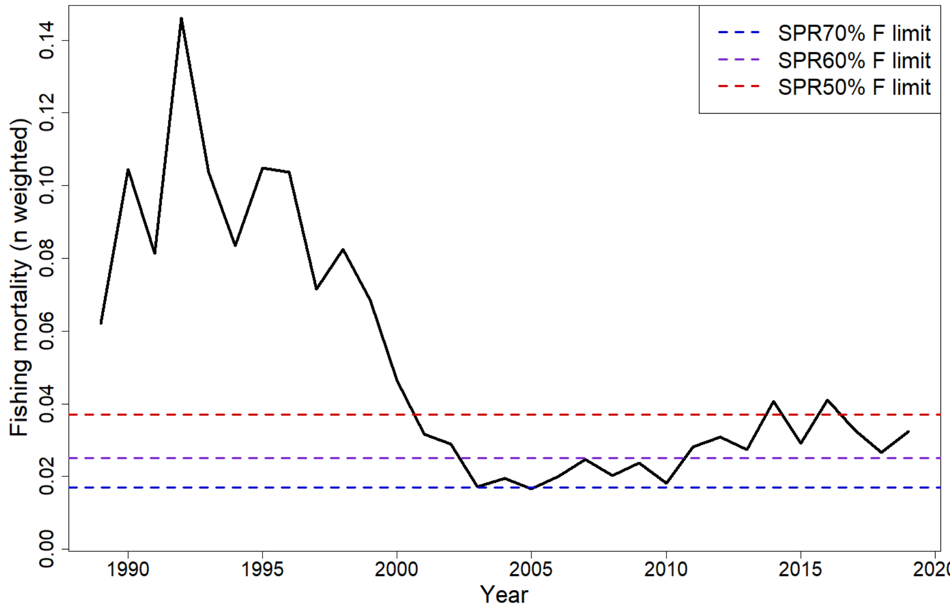


SPR% Reference Points

Three spawner per recruit reference points were considered – 50%, 60%, 70%. Fishing at 50% SPR produced less than 2 pups per recruit. Also, *F* was typically below the 50% SPR *F* limit during 2013-2019 and yet spawning output decreased rapidly.

When F was below the 60% SPR *F* limit, spawning output increased whereas it decreased when *F* was above this limit. For these reasons, SPR60% reference points were chosen.





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Reference Points using SPR60%

Target spawning output	370.8 million pups
Limit *F* rate (females 12+)	0.025
MSY	16,792 mt

Using these reference points, and assuming spawning output threshold is half the target, overfishing was occurring in 2019 (0.032 > 0.025) but the stock was not overfished

