Northeast Fisheries Science Center Reference Document 10-18

An Updated Spatial Pattern Analysis for the Gulf of Maine-Georges Bank Atlantic Herring Complex During 1963-2009

by Jonathan J. Deroba

August 2010

Recent Issues in This Series

09-14 *Update on Harbor Porpoise Take Reduction Plan Monitoring Initiatives: Compliance and Consequential Bycatch Rates from June 2007 through May 2008, Pinger Tester Development and Enforcement from January 2008 through July of 2009*, by CD Orphanides, S Wetmore, and A Johnson. September 2009.

09-15 *48th Northeast Regional Stock Assessment Workshop (48th SAW) Assessment Report*, by Northeast Fisheries Science Center. October 2009.

09-16 *Black Sea Bass 2009 Stock Assessment Update*, by GR Shepherd. October 2009.

09-17 *Stock assessment of summer flounder for 2009*, by M Terceiro. October 2009.

09-18 *Stock assessment of scup for 2009*, by M Terceiro. October 2009.

09-19 *Proration of Estimated Bycatch of Loggerhead Sea Turtles in U.S. Mid-Atlantic Sink Gillnet Gear to Vessel Trip Report Landed Catch, 2002-2006*, by KT Murray. November 2009

09-20 *River Herring Discard Estimation, Precision, and Sample Size Analysis*, by SE Wigley, J Blaylock, and P Rago. December 2009.

10-01 *49th Northeast Regional Stock Assessment Workshop (49th SAW) assessment summary report*, by Northeast Fisheries Science Center. January 2010.

10-02 *A Standard Method to Apportion Groundfish Catch to Stock Area for the Purpose of Real Time Quota Monitoring under Amendment 16*, by Michael C. Palmer. January 2010.

10-03 *49th Northeast Regional Stock Assessment Workshop (49th SAW) Assessment Report*, by Northeast Fisheries Science Center. February 2010.

10-04 *Brodeur's Guide to Otoliths of Some Northwest Atlantic Fishes*, edited by R.S. McBride, J.W. Hauser, and S.J. Sutherland. May 2010.

10-05 *Estimation of Albatross IV to Henry B. Bigelow calibration factors*, by Miller TJ, Das C, Politis PJ, Miller AS, Lucey SM, Legault CM, Brown RW, Rago PJ. May 2010.

10-06 *Biological Reference Points for Spiny Dogfish*, by PJ Rago and KA Sosebee. May 2010.

10-07 *North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS) 2009 Results Summary*, by C Khan, T Cole, P Duley, A Glass, and J Gatzke. May 2010.

10-08 In preparation.

10-09 *50th Northeast Regional Stock Assessment Workshop (50th SAW): Assessment Summary Report*, by Northeast Fisheries Science Center. July 2010.

10-10 *Estimates of Cetacean and Pinniped Bycatch in the 2007 and 2008 Northeast Sink Gillnet and Mid-Atlantic Gillnet Fisheries*, by CM Orphanides. July 2010.

10-11 *Northeast Fisheries Science Center Cetacean Biopsy Training Manual*, by F Wenzel, J Nicolas, F Larsen, and RM Pace III. July 2010.

10-12 *A Survey of Social Capital and Attitudes toward Management in the New England Groundfish Fishery*, by DS Holland, P Pinto da Silva, and J Wiersma. July 2010.

10-13 *Black Sea Bass 2010 Stock Assessment Update*, by GR Shepherd and J Nieland. July 2010.

10-14 *Stock Assessment of Summer Flounder for 2010*, by M Terceiro. July 2010.

10-15 *Bluefish 2010 Stock Assessment Update*, by GR Shepherd and J Nieland. July 2010.

10-16 Stock Assessment of Scup for 2010, by M Terceiro. July 2010.

10-17 50th Northeast Regional Stock Assessment Workshop (50th SAW) Assessment Report, by Northeast Fisheries Science Center. August 2010.

Northeast Fisheries Science Center Reference Document 10-18

An Updated Spatial Pattern Analysis for the Gulf of Maine-Georges Bank Atlantic Herring Complex During 1963-2009

by Jonathan J. Deroba

NOAA, National Marine Fisheries Service, 166 Water Street, Woods Hole MA 02543

US DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

August 2010

Northeast Fisheries Science Center Reference Documents

This series is a secondary scientific series designed to assure the long-term documentation and to enable the timely transmission of research results by Center and/or non-Center researchers, where such results bear upon the research mission of the Center (see the outside back cover for the mission statement). These documents receive internal scientific review, and most receive copy editing. The National Marine Fisheries Service does not endorse any proprietary material, process, or product mentioned in these documents.

All documents issued in this series since April 2001, and several documents issued prior to that date, have been copublished in both paper and electronic versions. To access the electronic version of a document in this series, go to *http://www.nefsc.noaa.gov/nefsc/publications/*. The electronic version is available in PDF format to permit printing of a paper copy directly from the Internet. If you do not have Internet access, or if a desired document is one of the pre-April 2001 documents available only in the paper version, you can obtain a paper copy by contacting the senior Center author of the desired document. Refer to the title page of the document for the senior Center author's name and mailing address. If there is no Center author, or if there is corporate (*i.e.*, non-individualized) authorship, then contact the Center's Woods Hole Laboratory Library (166 Water St., Woods Hole, MA 02543-1026).

Editorial Treatment: To distribute this report quickly, it has not undergone the normal technical and copy editing by the Northeast Fisheries Science Center's (NEFSC's) Editorial Office as have most other issues in the NOAA Technical Memorandum NMFS-NE series. Other than the four covers and first two preliminary pages, all writing and editing have been performed by the authors listed within. This report was reviewed by the Stock Assessment Review Committee, a panel of assessment experts from the Center for Independent Experts (CIE), University of Miami.

Information Quality Act Compliance: In accordance with section 515 of Public Law 106-554, the Northeast Fisheries Science Center completed both technical and policy reviews for this report. These predissemination reviews are on file at the NEFSC Editorial Office.

This document may be cited as:

Deroba JJ. 2010. An updated spatial pattern analysis for the Gulf of Maine-Georges Bank Atlantic herring complex during 1963-2009. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 10-18; 18 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

TABLE OF CONTENTS

ABSTRACT

Spatial pattern analysis of survey catches have been shown to reflect changes in Gulf of Maine-Georges Bank Atlantic herring abundance, but no such analysis has been conducted using data from the last 11 years (1999-2009). I conducted a spatial pattern analysis by updating previous analyses looking for temporal trends in the spatial distributions of Atlantic herring spring and fall survey catches during 1963-2009. The distribution of herring catch locations expanded to the southwest during spring bottom trawl surveys and generally occurred over a broader area during fall bottom trawl surveys as abundance increased during the mid- to late 1980s. Similarly, herring capture locations during spring and fall bottom trawl surveys became more evenly distributed among latitudes and more closely aggregated as abundance increased. These patterns that are indicative of relatively high abundance have persisted through 2009.

1. INTRODUCTION

Atlantic herring *Clupea harengus* (referred to as herring) on the eastern continental shelf of the United States (US) and Canada have been fished to some extent for centuries, but significant catches did not begin until the 1800s when sardine canneries began operating along the coast of Maine (Anthony and Waring 1980; Tupper et al. 1998). During the 1960s, distant water fleets began fishing on George's Bank and total landings peaked at 479,000 mt in 1968. Over the next decade, the stock complex was fished to near collapse with total landings reaching a low of 44,600 mt in 1983, with most of the landings being taken from the Gulf of Maine and Jeffrey's Ledge. In the 1990s, abundance rebounded and during 1995-2008 landings were stable and averaged 120,000 mt.

Some have hypothesized that fish stocks contract to the most favorable habitats during low abundance, and contractions consistent with this hypothesis have been observed for some pelagic fish stocks (Lluch-Belda et al. 1992; MacCall 1990; Barange et al. 1999). For example, Overholtz (2002) found that the distribution of locations where herring were captured shrank to the north during spring bottom trawl surveys and generally became limited to only the Gulf of Maine during fall bottom trawl surveys as abundance declined. Similarly, herring capture locations during spring and fall bottom trawl surveys were less evenly distributed among latitudes and less aggregated during years of low abundance. So, some spatial patterns in survey capture locations may be indicative of the abundance of a fish stock.

