

ATLANTIC STATES MARINE FISHERIES COMMISSION
REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN

**For Jonah Crab
(*Cancer borealis*)**

2019 FISHING YEAR



Prepared by the Plan Review Team

Approved October 19, 2020



Sustainable and Cooperative Management of Atlantic Coastal Fisheries

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**2019 REVIEW OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION FISHERY
MANAGEMENT PLAN FOR JONAH CRAB (*Cancer borealis*)**

2018 FISHING YEAR

1.0 Status of the Fishery Management Plan

<u>Year of ASMFC Plan's Adoption:</u>	FMP (2015)
<u>Framework Adjustments:</u>	Addendum I (2016) Addendum II (2017) Addendum III (2018)
<u>Management Unit:</u>	Maine through North Carolina
<u>States with a Declared Interest:</u>	Maine through Virginia (Excluding Pennsylvania and DC)
<u>Active Committees:</u>	American Lobster Management Board, Technical Committee, Plan Review Team, Advisory Panel, Electronic Reporting Subcommittee, Electronic Tracking Subcommittee

2.0 Status of the Fishery

2.1 Commercial Fishery

Historically, Jonah crab was taken as bycatch in the lobster fishery; however, in recent years a directed fishery has emerged causing landings to rapidly increase. Throughout the 1990's, landings fluctuated between approximately 2 and 3 million pounds, and the overall value of the fishery was low. In the early 2000's landings began to increase, with over 7 million pounds landed in 2005. By 2014, landings had almost tripled to 17 million pounds and a value of nearly \$13 million dollars. This rapid increase in landings can be attributed to an increase in the price of other crab (such as Dungeness), creating a substitute market for Jonah crab, as well as a decrease in the abundance of lobsters in Southern New England, causing fishermen to redirect effort on Jonah crab.

Today, Jonah crab and lobster are considered a mixed crustacean fishery in which fishermen can target lobster or crab at different times of the year based on slight gear modifications and small shifts in the areas in which the traps are fished. While the majority of Jonah crab is harvested as whole crabs, fishermen from several states, including New York, Maryland and Virginia, land claws. Jonah crab claws are relatively large and can be an inexpensive substitute for stone crab claws. As a result, they can provide an important source of income for fishermen. A historic claw fishery takes place along the Delmarva Peninsula where small boat fishermen harvest Jonah crab claws because they do not have a seawater storage tank on board to store whole crabs.

In 2019, landings along the Atlantic Coast totaled approximately 16 million pounds of Jonah crab, representing \$13.1 million in ex-vessel value. The states of Massachusetts (60%) and Rhode Island (25%) were the largest contributors to landings in the fishery. Landings in descending order also occurred in New Jersey, Maine, New York, New Hampshire, Maryland, Connecticut, and Delaware, and Virginia. Over 99% of coastwide landings in 2019 came from trap gear.

2.2 Recreational Fishery

The magnitude of the Jonah crab recreational fishery is unknown at this time; however, it is believed to be quite small in comparison to the size of the commercial fishery.

3.0 Status of the Stock

Jonah crab are distributed in the waters of the Northwest Atlantic Ocean primarily from Newfoundland, Canada to Florida. The life cycle of Jonah crab is poorly described, and what is known is largely compiled from a patchwork of studies that have both targeted and incidentally documented the species. Female crab (and likely some males) are documented moving inshore during the late spring and summer. Motivations for this migration are unknown, but maturation, spawning, and molting have all been postulated. It is also generally accepted that these migrating crab move back offshore in the fall and winter. Due to the lack of a widespread and well-developed aging method for crustaceans, the age, growth, and maturity of Jonah crab is poorly described.

The status of the Jonah crab resource is relatively unknown and no range wide stock assessment has been conducted. Massachusetts, Rhode Island, Maine, and New Hampshire conduct inshore state water trawl surveys, and NOAA Fisheries conducts a trawl survey in federal waters which collects data on Jonah crab abundance and distribution. In addition, several studies are on-going (Section 7.0) to gather more information on the species. A Data Workshop is scheduled for November 2020 to evaluate all available data sources and determine whether enough data of sufficient quality are available to conduct a stock assessment.

4.0 Status of Management Measures

Interstate Fishery Management Plan for Jonah Crab (2015)

Jonah crab is managed under the Interstate Fishery Management Plan (FMP) which was approved by the American Lobster Management Board in August 2015. The goal of the FMP is to promote conservation, reduce the possibility of recruitment failure, and allow for the full utilization of the resource by the industry. The FMP lays out specific management measures in the commercial fishery. These include a 4.75" minimum size and a prohibition on the retention of egg-bearing females. To prevent the fishery from being open access, the FMP states that participation in the directed trap fishery is limited to lobster permit holders or those who can prove a history of crab-only pot fishing. All others must obtain an incidental permit. In the recreational fishery, the FMP sets a possession limit of 50 whole crabs per person per day and prohibits the retention of egg-bearing females. Due to the lack of data on the Jonah crab fishery, the FMP implements a fishery-dependent data collection program. The FMP also requires harvester and dealer reporting along with port and sea sampling.

Addendum I (2016)

Addendum I establishes a bycatch limit of 1,000 pounds of crab/trip for non-trap gear (e.g., otter trawls, gillnets) and non-lobster trap gear (e.g., fish, crab, and whelk pots). In doing so, the Addendum caps incidental landings of Jonah crab across all non-directed gear types with a uniform bycatch allowance. While the gear types in Addendum I make minimal contributions to total landings in the fishery, the 1,000 crab limit provides a cap to potential increases in effort and trap proliferation.

Addendum II (2017)

Addendum II establishes a coastwide standard for claw harvest. Specifically, it permits Jonah crab fishermen to detach and harvest claws at sea, with a required minimum claw length (measured along the forearm of the claw) of 2.75" if the volume of claws landed is greater than five gallons. Claw landings less than five gallons do not have to meet the minimum claw length standard. The Addendum also establishes a definition of bycatch in the Jonah crab fishery, whereby the total pounds of Jonah crab caught as bycatch must weigh less than the total amount of the targeted species at all times during a fishing trip. The intent of this definition is to address concerns regarding the expansion of a small-scale fishery under the bycatch limit.

Addendum III (2018)

Addendum III improves the collection of harvester and biological data in the Jonah crab fishery. Specifically, the Addendum improves the spatial resolution of harvester data collection by requiring fishermen to report via 10 minute squares. It also expands the required harvester reporting data elements to collect greater information on gear configurations and effort. In addition, the Addendum established a deadline that within five years, states are required to implement 100% harvester reporting, with the prioritization of electronic harvester reporting development during that time. Finally, the Addendum improves the biological sampling requirements by establishing a baseline of ten sampling trips/year, and encourages states with more than 10% of coastwide landings to conduct additional sampling trips.

