

The Spatial Distribution of Bluefish (*Pomatomus saltatrix*): Insights from American Littoral Society Fish Tagging Data

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Abstract

The American Littoral Society Fish Tagging Program has tagged over 30,000 bluefish (*Pomatomus saltatrix*) since 1964. In recent years, stakeholders have reported larger bluefish are staying offshore and are less abundant inshore. The objective of this study was to analyze the American Littoral Society Fish Tagging Program's bluefish data to assess whether larger fish (> 18 inches) are being tagged and released or recaptured more frequently offshore in recent years. Over the duration of the program, 18,265 large bluefish were tagged and released, and 236 were recaptured (1.3% recapture rate). Large bluefish tagged and released ranged in length from 18.5 to 39 inches. Very few large bluefish were tagged and released or recaptured in the last five years. Analyses did not show that larger fish are being tagged and released or recaptured more frequently offshore in recent years. The disparity between the stakeholder reports and the results of this analysis could be due to limitations inherent to volunteer fish tagging program data.

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Introduction

The American Littoral Society (ALS) Fish Tagging Program began in 1964 (first full year of the program was 1965) and currently has over 1,000 active taggers. At the start of the program the focus was on tagging coastal Atlantic sharks, but in the early 1970's the focus shifted to tagging striped bass (*Morone saxatilis*), summer flounder (*Paralichthys dentatus*), bluefish (*Pomatomus saltatrix*), tautog (*Tautoga onitis*), black seabass (*Centropristis striata*), and other coastal fishes. The ALS asks anglers to record information about fish that are tagged and released (tag number, date caught, species, location released, length, weight) and also about tagged fish that are recaptured (tag number, date caught, species, location caught, length, weight, disposition of fish). Bluefish are the third most often tagged fish in the ALS Fish Tagging Program. The longest time between when a bluefish was tagged and subsequently recaptured was four years to the day for a fish tagged in Massachusetts and recaptured in New York (American Littoral Society 2022).

In recent years, stakeholders have reported larger bluefish are staying offshore and are less abundant in inshore waters, making them less accessible to the recreational fishery which does not operate far offshore (Mid-Atlantic Fishery Management Council 2019-2021). The objective of this study was to analyze the ALS Fish Tagging Program's bluefish data to provide further insights, if possible, into this stakeholder observation, and to assess whether larger fish are being tagged and released or recaptured more frequently offshore in recent years.

Methods

Given the voluntary nature of the Fish Tagging Program, there was no sampling schedule or protocol for systematically tagging and releasing fish or for recapturing fish. Both tag/release and recapture data from the full time series (1964 – 2020) were used in the analysis. Since large fish were reported to be staying offshore, only fish greater than 18 inches (which were considered large fish by Shepherd et al. 2006) were included in the analysis.

The variables analyzed in the tag/release and recapture data sets included the capture year and the capture location (inland, inshore, offshore). For the purposes of the ALS Fish Tagging Program, "inland" refers to fish captured greater than three miles inland from the coastline, "offshore", refers to fish captured greater than three miles offshore from the coastline, and "inshore" refers to the six miles in between the inland and offshore limits. In this analysis, the inland and inshore categories were combined into an "inland/inshore" category. For the tag/release data set, the master zone, which is the broad geographical location where the fish was caught, was also analyzed (Figure 1). There are no latitude and longitude data reported with fish tag/release and recapture events. Data were analyzed using RStudio (version 2021.9.0.351) (RStudio Team 2021).

Results

Tag and Release Data

Over the duration of the ALS Fish Tagging Program, 18,265 large bluefish were tagged and released (17,014 inland/inshore and 1,251 offshore). The first release of a large bluefish was on August 28th, 1965 in master zone D (Massachusetts South of Cape Cod) (Figure 1).

The number of large fish tagged and released has steadily declined over time from a high of 1,491 fish in 2004 (Figure 2). The majority of large fish were tagged inland/inshore, and the tagging effort (# of days tagging occurred) was generally proportional to the number of fish tagged and released (Figure 2). Standardizing the number of fish tagged and released in each location within a year by the number of days tagging occurred in each location within a year showed there have been very few large fish tagged offshore in recent years (Figure 3). The maximum yearly percentage of fish tagged and released offshore was 28% in 1992, but overall, the majority of fish were tagged and released inland/offshore (Figure 4). There was no increasing trend in the percentage of large fish tagged and released offshore in recent years (Figure 4).

Master zone E (Rhode Island) had the greatest number of large bluefish tagged and released (7,209 fish), whereas master zone J (New Jersey) had the greatest number of large fish tagged offshore (858 fish) (Figure 5). When looking at the tagging effort across the different master zones, it was generally proportional to the number of fish tagged and released in each master zone (Figure 5). The number of fish tagged and released per day offshore was higher than the number of fish tagged and released per day inland/inshore in seven (F, J, L, M, N, P, R) of the nineteen master zones (Figure 6). However, the offshore fish in Zone L are likely a data recording or entry error, as this master zone corresponds to the Chesapeake Bay and there is no offshore location in that master zone. The maximum percentage of fish tagged and released offshore (83%) occurred in master zone N (Virginia), but overall, the majority of fish were tagged and released inland/inshore (Figure 7). Plots of the number of fish tagged per day within each individual master zone across the time series also reflect that very few large fish were tagged offshore in recent years (Figures 8 - 25).

Large bluefish tagged and released over time ranged in length from 18.5 to 39 inches (Figure 26). Fish across this length range were tagged and released at both inland/inshore and offshore locations (Figure 26). In the past five years, the few fish tagged and released offshore were at the smaller end of the “large” length range (Figure 27). In master zone J (New Jersey), where the greatest number of large fish were tagged offshore, fish across the length distribution were still tagged and released at both inland/inshore and offshore locations (Figure 28).

Recaptures Data

Of the 18,265 large bluefish that were tagged and released, 236 were recaptured (1.3% recapture rate). The first recapture of a large bluefish was on September 20th, 1990 for a fish that was tagged on September 16th, 1987. The number of large fish recaptured has declined over time from a high of 19 fish in 2004 (Figure 29). The majority of large fish were recaptured inland/inshore (Figure 29). There was no increasing trend in the percentage of large fish recaptured offshore in recent years (Figure 30). The large bluefish recaptured over time ranged in

length from 19 to 37 inches (Figure 31). Fish across the length distribution were recaptured both inland/inshore and offshore (Figure 31).

Discussion

The ALS Fish Tagging Program's data on large bluefish did not show that larger fish are being tagged and released or recaptured more frequently offshore in recent years. Larger adult bluefish tend to reside offshore (Salerno et al. 2001) and make migrations farther offshore than smaller fish, which migrate in nearshore waters (Lund, Jr. and Maltezos 1970). In the 1990's and 2000's when recreational landings declined, there was also no evidence of bluefish displacement offshore in the bottom trawl surveys conducted by the National Marine Fisheries Service (Salerno et al. 2001; Buckel et al. 2009). The absence of the offshore movement trend, which has recently been observed in situ by stakeholders, in the ALS data set could be due to many confounding factors and limitations inherent to volunteer fish tagging programs.

First, there were not many tag and release and recapture events in recent years, making assessing recent trends difficult. Second, there was some indication from the effort standardized graphs that more large fish were caught per day in the offshore location than the inland/inshore location in certain master zones. However, since there was no way to quantify trips where the intent was to tag and release or recapture fish but none were caught, the standardized calculations are biased and potentially unreliable. Third, the inshore/inland and offshore location designations are large in spatial scale, and there is no information of how far inland/inshore or offshore fish were encountered due to the lack of latitude and longitude data. The large-scale location designations and lack of spatial coordinates associated with fish encounters prohibit analyses of smaller scale distribution shifts within a location. Lastly, the number of fish tagged and released or recaptured in a location is dependent on more than just whether fish are in a location. The number of fish tagged and released or recaptured in a location also heavily depends on how many anglers are actively tagging and releasing fish, their decision process for whether or not to tag a fish, their preferences for where they like to fish, whether they own a boat, what type of boat they own, the price of gas, boat maintenance costs, current events (e.g. the pandemic), among many others for which there are no data on.

Future analyses with this ALS Fish Tagging Program data could group the data across a predetermined set of years to try to reduce sparseness in the data set. Additionally, for fish that were tagged, released, and then recaptured, it could be informative to compare the locations where tagging/releasing occurred to the location where recapture occurred. Further, if the fish was less than 18 inches long at tagging and was greater than 18 inches long when recaptured, it would be interesting to analyze if the recapture location differed from the tag and release location.

References

- American Littoral Society. 2022. Citizen science along the coast: fish tagging. American Littoral Society, Highlands, New Jersey. <https://www.littoralsociety.org/fish-tagging.html>.
- Buckel, J. A., J. P. Pessutti, J. E. Rosendale, and J. S. Link. 2009. Interactions between Bluefish and Striped Bass: behavior of Bluefish under size-and number-impaired conditions and overlap in resource use. *Journal of Experimental Marine Biology and Ecology* 368(2):129-137.
- Lund, Jr., W. A., and G. C. Maltezos. 1970. Movements and migrations of the Bluefish, *Pomatomus saltatrix*, tagged in waters of New York and southern New England. *Transactions of the American Fisheries Society* 99(4):719-725.
- Mid-Atlantic Fishery Management Council. 2019-2021. Bluefish fishery performance report. Mid-Atlantic Fishery Management Council, Dover, Delaware. <https://www.mafmc.org/bluefish>.
- RStudio Team. 2021. RStudio: integrated development environment for R. RStudio, PBC, Boston. <http://www.rstudio.com/>.
- Salerno, D. J., J. Burnett, and R. M. Ibara. 2001. Age, growth, maturity, and spatial distribution of Bluefish, *Pomatomus saltatrix* (Linnaeus), off the northeast coast of the United States, 1985-96. *Journal of Northwest Atlantic Fishery Science* 29:31-39.
- Shepherd, G. R., J. Moser, D. Deuel, and P. Carlsen. 2006. The migration patterns of Bluefish (*Pomatomus saltatrix*) along the Atlantic coast determined from tag recoveries. *Fishery Bulletin* 104(4):559-570.

Figures

Figure 1

Depiction of the American Littoral Society master zones (provided by K. Drew). The locations of the lines delineating zones are approximate. Zones not shown in the figure but mentioned in the report include: R = Gulf Coast of Florida, S = Louisiana and Mississippi, and W = Hudson River.

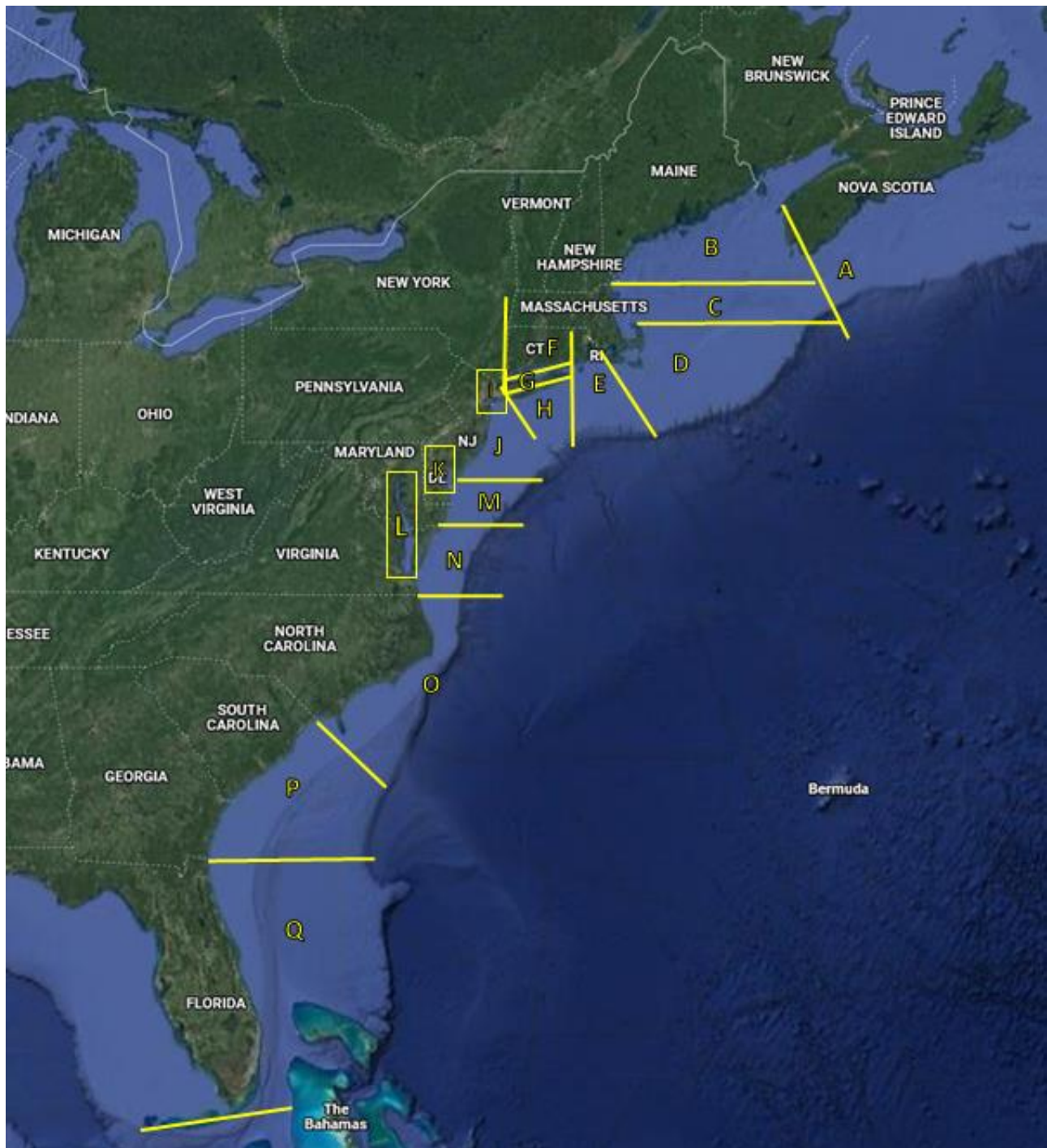


Figure 2

The number of large bluefish tagged and released inland/inshore and offshore throughout the time series with the total tagging effort (number of days tagging occurred) overlaid.

