 E 3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[RTID 0648-XR133; Docket No. 260209-0041]

Endangered and Threatened Wildlife; 90-Day Finding on Petitions to List the Atlantic horseshoe crab (*Limulus polyphemus*) under the Endangered Species Act

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; 90-day finding.

SUMMARY: NMFS announces our 90-day finding on two petitions to list the Atlantic (or American) horseshoe crab (*Limulus polyphemus*) under the Endangered Species Act (ESA) and to designate critical habitat. We find that the petitions do not present substantial scientific or commercial information indicating that the petitioned actions may be warranted.

DATES: This finding was made on **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER**].

ADDRESSES: Copies of the petitions and related materials are available from the NMFS website at *https://www.fisheries.noaa.gov/national/endangered-species-conservation/negative-90-day-findings*.

FOR FURTHER INFORMATION CONTACT: Danielle Palmer, NMFS Greater Atlantic Regional Fisheries Office, Protected Resources Division, (978) 282–8468, *danielle.palmer@noaa.gov*.

SUPPLEMENTARY INFORMATION:

Background

We received petitions on December 21, 2023, from the Friends of Animals and on February 27, 2024, from the Center for Biological Diversity to list the Atlantic (or

American) horseshoe crab (*Limulus polyphemus*) as an endangered or threatened species and to designate critical habitat for this species under the ESA. Both petitions identify four of the five ESA 4(a)(1) factors as threatening the continued existence of this species: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific or educational purposes; (3) the inadequacy of existing regulatory mechanisms; and (4) other natural or manmade factors affecting its continued existence. The petitions are available online (see **ADDRESSES**).

ESA Statutory, Regulatory, and Policy Provisions and Evaluation Framework

Section 4(b)(3)(A) of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq*.), requires, to the maximum extent practicable, that within 90 days of receipt of a petition to list a species as threatened or endangered, the Secretary of Commerce shall make a finding on whether that petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted, and promptly publish such finding in the **Federal Register** (16 U.S.C. 1533(b)(3)(A)). When we find that substantial scientific or commercial information in a petition indicates the petitioned action may be warranted (a “positive 90-day finding”), we are required to promptly commence a review of the status of the species concerned, during which we will conduct a comprehensive review of the best available scientific and commercial data. In such cases, within 12 months of receipt of the petition, we conclude the review with a finding as to whether, in fact, the petitioned action is warranted. Because the finding at the 12-month stage is based on a more thorough review of the best available information, as compared to the narrow scope of review at the 90-day stage, a positive 90-day finding does not prejudge the outcome of the status review.

Under the ESA, a listing determination may address a species, which is defined to also include subspecies and, for any vertebrate species, any distinct population segment

(DPS) that interbreeds when mature (16 U.S.C. 1532(16)). A joint NMFS – U.S. Fish and Wildlife Service (USFWS; jointly, “the Services”) DPS Policy clarifies the agencies’ interpretation of the phrase “distinct population segment” for the purposes of listing, delisting, and reclassifying a species under the ESA (61 FR 4722, February 7, 1996). A species, subspecies, or DPS is “endangered” if it is in danger of extinction throughout all or a significant portion of its range, and “threatened” if it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range (ESA sections 3(6) and 3(20), respectively, 16 U.S.C. 1532(6) and (20)). Pursuant to the ESA and our implementing regulations, we determine whether species are threatened or endangered based on any one or a combination of the following section 4(a)(1) factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or manmade factors affecting the species' continued existence (16 U.S.C. 1533(a)(1), 50 CFR 424.11(c)).

ESA-implementing regulations issued jointly by the Services (50 CFR 424.14(h)(1)(i)) define “substantial scientific or commercial information” in the context of reviewing a petition to list, delist, or reclassify a species as “credible scientific or commercial information in support of the petition’s claims such that a reasonable person conducting an impartial scientific review would conclude that the action proposed in the petition may be warranted. Conclusions drawn in the petition without the support of credible scientific or commercial information will not be considered “substantial information.” In reaching the initial (90-day) finding on the petition, we consider the information described in sections 50 CFR 424.14(c), (d), and (g) (if applicable) and may also consider information readily available at the time the determination is made (50 CFR 424.14(h)(1)(ii)).

Our determination as to whether the petition provides substantial scientific or commercial information indicating that the petitioned action may be warranted depends in part on the degree to which the petition includes the following types of information: (1) information on current population status and trends and estimates of current population sizes and distributions, both in captivity and the wild, if available; (2) identification of the factors under section 4(a)(1) of the ESA that may affect the species and where these factors are acting upon the species; (3) whether, and to what extent, any or all of the factors alone or in combination identified in section 4(a)(1) of the ESA may cause the species to be an endangered species or threatened species (*i.e.*, the species is currently in danger of extinction or is likely to become so within the foreseeable future), and, if so, how high in magnitude and how imminent the threats to the species and its habitat are; (4) information on adequacy of regulatory protections and effectiveness of conservation activities by States, as well as other parties, that have been initiated or that are ongoing, that may protect the species or its habitat; and (5) a complete, balanced representation of the relevant facts, including information that may contradict claims in the petition. *See* 50 CFR 424.14(d).

We may also consider information readily available at the time the determination is made (50 CFR 424.14(h)(1)(ii)). We are not required to consider any supporting materials cited by the petitioner if the petitioner does not provide electronic or hard copies, to the extent permitted by U.S. copyright law, or appropriate excerpts or quotations from those materials (*e.g.*, publications, maps, reports, and letters from authorities). *See* 50 CFR 424.14(c)(6) and 50 CFR 424.14(h)(1)(ii).

At the 90-day finding stage, we do not conduct additional research, and we do not solicit information from parties outside the agency to help us in evaluating the petition. We accept the petitioner's sources and characterizations of the information presented if they appear to be based on accepted scientific principles, unless we have specific information in our files that indicates the petition's information is incorrect, unreliable, obsolete, or otherwise irrelevant to the requested action. Information that is susceptible to more than one interpretation, or that is contradicted by other available information, will not be dismissed at the 90-day finding stage, so long as it is reliable and a reasonable person conducting an impartial scientific review could conclude it supports the petitioner's assertions. In other words, conclusive information indicating the species may meet the ESA's requirements for listing is not required to make a positive 90-day finding.

To make a 90-day finding on a petition to list a species, we first evaluate whether the information presented in the petition indicates that the petitioned entity constitutes a species eligible for listing under the ESA. If so, we evaluate whether the petition presents substantial scientific or commercial information indicating the subject species may be either a threatened or endangered species, as defined by the ESA. This may be indicated in information expressly discussing the species' status and trends or in information describing impacts and threats to the species. We evaluate whether the petition presents any information on specific demographic factors pertinent to evaluating extinction risk for the species (*e.g.*, population abundance and trends, productivity, spatial structure, age structure, sex ratio, diversity, current and historical range, habitat integrity, or fragmentation) and the potential contribution of identified demographic risks to extinction risk for the species. We then evaluate whether the petition presents information suggesting potential links between these demographic risks and the causative impacts and threats identified in section 4(a)(1) of the ESA.

Information presented on impacts or threats should be specific to the species and should reasonably suggest that one or more of these factors may be operative threats that act, or have acted, on the species to the point that it may warrant protection under the ESA. Broad statements about generalized threats to the species, or identification of factors that could negatively impact a species, do not constitute substantial information indicating that listing may be warranted. We look for information indicating not only whether the particular species is exposed to a factor, but also whether the species may be responding in a negative fashion. We then assess the potential significance of any such negative response.

Many petitions identify risk classifications made by nongovernmental organizations, such as the International Union for Conservation of Nature (IUCN), the American Fisheries Society, or NatureServe as evidence of extinction risk for a species. Risk classifications by other organizations or made under other Federal or State statutes may be informative, but such classification alone may not provide the rationale for a positive 90-day finding under the ESA. For example, as explained by NatureServe,[1] their assessments of a species' conservation status do not constitute a recommendation by NatureServe for listing under the ESA because NatureServe assessments have different criteria, evidence requirements, purposes, and taxonomic coverage than government lists of endangered and threatened species, and therefore these two types of lists should not be expected to coincide. Additionally, species classifications under IUCN and the ESA are not equivalent; data standards, criteria used to evaluate species, and treatment of uncertainty are also not necessarily the same. Thus, when a petition cites such classifications, we will evaluate the source of information that the classification is based upon in light of the standards on extinction risk and impacts or threats in accordance with the ESA and our implementing regulations as discussed above.

Atlantic (or American) Horseshoe Crab Species Description

There are four extant species of horseshoe crabs belonging to the phylum Arthropoda and the Family Limulidae (ASMFC 1998; Smith *et al.* 2017). The Atlantic (or American) horseshoe crab (HSC), *Limulus polyphemus*, is the only species of HSC that occurs along the Atlantic and Gulf of America coasts of North America. Atlantic

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[1] *https://explorer.natureserve.org/AboutTheData/DataTypes/ConservationStatusCategories*

HSCs range from Maine south to Yucatán, Mexico; however, the species has not been documented as occurring along the western and southern Gulf of America coasts from Texas to Tabasco, Mexico (ASMFC 1998, 2019; Smith *et al.* 2017). Information cited in the petitions suggests that the portion of the range of greatest biological significance to the Atlantic HSC is located within the center of the species' range, specifically, the Mid-Atlantic's Delaware Bay. Sources (ASMFC 2022a; Smith *et al.* 2016; Smith *et al.* 2017; Smith *et al.* 2023; Smith, J.A. *et al.* 2022) indicate that the Delaware Bay supports the largest population of Atlantic HSC. For example, Smith, J.A. *et al.* (2022) state that "the largest aggregation of spawning American horseshoe crabs in the world occurs in Delaware Bay." The significance of the Delaware Bay HSC population is further evidenced by the importance of this region to the ESA-listed red knot (*Calidris canutus rufa*), which primarily forage on HSC eggs. Specifically, the Delaware Bay is the only area identified across the red knot's range as containing an Atlantic HSC population large enough to produce sufficient surface egg abundance needed to support the energetic requirements of migrating red knots (ASMFC 2022a; Smith *et al.* 2017; Smith, J.A. *et al.* 2022).

Over an individual's lifetime, Atlantic HSCs generally stay near or within their natal waters (*e.g.*, estuaries or embayments) (ASMFC 2009, 2013, 2019; Smith *et al.* 2009; Smith *et al.* 2016; Smith *et al.* 2017; Smith, J.A. *et al.* 2022). Numerous genetic, isotope, tagging, and behavioral studies have indicated that the Atlantic HSC can be divided into regional population units (ASMFC 2019; Gerhart 2007; King *et al.* 2015; Smith *et al.* 2016; Smith *et al.* 2017; Smith *et al.* 2023). Specifically, based on the examination by King *et al.* (2015) of 13 polymorphic nuclear markers of the Atlantic HSC, at least 8 regional units were identified across the species' range: Maine (northern Maine, Hog Bay), Gulf of Maine (southern Maine to New Hampshire), Mid-Atlantic (Massachusetts to North Carolina), Southeast (South Carolina to Georgia), Florida-East

(Indian River, Florida-Atlantic), Florida-South (Biscayne Bay, Florida-Atlantic), Florida-Gulf of America (hereafter, "Gulf")[2], and Yucatán Peninsula, Mexico. Among these regional population units, King *et al.* (2015) found that the pair-wise genetic distance, which is a measure of the degree of genetic differentiation between two populations, was greatest between the regional units at the extremes of the species' range (*i.e.*, northern Maine (Hog Bay) and Yucatán Peninsula, Mexico). Large degrees of genetic differentiation were also observed when either regional unit at the extremes of the species' range (*i.e.*, northern Maine (Hog Bay) or Yucatán Peninsula, Mexico) was compared to the Gulf of Maine, Mid-Atlantic, Southeast, Florida-East, Florida-South, or Florida-Gulf regional units (King *et al.* 2015). King *et al.* (2015) identified barriers to gene flow (via isolation by distance or by physical oceanographic features (*e.g.*, currents)) as a contributing factor to the high degree of genetic differentiation detected between the populations at the extremes of the species' range and other regional population units, as well as between several isolated populations along Florida's east coast. For the remaining regional population units identified along the Atlantic and Gulf coasts, although genetic variation exists within and between regional population units, King *et al.* (2015) identified some degree of relatedness (or recent gene flow) among regional populations, specifically those neighboring one another. Based on these findings, King *et al.* (2015) concluded that gene flow occurs within each regional unit, and some low levels of gene exchange occur between neighboring regional units. Results of genetic studies, including those completed by King *et al.* (2015), also indicate that gene flow is primarily mediated by male dispersal (or movement) among spawning sites, as evidenced by the higher degree of genetic differentiation observed among females in different

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[2] King *et al.* (2015) identifies the "Gulf of Mexico" as one of the eight Atlantic HSC regional units. Pursuant to Executive Order 14172, issued on January 20, 2025, that body of water is now known as Gulf of America.

regional populations than males (ASMFC 2009; Gerhart 2007; King *et al.* 2015; Smith *et al.* 2017).

The life history of the Atlantic HSC is characterized by late maturation (*i.e.*, age of sexual maturity), with females maturing between 10 to 12 years and males between 9 to 10 years; high fecundity; low adult but high egg and larvae natural mortality; and a longevity of approximately 17 to 20 years (ASMFC 2019; Schuster and Sekiguchi 2003; Smith *et al.* 2017; Smith *et al.* 2009). Completion of each stage of the Atlantic HSCs life history, from embryo to adult, depends upon specific environmental cues (*e.g.*, temperature, tidal patterns, wind, water levels) which are broadly discussed below. However, as environmental conditions are not uniform across the species' range, numerous studies have documented the species ability to adapt to existing and changing environmental conditions at a local level (Banerjee and Mitra 2017; Botton *et al.* 2009; Botton *et al.* 2021; Chabot *et al.* 2011; Cheng *et al.* 2015; Estes *et al.* 2021; Smith *et al.* 2017). Atlantic HSCs are considered ecological generalists given the species' tolerance and adaptability to a wide range of environmental conditions, including hypoxia (low oxygen levels), salinity ranging from 35 parts per thousand (ppt) to approximately about 1.7 ppt, and temperature ranging from below 0^{o} Celsius to over 40^{o} Celsius (Banerjee and Mitra 2017; Botton *et al.* 2009; Botton *et al.* 2021; Laughlin 1983).

Upon reaching sexual maturity, environmental cues stimulate spawning behavior in adult Atlantic HSCs (ASMFC 2019; Chabot *et al.* 2011; Cheng *et al.* 2015; Estes *et al.* 2021; Smith *et al.* 2017). Given the geographic range of the species, initiation of spawning behavior varies temporally by latitude (ASMFC 2019; Estes *et al.* 2021; Smith *et al.* 2016; Smith *et al.* 2017; Smith *et al.* 2009). In general, at the most southern portion of the Atlantic HSC range (*i.e.*, Yucatán Peninsula, Mexico) spawning can occur year-round, while at the most northern portion of its range, (*i.e.*, New Hampshire to Maine) spawning begins when water temperatures reach approximately 12^{o} Celsius to 15^{o}

Celsius, generally between the months of April to June (ASMFC 2019; Smith *et al.* 2016; Smith *et al.* 2017; Smith *et al.* 2009). Regardless of geographic location, daily spawning activity is associated with high tides, which the species detects through changes in water depth (ASMFC 2019; Chabot *et al.* 2011; Cheng *et al.* 2015; Estes *et al.* 2021; Smith *et al.* 2017). Studies have shown that water level changes are the strongest cue for synchronization of spawning activities, with other environmental factors (*e.g.*, temperature, currents, salinity) playing a lesser role (Chabot *et al.* 2011). Numerous studies provided in Chabot *et al.* (2011) matched the spawning frequency of some Atlantic HSC populations with tidal periodicity, and it was noted in Chabot *et al.* (2011) that other populations that experience "micro tides (essentially no tidal water changes)" showed no synchronization of spawning activity.

