Characterization of the Massachusetts Spring Longfin Squid Fishery

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Presentation Overview

Background – Comprehensive Report on MA Spring Squid Fishery

- Biology, management, effort, sampling, conservation issues

Report Summary

- What, how, where, when and who

Data Analysis

- Landings - historical/coast-wide and recent/local
- Fleet profile
- Sea Sampling – effort, catch and bycatch

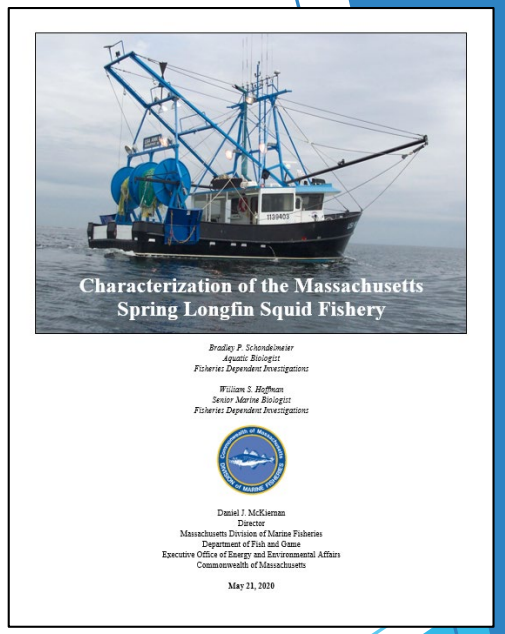
Report Takeaways

- Trends in catch data
- Interpretation of conservation concerns
- Importance of LFS fishery to commercial fishermen
- Evaluate current monitoring and management

Background

Characterization of the Massachusetts Spring Longfin Squid Fishery

by Bradley P. Schondelmeier and William S. Hoffman



Biology/Ecology

Longfin Squid (*Doryteuthis pealeii*, formerly *Loligo pealeii*)

- Resilient
  - ‘micro-cohorts’
  - fast-growing
  - inshore spring/summer spawn ←→ offshore fall/winter harvest
- Ecological importance
  - Predator of: plankton, shrimp, worms, whiting, mackerel, herrings…
  - Prey of: Dolphins, pilot whales, striped bass, bluefish, black sea bass, cod, haddock, pollock, dogfish, monkfish…

Background

Longfin Squid Management

Moratorium permits: Squid-Mackerel-Butterfish (SMB)
Tier 1 (unlimited), Tier 2 (5,000 lb), Tier 3 (2,500 lb)

- Trimester Quotas: T1 (43%), T2 (17%), T3 (40%)
- Closures → 2,500 lb/trip
- Accountability Measures:
  - T1 underharvest → T2&T3 T1/T2 overage → reduce T3
- Butterfish Mortality Cap → 2,500 lb LFS
- Catch Reporting: VTRs or daily VMS

To fish in MA state waters:

MADMF Coastal Access Permit (CAP) with Small-Mesh Trawl Squid endorsement

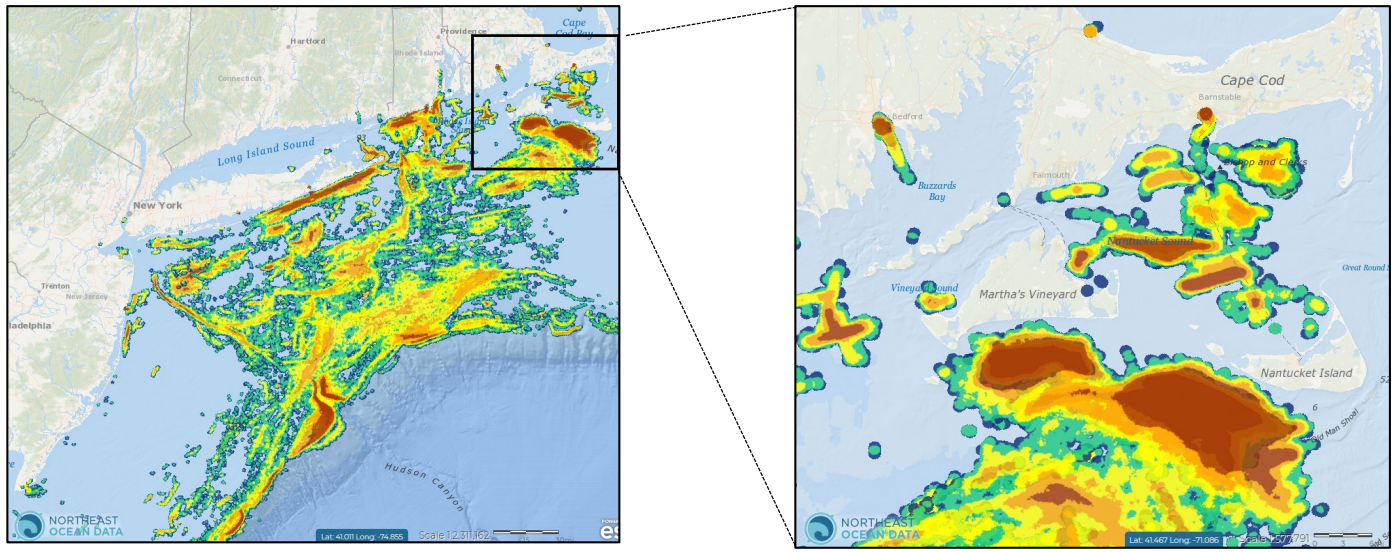
- No daily/trip LFS catch limit
- Monthly paper catch reporting (if not reporting federally)

Background

Fishery Effort

2014-2016 squid effort, from VMS data on squid-declared trips (<4kts)

Source: Northeast Ocean Data Portal



Coast-wide

Local

Fishery Sampling

Small-mesh sea days trips out of NE ports…

Past 12 months: 740

Q2 2019: 187

2019: 3 day-trips

Background

Conservation Concerns

Overfishing

- Too much effort on inshore LFS, or other species of concern?

Forage Removal

- Is there enough forage remaining for predators?
- Do predators depend solely on LFS for forage?

Bycatch/Discards

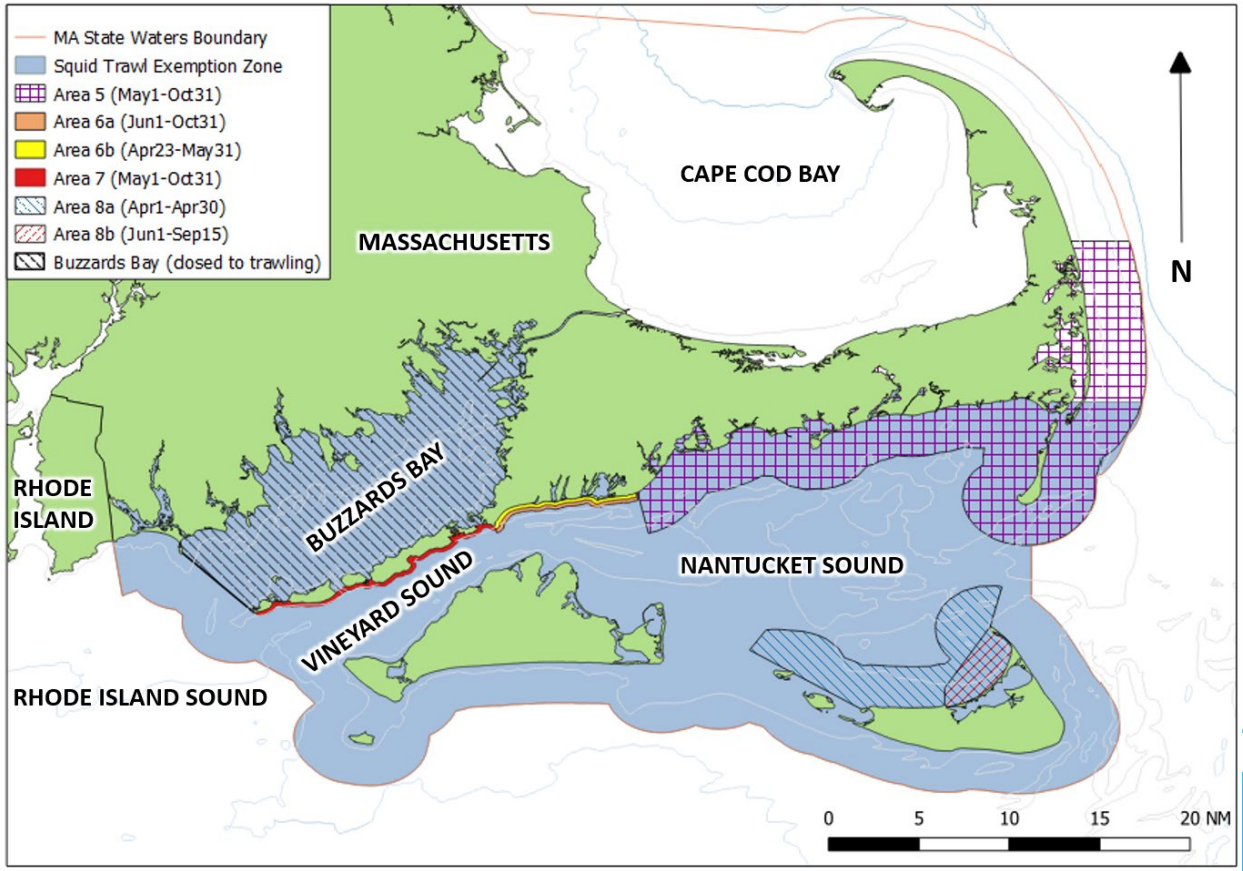
- Bycatch mortality concerning for any particular species?
- Overall discard rate too high? What is contributing?
- Interaction with squid egg mops?
- Discard of legal size/marketable fish? How to alleviate?

Report Summary

How?

Small Mesh Squid Trawl Exempted Area +
Small Mesh Trawl Squid Fishery Exemption +
Seasonal Mobile Gear Closures =

Where?



Report Summary

When?

April 23rd through June 9th … and

"the Director may issue permit conditions, in accordance with M.G.L c.130 §80 and 322 CMR 7.01(7) to extend the small mesh squid fishery season."

Who?

Vessels: No greater than 72 ft overall length,
Possess a Coastal Access Permit, with a
Small mesh trawl squid endorsement,

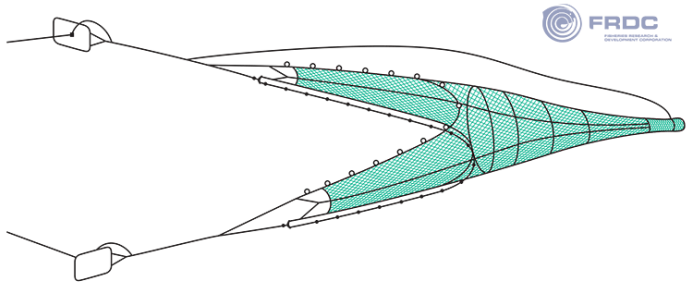
Fishing with: Fish weir, rod and reel/handline, or
Small mesh bottom otter trawl having;

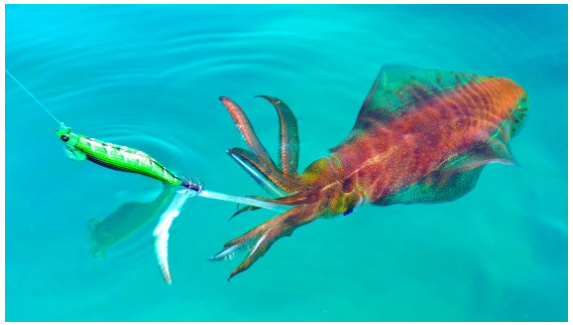
- Minimum codend mesh size of 1 7/8" ,
- Net rollers no larger than 12" diameter

Report Summary

What?

What does the ‘squid fishery’ look like?





How to select just “squid trips”?