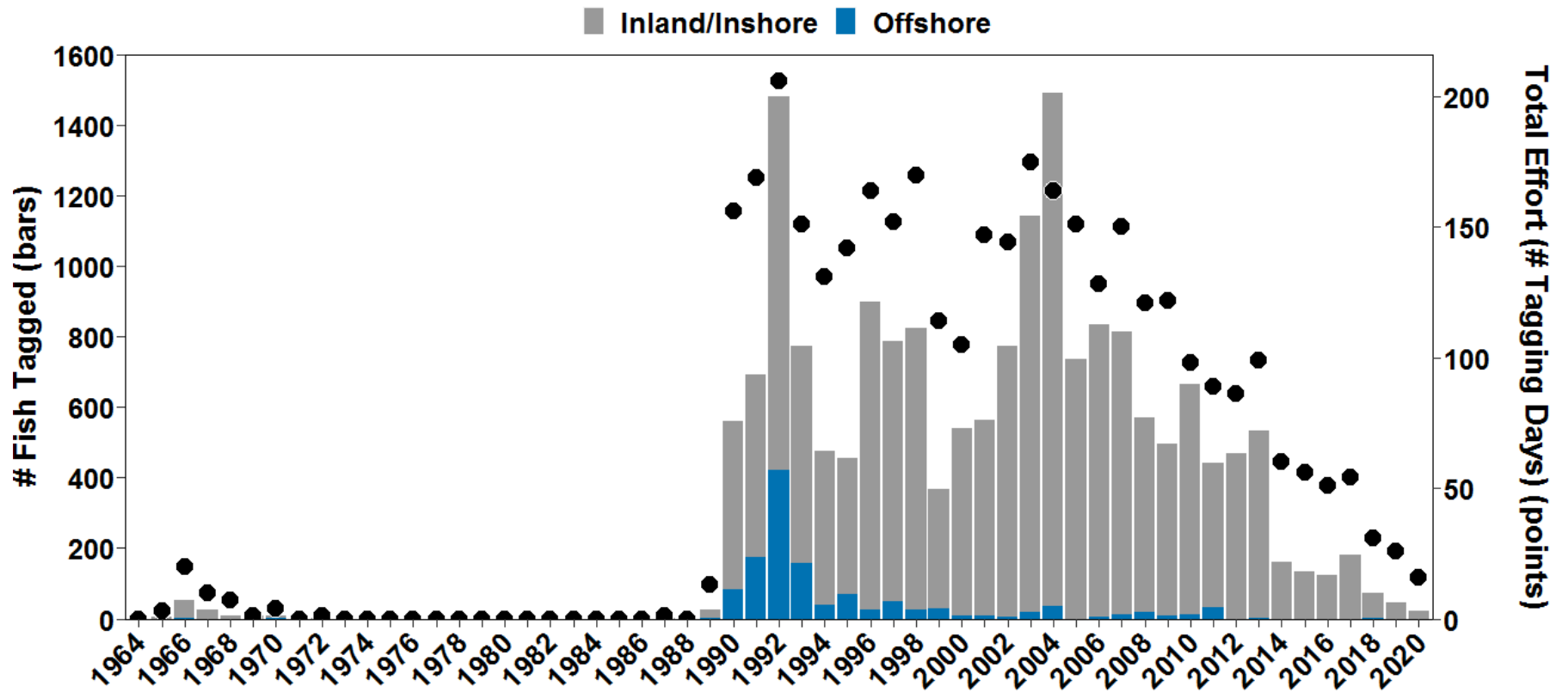


Figure 3

The number of large bluefish tagged and released per day at inland/inshore and offshore locations throughout the time series.

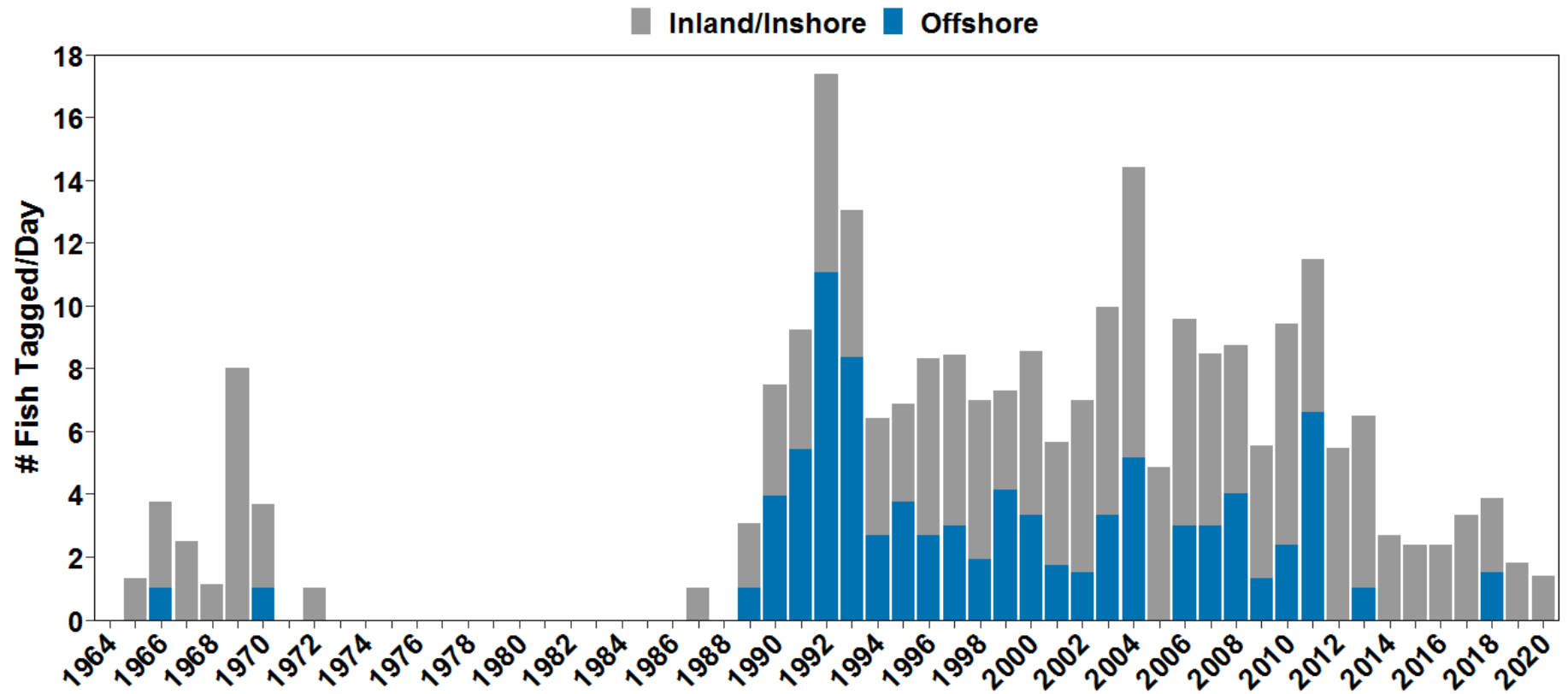


Figure 4

The percentage of large bluefish tagged and released inland/inshore and offshore throughout the time series. The total number of fish tagged and released each year (n) is reported in the year's corresponding bar. Years where no fish were tagged and released were excluded from the plot.

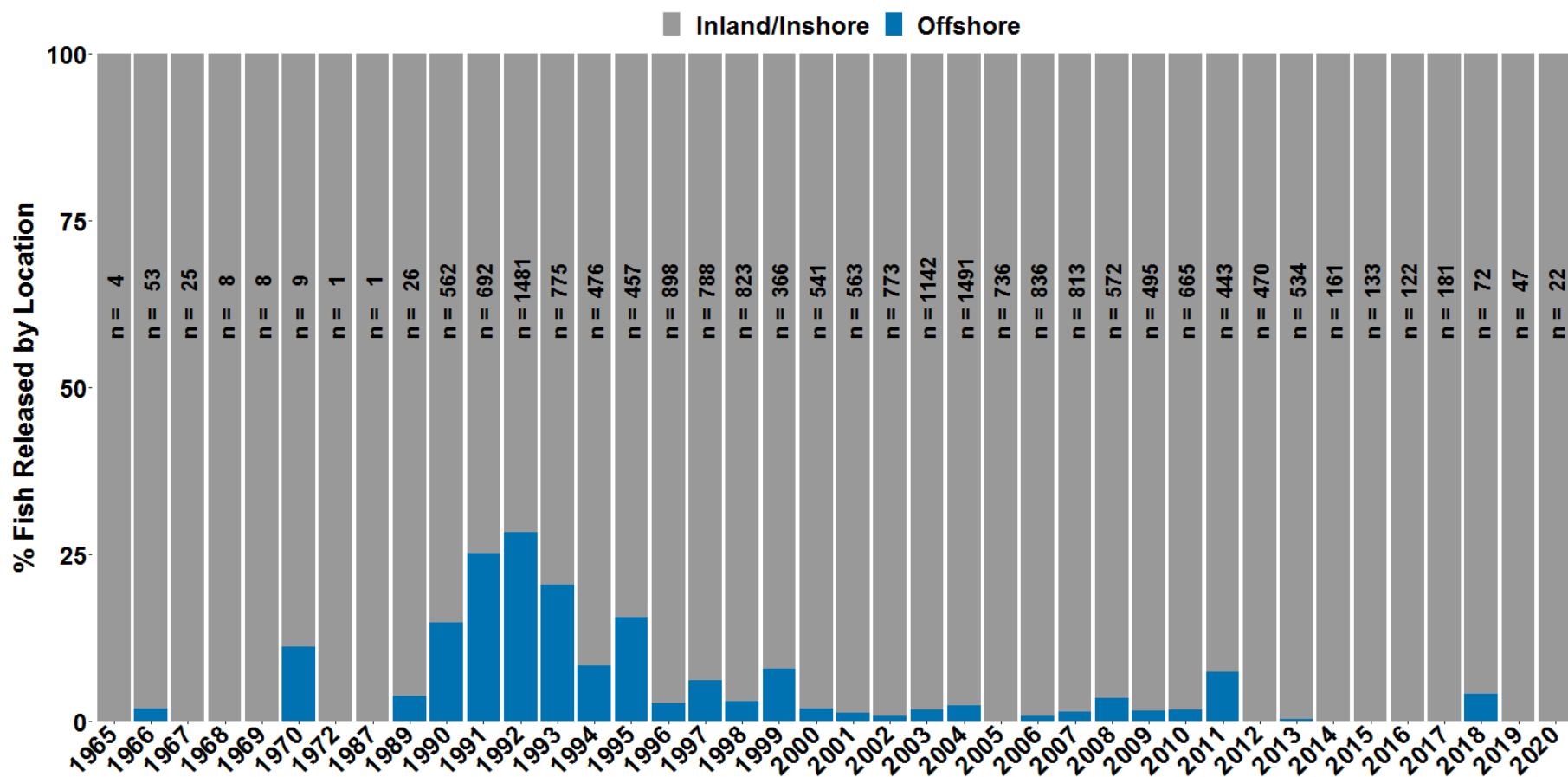


Figure 5

The number of large bluefish tagged and released inland/inshore and offshore across the master zones with the total tagging effort (number of days tagging occurred) overlaid.

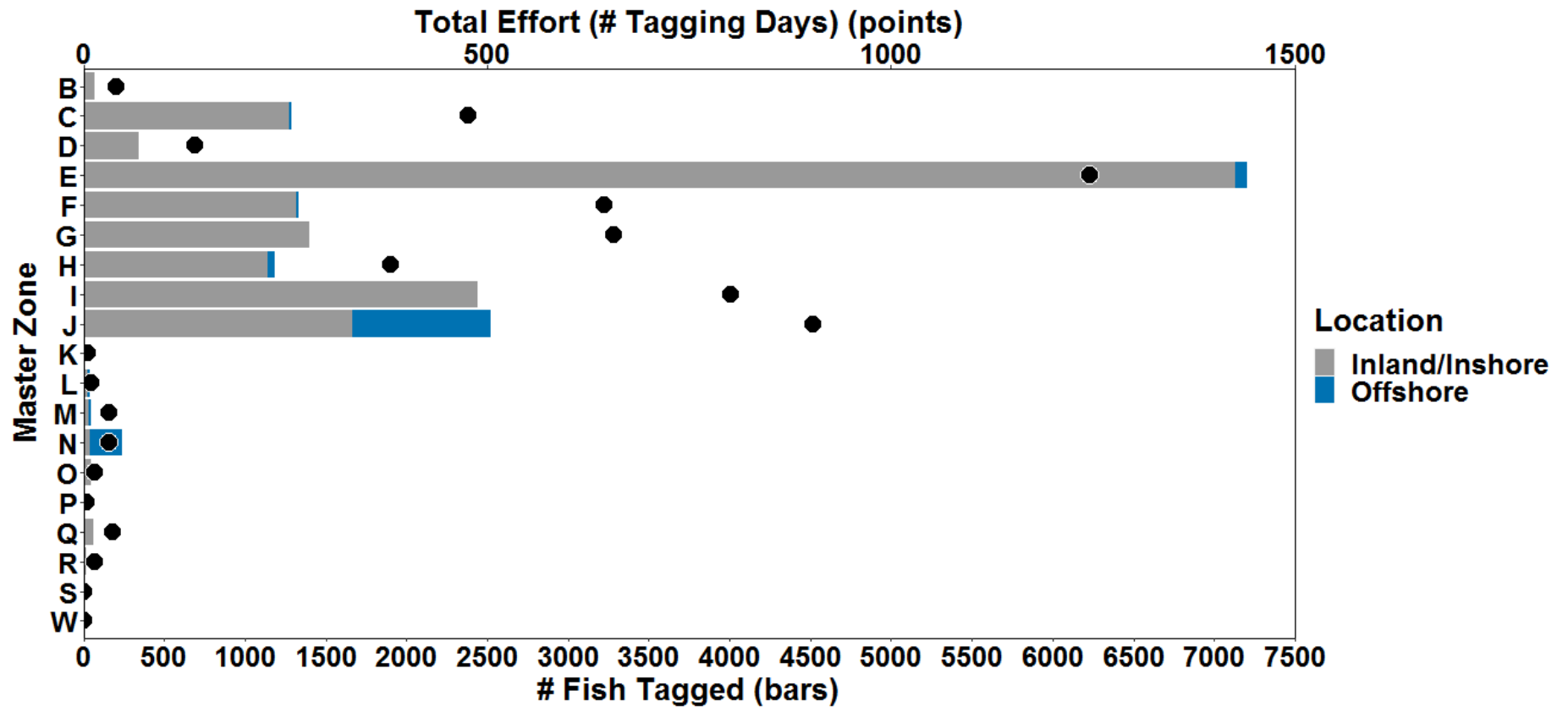


Figure 6

The number of large bluefish tagged and released per day at inland/inshore and offshore locations across the master zones.

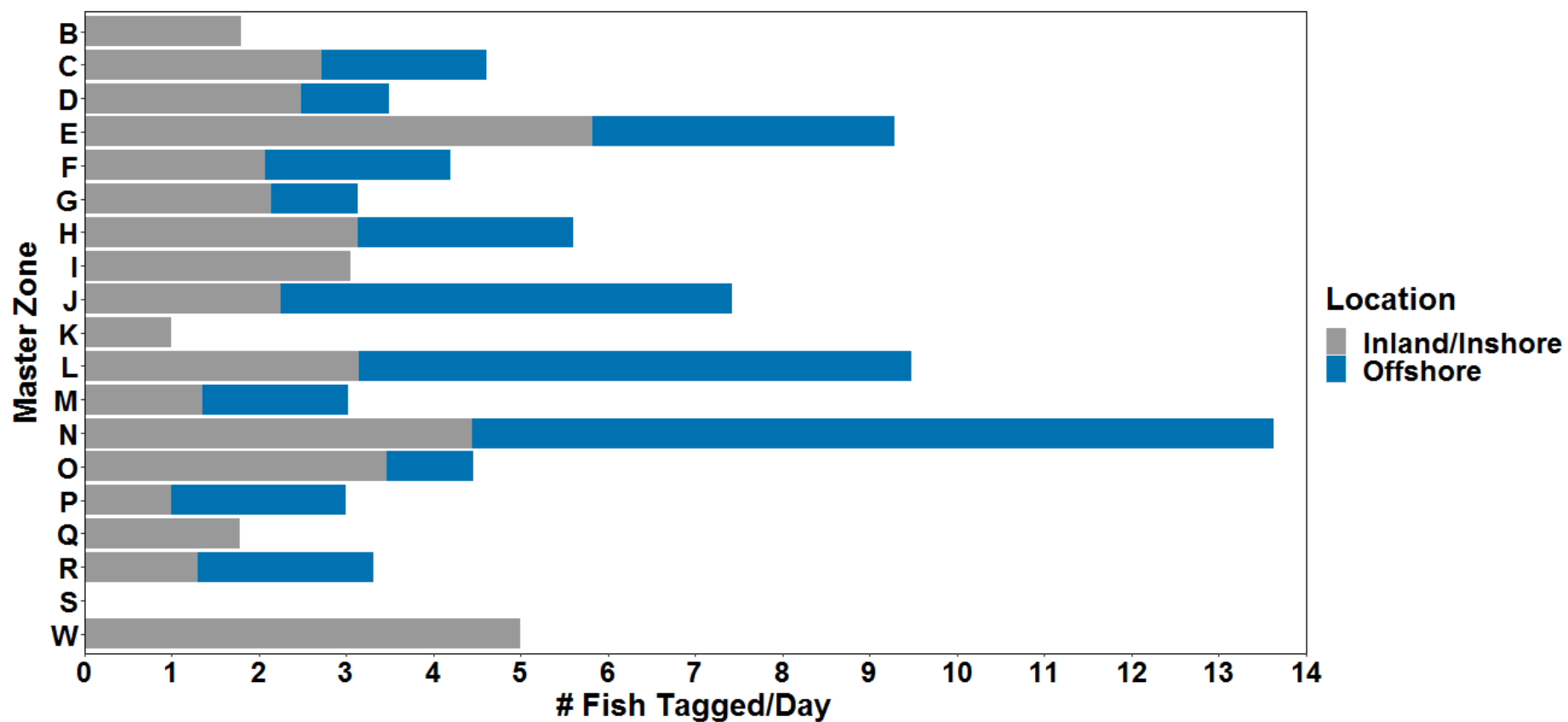


Figure 7

The percentage of large bluefish tagged and released inland/inshore and offshore across the master zones. The total number of fish tagged and released in each master zone (n) is reported in the master zone's corresponding bar. There were no large fish tagged and released in master zone S so it was excluded from the plot.