The objective of this study was to make inference about the abundance of Atlantic herring in the Gulf of Maine-George's Bank complex using an update to the spatial analysis of Overholtz (2002). This objective was addressed by conducting a similar analysis to that of Overholtz (2002) using data from spring and fall bottom trawl surveys, but with the addition of 11 years of data.

2. METHODS

2.1 Survey Data

Each analysis described below was done separately for spring and fall bottom trawl surveys conducted by the Northeast Fisheries Science Center. Each survey employs a stratified random sampling design using a standardized bottom trawl towed for 30 minutes at randomly selected stations within a stratum. The survey gear (i.e., nets and doors) has changed through time and in 2009 a new survey vessel was used. The analyses of this paper, however, are focused on capture locations and not relative abundance. Therefore, results and conclusions should be robust to these changes. Additional details of the surveys are provided in Azarovitz (1981), Byrne et al. (1981), and Despres et al. (1988). Data collected during 1968-2009 and in strata 1-30, 36-40, and 61-76 were used in the analyses for the spring survey, and data collected during 1963-2009 and in strata 1-30 and 36-40 were used in the analyses for the fall survey (Figure 1).

2.2 Analyses

The methods used for each of the analyses were similar to those used in Overholtz (2002) and the details of each method can be found in that manuscript. A brief overview was provided here. Some data has been updated or corrected since the analysis of Overholtz (2002) and so some differences may be evident, but they should be few and relatively minor.

2.2.1 Kernel Density Plots

Kernel density plots were used to describe the degree of concentration of herring sample sites in each of the surveys. These bivariate density contours illustrate where herring were most aggregated during each of the surveys. Six year intervals were plotted for spring (1983-2009) and fall (1980-2009) to illustrate the time-series changes in herring sample site locations. These years were chosen so that plots from when stock abundance was low (early 1980s) would be available for comparison to recent years. An arbitrary contour line was plotted with the sampling sites as a visual aid for following the spatial changes in the herring complex, similar to Overholtz (2002). Also as in Overholtz (2002), the analysis was not weighted by herring catch.

2.2.2 Frequency Histograms

Frequency histograms of the latitude and longitude of the herring capture locations were used to examine the degree of uniformity of the capture sites over the survey area. This method is useful for examining the medium scale positioning of the herring sample locations (Overholtz 2002). For this analysis, only selected years were plotted for the spring (1983, 1989, 1995, 2001, 2007, 2009) and fall (1985, 1990, 1995, 2000, 2005, 2009) to provide an overview of the changes in the herring complex without plotting all years and so that some years were the same as those presented in Overholtz (2002).

2.2.3 Nearest Neighbor Distances

Cumulative distributions of nearest neighbor distances were produced as indicators of how closely herring sample sites were spaced. A gradual, smooth curve suggests that the herring sample sites were relatively close and that few sites were “extremely” close or far from each other, while the opposite is true of an abrupt, fragmented curve. Nearest neighbor distances were corrected for regional longitude in the same way as Overholtz (2002). These distributions were plotted for the same range of years in each season as for the frequency histograms of latitude and longitude described above.

2.2.4 Indices of Dispersion

Indices of dispersion for each year and survey were also calculated based on nearest neighbor distances:

$$I = (N+1)\frac{\sum_1^N (x^2)^2}{\left(\sum_1^N x^2\right)^2};$$

where x was the nearest neighbor distance and N was the number of sample sites where herring were caught. A value of I = 2.0 suggests a random distribution, <2.0 suggests uniformity, and >2.0 aggregation.

2.2.5 Mean Latitude and Longitude

The mean latitude and longitude of catches for each year and survey was plotted as a measure of the approximate spatial center of abundance. This plot would allow for the examination of temporal trends in the spatial center of the distribution of the stock.

3. RESULTS

3.1 Kernel Density Plots

Kernel density plots for the spring and fall surveys showed a more expansive concentration of herring since abundance was low in the early 1980s. In 1983, the spring survey suggested that the stock complex was concentrated to the north of 40-41° latitude (Figure 2). As the stock recovered during the late 1980s, the herring concentration expanded and displayed an elongate southwest to northeast pattern (Figure 2). This pattern persisted during the 2000s.

In 1980, herring were only captured at one site during the fall survey (Figure 3). As the stock recovered during the late 1980s the herring concentration began to occupy a broader area and was found from approximately 41-43° latitude during 1986-1998 and 40-44° latitude during the 2000s (Figure 3).

3.2 Frequency Histograms

Frequency distributions of the latitude and longitude of herring catches in the spring and fall surveys were less fragmented and catches have occurred over a broader range since the stock recovered from low abundance in the early 1980s. In 1983, the frequency distribution of spring survey herring catches was fragmented and centered around 40-45° latitude and 67-71° longitude (Figure 4; Figure 5). As the stock recovered during the late 1980s the herring complex became more broadly distributed and catches between 39-45° latitude and 67-76° longitude became more frequent and remained so during the 2000s (Figure 4; Figure 5).

In 1985, the frequency distribution of fall survey herring catches was fragmented and most sites were north of 42° latitude and between 69-71° longitude (Figure 6; Figure 7). As the stock recovered, catches occurred more frequently towards the tails of the distributions with a greater frequency of sites south of 42° latitude and east of 69° longitude (Figure 6; Figure 7).

3.3 Nearest Neighbor Distances

Cumulative distributions of nearest neighbor distances from spring and fall survey catches have been less fragmented and more gradual since the stock recovered from low abundance in the early 1980s. In 1983, the cumulative nearest neighbor distance distribution for the spring survey was fragmented with about 50% of the distances between 0.1-0.2° and 60% between 0.1-0.4° (Figure 8). As the stock recovered, the cumulative distributions became more gradual. In 1989, the percentage of distances between 0.1-0.2° increased to about 60% with nearly 100% between 0.1-0.6°. Since then, >90% of the distances were between 0.1-0.4° (Figure 8).

The cumulative distributions of nearest neighbor distances from the fall survey have a similar pattern to the spring survey distributions. In 1985, the distribution was fragmented with about 90% of the distances between 0.1-0.6° (Figure 9). In 1990, the distribution was more gradual with about 90% of the distances between 0.1-0.4° (Figure 9). Since then, >90% of the distances were between 0.1-0.4° (Figure 9).

3.4 Indices of Dispersion

Distance indices of dispersion were variable during 1970-1990 for the spring survey and variable for the entire fall survey time series. Aggregation (I >2) was evident in all years of the spring survey except 1995 (I= 1.94) and 2009 (I= 1.94; Figure 10). Indices of dispersion were more variable during 1968-1990 (mean = 6.20, range = 2.05-28.27) than 1991-2009 (mean = 2.60, range = 1.94-3.71; Figure 10).

Aggregation was evident in all years of the fall survey except 1974 (I=1.98), 1977 (I=1.79), 1981 (I=1.50), and 1992 (I=1.96; Figure 10). Indices of dispersion have become increasingly variable over the fall survey time series (Figure 10).

3.5 Mean Latitude and Longitude

Mean latitude and longitude of herring catches during the spring and fall surveys have remained centered in different locations since the stock recovered from low abundance in the early 1980s. The capture locations from the spring survey were centered in the southwest during the late 1960s, shifted to the northeast during the 1970s, and even farther northeast during the mid-1980s (Figure 11). Since then, the capture locations have shifted back to the southwest near 41° latitude and 70-71° longitude (Figure 11).

The capture locations from the fall survey were generally centered in the southeast during the 1960s, but shifted to the northwest during the mid-1970s and early 1980s (Figure 11). Since then, the capture locations have shifted to the east near 42-43° latitude and 69° longitude (Figure 11).