5.0 Fishery Monitoring

The provisions of Addendum III went into effect January 1, 2019. Specifically, Addendum III requires reporting of additional data elements, the implementation of 100% harvester reporting within five years, and the completion of a minimum of ten sea and/or port sampling trips per year for biological sampling of the lobster/Jonah crab fishery. The Addendum III requirement for commercial harvesters to report their fishing location by 10 minute longitudinal/latitudinal square will not be implemented until 2021. *De minimis* states are not required to conduct fishery-independent sampling or port/sea sampling.

Overviews of the states' port and sea sampling are as follows:

- Maine: In 2019, Jonah crab data were collected on 15 lobster sea sampling trips for a total of 1,794 crabs. Sampling occurs through the lobster sea sampling program, which has a sampling protocol for Jonah crab including collecting data on carapace width, sex, reproductive status, cull status, and shell hardness. Maine's lobster port sampling program was suspended in 2011.

- New Hampshire: Staff sampled 72 Jonah crab on 8 sea sampling trips and collected information on sex, the presence of eggs, cull condition, molt stage, and carapace length. NH initiated a quarterly port sampling program in late 2016. Quarterly sampling took place at shellfish dealers, where an interview with the captain occurred and a biological sample was taken. A total of 222 Jonah crab were sampled through this new program, which were sexed, measured for carapace length, and weighed (when feasible).
- Massachusetts: Massachusetts conducted 11 port sampling trips and sampled 7,452 Jonah crab from four different boats. Data collected include shell width, sex, egg bearing status, cull status, and shell hardness.
- Rhode Island: Rhode Island DMF did not conduct sea sampling for Jonah crab in 2019, due to a lack of funding specific to this purpose. Inshore lobstermen who also target Jonah crab generally target either lobster or crab during a given trip, so opportunity to sample Jonah crab and lobsters simultaneously is limited. Rhode Island DMF conducted port sampling of Jonah crab from two fishing trips in 2019, sampling a total of 345 Jonah crabs.
- Connecticut: No sea sampling or port sampling trips were conducted for Jonah crab.
- New York: Staff conducted 11 market sample trips, sampling 204 Jonah crab. No sea sampling trips were conducted for Jonah crab.
- New Jersey: No sea or port sampling trips were conducted for Jonah crab in 2019.
- Delaware: No sea or port sampling trips were conducted for Jonah crab.
- Maryland: Maryland conducted one multi-day sea sampling trip and sampled 100 Jonah crab. Data collected included carapace width, egg bearing status, cull status, shell hardness, sex and whether the landings are whole crabs or parts.
- Virginia: No sea or port sampling trips were conducted for Jonah crab.

6.0 Status of Surveys

The FMP for Jonah crab encourages states to expand current lobster surveys (i.e. trawl surveys, ventless trap surveys, settlement surveys) to collection biological information on Jonah crab. The following outlines the fishery-independent surveys conducted by each state.

Maine

A. Settlement Survey

The Maine settlement survey was primarily designed to quantify lobster young-of-year (YOY), but has also collected Jonah crab data from the sites throughout the survey. Jonah crab information collected includes carapace width, sex (when large enough), ovigerous condition, claw status, shell hardness, and location. The density of YOY Jonah crab has increased over the past two decades with high values in 2012 and 2016 (Figure 1). In 2019, density of YOY Jonah crab decreased sharply from 2018 (Figure 1). The density of all Jonah crabs also decreased from 2018 in each of the sampled areas.

B. State Trawl Survey

The ME/NH Inshore Trawl Survey began in 2000 and is conducted biannually (spring and fall) through a random stratified sampling scheme. Jonah crab data has been collected throughout the history of this survey. The 2019 spring survey completed all 120 scheduled tows and

sampled a total of 179 Jonah crab. The spring abundance indices for Jonah crab significantly increased from 2013 to 2016, but declined in 2017, 2018, and 2019 (Figure 2). The 2019 fall survey completed 98 tows and sampled 225 Jonah crab. Abundance indices for Jonah crab declined in 2017 and 2018, and very slightly in 2019 (Figure 2).

C. Ventless Trap Survey

Maine began its Juvenile Lobster Ventless Trap Survey in 2006. Since the beginning of the survey, Jonah crab counts were recorded by the contracted fishermen, but the confidence in early years of this data is low because of the confusion between the two *Cancer* crabs (Jonah crab vs. rock crab) and similar common names. In 2016, the survey began collecting biological data for Jonah crab including carapace width, sex, ovigerous condition, claw status, shell hardness, and location. In 2019 concentrations of Jonah crab were highest in Statistical Area 511 and decrease to the southwest (Figure 3).

New Hampshire

A. Settlement Survey

Since 2009, species information has been collected on Jonah crab in the New Hampshire Fish and Game portion of the American Lobster Settlement Index. Figure 4 depicts the CPUE (#/m²) of Jonah crab for all NH sites combined, from 2009 through 2019. The time series shows a general upward trend to a time series high in 2018, followed by a decrease in 2019.

B. Ventless Trap Survey

Since 2009, New Hampshire Fish and Game has been conducting the coastwide Random Stratified Ventless Trap Survey in state waters (statistical area 513). A total of six sites were surveyed twice a month from June through September in 2018. Beginning in 2016 all Jonah crab were evaluated for sex and carapace length. A total of 51 Jonah crab over 19 trips were measured during the 2019 sampling season.

Massachusetts

A. Settlement Survey

The Juvenile Lobster Suction Survey has consistently identified *Cancer* crabs to genus level since 1995 Jonah crab since 2011, and to the species level since 2011. The number of Jonah crab per square meter were higher in 2018 and 2019 than any other point in the survey in all regions except Buzzards Bay, where Jonah crabs are rarely encountered (Figure 5).

B. Ventless Trap Survey

The MA DMF Ventless Tray Survey is conducted in MA territorial waters of NMFS SA 514 and 538. Stratified mean catch per trawl haul (CPUE) for the survey is standardized to a six-pot trawl with three vented and three ventless traps. The Jonah crab relative abundance index from Area 514 (Figure 6) has been fairly stable since 2009, with the exception of a down year in 2012. NMFS SA 538 had shown a modest increase in abundance from 2010 to 2017 but has declined since (Figure 7).

C. Trawl Survey

The MA DMF Trawl Survey data are divided into two regions, Gulf of Maine (survey regions 4 and 5), and Southern New England (survey regions 1-3). Recent trends in both regions during the fall, and GOM in the spring have been positive (Figure 8). The spring survey in SNE consistently catches few, if any crabs. While trends are generally positive, 2019 data points for all seasons and regions were below their time series medians, except for the spring survey in GOM.