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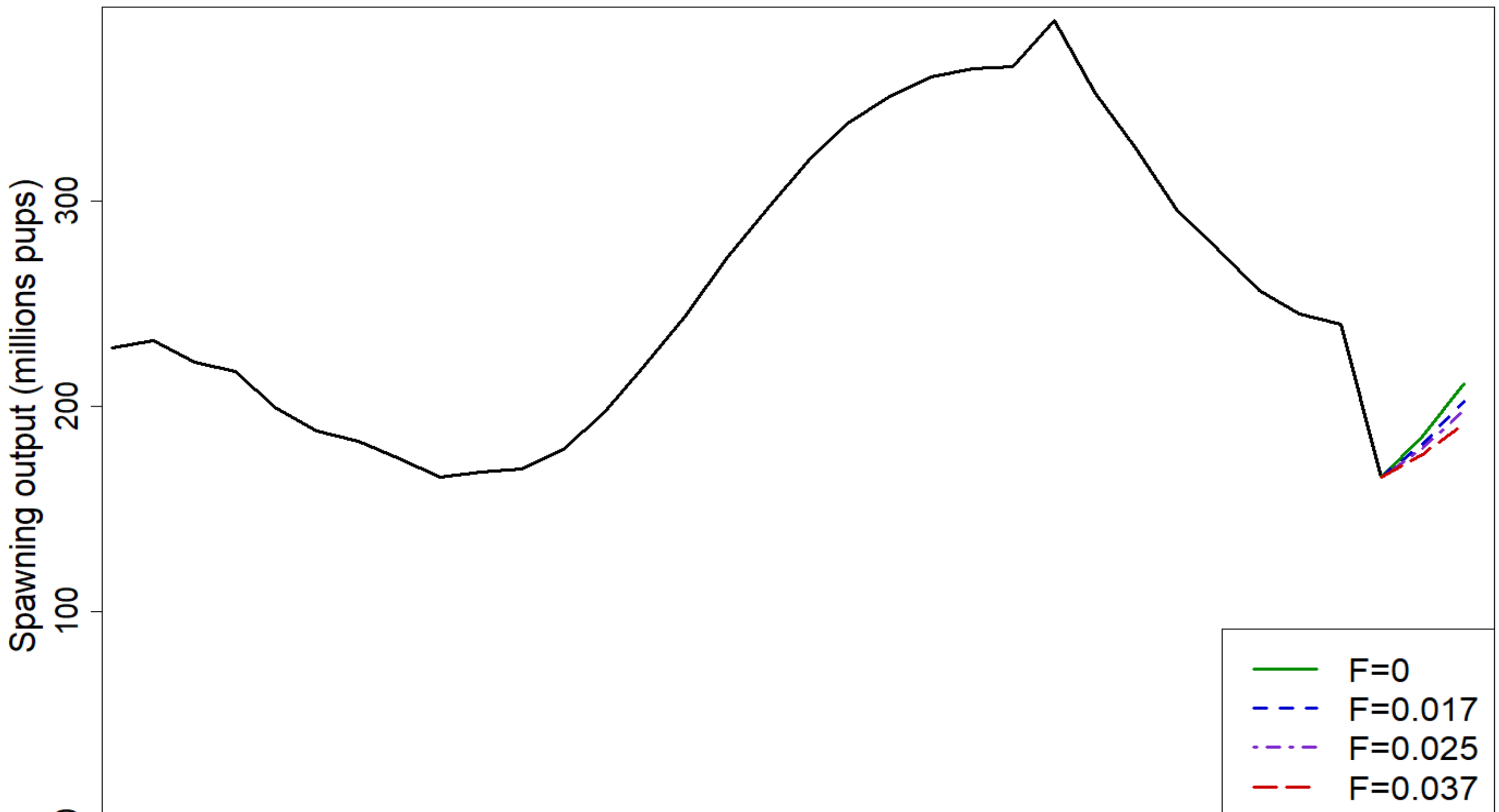
Projections using SS3

SS3 predicts a large drop in spawning output between 2019-2020, and then gradual increases, as several strong year classes begin to mature. Projection assuming F = 0.037 about on long-term trendline, similar to 2022 survey point



Uncertainties and research recommendations

The working group was unanimous that the lack of age/growth data during the last 40 years was the most problematic aspect of this assessment. In particular, using a stock assessment model to estimate growth parameters is not the best practice.

A stock assessment, including reference points, cannot be more accurate than its growth/ageing information

It recommended that an aging program for spiny dogfish should be established to allow for the continuous inclusion of such data and better inform growth in the assessment model.

Age and Growth for Spiny Dogfish

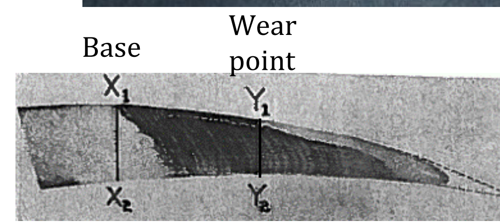
Ageing uses the 2nd dorsal spine; this method has been verified in several different ways (tagging, isotopes)

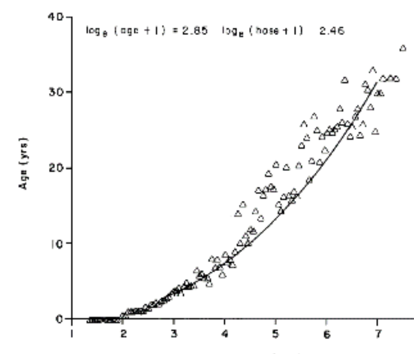
Assessments have relied on the growth curves estimated by Nammack (1985), based on spines collected 40+ years ago. There is strong evidence that growth has changed since that time, and in particular, the mean asymptotic size has declined.

