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Doryteuthis (*Amerigo*) *pealeii*

2023 Management Track Assessment

July 27, 2023 Presentation to MAFMC SSC

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Background Information

1. Life History Overview
2. Fisheries and TAC-based management
3. Previous Assessment

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Life History

1. Semelparous, neritic species with 6-8-month lifespan (Brodziak and Macy 1996; Macy and Brodziak 2001)

2. Spawn year-round, but results in two dominant intra-annual cohorts
   - Summer- vs. winter-hatched cohorts
   - Egg masses attached to seabed, vegetation and hard structures
   - Inshore fishery occurs on summer spawning grounds with egg bycatch

3. Rapid growth rates with high plasticity among individuals
   - Growth rates (and L50s) differ by cohort and are faster for the summer cohort
   - Age, not length data, are required to ID cohorts (costly, requires and expert)

Fisheries and TAC-based Management

1. **Winter, offshore fishery** (Nov-Apr) mainly harvests summer-hatched cohort caught in NEFSC fall surveys
   Summer inshore fishery (May-Oct) mainly harvests winter-hatched cohort caught in NEFSC spring surveys

2.

TAC	Period
Annual	1974-1999
Quarterly	2001-2005
Trimester	2000 and 2007-current

* Since 2010, T1 quota underages have been rolled over to T2 and T3

2020 MTA

1. Although a subannual species, the stock is only assessed every three years as per the NRCC assessment schedule

2. Since 2010 SARC/SAW 51 benchmark (NEFSC 2011), limited ability to change the methodology used because all were assessment updates (in 2017, 2020 and 2023). The 2020 and 2023 assessments were MTAs which do not allow changes in stock structure or introduction of new models.

3. First chance to explore new models and BRPs at 2024-2026 RTA

Previous assessment

2020 Level 3 Management Track Assessment (MTA)

Added 2017-2019 data for:

- Catches - landings + estimated discards (**1989-2019**)
  - Distant Water Fleet landings + hindcast discards (**1963-1988**)

- Daytime *q*-adjusted, swept-area B, by cohort, and annualized (i.e., annual avg. of spring and fall survey B) caught in:

  <u>1976-2019</u>
  - NEFSC spring surveys
  - NEFSC fall + (NEAMAP fall surveys since 2009)

- Exploitation indices (C/B), by cohort, and annualized (**1987-2019,** US fishery)

  - Jan-June C / spring survey B
  - July-Dec C / fall survey B

2020 MTA

1. **Catch efficiency highest during daytime** and daytime tows identified using solar zenith angle (Jacobson et al. 2015)

   - **Fall** (43-80°)
   - **Spring** (29-84°)

2. **Catchability based on median of composite "*q*-priors" (NEFSC 2011)**

2020 MTA

Stock Status Determination

1. **Annualized B (from SARC/SAW 51 and is currently in use)**
   - **1976-2019 two-yr moving avg. of annualized B** for 2019 (annual avgs. of NEFSC spring and fall surveys) was compared to 1976-2008 annualized $B_{Threshold}$ (= **50% of BMSY proxy**)
2. **Cohort-specific B**
   - **1987-2019 two-yr moving avg. of cohort-specific Bs** (NEFSC spring and fall surveys) for 2019 were compared to 1987-2018 cohort-specific $B_{Threshold}$ (= **50% of BMSY proxies**)
3. **No model so no FMSY proxy available**

2020 MTA

Assumptions of annualized BMSY proxy

1. **During 1976-2008, the stock was "lightly exploited"**
   Rationale: annual catches did not result in multi-year decreases in annualized B during most years. However, the SSC noted that the 2020 assessment suggests that this may not be the case for cohort-based biomass estimates

2. **Therefore, the 1976-2008 median** annualized B (76,329 mt) was **assumed to represent 90% of K**

   BMSY proxy = 0.50*(76,329/0.90) **= 42,405 mt**
   $\mathbf{B_{Threshold}}$ = 50% of BMSY proxy **= 21,203 mt**

Stock Status in 2019

1. Annualized

B_{2019} (63,349 mt) > $B_{Threshold}$ (21,203 mt)

Not overfished, overfishing unknown

2. Cohort-specific

Spring survey cohort B_{2019} (32,092 mt) > $B_{Threshold}$ (11,152 mt)

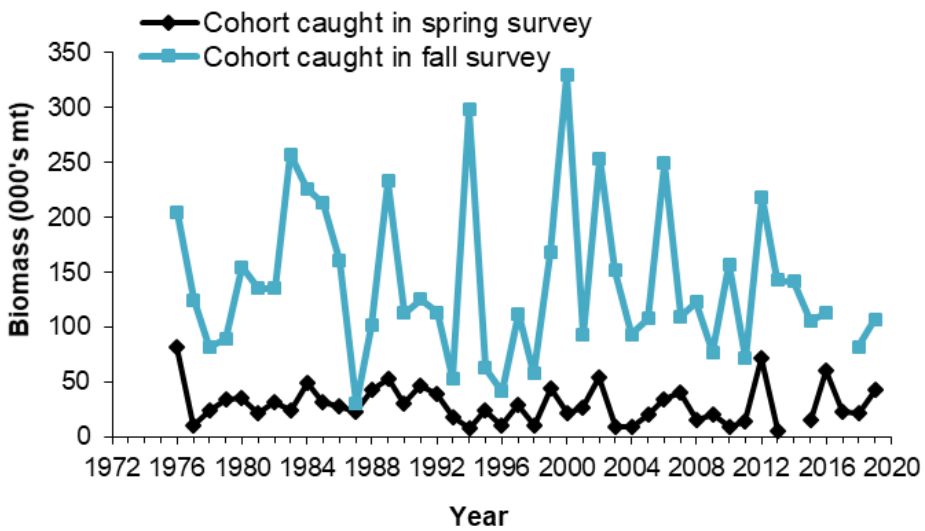
Not overfished, overfishing unknown

Fall survey cohort B_{2019} (94,606 mt) > $B_{Threshold}$ (56,268 mt)