4. CONCLUSIONS

The spatial patterns of the survey catches can be used to make inference about the general status of the herring complex (Overholtz 2002). The herring complex shrank in range and the spatial center of the survey catches in each season shifted when the stock was near collapse in the early 1980s (Overholtz 2002). As the stock recovered, the range expanded and the spatial center of the survey catches returned to a pattern similar to years prior to the collapse and has remained that way through 2009. These results suggest that the Gulf of Maine-George's Bank herring complex has not returned to a collapsed state since recovery.

The results of this analysis could be used in conjunction with formal stock assessment results to help managers make more informed decisions. The last herring stock assessment concluded that the herring stock was not overfished and that overfishing was not occurring (TRAC 2009). Although the analysis in this manuscript was too coarse to make conclusions about the abundance of herring relative to overfishing reference points, the results were consistent with the conclusions of the previous herring assessment. The previous herring assessment, however, also suffered from multiple sources of uncertainty (TRAC 2009). These uncertainties were considered so severe that the results of the last assessment were not explicitly used to calculate acceptable biological catches (ABC) for 2010-2012, and the New England Fishery Management Council (NEFMC) set the ABCs based on recent catches, which resulted in approximately a 45% decrease in ABCs from the previous three years (NEFMC 2010). By considering whether the results of formal stock assessments are consistent with the results of studies such as this one, managers may be more informed about whether future increases or decreases to ABCs are warranted.

5. ACKNOWLEDGEMENTS

I would like to thank the countless people that helped collect and process the survey data. Bill Overholtz and Gary Shepherd provided comments on an earlier draft of this manuscript. Dan Hennen provided advice on computer coding related to several of the analyses.

6. REFERENCES

Anthony, V.C. and G. Waring. 1980. The assessment and management of the Georges Bank herring fishery. In: The Assessment and Management of Pelagic Fish Stocks. Rapports et Procès-verbaux Des Rèunions Conseil International Pour L'Exploration de la Mer 177: 72-111.

Azarovitz, T.R. 1981. A brief historical review of the Woods Hole Laboratory trawl survey time series. In: Doubleday, W.G., and Rivard, D. (editors), Bottom Trawl Surveys. Canadian Special Publication of Fisheries and Aquatic Sciences 58: 62-67.

Barnage, M., I. Hampton, and B.A. Roel. 1999. Trends in the abundance and distribution of anchovy and sardine on the South African continental shelf in the 1990s, deduced from acoustic surveys. South African Journal of Marine Science 21: 367-391.

Byrne, C.J., T.R. Azarovitz, and M.P. Sissenwine. 1981. Factors affecting variability of research vessel trawl surveys. In: Doubleday, W.G., and Rivard, D. (editors), Bottom Trawl Surveys. Canadian Special Publication of Fisheries and Aquatic Sciences 58: 258-273.

Despres-Patanjo, L.I., T.R. Azarovitz, and C.J. Byrne. 1988. Twenty five years of fish surveys in the northwest Atlantic: The NMFS Northeast Fisheries Center's bottom trawl survey program. Marine Fisheries Review 50(4): 69-71.

LLuch-Belda, D, RA. Schwartzlose, R. Serra, R. Parrish, T. Kawasaki, D. Hedgecock, and R.J.M. Crawford. 1992. Sardine and anchovy regime fluctuations of abundance in four regions of the world oceans: a workshop report. Fisheries Oceanography 1(4): 339-347.

MacCall AD. 1990. Dynamic Geography of Marine Fish Populations. University of Washington Press, Seattle.

NEFMC. 2010. Proposed Atlantic Herring Specifications for the 2010-2012 Fishing Years. New England Fishery Management Council (available at: http://www.nefmc.org/).

Overholtz, W.J. 2002. The Gulf of Maine-Georges Bank Atlantic herring: spatial pattern analysis of the collapse and recovery of a large marine fish complex. Fisheries Research 57: 237-254.

TRAC. 2009. Transboundary Resources Assessment Committee Gulf of Maine/Georges Bank Atlantic Herring Stock Assessment Update. TRAC reference document 2009/04 (available at: http://www.mar.dfo-mpo.gc.ca/science/trac/rd.html).

Tupper MH, V.C. Anthony, S.B. Chenoweth, and H.A. MacCluen. 1998. Biology and Assessment of Gulf of Maine Herring Stocks. Gulf of Maine Aquarium, Portland.

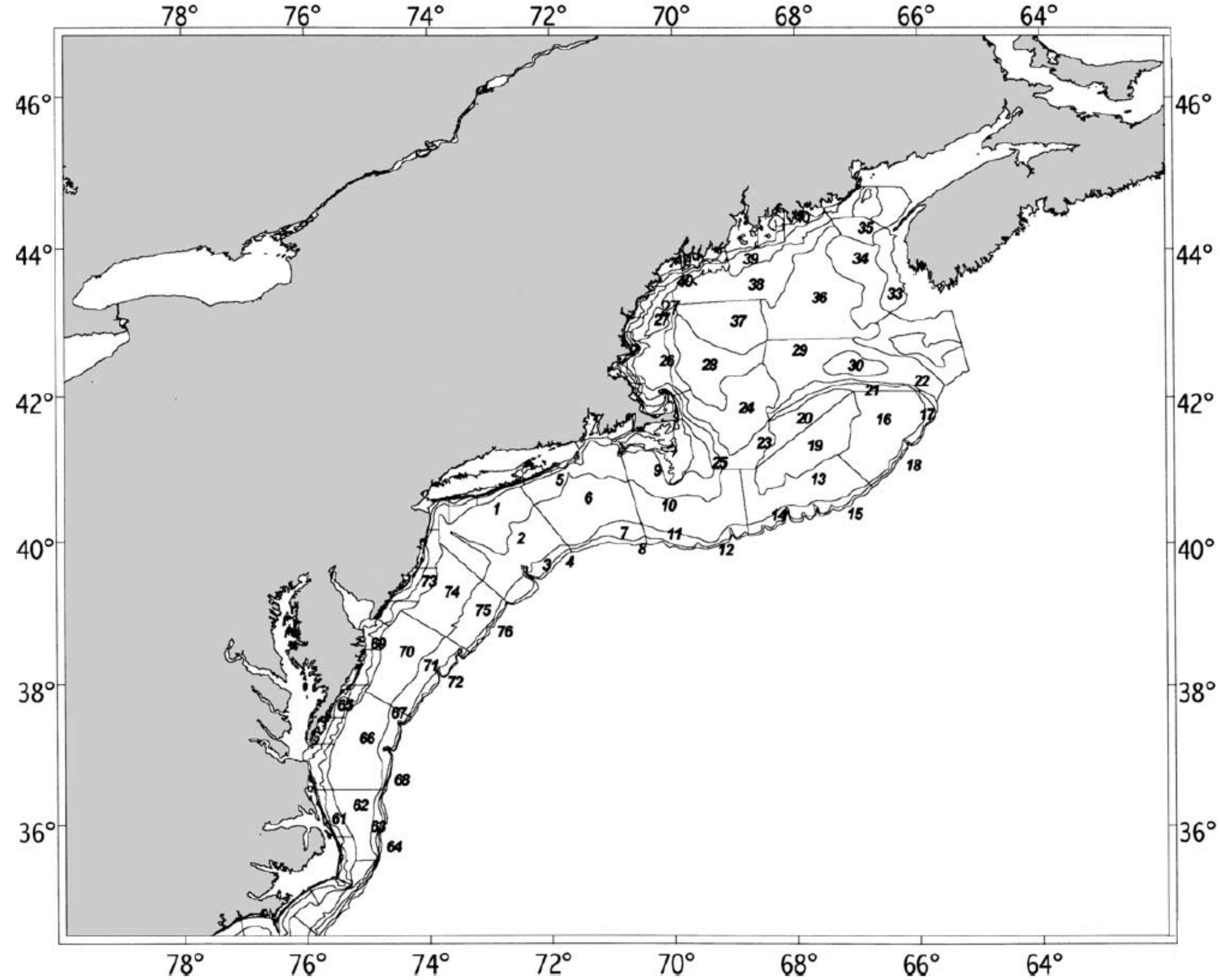

Figure 1. Survey strata used in Northeast Fisheries Science Center bottom trawl surveys.