Rhode Island

A. Settlement Survey

The RI DEM DMF YOY Settlement Survey (Suction Sampling) intercepts Jonah crabs. The 2019 Jonah crab index was 0.14/m² (Figure 9).

B. Ventless Trap Survey

Since its inception in 2006, the RI Ventless Trap Survey (VTS) has recorded counts of Jonah crab per pot. In 2014, carapace width and sex were also recorded for all individuals. In 2019, the stratified abundance index of Jonah crabs was 1.25 crabs per ventless trap, similar to the time series mean of 1.23 crabs per ventless trap (Figure 10).

B. Trawl Survey

RIDEM has conducted spring and fall trawl surveys since 1979, and a monthly trawl survey since 1990. However, the survey did not begin counting Jonah crab specifically until 2015. Given the short time series of Jonah crab data available and few Jonah crab observations by the surveys, the information is not available at this time. As the datasets for Jonah crab from these trawl surveys grow, these data will be provided as abundance indices.

Connecticut

A. Trawl Survey

Jonah crab abundance is monitored through the Long Island Sound Trawl Survey (LISTS) during the spring (April, May, June) and fall (September and October) cruises, all within NMFS statistical area 611. The survey documents the number of individuals caught and total weight per haul by survey site in Long Island Sound. The Long Island Sound Trawl Survey caught one Jonah crab in the fall 2007 survey and two in the fall 2008 survey. Both observations occurred in October at the same trawl site in eastern Long Island Sound. The fall 2018 trawl survey documented a total of 0.4 kg of Jonah crab, with crabs observed in one site in the central basin and one site in the eastern basin of Long Island Sound.

New York

A. Trawl Survey

New York initiated a stratified random trawl survey in the near shore ocean waters off the south shore of Long Island in 2018 from the Rockaways to Montauk Point and the New York waters of Block Island Sound. Three sampling cruises were conducted in 2019 during the winter (February), spring (June), and fall (December). The second trip in the spring during May and the summer trip in August were not conducted due to mechanical issues. Twenty-five to 30 stations

were sampled each trip. Twenty-four Jonah crabs were caught during the 2019 survey. They ranged in size from 20 to 144 mm shell width (SW) and averaged 53 mm SW.

New Jersey

A. Trawl Survey

A fishery-independent Ocean Trawl Survey is conducted from Sandy Hook, NJ to Cape May, NJ each year. The survey stratifies sampling in three depth gradients, inshore (18'-30'), mid-shore (30'-60'), and offshore (60'-90'). In 2019, a cruise was not conducted in April. The mean CPUE, which is calculated as the sum of the mean weight of Jonah crab collected in each sampling area weighted by the stratum area, has remained low throughout the time series, but increased slightly in 2019 (Figure 11).

7.0 Recent and On-Going Research Projects

A. Maturity Study

MA DMF, in collaboration with AOLA and CFRF, has conducted a Jonah crab maturity study. Results suggest that females mature at a smaller size than males (~88-94mm carapace width vs. ~103-117mm carapace width, depending on region sampled). Importantly, the sizes at maturity for both sexes are below the current minimum legal size for harvest (121 mm).

In addition, a graduate student at the University of Maryland Eastern Shore completed a master's thesis on the size at sexual maturity and reproductive biology of Jonah crabs in the Mid-Atlantic Bight in the spring of 2018. Jonah crabs were collected as bycatch in black sea bass and lobster pots from December 2015 to September 2017 as well as from the 2016 and 2017 Virginia Institute of Marine Science Mid-Atlantic Sea Scallop dredge survey. Measurements included: sex, weight, length, width, chela length and height, abdomen width (females), molt condition, presence/absence of egg clutches, and presence/absence of external sperm plugs. A gonadosomatic index was created for female Jonah crabs.

B. Tagging Study

MA DMF, in collaboration with AOLA, NH F&G, and ME DMR, completed a Jonah crab tagging study in 2018 in which over 32,000 Jonah crabs were tagged across 12 different NMFS statistical areas. Preliminary data suggests that most Jonah crabs are not migrating far; Most of the recaptures (over 900 crabs) were recaptured within 5 km of where they were released, though six crabs traveled more than 100 km. None of the seven crabs recaptured after more than 600 days had molted.

C. Declawing Study

New Hampshire Fish and Game and Wells National Estuarine Research Reserve conducted a laboratory study to investigate mortality rates associated with declawing Jonah crabs. Four mortality trials were conducted over three seasons. Mortality rates (% died) by treatment were: Controls=16%, 1-claw removed=51%, and 2-claws removed=70%. Additional research is being conducted to assess how declawing affects mating, feeding and movement.

D. Growth and Fishery Dependent Data

In 2019, two collaborative studies between the University of Rhode Island and Rhode Island DEM were published. The first of these was a growth study, which described molt increments for adult females and males and molting seasonality and molt probabilities for adult males in Rhode Island Sound. The second was an interview study in which fifteen in-person interviews were conducted with Jonah crab fishermen to collect their knowledge concerning Jonah crab biology and fishery characteristics. The interviews provided insight into aspects of the species biology and life history that have not been characterized in the literature (e.g., seasonal distribution patterns); identified topics requiring further study (e.g., stock structure and spawning seasonality); and highlighted predominant concerns related to fishery management (e.g., inshore-offshore fleet dynamics).

E. CFRF Research Fleet

The Commercial Fisheries Research Foundation (CFRF) has expanded their lobster commercial research fleet to sample Jonah crab. Biological data collected include carapace width, sex, shell hardness, egg status, and disposition. As of September 2020, 90,701 Jonah crabs have been sampled through the program.

8.0 State Compliance

All states except New York have implemented the provisions of the Jonah Crab FMP and associated addenda. The implementation deadline for the Jonah Crab FMP was June 1, 2016; the implementation deadline for Addendum I was January 1, 2017; the implementation deadline for Addendum II was January 1, 2018; and the implementation deadline for Addendum III was January 1, 2019 (with the exception of the 10 minute square reporting requirement).

- New York has not yet implemented the full suite of management measures required under the Jonah Crab FMP or Addendum I and II. New York crab legislation currently prohibits harvest of female crabs with eggs, limits recreational harvest to 50 crabs, establishes a 4.75" minimum carapace width, and establishes a 2.75" minimum claw length for harvest of claws only. Regulations to limit the directed trap fishery to lobster permit holders only and the 1,000 crab bycatch limit have not been implemented. New York will need to revise the crab legislation to require a lobster permit for the directed trap fishery and adopt regulations to allow a 1,000 crab daily bycatch to crab permit holders; it is unclear how long it will take to get the legislation revised. The state notes that NY has been seeing a decline in Jonah crab landings over time, and according to the draft FMP, New York contributed to 0.8% of the coastwide Jonah crab landings in 2019. New York does currently have limited entry for crab licenses and a moratorium on the lobster license.

