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NOAA Atlas NESDIS 20



WORLD OCEAN DATABASE 1998 VOLUME 3: Temporal Distribution of Expendable Bathythermograph Profiles

Washington, D.C.
June 1998

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service

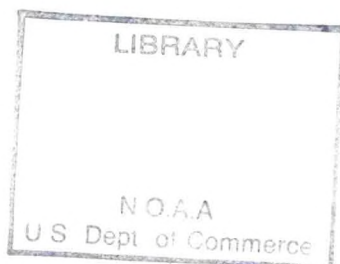
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WORLD OCEAN DATABASE 1998 Volume 3: Temporal Distribution of Expendable Bathythermograph Profiles



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National Oceanographic Data Center
Ocean Climate Laboratory

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PREFACE

The oceanographic databases described by this atlas series greatly expands on the *World Ocean Atlas 1994* (WOA94) database. Previous oceanographic databases including the NODC/WDC-A profile archives, and products derived from these databases, have proven to be of great utility to the international oceanographic, climate research, and operational environmental forecasting communities. In particular, the objectively analyzed fields of temperature and salinity derived from these databases have been used in a variety of ways. These include use as boundary and/or initial conditions in numerical ocean circulation models, for verification of numerical simulations of the ocean, as a form of "sea truth" for satellite measurements such as altimetric observations of sea surface height, and for planning oceanographic expeditions. The databases, and products based on these databases, are critical for support of international assessment programs such as the Intergovernmental Program on Climate Change (IPCC) of the United Nations.

We have expanded these earlier databases to include variables such as chlorophyll and plankton because:

- 1) there is a need for such databases to study the role of biogeochemical cycles in determining how the earth's climate system works, particularly the vulnerability of ocean ecosystems to climate change (IPCC, 1996);
- 2) the analysis of remotely sensed estimates of chlorophyll (SeaWiFS, ADEOS missions) requires knowledge of *in situ* variables such as chlorophyll and plankton;
- 3) our belief that the most comprehensive set of oceanographic databases should be available as a matter of course to the international research community.

It is well known that the amount of carbon dioxide in the earth's atmosphere will most likely double during the next century compared to CO₂ levels that occurred at the beginning of the Industrial Revolution. Regardless of one's scientific and/or political view of a possible "enhanced greenhouse warming" due to the increase of carbon dioxide, it is necessary that the international scientific community have access to the most complete historical oceanographic databases possible in order to study this problem, as well as other scientific and environmental problems. The science community should have access to the most complete oceanographic databases possible to fulfill its obligations.

The production of oceanographic databases is a major undertaking. Such work benefits from the input of many individuals and organizations. We have tried to structure the data sets in such a way as to encourage feedback from experts around the world who have knowledge that can improve the data and metadata contents of the database. It is only with such feedback that high quality global ocean databases can be prepared. Just as with scientific theories and numerical models of the ocean and atmosphere, the development of global ocean databases is not carried out in one giant step, but proceeds in an incremental fashion.

In the acknowledgment section of this publication we have expressed our view that creation of global ocean databases is only possible through the cooperation of scientists, data managers, and scientific administrators throughout the international community. I would also like to thank my colleagues and the staff of the Ocean Climate Laboratory of NODC for their dedication to the project leading to publication of this atlas series. Their integrity and thoroughness have made this database possible. It is my belief that the development and management of national and international oceanographic data archives is best performed by scientists who are actively working with the historical data.

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June 1998

IPCC, 1996: Impacts, Adaptations and Mitigation of Climate Change: Scientific Technical Analyses. Cambridge University Press, 872 pp.

Acknowledgments

This work was made possible by a grant from the NOAA Climate and Global Change Program which enabled the establishment of a research group at the National Oceanographic Data Center. The purpose of this group is to prepare research quality oceanographic databases, as well as to compute objective analyses of, and diagnostic studies based on, these databases.

The data made available as part of this atlas include the oceanographic data archives maintained by NODC/WDC-A as well as data acquired as a result of the NODC Oceanographic Data Archaeology and Rescue (NODAR) project and the IODE/IOC Global Oceanographic Data Archaeology and Rescue (GODAR) project. At NODC/WDC-A, "data archaeology and rescue" projects are supported with funding from the NOAA Environmental Science Data and Information Management (ESDIM) Program and NOAA Climate and Global Change Program. The majority of funding for these efforts is now provided by the ESDIM program. Support for some of the regional IOC/GODAR meetings was provided by the MAST program of the European Union (Levitus *et al.*, 1998).