Not overfished, overfishing unknown

2020 Assessment Review Panel Conclusions

1. All ToRs were satisfactorily addressed
2. Cohort-specific Bs and BRPs were recommended for stock status determination (instead of the annualized method)



~ fivefold difference in apparent productivity between cohorts

Review Panel Report (ToR 4 pg 12):

"…*the current averaging approach to determine whether the stock is overfished could fail to detect if biomass falls below the threshold with respect to each cohort*. ***Annual averaging of the spring and fall survey biomasses assumes that a single population is being exploited and does not account for the large difference in apparent productivity of the two intra-annual cohorts."***

" Because the generation time for longfin squid is only 6-8 months, overfishing of a single cohort potentially could jeopardize stock sustainability due to recruitment overfishing."

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2023 MTA

1. Used 2020 MTA methods

2. Updated C (landings+discards), survey B and exploitation indices (C/B); annualized and cohort-specific

3. Annualized stock status determination using same B Ref. Pt. proxies used in 2020 MTA

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2023 MTA

Differences from 2020 MTA

1. B estimates for 2009 onward (Bigelow yrs) computed using actual rather than nominal tow distance (an NTAP request for all stock assessments)

2. CAMS landings and discards added for 2020-2022
   - New database created by GARFO and a new discard calculation method was used

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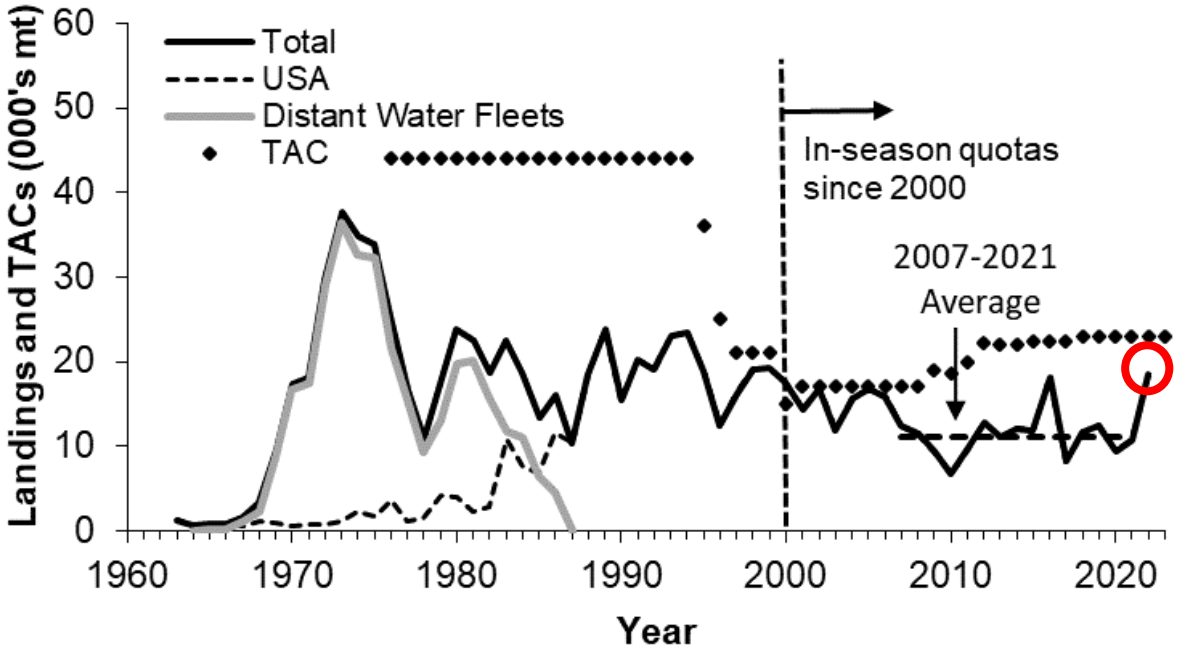
ToR 1 – Landings

Year	CAMS Landings	Landings (mt) AA database
2019	12,489	12,458
2020	9,449	
2021	10,759	
2022	18,489	

