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Massachusetts
Division of Marine Fisheries

Massachusetts 2023 Compliance Report to the Atlantic States Marine Fisheries Commission – Horseshoe Crab

Submitted by:
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I. Introduction

The bait fishery harvested 99.8% (139,746 crabs) of the 2023 Massachusetts self-imposed quota (140,000 crabs), based on dealer reports. Prosomal widths were taken from 1,139 bait crabs and 2,854 biomedical crabs as part of our market sampling program. Sampling intensity of the biomedical fishery has increased since the addition of a second Massachusetts biomedical firm, which opened in July 2022. In addition to bait and biomedical market sampling, which DMF has conducted since 2001, DMF conducted at-sea sampling trips aboard biomedical collection trips, sampled biomedical holding areas (e.g., pens), and biomedical release trips. Fifty-one commercial horseshoe crab sampling trips (bait and biomedical, combined) were conducted in 2023. The two biomedical companies operating in Massachusetts reported collecting and releasing (redacted) crabs from Massachusetts, and (redacted) from Rhode Island (based on biomedical reports). Massachusetts Division of Marine Fisheries (DMF) staff and numerous volunteer groups conducted spawning beach surveys at 14 beaches during the full and new moons of May and June. April spawning beach surveys were discontinued in 2021 because observations of April spawning activity have been low since the survey expanded in 2013 to include the second half of April.

II. Request for *de minimis* status – not applicable

III. Previous calendar year's fishery

a. Bait Harvest

In 2023, 42 of 202 horseshoe crab bait permits issued by DMF were actively fished, representing an increase of seven active permits and decrease of two issued bait permits from 2022. Three fishermen with Coastal Access Permits also participated in the fishery in 2023, which is a decrease of three from 2022. See Table 1 for associated harvests. Based on dealer data, 42% of the quota issued by ASMFC to Massachusetts (330,377 crabs), and nearly 100% of the more restrictive state quota voluntarily self-imposed by Massachusetts (140,000 crabs) was harvested. Bait dealers reported purchasing 139,746 crabs in 2023, which is 4,993 more than dealers reported in 2022. Harvesters reported harvesting 134,594 crabs (Table 2). In recent years, more bait crabs have been taken by mobile gear than by hand, but that was not the case in 2023. In 2023, bait crabs were harvested primarily by hand (including rakes, dipnets, and hand tongs; 62% of harvest). Mobile gear (trawl or dredge) was responsible for 38% of bait landings (Table 3). Bait crabs harvested in May and June accounted for 73% of all bait crabs landed in 2023 (Table 4), which is an increase from 2022 when 38% of the harvest was from May and June.

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Table 1. Number of permits issued, number of permits actively fished, and number of crabs fishermen reported harvesting by permit type (data source: Massachusetts Trip Level Reports and NMFS Vessel Trip Reports). Confidential data has been redacted.

Permit Type	# of Permits Issued	# of Permits Fished	# of Crabs Harvested
Biomedical	32	11	redacted
Commercial	202	42	131,001
Coastal Access	N/A	3	3,593

Table 2. Number of bait crabs reported by bait harvesters (data sources: Massachusetts Trip Level Reports, NMFS Vessel Trip Reports).

	Female	Male	Unclassified	Total
Bait Harvest	15,369	11,516	107,709	134,594

Table 3. Number of bait crabs captured by method, as reported by harvesters (data source: Massachusetts Trip Level Reports and NMFS Vessel Trip Level Reports). Confidential data has been redacted.

Harvest Method	# of Crabs	# of Total
Hand	83,753	62%
Mobile	50,837	38%
Other	redacted	0%

Table 4. Number of bait crabs harvested by month, as reported by harvesters (data sources: Massachusetts Trip Level Reports and NMFS Vessel Trip Reports). Confidential data has been redacted.

	# of Crabs
JAN	redacted
FEB	redacted
MAR	redacted
APR	7,975
MAY	68,740
JUN	28,890
JUL	19,385
AUG	3,125
SEP	0
OCT	0
NOV	0
DEC	0

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b. Scientific and Research Harvest

As a condition of permit renewal, researchers that wish to harvest horseshoe crabs in Massachusetts are required to report the number of horseshoe crabs taken for scientific purposes. Educational programs collected 225 crabs in 2023. Most institutions reported releasing these crabs after using them for educational or display purposes.

c. Biomedical Fishery

Two Massachusetts biomedical companies bled horseshoe crabs to produce *Limulus* Amebocyte Lysate (LAL) in 2023, Associates of Cape Cod (ACC) and Charles River Laboratories (CRL). Both companies filed monthly catch reports listing the dealers from whom they purchased crabs, location of harvest, the number and sex of crabs purchased, and the ultimate disposition of the crabs (harvested with biomedical permit then released, or harvested with a bait permit and returned to the bait market). They also reported the number of crabs they rejected or received dead by sex.

DMF has issued Letters of Authorization (LOAs) to biomedical companies since 2008. These LOAs conditioned biomedical permits, and if a company was found to be non-compliant with these conditions, their permit could be revoked. In 2023, these permit conditions were changed to full regulations. Massachusetts biomedical companies continue to be required to adhere to the following: cannot accept more than 1,000 crabs per permitted biomedical harvester per day, crabs must be separated by source (e.g., location of harvest), crabs cannot be held out of water more than 36 hours, crabs must be returned to harvester/dealer in good condition, crabs must be released in same embayment where they were originally collected, crabs must be kept moist during transport and storage, crabs must be transported in a temperature-controlled environment with the thermostat set between 50 and 60° F, keep crabs in the laboratory at ≤70° F, and hold crabs in barrels no more than approximately 2/3 full. DMF also requires that every bled crab harvested using a biomedical permit must be marked to indicate the crab was bled and that crab cannot be bled a second time in a calendar year. DMF assigns the mark annually, which is applied on the underside of the crab, and each company uses a waterproof paint color specific to that company.

In 2023, Massachusetts biomedical firms bled bait crabs from Massachusetts, Maryland, and Virginia, and biomedical crabs from Massachusetts and Rhode Island (Table 5). ACC and CRL reported purchasing (redacted) crabs (all sources combined), which is an increase of (redacted) crabs over 2022. The bait market contributed (redacted) of the crabs bled (Table 6). Both biomedical companies participated in the rent a crab program in 2023, whereas only ACC had participated previously. Bait dealers sold (redacted) crabs to the biomedical firms, which were bled and returned to the bait market. ACC imported bait crabs from Maryland and Virginia. Massachusetts biomedical firms bled (redacted) crabs from Massachusetts and (redacted) crabs from Rhode Island collected solely for LAL production. Data reported by the two companies resulted in a combined pre-bleeding mortality rate of 0.50% for males, and 0.52% for female crabs for Massachusetts biomedical-only crabs. ACC

reported pre-bleeding mortality rates of 0.52% and 0.62%, for male and female Rhode Island biomedical crabs, respectively (CRL did not bleed crabs from Rhode Island).

Eleven DMF biologists participated in 46 sampling trips specifically to collect data on the biomedical fishery in 2023 (Table 7). These trips included at-sea biomedical collection trips, pen/holding sampling, market sampling, and observation of at-sea releases of biomedical crabs. In total, there were 51 horseshoe crab sampling trips in 2023 (46 biomedical, 5 bait), making the horseshoe crab fishery the second most observed fishery by DMF in 2023, behind only the lobster fishery (58 trips). Based on DMF samples of crabs collected in Massachusetts, pre-bleeding mortality rates were 0.7% and 1.0% respectively, for males and females (Table 8). Additional 0.3% and 0.5% mortality rates were observed at the time of release (early-stage post-bleeding mortality) for males and females, respectively.

Table 5. Number of crabs bled, rejected, and dead by month from 2023 biomedical facility reports.

Table redacted due to confidentiality laws

Table 6. Number of purchased, rejected, and dead crabs from 2023 biomedical facility reports.

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Table 7. Number of biomedical sampling trips conducted by DMF staff in 2023, and number of crabs observed during sampling trips.