MAFMC Amend20 analysis → Trips >40% LFS landed 91% of all LFS (2014-16)

Trips: 2013-2017 VTR and state reports from Nantucket Sound/ adjacent waters

> 40% LFS

90.4% of trips landing LFS

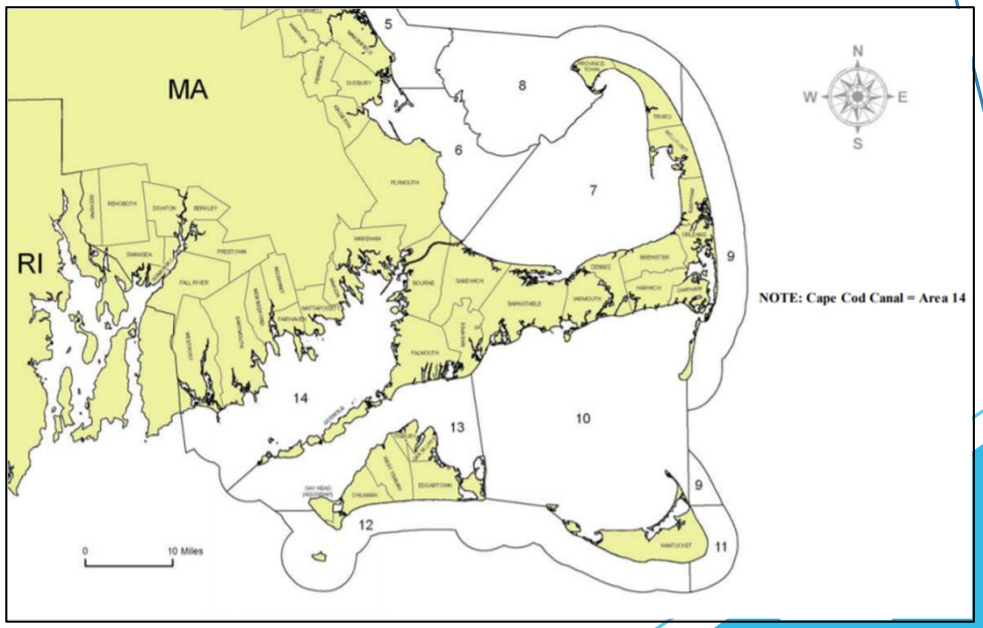
and…

99.3% of LFS landed

Data – Squid Landings

Landings data

Sources: Federal – VTR (from SA538) and CFDERS (dealer) databases,
State – SAFIS (from SRA 10, 13, 12)



Caveats: Reporting area mismatches (south of MV/Nantucket)

Data – Squid Landings

Past 20 years of coastwide longfin squid:

Landings by state

(millions of lbs)

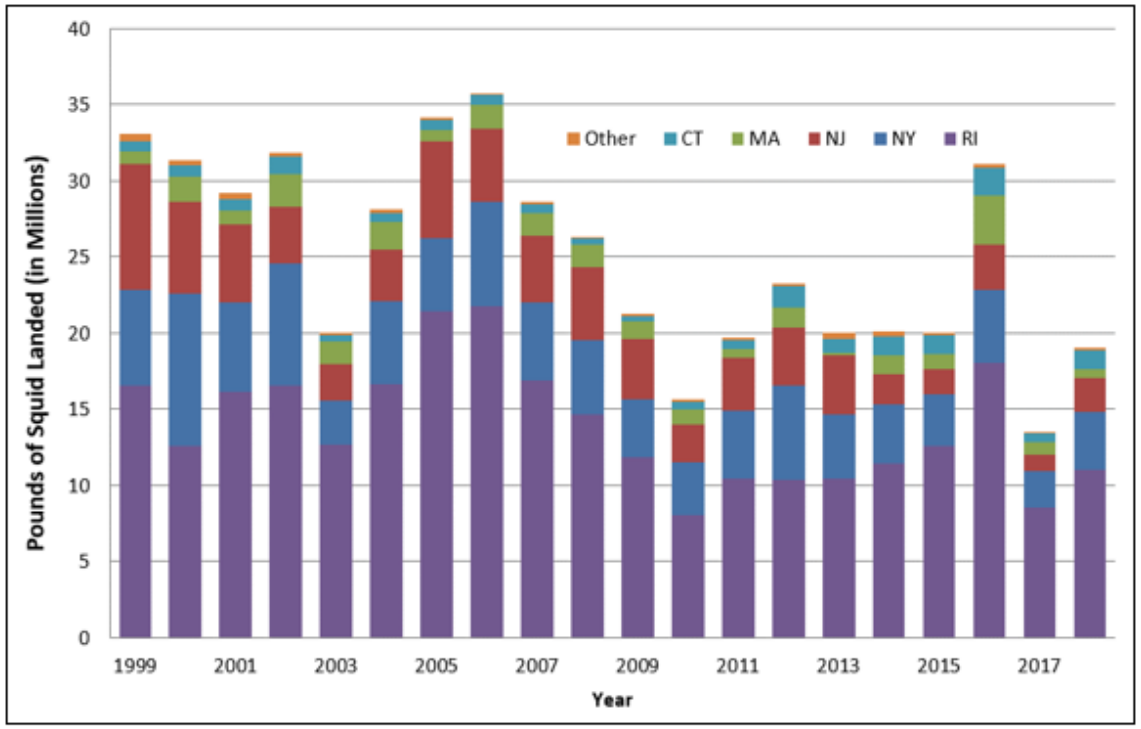


Figure 4 – Coastwide landings of longfin squid, all gear types, 1999-2018

Source: Unpublished NMFS VTR Data

Annual value and avg price/lb

(millions of lbs)

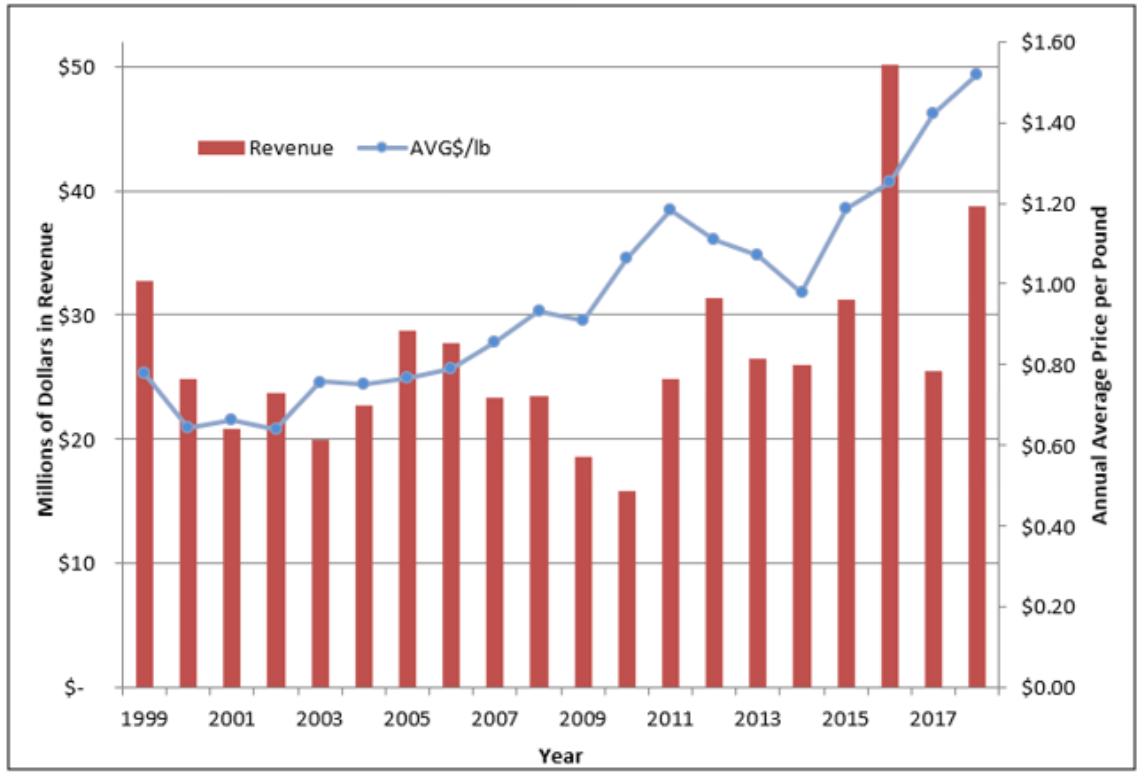


Figure 5 – Annual revenue generated by longfin squid sales and average annual price per pound, 1999-2018

Source: Unpublished NMFS Dealer Data

Data – Squid Landings

Local (landed in MA) and year-round

*all areas/months

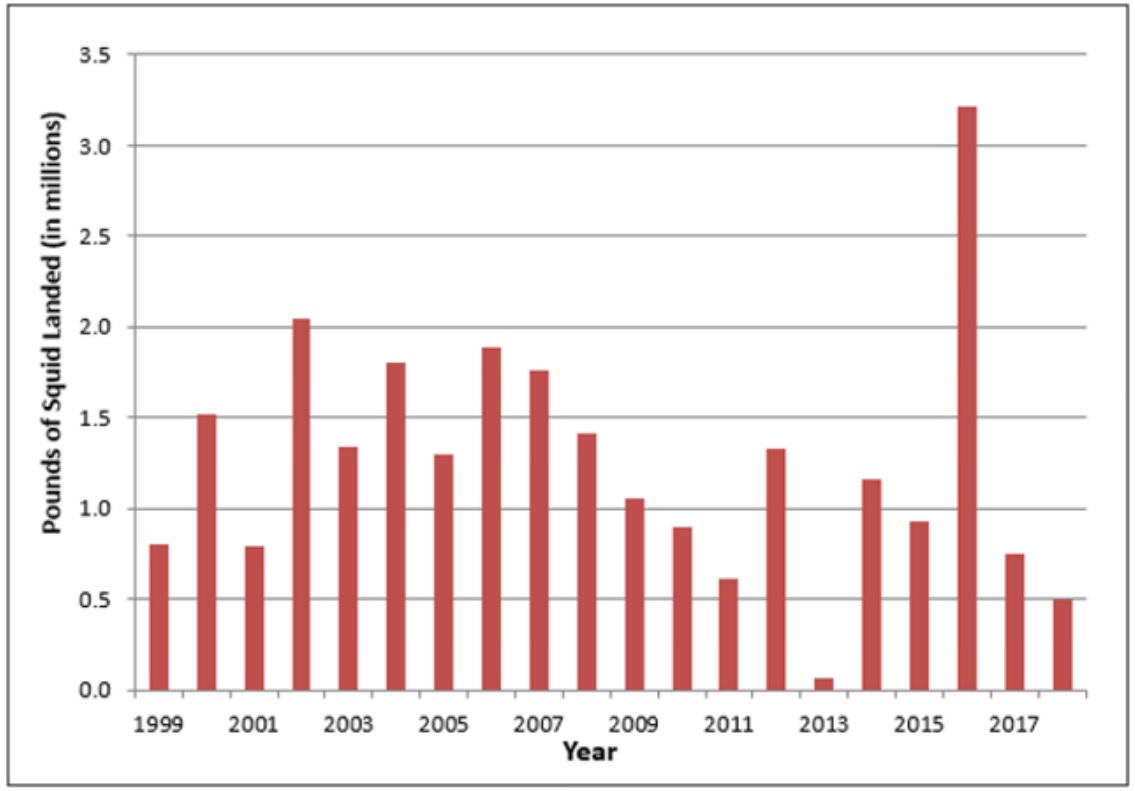
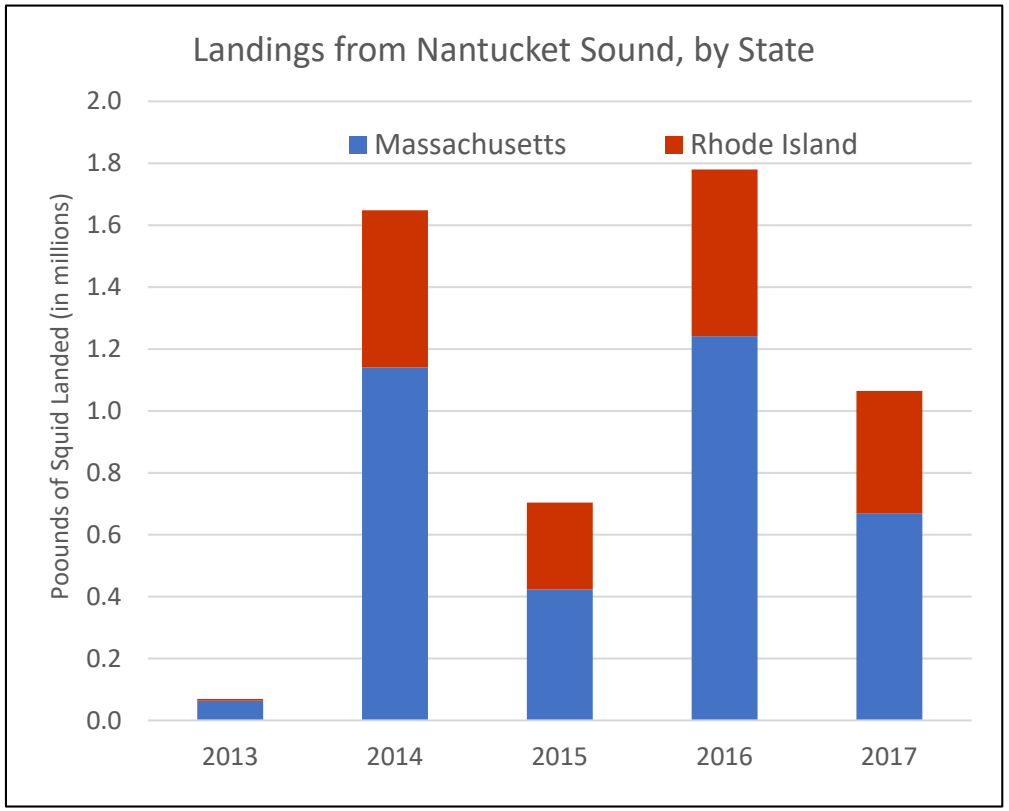