2019 CAMS landings only 0.25% > former AA landings

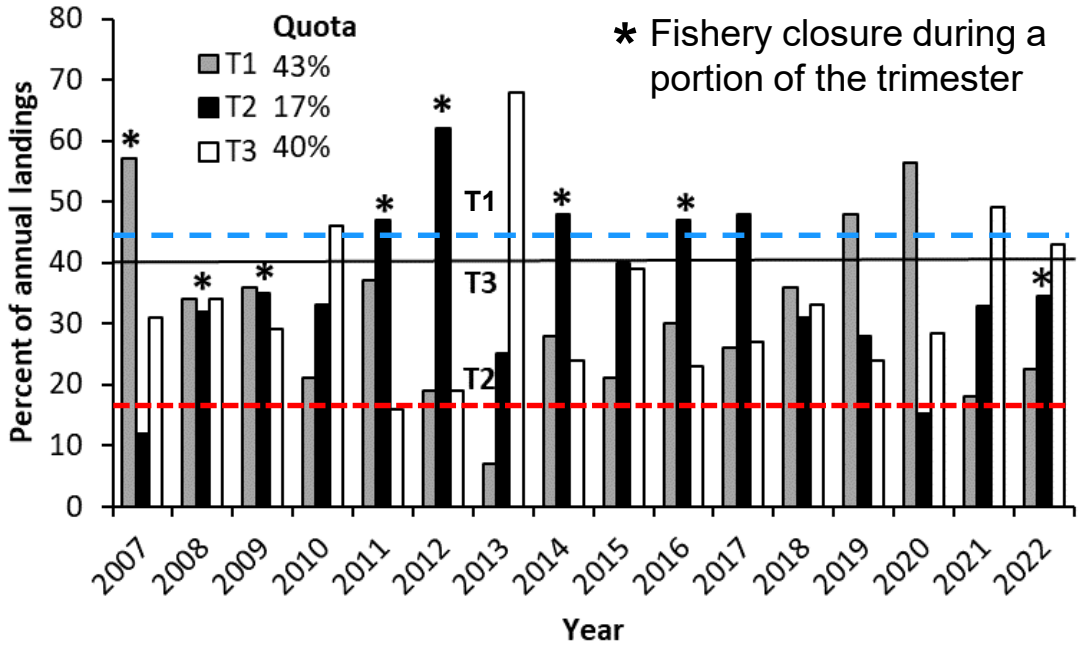
2020-2021 near avg.



2022 landings (000s mt) highest since 2012

T2 fishery on spawning grounds with longfin egg discards

T2 quota (17%, red line) exceeded during all but 2 yrs due to unused T1 quota rollovers to T2 and T3 as of 2010



% landings by trimester

ToR 1 – 2020-2022 CAMS discards (mt) used in assessment

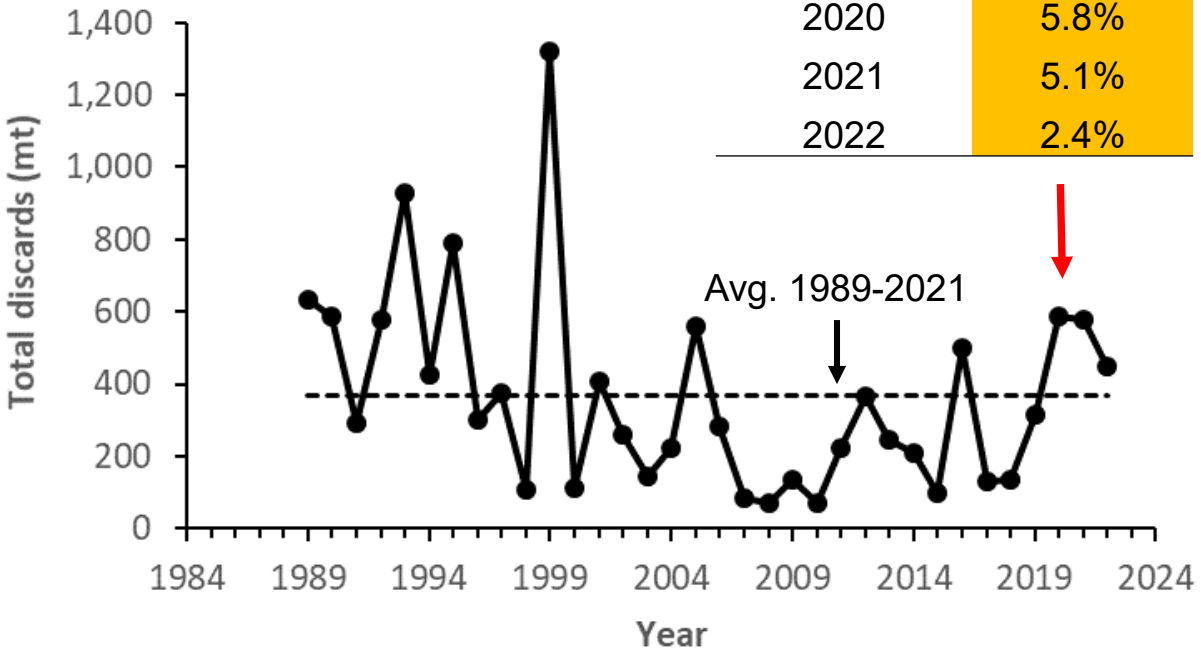
Year	Landings data source for estimating K_all (kept weight of all species)	Data source for estimating d/k ratio	Bottom trawl fleet codend mesh size categories (in.)	Discard estimator	Time step[1]	Discards (mt), 90% CL	CV
2019	cfdets2019aa	OBDBS via SAS dataset	sm (<= 2.49), med (2.50-5.49) and lg (≥ 5.50)	combined ratio	CY by trimester	315 (147, 483)	0.32
	CAMS	CAMS	sm (< 4.00) and lg (≥ 4.00)	"separate ratio" (cumulative)	FY by 12-month period	357	0.18
2020	CAMS	OBDBS in STOCKEFF	sm (<= 2.49), med (2.50-5.49) and lg (≥ 5.50)	combined ratio	CY by trimester	543 (218, 868)	0.36
	CAMS	CAMS	sm (< 4.00) and lg (≥ 4.00)	"separate ratio" (cumulative)	FY by 12-month period	586	0.28
2021	CAMS	OBDBS in STOCKEFF	sm (<= 2.49), med (2.50-5.49) and lg (≥ 5.50)	combined ratio	CY by trimester	250 (97, 403)	0.37
	CAMS	CAMS	sm (< 4.00) and lg (≥ 4.00)	"separate ratio" (cumulative)	FY by 12-month period	580	0.32
2022	CAMS	CAMS	sm (< 4.00) and lg (≥ 4.00)	"separate ratio" (cumulative)	FY by 12-month period	447	0.19

[1] For longfin squid, fishing year (FY) and calendar year (CY) are the same.