9.0 De Minimis Requests.

The states of Delaware, Maryland, and Virginia, have requested *de minimis* status. According to the Jonah crab FMP, states may qualify for *de minimis* status if, for the preceding three years for which data are available, their average commercial landings (by weight) constitute less than

1% of the average coastwide commercial catch. Delaware, Maryland, and Virginia meet the *de minimis* requirement.

10.0 Research Recommendations

The following research questions were compiled by the Jonah Crab TC and need to be answered in order to complete a coastwide stock assessment.

- **Growth Rates** – While there has been some research on Jonah crab growth rates, more studies are needed to determine growth rates along the entire coast. In particular, it is necessary to determine the molt frequency, molt increment, and if there is a terminal molt.
- **Maturity and Reproduction** – Studies are needed to determine the size at maturity of crabs in different regions, the size ratio of mating crabs, and sperm limitations.
- **Migration** – There are several tagging studies on-going in the Jonah crab fishery. Hopefully these studies will elucidate the migrations of Jonah crab as well as seasonal habitat preferences.
- **Natural Mortality** – An estimate of natural mortality must be developed for Jonah crab in order to carry out a stock assessment. In particular, it will be critical to determine the natural mortality of mature crabs.

11.0 Plan Review Team Recommendations

The following are recommendations from the Plan Review Team:

- The PRT recommends the Board approve the *de minimis* requests of DE, MD, and VA.
- The PRT raises concerns about the unimplemented Jonah crab regulations in NY, particularly the regulations to limit the directed trap fishery to lobster permit holders only and the 1,000 crab bycatch limit. Similar issues were raised in the 2018 and 2019 compliance reports and have not been addressed within the last year.
- The PRT notes that MA and CT have been unable to meet the August 1 deadline for compliance reports for the last several years.
- The PRT recommends that jurisdictions with crab-only fishermen report on the number of these fishermen, their collective number of traps fished, and the rules governing their fishing activity.
- The PRT recommends continued research of the Jonah crab species so that a coastwide stock assessment can be completed in the near future.
- The PRT recommends the LEC review compliance in the Jonah crab fishery, given it is a fairly new fishery management plan and lessons may be learned.

12.0 Tables

Table 1. Landings (in pounds) of Jonah crab by the states of Maine through Virginia. 2010-2018 landings were provided by ACCSP based on state data submissions. 2019 landings were submitted by the states (except for Massachusetts and Connecticut) as a part of the compliance reports and should be considered preliminary. *C= confidential data*

	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	Total
2010	1,093,962	C	5,689,431	3,720,440	C	968,122	30,441		18,045	C	11,690,987
2011	1,096,592	C	5,379,792	3,213,119	C	69,440	26,909		92,401	C	9,947,027
2012	556,675	C	7,540,510	3,774,300	2,349	410,349	68,459		C	C	12,560,390
2013	379,073	340,751	10,109,590	4,651,796	51,462	371,675	C		C	C	16,075,597
2014	348,295	404,703	11,904,611	4,435,934	C	83,060	C		153,714	C	17,413,451
2015	312,063	C	9,128,876	4,298,894	C	207,424	68,116	C	39,750	C	14,253,340
2016	602,206	150,341	10,660,871	4,224,092	C	165,427	260,856	C	14,656	C	16,093,104
2017	1,042,807	113,354	11,698,342	4,111,281	C	158,231	433,132	C	23,564	C	17,594,243
2018	1,054,489	22,118	13,227,380	4,665,701	C	231,642	880,192	C	60,628	C	19,816,742
2019*	761,695	70,704	9,697,607	4,078,838	C	122,879	1,262,451	C	47,739	C	16,043,181

**2019 values for MA and CT were provided by ACCSP because they were not provided in the state compliance reports. All other 2019 landings were provided in state compliance reports.*