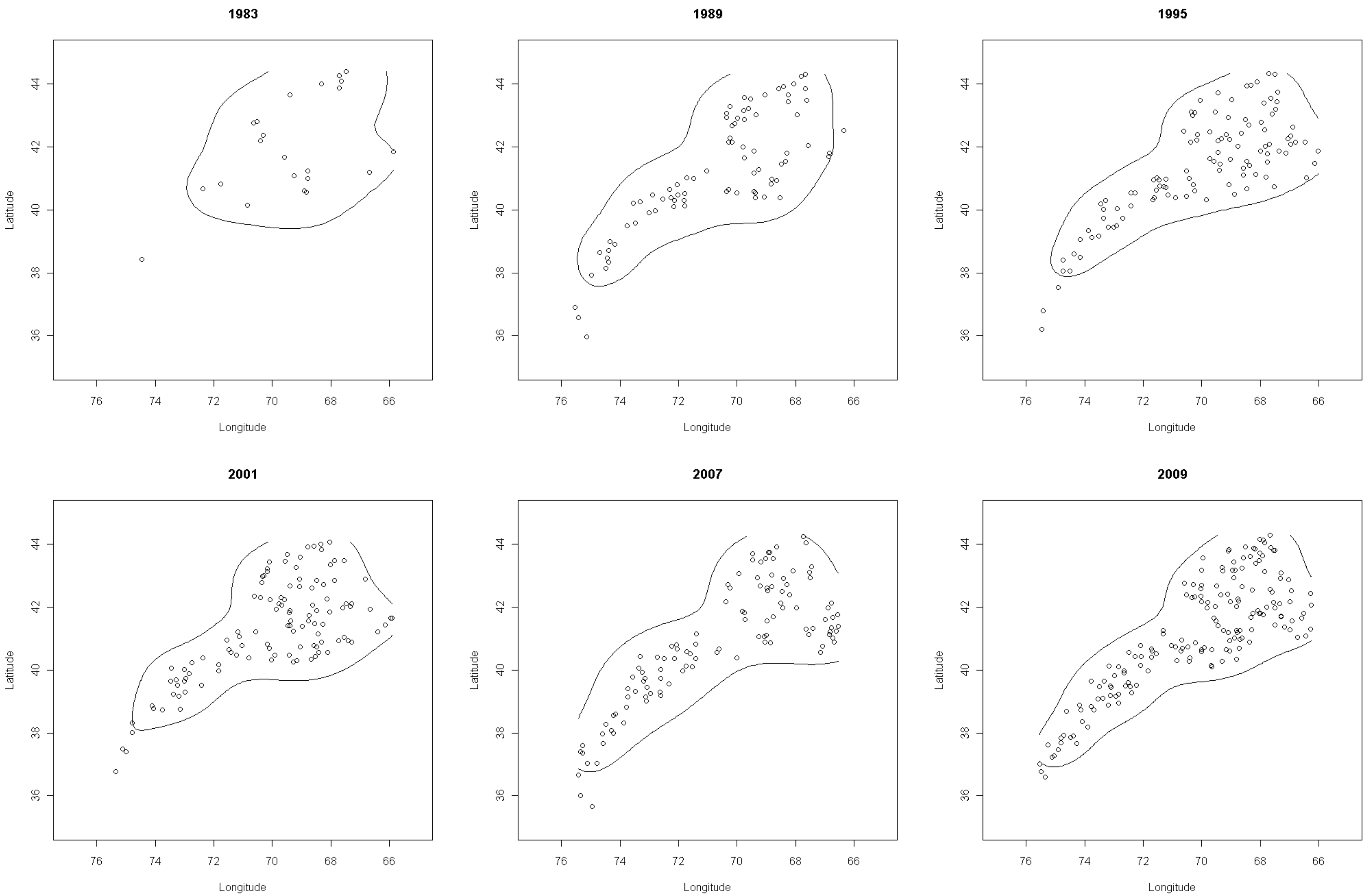

Figure 2. Kernel density plots (with arbitrary contour line) of herring capture locations for selected years from spring bottom trawl surveys.

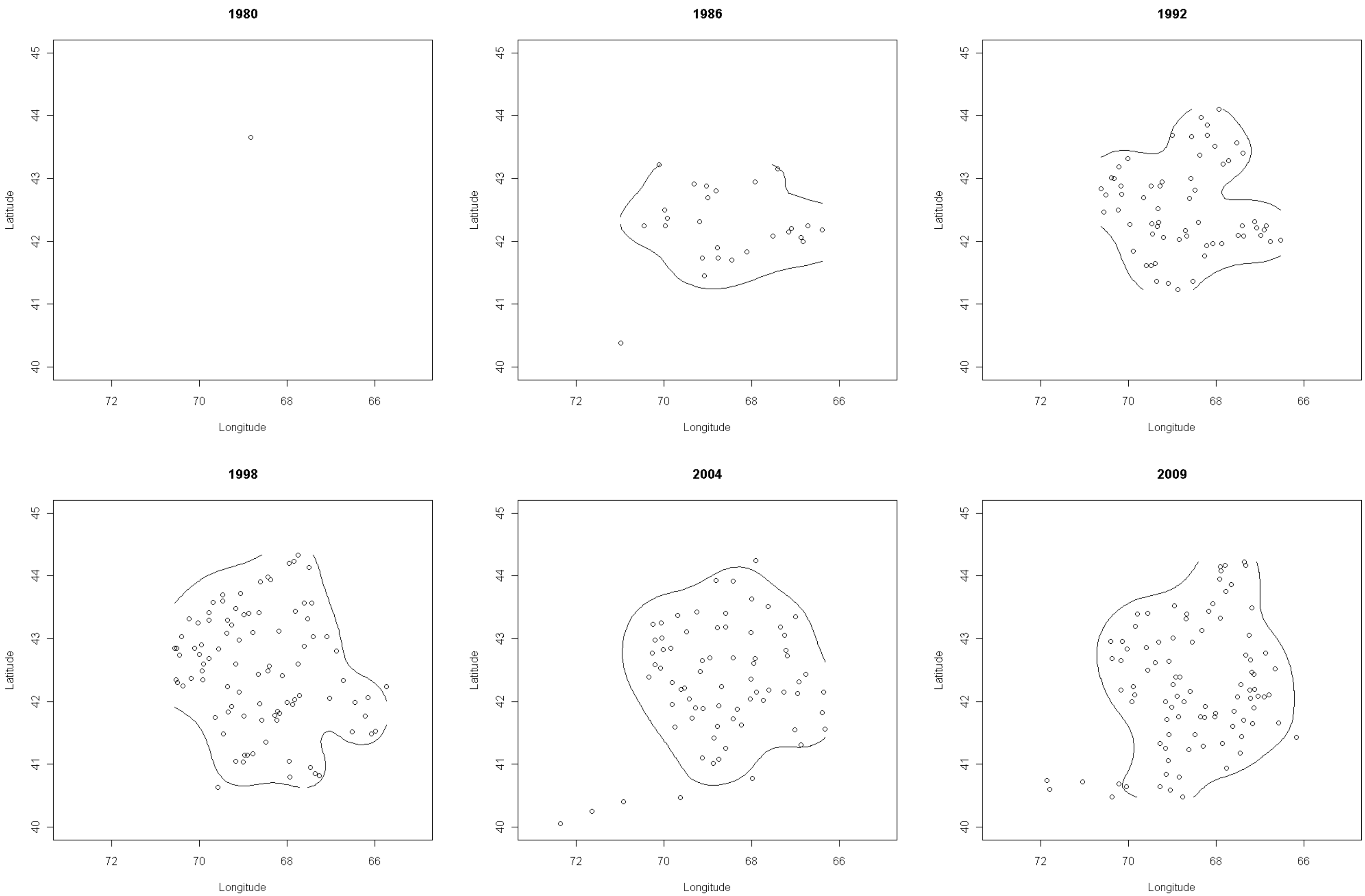

Figure 3. Kernel density plots (with arbitrary contour line) of herring capture locations for selected years from fall bottom trawl surveys.

