Introduction

The 2023 benchmark stock assessment for Jonah crab provides the most recent information on the status of US Jonah crab stocks. The assessment is the first of US Jonah crab stocks and was peer-reviewed by an independent panel of scientific experts through the Atlantic States Marine Fisheries Commission's external review process.

Management Overview

The US management unit for Jonah crab (*Cancer borealis*) extends from Maine through Virginia. The population is divided into four stock areas which include the inshore Gulf of Maine (IGOM), offshore Gulf of Maine (OGOM), inshore Southern New England (ISNE), and offshore Southern New England (OSNE) stocks. Differences in size-at-maturity among these areas were the primary basis for stock structure, though limited movement from tagging data as well as fishery and management characteristics associated with these areas were also considered.

Jonah crab is managed under the Interstate Fishery Management Plan (FMP) and its associated Addenda I-IV. 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 to limit effort and protect spawning stock biomass, including a 4.75 inch (120.65 mm) minimum carapace width (CW) and a prohibition on the retention of egg-bearing females. To prevent an open access fishery, the FMP limits participation in the directed Jonah crab trap fishery to lobster permit holders or those who can prove a history of crab-only pot fishing.

Subsequent addenda to the FMP established a bycatch limit of 1,000 pounds of crab per trip for non-trap gear and non-lobster trap gear (Addendum I); established a minimum claw length (2.75 inches) for claw fisheries and a bycatch definition (Addendum II); improved data collection and reporting requirements (Addendum III); and further enhanced reporting requirements through electronic vessel tracking for federally-permitted vessels (Addendum IV).

What Data Were Used?

Jonah crab are a data-poor species. Most data available are fishery-dependent data from the commercial fishery and fishery-independent data from research trawl surveys. Information on life history is limited and is best used to describe maturity rates.

Life History

Jonah crab are a bottom-dwelling crustacean ranging from Newfoundland to Florida, but are most abundant in the northern latitudes. The species can be found on varying substrates including sand, mud, and complex, rocky habitat. Jonah crab are found at depths ranging from the intertidal zone to 800m dependent on several factors including sex, size, season, water temperature, and latitude.

Jonah crab grow by molting, which results in incremental growth patterns. Important aspects of growth include seasonal timing of molting, frequency of molting, and size of growth increments. Growth studies have found molting occurs in late spring and early summer, with the frequency of molting decreasing as crabs grow to larger sizes. Female growth increments decrease as they grow while male growth increments increase resulting in larger attainable sizes for males that make them more available to fisheries. It is estimated that crabs in the IGOM stock reach minimum legal size anywhere from four to ten years of age. However, data are limited for adult crabs and growth is poorly understood for crabs available to the fishery, including whether crabs stop growing (terminal molt). This poor understanding of growth coupled with limited tagging data for individuals that have been recaptured after long periods of time also contribute to a poor understanding of lifespan and natural mortality rates.

Maturity is detected by changes in growth patterns of the chela (claw) of males and abdominal width of females. Females mature at smaller sizes than males and crabs mature at larger sizes moving from south to north and from adjacent inshore to offshore areas. The size at which 50% of crabs are estimated to be mature is smaller than the minimum legal size established in the FMP for all stocks except OGOM.
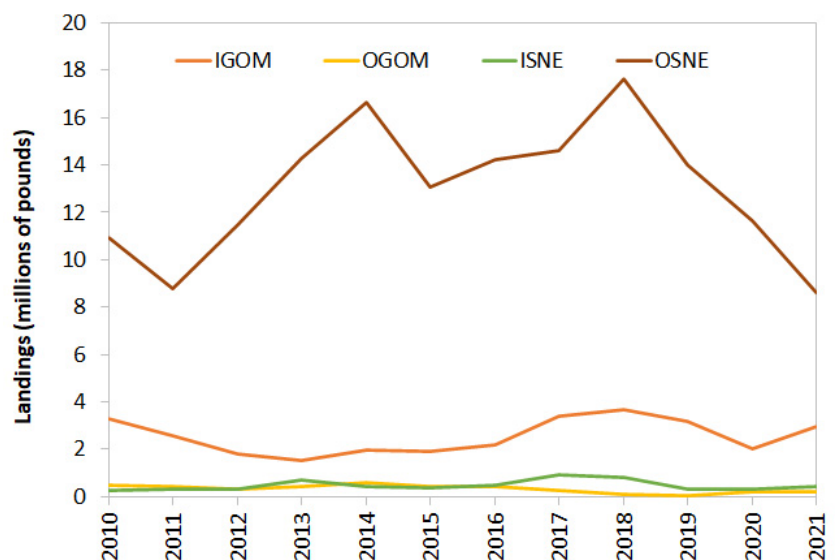
Fishery-Dependent Data
Fishery-dependent data sources used in the stock assessment include commercial landings, effort, and biological sampling during at-sea and port sampling.