Avg. of discard CVs during 2007-2021 = 0.38

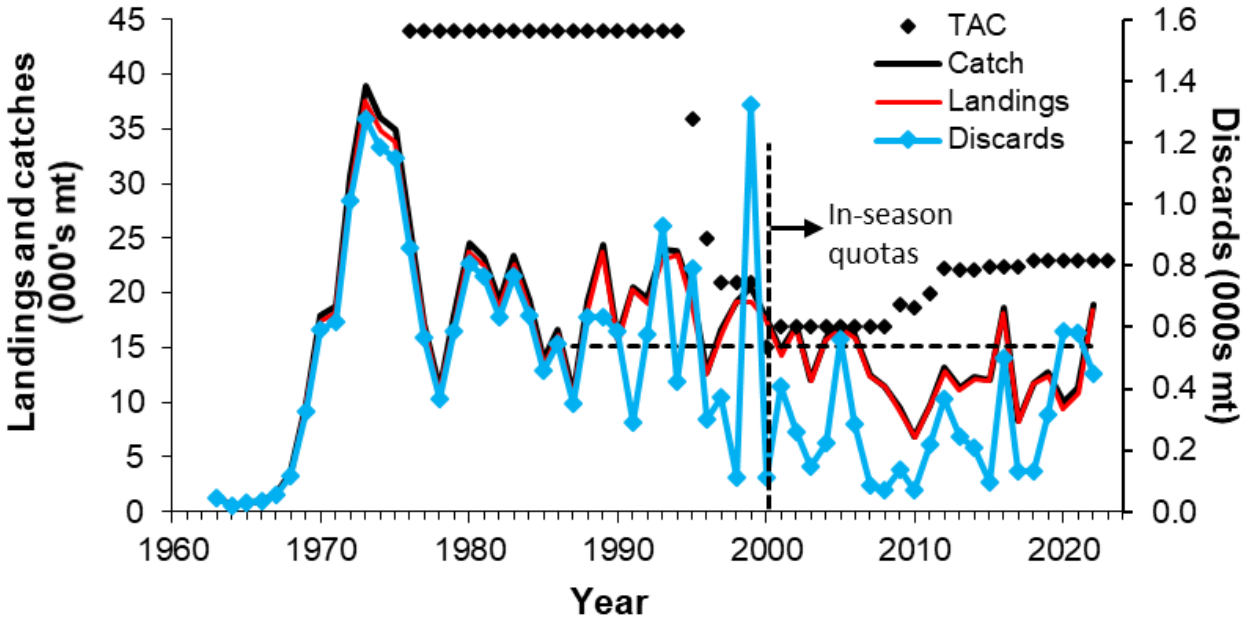
ToR 1 – Discards and catches

Year	Discard % of catch
2019	2.5%
2020	5.8%
2021	5.1%
2022	2.4%



Discards, 1989-2022

From 2020 MTA



Catches, 1963-2022

Discards avg. 2.1% of catch during 2007-2022

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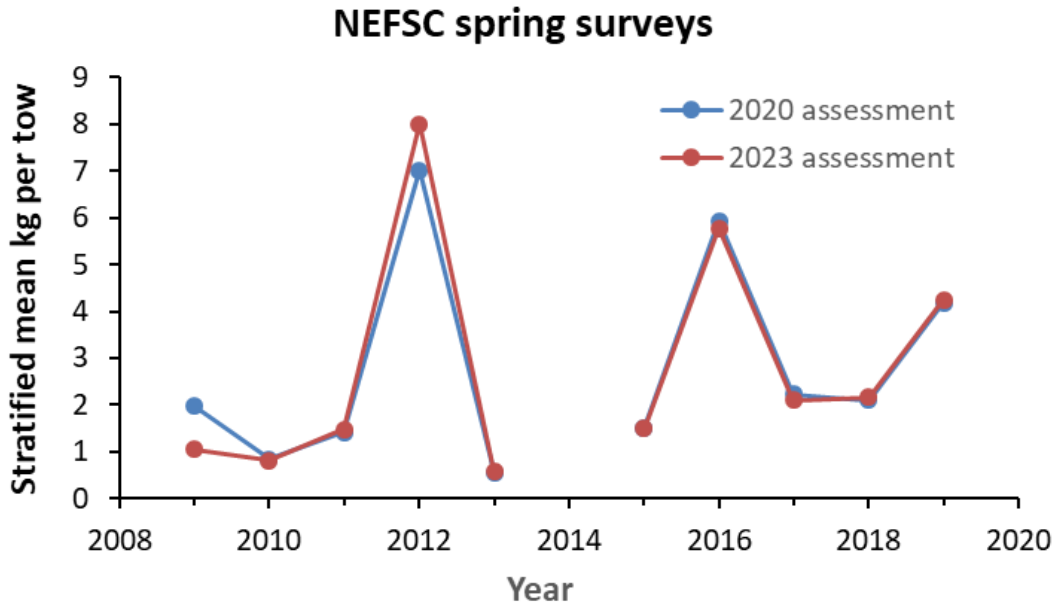
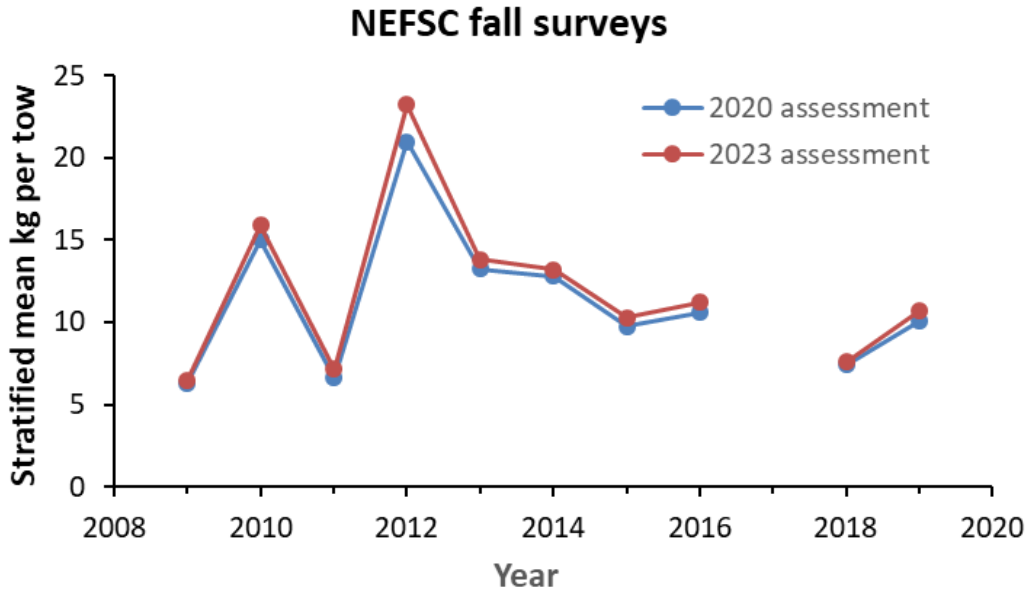
ToR 2 – Evaluate indices used in assessment