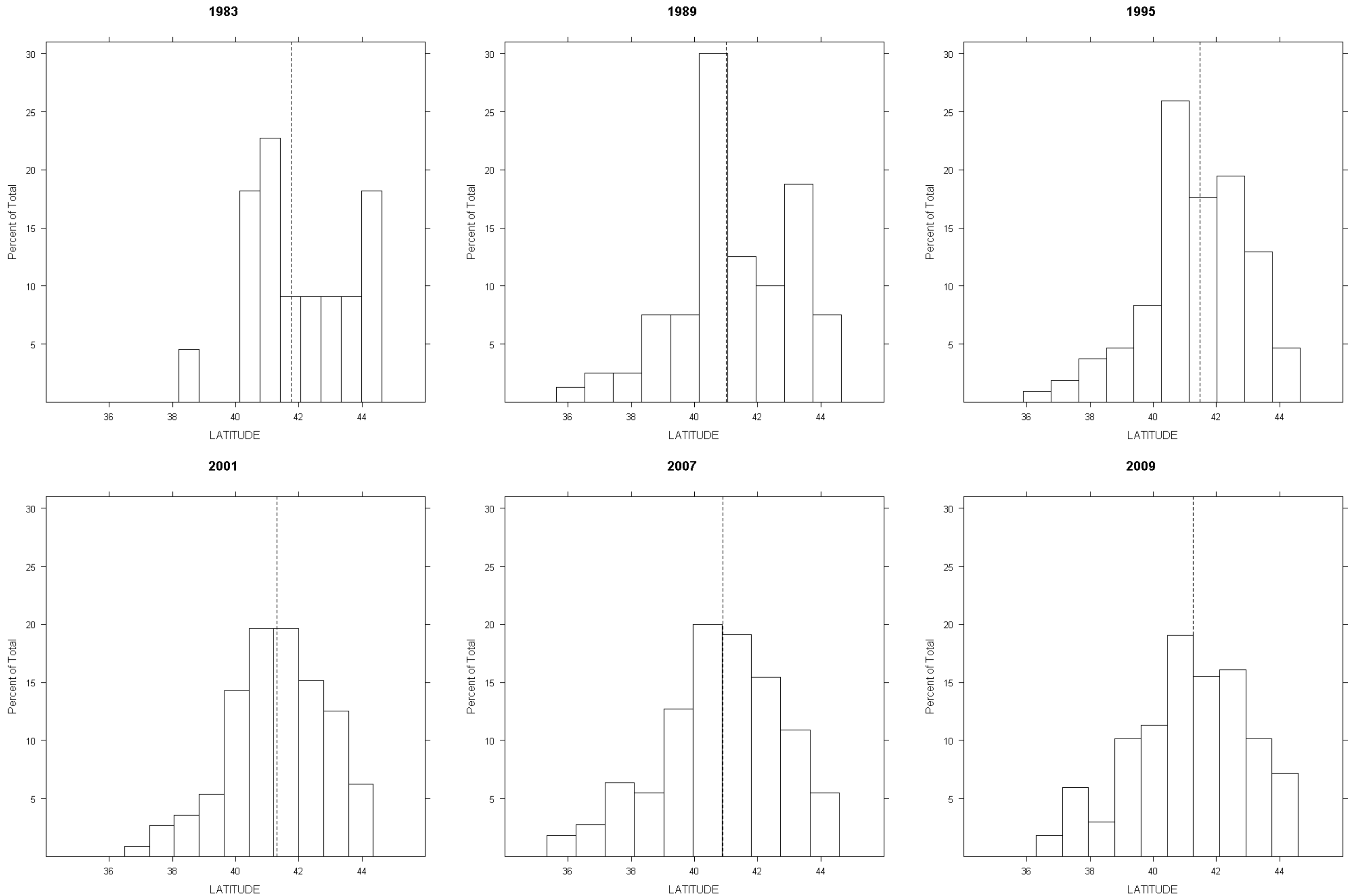

Figure 4. Frequency histograms of the latitude of herring capture locations for selected years from spring bottom trawl surveys. The dashed vertical line represents the median.

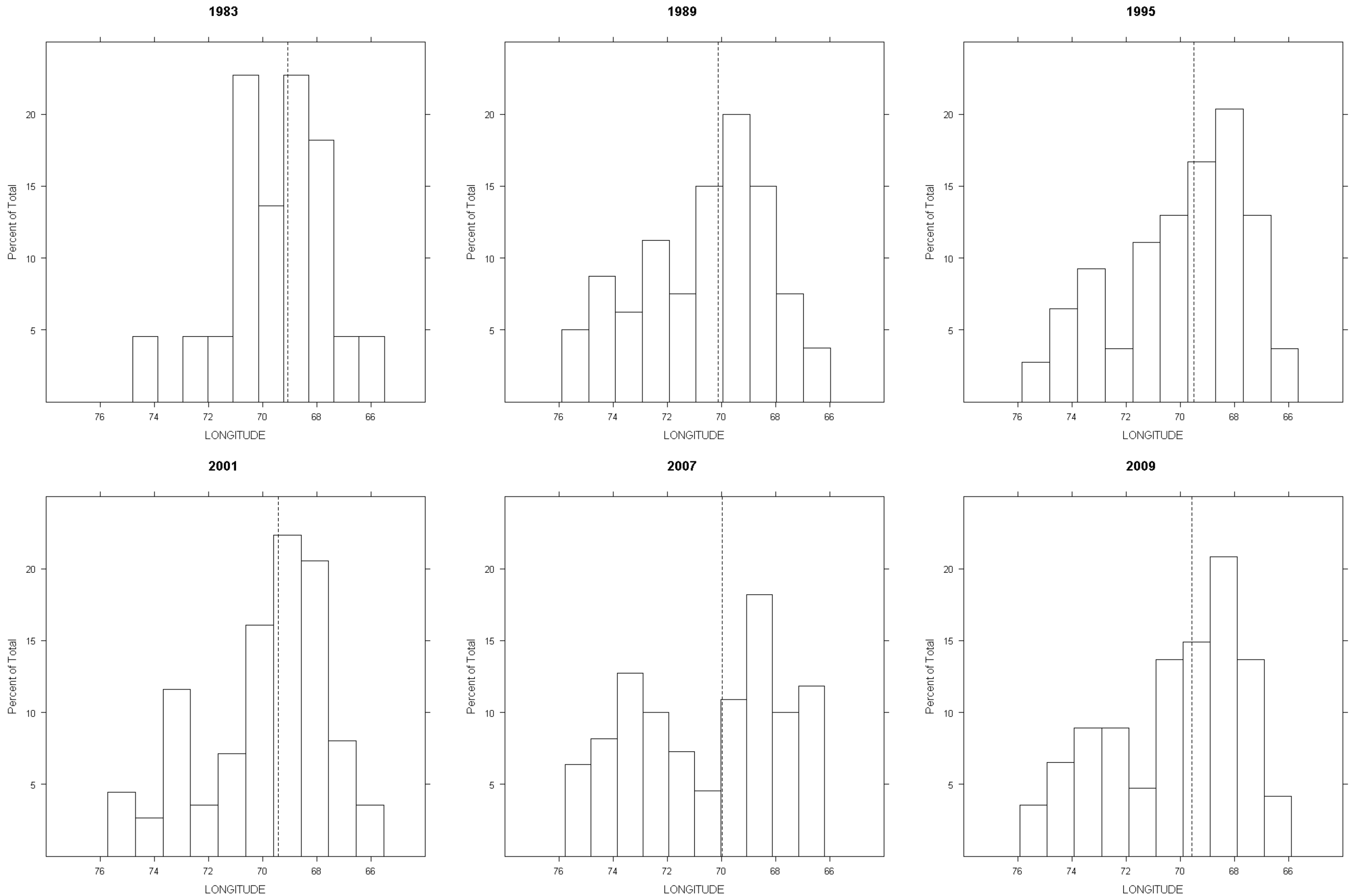

Figure 5. Frequency histograms of the longitude of herring capture locations for selected years from spring bottom trawl surveys. The dashed vertical line represents the median.