	# of 2023 Trips	# of Crabs Observed
Biomedical Collection Trips	9	2,399
Biomedical Pen Samples	14	2,655
Biomedical Market Samples	9	2,854
Biomedical Release Samples	14	2,898
Total	46	10,806

Table 8. Percent mortality by sex and stage from DMF biomedical sampling. Note that this table includes both pre-bleeding (capture, pens, and lab) and post-bleeding mortality (release).

	Capture	Pens	Lab	Release	Total
Male	0.0%	0.3%	0.4%	0.3%	1.0%
Female	0.0%	0.4%	0.6%	0.5%	1.5%

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d. Shorebird monitoring- Not applicable

e. Fisheries Independent Sampling

Except for 2020, which was missed due to the Covid-19 pandemic, DMF's Resource Assessment Project has conducted seasonal spring (May) and fall (September) bottom trawl surveys in state waters since 1978. Approximately 100 tows are made during each season in five bio-geographic areas (Figure 1), using a stratified random sampling design, with 22 total strata. The net's design (¾-sized two seam 39' x 51' otter trawl with 3 ½" cookies on a chain sweep, ¼" knotless codend liner) is appropriate for sampling horseshoe crabs; however, the vessel size precludes towing inside most shallow embayments less than approximately 25 feet. For this report, areas 1–3 are considered Southern New England (SNE), and areas 4–5 are the Gulf of Maine (GOM). All data reported are from the survey's two shallowest depth strata (0–30' and 30–60', combined) because nearly all horseshoe crabs caught in this survey since 1978 have come from these two strata.

The 2023 DMF Trawl Survey was successfully completed, except for several stations that were not completed during the fall survey in SNE due to staffing and weather conditions. Survey indices (stratified mean number per tow and stratified mean weight per tow) from the MA DMF Trawl Survey are mixed. The spring survey has shown a sharp increase in both male and female number and weight per tow in SNE (where most of the MA commercial fishery operates) since around 2010 (Figure 2 and Figure 3), while the fall survey has remained near the time series median. No crabs were caught in the fall 2023 survey in SNE, though there is increased uncertainty in the SNE fall data points because the stations that were missed in the 2023 survey were in eastern Nantucket Sound, which is where crabs are most frequently observed in the survey. The 2023 data points for both sexes and both seasons were at or below time series medians in GOM (Figure 4 and Figure 5). Size distribution data are given in Figure 6 through Figure 13. SNE crabs are usually larger and more numerous than GOM crabs.

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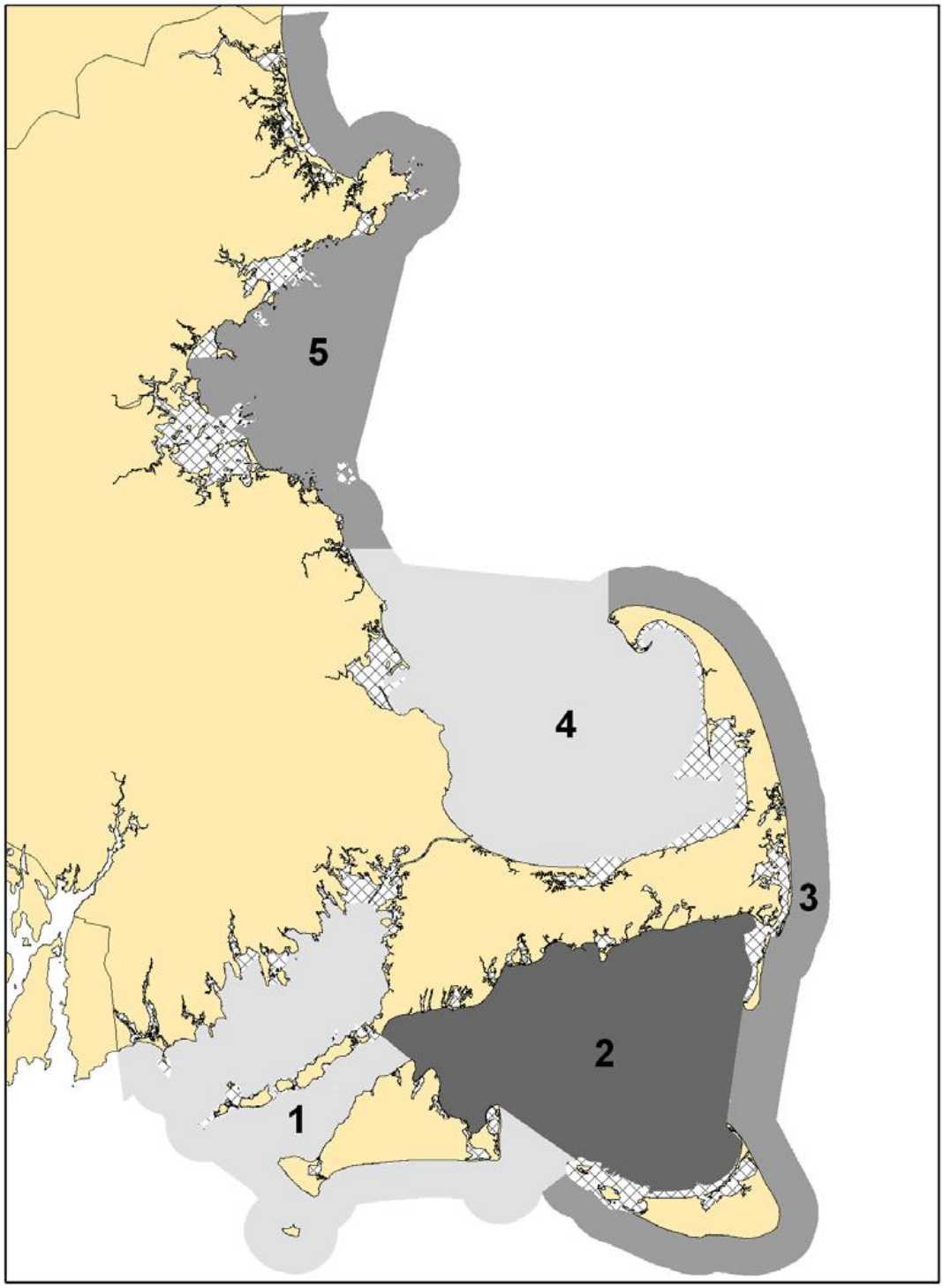

Figure 1. Map of regions for DMF's bottom trawl survey. For this report, regions 1–3 are considered Southern New England (SNE) and regions 4–5 are Gulf of Maine (GOM).

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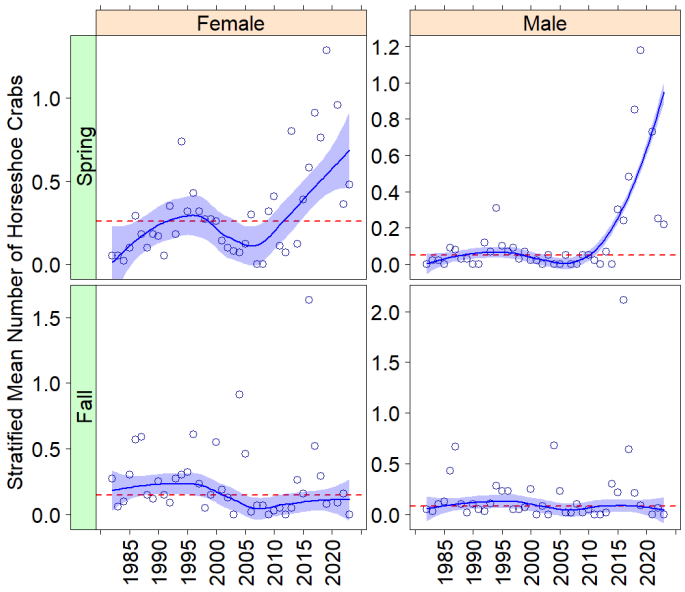

Figure 2. Bootstrapped mean number of horseshoe crabs per tow from the two shallowest depth strata (0–30' and 30–60' combined) of the DMF bottom trawl survey in SNE, by survey season and crab sex. The survey was not conducted in 2020 due to the Covid-19 pandemic. Red, dashed line is the time series median, blue line is a loess fit using family=symmetric, and span=0.66. These settings provide a resistant fit to outliers at the end of the time-series. Blue shaded area is an approximate 95% confidence interval for the fit.