Once spawning environmental cues are received, males and females migrate from deeper oceanic or estuarine waters to spawning beaches (ASMFC 2019; Chabot *et al.* 2011; Cheng *et al.* 2015; Smith *et al.* 2017). Females typically arrive at the spawning beach with an attached male, along with several males following the attached pair (ASMFC 2019; Smith *et al.* 2016; Smith *et al.* 2017). In general, adults prefer to spawn on sandy, undisturbed beaches of bays, coves, and lagoons protected from wave energy and preferably near intertidal flats that serve as a nursery habitat for Atlantic HSC larvae and juveniles (ASMFC 2019; Smith *et al.* 2017; Smith, J.A. *et al.* 2022). However, depending on location within the species' range, Atlantic HSCs may spawn in estuarine shoreline habitat, near the edges of small mangrove islands, on offshore sandbars, or on beaches in other estuarine shoreline habitats comprised of mud, fine grained, or cobble substrate (Smith *et al.* 2017; Smith *et al.* 2023). On a single tide, females will create multiple nests between the low-tide terrace (tidal flat) and the extreme high-tide water line (ASMFC 2019; Smith *et al.* 2016; Smith *et al.* 2017). Larger females produce and carry more eggs than smaller females (Smith *et al.* 2009; Smith *et al.* 2017). For example, females with a prosomal width (*i.e.*, the largest straight-line width of the HSC body) of 265 millimeters (mm) have been reported to carry 80,000 eggs (Smith *et al.* 2009), while females with a prosomal width of 201 mm have been reported to carry approximately 14,500 eggs (Smith *et al.* 2017). However, egg cluster size does not appear to be solely related to female size because latitudinal variation in cluster size has been documented, with cluster size appearing to be larger for those populations in the middle of the species' range (*e.g.*, Delaware Bay, reported eggs/cluster = 2,365 to 5,836) and smaller towards the more northern and southern ends of the species' range (*e.g.*, in Cape Cod, reported eggs/cluster = 640 to 1,280; in Florida, reported eggs/cluster =1,644 to 1,739) (ASMFC 2019; Smith *et al.* 2017). Once eggs are deposited, according to studies cited in Smith *et al.* (2017), in general, optimal egg development occurs at salinities between 20 and 30 ppt; however, optimal egg development for HSCs located in microtidal lagoon systems has been observed to occur at 30 to 40 ppt. Studies have found that egg development occurs most rapidly at temperatures ranging from 25^{o} Celsius to 30^{o} Celsius (Smith *et al.* 2017). However, Bottom and Itow (2009) found that Atlantic HSC embryos and larvae are very tolerant and well adapted to survive a broad range of temperatures and salinities; similar findings were made by Gerhart (2007) and Laughlin (1983).

In general, 2 to 4 weeks after egg deposition, environmental cues associated with patterns of tidal inundation (*i.e.*, hydration, physical disturbance, hypoosmotic shock) trigger eggs to hatch (ASMFC 2019; Smith *et al.* 2017). Newly hatched Atlantic HSC larvae, termed trilobites, depend on tidal inundation of the nest to be transported to nearshore, shallow, intertidal flats, just off the spawning and nesting beaches; these areas support growth and development of trilobite and juvenile stages of Atlantic HSC (ASMFC 2019; Smith *et al.* 2016; Smith *et al.* 2017). As juvenile Atlantic HSC near sexual maturity, between the ages of 7 or 8, they begin to incrementally move to deeper, subtidal waters of bays or estuaries, before moving to deeper waters of the continental shelf to continue to mature to adulthood (ASMFC 2019; Smith *et al.* 2016; Smith *et al.* 2017). Outside of the spawning and nesting season, adult Atlantic HSC may be found in embayments, lagoons, or in offshore waters of the continental shelf and, therefore, may occupy a range of salinities from < 10 ppt to > 50 ppt (ASMFC 2019; Smith *et al.* 2017).

Analysis of Petition

The petitions address a single species, *L. polyphemus*, provide the scientific and common names for this species, and clearly indicate the administrative measures being requested. The petitions also contain detailed, narrative justifications for the requested listing under the ESA and provide information on the species' taxonomy, geographic distribution, and threats. Abundance estimates are lacking for this species; however, information is provided in the petitions and supporting references regarding population status and trends. In the section below, we provide a summary of Atlantic HSC population abundance, status, and trends, and we provide our analysis of whether the information provided in the petitions indicates that the petitioned actions may be warranted.

Abundance, Status, and Population Trends

The abundance of Atlantic HSC, regionally or range-wide, is unknown, with no available historical baseline population data (ASMFC 1998, 2019; Botton *et al.* 2021; Smith *et al.* 2016; Smith *et al.* 2017; Smith *et al.* 2023; Smith, J.A. *et al.* 2022; Zaldívar-Rae *et al.* 2009). As a result, the size and demographic characteristics of the species prior to unregulated harvest between the mid-19th to late 20th centuries remains uncertain. Most information regarding status and population trends comes from the U.S. east coast (*i.e.*, Maine to Florida-Atlantic) where the species is managed by the Atlantic States Marine Fisheries Commission (ASMFC) in accordance with the Interstate Fisheries Management Plan (ISFMP) issued in 1998 (ASMFC 1998; Smith, J.A. *et al.* 2022).

In terms of its status, both petitions rely largely on the IUCN Red List assessment of the Atlantic HSC (cited on the IUCN website as Smith *et al.* (2016) and published as Smith *et al.* (2017)) to support the petitions' claims that the Atlantic HSC is in decline and in danger of extinction. The petitioners focus on the risk assessment profiles by Smith *et al*. (2016, 2017) of six genetically defined regional (and three Mid-Atlantic sub-regional) Atlantic HSC populations (see table 1); these regional units were informed by the genetic findings of King *et al.* (2015). Although Smith *et al.* (2016, 2017) consider the population range-wide (*i.e.*, Maine to Yucatán Peninsula, Mexico), quantitative data for their assessment relies largely on the fishery-independent data (*i.e*., data collected from regional surveys or research outside of the fishery) used for the ASMFC's *2013 Horseshoe Crab Stock Assessment Update* (ASMFC 2013). Specifically, the ASMFC HSC assessments rely on regional fishery-independent survey data collected along the U.S. eastern seaboard since the 1970s, 1980s, or 1990s to inform regional HSC population trends. Regional population units are defined based on tagging and genetic studies (*e.g.*, King *et al.* 2015), and U.S. east coast state boundaries (ASMFC 2019). The regional HSC population trends identified by the ASMFC (2013) are representative of each regional population, where 2012 was the terminal year of the assessment. Given the above, although Smith *et al.* (2016, 2017) and the ASMFC (2013) sort regional Atlantic HSC populations into slightly different population units and use different methodologies and terms to describe population trends, these two assessments are in general agreement with respect to regional trends through 2012. Specifically, as of 2012, population trends for populations in the Southeast region were increasing, the Delaware Bay region was stable, and population declines were evident in the New York and New England/Northeast regions (see table 1).

Since the implementation of the 1998 ISFMP, the ASMFC has issued multiple Atlantic HSC stock assessments (*i.e.*, ASMFC 2009, 2013, 2019, 2024a). Together, the

ASMFC's 2019 and 2024 stock assessments provide an additional 10 years of data on Atlantic HSC regional populations from New Hampshire through Florida since Smith *et al.* (2016, 2017). Additionally, although both petitions cite the *2019 Horseshoe Crab Stock Assessment and Peer Review Report* (ASMFC 2019), and the CBD petition cites the IUCN's Green Status Assessment[3] (cited on the IUCN website as Smith *et al.* (2022) and published and referenced here as Smith *et al.* (2023)) to provide information about threats to the species, neither petition recognizes improvements to the status and trends that were noted in the ASMFC (2019) (table 2) and Smith *et al.* (2023) (table 3). For example, as of 2012, the ASMFC (2013) reported a declining trend for the Northeast regional population (termed New England under Smith *et al.* (2016, 2017)); however, as of 2017 (the terminal year of the survey time series reported in the ASMFC (2019)), the Northeast regional population trend was mixed (ASMFC 2019) (tables 1 and 2). Relying on data from the same time period evaluated in the ASMFC (2019), Smith *et al.* (2023) described populations in this area (identified by Smith *et al*. 2023 as the Mid-Atlantic: Northeast spatial unit) as "viable" because populations were stable or increasing (table 3). In the 2024 assessment issued by the ASMFC, the Northeast population maintained a "neutral" status (ASMFC 2024a). The information above indicates that when the complete set of available data is considered, there has been improvement in the population status and trends of regional populations from New Hampshire to Florida-Atlantic, with the exception of New York; the petitions do not present this information.

The status and trends of the Gulf of Maine, Northeast-Gulf, and the Yucatán Peninsula regional populations defined by Smith *et al*. (2016, 2017) (table 1) have been described only qualitatively given the lack of quantitative population data for these specific populations. For these populations, both petitions again rely upon obsolete

[3] The IUCN Green Status Assessment (*https://www.iucnredlist.org/about/green-status-species*) is a tool to evaluates the recovery of species' populations, and measures their conservation success. It serves as a complement to the IUCN Red List Assessment.

descriptions of the status of these populations from 2012 and earlier (*i.e.*, Smith *et al.* 2016, 2017). The CBD petition, despite citing Smith *et al.* (2023), does not incorporate new information on the status of these populations provided by this reference. For example, referring to studies conducted in Maine between 2001 to 2010, Smith *et al.* (2016, 2017) described the Gulf of Maine regional population as small and fragmented, with limited to no spawning; in contrast, Smith *et al.* (2023) described the "most likely" status for the Gulf of Maine regional population (identified as the Northern Gulf of Maine spatial unit by Smith *et al.* 2023) as "functional," which they assigned to populations they consider to be "viable (*i.e.*, not threatened with extinction)" and functioning appropriately from an ecological standpoint (table 3) (Akcakaya *et al.* 2018; Smith *et al.* 2023). Similarly, for the Northeast-Gulf regional population, which consists of Atlantic HSCs found in the coastal waters of western Florida, Alabama, Mississippi, and Louisiana, Smith *et al.* (2016, 2017) identified a decreasing population trend; however, Smith *et al.* (2023), described the "most likely" status of this population (identified as the Eastern Gulf (Florida Southwest and Florida West) and North Central Gulf spatial units by Smith *et al.* 2023) as "viable" or "functional" depending on spatial unit (table 3). For the Yucatán regional populations, information provided indicates the species was recognized by Mexico as "in danger of extinction" in 1994 (Botton *et al.* 2021; Smith *et al.* 2023; Zaldívar-Rae *et al.* 2009). Smith *et al*. (2016, 2017) relied upon studies completed between the 1960s to the early 1990s and described this population as fragmented, with decreased population sizes. However, newer information in Smith *et al.* (2023) described the "most likely" status of the Yucatán areas as "viable," which they assigned to populations they considered not to be threatened with extinction (*e.g.*, stable or increasing) but not fully recovered from previous declines (table 3) (Akcakaya *et al.* 2018; Smith *et al.* 2023)." Given the above, while information provided by the petitions indicates the status and trends of these regional populations have been impacted historically, that same information does not support claims that these populations are currently declining (Smith *et al.* 2023).

Table 1 -- Summary of Population Trends for the Atlantic Horseshoe Crab described by Smith *et al.* (2016, 2017) in comparison to the ASMFC (2013).

Smith *et al.* (2016, 2017) Regions: Subregions	Smith *et al.* (2016, 2017) Trends	ASMFC Regions	ASMFC (2013) Status/Trends
Gulf of Maine (northern ME (Hogs Bay)-northern NH (Great Bay))	Decreasing	N/A	
Mid-Atlantic: ***New England*** (southern NH (south of Great Bay)-RI)	Decreasing	***Northeast*** (NH-RI)	Poor/Declining
Mid-Atlantic: New York (CT-NY)	Decreasing	***New York*** (CT-NY)	Neutral/Declining
Mid-Atlantic: Delaware Bay (NJ-VA, including Delaware Bay)	Stable	***Delaware Bay*** (NJ-VA, including Delaware Bay)	Neutral/Stable
Southeast (NC-GA)	Increasing	***Southeast*** (NC-Florida, Atlantic)	Good/Increasing
Florida-Atlantic	Uncertain		
Northeast-Gulf (west coast of FL-LA)	Decreasing	N/A	
Yucatán Peninsula (Mexico)	Uncertain	N/A	

List of abbreviations used in table 1: CT-Connecticut; FL-Florida; GA-Georgia; LA-Louisiana; ME-Maine; NH-New Hampshire; NJ-New Jersey; NY-New York; SC-South Carolina; VA-Virginia; N/A-Not Applicable.

Table 2 -- The status and trends of the Atlantic HSC according to Smith *et al.* (2016, 2017) and the ASMFC (2019, 2024a).

Smith *et al.* (2016, 2017) Regions: Subregions	Smith *et al.* (2016, 2017) Trends	ASMFC Regions	ASMFC (2019) Status/Trends	ASMFC (2024a) Status/Trends
Gulf of Maine (northern ME (Hogs Bay)-northern NH (Great Bay))	Decreasing	N/A		

Mid-Atlantic: New England (southern NH (south of Great Bay)-RI)	Decreasing	***Northeast*** (NH-RI)	Neutral/Mixed	Neutral/Mixed
Mid-Atlantic: New York (CT-NY)	Decreasing	***New York*** (CT-NY)	Poor/Decreasing	Poor/Decreasing
Mid-Atlantic: Delaware Bay (NJ-VA, including Delaware Bay)	Stable	***Delaware Bay*** (NJ-VA, including Delaware Bay)	Neutral/Mixed	Good/Increasing
Southeast (NC-GA)	Increasing	***Southeast*** (NC-Florida, Atlantic)	Good/Increasing	Good/Increasing
Florida-Atlantic	Uncertain			
Northeast-Gulf (west coast of FL-LA)	Decreasing	N/A		
Yucatán Peninsula (Mexico)	Uncertain	N/A		

See table 1 for list of abbreviations.

Table 3 -- The status of the Atlantic HSC according to Smith *et al*. (2023).