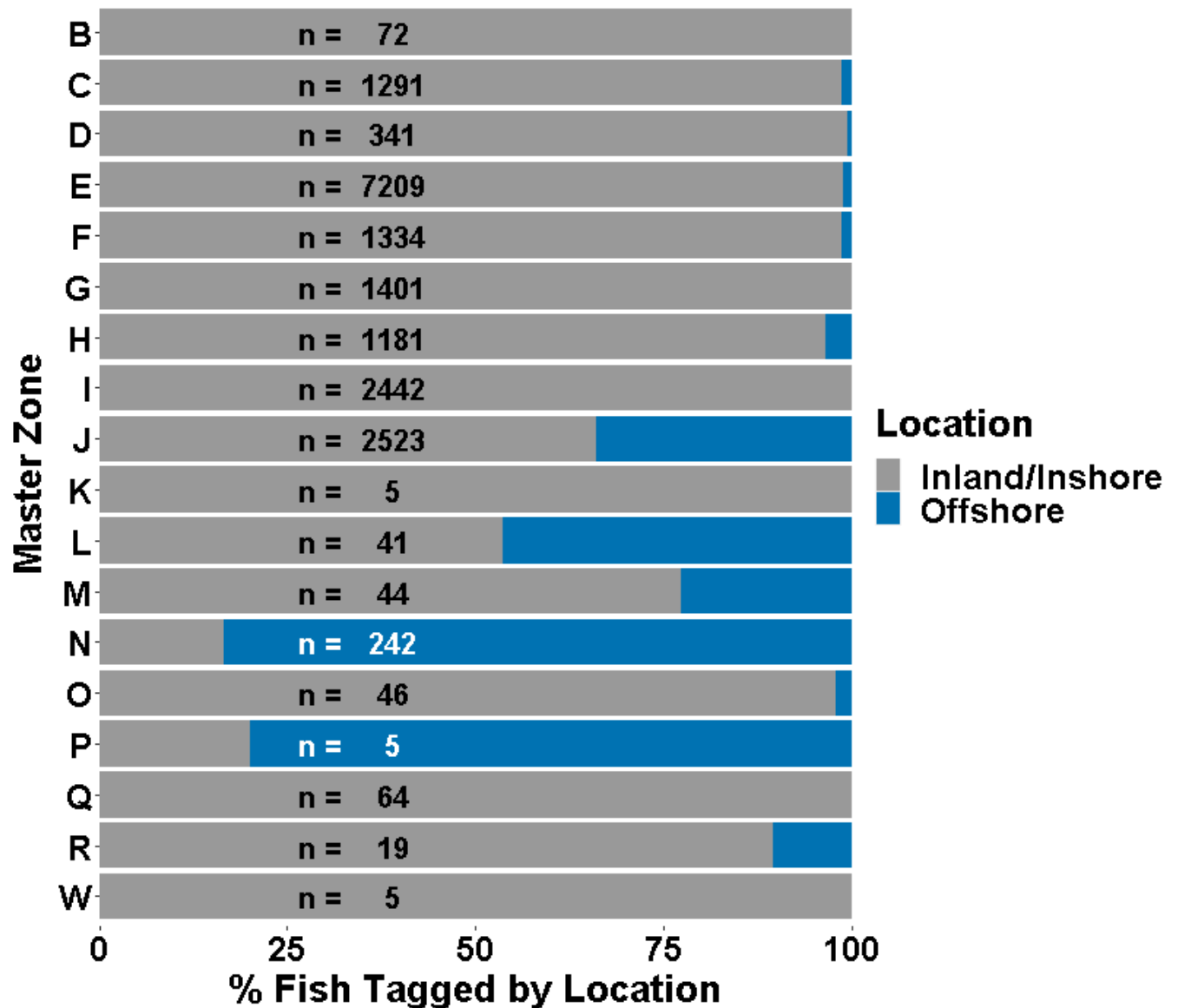


Figure 8

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone B (Maine and New Hampshire).

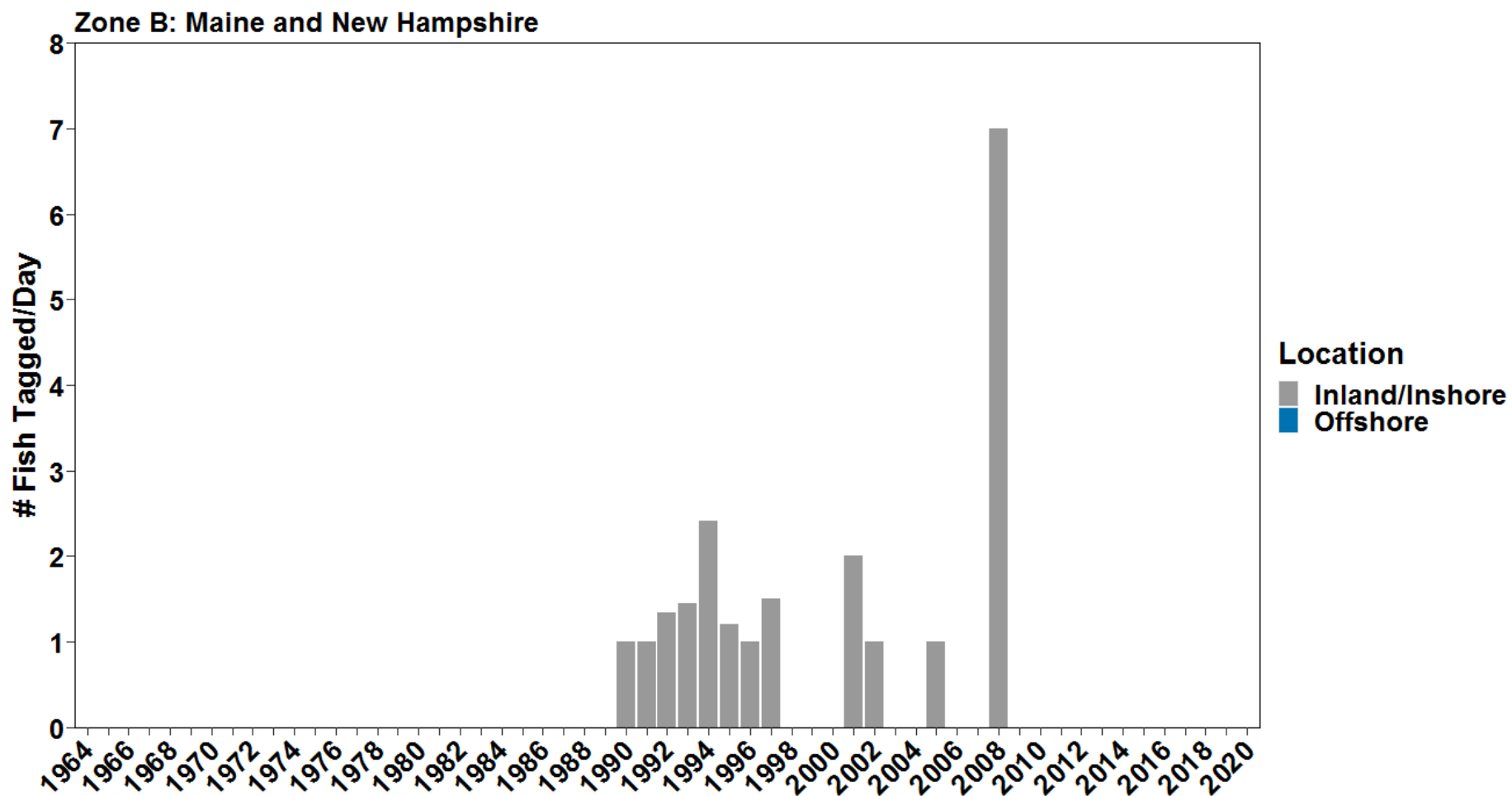


Figure 9

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone C (Massachusetts North of Cape Cod).

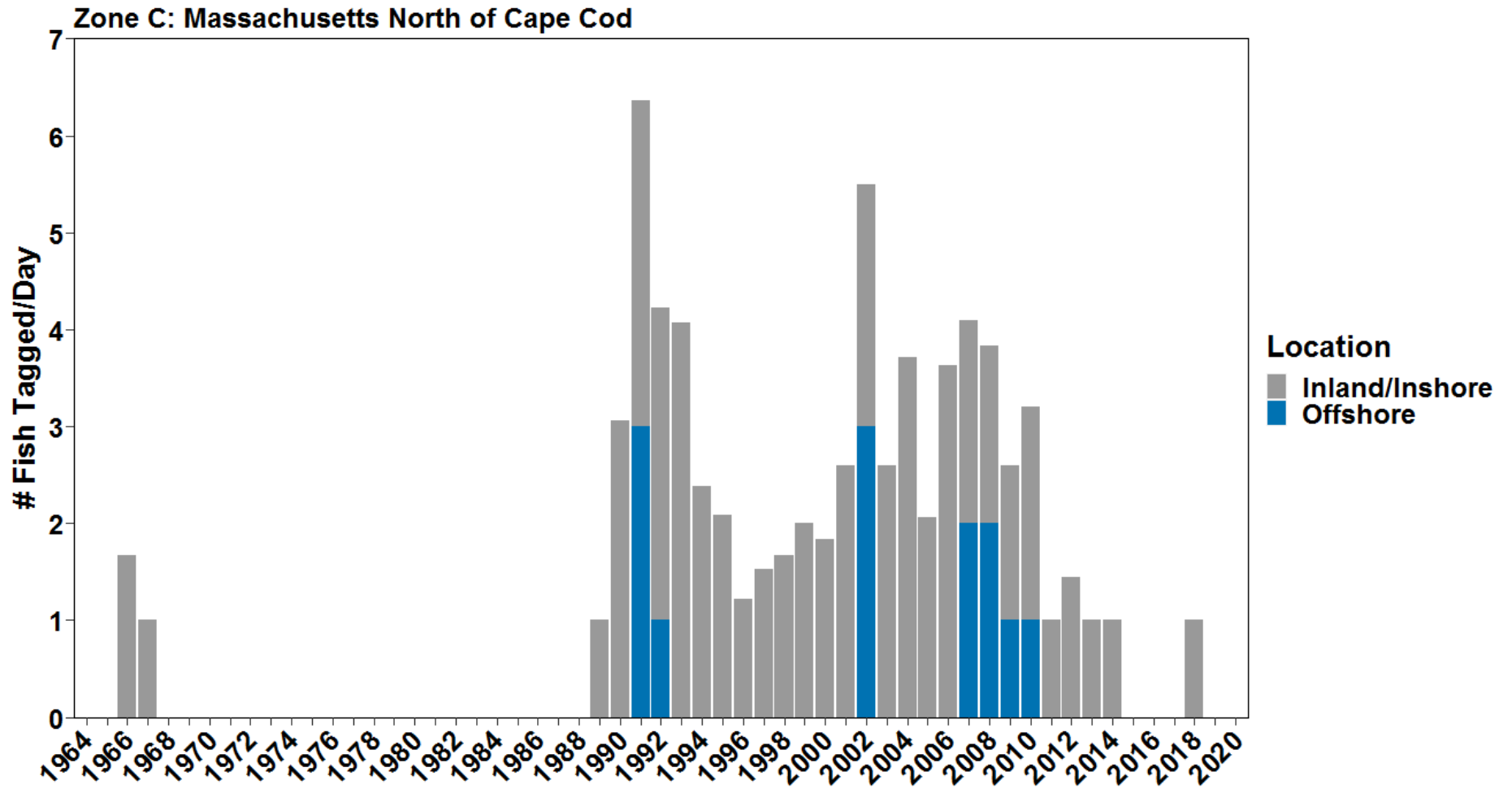


Figure 10

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone D (Massachusetts South of Cape Cod).

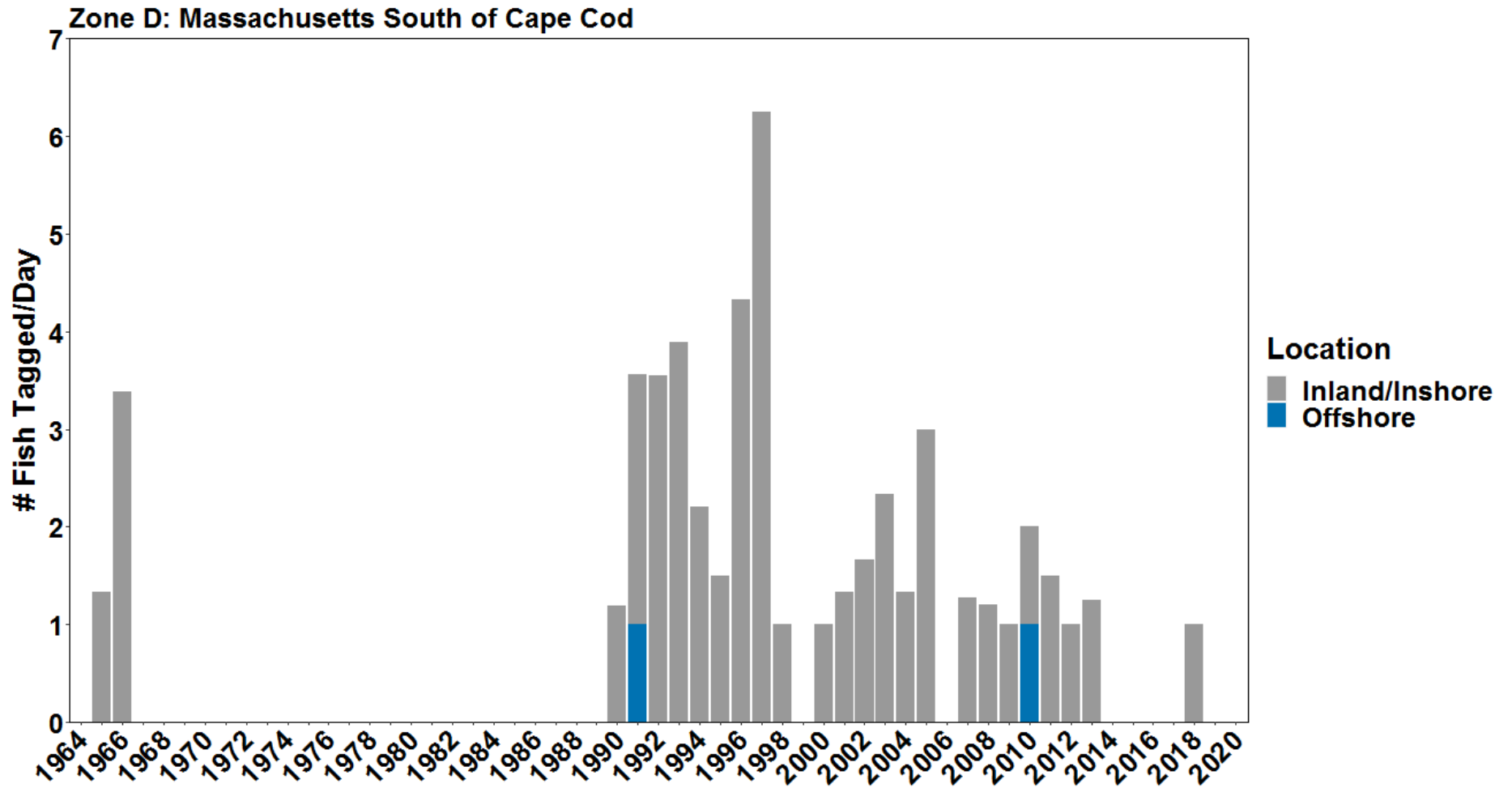


Figure 11

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone E (Rhode Island).