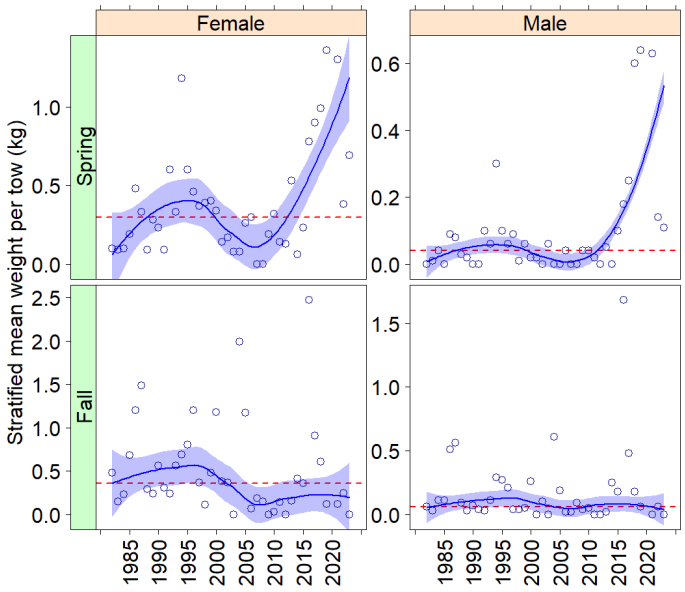

Figure 3. Bootstrapped horseshoe crab mean weight (kg) per tow from the two shallowest depth strata (0–30' and 30–60' combined) of the DMF bottom trawl survey in SNE, by survey season and crab sex. The survey was not conducted in 2020 due to the Covid-19 pandemic. Red, dashed line is the time series median, blue line is a loess fit using family=symmetric, and span=0.66. These settings provide a resistant fit to outliers at the end of the time-series. Blue shaded area is an approximate 95% confidence interval for the fit.

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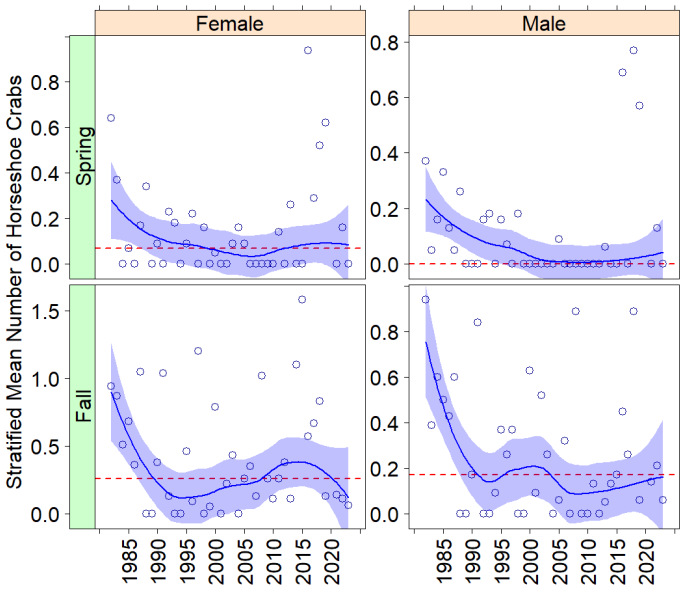

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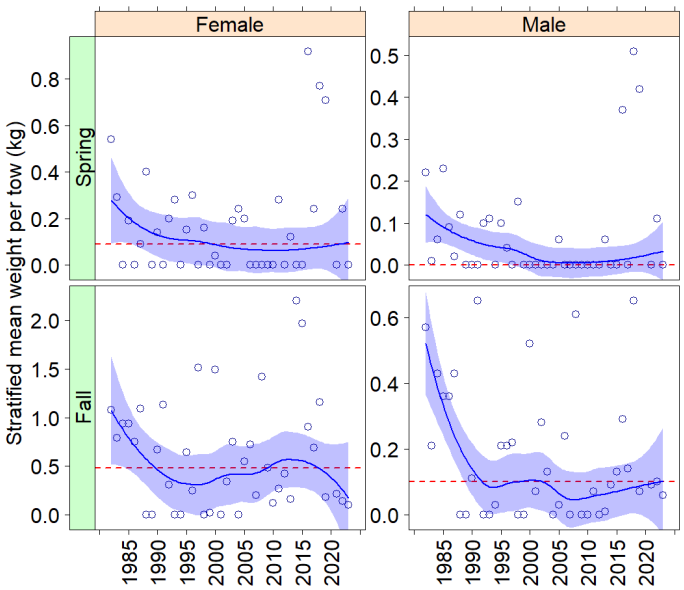

Figure 5. Bootstrapped horseshoe crab mean weight (kg) per tow from the two shallowest depth strata (0–30 and 30–60' combined) of the DMF bottom trawl survey in GOM, by survey season and crab sex. The survey was not conducted in 2020 due to the Covid-19 pandemic. Red, dashed line is the time series median, blue line is a loess fit using family=symmetric and span=0.66. These settings provide a resistant fit to outliers at the end of the time-series. Blue shaded area is an approximate 95% confidence interval for the fit.

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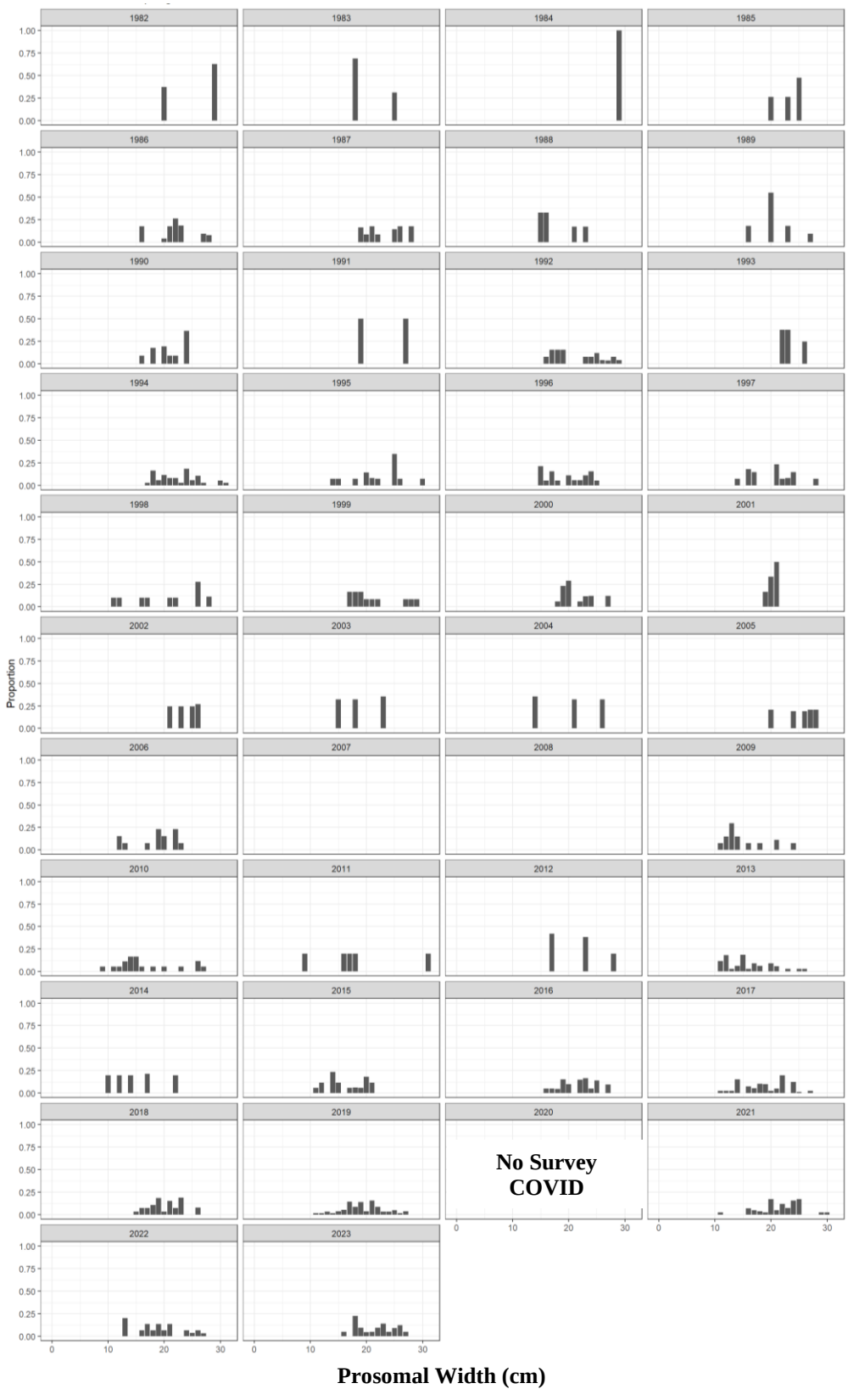