There are notable differences between the fisheries that operate in each of the stock areas. The vast majority of coastwide landings have come from the OSNE stock, accounting for 70-85% of annual coastwide landings from 2010-2021. The IGOM stock has supported the second largest fishery, accounting for 9-24% of annual coastwide landings from 2010-2021. Both the ISNE and OGOM have supported smaller fisheries, never accounting for more 5% of annual coastwide landings from 2010-2021. Landings have shown different trends across stocks, but the landings from OSNE declined steadily from the time series high in 2018 (17.6 million pounds) in the last three years of the time series.

Figure 1. Jonah Crab Commercial Landings by Stock Area

The high proportion of participants contributing to Jonah crab landings indicate a directed fishery in the OSNE stock that targets Jonah crab, yet there are relatively few participants that account for the large magnitude of landings from this stock. The other three stocks have fisheries that are characteristic of bycatch fisheries that are targeting American lobster. These fisheries have low proportions of participants that land Jonah crab from pot/trap gears. In the case of the IGOM stock, there is a relatively high number of participants targeting lobster and not landing Jonah crab. This represents

considerable capacity for growth in a Jonah crab fishery if these participants were to switch to targeting Jonah crab.

Commercial at-sea and port sampling programs provide data that characterize the size composition of commercial catch and landings. Data are still too limited to provide a comprehensive picture of stockwide size compositions, but spatial snapshots of data, including those from statistical areas accounting for the most landings, indicate stable size compositions. These data need to be evaluated further in future stock assessments as time series grow to determine if they can reliably indicate changing exploitation levels.

Fishery-Independent Data

Several fishery-independent surveys that encounter Jonah crab were evaluated for use in the stock assessment. These surveys target other species or multiple species and none have high catch rates of Jonah crab. Jonah crab behavior in regards to survey gears is poorly understood and is believed to be the reason for low catchability among these surveys. Ventless trap surveys designed to catch American lobster were shown to measure different Jonah crab trends than trawl surveys that target multiple species. These conflicting trends are due to Jonah crab's tendency to avoid American lobster and not enter traps occupied by lobster. This behavior leads to decreasing Jonah crab catch as American lobster abundance increases, limiting utility of these gears for indexing abundance of Jonah crab.

There are multiple trawl surveys that operate throughout the species' range, measure Jonah crab biological attributes, and, in some cases, overlap in coverage. Surveys include the NOAA Fisheries Northeast Fisheries Science Center (NEFSC) Survey, covering waters from Maine to North Carolina including portions of each Jonah crab stock; the Maine/New Hampshire (ME/NH) Survey, covering IGOM waters; and the Massachusetts Survey, covering IGOM waters. It's notable that the NEFSC Survey is the only survey that covers SNE stocks, while all three surveys cover portions of GOM stocks. These surveys all employ a stratified random sampling design and occur twice a year, in the spring and fall. Survey catch rates are still relatively low, but do show consistency in trends where they overlap, improving confidence that these surveys are able to measure an abundance signal.