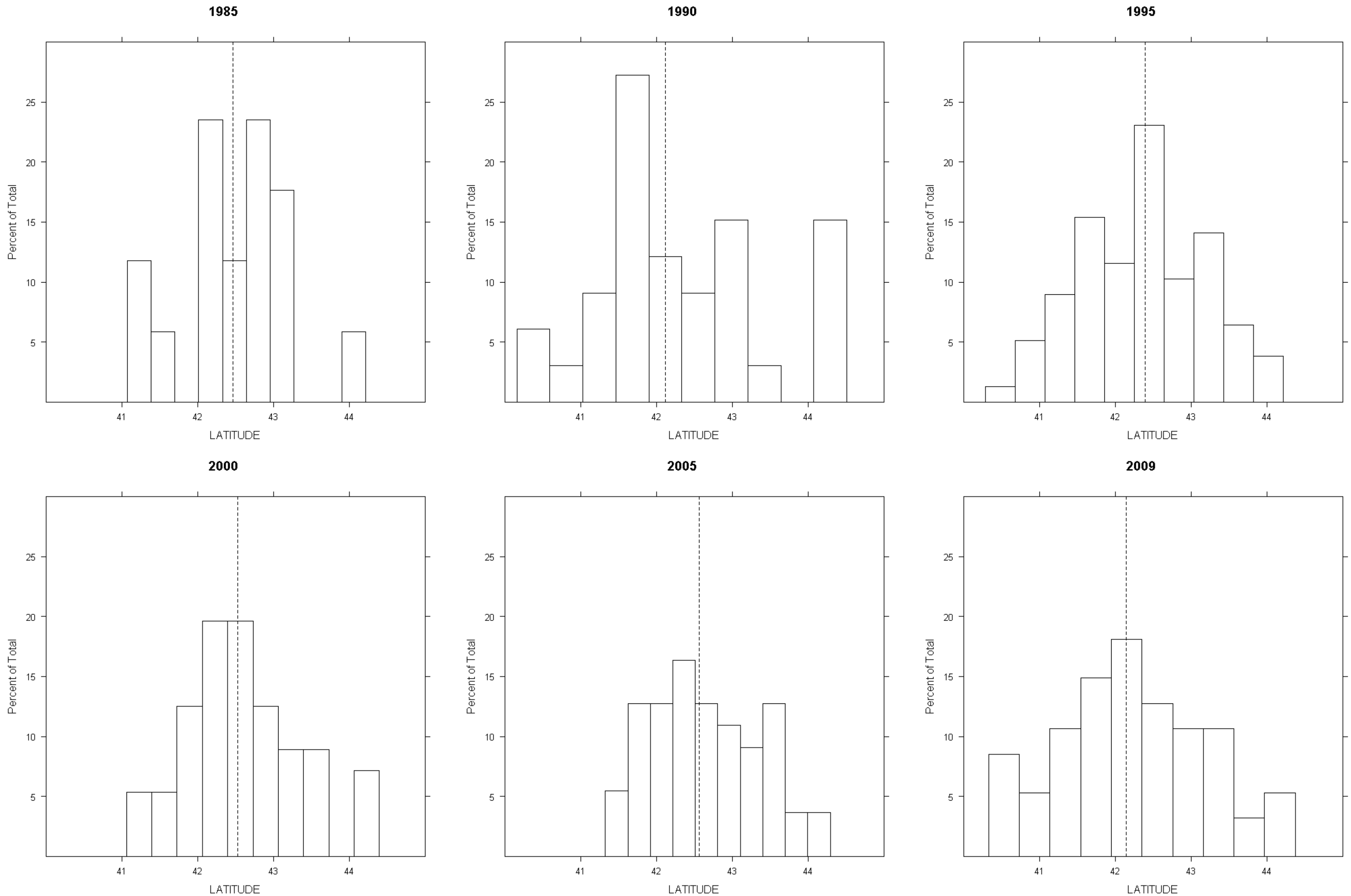

Figure 6. Frequency histograms of the latitude of herring capture locations for selected years from fall bottom trawl surveys. The dashed vertical line represents the median.

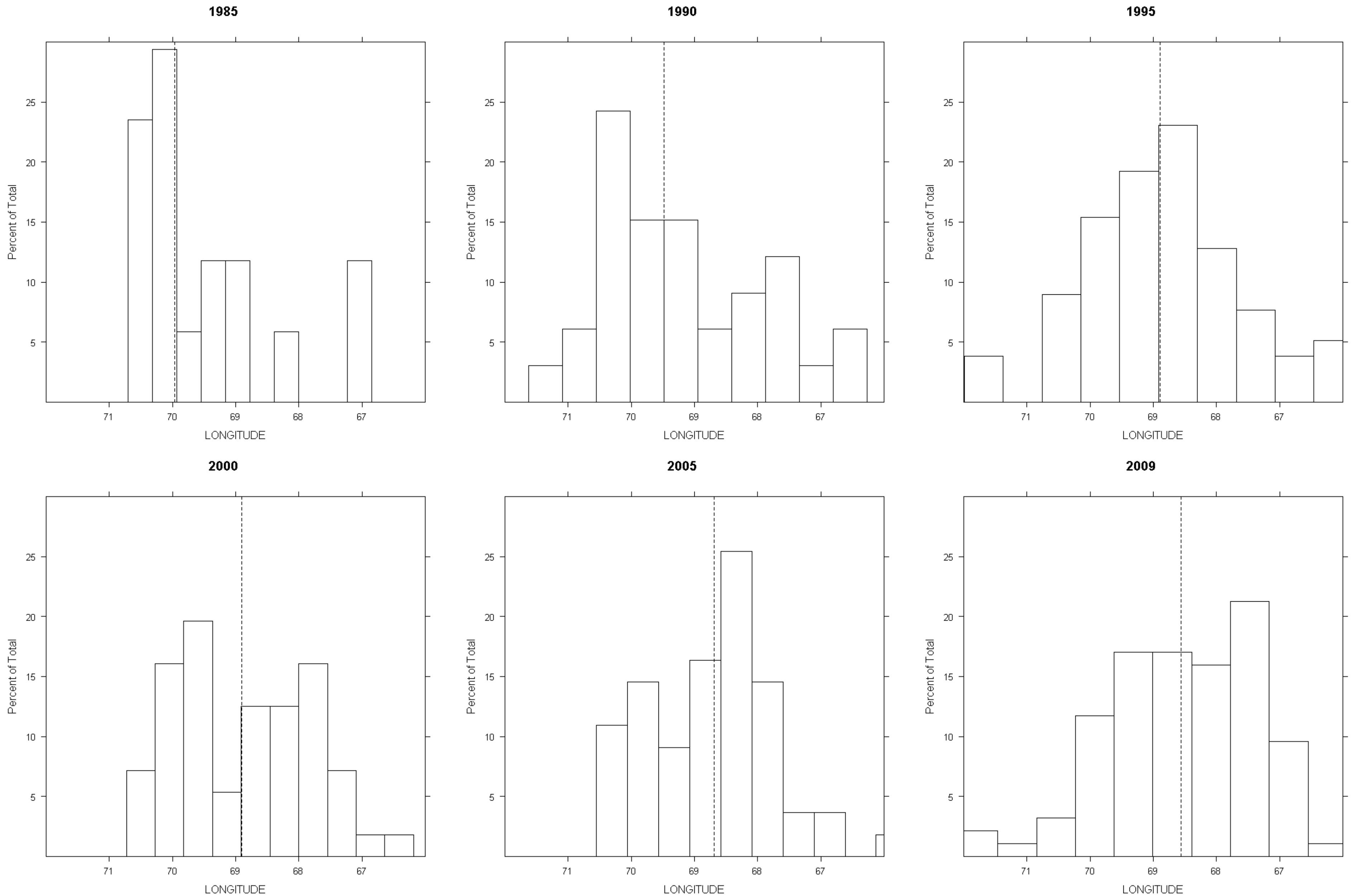

Figure 7. Frequency histograms of the longitude of herring capture locations for selected years from fall bottom trawl surveys. The dashed vertical line represents the median.