Smith et al. (2023) Spatial Units[a]	Status
Northern Gulf of Maine	Functional[b]
Mid-Atlantic: Northeast	Viable[c]
Mid-Atlantic: New York	Present[d]
Mid-Atlantic: Delaware Bay	Viable
Southeast: South Carolina and Georgia	Viable
Southeast: North Florida	Viable
Florida Atlantic: Florida Indian River	Viable
Florida Atlantic: Florida South	Viable
Eastern Gulf: Florida Southwest	Viable
Eastern Gulf: Florida West	Functional

North Central Gulf	Viable
Western Yucatán Peninsula	Viable
Northern Yucatán Peninsula	Viable
Eastern Yucatán Peninsula	Viable

[a] Smith *et al*. (2023) defined *spatial units by considering Smith et al. (2016, 2017) Atlantic HSC regional populations, as well as the spatial distribution of genotypic or phenotypic characteristics, major threats, and management/conservation efforts of Atlantic HSC.*
[b]*Functional: a population that is "viable (see below)" and "functions appropriately from an ecological standpoint (Smith et al. 2023)."*
[c]*Present: a population that "occurs in the wild but is threatened, or near threatened, and declining (Smith et al. 2023)."*
[d]*Viable: a population that "is not threatened (e.g., stable or increasing) (Smith et al. 2023)."*

The Friends of Animals petition relied only on Smith *et al.* (2016) to define the status and trends of the species. The CBD petition, in addition to citing Smith *et al.* (2016, 2017) cites additional demographic studies completed on localized populations to further support its claims that the species is declining and at risk of extinction. A number of the reports are based upon research completed on data collected more than 10 years ago (Beekey and Mattei 2015; Novitsky 2015; Rudloe 1982; Smith *et al.* 2017; Smith *et al.* 2009; Tanacredi and Portilla 2015), and, therefore, are reflective of the historic population status and trends of the species (*i.e.*, 2012 or prior). As additional information and research on the Atlantic HSC has been collected since 2012, the findings of these earlier reports have been updated and/or replaced by newer studies and findings on the status and trends of the Atlantic HSC (*e.g.*, ASMFC 2019, 2022a, 2024a; Hallerman and Jiao (2021); Smith *et al.* 2023). However, the petitions do not discuss these newer findings. For example, as noted above, the CBD petition provides literature (*i.e.*, ASMFC 2019 and Smith *et al.* 2023) that addresses more recent (*i.e.*, through 2022) changes in the status and trends of most regional Atlantic HSC populations (table 2), which are primarily positive, with the exception of New York; however, the petition does not discuss these updates in its assessment of the species status or trends. As a result, the CBD petition's reliance on obsolete information, despite acknowledging other sources of new information, results in the petition providing an unbalanced representation of the relevant facts.

The CBD petition cites two more recent studies to further support its claims of declines in the Delaware Bay (*i.e.*, Garmoe *et al.* 2021) and Southeast (*i.e.*, Hunt 2022) regional Atlantic HSC populations. Garmoe *et al.* (2021) report on results of the Delaware Inland Bays Volunteer Horseshoe Survey completed in 2020. Although the 2020 survey detected a decline in observed spawning Atlantic HSCs in inland Delaware Bay relative to 2019 (*i.e.*, HSC spawning density of 6.78 in 2019 to 2.93 in 2020), according to Garmoe *et al.* (2021), the observed numbers "were still near the approximate median (*i.e.*, Atlantic HSC spawning density of 3.02) of spawning populations recorded over the last 6 years." Garmoe *et al.* (2021) also noted that the reported decline in 2020 may have also been due to the limited availability of personnel to conduct the surveys due to the COVID-19 pandemic. Hunt (2022) provides an overview of purported Atlantic HSC declines in South Carolina. Citing Niles (2021) and Niles *et al.* (2021), Hunt (2022) states that, similar to the Delaware Bay, HSC egg densities have decreased by approximately 80 percent in the past three decades in South Carolina. To support this claim, Hunt (2022) refers to increases in biomedical Atlantic HSC harvest levels in South Carolina between 1991 to 2021 (*i.e.*, from 5,000 crabs to 150,000 crabs), as well as local accounts of declining Atlantic HSC populations along specific areas of South Carolina from 2019 or earlier. For example, Hunt (2022) notes that South Carolina Department of Natural Resources and the U.S. Fish and Wildlife Service, based on beach survey and tagging reports from 2017 through 2019, indicated declines in HSC sightings (*e.g.*, hundreds of HSCs to four or five as of 2019) on priority spawning grounds (*e.g.*, Marsh and Hilton Head Islands, Turtle Island Wildlife Management Area) that had experienced heavy harvest. Additionally, Hunt (2022) acknowledges several local accounts of Atlantic HSC population declines in South Carolina since 2004, with one account noting a decline in the number of tagged Atlantic HSCs returning to spawning beaches on Harbor Island, South Carolina, between 2004 and 2018, and another account noting a decline in all wildlife, including Atlantic HSC, in Beaufort County, South Carolina.

Based on our review of the information cited in the petition and in our files, the information provided by Garmoe *et al.* (2021) and Hunt (2022) are not representative of the status and trends of the Delaware Bay and Southeast Atlantic HSC regional populations as a whole. Specifically, as provided in table 2, the Delaware Bay regional population consists of Atlantic HSC populations along New Jersey, Delaware, Maryland, and Virginia coastlines (including the Delaware Bay), with the ASMFC estimating the Delaware Bay regional population abundance by collating data from three trawl surveys (*i.e.*, Virginia Tech (VT), Delaware Adult, and New Jersey Ocean) operating within this geographical range (ASMFC 2021; ASMFC 2022a; Hallerman and Jiao 2021). The VT trawl survey operates from Atlantic City, New Jersey, to Wachapreague, Virginia, including the lower Delaware Bay; the Delaware Adult trawl survey operates in the upper and lower Delaware Bay; and the New Jersey Ocean trawl survey operates throughout the entire coast of New Jersey, extending from shore to waters beyond 12 nautical miles (1,852 meters) (ASMFC 2021; ASMFC 2022a; Hallerman and Jiao 2021; see below and Factor (D), *Inadequacy of Existing Regulatory Mechanisms*, for detailed information on the geographical extent of each survey). The study completed by Garmoe *et al.* (2021) is representative of only two bays found within the state of Delaware (*i.e.*, Rehoboth and Indian River Bays), and the trends in Atlantic HSC abundance detected by Garmoe *et al.* (2021) are not reflective of the larger Delaware Bay regional population, (*i.e.*, coastal waters ranging from New Jersey through Virginia (including the Delaware Bay)) which most recently has been determined by the ASMFC (2024a) to be increasing (table 2). The Southeast regional population consists of Atlantic HSC populations along the coasts of North Carolina, South Carolina, Georgia, and Florida. Hunt (2022) considers only Atlantic HSC populations in South Carolina, and the population trends identified in this report are not reflective of the larger Southeast regional population, which most recently has been determined by the ASMFC (2024a) to be increasing (table 2). Based on this, we find that neither Garmoe *et al.* (2021) nor Hunt (2022) provides sufficient scientific or commercial evidence to support the petition’s claims that the current status and trends for the Delaware Bay and Southeast Atlantic HSC regional populations as a whole are poor and in decline.

The CBD petition identified specific population metrics (*e.g.*, low abundance of newly mature females, low egg densities, decrease in the number of spawning Atlantic HSCs) as additional evidence of a range-wide decline in the Atlantic HSC population. However, review of the information cited in the petition indicates that the identified metrics do not apply to the species range-wide but, instead, are specific to the Delaware Bay regional population as defined by the ASMFC (see table 2). Although the population metrics identified by the petition do not support the petition's claims of a range-wide decline, we evaluated whether the demographic information for the Delaware Bay regional population may provide evidence of declines because information provided and found in our files suggests that the Delaware Bay may be of biological significance to the species (see *Species Description* section).

The CBD petition identifies the recent decrease in the Delaware Bay regional population's abundance of newly mature Atlantic HSC females as an indicator of the species' poor health and status. The petition claims that despite the ASMFC's prohibition on the harvest of female Atlantic HSCs from the Delaware Bay regional population from 2013 through 2022 (ASMFC 2012, 2022b), the abundance of newly mature female Atlantic HSCs was zero in 2019 and 2020 (Lipcius 2022). Lipcius (2022) cites Hallerman and Jiao (2021) as the basis for its estimate of zero newly mature females. Our review of Hallerman and Jiao (2021) indicates that although zero newly mature females were detected in 2019 and 2020, this estimate was only for the portion of the HSC trawl survey completed in the lower Delaware Bay. The other portion of the HSC trawl survey occurred in the coastal Delaware Bay area, which Hallerman and Jiao (2021) delineated as the area in the Atlantic Ocean extending from shore (including the mouth of the Delaware Bay) out to 12 nautical miles (1,852 meters) and from 39^{o} 20' N (Atlantic City, New Jersey) to 37^{o} 40' N (slightly north of Wachapreague, Virginia). In the coastal Delaware Bay survey area, Hallerman and Jiao (2021) estimated the population of newly mature females to be 77,000 in 2019, and 134,000 in 2020. While Hallerman and Jiao (2021) acknowledge these are the lowest newly mature female population estimates in the survey's time series (*i.e.*, 2002 through 2020), the authors note that over this timeframe, population trends of newly mature females are variable. Additionally, based on survey findings, Hallerman and Jiao (2021) concluded that from 2002 to 2020, there was an increase in the estimated mature male and female Atlantic HSC populations in the survey region (*e.g.*, within the coastal Delaware Bay survey area: approximately 4,959 mature females and 11,584 mature males in 2002 versus approximately 10,803 mature females and 31,546 mature males in 2020). The petition does not acknowledge these additional findings of the Hallerman and Jiao (2021) report, which show that the Delaware Bay regional population has variable trends depending on life stage and is not necessarily declining. Additionally, review of information in our files indicates that the ASMFC, using a Catch Multiple Survey Analysis (CMSA), which incorporates data collected by the VT, New Jersey Ocean, and Delaware Adult trawl surveys (tables 1 and 2; refer to Factor (B) for additional information on the CMSA), reported an increase in the Delaware Bay regional population in its 2024 Atlantic HSC stock assessment (ASMFC 2024a). The total mature (newly mature plus mature) female abundance increased from an estimated 6.1 million Atlantic HSCs in 2003 (beginning of the CMSA's time series), to 10.7 million in 2020, to 16.2 million female Atlantic HSCs in 2022. For total mature (newly mature plus mature) male abundance, the ASMFC estimated 15.2 million Atlantic HSCs in 2003, 18.8 million in 2020, and 40.3 million Atlantic HSCs in 2022 (ASMFC 2024a). Given the above, we find that, based on the information presented in the petition and readily available in our files, a reasonable person conducting an impartial scientific review would conclude that abundance of mature male and female Atlantic HSCs in the Delaware Bay regional population has improved since 2003 and continues to improve. As a result, there is not sufficient credible scientific or commercial information that supports the petition's claims that low abundance of newly mature females is indicative of a decline in the Delaware Bay regional population.

The CBD petition claims that the decline in spawning Atlantic HSCs and associated egg densities on Delaware Bay spawning beaches are population metrics that are indicative of a declining population trend. The CBD petition states that historical data on egg density and number of spawning HSCs provide insight on the poor condition of the Delaware Bay regional population. For example, the petition cites Smith, J.A. *et al.* (2022), who conclude that "past and current measurements of horseshoe crab eggs in the bay indicate that abundance in the 1980s was an order of magnitude greater" (*e.g.*, between 1985 and 1987: estimated average egg density in Delaware Bay = 156,600 HSC eggs/m^2; between 2015 and 2021, average egg density in Delaware Bay = 10,243 HSC eggs/m^2). However, Smith, J.A. *et al.* (2022) also conclude that between 2000 and 2021, there is an increasing trend in annual point estimates of egg densities (*i.e.*, model-based estimates of approximately 2,500 HSC eggs/m^2 in 2000, to 9,000 HSC eggs/m^2 in 2021), with surface egg densities projected to approach the 1980 baseline abundances (*e.g.*, 100,000/m^2) in 2065 (Smith, J.A. *et al.* 2022). The CBD petition also references the *Delaware Bay Horseshoe Crab Spawning Survey* reports conducted from 1990 (the first year in which the spawning surveys began) through 2022, as evidence of declines in the number of spawning HSC in Delaware Bay. The petition states that in 1990, 1.2 million Atlantic HSCs spawned in Delaware Bay (Finn *et al.* 1990) and in 2020, this number decreased to 335,211 (Swan *et al.* 2020). The petition provides no additional information on the 2021 or 2022 *Delaware Bay Horseshoe Crab Spawning Survey* reports. However, our review of the information provided in the reports from 1990 through 2022 (Finn *et al.* 1990; Swan 2022; Swan *et al.* 1991, 1992, 1993, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021) indicates that, contrary to the petition's claims, Atlantic

HSC spawning abundance in the Delaware Bay, while variable throughout the time series, has shown an overall increasing trend (table 4). Although 2020 was one of the lowest estimated numbers of spawning Atlantic HSC, the petition fails to acknowledge that although spawning numbers were lower than those reported in 1990, only 6 of the standard 25 beaches were surveyed in 2020 due to the COVID pandemic (Swan *et al.* 2020). As a result, the 2020 survey report concluded that the data collected in 2020 are not an accurate depiction of spawning activity and should not be used to compare past years spawning trends (Swan *et al.* 2020). The petition's failure to acknowledge that the reason for the decrease in abundance in 2020 relative to previous years in the time series was due to the smaller number of beaches surveyed, as well as the 2021 and 2022 *Delaware Bay Spawning Survey* reports, which indicate a rebound in spawning Atlantic HSC abundance (table 4), results in an inaccurate and unbalanced representation of the data, and, in turn, an inaccurate view of the health of the spawning population of Atlantic HSCs in Delaware Bay. Given the above, we find that, based on the information presented in the petition, a reasonable person conducting an impartial scientific review would not conclude that there is a decrease in egg densities or abundance of spawning Atlantic HSCs in the Delaware Bay, which, as noted above, may be of biological significance to the species (see *Species Description* section). As a result, there is not sufficient credible scientific or commercial information that supports the petition's claims that the Delaware Bay regional population metrics point to potential declines in the species as a whole.

Table 4 -- *Delaware Bay Horseshoe Crab Spawning Survey's* total estimated number of spawning Atlantic HSC from 1990 through 2022. Annual estimates are calculated by combining counts of spawning Atlantic HSCs on surveyed beaches in Delaware and New Jersey.

Year	Estimated Total Number of Spawning HSCs
1990	1,139,658
1991	1,152,004
1992	432,218
1993	396,174
1994	104,000
1995	112,912
1996	466,124
1997	703,846
1998	528,006
1999	1,277,533
2000	1,324,684
2001	1,214,726
2002	1,299,948
2003	1,206,521
2004	1,493,033
2005	1,307,429
2006	1,885,355
2007	1,947,372
2008	1,578,618
2009	2,049,200
2010	1,558,217
2011	1,997,203
2012	1,291,569
2013	1,778,939
2014	1,401,580
2015	1,815,426
2016	2,461,704
2017	2,039,709
2018	2,865,087
2019	3,397,246
2020	679,360
2021	1,846,490
2022	2,608,111

References: Finn et al. 1990; Swan 2022; Swan *et al.* 1991, 1992, 1993, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021.