We would like to acknowledge the scientists, technicians, and programmers who have submitted data to national and regional data centers as well as the managers and staff at the various data centers. Our database now allows for the storage of additional metadata including information about Principal Investigators to recognize their efforts as well as to provide information that may be useful in determining the quality of data.

The OCL expresses thanks to those who provided comments and helped develop an improved *World Ocean Database 1998* product. In particular, Dr. Steve Worley of NCAR, Dr. Harry Dooley of ICES, Dr. Norm Hall (NODC) for testing the CD-ROMs prior to distribution. John E. O'Reilly (NMFS/NOAA) contributed the program for converting from OCL ASCII format to IDL, Dr. Harry Dooley contributed the conversion program from OCL ASCII format to the ICES/OceanPC format. Any errors are the responsibility of the Ocean Climate Laboratory.

Ron Moffatt and Ervin Godfrey Trammell of the NODC International Data Exchange Team helped locate data in the WDC-A archives for digitization. The OCL would also like to acknowledge the help received over the last several years from colleagues in other NODC divisions. Francis Mitchell helped with all the code lists and accessions, Melanie Hamilton supplied GTSP data, J.D. Hardy researched and documented the correct status of many plankton names, Sheri Phillips helped Olga Baranova design our CD-ROM graphics, Mike Simmons, Carla Bazemore, and Maggie Dunklee wrote the NODC P3 format description presented in the documentation of WOD98.

Recent declassification of substantial amounts of naval oceanographic data by the Russian Naval Ocean Research Center, the United Kingdom Hydrographic Office, and the Argentine Navy is acknowledged. The Intergovernmental Oceanographic Commission has requested such declassification efforts in recent years.

We appreciate the efforts of David Adamec, Jim Carton, and Gennady Chepurin in reviewing the manuscript version of this publication.

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World Ocean Database 1998, Volume 3: Temporal Distribution of Expendable Bathythermograph Profiles

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ABSTRACT

This atlas describes a collection of scientifically quality controlled ocean Expendable Bathythermograph (XBT) profiles. Yearly distributions and seasonal data distributions for individual years of all XBT profiles in the database are presented to provide information on the state of ocean XBT profile observations.

1. INTRODUCTION

The Expendable Bathythermograph (XBT) was deployed beginning in 1966 and has replaced the MBT in many measurement programs. There are different models of XBT instruments which have different maximum depth penetration and/or other different characteristics. The T-4, T-6, and T-7 probes reach maximum depths of 450, 750, and 750 m respectively. The T-7 probe differs from the T-6 probe in that it can be dropped from a faster moving ship and still maintain certain accuracy standards. The T-5 probe reaches a maximum depth of about 1800 m.

The depth of a temperature measurement from an XBT instrument is determined using the time elapsed between when the probe enters the water and the time each temperature measurement is made. A vendor supplied drop-rate equation is utilized. However, the vendor supplied drop-rate equation for T-4, T-6, and T-7 probes was found to have a systematic error and a new equation has been developed by the international research community (Hanawa *et al.*, 1995; UNESCO, 1994). The recommended practice regarding exchange and archiving of XBT profiles is that XBT profile data be exchanged or sent to data centers without correction for the systematic depth error, until an "international mechanism is established to implement the general use of the new equation" (UNESCO, 1994). This policy is to avoid double corrections.

2. The XBT drop rate error

The XBT instrument does not measure pressure or depth directly. Depth of the instrument is

computed from the elapsed time from when the probe enters the water through use of a drop-rate equation. There are several models of the Sippican Expendable Bathythermograph instrument. The manufacturer's drop rate equation for the T4, T-6, and T-7 models are known to contain a systematic error. To correct for this error a new drop rate equation has been computed (Hanawa *et al.*, 1995; UNESCO, 1994). By international agreement (UNESCO, 1994), XBT profile depths are supposed to be reported and archived using depths computed from the "old" drop-rate equation. This policy is to avoid possible confusion as to whether the profiles have been converted or not so as to avoid double conversion. NODC/WDC-A archives the XBT data as submitted. **The observed level XBT profiles are the same data as submitted by originators. However, in preparing standard level data for WOD98, the NODC/OCL corrected the depths of the originator's XBT profiles using the new drop-rate equation before interpolating to standard levels.**