NEFSC spring and fall B indices, 2009-2019

Nominal (2020 MTA) vs. measured tow distance (2023 MTA)

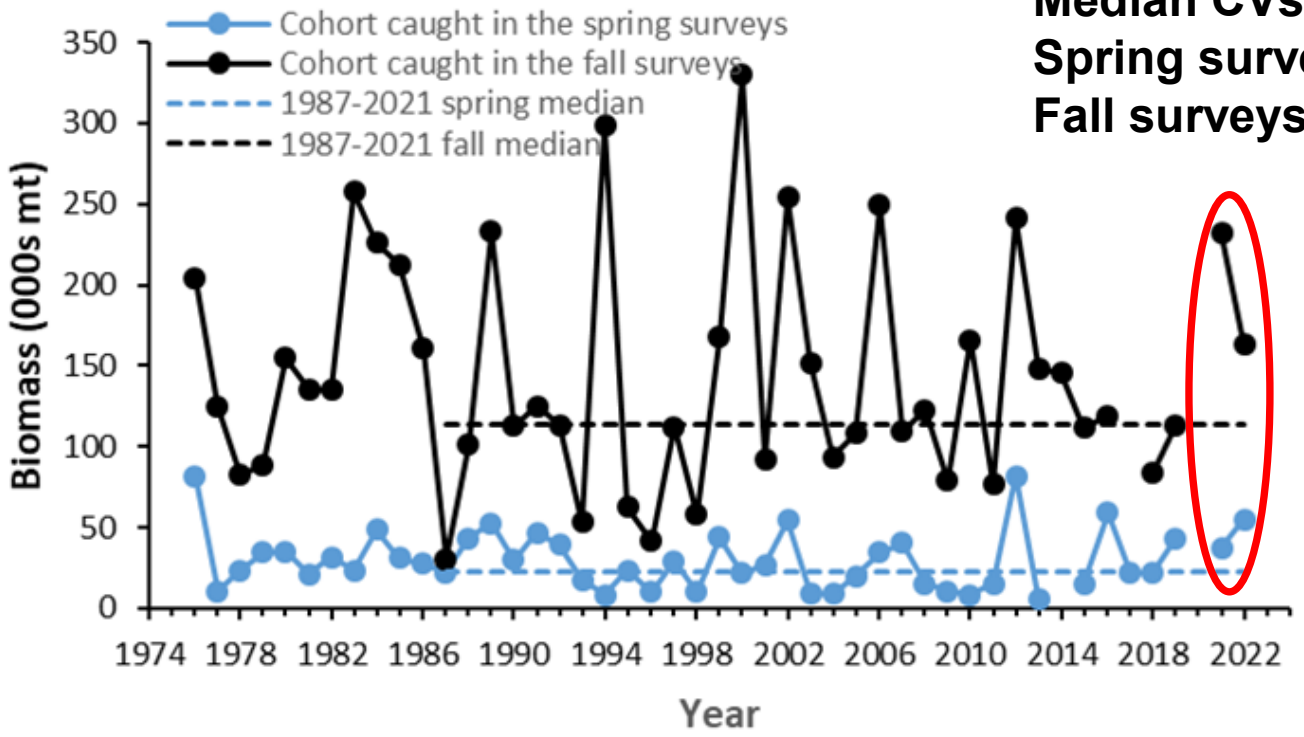




This change had a minor effect on B estimates

ToR 2 – Evaluate indices used in assessment

Cohort-specific swept-area B, 1976-2022



Median CVs for strat. mean B indices
Spring surveys = 0.13
Fall surveys = 0.11

1987-2021 med. B

Fall = 113,169 mt

Spring = 22,304 mt

Five-fold apparent productivity difference between the cohorts caught in each survey