Figure 6. Proportion of SNE female horseshoe crab by size (prosomal width) from the two shallowest strata (0–30' and 30–60' combined) of the DMF spring bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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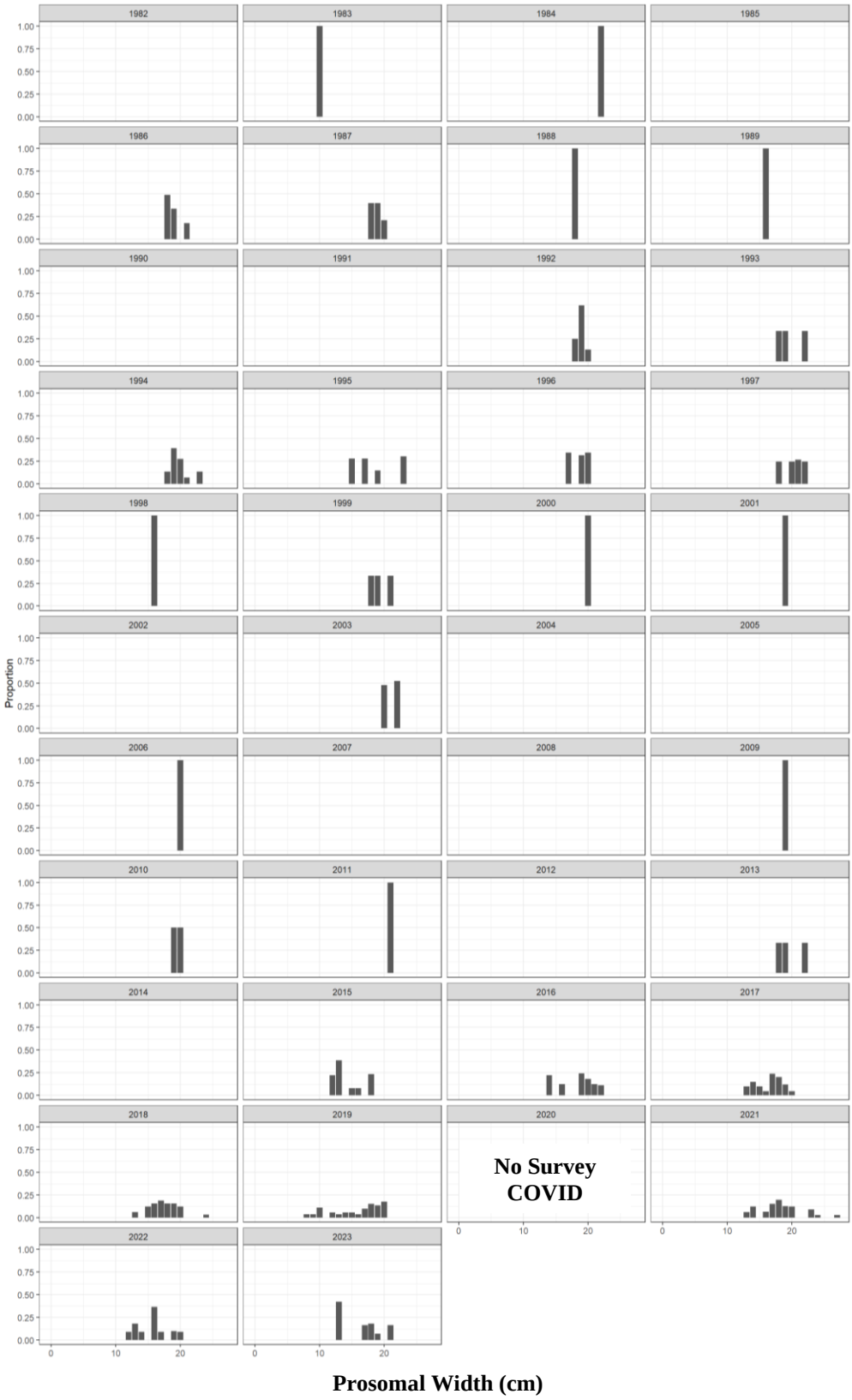

Figure 7. SNE male horseshoe crab size distribution from the two shallowest strata (0–30' and 30–60' combined) of the DMF spring bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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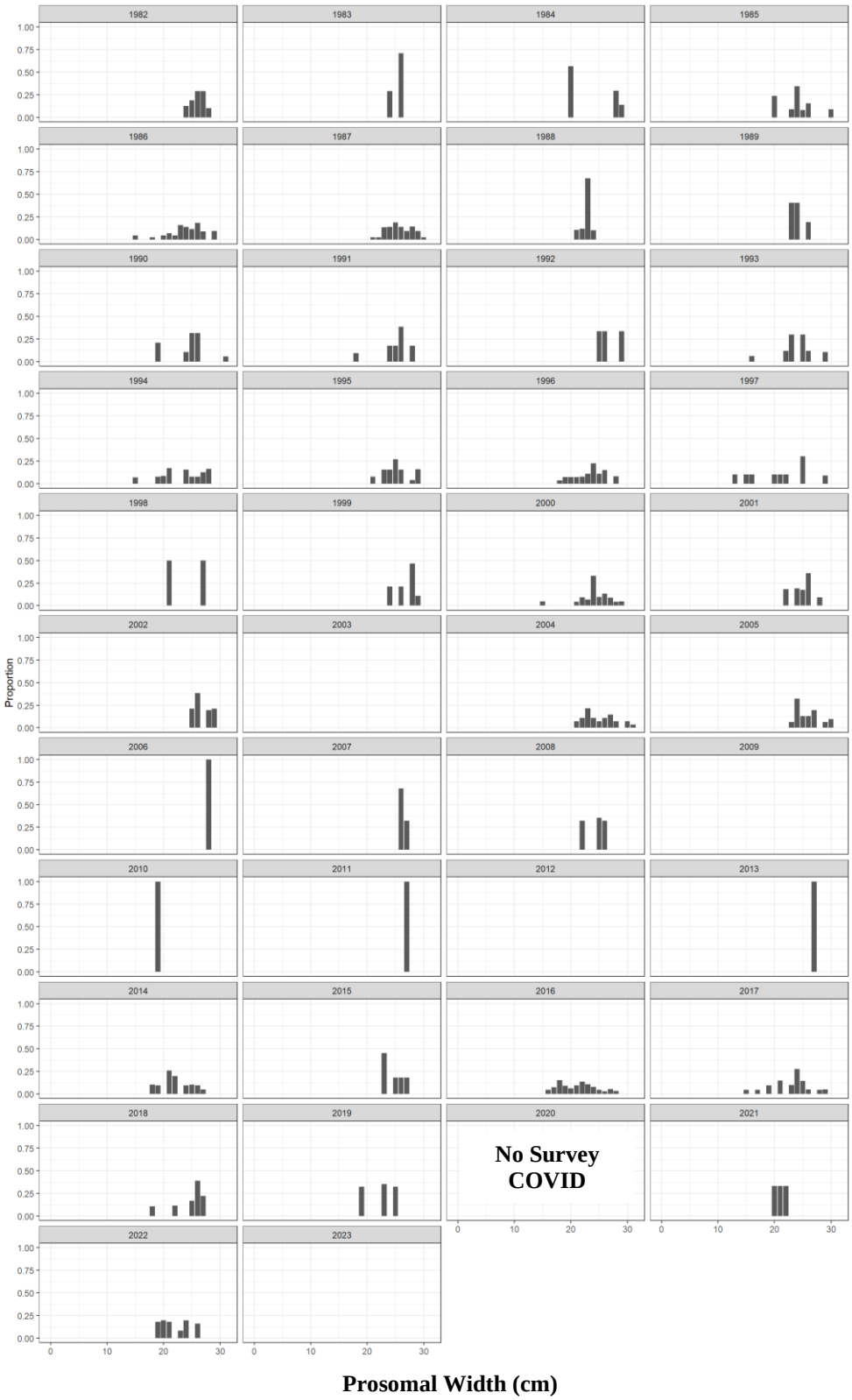