Figure 6 – Historical landings of longfin squid in Massachusetts ports (from all areas in all months)
Source: Unpublished NMFS VTR Data

Local (caught in Nantucket/Vineyard Sound) & recent (2013-2017)



Data – Landings Value

Coast-wide & recent (2013-2017) prices during the MA spring squid season

Year	RI	MA	NY	CT	NJ	Other	Coastwide
2013	$ 1.66	$ 2.32	$ 1.92	$ 1.73	$ 1.46	$ 1.73	$ 1.88
2014	$ 1.03	$ 0.97	$ 1.30	$ 1.11	$ 1.20	$ 0.87	$ 1.03
2015	$ 1.33	$ 1.47	$ 1.53	$ 1.66	$ 1.88	$ 1.01	$ 1.39
2016	$ 1.37	$ 1.34	$ 1.30	$ 1.28	$ 1.49	$ 1.12	$ 1.35
2017	$ 1.63	$ 1.69	$ 1.43	$ 1.64	$ 1.40	$ 1.48	$ 1.61

Table 4 – Average annual price (dollars per pound) of longfin squid, by state of landing, during the spring squid fishery

Source: Unpublished NMFS and MADMF Dealer Data

Year	Month	RI	MA
2013	Apr	$ 2.04	$ 2.55
	May	$ 1.79	$ 2.22
	Jun	$ 1.42	$ 2.31
2014	Apr	$ 1.09	$ 1.92
	May	$ 1.02	$ 0.99
	Jun	$ 1.01	$ 0.89
2015	Apr	$ 1.51	$ 1.87
	May	$ 1.43	$ 1.55
	Jun	$ 1.30	$ 1.31
2016	Apr	$ 1.37	$ 1.79
	May	$ 1.52	$ 1.39
	Jun	$ 1.33	$ 1.20
2017	Apr	$ 1.46	$ 2.16
	May	$ 1.69	$ 1.62
	Jun	$ 1.53	$ 1.50

From Table 5

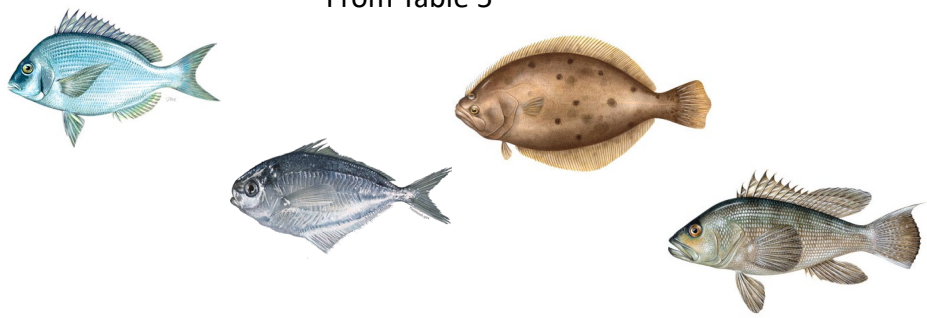
Value of other retained species

Species	Pounds Landed	#Trips Landing 1+ lb	Average $/Pound *
SQUID, ATL LONG-FIN	5,266,552	1,726	$ 1.45
SCUP	386,580	1,150	$ 0.42
BUTTERFISH	53,211	664	$ 1.70
FLOUNDER, SUMMER (FLUKE)	23,425	778	$ 4.13
BLUEFISH	12,457	337	$ 0.72
MACKEREL, ATLANTIC	8,110	367	$ 0.48
CRAB, HORSESHOE	4,058	151	$ 1.35
SEA BASS, BLACK	3,799	96	$ 4.09
FLOUNDER, WINTER	1,402	96	$ 2.14
TAUTOG	797	69	$ 3.21
HAKE, RED	682	11	$ 0.38

Table 6 – Top ten species landed from Nantucket and Vineyard Sound longfin squid trips, 2013-2017

Source: Unpublished NMFS VTR and Dealer Data, and MADMF Harvester Data

*Value generated from regional dealer prices, April-June, on trips using bottom trawl gear only.



Squid Fleet Profile

Participation by Vessel Size Group

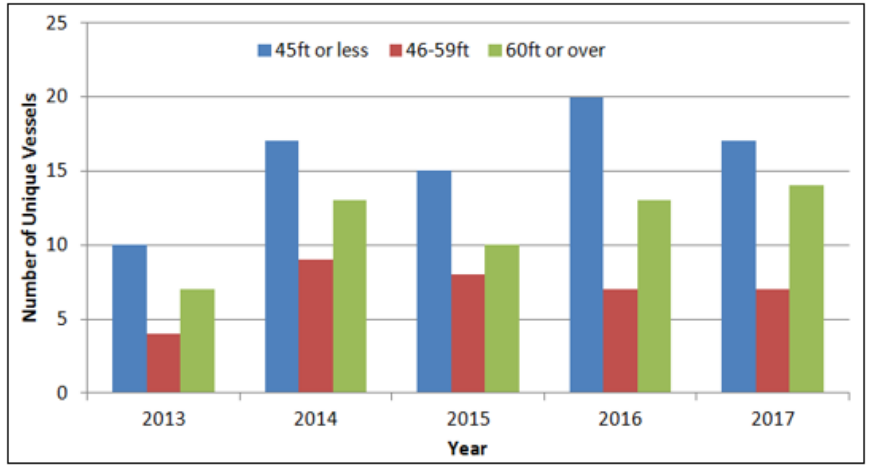


Figure 7 – Number of unique participating vessels that, by SA 538, by vessel length

Source: Unpublished NMFS and MADMF Dealer and VTR Data

Number of Trips by Vessel Size Group

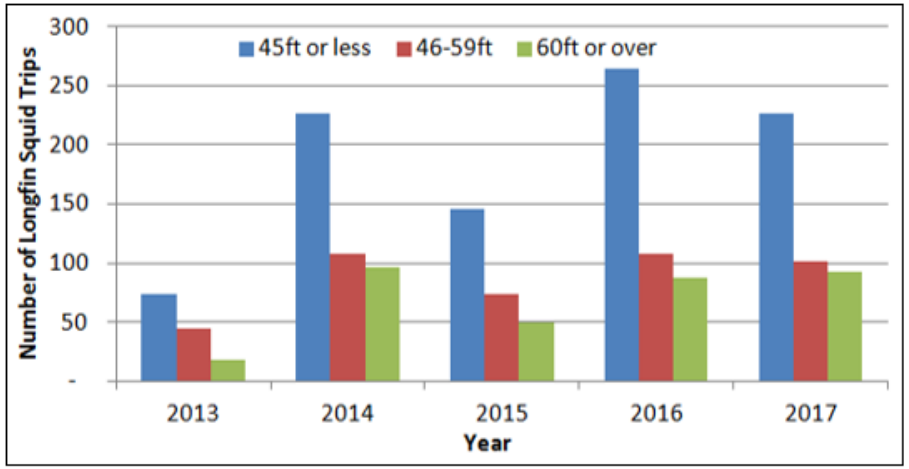


Figure 8 – Number of longfin squid trips conducted in SA 538, by vessel length class

Source: Unpublished NMFS and MADMF Dealer and VTR Data

Pounds landed by Vessels Size Group

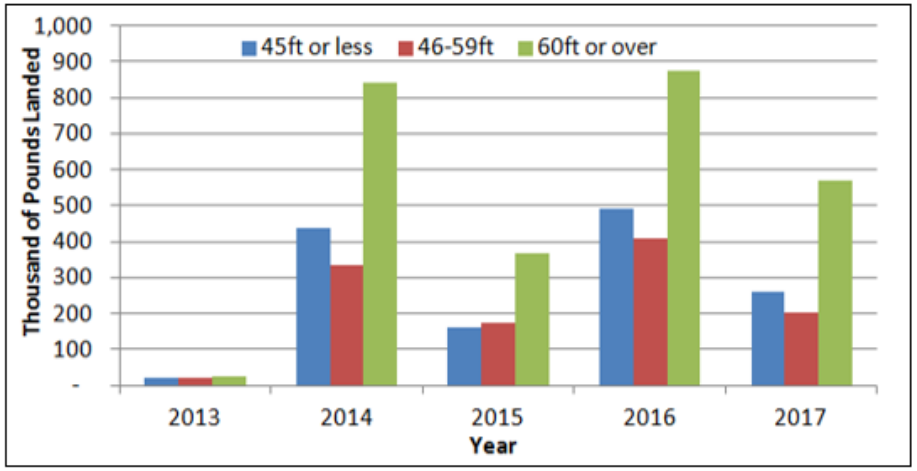


Figure 9 – Pounds of longfin squid landed from SA 538, by vessel length class

Source: Unpublished NMFS and MADMF Dealer and VTR Data

Trip Duration by State Landed (VTR&OBS)

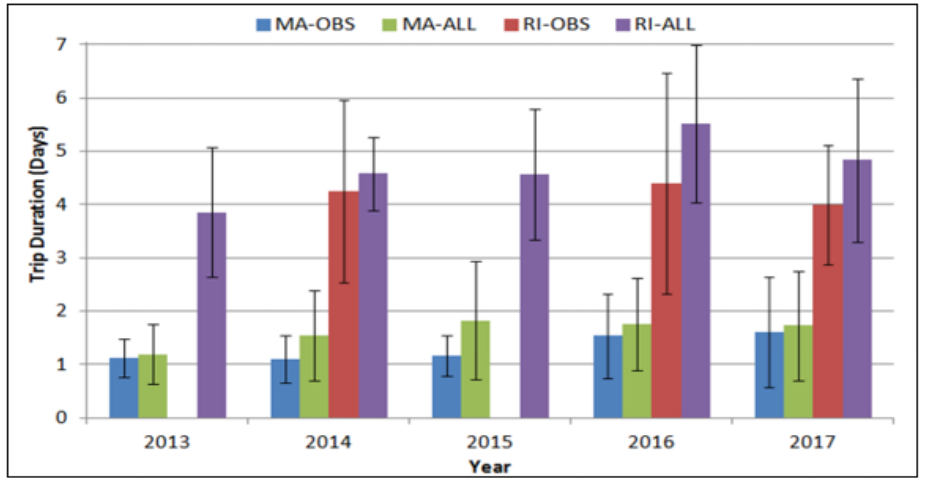


Figure 10 – Duration of observed trips and all trips conducted in Nantucket and Vineyard Sound