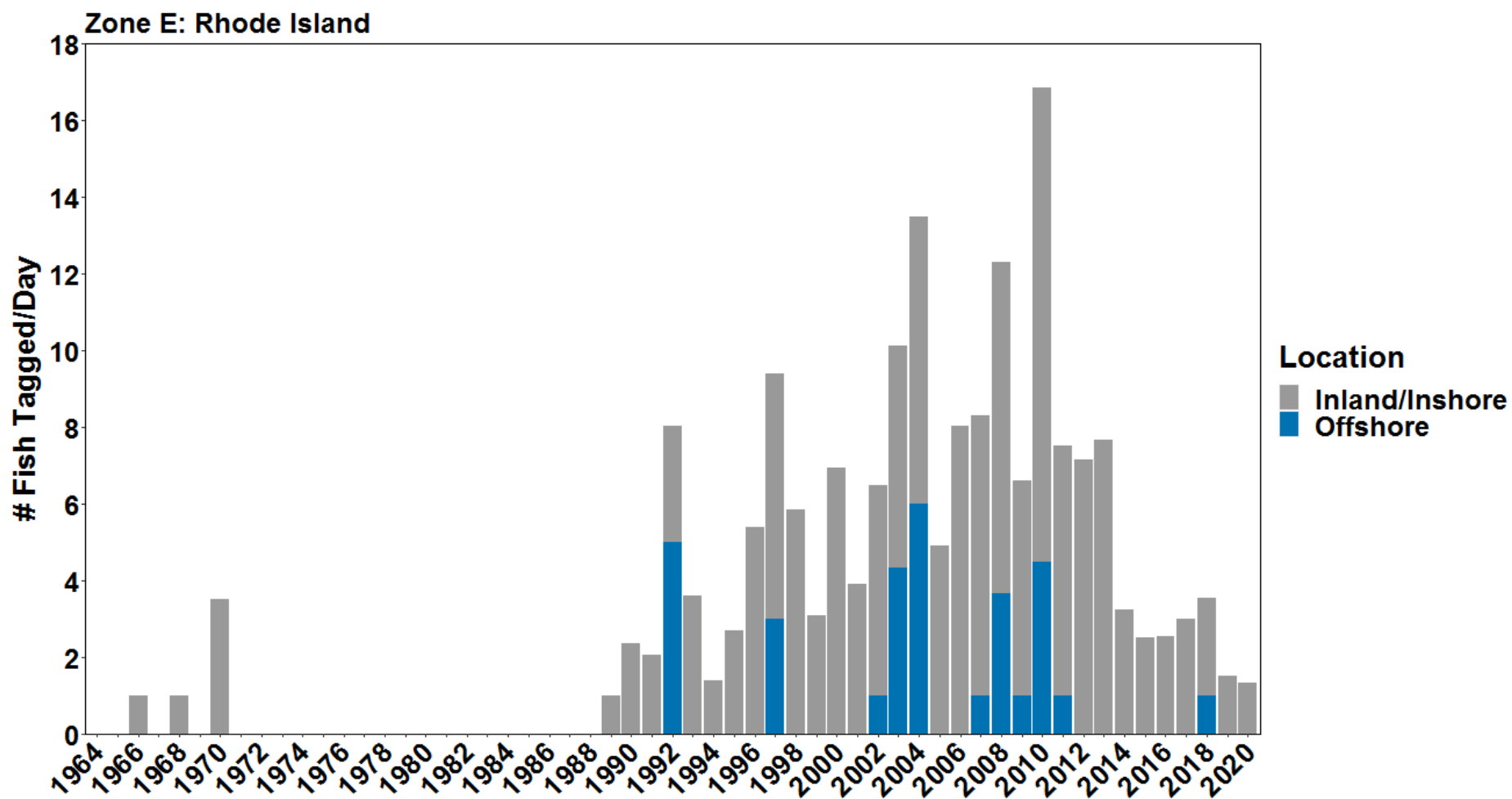


Figure 12

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone F (Connecticut).

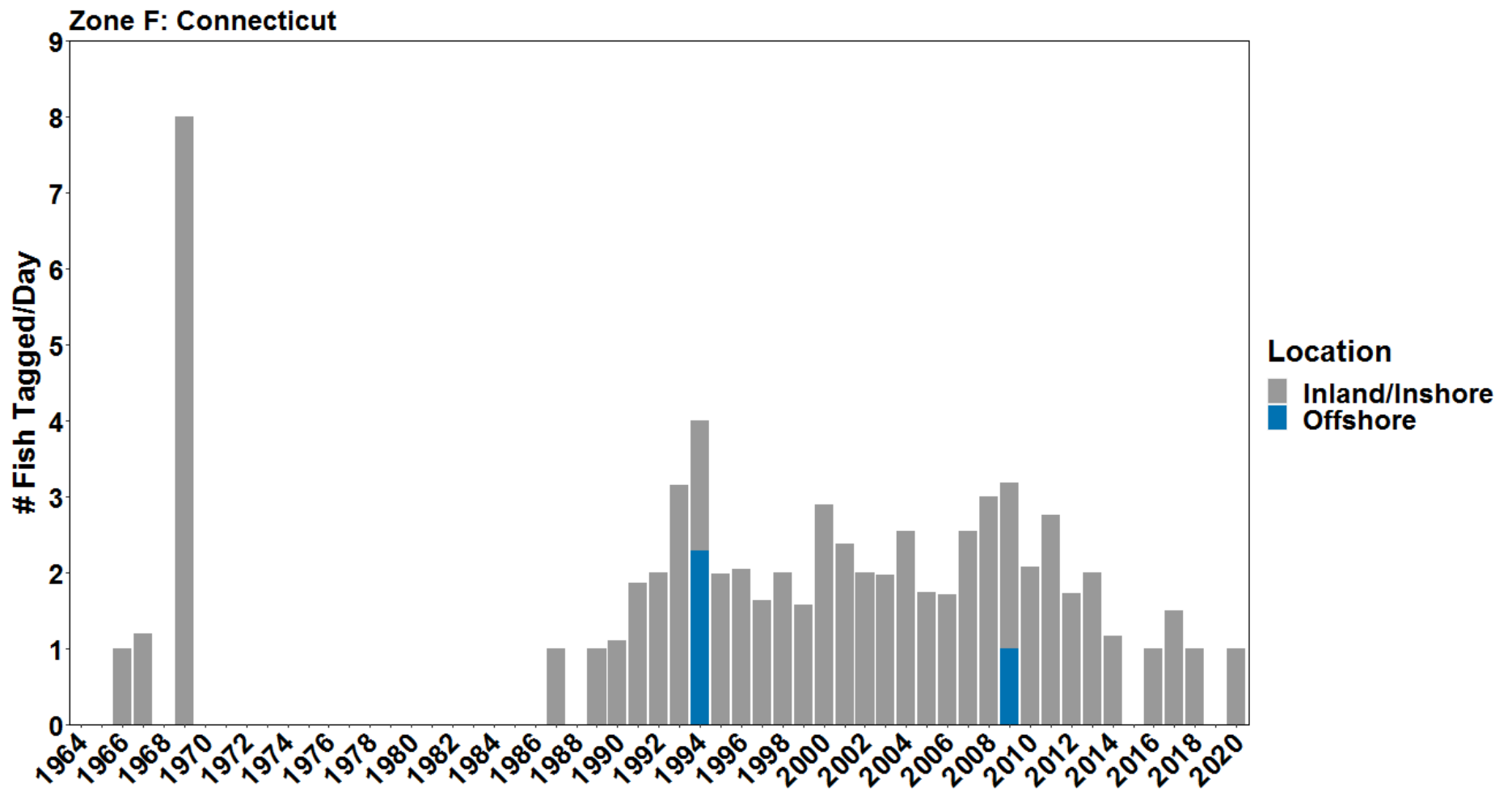


Figure 13

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone G (Long Island Sound). The offshore tagged and released fish in 2013 are likely a data entry error.

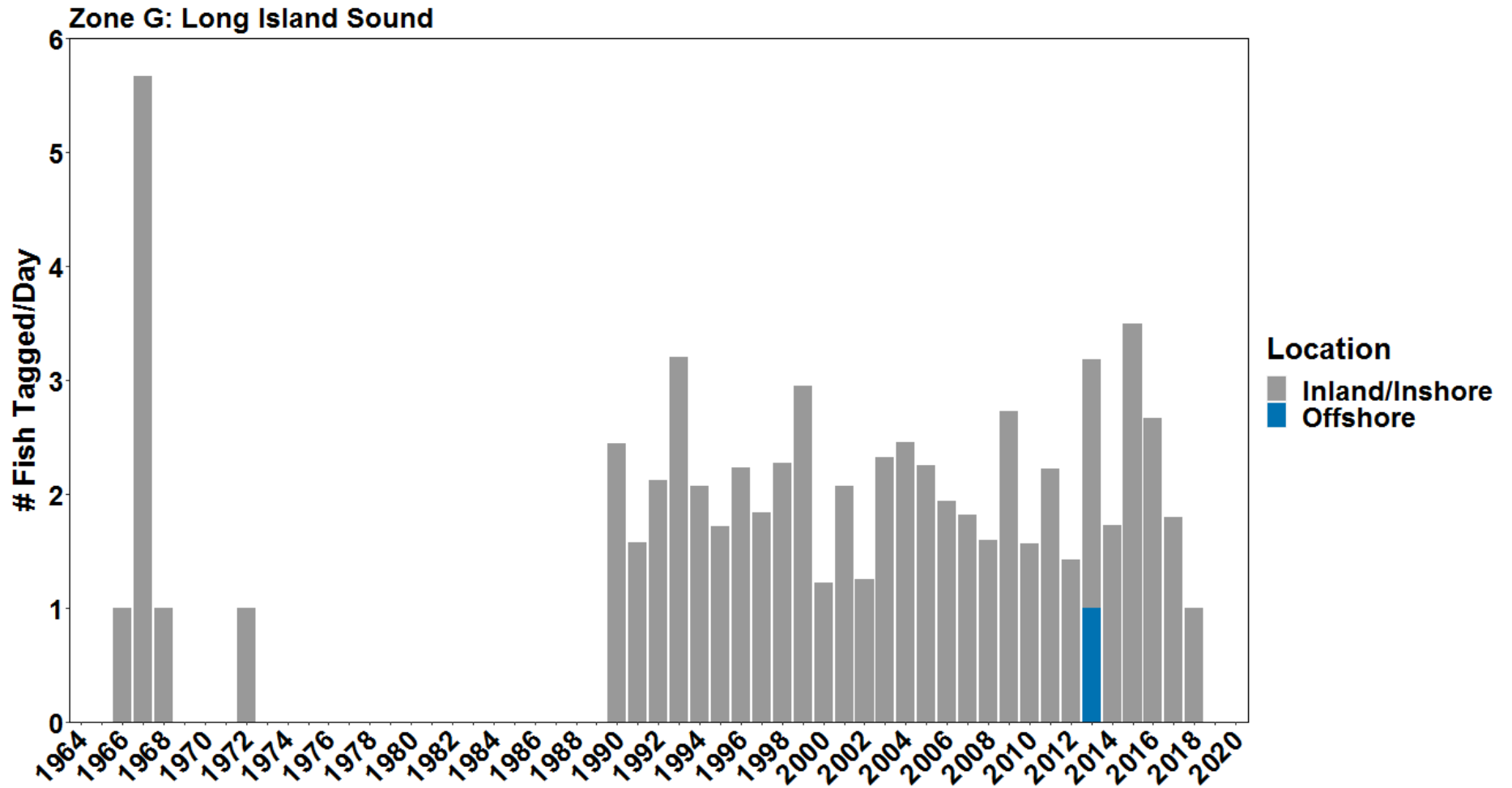


Figure 14

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone H (Atlantic Coast of Long Island).

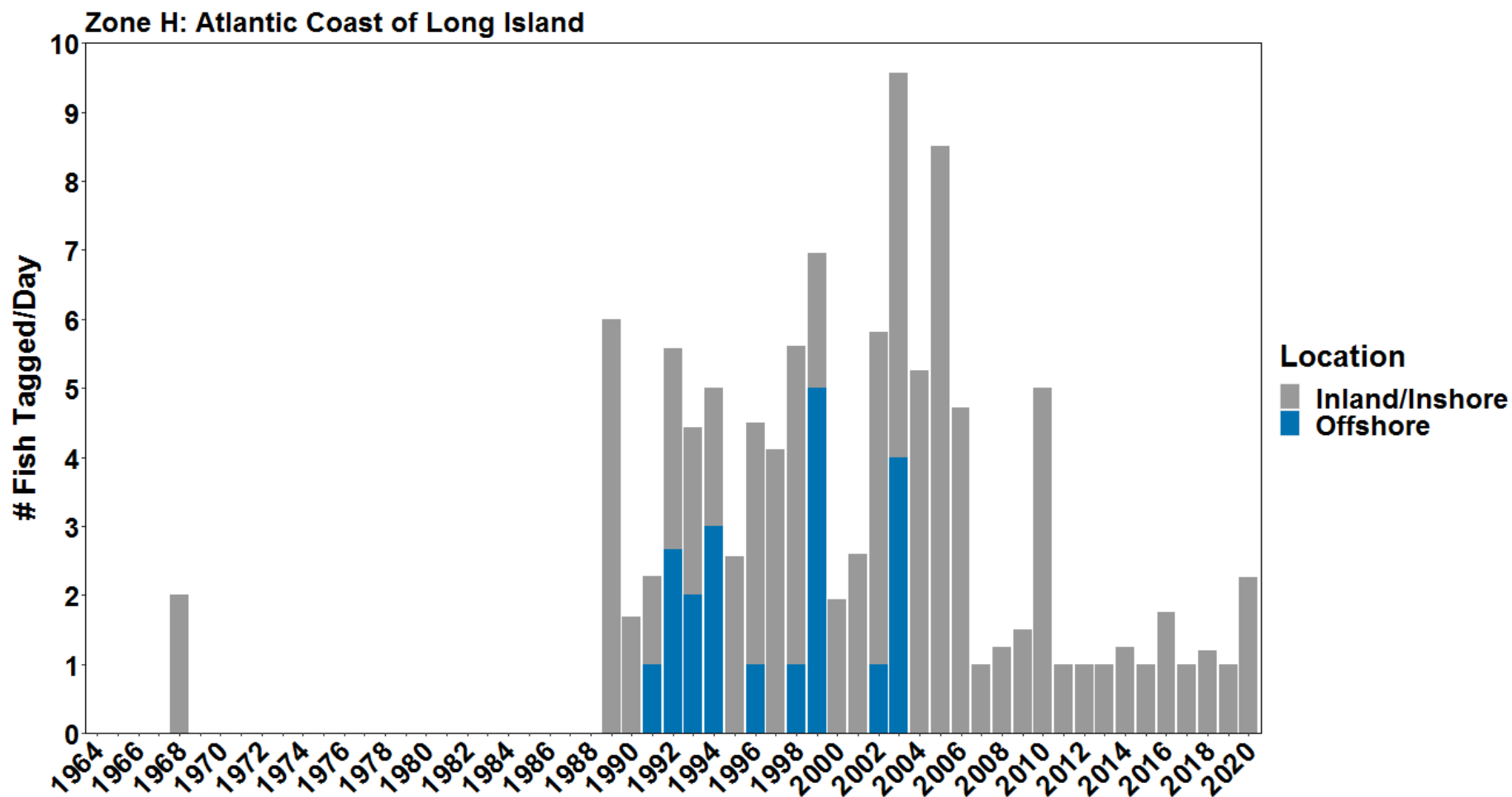


Figure 15

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone I (Raritan Bay and New York Harbor).