Figure 8. SNE female horseshoe crab size distribution from the two shallowest strata (0–30' and 30–60' combined) of the DMF fall bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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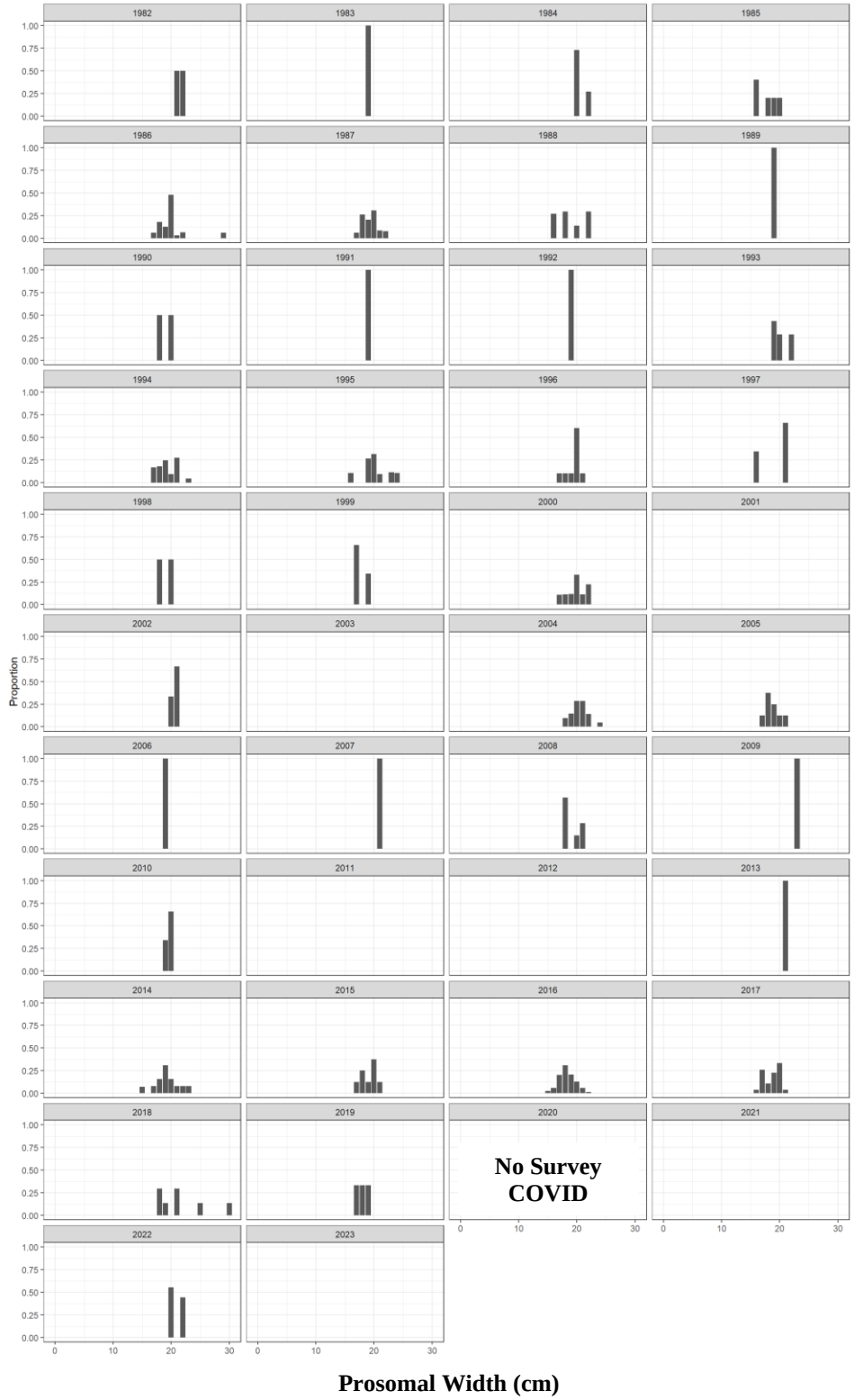

Figure 9. SNE male horseshoe crab size distribution from the two shallowest strata (0–30' and 30–60' combined) of the DMF fall bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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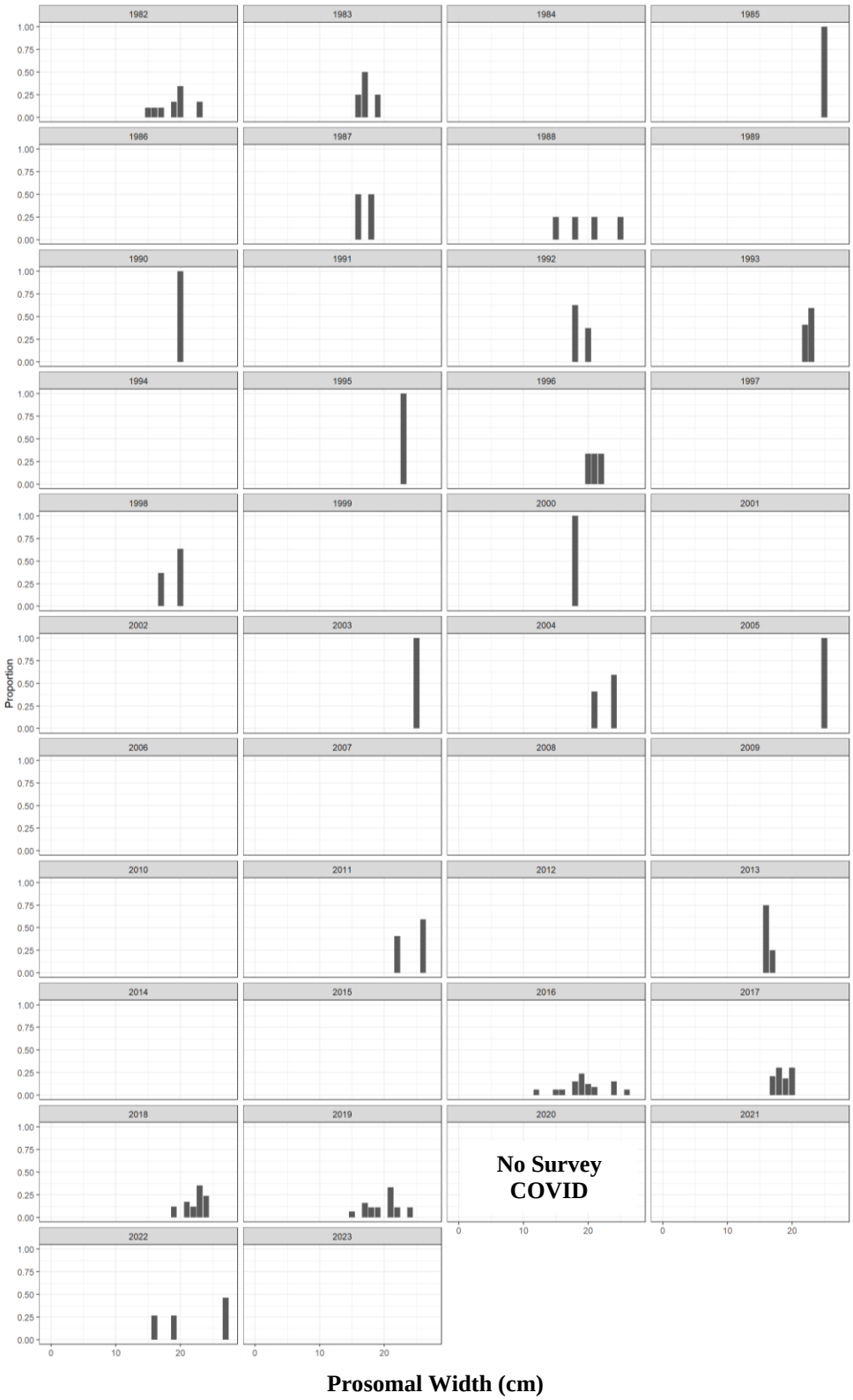