Source: Unpublished NEFOP and NMFS VTR data

Note: Confidential data is omitted for 2013 and 2015

Sea Sampling

Programs

NEFOP

DMF-FDI

Sampling Protocols

- Actual weights on discards
- Subsample using volume to volume expansion
- Lengths on discards, then kept species

Data Query

When: Apr23-fishery close, 2013-2017

What: Hauls where LFS was a stated target species

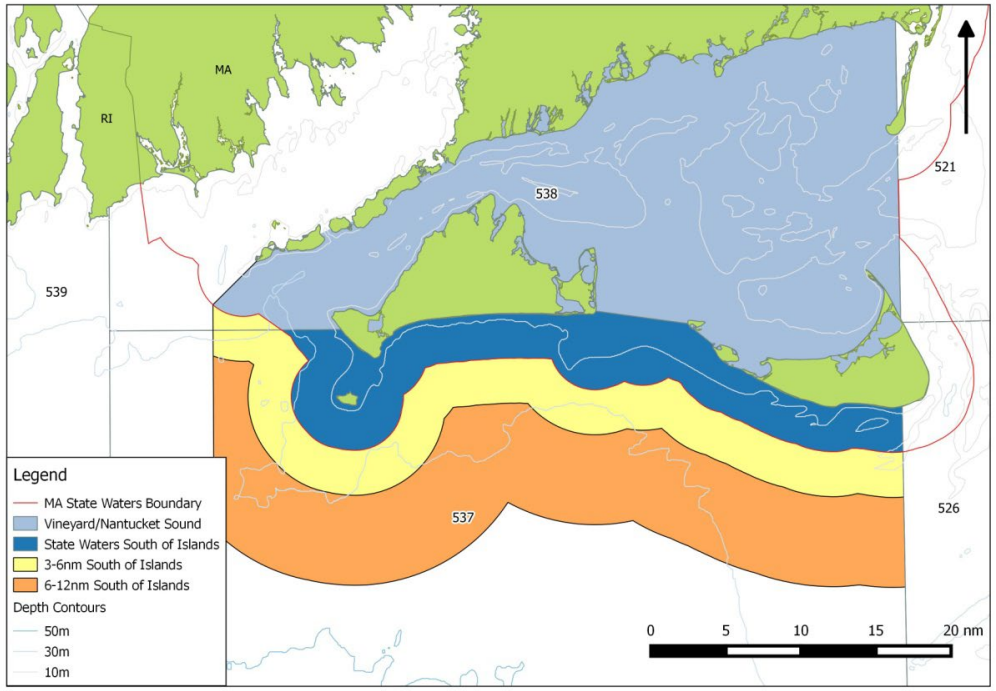
Where: Haul begin in Vineyard/Nantucket Sound or within 12nm of Martha's Vineyard/Nantucket Islands

Results: 1,405 observed hauls, 199 unique trips, 1.23 mil lbs, >13k lengths

Sea Sampling Data

Split area into 4 spatial sub-areas:

State waters – “VinNanSound”
“0-3nmS”
Federal waters – “3-6nmS”
“6-12nmS”



Number trips (hauls) by sub-area, by year

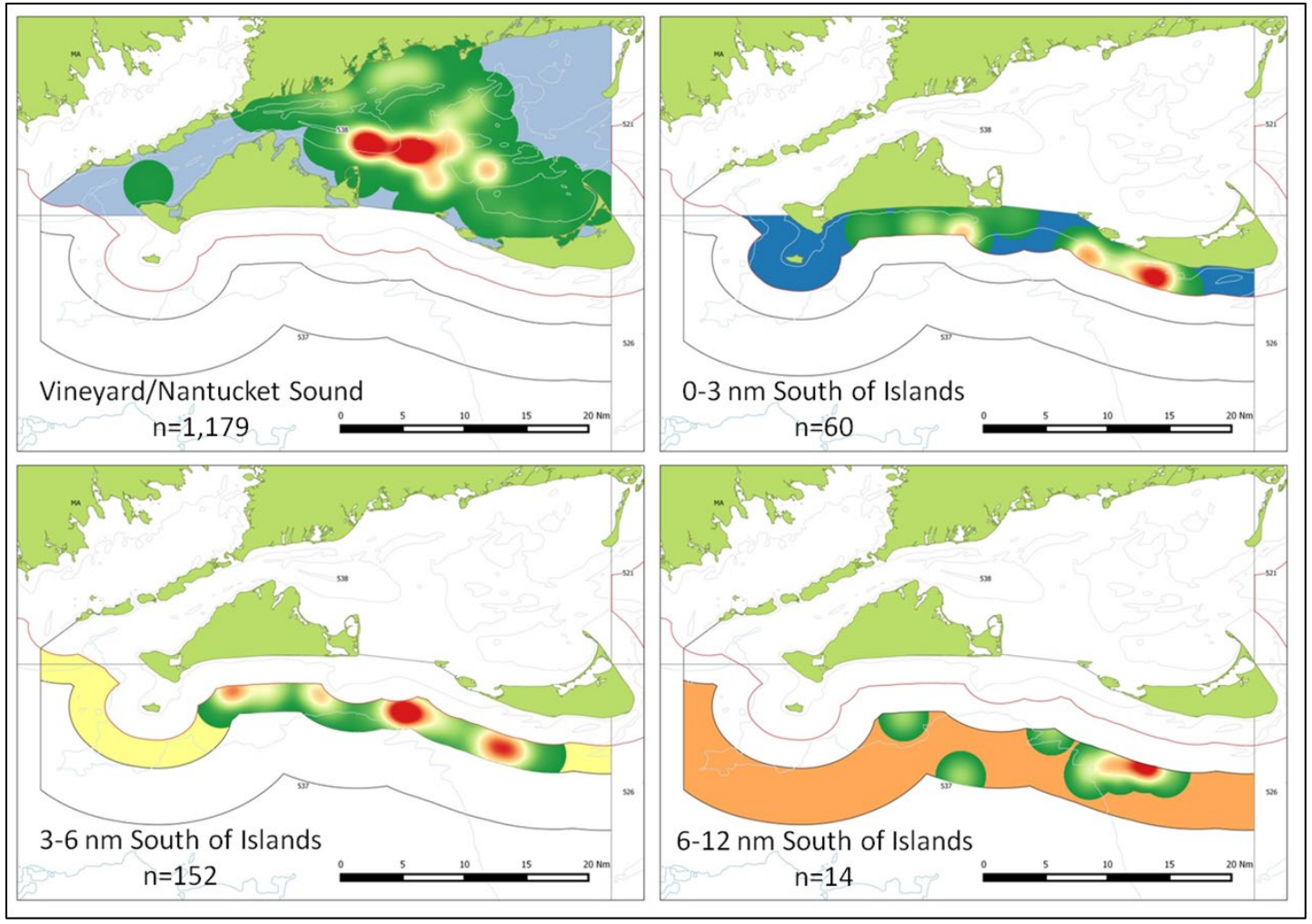
Observed Trips (hauls)	All Areas	State Waters		Federal Waters	
		VinNanSound	0-3nmS	3-6nmS	6-12nmS
2013	12 (95)	10 (82)	0	1.5 (10)	0.5 (3)
2014	63 (392)	61 (375)	1 (2)	0.5 (14)	0.5 (1)
2015	21 (144)	19 (127)	1.5 (15)	0.5 (2)	0
2016	44 (385)	31.17 (240)	4.17 (29)	7.67 (109)	1 (7)
2017	59 (389)	47.83 (355)	2.33 (14)	7 (17)	1.83 (3)
Total	199 (1,405)	**169 (1,179)**	**9 (60)**	**17.17 (152)**	**3.83 (14)**

VinNanSound coverage %

VinNanSound	% Sampled
2013	7.2%
2014	14.1%
2015	7.1%
2016	6.8%
2017	11.3%
Total	**9.8%**

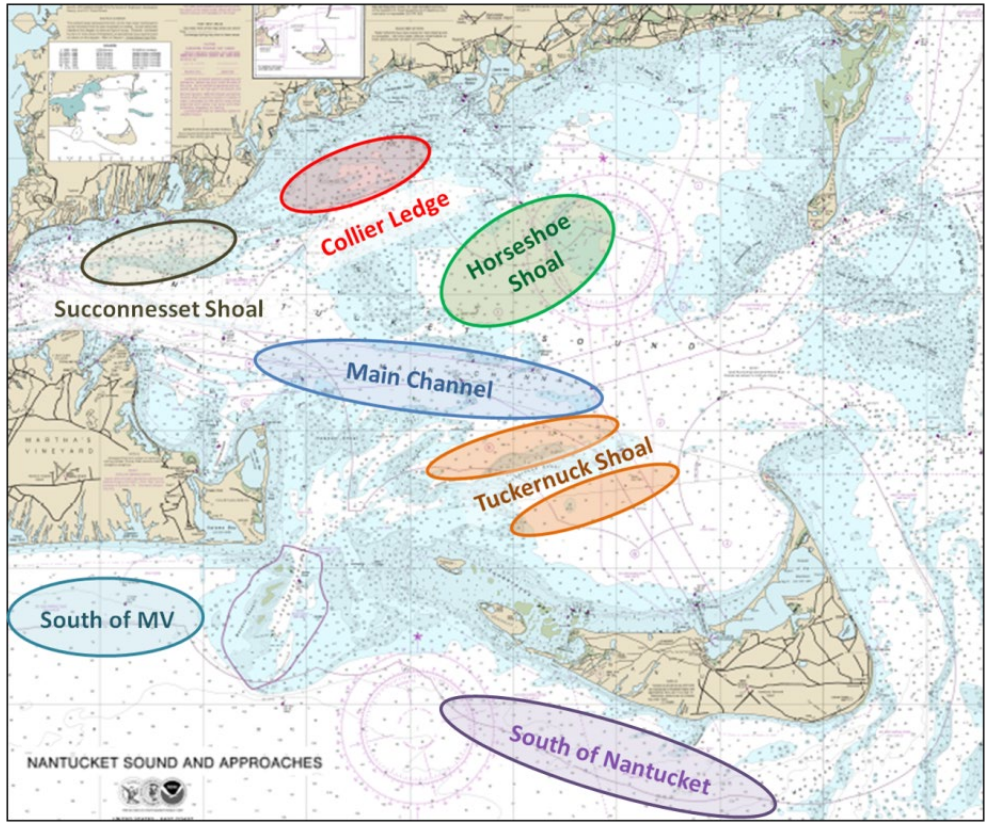
Sea Sampling Data

Tow (begin) locations



Distinct tows can be seen in the observer data

Traditional fishing locations



Sea Sampling Data

Kept vs Discarded Catch Ratios (by area and year): Overall Discard Ratio=**28.6%**