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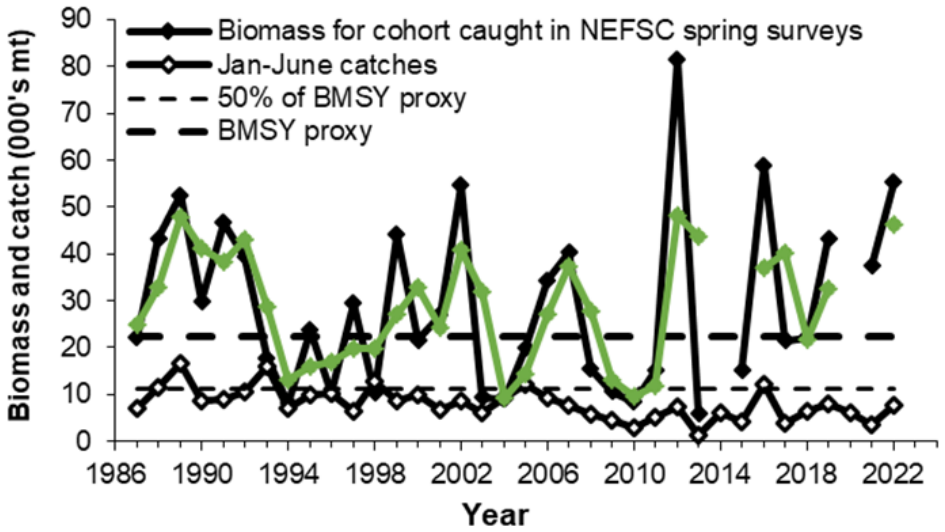
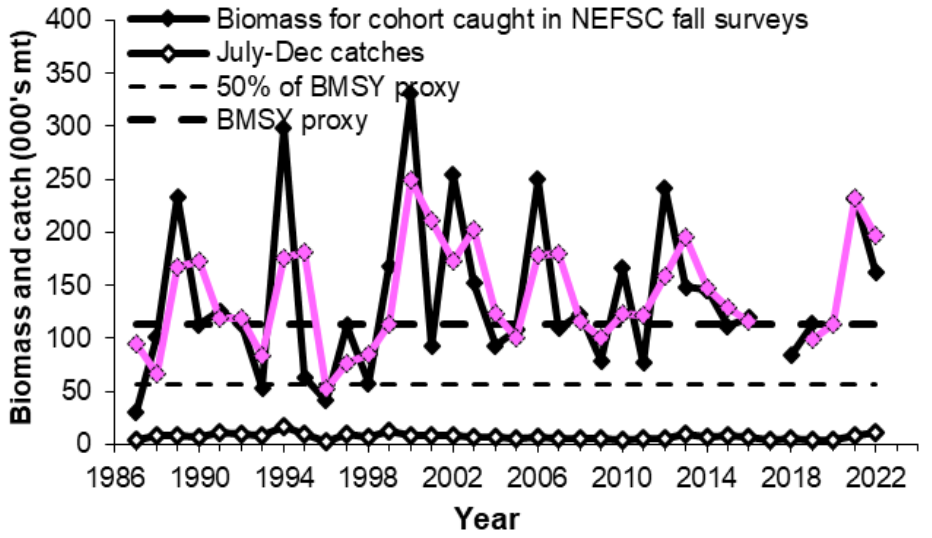
ToR 2 – Evaluate indices used in assessment

Cohort-specific biomass and US fishery catches, 1987-2022



Spring B relative to Jan-June C and B Ref. Point proxies



Fall B relative to July-Dec C and B Ref. Point proxies

Lower apparent productivity, but higher catches (Jan-June) in relation to B

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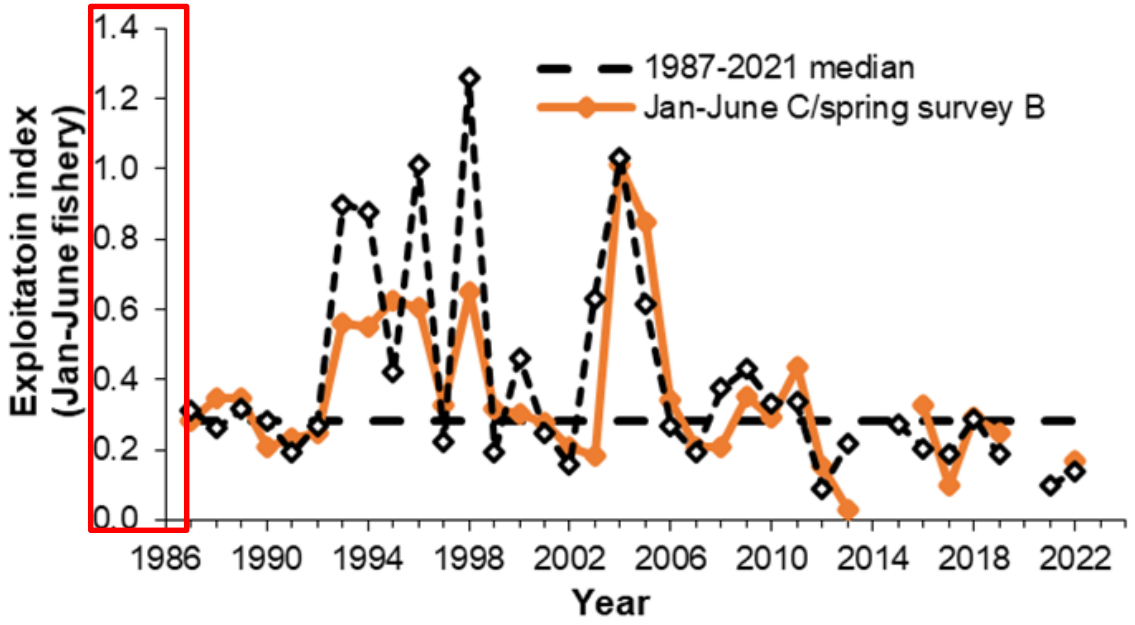
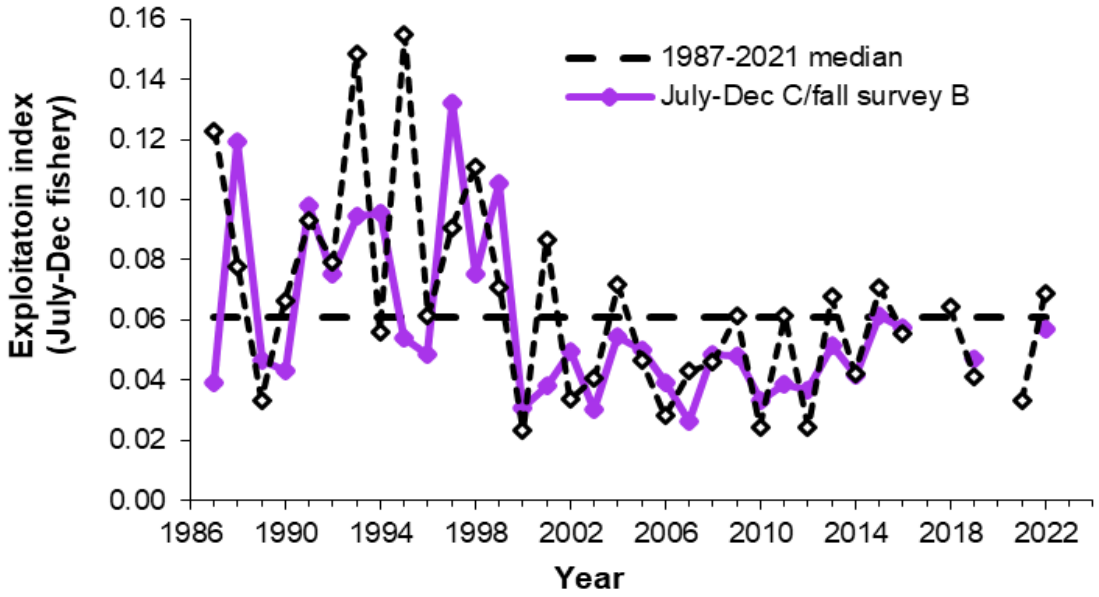
ToR 2 – Evaluate indices used in assessment