13.0 Figures

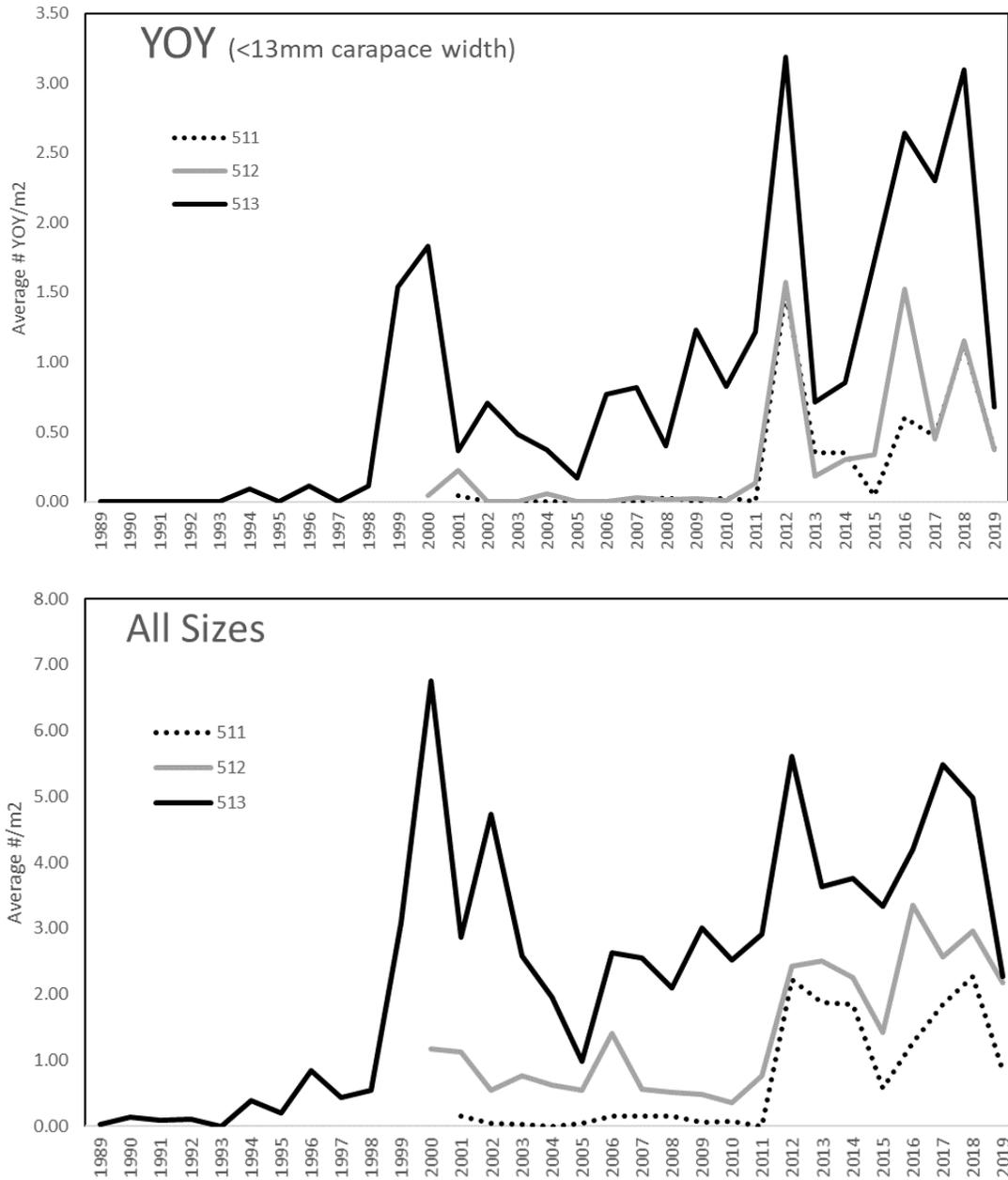


Figure 1: The density of Jonah crab measured over time in the Maine Settlement Survey by statistical area. The top graph shows the density of YOY Jonah crab (<13mm carapace width) and the bottom graph shows the density of all Jonah crab.

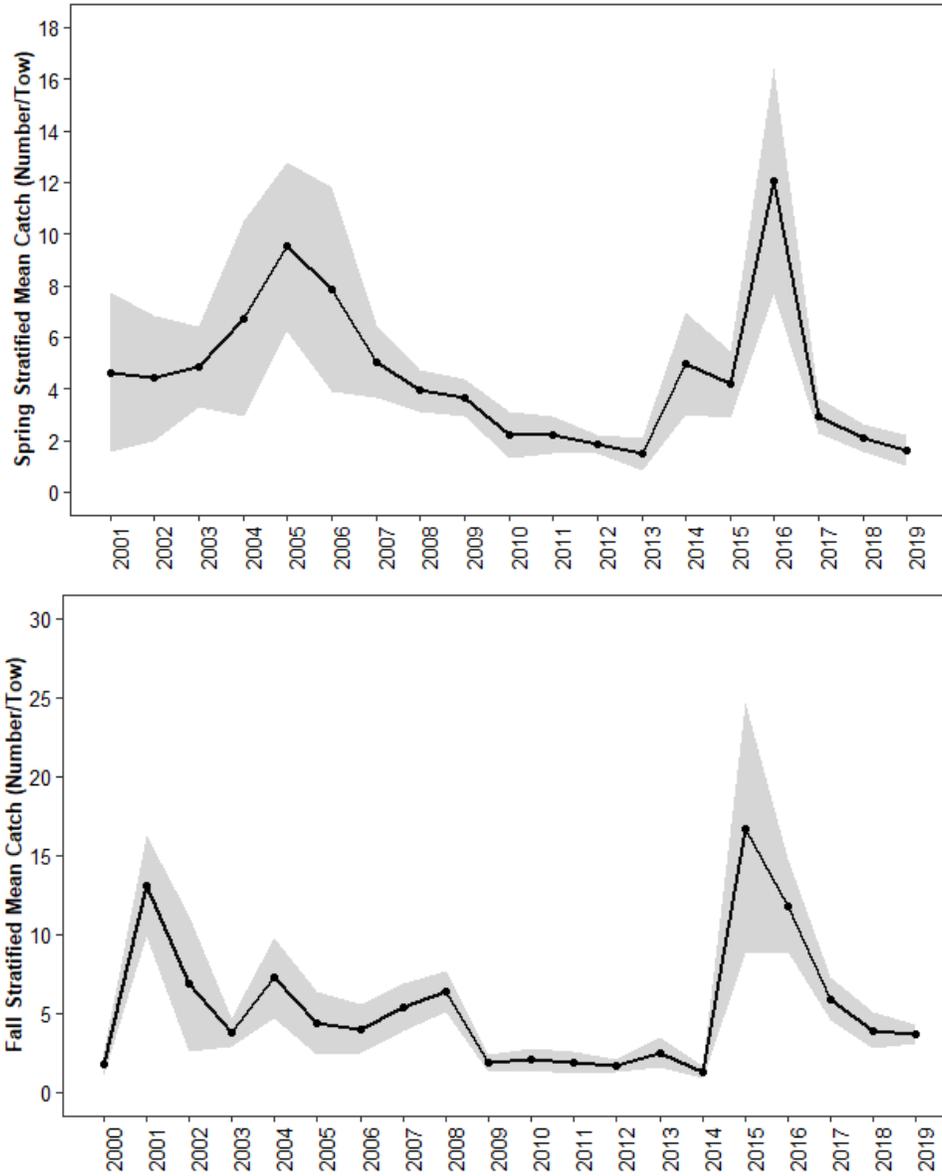


Figure 2: Maine-New Hampshire survey abundance indices for Jonah crab, 2001-2018. Results of the spring survey are on the top and results from the fall survey are on the bottom.

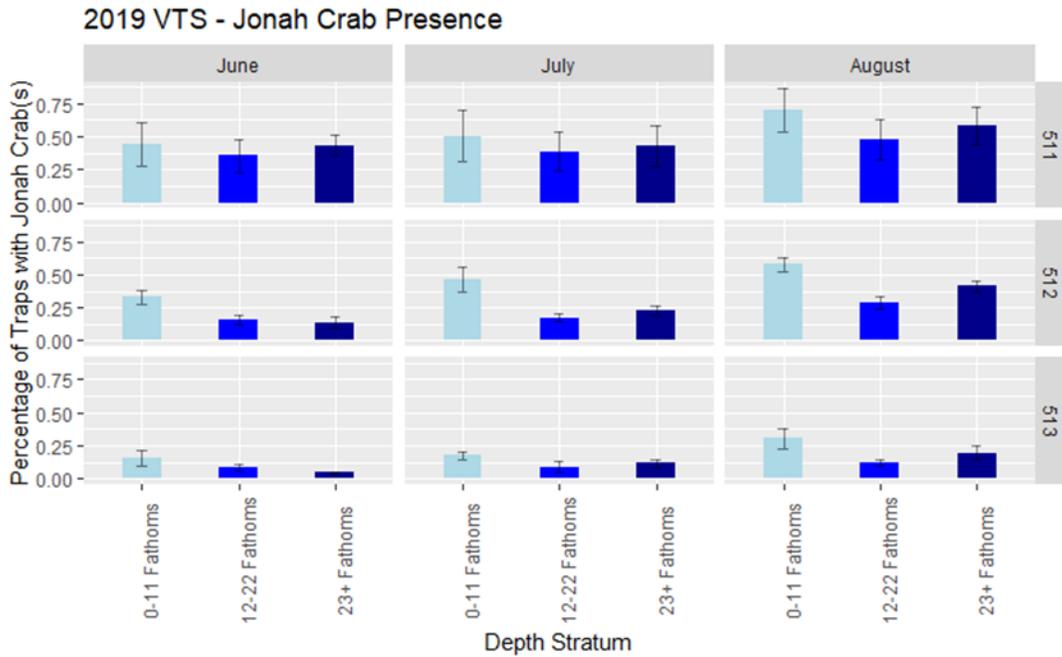


Figure 3: Jonah crab size frequency by sex from the 2018 Maine Ventless Trap Survey.