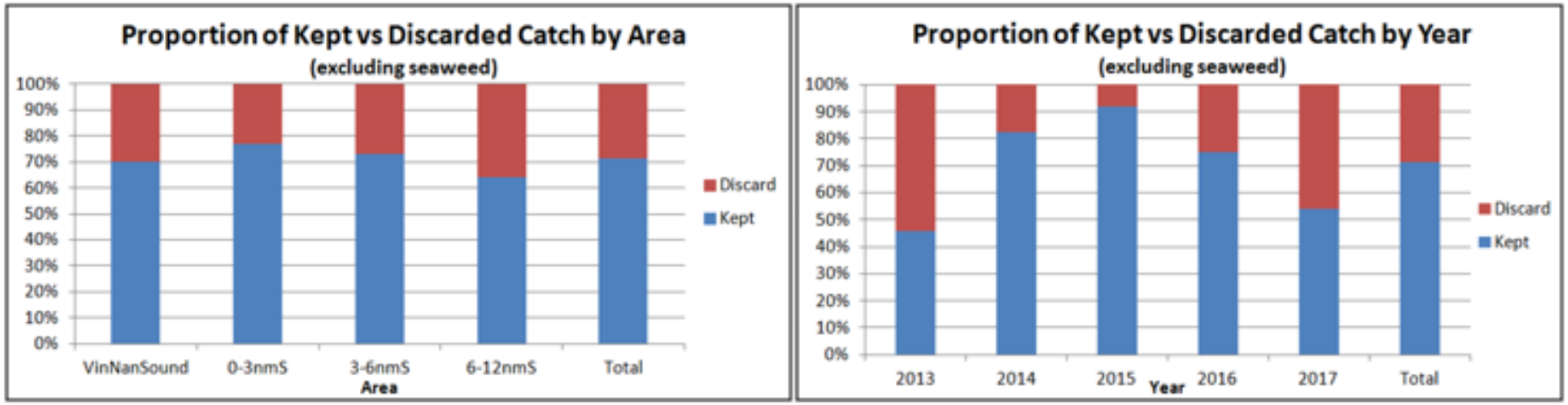


Figure 23 – Proportion of catch kept and discarded, by year and area

Reasons for Discarding

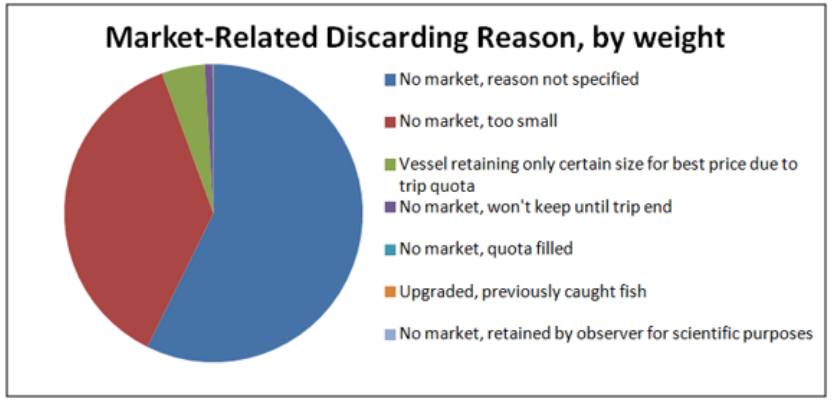


Figure 44 – Proportion of market-related discards, by recorded reason

Source: Unpublished NEFOP data

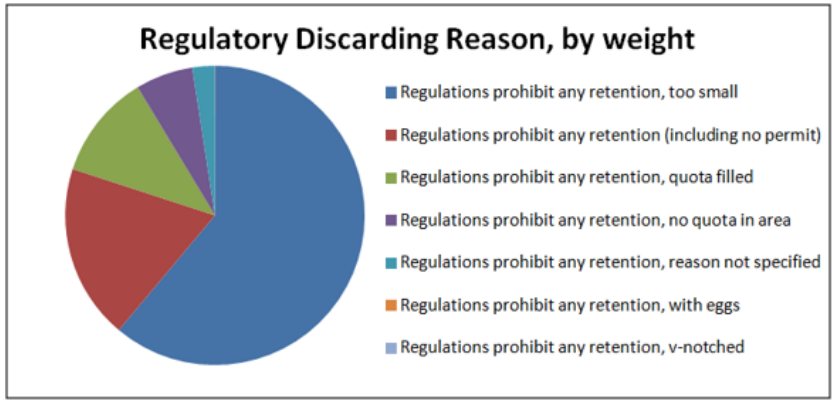


Figure 45 – Proportion of regulatory discards, by recorded reason

Source: Unpublished NEFOP data

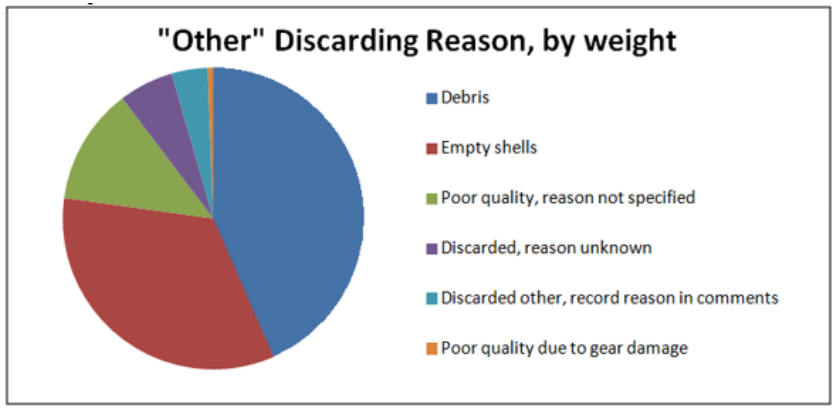


Figure 46 – Proportion of "other" discards, by recorded reason

Source: Unpublished NEFOP data

Sea Sampling Data

Master Data: Finfishes, Shellfishes and Other/Debris

Species Group	Kept lbs	Discard lbs	Total lbs	% Discard	% Total Catch
Finfishes	41,357	283,516	324,873	87.3%	26.4%
Shellfishes (including squids)	763,046	36,538	799,585	4.6%	65.0%
Other Species/Debris	0	105,848	105,848	100.0%	8.6%
Grand Total	804,403	425,902	1,230,305	34.6%	100%

FINFISH Species (top10)	Kept lbs	Discard lbs	Total lbs	% Discard	% Finfish Catch	% Total Catch
SCUP	**23,881**	**136,933**	160,814	85.1%	49.5%	14.3%
SEA BASS, BLACK	**1,354**	**22,091**	23,445	94.2%	7.2%	2.1%
BUTTERFISH	**6,330**	**15,376**	21,706	70.8%	6.7%	1.9%
SKATE, LITTLE	0	20,679	20,679	100.0%	6.4%	1.8%
SEA ROBIN, NORTHERN	24	19,129	19,152	99.9%	5.9%	1.7%
SKATE, WINTER	1,162	17,705	18,867	93.8%	5.8%	1.7%
FLOUNDER, SUMMER (FLUKE)	**3,007**	**9,325**	12,331	75.6%	3.8%	1.1%
MACKEREL, ATLANTIC	1,988	7,811	9,798	79.7%	3.0%	0.9%
DOGFISH, SMOOTH	189	6,483	6,672	97.2%	2.1%	0.6%
FLOUNDER, WINTER	105	4,457	4,561	97.7%	1.4%	0.4%

SHELLFISH Species (top 10)	Kept lbs	Discard lbs	Total lbs	% Discard	% Shellfish Catch	% Total Catch
SQUID, ATL LONG-FIN	**755,848**	**1,786**	757,634	0.2%	94.8%	67.2%
CRAB, LADY	0	15,335	15,335	100.0%	1.9%	1.4%
SQUID, NK	5,950	15	5,965	0.3%	0.7%	0.5%
CRAB, SPIDER, NK	0	5,866	5,866	100.0%	0.7%	0.5%
SQUID EGGS, ATL LONG-FIN	0	5,069	5,069	100.0%	0.6%	0.4%
CRAB, HORSESHOE	1,076	2,140	3,216	66.5%	0.4%	0.3%
CRAB, ROCK	0	2,008	2,008	100.0%	0.3%	0.2%
SHELL, NK	0	1,224	1,224	100.0%	0.2%	0.1%
CRAB, JONAH	0	1,014	1,014	100.0%	0.1%	0.1%
SQUID, SHORT-FIN	67	797	864	92.3%	0.1%	0.1%

Other Species/Debris (top 10)				
SEAWEED, NK	JELLYFISH, NK	SPONGE, NK	EGGS, NK	DEBRIS, PLASTIC
DEBRIS, FISHING GEAR	DEBRIS, ROCK	DEBRIS, WOOD	UNKOWN LIVING MATTER	DEBRIS, METAL

The BIG FIVE:

Squid Fishery Catches

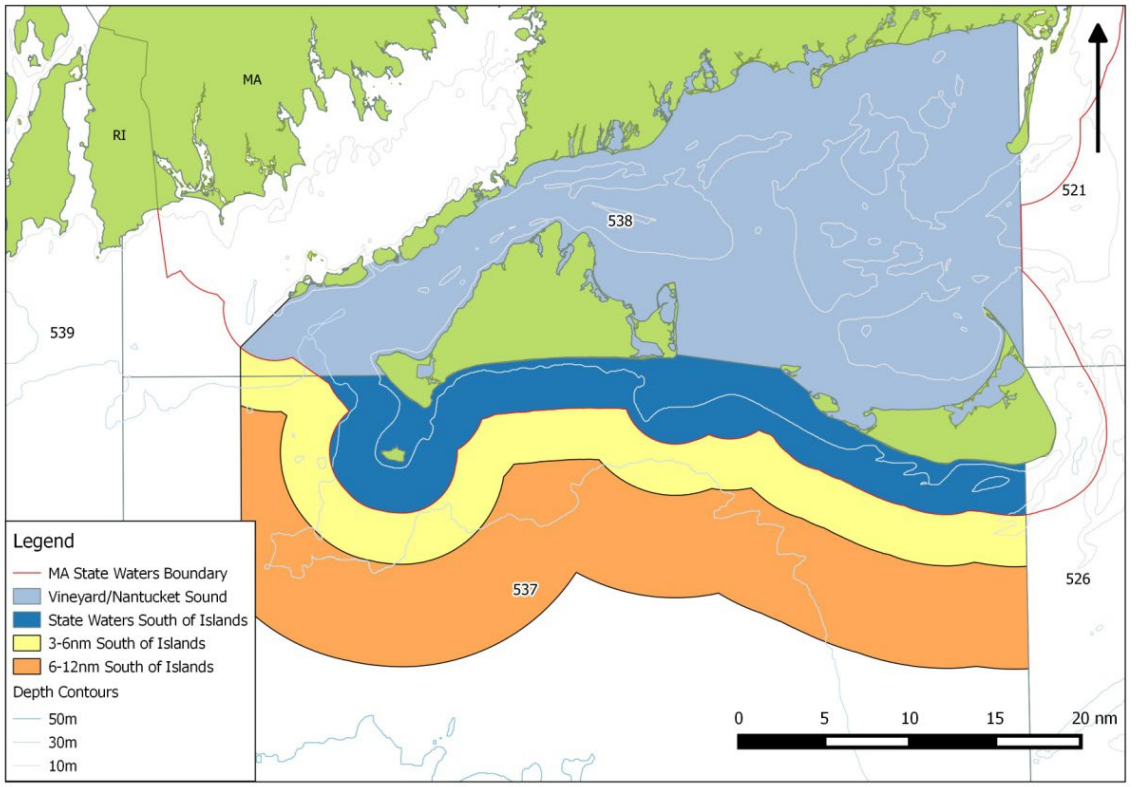
The Big Five: Squid, scup, butterfish, summer flounder, black sea bass

Analysis:

- Catch per Unit Effort (lbs K/D per hour) by sub-area and year
- Reason for discarding
- Length frequency distribution