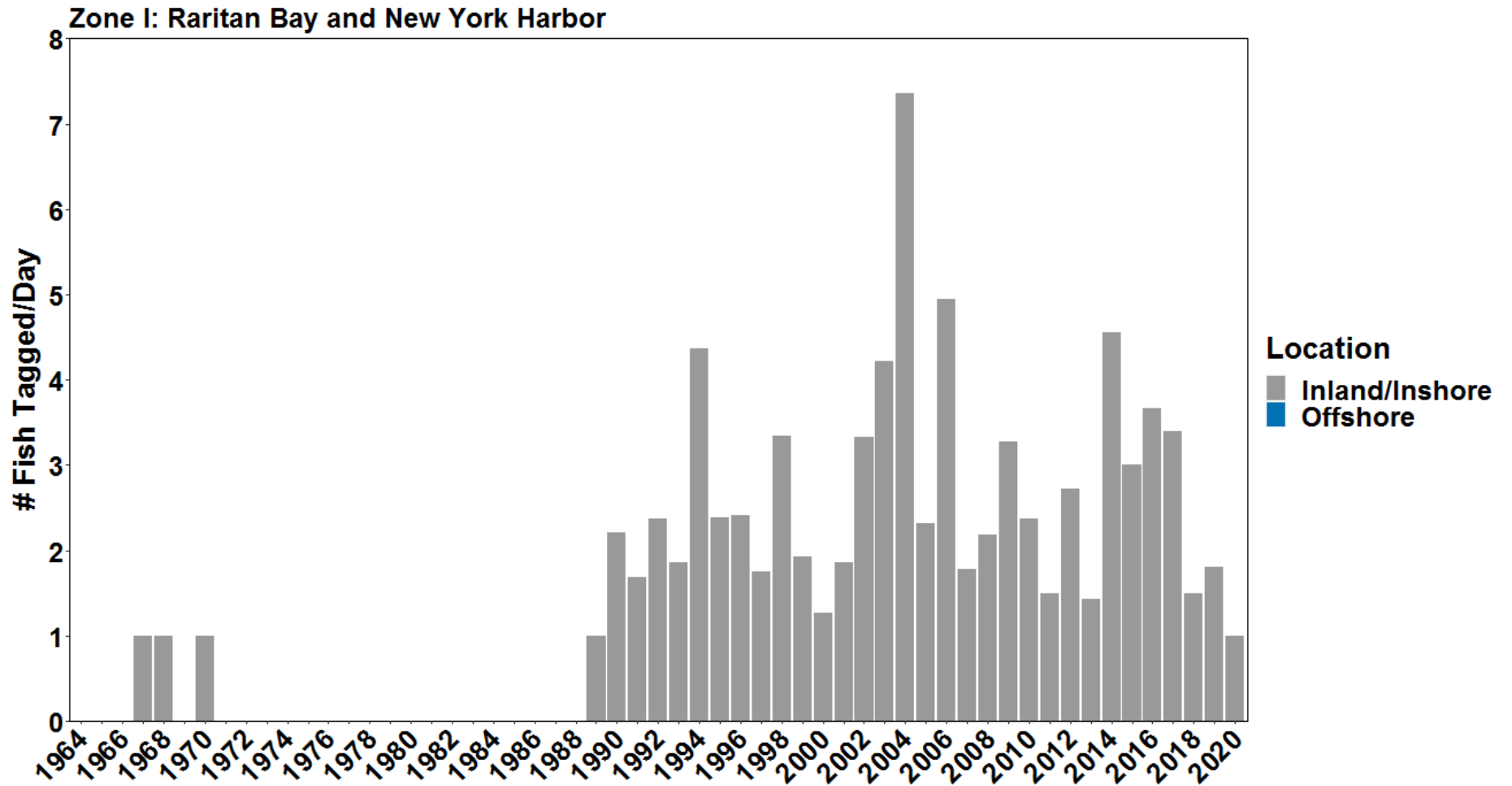


Figure 16

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone J (New Jersey).

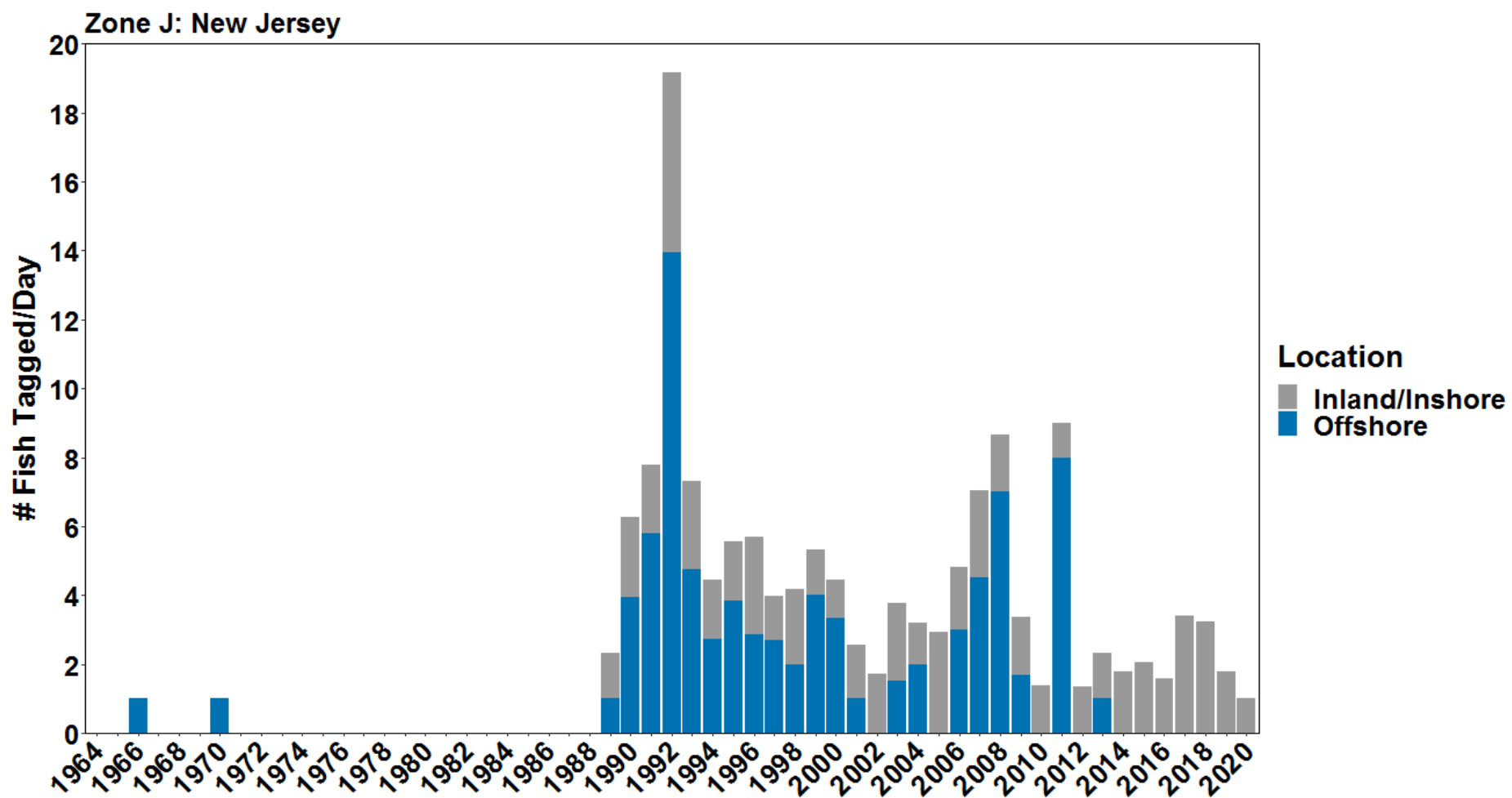


Figure 17

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone K (Delaware Bay).

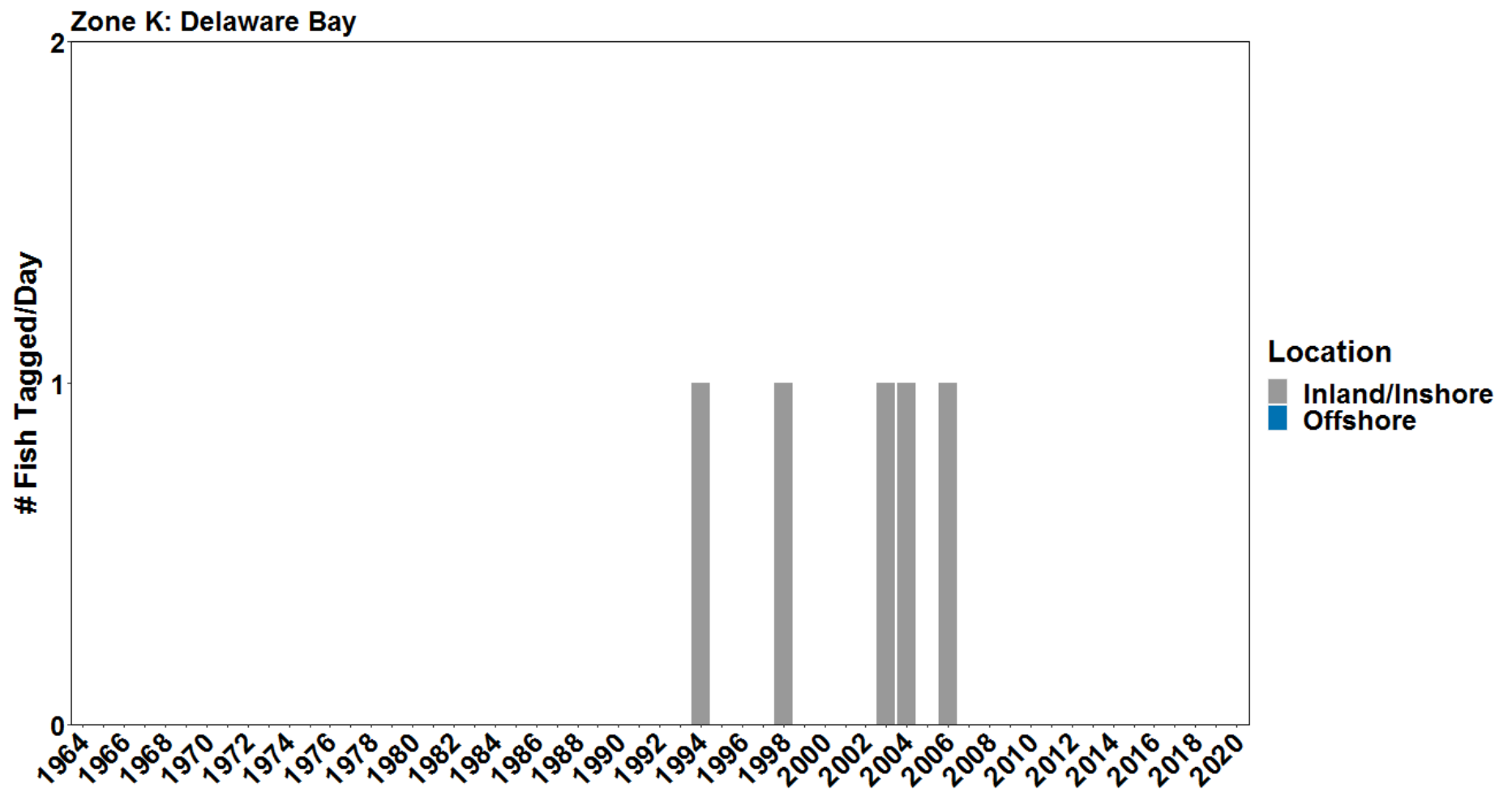


Figure 18

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone L (Chesapeake Bay). The offshore tagged and released fish in 1992 are likely a data recording or entry error.

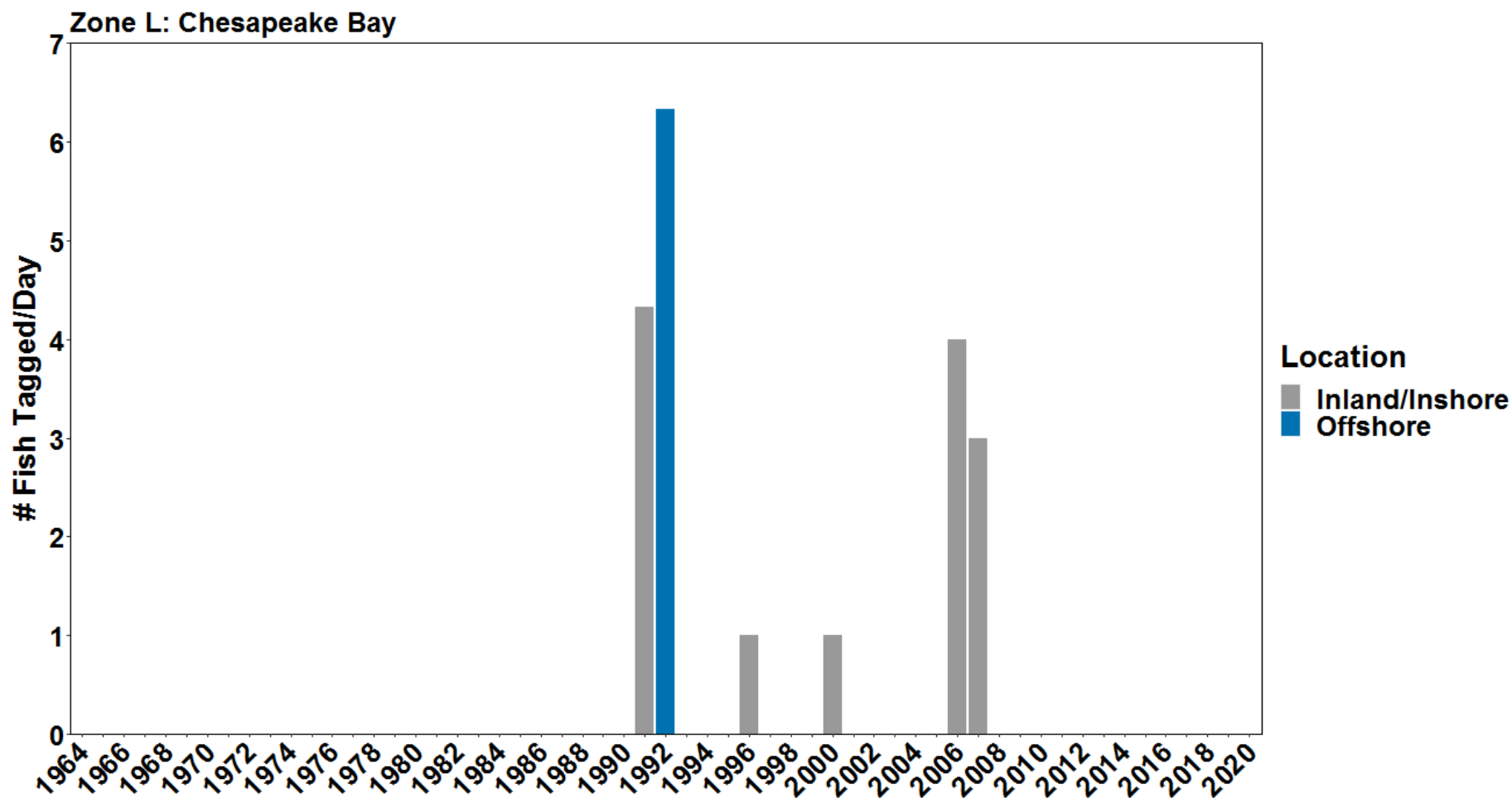


Figure 19

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone M (Delaware and Maryland).