With the exception of the New York regional population, the most recent information (ASMFC 2024a; Smith *et al.* 2023) indicates that population trends across the species' range are showing signs of stability or improvement. Although the status of the New York regional population has remained poor over the last 10 years (table 1 and 2), there is no information provided in the petitions or in our files to suggest that this region is a significant portion of the species' range, such that listing may be warranted. As provided in the *Species Description*, the available genetic evidence does not provide substantial information indicating that there is a high degree of genetic differentiation between the New York regional population and other regional populations (*i.e.*, Northeast, Delaware Bay, Southeast) located along the Atlantic coast of the species' range that may indicate genetic significance to the species viability (King *et al.* 2015; Smith *et al.* 2016, 2017). King *et al.* (2015) reported the lowest pairwise estimates of genetic differentiation between Atlantic HSCs from the New York and Delaware Bay regional population units, indicating a high degree of relatedness. Corroborating the findings of King *et al.* (2015), the ASMFC (2022a) reported that 44 percent of the HSCs harvested for bait in New York's Long Island Sound have genotypes indicating that they originated from the Delaware Bay. The ASMFC (2019) also noted that both tagging and commercial catch data suggest a greater rate of movement from Delaware Bay to New York than from New York to Delaware Bay, indicating that the Delaware Bay regional population likely serves as a source population for the New York regional population. Additionally, Atlantic HSCs that comprise the New York regional population inhabit coastal waters, bays, and sounds from New York through Connecticut, spawning on the shorelines of these respective states (ASMFC 2019, 2024a; Smith *et al.* 2017). Across this range, there is no evidence provided in the petition or in our files that indicates that the shorelines or coastal waters, bays, and sounds from New York through Connecticut contain unique ecological features necessary for Atlantic HSC growth, reproduction, or rearing (see *Species Description* for additional information on life history) that are not already present in other portions of the species' range (ASMFC 2019; Smith *et al.* 2016, 2017). Additionally, review of information cited in the petition and in our files also provides no evidence that the Atlantic HSCs comprising the New York regional population are exposed to unique environmental parameters (*e.g.*, temperature, salinity, tides) that would introduce unique adaptions not seen in other regional populations across the species' range (ASMFC 2019, 2024a; Smith *et al.* 2017). Based on the above findings of King *et al.* (2015), Smith *et al.* (2016, 2017), and the ASMFC (2019, 2022a) as well as information provided in the *Species Description,* there is no information provided by the petitions or in our files to suggest that the New York regional population may be a significant portion of the Atlantic HSC's range.

Taking into consideration the information provided above, the petitions rely on obsolete and incorrect information to infer the current status and trends of the species. As a result, we do not find that the demographic information presented in the petitions constitutes credible scientific information that indicates the Atlantic HSC is in decline and may be in danger of extinction throughout all or in a significant portion of the species' range.

ESA Section 4(a)(1) Factors

The petitions assert that *L. polyphemus* is threatened by four of the five ESA section 4(a)(1) factors: (A) the present or threatened destruction, modification, or curtailment of habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (D) inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. In the following sections, we discuss information presented in the petitions and in our files and present our assessment of whether the petitioned action may be warranted. Factor (C) (disease or predation) is not identified as a primary threat to the species in the petitions, and we have no information in our files indicating that disease or predation are posing a threat Atlantic HSCs such that they are contributing to extinction risk for the species.

(A) The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The petitions assert that Atlantic HSC habitat is being threatened by sea-level rise associated with climate change and provide general information about climate-related projections as evidence that spawning habitat is threatened (IPCC 2014; NOAA 2022). In describing the species-specific climate change related risks, both petitions cite to the *NOAA Fisheries Vulnerability Assessment on the Northeast U.S. Continental Shelf* (Hare *et al.* 2016), which characterizes the vulnerability of this species as "very high." This assessment reviewed life history traits and population information of 82 different species from the Northeast U.S. shelf and ranked the exposure of the species to the stressor (*i.e.*, climate change and decadal variability), as well as the species' sensitivities to that stressor. The assessment defines vulnerability "as the likelihood that the productivity or abundance of the species could be impacted by climate change." Using population information from ASMFC's 2013 stock assessment (ASMFC 2013), Hare *et al.* (2016) rated the Atlantic HSC's overall climate vulnerability as "very high," linking the species' climate exposure and biological sensitivities ratings to possible changes to and reliance on intertidal spawning habitat, respectively. As indicated in the assessment, this was a broad examination based upon expert opinion of whether climate change is likely to impact fish and invertebrate species where over half of the species assessed were ranked "high" or "very high" (*i.e.*, likely to experience productivity or abundance impacts as a result of climate change stressors). Although this assessment provides a vulnerability rating for each species, the assessment does not provide details on the likely magnitude of climate-related impacts on species' populations, nor does it provide information related to the species' extinction risk as a result of this stressor. Similar to the Hare *et al.* (2016) assessment, Smith *et al.* (2023) indicate that widespread climate-related alterations to Atlantic HSC spawning habitat are likely to have impacts on Atlantic HSCs. Impacts are anticipated to vary regionally; while range shifts are possible, the greatest impacts may be in areas where the shoreline lacks space for landward migration (Smith *et al.* 2023). However, Smith *et al.* (2023) note that the species could use habitats other than sandy beaches for spawning or adapt to different conditions for spawning (*e.g.*, use deeper water). Smith *et al.* (2023) even suggested that sea-level rise could create new habitat for Atlantic HSC, noting an example in Mexico where Atlantic HSCs spawn and develop in coastal lagoons that were created from flooding pre-existing wetlands. Overall, Smith *et al.* (2023) note that the "net result upon population status is uncertain owing to a lack of reliable projections, the inherent adaptability of horseshoe crabs to varied habitats at a local level, and the potential for phenological shifts to affect communities in complex and unknown ways."

Citing to the IUCN Green Status Assessment of the Atlantic HSC (cited on the IUCN website as Smith *et al.* (2022) and published as Smith *et al.* (2023); see *Abundance, Status, and Population Trends* section) the CBD petition states the species has a "Recovery Potential" of zero due to the pressures of climate change on habitat. Smith *et al.* (2023) note improvements in HSC populations in comparison to the past, but also note uncertainty about future growth. Improvements in population status were attributed to the positive effects of harvest regulations and habitat protection throughout large portions of the species' range. The Atlantic HSC received a "Green Score" of 69 percent, on a scale to 100, where 100 equals fully recovered range-wide. Smith *et al.* (2023) estimate that the "Green Score" will not change from the present (69) in 100 years (in other words, as cited in Smith *et al.* (2022), the "Recovery Potential" is zero) but also note that the "future effects of climate change and development make the Recovery Potential [score] highly uncertain." Taking into account information on environmental and anthropogenic threats to each spatial unit, as well as information provided in the ASMFC (2019), Smith *et al.* (2023) described the most probable current status of 13 out of the 14 spatial units of Atlantic HSC as either “viable” (*i.e.*, not threatened with extinction) or ”functional;” the exception was the “Mid-Atlantic: New York” spatial unit (table 3). While the Smith *et al.* (2023) assessment indicates that climate change and other threats may limit population growth in the future (*i.e.*, 100 years), it does not provide evidence that the species is declining throughout its range as a result of these threats.

The CBD petition points to a number of other factors it claims contribute to habitat loss and degradation, including urban development and harmful algal blooms. As Atlantic HSC habitat used for foraging and the completion of essential life functions (*e.g.*, spawning, development, overwintering) is located within coastal and intertidal areas, the petition asserts that coastal development, including habitat alterations to support coastal urbanization (*e.g.*, beach renourishment, sand mining, shoreline hardening, beach armoring, creation of impervious surfaces), can eliminate, modify, and/or fragment Atlantic HSC habitats such that they are no longer suitable for the completion of these essential life functions. The petition supports this claim by citing Hartley and Weldon (2020), Hopkinson and Vallino (1995), Jackson *et al.* (2015), Miththapala (2013), Paule-Mercado *et al.* (2017), Pearce (2019), Smith *et al.* (2016), Qiu *et al.* (2020), Smith, J.A. *et al.* (2020); Zaldívar-Rae *et al.* (2009). Most of the sources cited focus largely on generalized impacts to coastal ecosystems from urban and coastal developmental activities (Hartley and Weldon 2020; Hopkinson and Vallino 1995; Jackson *et al.* 2015; Miththapala 2013; Paule-Mercado *et al.* 2017; Pearce 2019; Smith *et al.* 2016; Qiu *et al.* 2020; Smith, J.A. *et al.* 2020; and Zaldívar-Rae *et al.* 2009). While coastal development has the potential to negatively impact Atlantic HSC habitat, our review of these sources found that none provide specific information indicating how and where coastal development is impacting, or is anticipated to impact, Atlantic HSC habitat.

Only three sources (Jackson *et al.* 2015; Smith, J.A. *et al.* 2020, and Zaldívar-Rae *et al.* 2009) referenced in the CBD petition pertain to specific impacts to Atlantic HSC habitat from coastal development and associated alteration processes (*i.e.*, beach nourishment, bulkhead placement, urbanization) in localized areas throughout the species' range (*i.e.*, Delaware Bay and Yucatán Peninsula, Mexico). For example, the information provided by Zaldívar-Rae *et al.* (2009) on the Atlantic HSC in the Yucatán Peninsula, Mexico, indicates that human population growth in coastal cities along the Yucatán Peninsula have caused the disappearance of some nesting and nursery habitats for Atlantic HSCs, as well as the degradation of some adjacent water bodies due to pollution. However, Zaldívar-Rae *et al.* (2009) indicate that important areas of Atlantic HSC habitat still remain. For example, since 2002, offshore Atlantic HSC habitat, as well as Atlantic HSC nesting and nursery areas have been protected in the areas of Laguna de Terminos, Celestun, Rio Lagartos, Isla Arena, and Holbox pursuant to Mexico's federal "Areas for the Protection of Flora and Fauna or Biosphere Reserves" managed by Mexico's National Commission for Natural Protected Areas (Zaldívar-Rae *et al.* 2009). Jackson *et al.* (2015) assessed the influence of bulkhead configuration on Atlantic HSC use of estuarine beaches in Delaware Bay and found that bulkheads installed along Delaware Bay shorelines did not prevent Atlantic HSC from spawning in the area. With respect to beach renourishment, Smith, J.A. *et al.* (2020), assessed the impacts of a multi-year beach restoration project on Atlantic HSC spawning habitat in the Delaware Bay and found that beach restoration can improve habitat quality for Atlantic HSC. Taking into consideration the above, the petitions do not provide sufficient scientific or commercial evidence to support the claims that coastal development, including habitat alteration to support coastal urbanization, has or will destroy Atlantic HSC habitat such that populations throughout or in a significant portion of the species' range may be threatened. As described in the *Species Description* and the *Abundance, Status, and*

Population Trends sections, despite past alterations to coastal habitat or differences in habitat quality, populations are largely stable or increasing, including those in Delaware Bay and the Yucatán Peninsula.

The CBD petition identifies harmful algal blooms, such as red tides, as threatening the habitat of Atlantic HSCs. Although the petition cites incidences of harmful algal blooms that have occurred in portions of the species' range, the petition does not provide evidence of specific Atlantic HSC habitat features that have been degraded, modified, or lost as a result of periodic algal blooms. Instead, the petition relies on several specific regional events identified in Brockmann *et al.* (2015) and Smith *et al.* (2017) and the number of Atlantic HSCs that were or that may have been affected in each event to support its claims. For example, citing Smith *et al.* (2017), CBD claims that in 1999, "an estimated 100,000 adult *L. polyphemus* died in the northern part of Florida's Indian River and the southern portion of Mosquito Lagoon due to a red tide event." However, upon review, Smith *et al.* (2017) actually state that, "an estimated 100,000 adult *L. polyphemus* died in the northern part of the Indian River and the southern portion of Mosquito Lagoon (Scheidt and Lowers 2001), although a link to algal blooms or pollution could not be established." Further, when reviewing the threats of eutrophication and red tides, Smith *et al.* (2017) found little evidence of these threats having a significant impact on the Atlantic HSC. The CBD petition, citing Totoiu and Lopez (2022), also claims that harmful algal blooms have been increasing in frequency and severity in portions of the Atlantic and Gulf coasts where Atlantic HSCs occur. However, our review of Totoiu and Lopez (2022) indicates that it provides no information on Atlantic HSCs and instead is focused specifically on harmful algal bloom events in Florida's Lake Okeechobee. The CBD petition also cites Brockmann *et al.* (2015) in support of its claims. Based on our review of Brockmann *et al.* (2015), we found only the following statement pertaining to Atlantic HSC and red tides: "Water quality issues may be particularly important in Florida where red tides are common in nearshore communities particularly in southwest Florida where young horseshoe crabs are one of the affected species (Galtsoff 1949).” No other information is provided in Brockmann *et al.* (2015) on this topic or its impact to Atlantic HSC habitat. Taking into consideration the above, the petition does not provide sufficient scientific or commercial evidence to support the petition’s claims that harmful algal blooms have or will destroy Atlantic HSC habitat such that populations range-wide or in a significant portion of the species’ range may be threatened.

The CBD petition identifies impingement, dredging and deepening of navigation channels, oil spills, and exposure to urban pollutants from industrial, municipal, and nonpoint sources as threatening Atlantic HSC habitat. However, the literature cited in the petition to support these claims provides no specific evidence that these factors are causing the loss, destruction, or modification of habitat. As some of the petition’s assertions and cited references are specific to the potential effects of these factors to the species, we discuss those assertions further under Factor (E) *Other Natural or Manmade Factors*.

In summary, it is reasonable to predict that some of the habitat-related threats identified by the petitions may result in some localized changes to the habitat of Atlantic HSC. However, the petitions did not present substantial scientific information that the scale and scope of these threats indicate that the species may be impacted throughout all or in a significant portion of its range now or in the foreseeable future. Thus, sufficient scientific or commercial information is not presented or is not otherwise available in our files indicating there is present or threatened destruction, modification, or curtailment of the Atlantic HSC’s habitat or range such that a reasonable person conducting an impartial scientific review would conclude that listing may be warranted.

(B) Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The petitions identify overutilization for commercial and scientific purposes as a major threat to Atlantic HSCs. The species is harvested for bait, its blood, and the marine life/aquarium trade, and is also captured incidentally as bycatch in commercial gillnet, dredge, and trawl fisheries (ASMFC 2019; Smith *et al.* 2017, 2023).

The petitions cite the historical overuse of Atlantic HSC as fertilizer and feed and the current harvest of Atlantic HSC in commercial fisheries "as evidence that the HSC has, and continues to be overutilized for commercial purposes." The petitions assert there is overutilization of the species due to harvest specifications set along the U.S. eastern seaboard (*i.e.*, Maine to Florida-Atlantic) by the ASMFC pursuant to the 1998 Atlantic HSC ISFMP. The petitions claim that continued harvest in the Atlantic HSC bait fishery, even with set quotas, is resulting in the commercial overutilization of the species and that commercial harvest "is not sustainable and threatens overall species survival."

While we agree with statements in the petitions that historical harvest of Atlantic HSCs between the mid- 19th to late 20th centuries resulted in the significant reduction of Atlantic HSC populations along the U.S. Eastern Seaboard, neither petition provides substantial commercial or scientific information to support the claim that Atlantic HSCs are currently being overutilized in the commercial bait fishery or that this use may put the species at risk of extinction. Based on the information in the petitions and in our files, the commercial harvest of Atlantic HSC for bait occurs primarily in state waters of Massachusetts, Connecticut, New York, Delaware, Maryland, Virginia, and to a lesser extent Rhode Island and North Carolina, under the management of the ASMFC and the respective states (ASMFC 1998, 2022d, 2023d; Smith *et al.* 2017, 2023). In other portions of the species' range, harvesting for bait is minimal, prohibited, or absent (Smith *et al.* 2017, 2023). While the petitions acknowledge that the ASMFC's 1998 Atlantic

HSC ISFMP helped to slow the decline of Atlantic HSC populations by instituting a cap on landings for the commercial bait fishery, the petitions conclude that the ISFMP fails to protect the long-term survival of the Atlantic HSC. Pursuant to the 1998 Atlantic HSC ISFMP, the goal of the plan is "to conserve and protect the horseshoe crab resource to maintain sustainable levels of spawning stock biomass to ensure its continued role in the ecology of coastal ecosystems, while providing for continued use over time (ASMFC 1998)." Our review of ASMFC regulations implemented over the past 26 years indicates that the ASMFC is actively managing the species and continuing to implement regulatory measures to help meet their stated goals (*e.g.*, state specific caps on Atlantic HSC landings, female Atlantic HSC harvest prohibitions in the Delaware Bay region) (ASMFC 2000, 2001, 2004, 2006, 2008, 2010, 2012, 2022a, b, 2023b, d). We also note that the IUCN has concluded that the overharvest of the species has "been corrected through active management intervention over much of the range" (Smith *et al.* 2016, 2017). Additionally, several other sources (*e.g.*, Okun 2012; Smith *et al.* 2009; Smith, J.A. *et al.* 2022)) recognize the success of the ASMFC's 1998 HSC ISFMP in managing the Atlantic HSC population. Further, pursuant to the 1998 HSC ISFMP, some states (*e.g.*, Massachusetts, New York, Connecticut, New Jersey) also have, and continue to implement, more restrictive harvest caps and/or other regulatory specifications than those specified by the ASMFC (ASMFC 2006, 2008, 2010, 2012, 2019, 2022d, 2023d; CTDEEP 2024; MADMF 2024; NJDEP 2024; NYSDEC 2024). Collectively, according to the information cited in the petition and readily available in our files, state and coastwide quotas implemented by the ASMFC over the last 26 years have never been exceeded (ASMFC 2000, 2001, 2004, 2006, 2008, 2010, 2012, 2022b, d, 2023b, d). Despite the continued commercial harvest of Atlantic HSCs for bait along the U.S. eastern seaboard, available population data do not support the conclusion that the level of authorized harvest in the bait fishery is causing significant population declines or that levels of harvest may pose a risk of extinction to this species. Rather, available data indicate stable to increasing population trends for most regional populations that are managed by the ASMFC along the U.S. eastern seaboard (see *Abundance, Status, and Population Trends*).