Interpretations of data

Explanations of trends



Squid Catch Analysis

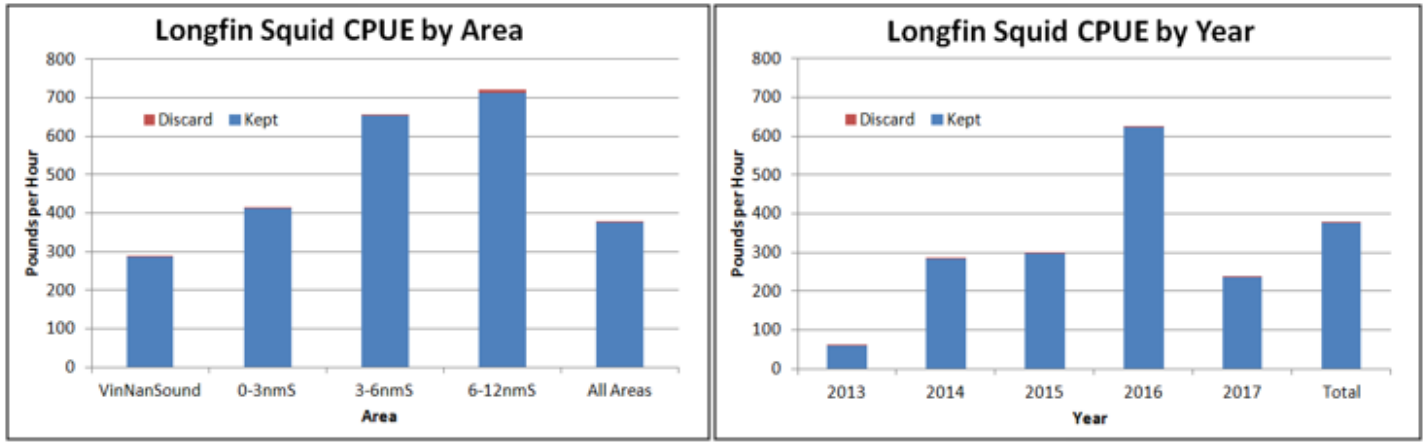


Figure 17 – Catch per Unit Effort of longfin squid by area and year

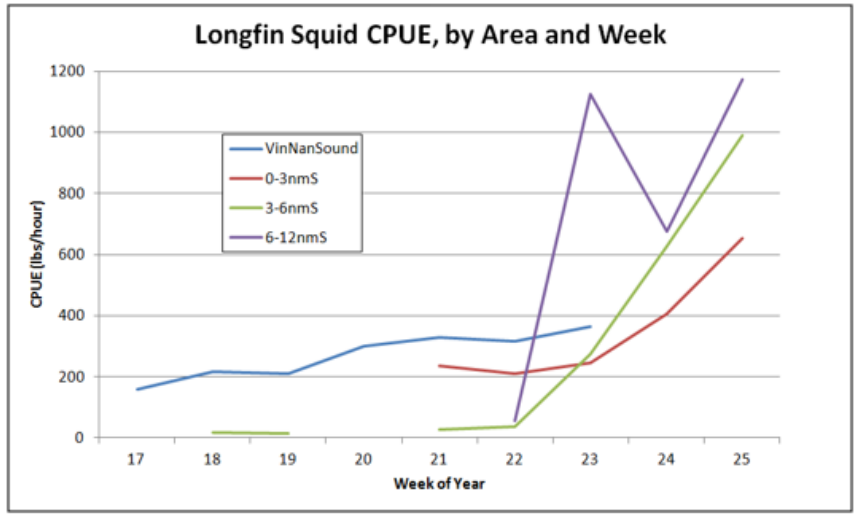


Figure 18 – Catch per unit effort of longfin squid, by week of season and area

Source: Unpublished NEFOP data

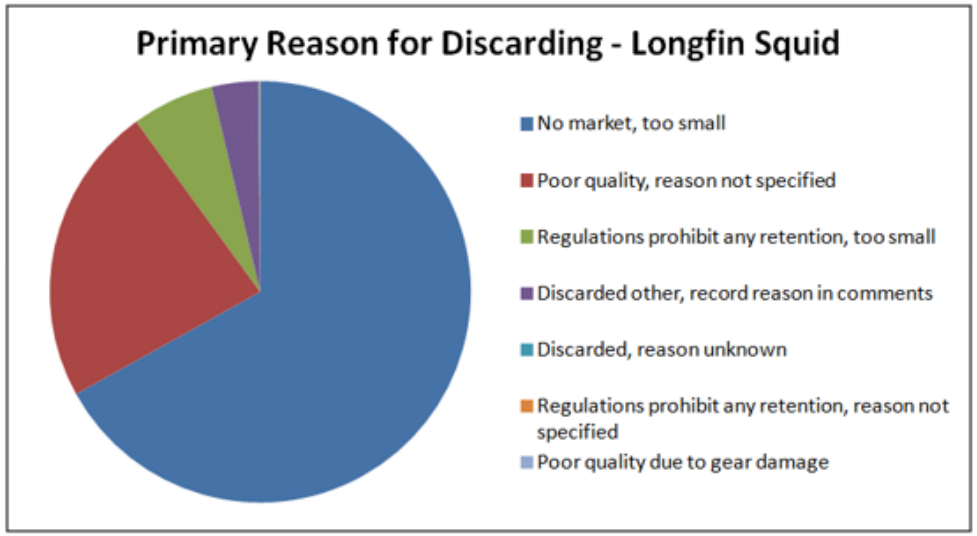


Figure 35 – Recorded reason for discarding of longfin squid

Source: Unpublished NEFOP data

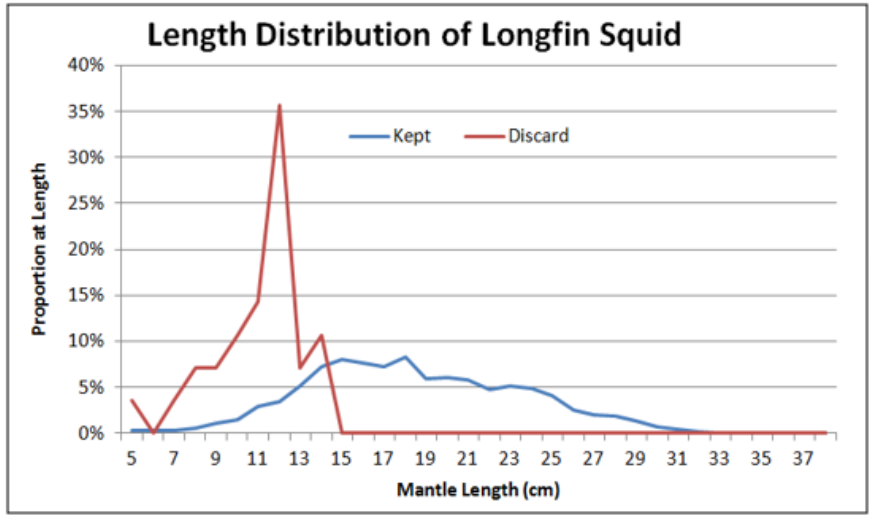
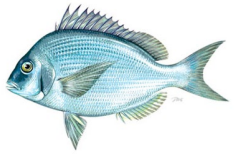


Figure 34 – Length distribution of kept (n=2915) and discarded (n=28) longfin squid

Source: Unpublished NEFOP data



Squid Fishery CPUEs

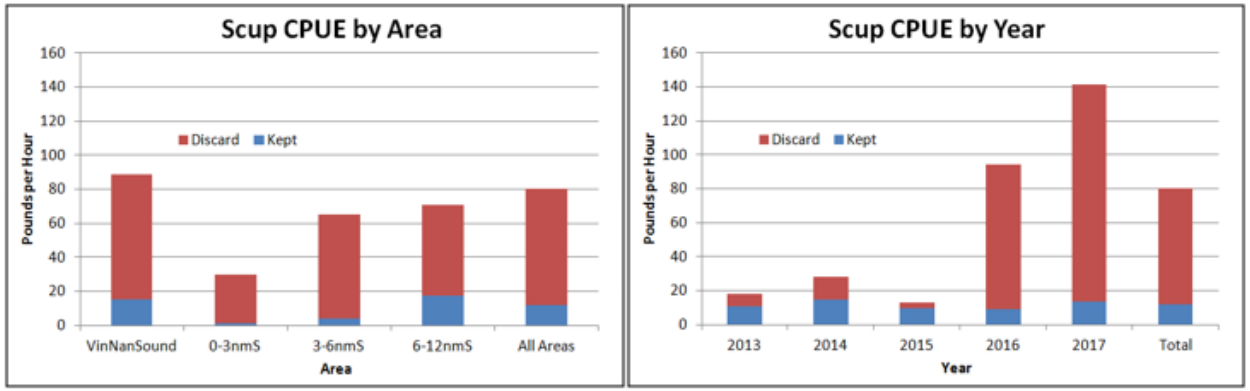
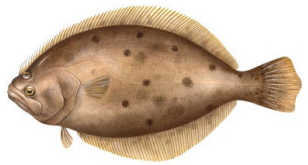