Figure 10. GOM female horseshoe crab size distribution from the two shallowest strata (0–30' and 30–60' combined) of the DMF spring bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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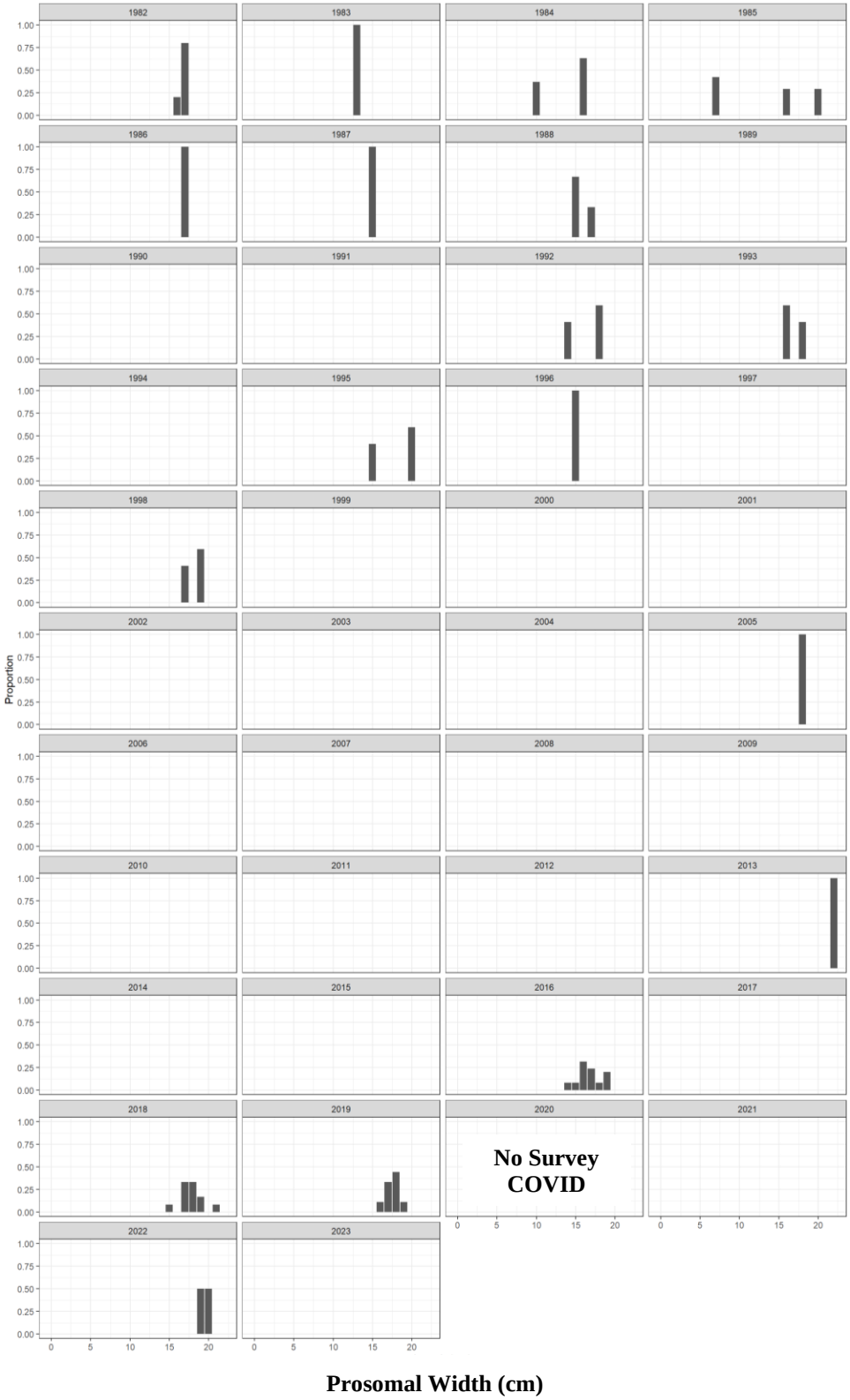

Figure 11. GOM male horseshoe crab size distribution from the two shallowest strata (0–30' and 30–60' combined) of the DMF spring bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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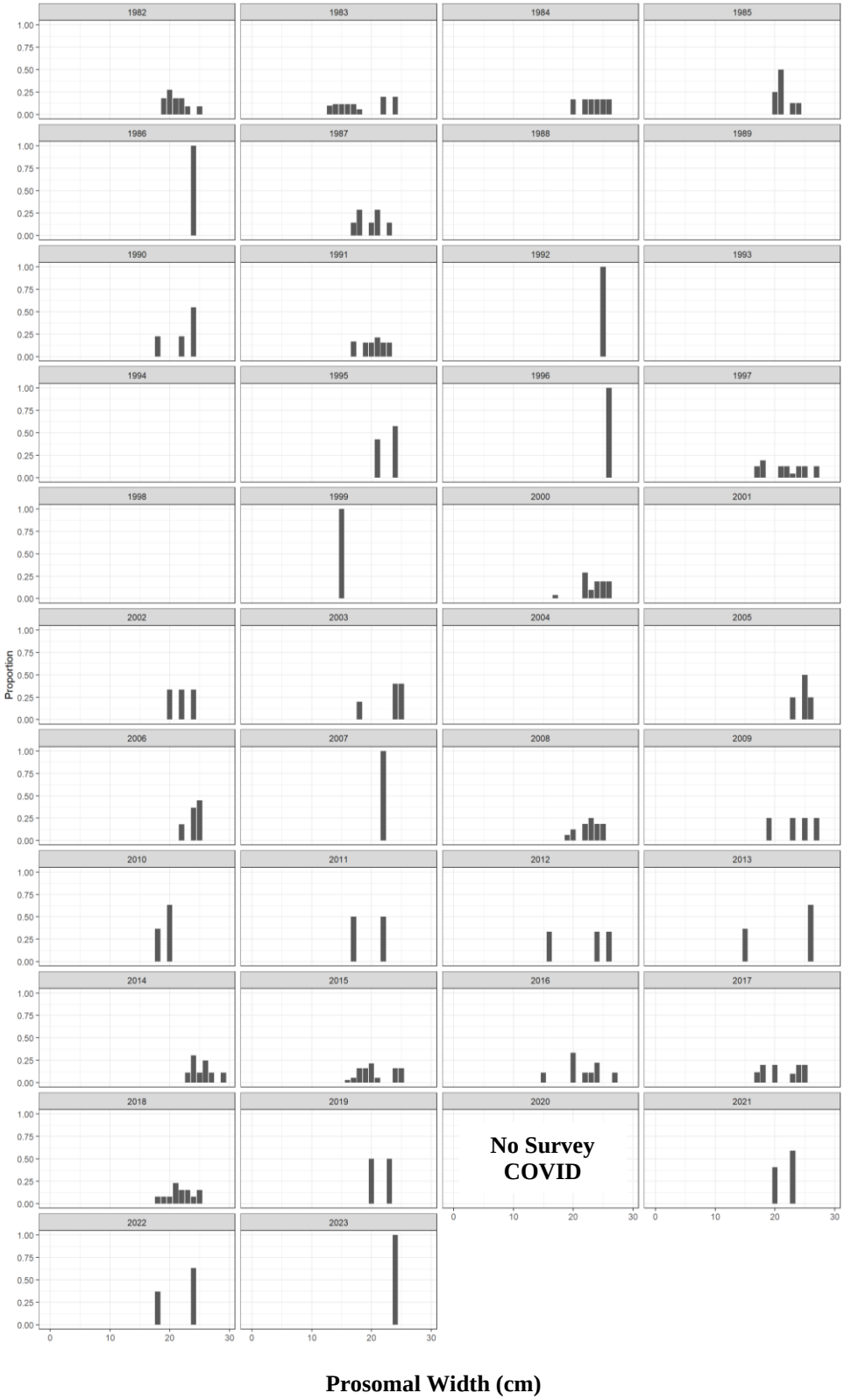