The CBD petition, citing Rudloe (1982) and Smith *et al.* (2017), states that the Northeast-Gulf (United States) and Yucatán Peninsula (Mexico) regional populations, both outside the jurisdiction of the ASMFC, are experiencing bait harvest pressures that are impeding both populations' ability to recover from harvesting events that occurred more than 30 years ago. The petition, however, provides no information on the historical or current population size of either regional population and limited information on the bait harvest pressures experienced by these regional populations in the past 30 years. Our review of the information cited in the petition and available in our files indicate little to no bait harvest in the Northeast-Gulf Atlantic HSC regional population (identified by Smith *et al.* 2023 as the North Central Gulf spatial unit), with Smith *et al.* (2017, 2023) concluding that the bait fishery poses little to no threat to Atlantic HSCs in this portion of the species' range. Along the Yucatán Peninsula, illegal harvest of Atlantic HSC as bait in the octopus fishery has been documented (Smith *et al.* 2017, 2023; Zaldívar-Rae *et al.* 2009) despite Mexico's prohibition on the harvesting of Atlantic HSCs. However, there is no information provided in the petition or in our files that indicates the magnitude of illegal harvesting or its impact on the continued existence of the Atlantic HSC populations in the Yucatán Peninsula (Smith *et al.* 2017, 2023; Zaldívar-Rae *et al.* 2009). Despite the Northeast-Gulf and Yucatán Peninsula, Mexico, regional populations experiencing some level of bait harvest pressures, available population data do not support the petition's claims that the level of harvest is causing significant population declines or that levels of harvest may pose a risk of extinction to this species. Rather, available data sources (Smith *et al.* 2023) indicate stable to increasing population trends for the Northeast-Gulf and Yucatán Peninsula, Mexico, regional populations (see *Abundance, Status, and Population Trends; table 3*).

The petitions identify biomedical harvest of Atlantic HSC as a source of overutilization. In the United States, the biomedical industry harvests Atlantic HSCs to extract blood for use in the production and manufacturing of the Limulus Amebocyte Lysate (LAL) test. The LAL test uses amebocytes harvested from Atlantic HSC blood to detect endotoxins in vaccines or other medical devices before their distribution for use. Both petitions claim that unsustainable biomedical harvest (*e.g.*, almost 1 million Atlantic HSCs in 2022) with lethal and sublethal impacts, pre- and post-bleeding, on Atlantic HSCs pose an urgent threat to the species' survival (Gauvry 2015; Krisfalusi-Gannon *et al.* 2018; Liao *et al.* 2019; Marani *et al.* 2021; World Health Organization 2023). The petitions claim that the post-bleeding mortality rate of Atlantic HSCs could range up to 30 percent and that mortality rates could be even higher given deaths that occur throughout the biomedical harvesting process (*e.g.*, mortalities occurring during capture, transportation, and handling) (Anderson *et al.* 2013; Gorman 2020; Krisfalusi-Gannon *et al.* 2018; Leschen *et al.* 2010; Novitsky 2015). The CBD petition further asserts that the ASMFC's continued use of a 15-percent biomedical mortality rate in its estimation of Atlantic HSC abundance in the Delaware Bay regional population results in inflated population sizes, which in turn results in unsustainable harvest specifications for this regional population.

Although the information provided in the petitions and in our files confirms the petition's claims that biomedical harvest of Atlantic HSCs has increased and that lethal and sublethal effects can occur to Atlantic HSCs pre- or post-bleeding, the petitions address only the studies with the highest post-bleeding mortality rates and, therefore, provide an unbalanced and incomplete representation of the relevant facts. For example, relying on the information cited in Anderson *et al.* (2013) and Leschen and Corriea

(2010), the petitions claim that post-bleeding mortality rates to Atlantic HSC could be as high as 30 percent. Leschen and Corriea (2010) reported an average post bleeding mortality rate ranging from 22.5 percent to 29.8 percent, while Anderson *et al.* (2013) reported an average mortality rate of 17.9 percent. Our review of the information provided by the petitions and in our files indicates that there are numerous other laboratory studies completed on the post-bleeding mortality rates of Atlantic HSC, with average mortality rates never exceeding 20 percent, and most (8 out of 11) below 15 percent (DeLancey and Floyd 2012; Endosafe 1999; Hurton and Berkson 2005; Kurz James-Pirri 2002; Linesch 2017; Rudloe 1983; SCDNR 1999; Thompson 1998; Walls and Berkson 2003; Wenner and Thompson 2000; and Yadon 1999, as cited in the ASMFC 2019). The findings of these studies are not acknowledged by the petitions. The ASMFC (2024a) evaluated several recent studies on the biomedical mortality rate of Atlantic HSCs (pre- or post- bleeding) (Litzenberg 2023; Owings *et al.* 2019, 2020; Smith *et al.* 2020; Tinker-Kulberg*et al.* 2020a,b,c; Watson III *et al.* 2022, as cited in ASMFC 2024a). Based on the meta-analyses of these studies, as well as those studies evaluated in ASMFC (2019), a bleeding mortality rate of 15 percent was applied by the ASMFC (2024a) in its estimation of total annual biomedical Atlantic HSC mortalities. By acknowledging only the highest post-bleeding mortality rates, the petitions provide an inaccurate and incomplete view of the post-bleeding biomedical mortality rate of Atlantic HSCs and, therefore, do not provide a balanced or complete representation of the relevant facts. Our review of the information cited in the petition and in our files indicates that the petitions' characterizations of the level of utilization as it relates to population sustainability are misleading and unsupported by the literature. Specifically, the ASMFC has incorporated anthropogenic removals, including biomedical removals, to inform the CMSA used to estimate male and female abundance in the Delaware Bay regional population, which in turn are used as inputs to the Adaptive Resource Management

(ARM) Framework used to set harvest specifications in the Delaware Bay Region. According to the 2024 Atlantic HSC stock Assessment Update (ASMFC 2024a), results of the CMSA show increasing trends in male and female abundance, with the highest abundance indices within the time series (2003 through 2022) shown in 2022. Further, as provided in the *Abundance, Status, and Population Trends* section, with the exception of the New York regional population, other regional populations under the jurisdiction of the ASMFC exposed to biomedical harvesting (*e.g.*, Northeast, Delaware Bay, Southeast) have shown signs of population stability or improvement, suggesting that harvesting rates are sustainable in these affected populations.

The petitions also claim that the biomedical bleeding process results in sublethal effects (e.g., reduced reproductive fitness and mobility) to Atlantic HSC crabs released after bleeding. According to the Friends of Animals petition, these sublethal effects are causing harm to Atlantic HSCs at a population level. In support of this claim, both petitions cite Krisfalusi-Gannon *et al.* (2018) and Smith *et al.* (2017). Additionally, the CBD petition cites Novitsky (2015), while the Friends of Animals petition supports its claim by also citing Anderson *et al.* (2013), Ghubril (2019), and Gorman (2020). After reviewing these sources we found that five (Ghubril 2019; Gorman 2020; Novitsky 2015; Krisfalusi-Gannon *et al.* 2018; Smith *et al.* 2017) are literature reviews that focus primarily on the biomedical utilization of the Atlantic HSC and mortality that may result from the bleeding process. All five of these literature reviews cite to Anderson *et al.* (2013) to briefly mention that sublethal effects may also occur. Anderson *et al.* (2013) is the only source cited that examines the sublethal post-bleeding impacts to Atlantic HSC. Specifically, Anderson *et al.* (2013) assessed, over a period of 6 weeks, the post-bleeding behavioral (*i.e.*, movement, activity, and circatidal rhythm) and physiological (*i.e.*, hemocyanin concentration) effects to Atlantic HSCs under differing laboratory and outdoor conditions. That report showed that two weeks after bleeding, there were decreases in Atlantic HSC activity, movement (linear and angular velocity), and expression of circatidal rhythms from all treatment groups; however, by the third week, full recovery to pre-bleeding activity levels were reported in Atlantic HSC from the outdoor treatment group. In terms of physiological effects, 6 weeks post bleeding, Anderson *et al.* (2013) reported a decrease in hemocyanin concentrations in Atlantic HSC from all treatment groups. While Anderson *et al.* (2013) indicated that these types of sub-lethal impacts could alter Atlantic HSC breeding success post-bleeding and may "partially account for declining populations in heavily harvested regions," the authors noted that certain treatment conditions (specifically lack of access to food in the laboratory groups) may have prolonged the stress recovery periods and, therefore, rates of behavioral or physiological recovery. The ASMFC (2019) reviewed Anderson *et al.* (2013) and similarly expressed concerns about treatment conditions exacerbating the outcomes of the study. The ASMFC (2019) noted that the Atlantic HSCs used in Anderson *et al.* (2013) were exposed to high stress conditions (*e.g.*, prolonged (greater than four hours) heat/sun exposure, holding of Atlantic HSC out of water for more than 24 hours, starvation of laboratory animals). Additionally, none of the tests by Anderson *et al.* (2013) were conducted using the biomedical harvest best management practices (BMPs) developed by the ASMFC and biomedical representatives in 2011, which are used by biomedical facilities pursuant to the licensing requirements of the Food and Drug Administration (FDA) (ASMFC 2019; Novitsky 2015). The ASMFC (2019) also noted a master's thesis by Owings (2017) which found that bled crabs mated less post-release; however, similar to the previous study, the BMPs were not followed and the ASMFC concluded that additional research that adheres to BMPs was needed to better understand the impacts of biomedical bleeding (ASMFC 2019). Additionally, while the petitions provide a reasonable assumption that demand for LAL could increase in the coming decades to meet increasing biomedical needs as a result of declining Asian HSC populations (*i.e.*, decreased Tachypleus Amebocyte Lysate (TAL) availability), the CBD petition also mentions that the animal-free alternative to LAL could reduce this demand (Smith *et al.* 2023). Based on the information provided by the petitions and in our files, we are unable to draw reasonable inferences that sublethal impacts from biomedical bleeding may be contributing to extinction risk of Atlantic HSC now or in the foreseeable future.

The CBD petition identifies the "rent-a-crab" program, which refers to the dual use of Atlantic HSCs by the bait and biomedical industries, as threatening the continued survival of the species. Referring specifically to Atlantic HSC populations in Massachusetts, the CBD petition claims that Massachusetts's rent-a-crab program has caused increased mortality to Atlantic HSCs. According to the information in our files, the rent-a-crab program allows permitted bait harvesters and/or dealers to send crabs caught for the bait industry to a bleeding facility, with the crabs returned to the bait vendor after bleeding (ASMFC 2022d, 2023d, 2024b). According to the CBD petition, the rent-a-crab program creates incentive for increases in bait harvest levels in order to meet biomedical demand; however, the information provided in the petition and in our files does not support the petition's claims. For example, Atlantic HSCs used in the rent-a-crab program can be caught and landed only by permitted bait harvesters and must be counted against the bait quota of the state of origin of the harvester's permit (ASMFC 1998, 2000, 2022d, 2023d, 2024b; MADMF 2024). Additionally, all permitted harvesters participating in the rent-a-crab program must comply with that state's regulations for bait harvest, including penalties for exceeding or approaching the ASMFC and/or state's quota (*e.g.*, closures and reduced trip limits) (ASMFC 1998, 2000, 2022d, 2023b, 2024b; MADMF 2024). The available information in our files also lacks any indication that bait quotas specified by the ASMFC or the states have been exceeded over the past several years (ASMFC 2022d, 2023b, 2024b). Additionally, information in our files indicates that Massachusetts experienced an increase in biomedical landings in 2022 as a result of the introduction of a second biomedical firm; this firm, according to Massachusetts DMF (2023), did not participate in the rent-a-crab program and sourced HSCs from biomedical harvesters. In response to the increased biomedical landings, Massachusetts put subsequent management measures in place to prevent further increases, including a biomedical processor quota and lowering their state bait quota (322 CMR 6.34, as referenced in MADMF 2024). Altogether, we do not find that the petition offers substantial scientific or commercial information that would suggest that the rent-a-crab program is a mechanism of overutilization that may be negatively affecting the continued existence of the Atlantic HSC. This is especially true when considering the overall improvement of most Atlantic HSC populations, as identified in the *Abundance, Status, Population Trends* section (*e.g.*, the Northeast regional population, which includes Massachusetts, going from declining (ASMFC 2013) to neutral/mixed (ASMFC 2024a)).