Figure 19 – Catch per Unit Effort of scup by area and year



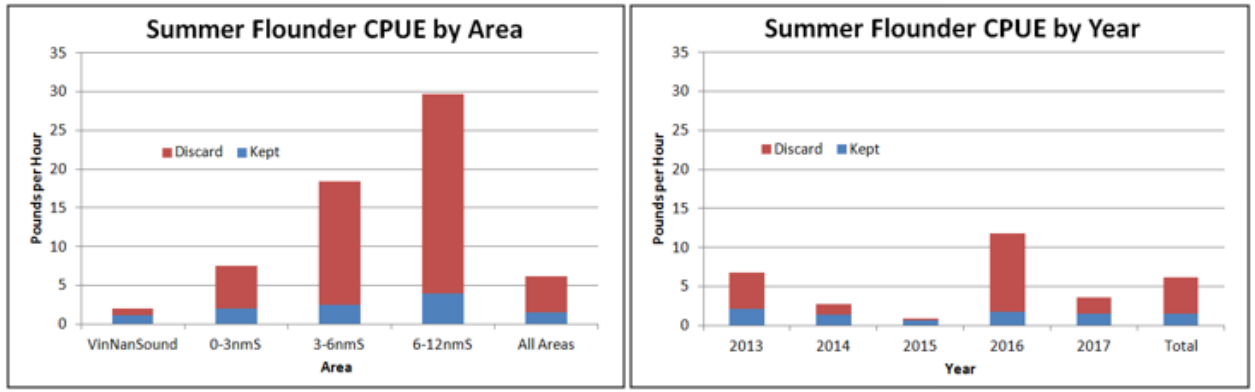


Figure 21 – Catch per Unit Effort of summer flounder by area and year

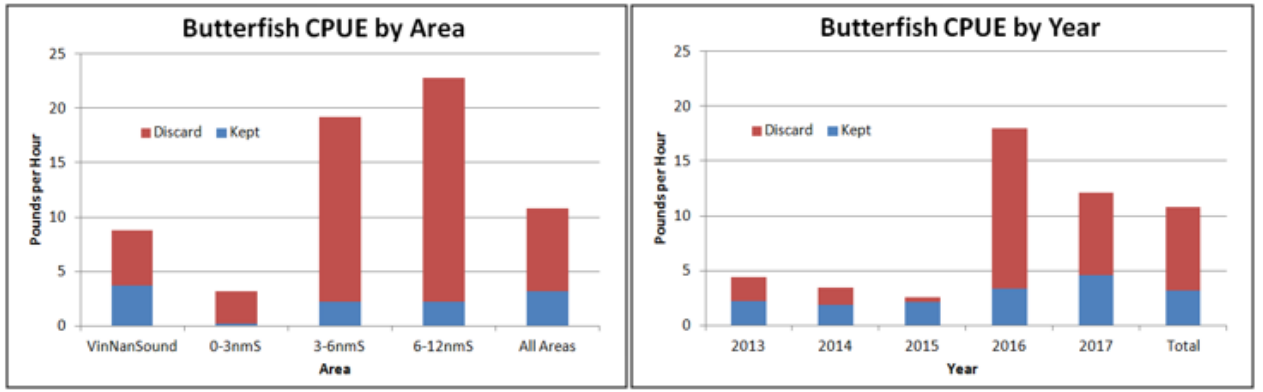


Figure 20 - Catch per Unit Effort of butterfish by area and year

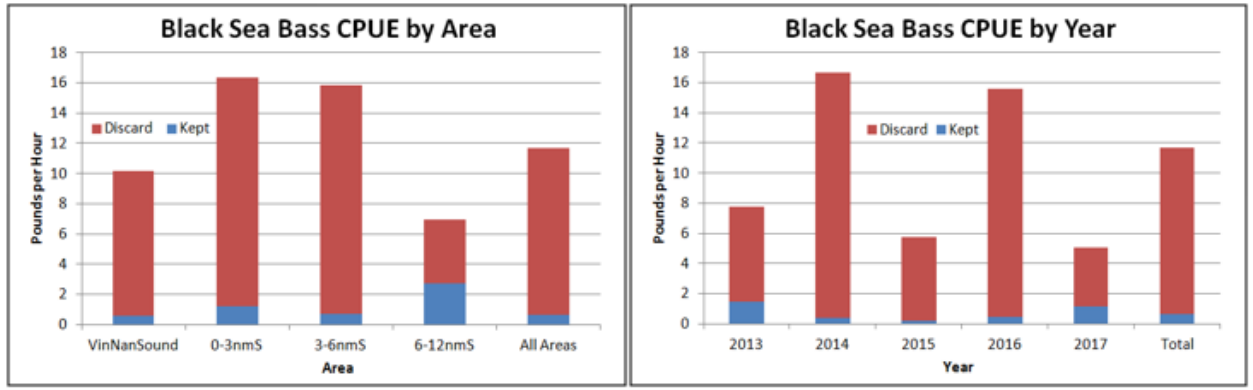
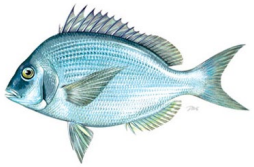


Figure 22 – Catch per Unit Effort of black sea bass by area and year

Squid Fishery-Reason for Discards



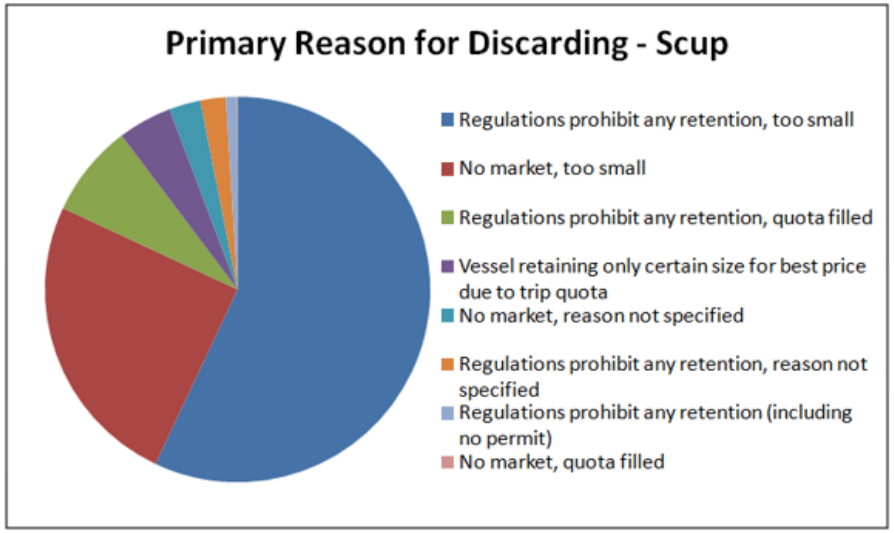


Figure 39 – Recorded reason for discarding of scup

Source: Unpublished NEFOP data

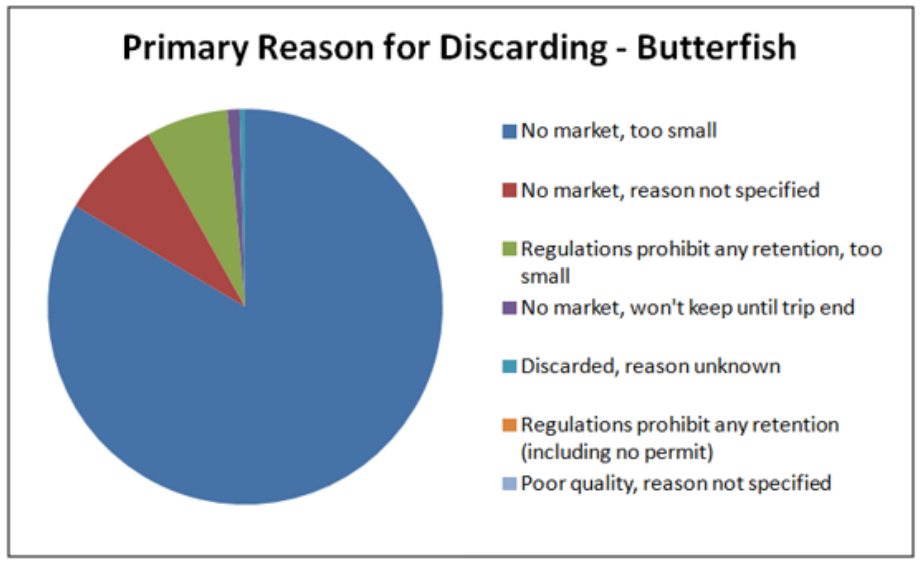
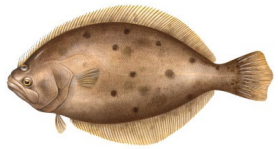


Figure 38 – Recorded reason for discarding of butterfish

Source: Unpublished NEFOP data



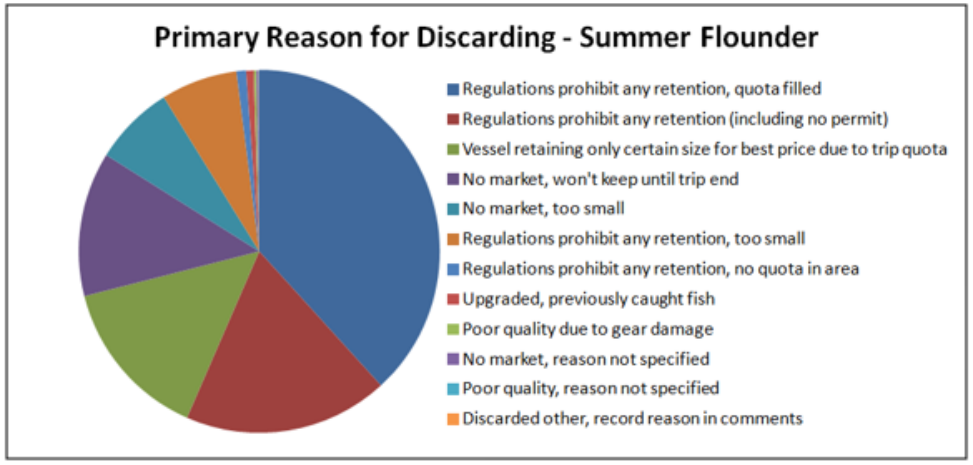


Figure 41 – Recorded reason for discarding of summer flounder

Source: Unpublished NEFOP data

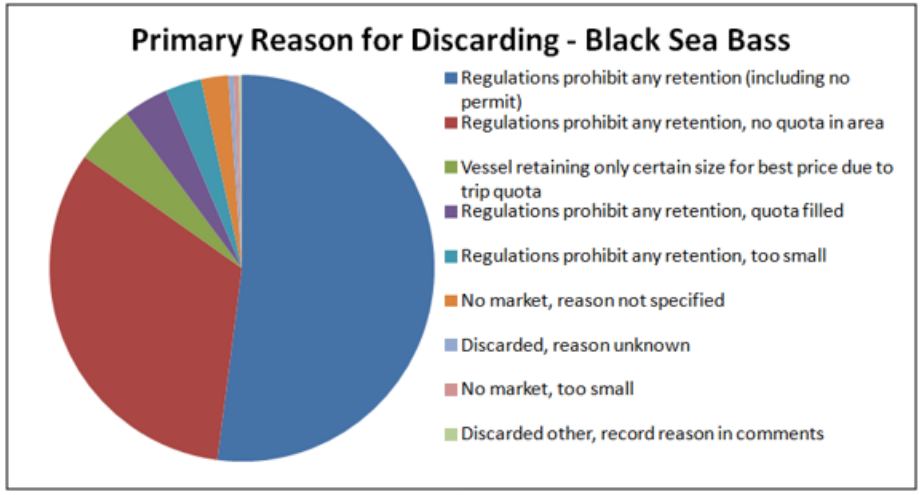
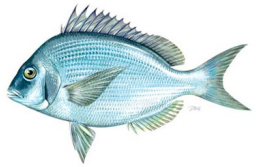


Figure 43 – Recorded reason for discarding of black sea bass

Source: Unpublished NEFOP data

Squid Fishery-Length Distribution



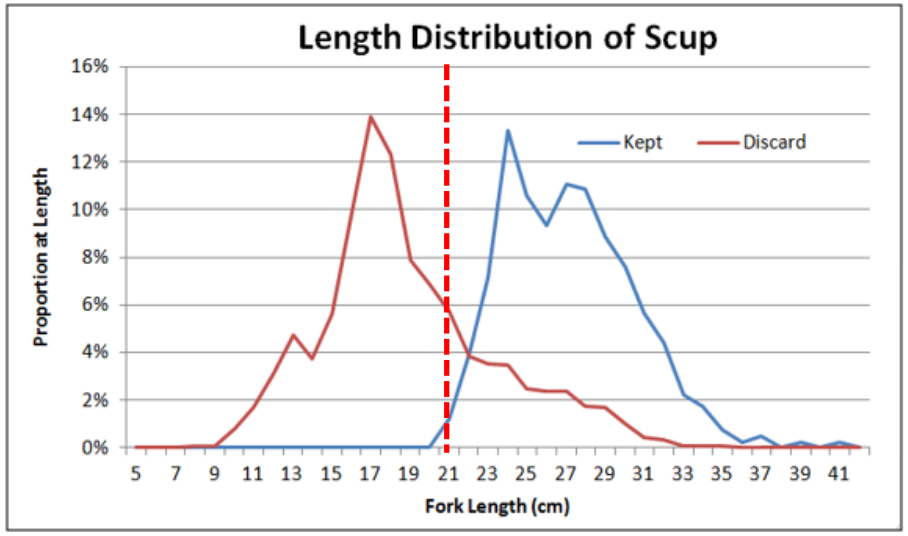


Figure 36 - Length distribution of kept (n=406) and discarded (n=3177) scup

Source: Unpublished NEFOP data

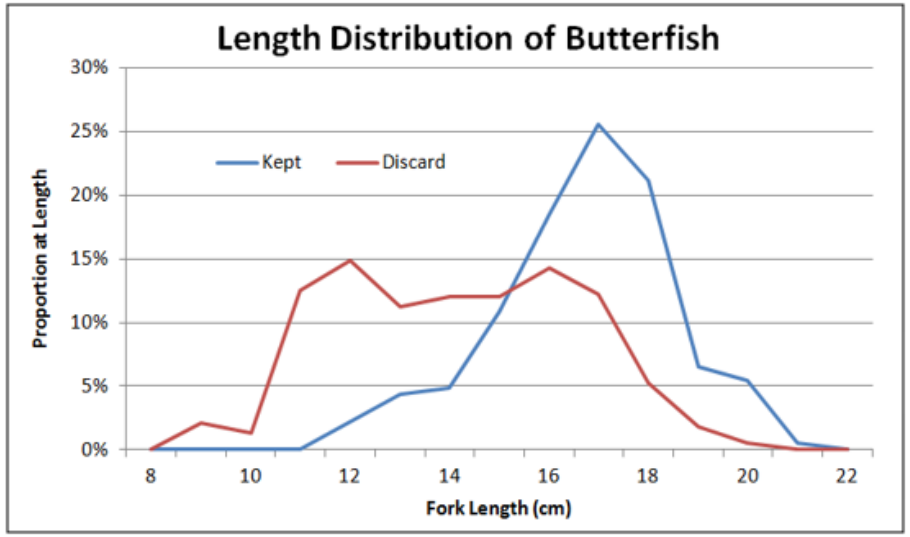
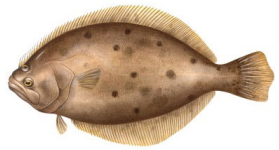