Review of spine ageing methods

- Band counting method validated (Campana et al. 2006), also used for Pacific spiny dogfish ageing
- Second dorsal spine used, but subject to wear
- Spine base diameter, "wear-point" measurements required
- Calculation of worn-spine correction model using unworn spine base measurements/band counts (Ketchen 1975)
- Corrected ages inform final growth models

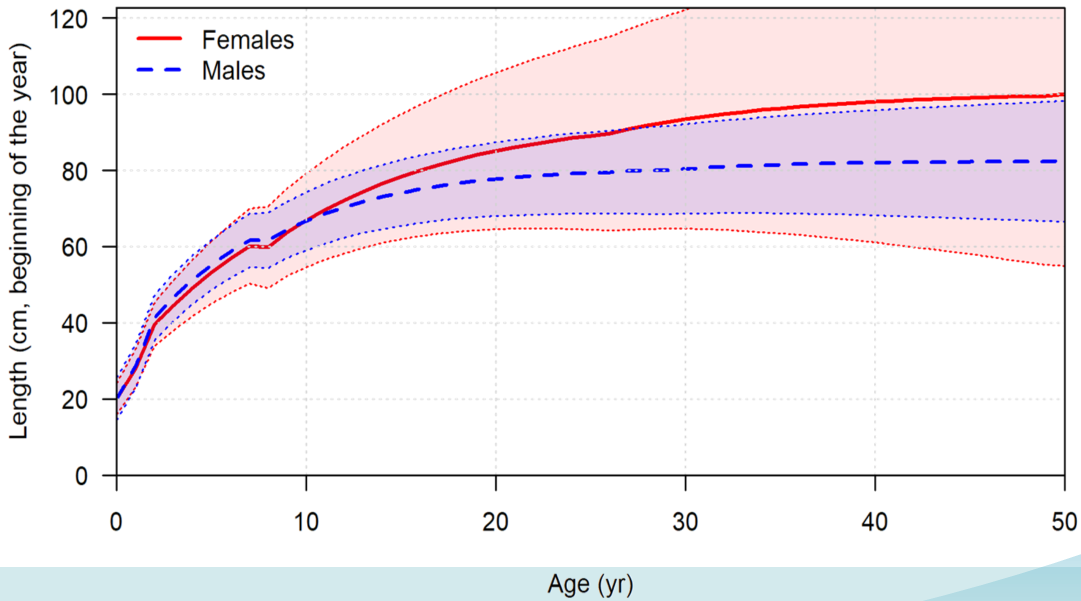
Ages for younger sharks/unworn spines underlie correction model





Ageing work for the RT assessment

Because the NEFSC A&G group lacked the time and expertise to age spiny dogs, a contract was given to Washington State F&W to age spines collected between 2007 and 2012. This group had experience ageing Pacific spiny dogfish. Ages from this work had unacceptably high variance in length at age, among other issues. However, the estimated mean L_∞ for females was 91 cm, considerably less than the Nammack 100.5 cm, giving further evidence for a reduction in L_∞



Proposed new aging work

The NEFSC Apex Predator group obtained considerable expertise in ageing spiny dogfish from the research track ageing work

It is proposed to hire and train a technician to age spines collected between 2021-2023 as well as re-age the 2007-2012 spines. Sufficient double reads will be performed to estimate aging error.

Additional proposed work includes:

Convening a workshop of experts to outline best practices specific to Atlantic spiny dogfish for band counting and calculating worn spine corrections (fall 2023)

Obtaining samples from other sources/areas to procure larger fish if present (are the large fish still around but using habitat differently?)

Defining spine measurements and presence of gestational bands at birth, as well as re-examining size at birth