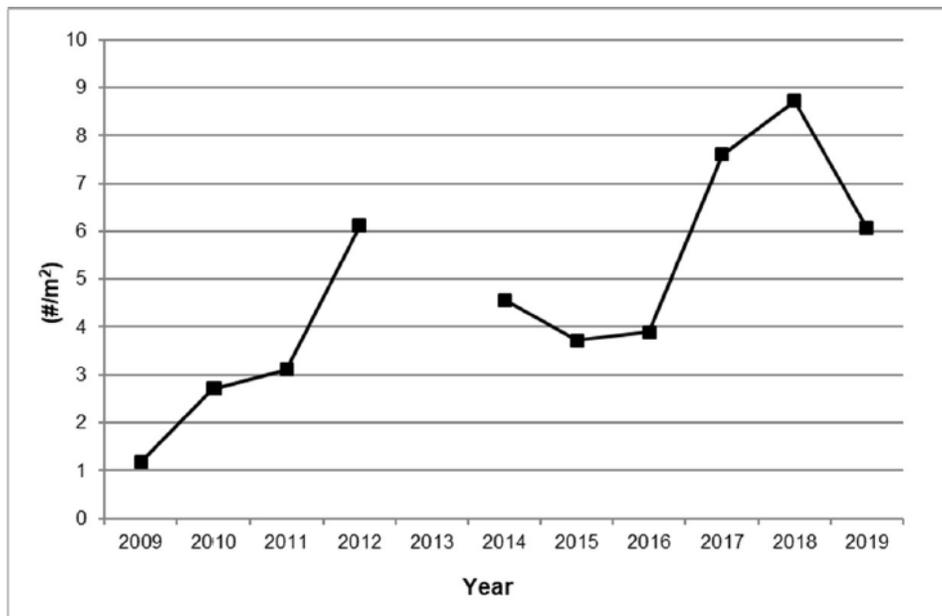


Figure 4: Catch per unit effort (#/m²) of Jonah crab during the American Lobster Settlement Index Survey, in New Hampshire, from 2009 through 2018.

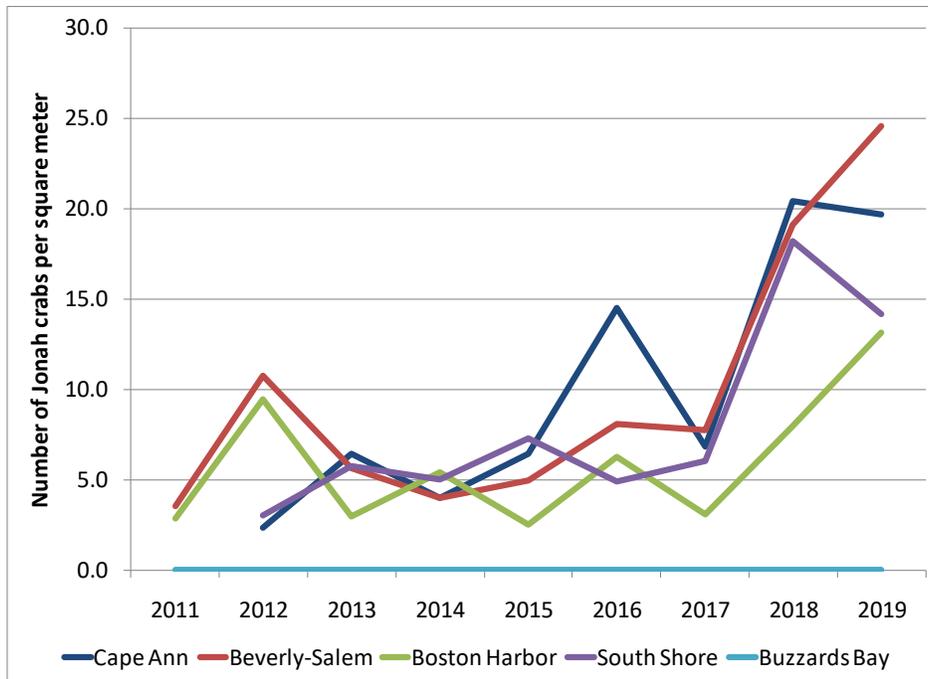


Figure 5: Number of Jonah crab per square meter from the MA DMF juvenile lobster suction survey. Cape Ann, Beverly/Salem, Boston Harbor, South Shore, and Cape Cod Bay are in NMFS statistical area 514; Buzzards Bay and Vineyard Sound are in statistical area 538.

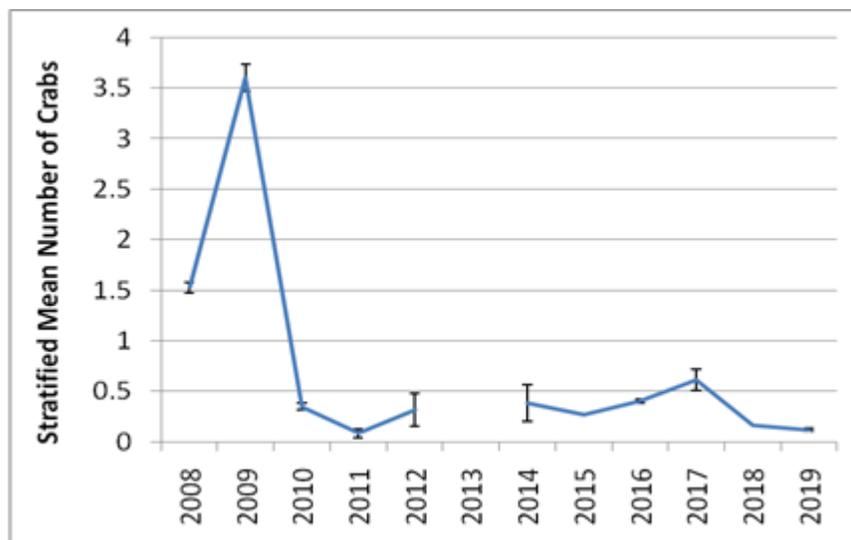


Figure 6. Number of Jonah crab per trawl haul from NMFS stat area 538 from the MA DMF Ventless Trap Survey. CPUE is standardized to a six pot trawl with three vented and three ventless traps. Error bars are \pm two times the standard error. The survey did not occur in 2013.