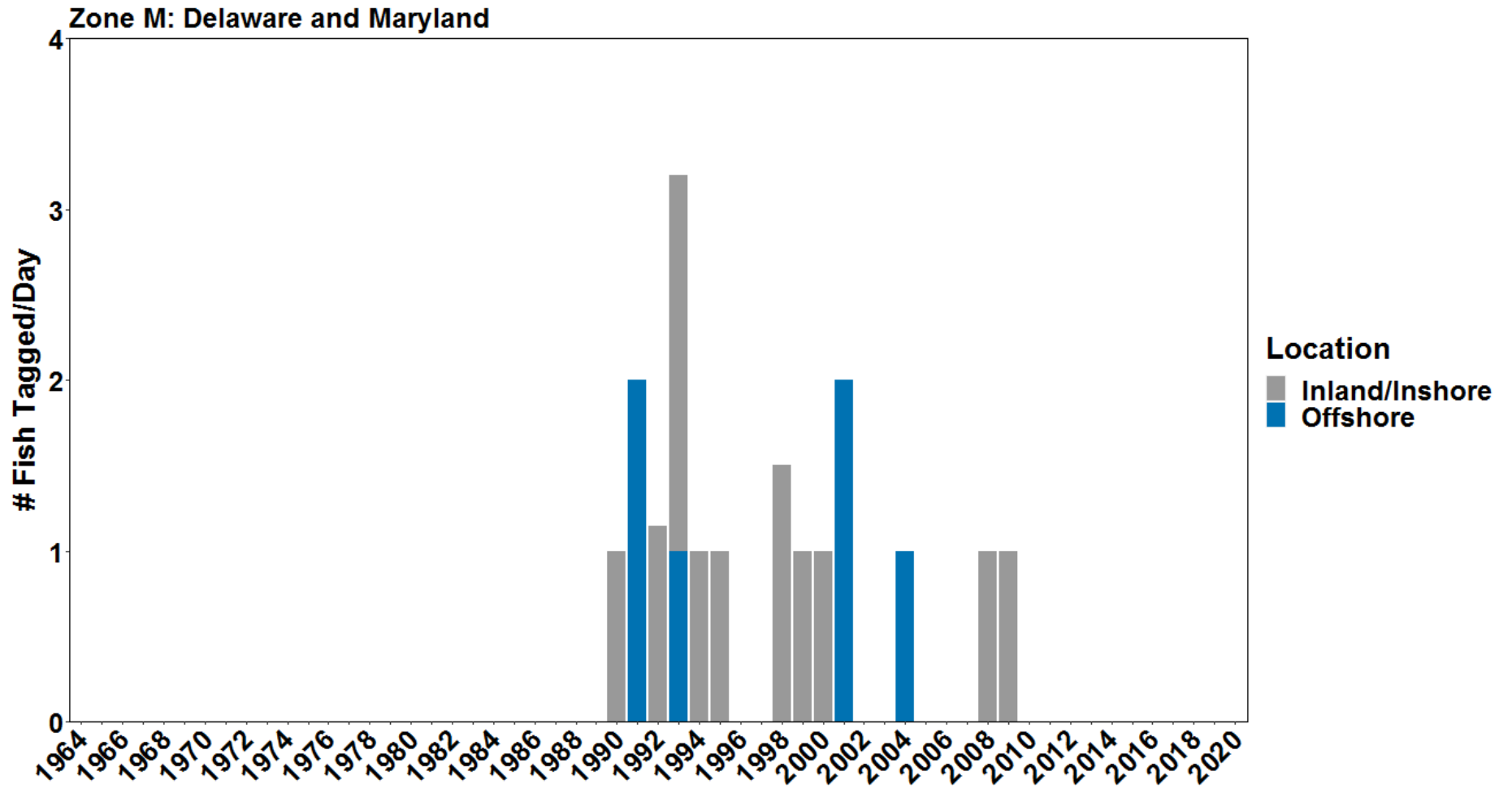


Figure 20

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone N (Virginia).

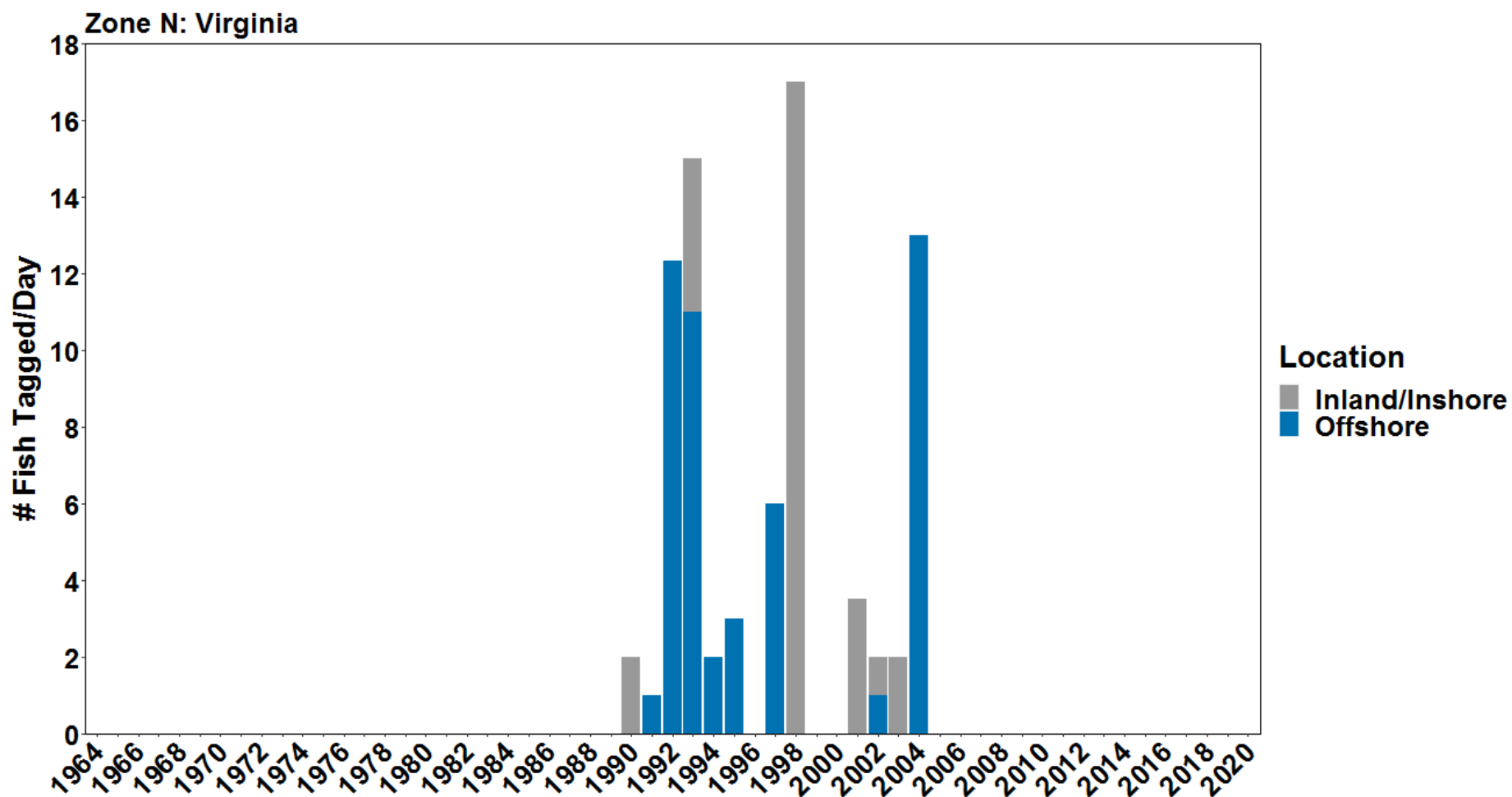


Figure 21

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone O (North Carolina).

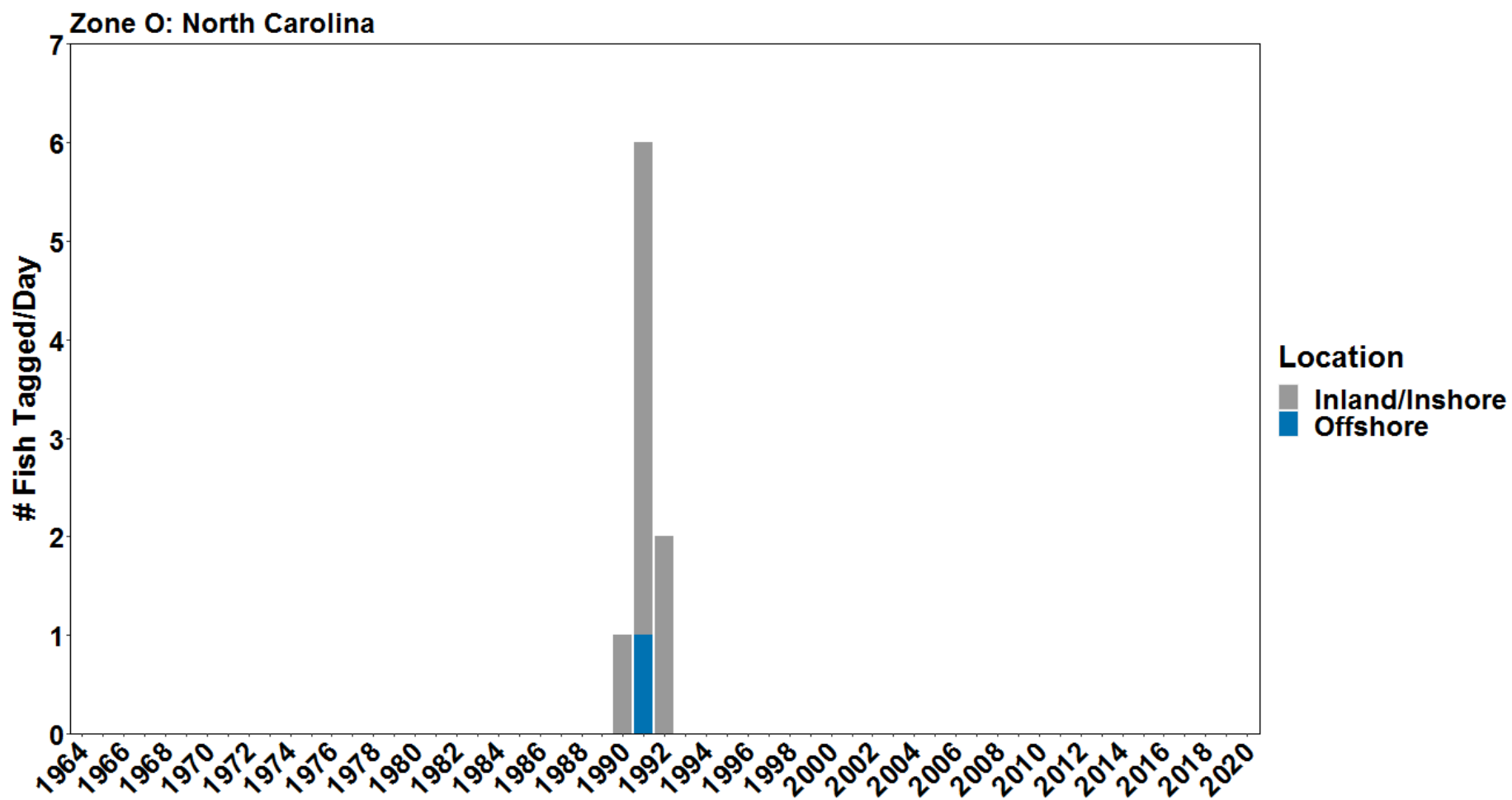


Figure 22

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone P (South Carolina and Georgia).

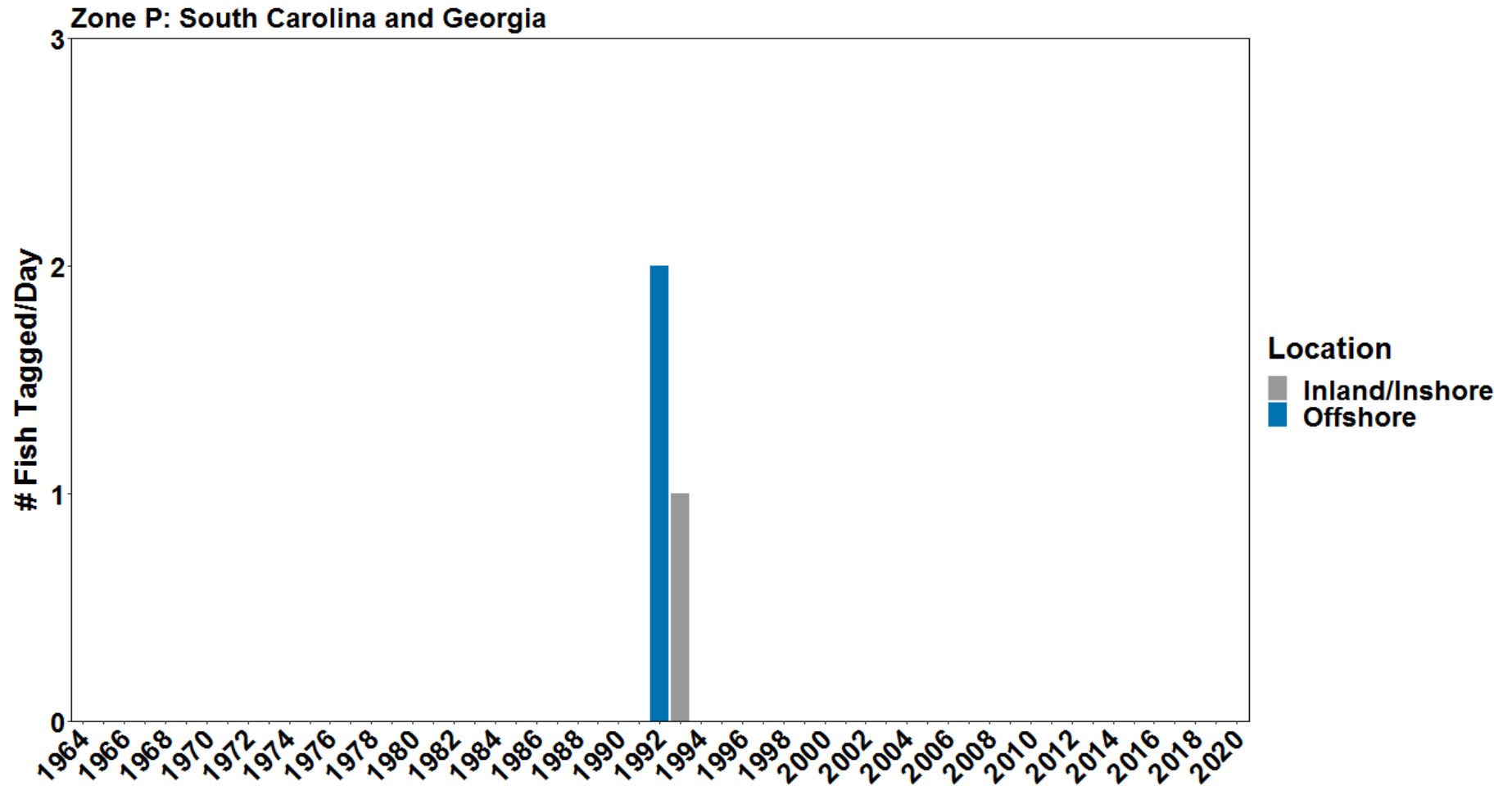


Figure 23

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone Q (Atlantic Coast of Florida).