Cohort-specific exploitation indices (C/B), 1987-2022





Exploitation indices for the Jan-June fishery are much higher on the smaller spring survey cohort.

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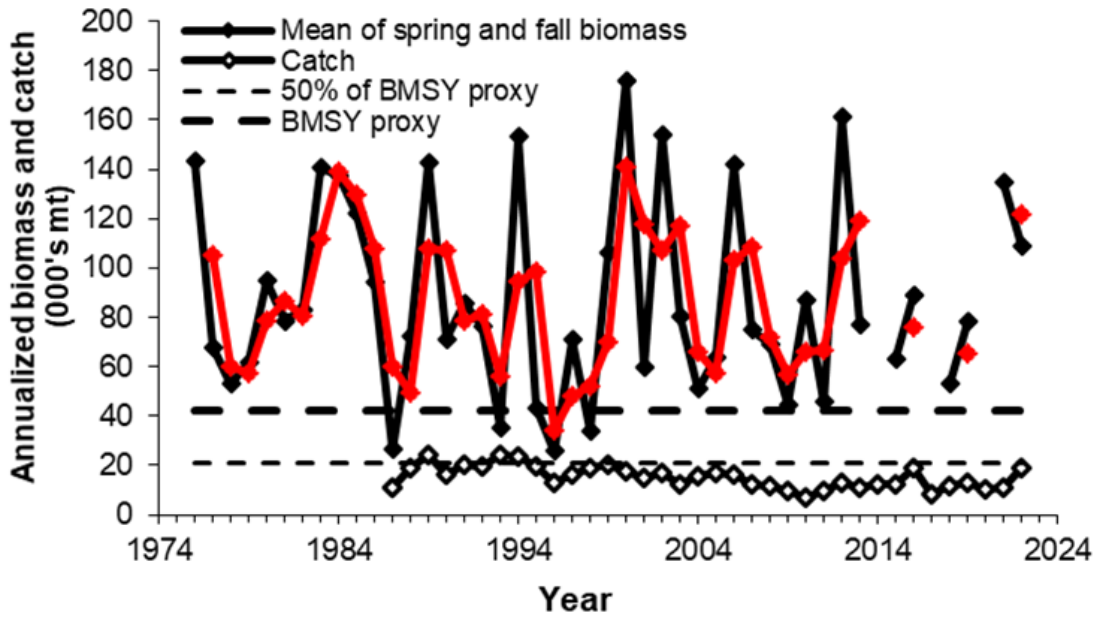
ToR 2 – Evaluate indices used in assessment

Annualized indices

Biomass and catch

(avg. of spring and fall survey Bs)