The CBD petition notes that the harvesting of juvenile Atlantic HSCs in the marine life or aquarium trade is threatening the Atlantic HSC, specifically those populations in Florida. Relying on information provided by Smith *et al.* (2017), the petition asserts that the extensive removal of juveniles in Florida for Florida's aquarium trade "could hinder the population's ability to sustain itself." However, the information in the petition and in our files does not support the petition's claims. For example, relying on data collected by Brockmann *et al.* (2015), Smith *et al.* (2017) report that between 2008 and 2013, 4,938 juvenile Atlantic HSCs were collected per year on the east coast of Florida, with 22,597 Atlantic HSCs collected on the west coast of Florida. Smith *et al.* (2017) acknowledge that although this level of harvest is small, "the magnitude of the threat from the marine-life and aquarium trade is unknown because population size is unknown." Similar conclusions were made by Brockmann *et al.* (2015) and Gerhart (2007). Smith *et al.* (2023) provide updated estimates of harvest rates in Florida's marine life or aquarium trade. On the east coast of Florida, Smith *et al.* (2023) identify three regional spatial units: “Southeast: North Florida,” “Florida Atlantic: Florida Indian River” and “Florida Atlantic: Florida South.” For the “Southeast: North Florida” regional spatial unit, no known harvest of any kind has been documented. From 2013 to 2022, approximately 2,640 juvenile Atlantic HSCs were harvested in the “Florida Atlantic: Florida Indian River” regional spatial unit, and from 2012 to 2022, 7,429 juvenile Atlantic HSCs were harvested in the “Florida Atlantic: Florida South” regional spatial unit (Smith *et al.* 2023). On the west coast of Florida, Smith *et al.* (2023) identify two regional spatial units: “Eastern-Gulf: Florida Southwest” and “Eastern-Gulf: Florida West.” From 2012 to 2022, approximately 179,620 juvenile Atlantic HSC crabs were harvested from the “Eastern-Gulf: Florida Southwest” regional spatial unit, and from 2013 to 2022, approximately 6,544 juvenile Atlantic HSCs were harvested in the “Eastern-Gulf: Florida West” regional spatial unit (Smith *et al.* 2023). Taking into consideration the above, as well as information on other potential threats (*e.g.*, overharvest, climate change, habitat loss) experienced by each of the regional spatial units identified on the east or west coasts of Florida, Smith *et al.* (2023) conclude that the current status of Florida’s east coast regional spatial units (*i.e.*, Southeast: North Florida, Florida Atlantic: Florida Indian River, and Florida Atlantic: Florida South) are “viable,” and for Florida’s west coast regional spatial units, the current status is “viable (Eastern-Gulf: Florida Southwest)” or “functional (Eastern-Gulf: Florida West)” (table 3). Smith *et al.* (2023) also describe the long term (*i.e.*, 100 years) status of each of the east and west coast regional spatial units as “viable.” Aside from Florida (east and west coasts), harvest of Atlantic HSCs for the marine life or aquarium trade in other portions of the species’ range is limited to absent, and no information cited in the petition or in our files indicates that the level of marine life harvest that does occur may be threatening or may be likely to threaten the continued existence of the species (Brockman *et al.* 2015; Smith *et al.* 2017, 2023). Considering the limited and localized impacts from the marine life or aquarium trade, as well as information regarding the overall status of Atlantic HSC populations in these regional spatial units (see *Species Description,* and *Abundance, Status, and Population Trends* sections), we do not find that the petition offers substantial scientific or commercial information that would suggest that the harvesting of juvenile Atlantic HSC for the marine life or aquarium trade may be negatively affecting the continued existence of the Atlantic HSC throughout all or in a significant portion of the species' range.

Both petitions claim that Atlantic HSCs are overharvested as bycatch in commercial gillnet, trawl, and dredge fisheries operating throughout the species' range. The petitions claim that given the number of Atlantic HSCs injured or killed as bycatch during commercial fishing, the continued existence of the Atlantic HSC is threatened. The CBD petition, citing the ASMFC (2023c, d), states that "the number of dead horseshoe crabs due to discarding can vary from about a fourth to half of the number of crabs harvested for bait." While the CBD petition is accurate in its summary of information provided in the ASMFC (2023b, c), the CBD petition does not provide a complete representation of the relevant facts. Contrary to CBD's claims, our review of the information cited in the CBD petition indicates that the bycatch metrics do not pertain to the species' range wide, but, instead, are specific to the Delaware Bay regional population and, as such, cannot be used to assess the magnitude of bycatch as a threat to the Atlantic HSC throughout all its range. Further, there is no evidence cited in the petition or in our files that indicates that bycatch and any associated discard mortality may be negatively affecting the continued existence of the Delaware Bay regional Atlantic HSC population, a population that may be a significant portion of the Atlantic HSC's range. In fact, Smith *et al.* (2023) state that "the severity of bycatch is expected to vary spatially but has been found overall to be negligible relative to horseshoe crab abundance and is not expected to cause declines in the Delaware Bay population where the effect of bycatch has been most closely evaluated.” Taking into consideration the above information, as well as the limited information provided in the petition on the level of discard mortality across the species’ range (Smith *et al.* 2017, 2023), we do not find that the petition offers substantial scientific or commercial information that would suggest that bycatch in commercial fisheries is a mechanism of overutilization that may be negatively affecting the continued existence of the Atlantic HSC. This determination is further supported by available population data (see *Species Description* and *Abundance, Status, and Population Trends* sections) indicating stable to increasing trends for most Atlantic HSC populations, including the Delaware Bay regional population.

Altogether, while the petition presents information on the commercial and scientific harvest, as well as the incidental bycatch of Atlantic HSCs, sufficient information is not provided or otherwise available to indicate that the harvest and collection mechanisms identified by the petitions may cause the species to become endangered or threatened with extinction. Specifically, given the information provided in the *Species Description* and the *Abundance, Status, and Population Trends* sections, there is no evidence that the species is at or near a level of abundance that may place its current or future persistence at risk throughout all or a significant portion of the species’ range due to overutilization. Therefore, we conclude the petition does not present substantial scientific information indicating that listing may be warranted due to overutilization for commercial, recreational, scientific, or educational purposes.

(C) Disease or Predation

Disease and predation are not identified as primary threats to the species in the petitions. Further, in the face of other stressors, there is no evidence in the petitions or in our files indicating that disease or predation are negatively impacting the species.

(D) Inadequacy of Existing Regulatory Mechanisms

The CBD petition asserts the absence of federal regulations implemented under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) has resulted in the inadequate protection of Atlantic HSCs in state and federal waters. However, the petition provides no evidence to support this assertion. It is unclear how the MSA would afford greater protections to Atlantic HSC populations relative to existing regulatory mechanisms implemented by the ASMFC pursuant to the Atlantic Coastal Fisheries Cooperative Management Act (ACA) (16 USC Ch. 71).

As discussed under Factor (B), *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*, the ASMFC and Atlantic coastal states cooperatively manage Atlantic HSC populations along the U.S. Atlantic coastline, from Maine to Florida (Atlantic), pursuant to the 1998 Atlantic HSC ISFMP and subsequent addenda. Both petitions assert that the existing regulatory mechanisms of the ASMFC and the states are failing to protect and restore Atlantic HSC populations. Specifically, the petitions assert that the ISFMP's "patch-work" of state specific harvesting measures, its use of "flawed" data and modeling methodologies, and its failure to regulate biomedical harvest of the Atlantic HSC are threatening the species' continued survival. The CBD petition also cites demographic metrics (*e.g.*, egg density, mature female abundance, numbers of spawning Atlantic HSCs) as additional evidence of the ISFMPs' failure to protect and restore Atlantic HSC populations. Our assessment of these metrics in relation to the health of the Atlantic HSC population are provided in the *Abundance, Status, and Population Trends* section above and will not be discussed further in this section.

The petitions claim that when a state strengthens its regulations (*e.g.*, state moratorium on Atlantic HSC harvest), other states experience corresponding increases in harvest rates, thereby negating any intended conservation benefits to the species. The petitions term this behavior as "regulatory leakage." The CBD petition further asserts that, due to regulatory leakage, all state regulations in place for Atlantic HSC have "proven inadequate to prevent further declines in horseshoe crabs." This is an inaccurate representation of the relevant facts. While the petitions provide references to the ASMFC's 1998 Atlantic HSC ISFMP and subsequent addenda, as well as state-specific management measures, petition statements claiming the failure of these measures are unsupported. Instead, information provided in the petitions and in our files indicates that management measures have become more restrictive since the implementation of the 1998 ISFMP and, as a result, Atlantic HSC populations are beginning to demonstrate improvements. In fact, many states have, and continue to implement, stricter regulatory harvest controls than those established by the ASMFC to protect the long-term viability of the Atlantic HSC in their waters (ASMFC 2008, 2022d, 2023d, 2024b). For example, since 2006, there has been a state moratorium in New Jersey on the harvesting of Atlantic HSCs (ASMFC 2008, 2019; NJDEP 2024) and, in Massachusetts, the Department of Marine Fisheries (MADMF) has implemented numerous Atlantic HSC harvest regulations (322 CMR 6.34), including the recent (2023) harvest prohibitions within the Monomoy National Wildlife Refuge and the Cape Cod National Seashore (MADMF 2024). Additionally, in 2023, Connecticut implemented Bill no. 6484 which prohibits the hand-harvesting of Atlantic HSCs or its eggs (CTDEEP 2024), and Maryland issued regulations to prohibit catch or possession of female Atlantic HSCs (MDDNR 2024). The petitions' claims of leakage are contradicted by recent compliance and monitoring information which indicates that landings for the states participating in the ISFMP are well below the ASMFC established quotas, and most are well below their own state established quotas (ASMFC 2022d, 2023d, 2024b; CTDEEP 2024; FWCC 2024; GADNR 2024; MADMF 2024; MDDNR 2024; NCDMF 2024; NYSDEC 2024; RIDEM 2024; SCDNR 2024). As noted under Factor (B) *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*, numerous sources (*e.g.*, Okun 2012;

Smith *et al.* 2009, 2016, 2017; Smith, J.A. *et al.* 2022) recognize that threats of overharvest are reduced over much of the Atlantic HSC's range as a result of the ASMFC's management of the species. Smith *et al.* (2023) reaffirm this assertion that harvest regulations and habitat protections over much of the species' range have had a positive effect on conservation of the Atlantic HSC, noting that "effective conservation of HSCs takes the form of harvest regulations" implemented by the ASMFC and the states. Taking into consideration the information above, the petitions provide no substantial scientific or commercial information to indicate that regulatory measures implemented by the ASMFC and the states are inadequate to protect the Atlantic HSC.

The petitions assert that the continued existence of the Delaware Bay Atlantic HSC regional population is threatened by the ASMFC's use of "flawed" data and modeling methodologies to manage this regional population. Specifically, the petitions point to the ASMFC's ARM Framework, first implemented for management purposes in 2012 to set harvest specifications for the Delaware Bay regional population (ASMFC 2012), and subsequently revised in 2022 via Addendum VIII of the Atlantic HSC ISFMP (ASMFC 2022b). Part of the 2022 revisions to the ARM Framework include the incorporation of the CMSA, which estimates male and female Atlantic HSC abundance in the Delaware Bay regional population using all quantifiable sources of mortality (*i.e.*, natural, bait, fisheries bycatch, and biomedical) as well as abundance indices provided by three trawl surveys (*i.e.*, Virginia Tech (VT), Delaware Adult, and New Jersey Ocean Trawl) (ASMFC 2019, 2022a, b, 2024a). Citing the ASMFC (2022a), the petitions assert that only the VT Trawl Survey is designed for the purpose of estimating Atlantic HSC abundance in this regional population. The petitions also assert that the CMSA's collation and equal weighting of all three surveys results in artificially inflated population estimates, which in turn, results in skewed ARM recommendations that increase Atlantic HSC harvest thresholds in the Delaware Bay regional population, thereby preventing the population from increasing and recovering to pre-exploitation numbers (*i.e.*, prior to the mid-19th century; see *Abundance, Status and Population Trends* section).

Based on our review of information cited in the petition and in our files, we find that although the petitions are correct that the VT Trawl Survey is designed specifically for the collection of Atlantic HSCs, the petitions do not provide a complete representation of the relevant facts about the VT, Delaware Adult, and New Jersey Ocean trawl surveys or the ASMFC's rationale for collating the three surveys in the CMSA. There is no evidence that the ASMFC's collation of the survey data artificially inflates population estimates to allow for larger harvest thresholds. Relative to the area encompassed by the Delaware Bay regional population (*i.e.*, coastal waters ranging from New Jersey through Virginia (including the Delaware Bay)), the ASMFC determined that the VT trawl survey alone would likely underestimate the abundance of the Delaware Bay regional population given the spatial extent of the VT trawl survey (*i.e.*, lower Delaware Bay and the area in the Atlantic Ocean extending from shore out to 12 nautical miles (1.85 kilometers) from 39° 20' N (Atlantic City, New Jersey) to 37° 40' N (slightly north of Wachapreague, Virginia) (Hallerman and Jiao 2021)) combined with the trawl's catch efficiency (*i.e.*, less than 100 percent) (ASMFC 2019, 2022a). As a result, the Delaware Adult and New Jersey Ocean trawl surveys were incorporated into the CMSA to supplement the data provided by the VT Trawl Survey (ASMFC 2019, 2021; 2022a). Based on the information provided in the ASMFC (2019, 2021, 2022a) and Hallerman and Jiao (2021), as the VT, Delaware Adult, and New Jersey Ocean surveys each provide temporal (spring through winter for Delaware Adult and New Jersey Ocean trawl surveys, fall for VT trawl survey) and spatial (Delaware Adult trawl survey: Upper and Lower and Delaware Bay, at depths ranging from 7 – 35 m; New Jersey Ocean trawl survey: entire coast of New Jersey, extending from shore to waters beyond 12 nautical miles (1,852 meters); VT trawl survey: from Atlantic City, New Jersey, to Wachapreague, Virginia, including the lower Delaware Bay) sampling inputs not shared by the other respective surveys, the CMSA's collation of the three surveys provides a more comprehensive relative abundance estimate of the Delaware Bay regional population. As such, the collation of the three surveys is commensurate with the spatial and temporal range of the Delaware Bay regional population's range. According to the information provided in the ASMFC 2024a (table A5), the collation of the three survey data sets into the CMSA does result in higher estimates of relative abundance of Atlantic HSC than if the CMSA relied only on the data provided by VT trawl survey. However, there is no evidence provided by the petitions or in our files that indicates that these abundance estimates are overestimates of the Delaware Bay regional population of Atlantic HSC. According to information in our files, the CMSA underwent multiple peer reviews (*e.g.*, ASMFC 2009, 2019, 2022a, 2024c), with each review concluding that the collation of the three survey's data to be a scientifically sound measure of HSC abundance (ASMFC 2024c). Further, as it relates to the weighting (*i.e.*, degree of contribution) of each survey in the CMSA, based on numerous sensitivity runs and peer review comments, the ASMFC (2022a) modified the CMSA by removing all survey weights in its calculation of Atlantic HSC abundance so as to eliminate the possibility of double-weighting the survey inputs and to acknowledge the differences in the surveys discussed above. Based on this and the information provided above, the petitions omit relevant information, resulting in inaccurate claims about the ASMFC's consideration and treatment of available data in the CMSA. Specifically, there is no information provided in the petition or in our files that supports the petition's claims that the methodology applied in the CMSA results in artificially inflated population estimates, which, in turn, result in skewed ARM recommendations to increase harvest thresholds of the Delaware Bay regional population of Atlantic HSCs, thereby preventing this population from increasing. Information provided in the *Abundance, Status, and Population Trends* section shows that, under the current CMSA and ARM recommendations, the Delaware Bay regional Atlantic HSC population has shown increasing population trends.