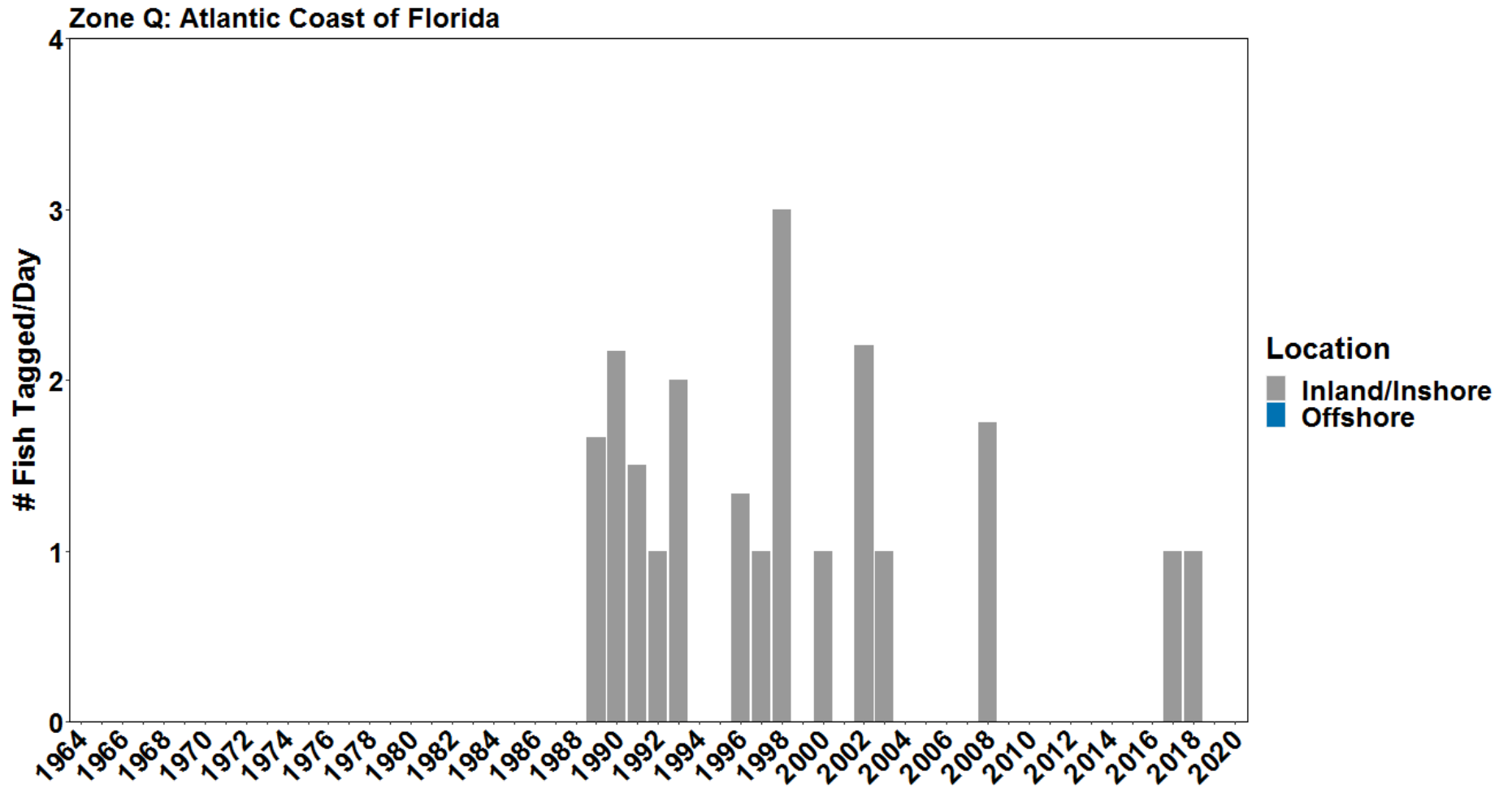


Figure 24

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone R (Gulf Coast of Florida).

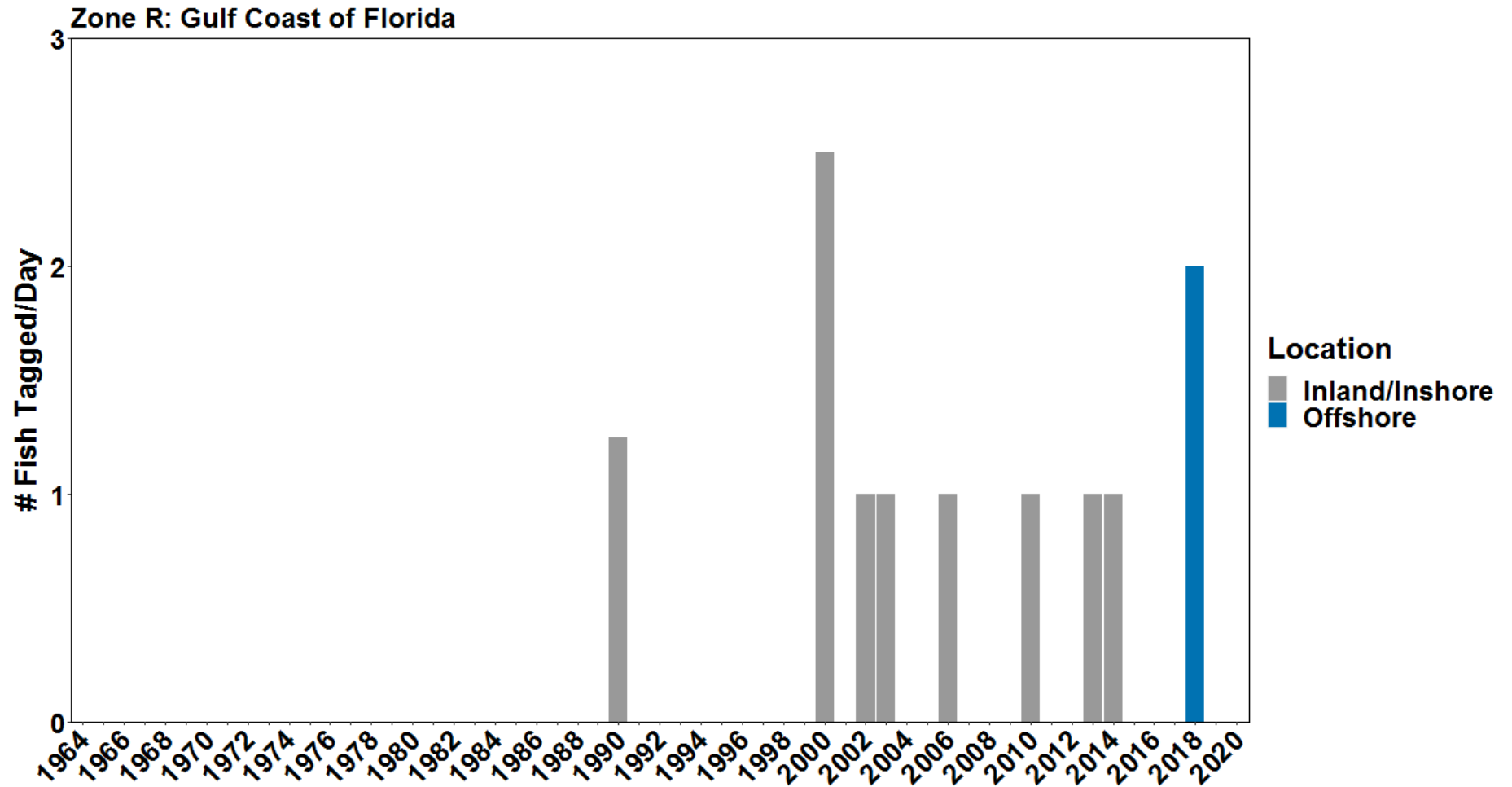


Figure 25

The number of large bluefish tagged and released per day at inland/inshore and offshore locations in master zone W (Hudson River).

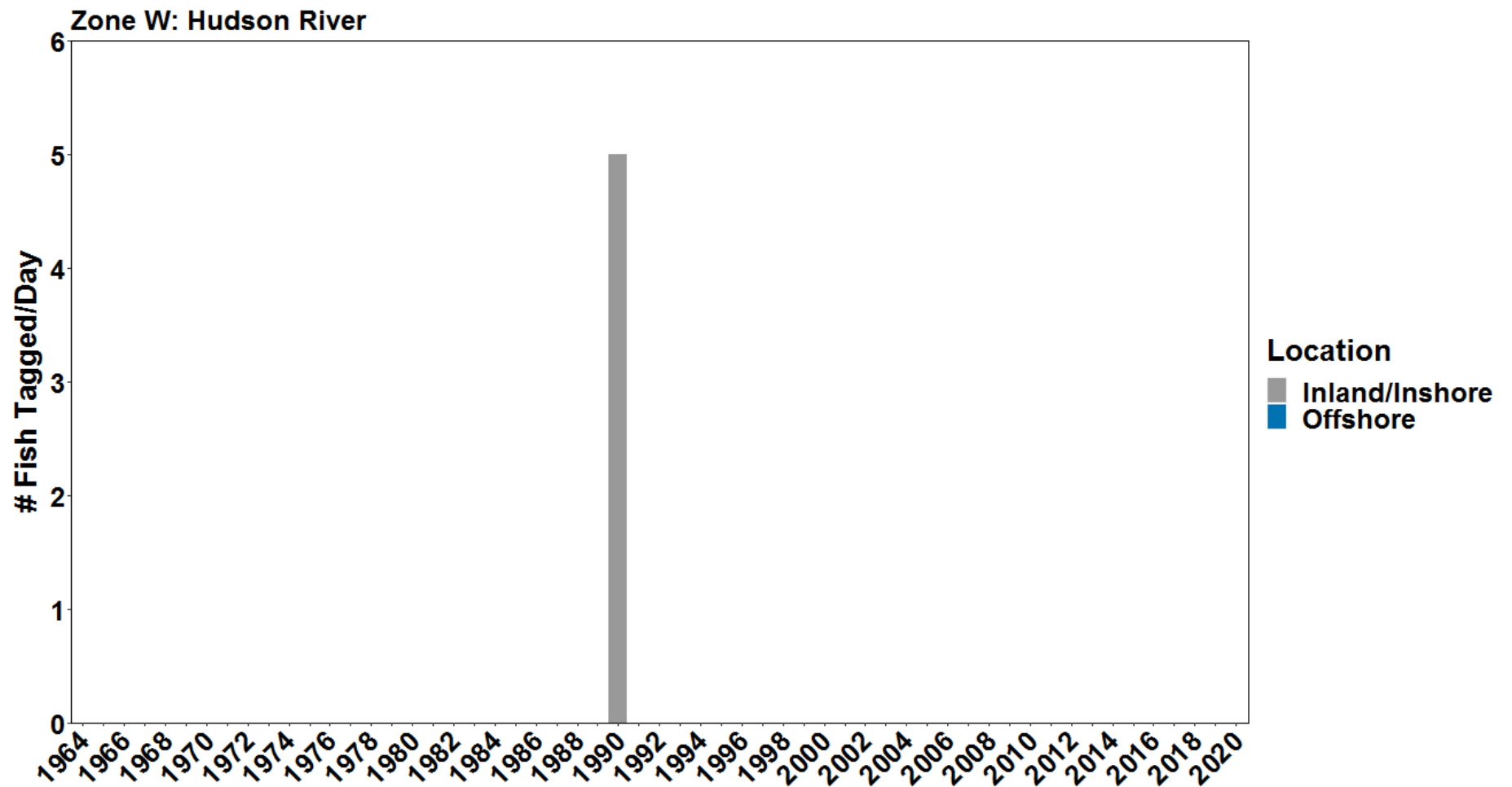


Figure 26

The lengths of large bluefish tagged and released at inland/inshore and offshore locations throughout the time series.

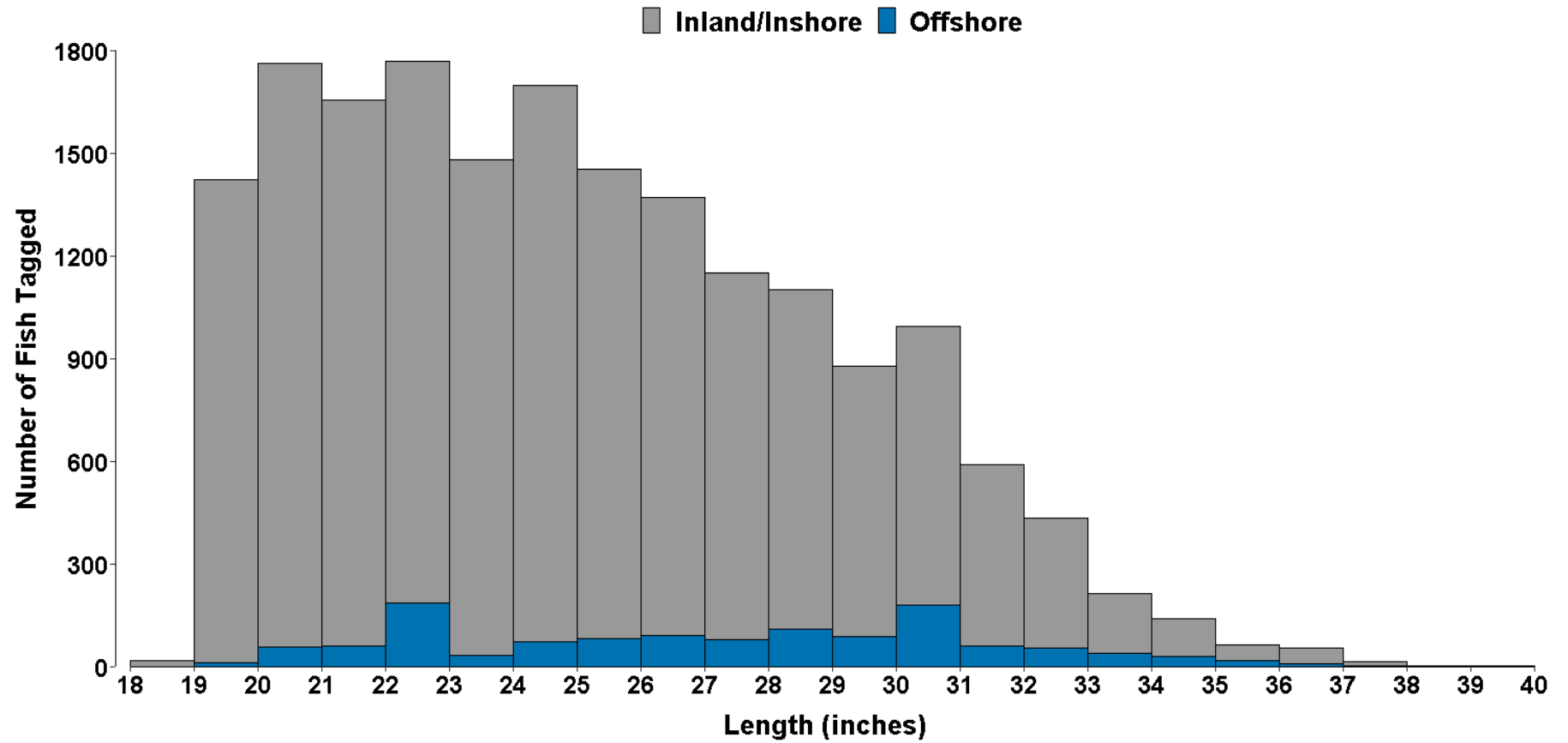


Figure 27

The lengths of large bluefish tagged and released at inland/inshore and offshore locations from 2016 to 2020.