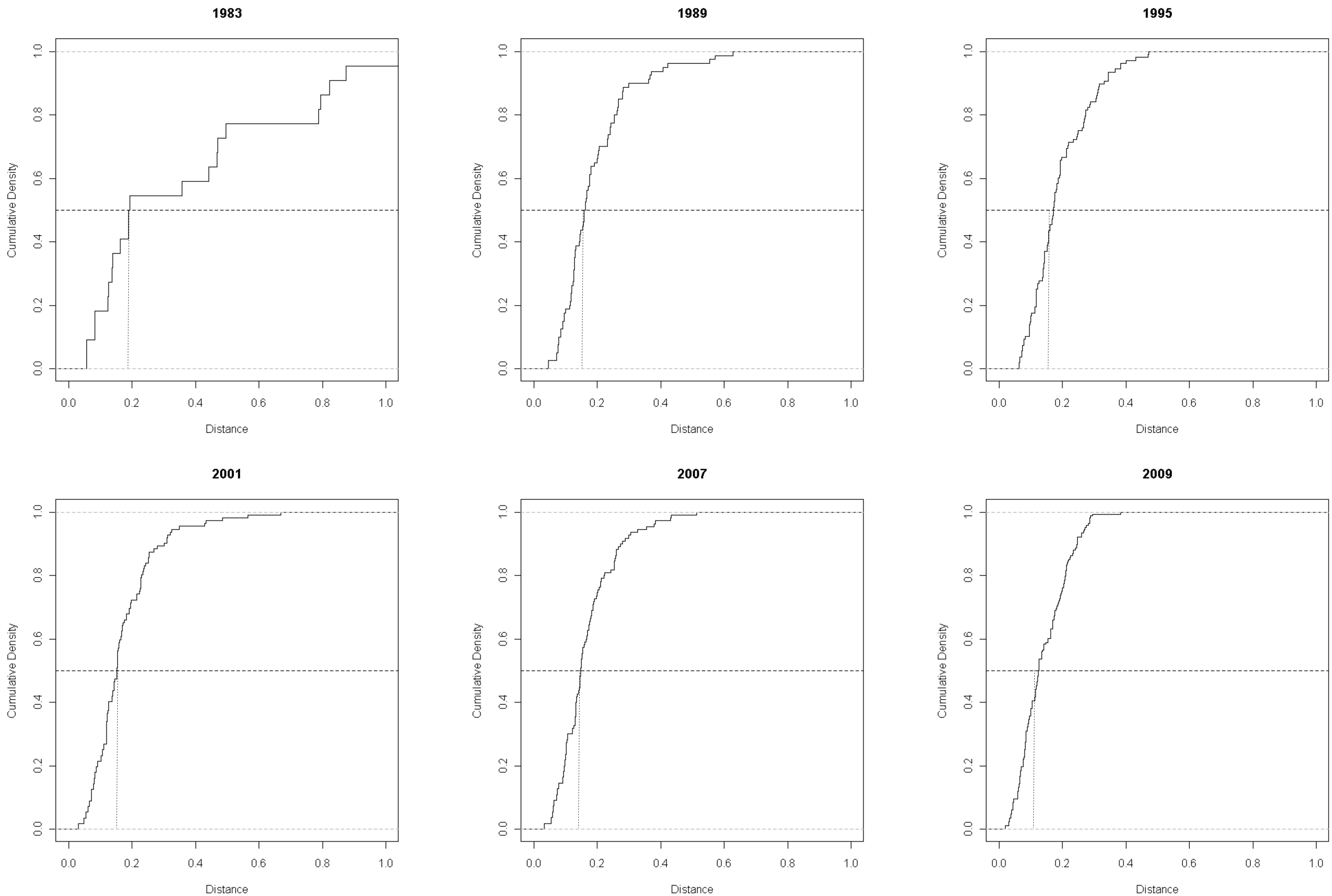

Figure 8. Cumulative distributions of nearest neighbor distances of herring capture locations for selected years from spring bottom trawl surveys. Dashed horizontal lines represent cumulative densities of 0.0, 0.5, and 1.0. The dashed vertical line represents the distance at a cumulative density of 0.5.

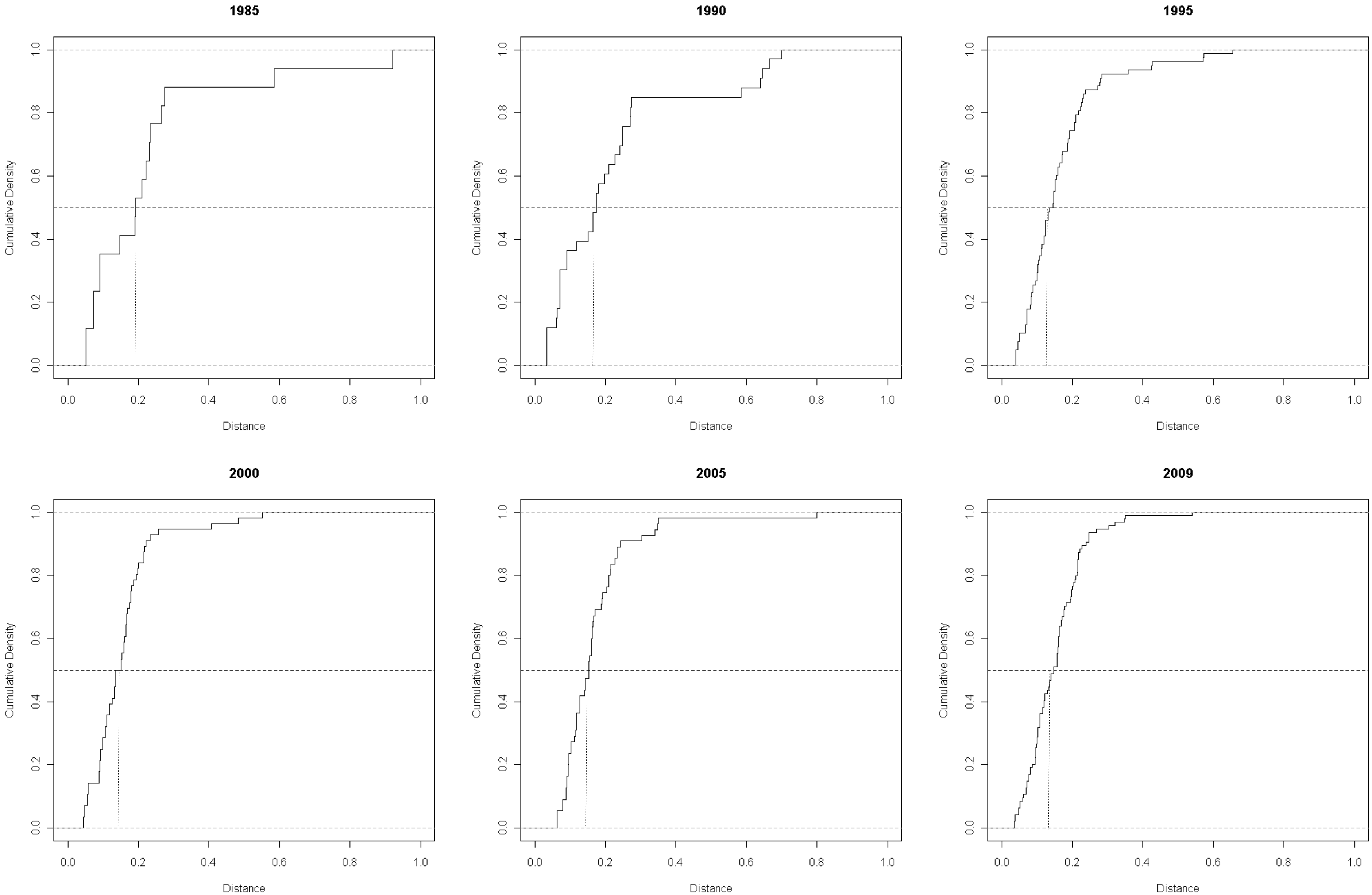

Figure 9. Cumulative distributions of nearest neighbor distances of herring capture locations for selected years from fall bottom trawl surveys. Dashed horizontal lines represent cumulative densities of 0.0, 0.5, and 1.0. The dashed vertical line represents the distance at a cumulative density of 0.5.