Indices have generally increased through time from very low levels. Both IGOM and OGOM indices show brief, large-scale increases in abundance around the mid-2010s that decline back to levels observed before this pulse in the most recent years of the assessment.
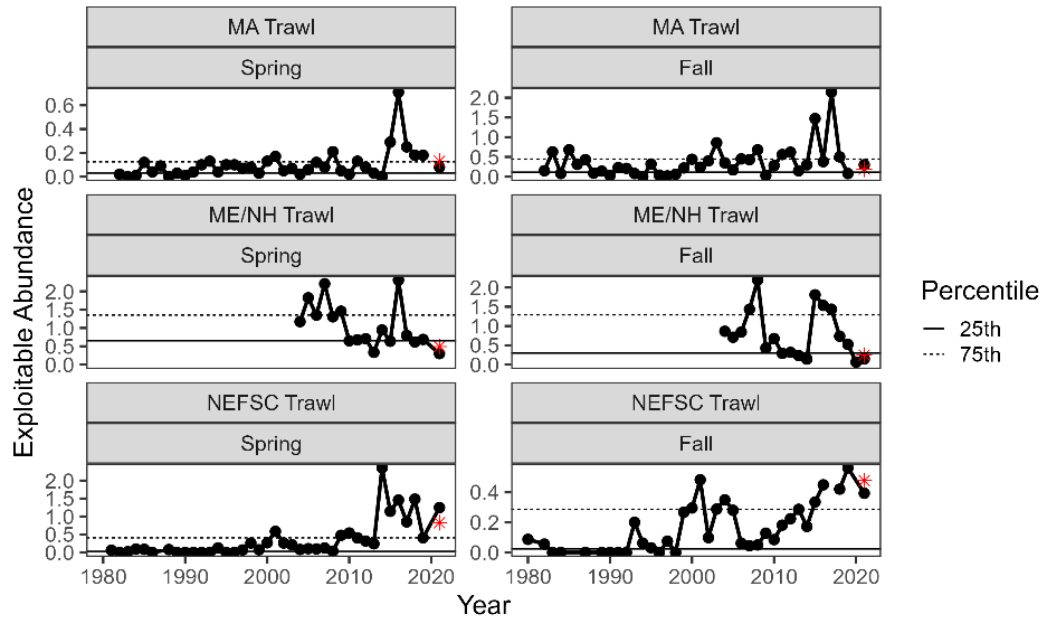
Young-of-the-year (YOY) settlement surveys are also used to provide information regarding year class strength. There are surveys available from Maine, New Hampshire, and Massachusetts. All of these surveys occur in the IGOM stock and recruitment sources to OGOM and SNE stocks are unknown. These surveys are SCUBA-based air-lift suction sampling that provide density estimates of newly settled YOY Jonah crab. Indices have shown increases in the 2010s that then stabilize at these higher levels.

What Methods Were Used?

Given data limitations and a poor understanding of Jonah crab life history, no stock assessment models could be developed to estimate abundance, fishing mortality, and biological reference points. Instead, simple, empirical stock indicators were developed from available data time series. These indicators

provide a clear characterization of stock condition relative to historical levels. If the indicator in any given year is below 25% of observed values during it's time series, it is considered a negative condition. If it is above 25% of observed values, but below 75% of observed values, it is considered a neutral condition. If it is above 75% of observed values, it is considered a positive condition.

Figure 2. Jonah Crab IGOM Exploitable Abundance Stock Indicators
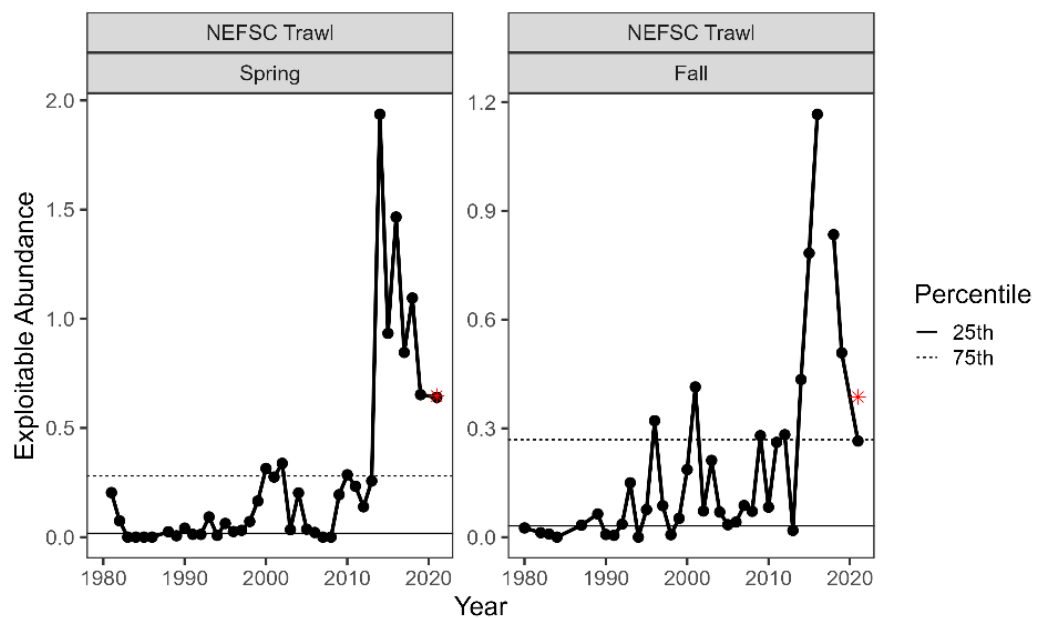The red asterisk is the 3-year average of data for 2019-2021.