The CBD petition cites two expert reviews (Lipcius 2022, and Shoemaker 2022), to further support its claims that the CMSA and ARM Framework are flawed in terms of CMSA's treatment of survey gap years and the ARM Framework's failure to adequately account for uncertainty in mean recruitment rates). Our review of ASMFC (2022a), Lipcius (2022), and Shoemaker (2022), as well as other information provided in the petition and in our files, indicates that the ASMFC (2024c) provided technical responses to the comments received by Lipcius (2022) and Shoemaker (2022), which included detailed documentation of the errors and misconceptions provided by those reviews (*e.g.*, inaccurate assumptions regarding female abundance, promosomal width, and recruitment rates, relative to the CMSA's total estimated Atlantic HSC population size). Additionally, the information in the petition and in our files indicates that beyond the ASMFC's consideration of the critiques provided by Lipcius (2022), and Shoemaker (2022), between 2009 through 2023, the ARM and/or CMSA underwent numerous peer and technical reviews, with the ASMFC: (1) documenting its decision-making process extensively, (2) providing detailed documentation of the comments received, (3) addressing any errors and misconceptions in received reviews (*e.g.*, use of incorrect Atlantic HSC abundance data (sample period occurred when Atlantic HSCs are not fully available to the surveys) to subset trawl survey indices of abundance in order to estimate population trends in the Delaware Bay), and (4) explaining how the comments informed the final Framework (ASMFC 2009, 2019, 2022a, 2024c; Earthjustice 2023). The CBD petition does not acknowledge any of these documents issued by the ASFMC between 2009 to the present. Based on our review of the ASMFC (2009, 2019, 2022a, 2024c) and Earthjustice (2023), as well as other information cited in the petition and in our files, there is no evidence that indicates the ASMFC has ignored or overlooked any potential flaws in the data being used to inform the final revisions to the CMSA and the ARM Framework. Review of information in our files indicates that the ARM Revision (including the CMSA) was fully evaluated and endorsed by an independent panel of scientific experts through the ASMFC's external peer review process, with criticisms of the model, including those identified in the petition, fully addressed throughout the ARM revision process (ASMFC 2009, 2019, 2022a, 2024c). Further, contrary to the petition's claims that the ASMFC's use of flawed data in the CMSA and ARM Framework have resulted in inflated population estimates for the Delaware Bay regional population, according to the ASMFC (2024c), "HSC population trends from the ARM revision are consistent with other published values or data sources in the Delaware Bay region." Taking into consideration the above, the CBD petition provides an unbalanced and inaccurate representation of the relevant facts, resulting in a mischaracterization of the CMSA and ARM Framework, and, in turn, inaccurate claims that the ASMFC is using risk-prone management decisions that threaten the continued survival of Atlantic HSCs of the Delaware Bay regional population. In contrast, available population data indicate an increasing population trend for this regional population under the ASMFC's current management (ASMFC 2024a; see *Abundance, Status, and Population Trends* section).

The petitions assert that the Atlantic HSC ISFMP's failure to regulate the biomedical harvest and bleeding of the Atlantic HSC threatens the continued survival of the species. The petitions note that although the Atlantic HSC ISFMP states that, "if horseshoe crab mortality associated with collecting, shipping, handling, or use by the biomedical industry exceeds 57,500 horseshoe crabs per year, the Commission would reevaluate potential restrictions on horseshoe crab harvest by the biomedical industry." While the petitions' claims that the threshold of 57,500 Atlantic HSC established in the ISFMP has been exceeded are correct, the ASMFC subsequently reevaluated the threshold and determined that harvest restrictions or a change in the threshold were not warranted (ASMFC 2022d). Specifically, the ASMFC (2022d) determined that establishment of a revised biologically based biomedical mortality threshold was not possible given the absence of a coastwide Atlantic HSC population estimate. According to the information in our files, the ASMFC also took other actions to minimize mortality and injury of Atlantic HSCs involved in the biomedical bleeding process (*i.e.*, from harvest to post-bleeding release) as result of the exceedance of the 57,500 threshold (ASMFC 2023a). Pursuant to Addendum III of the ISFMP, the ASFMC requires all states where Atlantic HSCs are captured for biomedical use to monitor and report monthly and annually the harvest of Atlantic HSC by biomedical facilities (ASMFC 2004). Specifically, Addendum III states that "all states must identify [the] percent [of] mortality up to the point of release (including harvest, shipping, handling, and bleeding mortality), harvest method, number or percent of males and females, disposition of bled crabs and condition of holding environment of bled crabs prior to release." Since implementation of Addendum III in 2004, the ASMFC closely monitors biomedical harvest of Atlantic HSCs and associated mortality, and accounts for biomedical mortalities to help inform management decisions of the species (*i.e.*, CMSA and ARM Framework, see section above and Factor (B) *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*). Further, as provided under the *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes* section (Factor (B)), pursuant to the licensing requirements of the FDA, most biomedical facilities follow biomedical harvest BMPs developed by the ASMFC and biomedical representatives in 2011 to mitigate harm to bled Atlantic HSCs and, therefore, sustain the Atlantic HSC population (ASMFC 2019; Novitsky 2015). These BMPs, although not regulatory under the ISFMP, are reviewed and reassessed by the ASMFC as part of the Atlantic HSC stock assessment reports to determine if modifications to the BMPs are warranted in order to continue to meet the goals and objectives of BMPs established in 2011. Further, harvest of Atlantic

HSCs for biomedical use is subject to state regulations, separate from those implemented by the ASMFC or particular states on harvest and landing of Atlantic HSC for bait (ASMFC 2023d, 2024b). Some states implement annual quotas which, once reached, close Atlantic HSC biomedical harvest (*e.g.*, ASMFC 2024b; MADMF 2024 (including citation of 322 CMR 6.34); RIDEM 2024). Other states have biomedical or scientific permitting requirements, including revocation of biomedical permits for failure to comply with reporting mandates (*e.g.*, Title 6 of the New York Codes, Rules and Regulations, Part 44.3 (6 NYCRR § 44.3)) or refusal to issue hand harvesting permit for scientific purposes if such harvesting will equate to harm to the Atlantic HSC population (*e.g.*, *Connecticut House Bill No. 6484, Public Act No. 23-6* (CTDEEP 2024)). Based on the above, the petitions provide an incomplete view of the regulatory mechanisms associated with the biomedical harvest and bleeding of the Atlantic HSC, and, as a result, do not provide sufficient scientific or commercial information to support their claims that the ISFMP's failure to regulate the biomedical harvest of the Atlantic HSC threatens the continued survival of the species. In contrast to their claims, under the existing regulatory mechanisms of the ISFMP and the states, available population data indicate that, with the exception of the New York regional population, all other regional Atlantic HSC populations are stable to increasing.

Although the petitions' claims of regulatory inadequacy focus on the ASMFC and the Atlantic states, the CBD petition also asserts that regulatory mechanisms to protect Atlantic HSCs are inadequate in portions of the species' range that extend beyond the jurisdiction of the ASMFC (*i.e.*, coastal waters of western Florida, Alabama, Mississippi, Louisiana, Texas, and Yucatán Peninsula, Mexico). Along the coastal waters of western Florida, Alabama, Mississippi, Louisiana, and Texas, the CBD petition asserts that there are no Atlantic HSC harvesting regulations in place and concludes that state regulations are inadequate to protect Atlantic HSCs. However, the petition provides no scientific or commercial information to support these assertions. Although we could not find any information in our files that pertained to the petition's claims, we did identify some, albeit limited, information based on our review of Smith *et al.* (2023). According to Smith *et al.* (2023), "Gulf coastal states may enact state-specific regulations," and that "harvest in the Gulf in the USA is regulated at the local or state levels in some locations;" however, specifics on such regulations are not provided. Additionally, Smith *et al.* (2023) note that there is little to no harvesting of Atlantic HSCs in this portion of the species' range; as an example, the authors note that between 2013 and 2022, approximately 2,152 adult Atlantic HSCs were harvested in coastal waters of western Florida, and there was no documented harvest in Alabama, Mississippi, or Louisiana. Although it remains unclear to what degree regulatory mechanisms exist within this portion of the species' range, the available information indicates that in some coastal waters of western Florida, Alabama, Mississippi, Louisiana, or Texas, harvest regulations do exist. Additionally, contrary to the CBD petition's claims that state regulations are inadequate to protect Atlantic HSCs in this portion of the species' range, available population data describes the Atlantic HSC populations along the coastal waters of western Florida, Alabama, Mississippi, Louisiana, and Texas as "viable" or "functional" (Smith *et al.* 2023; refer to *Abundance, Status, and Population Trends, table 3*).

The CBD petition also asserts that regulations in Mexico are inadequate to protect Atlantic HSCs throughout the Yucatán Peninsula; however, the petition provides limited information (*i.e.*, Zaldívar-Rae *et al.* 2009) to support this claim. Information provided indicates that Atlantic HSCs were recognized by Mexico as "in danger of extinction" in 1994, with harvesting of the species prohibited throughout the Yucatán Peninsula (Botton *et al.* 2021; Smith *et al.* 2023; Zaldívar-Rae *et al.* 2009). Botton *et al.* (2021) and Zaldívar-Rae *et al.* (2009) note that within Mexico, important Atlantic HSC nesting and nursery areas have been protected by Mexico's National Commission for Natural

Protected Areas since 2000. While illegal poaching still occurs in Mexico when other bait sources are scarce (Smith *et al.* 2023; Zaldívar-Rae *et al.* 2009), conservation activities are underway to address this threat. According to Smith *et al.* (2023), "stakeholders in the Yucatán Peninsula octopus fishery are currently involved in the process of third-party certification of the industry's sustainability in order to maintain access to international markets, especially in the European Union. Among the key criteria in the proposed certification process is that no horseshoe crabs are used as bait in the octopus fishery." Taking into consideration the above protections, as well as the available data sources (Smith *et al.* 2023) indicating stable to increasing population trends for the Yucatán Peninsula regional populations (see *Abundance, Status, and Population Trends,* table 3), overall, the petition does not provide substantial information regarding the existing regulatory mechanisms for the species outside of the United States or whether they are inadequate to protect the species.

Overall, the petition fails to provide substantial scientific or commercial information indicating existing regulatory mechanisms for harvest are inadequate to prevent extinction risk for Atlantic HSCs throughout all or a significant portion of its range such that listing may be warranted. To the contrary, the CBD petition notes that "bait harvest quotas have helped to slow the decline in horseshoe crab populations," and the Friends of Animals petition states that the "FMP resulted in decreased numbers of crabs harvested as bait." Further, scientific and commercial information provided in the petitions and in our files indicates that there has been a history of effective regulatory actions to conserve and protect Atlantic HSCs. The effectiveness of the regulatory actions is further evidenced by the stable to increasing population trends for most regional populations throughout all or a significant portion of the species' range (refer to *Species Description* and *Abundance, Status, and Population Trends*).

The CBD petition argues that the Outer Continental Shelf Lands Act provides inadequate protections to Atlantic HSCs from threats posed from oil and gas exploration and development. Specifically, they note oil spills as a threat to the species, indicating that Delaware Bay has had nine "oil spills over the past decade" referencing Botton *et al.* (2009). The CBD petition also discusses oil and gas wells or pipelines which may not be properly decommissioned in the Gulf, claiming that these wells or pipelines could leak into Atlantic HSC habitat resulting in impacts to nearby populations. We addressed the threat of oil spills under Factors A and E, noting that Smith *et al.* (2017) found little evidence of this threat having a significant impact on Atlantic HSC populations. The likelihood of oil spill occurrence is low, and many factors influence the severity of the events (Smith *et al.* 2023). With no further information provided by the petition, evidence to inform the degree to which unplugged oil and gas wells are impacting or may impact the species is lacking, and, therefore, whether additional regulations may be warranted to address the impact of oil and gas exploration and development on the species is uncertain.

The CBD petition asserts that the National Wildlife Refuge System Act and marine reserves provide insufficient protections to Atlantic HSCs. The petition indicates that federal protections fail to protect Atlantic HSC, as biomedical harvest occurs in refuges in the South Carolina and Georgia areas, and is allowed in the Carl N. Shuster, Jr. Horseshoe Crab Reserve in New Jersey. Hunt (2022), which is referenced by the petition, suggests that illegal harvest may be occurring at Tybee National Wildlife Refuge and at Turtle Island Wildlife Management Area; however, no information is provided as to the degree of these impacts to local Atlantic HSC populations. While the petition is correct that biomedical harvest of Atlantic HSC within the Carl N. Shuster Jr. Horseshoe Crab Reserve in New Jersey was allowed, the petition fails to acknowledge that biomedical harvest was allowed only under an Exempted Fishing Permit (EFP) issued by NMFS and that the last EFP issued was in 2016. Pursuant to 50 CFR 697.22, the NMFS Regional Administrator can issue an EFP only if the exemption will not have a detrimental effect on Atlantic HSC. Review of the information in our files indicates that prior to 2016, NMFS issued 15 EFPs to a biomedical facility to harvest Atlantic HSC in the Carl N. Shuster, Jr. Horseshoe Crab Reserve (66 FR 42832, August 15, 2001; 67 FR 45445, July 9, 2002; 68 FR 42360, July 17, 2003; 69 FR 31588, June 4, 2004; 70 FR 36124, June 22, 2005; 71 FR 40076, July 14, 2006; 72 FR 36427, July 3, 2007; 73 FR 31434, June 2, 2008; 74 FR 36459, July 23, 2009; 75 FR 31421, June 3, 2010; 76 FR 31941, June 2, 2011; 77 FR 55457, September 10, 2012; 78 FR 29331, May 20, 2013; 80 FR 60633, October 7, 2015; 80 FR 64397, October 23, 2015; 81 FR 56602, August 22, 2016). According to information in our files, all 15 EFPs issued by NMFS required the EFP applicant to comply with specific EFP terms and conditions, including a cap on the number of Atlantic HSCs collected annually, as well as reporting to NMFS the number of Atlantic HSC collected and the return location of all post-bled Atlantic HSC. NMFS authorized these EFPs only after taking into consideration information provided by the ASMFC. Smith *et al.* (2023) and the ASMFC (2019, 2024a) assess South Carolina and Georgia Atlantic HSCs under a single regional population (or spatial unit) labeled as the Southeast (or Southeast: South Carolina and Georgia); Atlantic HSCs in New Jersey are grouped as part of the mid-Atlantic Delaware Bay regional population (or spatial unit) (table 2, table 3). Bait harvest is prohibited in South Carolina and Georgia, but biomedical harvest occurs in this regional population (ASMFC 2019; Smith *et al.* 2023). As noted in *Abundance, Status, and Population Trends,* the ASMFC (2019, 2024a) describes the status of the Southeast regional population as “good” (see table 2). Smith *et al.* (2023) describe the current status as “viable” (see table 3). Further, Smith *et al.* (2023) describe the “most likely” status as “ecologically functional” in the near and long term provided demands do not increase and adequate management remains in place. In the mid-Atlantic's Delaware Bay regional population (or spatial unit), which includes New Jersey, increasing population trends are reported (ASMFC 2019, 2024a; Smith *et al.* 2023; table 2 and table 3) and long-term trends are described as most likely "viable" with continued management in place (Smith et al. 2023).

Overall, given the information provided above, we find that the claims presented by the petitions do not comprise substantial scientific or commercial information indicating inadequacies of existing regulatory mechanisms such that a reasonable person conducting an impartial scientific review would conclude that listing may be warranted.

(E) Other Natural or Manmade Factors

In addition to pointing to the habitat impacts associated with climate change (see Factor (A) *The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range)*, the CBD petition asserts that climate change can result in changes to temperature, salinity, tidal patterns, and ocean acidity, which could significantly impact the species' life cycle or development. Information provided in the petition (Cheng *et al.* 2015; Laughlin 1983; Leith *et al.* 2021; Subramoniam 2018) focuses on how environmental factors support development of Atlantic HSCs or cue certain behaviors associated with breeding and foraging either in Atlantic HSCs or invertebrates generally. To support its claims, the CBD petition also provides information (Cheng *et al.* 2020; IPCC 2022; NOAA 2021) on general predictions regarding changes to certain environmental factors as a result of climate change; however, the information cited does not provide species-specific information about likely impacts as a result of these factors changing. As noted in the *Species Description*, Atlantic HSCs are ecological generalists and occur over a wide geographic range, which corresponds to the species surviving and developing over a range of different environmental conditions. Across the range there is variation in the temperatures that cue different behaviors and local populations may respond to complex interactions between various environmental factors to initiate behaviors such as spawning (Smith *et al.* 2017, 2023). Smith *et al.* (2023) acknowledge that changes in temperature might negatively affect reproductive activity in the next 100 years, especially in the southern spatial units. However, as noted earlier, the results of these effects on population status remain uncertain, particularly given other factors such as the adaptability of the species or the potential for phenological shifts (Smith *et al.* 2017, 2023) (*see also Species Description* and *Abundance, Status, and Population Trends* sections and Factor (A) *Present or Threatened Destruction, Modification, or Curtailment of Species Habitat or Range*). Accordingly, while we acknowledge the potential for the Atlantic HSC to experience impacts due to changes in environmental factors over time, we find that there is insufficient scientific or credible information to indicate the petitioned action may be warranted due to changes in these factors.