Figure 10. Indices of dispersion distance between herring capture locations during spring (top panel; 1968-2009) and fall (bottom panel; 1963-2009) bottom trawl surveys.

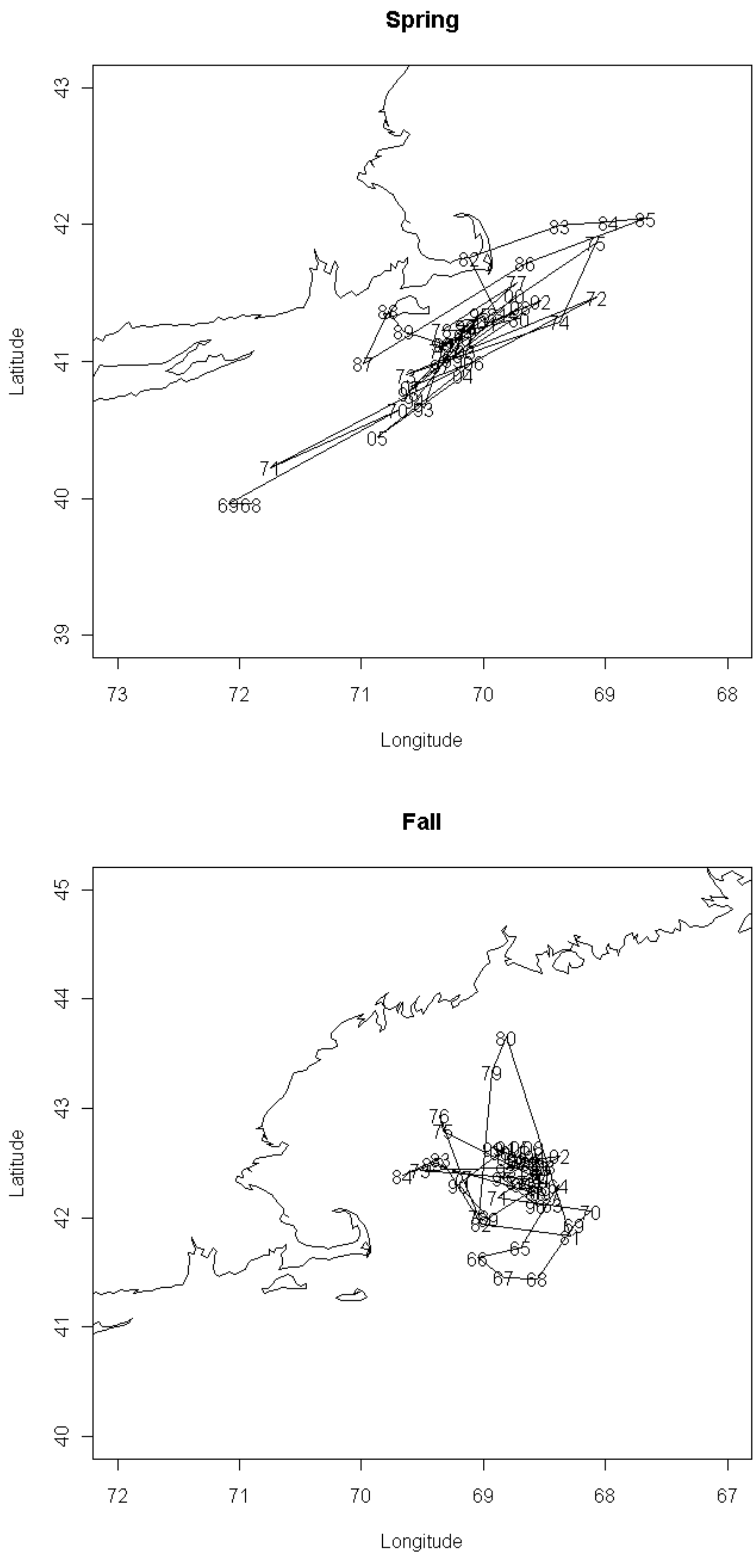

Figure 11. Relative center of herring abundance based on mean latitude and longitude of herring catches during spring (top panel; 1968-2009) and fall (bottom panel; 1963-2009) bottom trawl surveys.

Procedures for Issuing Manuscripts in the *Northeast Fisheries Science Center Reference Document* (CRD) Series

Clearance

All manuscripts submitted for issuance as CRDs must have cleared the NEFSC's manuscript/abstract/webpage review process. If any author is not a federal employee, he/she will be required to sign an "NEFSC Release-of-Copyright Form." If your manuscript includes material from another work which has been copyrighted, then you will need to work with the NEFSC's Editorial Office to arrange for permission to use that material by securing release signatures on the "NEFSC Use-of-Copyrighted-Work Permission Form."

For more information, NEFSC authors should see the NEFSC's online publication policy manual, "Manuscript/abstract/webpage preparation, review, and dissemination: NEFSC author's guide to policy, process, and procedure," located in the Publications/Manuscript Review section of the NEFSC intranet page.

Organization

Manuscripts must have an abstract and table of contents, and (if applicable) lists of figures and tables. As much as possible, use traditional scientific manuscript organization for sections: "Introduction," "Study Area" and/or "Experimental Apparatus," "Methods," "Results," "Discussion," "Conclusions," "Acknowledgments," and "Literature/References Cited."

Style

The CRD series is obligated to conform with the style contained in the current edition of the United States Government Printing Office Style Manual. That style manual is silent on many aspects of scientific manuscripts. The CRD series relies more on the CSE Style Manual. Manuscripts should be prepared to conform with these style manuals.

The CRD series uses the American Fisheries Society's guides to names of fishes, mollusks, and decapod crustaceans, the Society for Marine Mammalogy's guide to names of marine mammals, the Biosciences Information Service's guide to serial title abbreviations, and the ISO's (International Standardization Organization) guide to statistical terms.

For in-text citation, use the name-date system. A special effort should be made to ensure that all necessary bibliographic information is included in the list of cited works. Personal communications must include date, full name, and full mailing address of the contact.

Preparation

Once your document has cleared the review process, the Editorial Office will contact you with publication needs – for example, revised text (if necessary) and separate digital figures and tables if they are embedded in the document. Materials may be submitted to the Editorial Office as files on zip disks or CDs, email attachments, or intranet downloads. Text files should be in Microsoft Word, tables may be in Word or Excel, and graphics files may be in a variety of formats (JPG, GIF, Excel, PowerPoint, etc.).

Production and Distribution

The Editorial Office will perform a copy-edit of the document and may request further revisions. The Editorial Office will develop the inside and outside front covers, the inside and outside back covers, and the title and bibliographic control pages of the document.

Once both the PDF (print) and Web versions of the CRD are ready, the Editorial Office will contact you to review both versions and submit corrections or changes before the document is posted online.

A number of organizations and individuals in the Northeast Region will be notified by e-mail of the availability of the document online.

Research Communications Branch
Northeast Fisheries Science Center
National Marine Fisheries Service, NOAA
166 Water St.
Woods Hole, MA 02543-1026

MEDIA MAIL

Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

NOAA Technical Memorandum NMFS-NE -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

Northeast Fisheries Science Center Reference Document -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review and most issues receive copy editing.

Resource Survey Report (formerly *Fishermen's Report*) -- This information report is a regularly-issued, quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. This report undergoes internal review, but receives no technical or copy editing.

TO OBTAIN A COPY of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2350) or consult the NEFSC webpage on "Reports and Publications" (http://www.nefsc.noaa.gov/nefsc/publications/). To access *Resource Survey Report*, consult the Ecosystem Surveys Branch webpage (http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/).