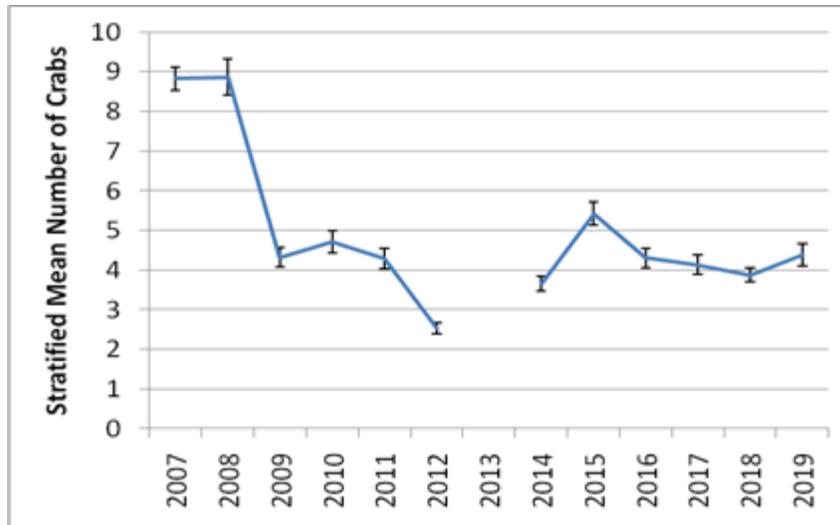


Figure 7. Number of Jonah crab per trawl haul from NMFS stat area 514 from the MA DMF Ventless Trap Survey. CPUE is standardized to a six pot trawl with three vented and three ventless traps. Error bars are \pm two times the standard error. The survey did not occur in 2013.

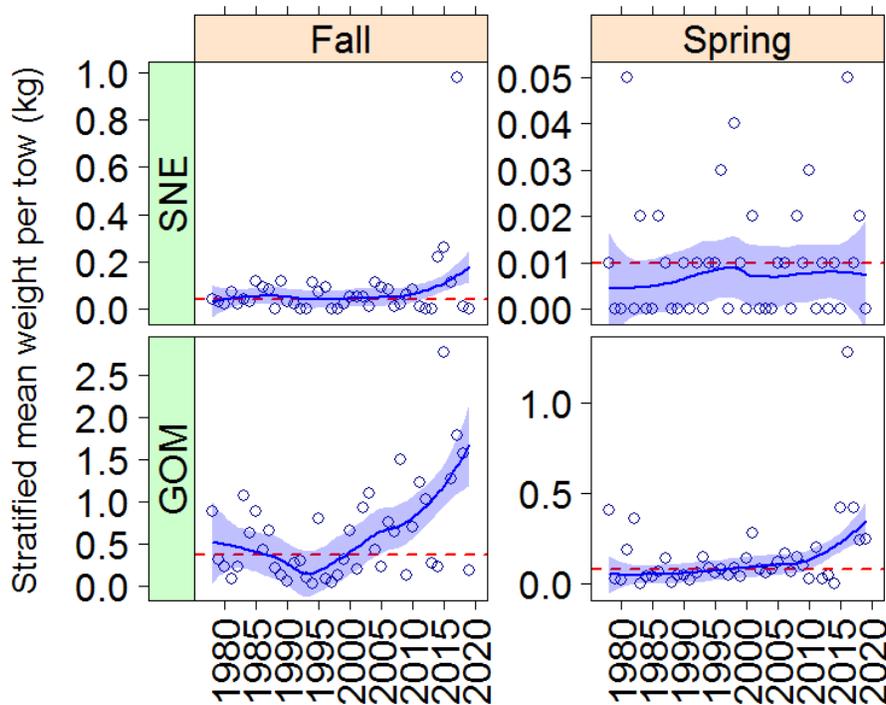


Figure 8. Bootstrapped Jonah crab mean weight (kg) per tow from the DMF bottom trawl survey by season and region. Red, dashed line is the time series median, blue line is a loess fit using family=symmetric and span=0.66. These settings provide a resistant fit to outliers at the end of the time-series. Blue shaded area is an approximate 95% confidence interval for the fit.

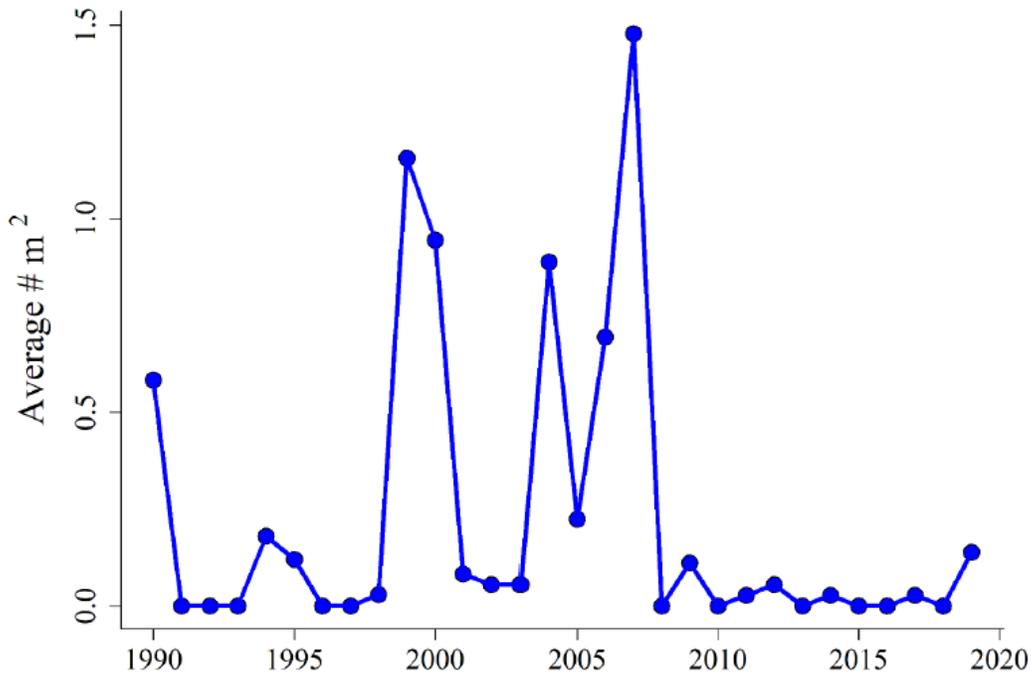


Figure 9. Rhode Island YOY Settlement Survey trend for all Jonah crabs caught.



Figure 10. Average number of Jonah crabs caught per ventless trap in RI DMF's ventless trap survey, 2006-2019.