Figure 12. GOM female horseshoe crab size distribution from the two shallowest strata (0–30' and 30–60' combined) of the DMF fall bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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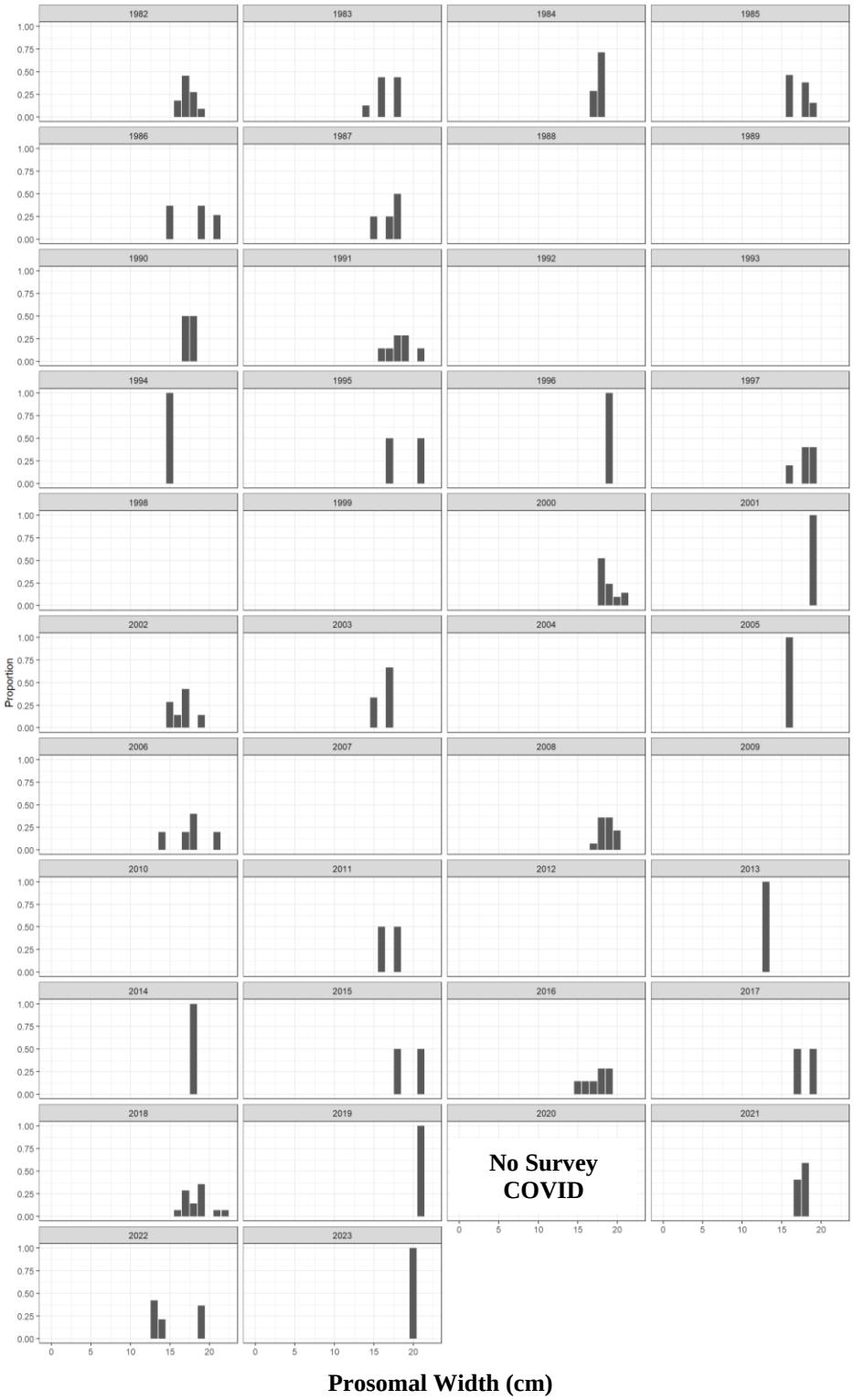

Figure 13. GOM male horseshoe crab size distribution from the two shallowest strata (0–30' and 30–60' combined) of the DMF fall bottom trawl survey. The survey was not conducted in 2020 due to the Covid-19 pandemic.

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The Massachusetts Horseshoe Crab Spawning Survey is a volunteer-based survey that started in 2008. The number and locations of surveyed beaches has been somewhat variable over time, as has the percentage of scheduled surveys completed at many locations. Most survey beaches are located on Cape Cod and the Islands (Nantucket and Marthas Vineyard). Some beaches are located within areas closed to fishing, some are in areas only open to biomedical fishing, and others are open to all fishing. Surveys are scheduled to occur two days prior, the day of, and two days after the new and full moons of May and June. Surveys are conducted at high tide, with most beaches surveying both daytime and nighttime high tides.

In 2023, 14 beaches were surveyed (Figure 14), with data contributed by the North and South Rivers Association, Southeastern Massachusetts Pine Barrens Alliance, Mass Audubon, Erik Hunter, Maria Mitchell Association, Nantucket Conservation Foundation, and the Massachusetts Division of Marine Fisheries. More than half (59%) the 2023 survey data points were below their time series medians (Table 9). However, 71% of beaches have an increasing trend over the last five years, and 77% have an increasing trend over the last ten years.

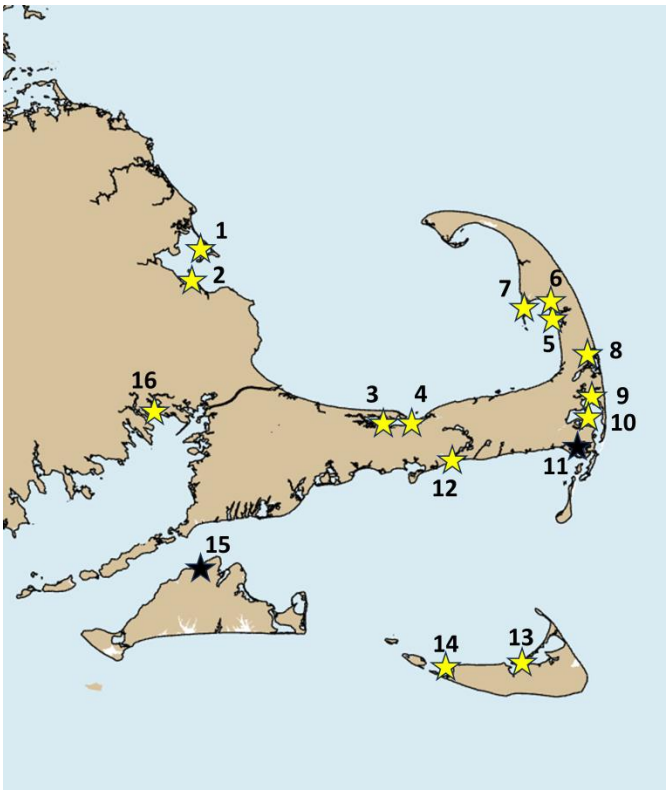

Figure 14. Spawning survey beaches from the Massachusetts Horseshoe Crab Spawning Beach Survey. Yellow stars are shown for beaches that conducted 2023 surveys. Sites with black stars did not conduct any surveys in 2023.