The CBD petition points to biological factors, including the Atlantic HSC's slow maturation rates and low survival to adulthood, to claim Atlantic HSCs are susceptible to overharvest and that human-driven mortality leaves this species highly vulnerable to extirpation. Although information provided in the petition does support the characterization of the Atlantic HSC as being slow to mature and as having low juvenile survival rates (*e.g.*, 3 out of 100,000 survive their first year (Gauvry 2015)), the information also indicates that the Atlantic HSC has other life history traits, such as high fecundity and adaptation to different habitats over a wide geographic range, that have supported the successful survival of this species over millions of years (ASMFC 2019; Błażejowski 2015; Gauvry 2015; Smith *et al.* 2017, 2023). These life history traits (*e.g.*, late maturing, high fecundity, multiple spawning events over species lifetimes) are adaptive strategies that have evolved in many marine species to compensate for high mortality rates experienced during their early life stages, thereby ensuring reproductive success in the species (Heppell *et al.* 2005; Palumbi and Hedgecock 2005). Importantly, neither the petition nor information in our files suggests that overharvest may be occurring (see Factor (B) *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*) or that current pressures may pose an extinction risk for this species throughout all or in a significant portion of the species' range. As noted in the *Abundance, Status, and Population Trends* section, information in the petitions and in our files indicates that, with the exception of the New York regional population, Atlantic HSC population trends have improved throughout all or in a significant portion of the species' range, in large part due to the regulations introduced through the ASMFC's ISFMP (see also *Species Description*; *Abundance, Status, and Population Trends*; Factor (B) *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes;* and Factor (D) *Inadequacy of Existing Regulatory Mechanisms* sections above) (ASMFC 2019, 2024a; Smith *et al.* 2023).

The CBD petition asserts that genetic factors put the Atlantic HSC at risk of extinction. Specifically, the petition asserts that if a population were to be extirpated due to a major climatic event, given the sex-biased dispersal observed among the Atlantic HSC, gene flow alone would not be sufficient to repopulate an area due to limited female migration and larval dispersal, placing populations at risk at of extirpation. We discussed genetic factors, including sex-biased dispersal and gene flow, under the *Species Description* section, noting that low levels of gene exchange occur between neighboring regional units and that it is primarily mediated by male dispersal. As noted above, we found no information to suggest regional populations may be at risk of extirpation (see *Abundance, Status and Population Trends* section). Similar to an oil spill, Atlantic HSC populations could experience negative localized impacts depending on the temporal scope and scale due to a major climatic event; however, the likelihood of such an event occurring and resulting in extirpation are low. Further, this species is adapted to dynamic coastal environments, where life-history traits such as slow maturation help to ensure population resilience over time (Banerjee and Mitra 2017; Botton *et al.* 2009; Botton *et* *al.* 2021; Heppell *et al.* 2005; Palumbi and Hedgecock 2005). Overall, the petition fails to present substantial scientific or commercial information indicating that genetic factors are posing a threat to the continued existence of Atlantic HSCs such that listing may be warranted.

Under "Other Natural or Manmade Factors," the CBD petition also makes several claims related to the management of Atlantic HSCs. Specifically, CBD suggests that insufficient information about baseline populations (referred to by the petition as "shifting baseline syndrome") has led to inadequate management targets for the species, that sex-ratios are skewed in several areas of the range as a result of overutilization of females in certain areas, and that a uniform conservation approach will fail to provide effective conservation for regional populations given niche divergence[4]. The petition did not provide specific information linking the lack of historical baseline information to the extinction risk of the species (see *Abundance, Status, and Population Trends* section). While the petition provides information detailing skewed sex ratios for Raritan Bay and Sandy Hook, New Jersey (SCW 2023), there is insufficient information provided to support other claims (generally identified above) regarding this skewed ratio being linked to harvest in New York or overall preferential harvesting of females coastwide. Instead, information in the petitions and in our files indicates higher impacts to male Atlantic HSCs (ASMFC 2019, 2022d, 2023d, 2024a, b). For example, the AMFC's ISFMP requires states with greater than 5 percent of the coastal landings to report the Atlantic HSC sex for a portion of their bait harvest (ASMFC 2004). In 2023, the latest annual review of the fishery, this requirement applied to the states of Massachusetts, New York, Delaware, Maryland, and Virginia (east of the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) line), with the ASMFC

[4] According to Zhu *et al.* (2020), niche divergence occurs when populations enter a new environment, and the ecological niche (role) of the species changes to adapt to the novel environment; these new adaptations may subsequently lead to natural selection and speciation over time.

allocating quota for male-only harvest in New Jersey, Delaware, Maryland, and Virginia (ASMFC 2024b). According to the ASMFC (2024b), in 2023, within the states of New York, Delaware, Maryland, and Virginia, 77 percent of reported bait landings were male, 5 percent were female, and 18 percent were unclassified; data for Massachusetts were not received in time for the 2023 fishing year report and, as such, were not included in the annual review of landings (ASMFC 2024b). According to the ASMFC (2024b), "reported coastwide landings since 1998 show more male than female horseshoe crabs were harvested annually." In particular, 52.9 percent of the coastwide biomedical mortalities were reported to be males and 42.1 percent were female in 2023 (ASMFC 2024b). Further, Atlantic HSC experts point out that skewed ratios at spawning beaches may not be indicative of female population declines, as increasing male numbers on spawning beaches can be an early sign of a growing population because males mature earlier (ASMFC 2019). With regard to niche divergence, the petition claims that a one-size-fits-all approach to conservation assessments, such as the ARM Framework, will not preserve Atlantic HSCs. Information provided in the petition and in our files does not indicate that the Northeast, New York, Delaware Bay, and Southeast regional populations under the jurisdiction of the ASMFC are being uniformly managed or conserved using the ARM framework; refer back to Factor (B) *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*, and Factor (D) *Inadequacy of Existing Regulatory Mechanisms* sections where we discuss not only how this species is managed under the ASMFC, but also how the ARM Framework pertains specifically to the management of the Delaware Bay regional population. Though conservation efforts vary across the range, assessment information indicates improvements from previous years as a result of various management strategies (ASMFC 2019, 2024a; Smith *et al.* 2017, 2023) (see also *Abundance, Status, and Population Trends* section).

The CBD petition claims that a global HSC decline should serve as a warning for Atlantic HSC conservation and that, as noted in the Factor (B), *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes* section, declines in Asian crab populations will cause subsequent declines in TAL production for the biomedical industry. The petition notes that the lack of TAL could shift demands to LAL and negatively impact the Atlantic HSC through increased biomedical harvest. Information provided in the petitions indicates that it is reasonable to expect that a decline in TAL could shift the world-wide demand for amebocyte lysate to the Atlantic HSC (Smith *et al.* 2017); however, an animal-free alternative has also been developed and could stem this demand (Smith *et al.* 2023). Given the lack of information with regard to the potential demand, we cannot draw reasoned inferences about the extinction risk to the petitioned species from this information.

Both petitions also assert that pollution (*e.g.*, oil spills, urban runoff) of coastal and intertidal waters is contributing to the extinction risk of the species. The Friends of Animals petition claims that "oil spills during the horseshoe crab spawning season could threaten populations in the Delaware Bay" and refers to a statement in Smith *et al.* (2016) that "an oil spill that coincides with spawning activity, with oil washed onto spawning beaches, could be catastrophic to a local population," to support the petition claims. However, Smith *et al.* (2017) state that although Delaware Bay has experienced oil spills, "the effects on the horseshoe crab population has not been evident largely because the timing and spatial extent of the spills have not overlapped with horseshoe crab spawning." Further, contrary to the petition's assertions, the Friends of Animals petition admits "that the Atlantic HSC has not yet been affected by an oil spill" in the Delaware Bay, and that such an event is "a matter of chance." The CBD petition also asserts that oil spills pose a threat to the Atlantic HSC, citing several pieces of information that summarize laboratory findings that suggest survival and development of early life stages may be impacted by exposure to oil (Botton and Itow 2009; Smith *et al.* 2017). However, neither Bottom and Itow (2009) nor Smith *et al.* (2017) makes any definite conclusions about the impact of oil exposure to early life stages and population sustainability. Rather, Bottom and Itow (2009), based on the laboratory studies they evaluated, concluded that early life stages (*i.e.*, embryos and larvae) of *L. polyphemus* are capable of surviving over a wide range of contaminant levels and that the declines in Atlantic HSC populations in the United States seen in the early 2000s were not related to pollution events such as oil spills. Taking into consideration the above information, neither petition provides substantial scientific evidence to support its claims that oil spills have threatened or will threaten the continued existence of Atlantic HSC throughout all or in a significant portion of the species' range.

The CBD petition identifies urban pollutants from industrial, municipal, and nonpoint sources as threatening the continued existence of Atlantic HSC by potentially causing a range of effects from death to developmental impairments to early life stages. However, while our review of the information cited in the petition indicate that laboratory studies conducted on early life stages of Atlantic HSC exposed to pollutants, such as heavy metals, did cause mortality or developmental impairments (Estes *et al.* 2021; Burger 2023), the CBD petition provides no substantial scientific evidence to support the petition claims that Atlantic HSCs may be at risk of extinction as a result of such exposure. Considering the information provided in both petitions, we are unable to draw reasonable inferences that exposure to pollutants, either from oil spills or from industrial, municipal, and non-point sources, may be measurably impacting the extinction risk of this species throughout all or in a significant portion of the species' range.

Both petitions identify impingement on either coastal infrastructure or power plant intakes as threat to the continued existence of the Atlantic HSC; the CBD petition also identifies impingement or entrainment in dredges as a threat to the species. Although the petitions cite several examples of incidences of observed impingement of Atlantic HSCs occurring in local power plants in Florida, Maryland, and Connecticut and HSCs impinged upon coastal infrastructure (*i.e.*, breakwaters) in localized areas of Delaware Bay or Florida, none of the examples indicate that the magnitude of the localized impingements events caused significant declines in the affected population or threatened the continued existence of the affected populations. The petitions, therefore, provide an incomplete assessment of this potential threat, and, as a result, do not provide sufficient scientific or commercial information to support their claims that impingement threatens the continued survival of the species throughout all or in a significant portion of the species' range. Citing only Ray and Clark (2010), the CBD petition also asserts that Atlantic HSC impingement and entrainment in dredges poses a potential threat to the continued existence of the species. Our review of the information provided by the petitions and in our files indicates that dredging has resulted in impacts to this species in localized areas where deepening of waterways has occurred (Ray and Clark 2010; Smith *et al.* 2017, 2023); however, past studies, such as Ray and Clark (2010), have informed management recommendations (*e.g.*, inclusion of observers on dredging vessels to monitor Atlantic HSC bycatch) as well as dredge mitigation strategies (*e.g.*, temporal and spatial dredge restrictions during months of Atlantic HSC spawning) to reduce dredge entrainment and impingement impacts to Atlantic HSCs. Further, in accordance with the Fish and Wildlife Coordination Act (FWCA), NMFS provides recommendations to entities that are seeking federal permits or licenses (under the Clean Water and Rivers and Harbors Acts). Acknowledging the findings of Ray and Clark (2010), the recommendations provided by NMFS under the FWCA include seasonal restrictions on dredging activities in nearshore waters to reduce impacts to Atlantic HSCs, particularly in sensitive areas like Delaware Bay (Gorski *et al.* 2012). Smith *et al.* (2023) recognizes that localized impingement threats can be reduced or prevented by engineered solutions.

While incidences of dredge entrainment or impingement may have localized impacts on Atlantic HSC populations, information suggests that these threats are actively managed to reduce their impact, as evidenced by available population data indicating that most populations are stable or increasing, despite ongoing localized dredging operations, throughout all or in a significant portion of the species' range (see *Species Description* and *Abundance, Status, and Population Trends* sections). Altogether, while we acknowledge the potential for Atlantic HSCs to experience impacts due to impingement on, or entrainment in, power plants or dredges, as well as impingement on other coastal infrastructure, we find that there is insufficient scientific or credible information to indicate the petitioned action may be warranted due to these interactions.

The Friends of Animals petition also identifies bycatch as another factor that is contributing to extinction risk to the species. We considered this claim under Factor (B) *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes,* and provide no further information here.

Petition Finding

As explained in the *Species Description* and *Abundance, Status, and Population Trends* sections, estimates of total Atlantic HSC abundance regionally or range-wide do not exist; however, the status and trends of regional populations have been described quantitatively or qualitatively based on data collected from various mechanisms (*e.g.*, fishery independent surveys, spawning and tagging studies, recruitment rates) over the last 30 or more years. Overall, across the species' range, most regional populations are considered to be stable or increasing with the exception of the New York regional population (see *Species Description* and *Abundance, Status, and Population Trends* sections). However, there is no information provided in the petitions or in our files to suggest that the New York regional population is a significant portion of the species' range. In contrast, as previously noted, information cited in the petitions and in our files suggests that the Atlantic HSCs located within the center of the species' range, specifically, the Mid-Atlantic's Delaware Bay (a component of the Delaware Bay regional population), may be a significant portion of the species' range.

Given the available information on the status and trends of the species, we considered each of the ESA section 4(a)(1) factors to determine whether any one of the factors may contribute significantly to the extinction risk of the species. We also considered the combination of those factors to determine whether they collectively contribute significantly to extinction risk. Based on our synthesis and integration of the foregoing information and the effects on the status of the species throughout all or in a significant portion of the species' range, we determined that the petition does not present substantial scientific or commercial information indicating that the petitioned action may be warranted.

To summarize, the factors supporting this conclusion include: (1) the species is broadly distributed over a large geographic range, occurring along the U.S. Atlantic and Gulf coasts, to the Yucatán Peninsula, Mexico, with no marine barriers to dispersal; (2) genetic data indicate that, with the exception of the regional population at the extremes of the species' range (which show the highest degree of genetic differentiation between each other and between other regional populations within the bounds of these geographic extremes), regional populations show connectivity (low genetic differentiation) among populations, despite regional groupings; (3) there is no evidence of current overutilization (*i.e.*, bait fishery, biomedical industry) of the species, as indicated by the stable to increasing population trends for most regional populations across the species' range (see above); (4) regulatory mechanisms implemented by the ASMFC, states, and/or the FDA have effectively managed harvesting of Atlantic HSCs for bait or biomedical purposes such that overuse of the species is currently not occurring throughout all or in a significant portion of the species' range; (5) there is no evidence that disease or predation is contributing to increasing the risk of extinction; and (6) there is no evidence that the species is currently suffering from depensatory processes (such as reduced likelihood of finding a mate or mate choice or diminished fertilization and recruitment success) or is at risk of extinction due to environmental variation or anthropogenic perturbations (*e.g.*, coastal development) throughout all or in a significant portion of the species' range.

As such, having thoroughly reviewed the information presented in the petitions and other information readily available in our files, we conclude the petitions do not present substantial scientific or commercial information indicating that the petitioned action to list *L. polyphemus* as a threatened or endangered species may be warranted.

References Cited

A complete list of all references cited herein is available upon request (see **FOR FURTHER INFORMATION CONTACT** section).

Authority: The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: February 10, 2026.

Samuel D. Rauch III,

Deputy Assistant Administrator for Regulatory Programs,

National Marine Fisheries Service.

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