Indicators selected for stock abundance conditions included YOY settlement and recruit abundance, exploitable abundance, and spawning abundance indices from trawl surveys. Recruit abundance includes male Jonah crabs 90-119mm CW that are expected to grow to legal size after their next molt, exploitable abundance includes male crabs that are legal size (>119mm CW), and spawning abundance includes mature female crabs (≥80mm CW). Fishery performance indicators were also developed, including landings, the number and proportion of pot/trap trips that landed Jonah crab, and the number and proportion of active lobster/crab permits that landed Jonah crab. As the names of these indicators imply, they provide information on the performance of the fishery and not the condition of the stocks.
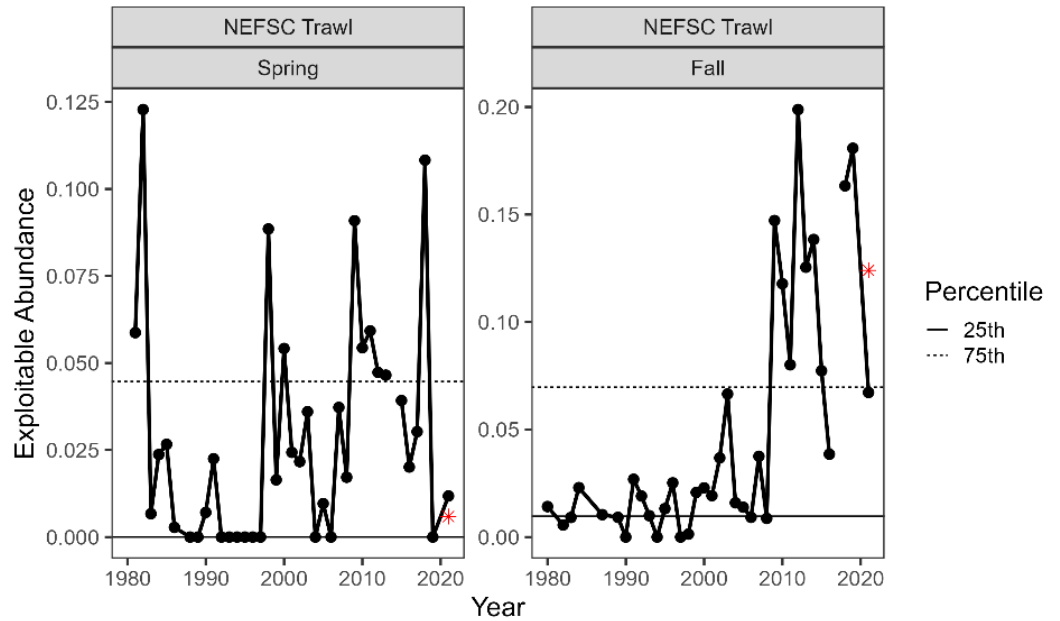
What is the Status of the Stock?

According to the stock indicators, IGOM, OGOM, and OSNE recruit, exploitable, and spawning abundance conditions in the last three years of the time series were neutral or positive. The one exception is from the ME/NH Trawl survey,

Figure 3. Jonah Crab OGOM Exploitable Abundance Stock Indicators
The red asterisk is the three-year average for 2019-2021.

but this is due to the shorter time series of this survey not capturing historical lows observed in earlier years by other surveys. Indicators generally agree across these stocks that abundance has not been depleted to historical lows observed in the 1980s and 1990s. There are no reliable abundance indicators for the ISNE stock and an inference cannot be made about the condition of this stock's abundance at this time.

Figure 4. Jonah Crab OSNE Exploitable Abundance Stock Indicators
The red asterisk is the three-year average for 2019-2021.

YOY indicators generally indicate neutral conditions and do not indicate that recruitment in GOM stocks will decline to historical lows in the near future. Settlement conditions are unknown for SNE stocks.

There was insufficient information to make statements about fishing mortality or exploitation with confidence and these population parameters remain major uncertainties. Recent landings have steadily declined in the OSNE stock which is the primary stock with targeted/mixed effort for Jonah crab and the stock accounting for the vast majority of coastwide landings. This trend is believed to be influenced by factors other than available abundance.

During the Peer Review Workshop, an additional time series of fishery catch-per-unit-effort (CPUE) was developed and indicated a decline in recent years including a large decrease in 2021, the terminal year of the assessment (see graph on next page). According to the Peer Review Panel, "Despite the limited availability of current data, there is considerable urgency for the assessment due to a very steep, three-year, decline in landings. Commercial landings have declined 51% in three years, after an unprecedented 30-fold rise in landings. Although the recent decline is not well-detected in fishery-independent stock indicators, there is some evidence of declining CPUE in the fishery, creating substantial concern and uncertainty for the status of the stock. Given the mixed signals, the status of the Jonah crab stock is highly uncertain.