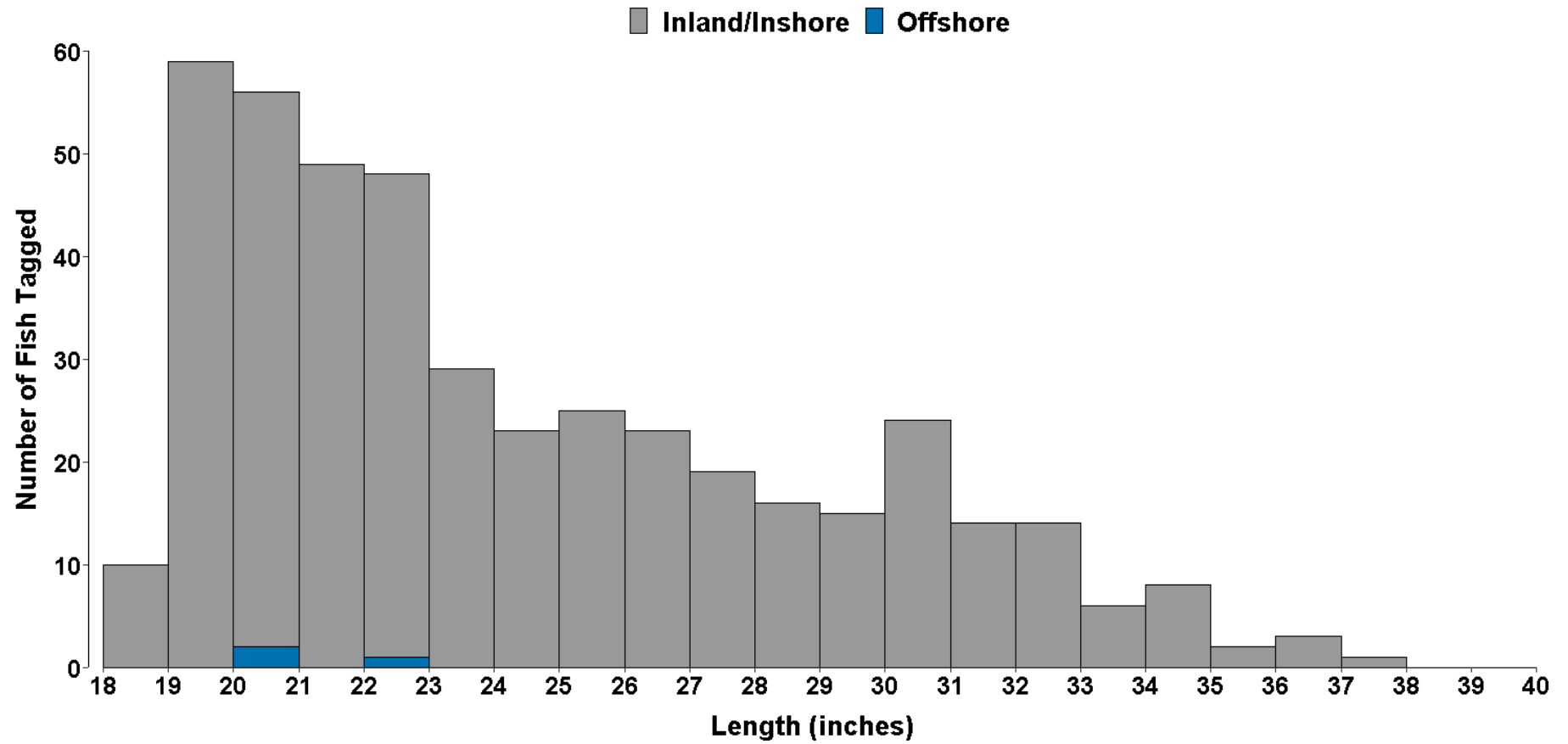


Figure 28

The lengths of large bluefish tagged and released at inland/inshore and offshore locations in master zone J (New Jersey).

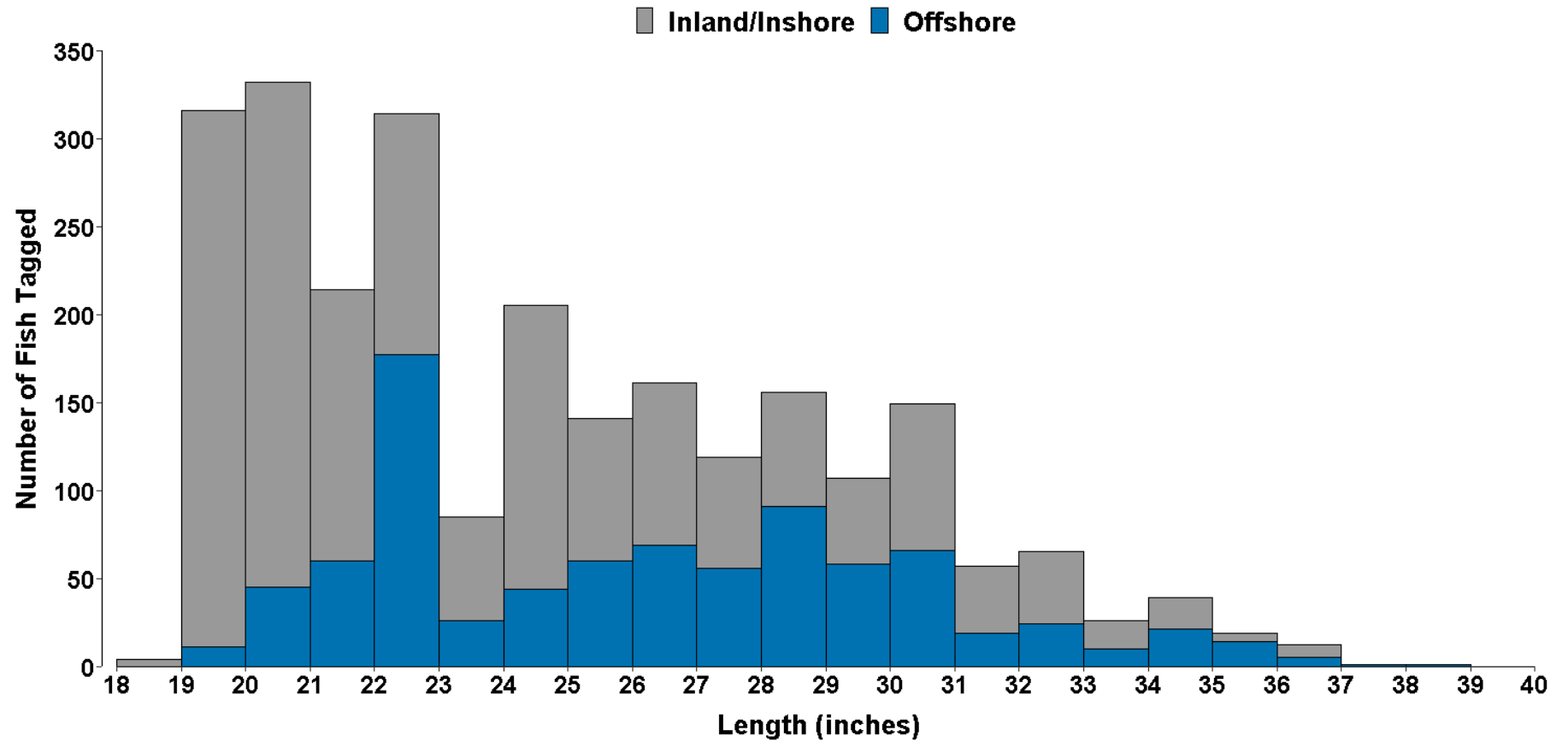


Figure 29

The number of large bluefish recaptured inland/inshore and offshore throughout the time series.

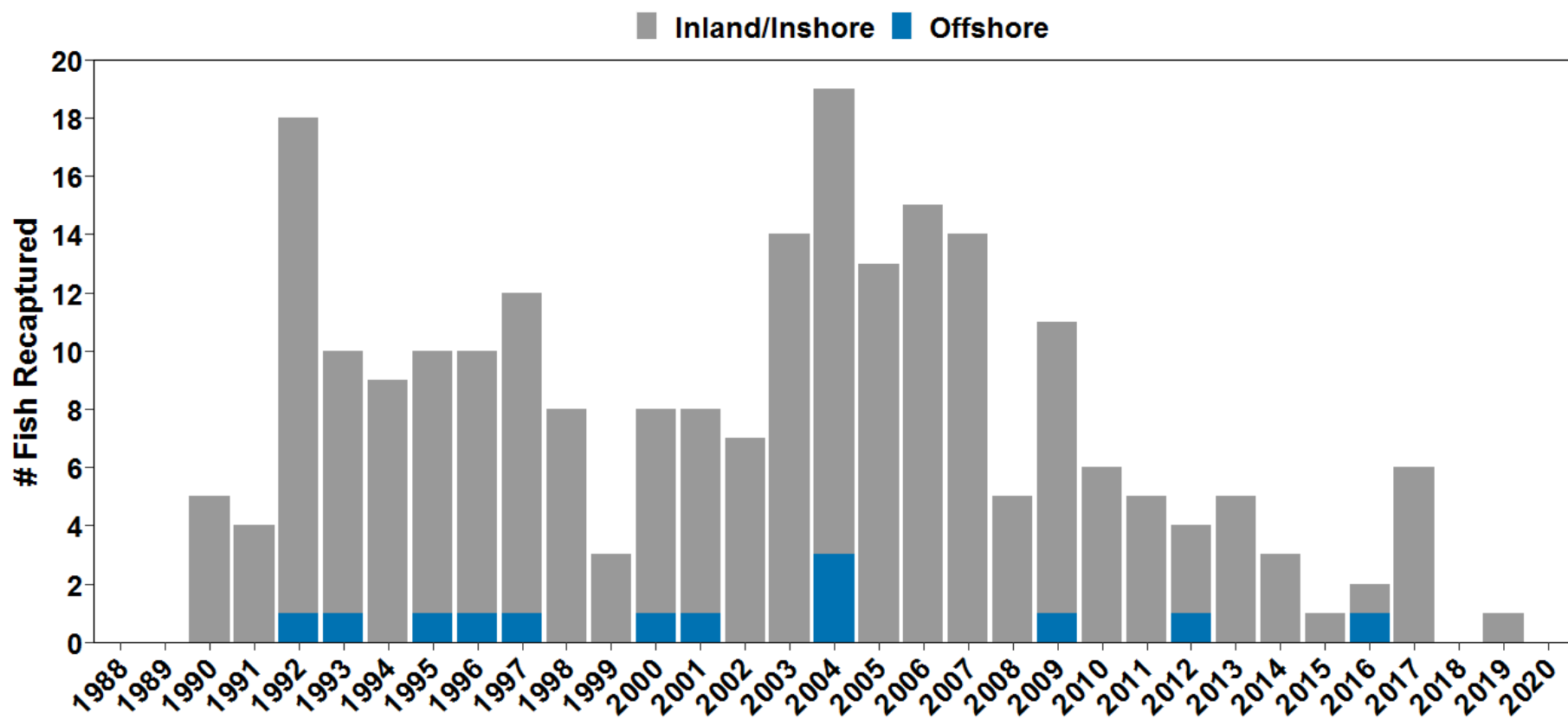


Figure 30

The percentage of large bluefish recaptured inland/inshore and offshore throughout the time series. The total number of fish recaptured each year (n) is reported in the year's corresponding bar. Years where no fish were recaptured were excluded from the plot.

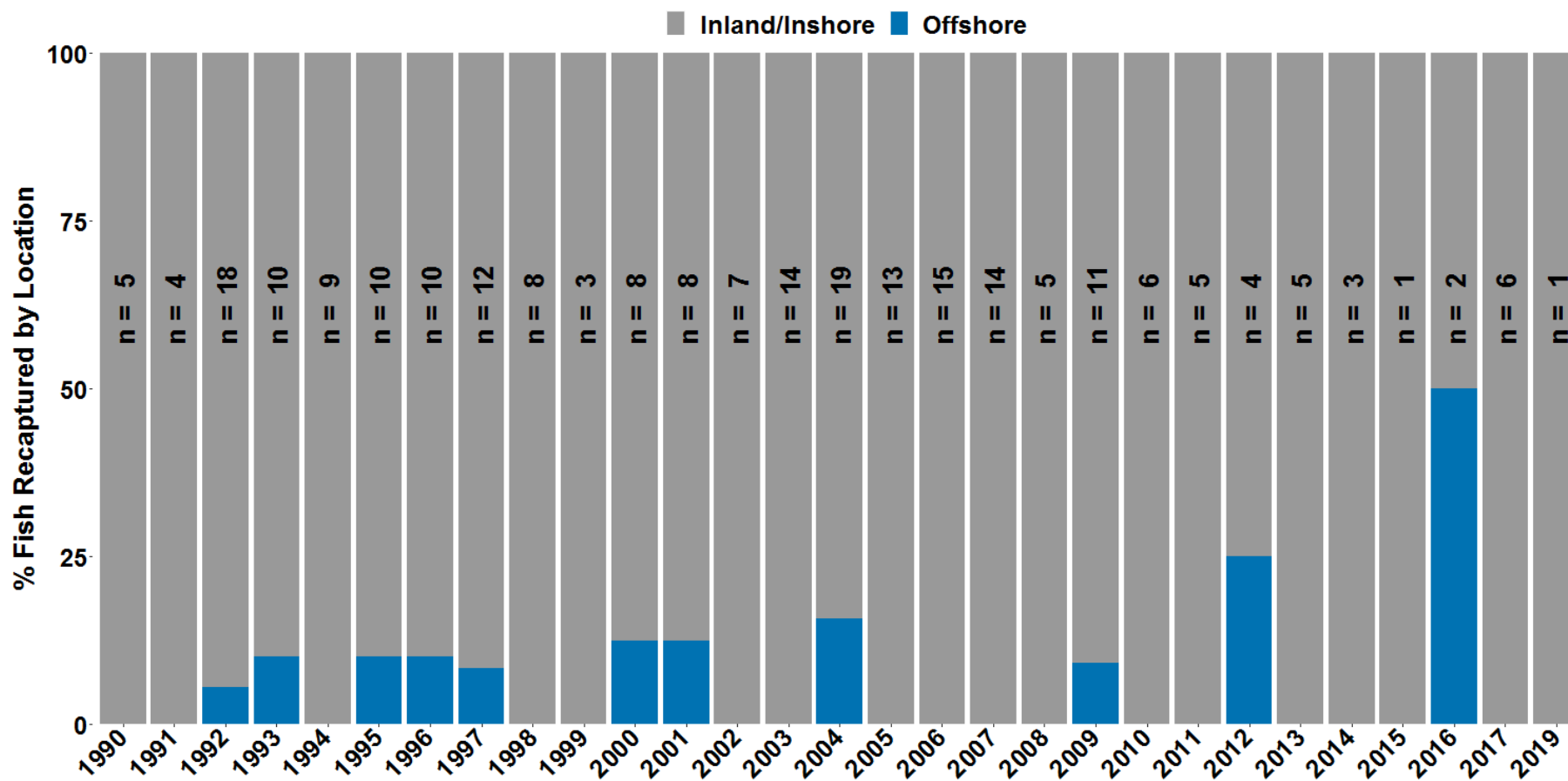


Figure 31

The lengths of large bluefish recaptured at inland/inshore and offshore locations throughout the time series.