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Region	Beach	Time of Day	2023 vs Median	10-year trend	5-year trend
Cape Cod Bay	Duxbury	Day	below	decreasing	increasing
	Duxbury	Night	above	decreasing	increasing
	Long Beach	Day	below	NA	decreasing
	Long Beach	Night	below	NA	increasing
	Millway	Day	below	increasing	increasing
	Millway	Night	above	increasing	increasing
	Long Pasture	Day	above	increasing	increasing
	Sanctuary Beach	Day	below	increasing	increasing
	Indian Neck	Day	below	decreasing	decreasing
	Indian Neck	Night	below	increasing	decreasing
	Great Island	Day	below	increasing	increasing
Outer Cape Cod	Priscillas Landing	Day	above	increasing	decreasing
	Marsh 2-3	Day	above	increasing	increasing
	Erica's Beach	Day	below	increasing	decreasing
Nantucket Sound	Stage Harbor	Day	NA	NA	NA
	Stage Harbor	Night	NA	NA	NA
	Bass River	Day	below	NA	increasing
	Bass River	Night	above	NA	increasing
	Monomoy	Day	equal	increasing	NA
	Monomoy	Night	below	increasing	NA
	Warrens Landing	Day	above	increasing	increasing
	Warrens Landing	Night	above	increasing	increasing
	Tashmoo	Day	NA	increasing	NA
	Tashmoo	Night	NA	increasing	NA
Buzzards Bay	Swifts Beach	Day	below	decreasing	decreasing
	Swifts Beach	Night	below	decreasing	increasing

Table 9. 2023 summary table from the Massachusetts Horseshoe Crab Spawning Survey by region, beach, and time of day. The "2023 vs Median" column shows whether the 2023 data point was above or below the time series median for a survey location. Cells are shaded red when the 2023 data point was below the time series median, green when it was above, and uncolored when there is insufficient data, or the 2023 data point was equal to the median. The 10 and 5-year trends are based on linear trend lines being fit to the data. If the slope is positive, there is an increasing trend (green). If the slope is negative, there is a decreasing trend (red). Unshaded cells have insufficient/missing data.

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The Massachusetts Seine Survey started in 1976, but did not consistnetly enumerate horseshoe crabs until 1984. The survey is conducted by the Massachusetts Division of Marine Fisheries Resource Assessment Project in several south facing embayments along the south side of Cape Cod (Figure 15). The net is a 6.4 by 2.4 meter (21' by 8') seine net with 4.8 mm mesh (3/16"). Three replicate seine hauls are conducted at each site parallel to the shoreline in waist-deep water during daylight hours within two hours of high tide. A restricter line is spread along the head rope is used to maintain a consistent net opening. The distance the net is towed is measured for each set.

The 2023 data point was the second highest of the seine survey time series (Figure 16). The survey has an increasing trend since around 2008. Each annual data point has been above the time series median since 2014.

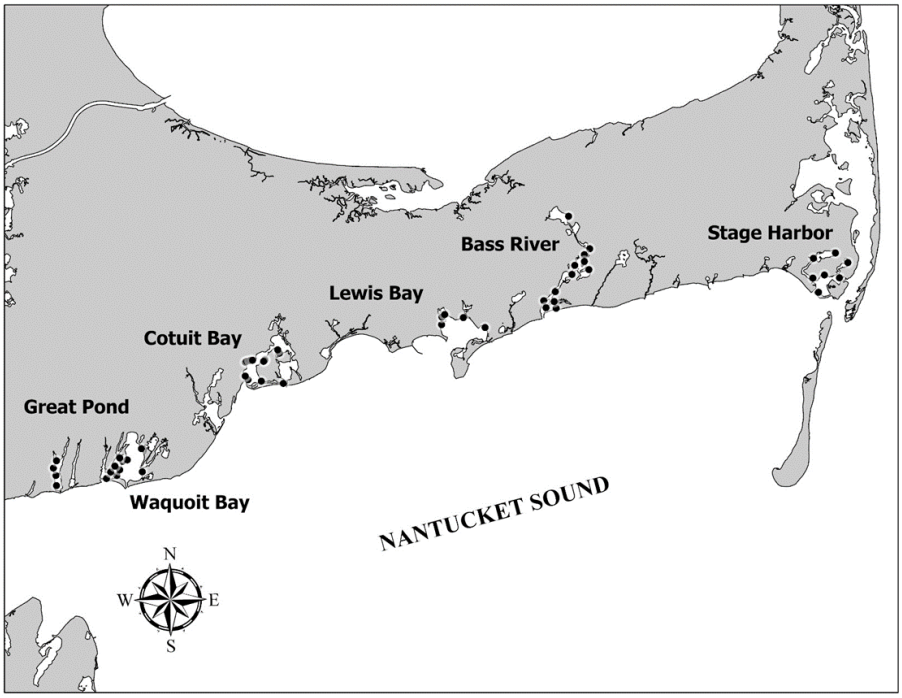

Figure 15. Map of Massachusetts Seine Survey sites.

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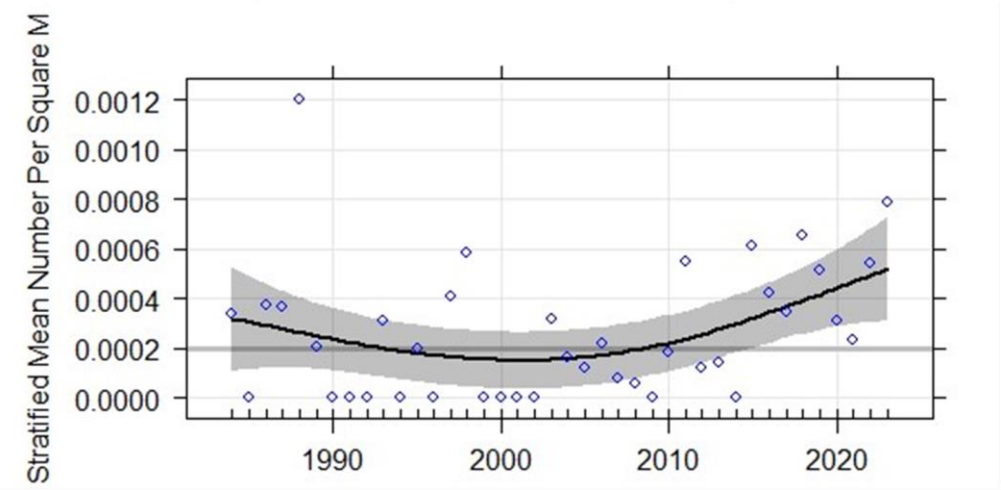

Figure 16. Stratified mean number of horseshoe crabs per square meter from the Massachusetts Seine Survey from 1984-2023. The solid gray line is the time series median. Black line is a GAM fit. Circles are annual means.

IV. Planned management programs for the current calendar year (2024)

a. Summary of changes from previous years

- An April 15th through June 7th harvest closure was approved for 2024. The closure applies to all harvest (bait and biomedical).
- The commercial hand harvest bait trip limit was reduced from 400 to 300 crabs per day starting with the 2024 season.
- Massachusetts enacted prohibitions on horseshoe crab harvest within the Monomoy National Wildlife Refuge and the Cape Cod National Seashore to complement existing federal prohibitions. Enacting this regulation allows Massachusetts Environmental Police to more easily enforce the closure.
- Full list of regulations can be found at https://www.mass.gov/doc/322-cmr-6-regulation-of-catches/download in section 6.34

b. Summary of monitoring programs that will occur

- DMF will continue collecting catch reports from all crab harvesters, dealers, and scientific permit holders.
- DMF will continue to collect monthly reports from the biomedical industry.
- DMF will also continue to characterize the commercial bait and biomedical fisheries through market sampling and sea sampling. Sampling of the biomedical industry will include direct observations by DMF staff of biomedical holding conditions (pens and other holding systems) and release trips.
- DMF spring and fall trawl surveys will continue to monitor and record weight, number,

and prosomal width by sex of individuals collected.

- DMF will continue to coordinate and support spawning beach surveys conducted in collaboration with various volunteer organizations.
- The DMF seine survey will continue counting horseshoe crabs.

V. Law Enforcement reporting requirements

The Massachusetts Environmental Police and Massachusetts-based Federal Wildlife Officers for U.S. Fish and Wildlife reported that they did not have any horseshoe crab related violations in 2023.