1976-2022

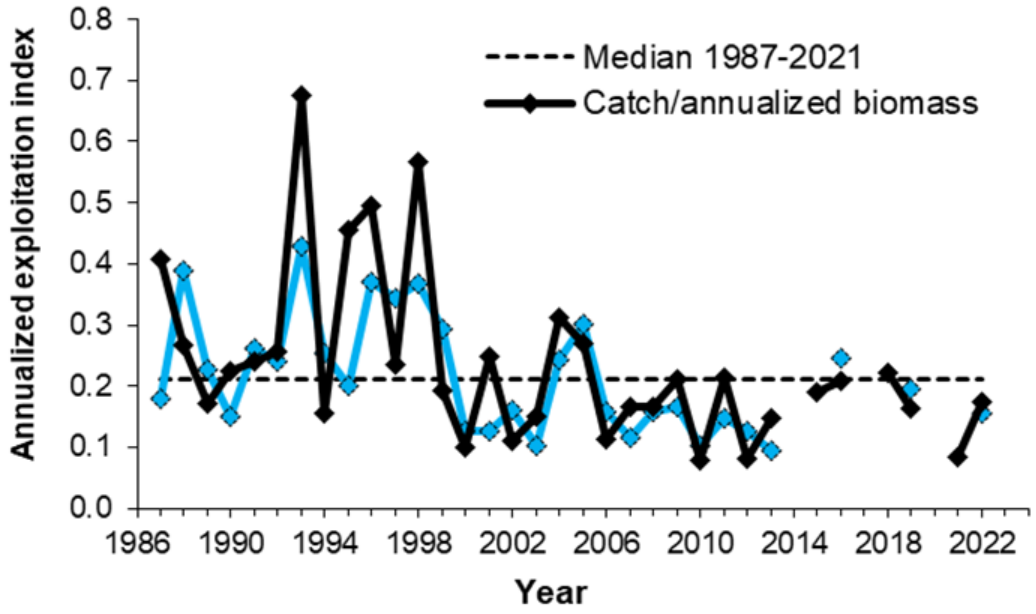


Assumes a single population and it's unclear what these averaged biomasses represent

Exploitation indices

(annual C/annualized B)

1987-2022



Most indices near or below the median since 2006

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ToR 3 – Estimate F, R and B, as possible, using approved assessment method and prepare a "Plan B" assessment in case the analytical assessment does not pass review.

As in prev. assessments, only biomass and exploitation indices could be estimated.

A "Plan B" assessment was not possible for this stock.

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ToR 4 – Re-estimate or update BRPs and recommend stock status.

There are no F Reference Points or proxies. The 2022 stock status, was determined using the 2020 MTA $B_{Threshold}$ proxies.

Biomass Reference Point Proxies (mt)		Biomass (mt) (80% CI)		Overfished Stock Status in 2022
		2022[3] (2023 assessment)	**2019**[3] (2020 assessment)	
Spring survey cohort [1] Target B	22,304			
Threshold B	11,152	46,336 (42,545, 50,128)	32,092 (27,608, 36,576)	**Not Overfished**
Fall survey cohort [1] Target B	112,536			
Threshold B	56,268	197,335 (167,403, 227,268)	94,606 (87,126, 102,085)	**Not Overfished**
Annualized [2] Target B	42,405			
Threshold B	21,203	121,836 (106,748, 136,923)	63,349 (58,989-67,709)	**Not Overfished**

[1] Cohort-based biomass Reference Point proxies were computed as the 1987-2021 median biomasses for each of the two cohorts caught in the NEFSC spring and fall bottom trawl surveys. [2] Annualized biomass Reference Point proxies were computed in 2010 by the SAW/SARC 51 Working Group (SAW/SARC 51; NEFSC 2011a; 2011b).[3] Two-year moving average biomass.

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ToR 4 – A request to the AOP was made to change the baseline time period of the annualized biomass Ref. Points from 1976-2008 to 1997-2018 to account for recent changes in environmental conditions (e.g., warming).

Analyses were requested by the AOP to substantiate this request.

After beginning this work, it was decided that the analysis warranted a much more detailed investigation that would be best conducted next year at the Research Track Assessment of this stock.

ToR 5 – Conduct short-term stock projections when appropriate.

There is no accepted assessment model with which to conduct projections.

ToR 6 - Respond to review panel comments from the most recent MTA

2020 Level 3 MTA Review Panel ("PRC") recommendations:

1. ***The PRC recommends considering cohort-specific reference points for determining stock status in the 2023 MTA.*** ***One approach would be to calculate separate stock statuses for the two cohorts sampled in the NEFSC spring and fall surveys. If either of the cohort-specific B estimates fell below its respective B threshold, then the stock would be considered overfished in that year. This recommendation also could apply to Northern shortfin squid.***

Note: This recommendation was addressed in the 2023 MTA. The current assessment process for this sub-annual species renders assessments outdated before they are conducted. As stated in squid assessments since the late 1990s, annual pre- or in-season stock assessments are necessary to address this issue.

ToR 6 - Respond to review panel comments from the most recent MTA

2020 MTA Review Panel ("PRC") recommendations:

2. ***The PRC recommends continuing development of a stock assessment approach that is specifically tailored to this species' life cycle and data availability.*** ***Consider assessment/ management approaches for other semelparous species (e.g., Pacific salmon).***

Note: This recommendation can only be addressed in a Research Track Assessment (RTA), and along with the research recommendations listed in the 2023 MTA Report and previous assessments (beginning with the 2010 benchmark), should be investigated during the 2024-2026 RTA.

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2023 MTA Review Panel Report Summary

1. The 2023 MTA fulfilled the recommendations of the AOP and is technically sufficient to evaluate stock status for biomass. The assessment met all ToRs and the Panel agreed that the stock was not overfished in 2022.

2. **While the overfishing status is unknown, exploitation rates for both cohort-based and annualized B estimates were near or above the B_{MSY} target values in recent years.**

3. The Panel concurred with the 2020 MTA review panel recommendation to consider cohort-specific rather than annualized Reference Points and recommended that they be evaluated at the 2024-2026 RTA.

4. **It is important to understand growth and mortality rates of each of the two cohorts to determine their contributions to total stock biomass and to spring & fall surveys.**
   Note: Cohort-specific growth rates in Brodziak and Macy (1996) and Macy and Brodziak (2001) and both surveys are dominated by individuals ≤10 cm DML.

5. Determine whether biomass is underestimated in NEFSC spring surveys (e.g., Jan-June exploitation indices were > 1 in three years during 1987-2022)

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