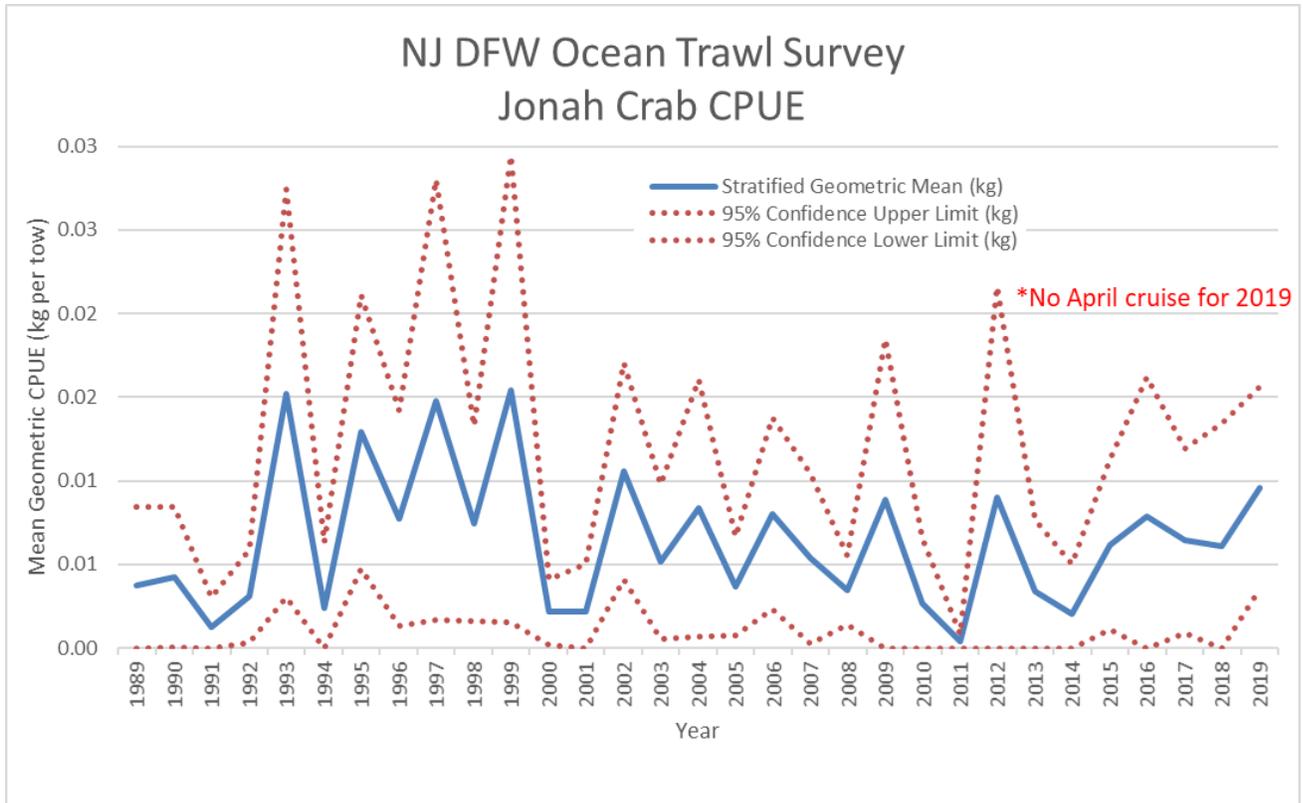


Figure 11. Stratified mean CPUE of all Jonah crab collected aboard the NJDFW Ocean Trawl Survey. The survey stratifies sampling in three depth gradients, inshore (18'-30'), mid-shore (30'-60'), offshore (60'-90'). The mean CPUE was calculated as the sum of the mean weight (in kg) of Jonah crab per size class collected in each sampling area weighted by the stratum area.

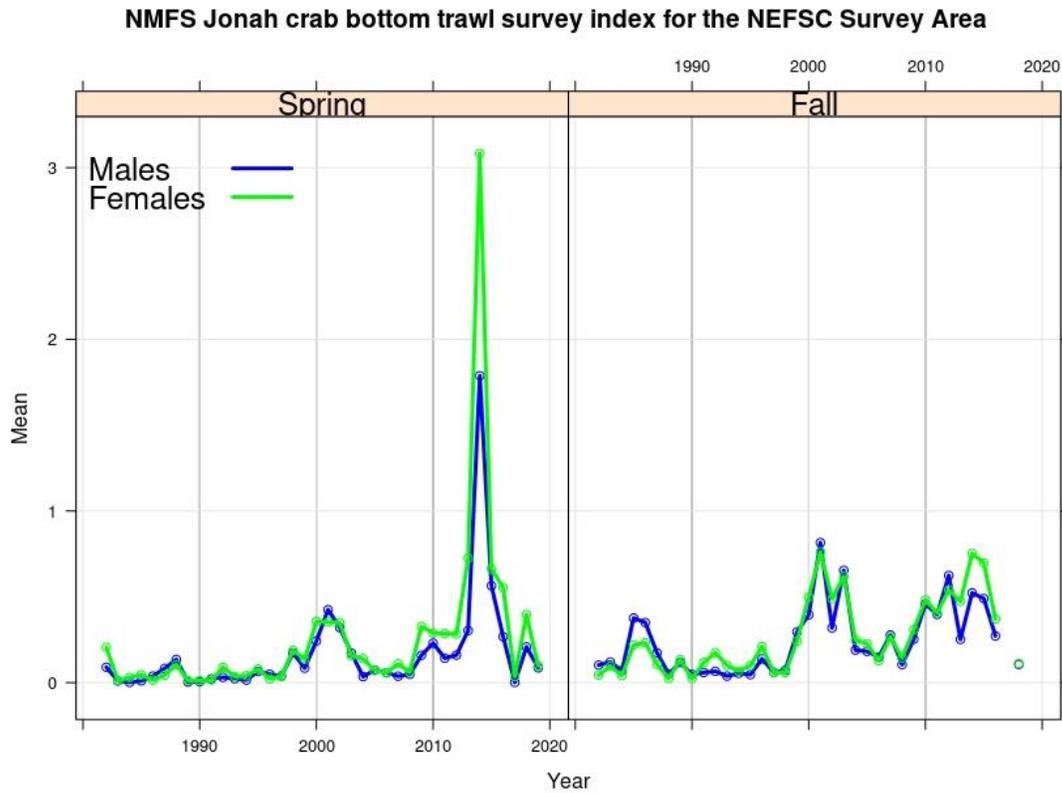


Figure 12. NMFS Jonah Crab index (mean number per tow) from the bottom trawl survey for the NEFSC Survey Area, through spring 2019.