Figure 37 - Length distribution of kept (n=184) and discarded (n=384) butterfish

Source: Unpublished NEFOP data

min. = legal size



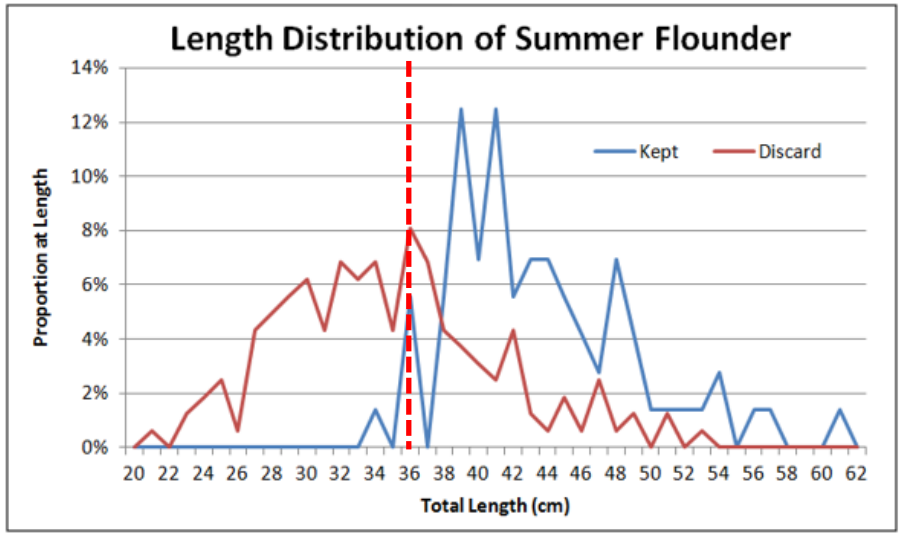


Figure 40 – Length distribution of kept (n=72) and discarded (n=161) summer flounder

Source: Unpublished NEFOP data

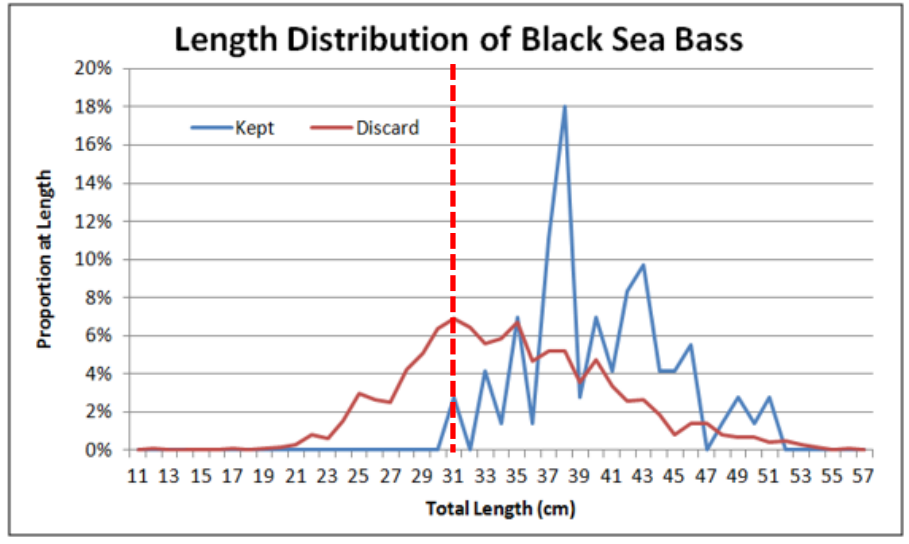


Figure 42 – Length distribution of kept (n=72) and discarded (n=1284) black sea bass

Source: Unpublished NEFOP data

Other Squid Fishery Catches

Other Notable Catches

Species subject to interstate management plans

Species Name	Total Catch lbs	% Total Catch	% Discard	% of hauls with discard lbs			
				VinNanSound	0-3nmS	3-6nmS	6-12nmS
ALEWIFE	3,349	0.29%	97.0%	26.5%	8.3%	26.3%	28.6%
CRAB, HORSESHOE	3,216	0.29%	66.5%	22.8%	0.0%	0.7%	0.0%
TAUTOG (BLACKFISH)	1,690	0.15%	88.5%	20.4%	0.0%	0.7%	0.0%
BASS, STRIPED	1,479	0.13%	100%	5.5%	16.7%	19.7%	14.3%
HERRING, BLUEBACK	468	0.04%	100%	7.0%	15.0%	10.5%	21.4%
SHAD, AMERICAN	444	0.04%	100%	4.7%	0.0%	28.3%	35.7%

Individual Animal Observations (released alive 85% of time)

Torpedo ray, basking shark, sand tiger shark, mola mola (6 of 199 trips)

Incidental Takes

Grey seal, Risso's dolphin, dolphin NK (5 of 1,405 hauls)

Discussion and Findings

Conservation Concerns

Overfishing?

- LFS are biologically resilient
- No significant catches of species currently (Dec2019)…

  Overfished: Atl. mackerel (0.87%), winter fl. (0.41%), bluefish (0.19%)

  Overfishing occurring: Atl. mackerel (0.87%), red hake (0.03%), Atl. cod (0.001%)

Forage Removal?

- Is there sufficient forage for marine mammals, striped bass, bluefish, black sea bass, Atlantic cod, etc.?
- Dependency of predators on LFS alone?
  - Striped bass in Nantucket Sound (1997-2000) preyed mostly on crustaceans (50% by weight) and fishes (40%; sand lance, N. sea robin, menhaden and scup). Squids = 3.3% *(Nelson et al. 2003)*

Discussion and Findings

Conservation Concerns

Bycatch Impacts ?

- Species of recreational importance

  Striped bass (0.1% of total catch), scup (14.3%), black sea bass (2.1%), summer flounder (1.1%), bluefish (0.2%) and tautog (0.1%)

- Disruption of squid egg mops

  Possible reduction in viability → indirect impact on offshore biomass

  Room for future investigation?

- Discard rates relative to other fisheries

  2013-2017 data (MA inshore/spring)

  28.6% discard rate

  National Bycatch Report (2015)

  NE SM-BOT = 25%

  MAtl SM-BOT = 30%

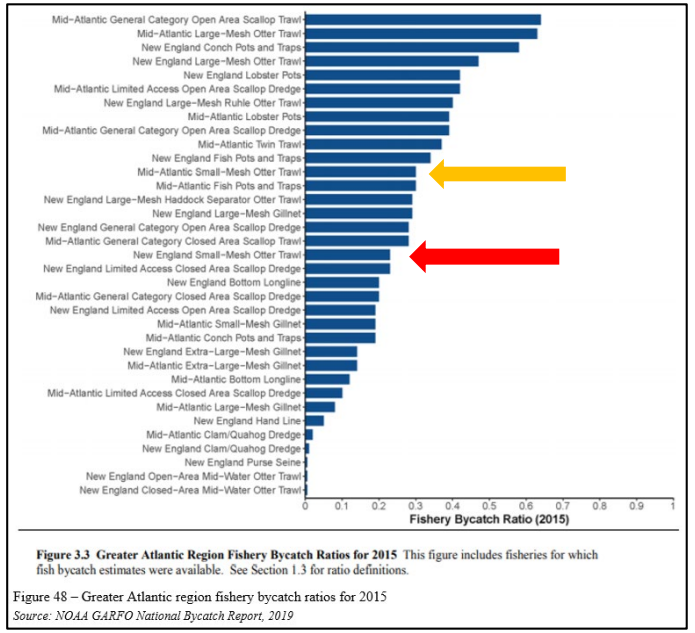


Figure 3.3 Greater Atlantic Region Fishery Bycatch Ratios for 2015 This figure includes fisheries for which fish bycatch estimates were available. See Section 1.3 for ratio definitions.

Figure 48 – Greater Atlantic region fishery bycatch ratios for 2015

Source: NOAA GARFO National Bycatch Report, 2019

Discussion and Findings

Importance of Longfin Squid Fishery

Coast-wide: in an average year (2013-2017) LFS fishery created

- 2,539 full-time jobs
- $20-30 million in revenue to vessels
- $99.74 million in income
- $243.56 million in economic output across all sectors (Scheld, 2020)

Vessels landing LFS in MA ports (avg >10,000lbs and active 3 of 5 years)

↳ "Massachusetts Squid Fleet" (23 vessels)

Species	Percent of Revenue
Longfin squid	22.7%
Summer fl.	11.5%
Sea scallops	10.0%
Monkfish	7.0%
Multispecies groundfish	**33.8%**
Am. plaice fl. (7.7%), Atl. cod (4.6%), winter fl. (4.5%), haddock (4.2%), white hake (4.1%), witch fl. (3.4%), yellowtail fl. (2.3%), pollock (1.7%), etc…	

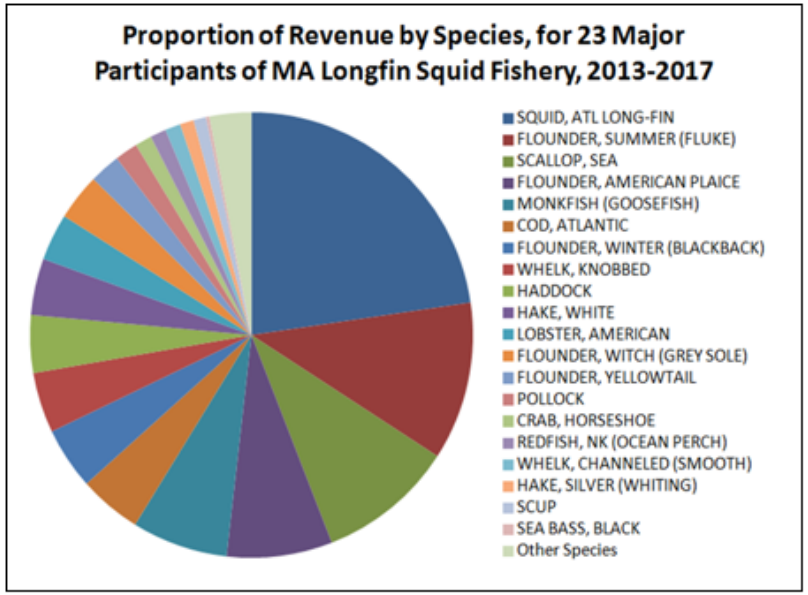


Figure 11 – Proportion of overall revenue by species sold, 2013-2017

Source: Unpublished NMFS Dealer Data

Discussion and Findings

Robust Monitoring and Management

Sea Sampling

- SBRM allocates sea days based on discards/variability
- NEFOP/DMF have good rapport with fishermen
- Data collection protocols and QA/QC are robust, data is made available quickly

Quota Monitoring

- Trimester 2 (May-Aug) is 17% of annual quota
- Limit to amount of quota carryover
- Overage reductions come from same year

State Management

- Flexible and responsive to stakeholder concerns
- Conduct additional sampling where needed
- Outstanding working relationship with NEFOP
  - NEFOP sends DMF in-season data to inform the June LFS fishery extension

Federal Management

- MAFMC- SMB Advisory Panel has members from all sectors (rec/charter, commercial, ENGO)
- Bycatch (butterfish) accountability maintained via caps

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Industry/Academic advisors

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