Current conditions closely resemble early stages of the collapse of the Canada Jonah crab fishery in the early 2000s. In the first three years of the crash, Canada landings dropped 58%. Within five years, landings fell 97%, and stock biomass could no longer support a fishery. Fishery-independent trawl indicators had not fully captured the signals of a rapidly declining stock. However, declining fishery CPUE was observable preceding and during the landings crash.

Given the high level of uncertainty in the status of the Jonah crab stock, the Panel strongly recommends close monitoring of annual stock indicators in the next few years. Annual indicators can determine whether sharply declining recent landings are signaling the start of a 'bust' phase of a boom-and-bust arc, or are due to fishery and market-related factors uncoupled with Jonah crab abundance."

Data and Research Needs

The Jonah Crab Technical Committee (TC) compiled a list of prioritized research needs to improve understanding of Jonah

Figure 5. Rhode Island Commercial Jonah Crab CPUE (harvest per fishing day) of a Harvester Group Targeting Jonah Crab
(Analysis is preliminary)

crab life history and population dynamics and aid in the development of future stock assessments. High priority needs include (1) collection of growth data with an emphasis on adults and the OSNE stock, (2) conducting video-based surveys to better understand Jonah crab exploitation, behavioral interactions with existing survey gears such as trawls, and catchability effects such as temperature and bottom substrate, (3) research to understand recruitment dynamics, recruitment source for OSNE, and environmental drivers of recruitment, and (4) determining how to interpret fisheries-dependent data.

What are the Next Steps for Management?

Given the trends seen at the end of the assessment and uncertainty in stock status, the American Lobster Management Board tasked the TC with recommending possible measures or actions to address these concerns. The TC will provide a report on this task during the Commission's 2024 Winter Meeting in January.

Whom Do I Contact For More Information?

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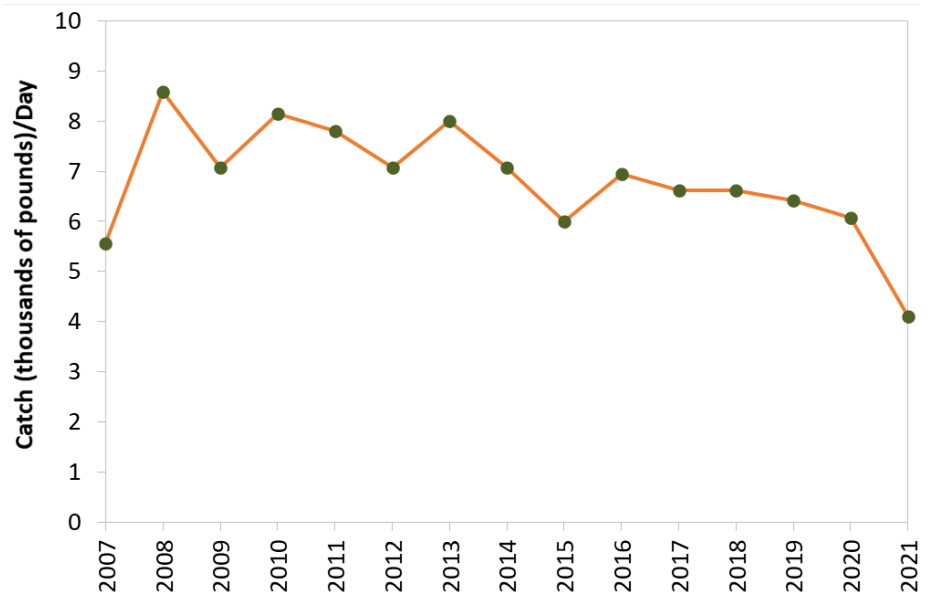Arlington, VA 22201
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Glossary

Chela: Claw at the end of the first pair of legs on a crab.

Exploitation: The percent of abundance removed by fishing over the course of a year.

Fishery-Dependent Data: Information collected from fishermen and seafood dealers on catch, landings, and effort.

Fishery-Independent Data: Information collected by scientists via a long-term research survey or other scientific survey.

Recruit: An individual fish/organism that has entered a defined group through growth, migration, or maturation. Individuals recruit to the fishery when they reach the minimum legal size. Individuals recruit to the spawning stock when they become sexually mature.

Recruitment: The total weight or number of individuals that enter a defined group, such as the spawning stock or fishable stock.

Young-of-the-year (YOY): An individual fish/organism in its first year of life.

References

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