3. XBT PROFILE DISTRIBUTIONS

Figure 1 shows the number of XBT profiles contained in WOD98 for the World Ocean as a function of year. Figures 2 and 3 show the time series for the northern and southern hemispheres respectively. There are a total of 1,644,911 XBT profiles for the entire World Ocean with 279,145 profiles (16.9%) measured in the southern hemisphere and 1,365,603 profiles (83.1%) measured in the northern hemisphere. Table 1 provides the exact number of XBT profiles included in WOD98 as a function of year. The geographic distribution of XBT profiles for individual years for 1966-1996 are shown in Figures A1-A31. The geographic distribution of XBT profiles for each season by individual years for 1966-1996 are shown in Figures B1-B124. Most profiles have been made in the northern hemisphere, but the southern hemisphere coverage has been increased due to international data archaeology and rescue efforts and the World Ocean Database project (Levitus *et al.* 1994, 1998).

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Table 1 National contributions of Expendable Bathymograph (XBT) profiles sorted by percent contribution of each country

*NODC	Country	XBT	% of
Country	Name	Count	Total
Code			
31	UNITED STATES	659382	40.09
32	UNITED STATES	234483	14.25
33	UNITED STATES	3080	0.19
49	JAPAN	212555	12.92
74	UNITED KINGDOM	155169	9.43
9	AUSTRALIA	71137	4.32
99	UNKNOWN	47911	2.91
18	CANADA	46186	2.81
6	GERMANY, FED. REP.	45366	2.76
35	FRANCE	33430	2.03
54	LIBERIA	23471	1.43
PA	PANAMA	19144	1.16
90	RUSSIA	13693	0.83
64	NETHERLANDS	11046	0.67
SI	SINGAPORE	8739	0.53
26	DENMARK	5852	0.36
61	NEW ZEALAND	5404	0.33
77	SWEDEN	4441	0.27
46	ICELAND	4292	0.26
AG	ANTIGUA	4205	0.26
58	NORWAY	4124	0.25
76	CHINA, PEOPLES REP	3349	0.2
SV	SAINT VINCENT	2920	0.18
29	SPAIN	2812	0.17
91	SOUTH AFRICA	2750	0.17
20	CHILE	2359	0.14
BH	BAHAMAS	2079	0.13
57	MEXICO	1959	0.12
8	ARGENTINA	1909	0.12
67	POLAND	1320	0.08
CY	CYPRUS	1256	0.08
42	INDONESIA	1178	0.07
TN	TONGA	1165	0.07
66	PHILIPPINES	1001	0.06
KU	KUWAIT	865	0.05
HK	HONG KONG	775	0.05
65	PERU	714	0.04
68	PORTUGAL	714	0.04
28	ECUADOR	492	0.03
48	ITALY	339	0.02
ML	MALTA	301	0.02
BA	BARBADOS	225	0.01
14	BRAZIL	216	0.01
41	INDIA	205	0.01
ZZ	MISC. ORGANIZATIONS	178	0.01
SA	SAUDI ARABIA	166	0.01
92	URUGUAY	147	0.01
7	GERMANY, DEM. REP.	66	0
FJ	FIJI ISLANDS	64	0

*NODC Country Code	Country Name	XBT Count	% of Total
55	MALAGASY REP.	62	0
24	KOREA, REP. OF	53	0
MA	MAURITIUS	52	0
22	COLOMBIA	32	0
CR	COSTA RICA	31	0
86	THAILAND	29	0
IC	IVORY COAST	14	0
21	TAIWAN	3	0
TT	TRINIDAD/TOBAGO	1	0
	TOTAL	1644911	

*The United States, Russia, and Japan have multiple country codes. This is because the NODC Institution Code is limited to two digits and these three countries each have more than 99 institutions that can potentially transfer data to NODC/WDC-A.

There are 163 profiles reported for years prior to 1966. Some of these represent profiles with "incorrect" years because they predate the deployment of the XBT in 1965/1966.

The XBT profiles with the "early" dates are included in this table as well as in the WOD98 CD-ROMs.

Table 2 The number of XBT profiles* in WOD98 as a function of year for the World Ocean. The total number of profiles = 1,644,748

YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE
1966	1747	1974	54500	1982	53160	1990	69284
1967	9259	1975	53592	1983	53147	1991	60327
1968	26482	1976	47815	1984	53262	1992	66033
1969	33629	1977	54243	1985	66817	1993	73154
1970	44007	1978	52389	1986	72358	1994	65188
1971	57350	1979	51433	1987	69243	1995	81055
1972	52815	1980	52118	1988	59313	1996	64303
1973	54462	1981	50734	1989	41529		

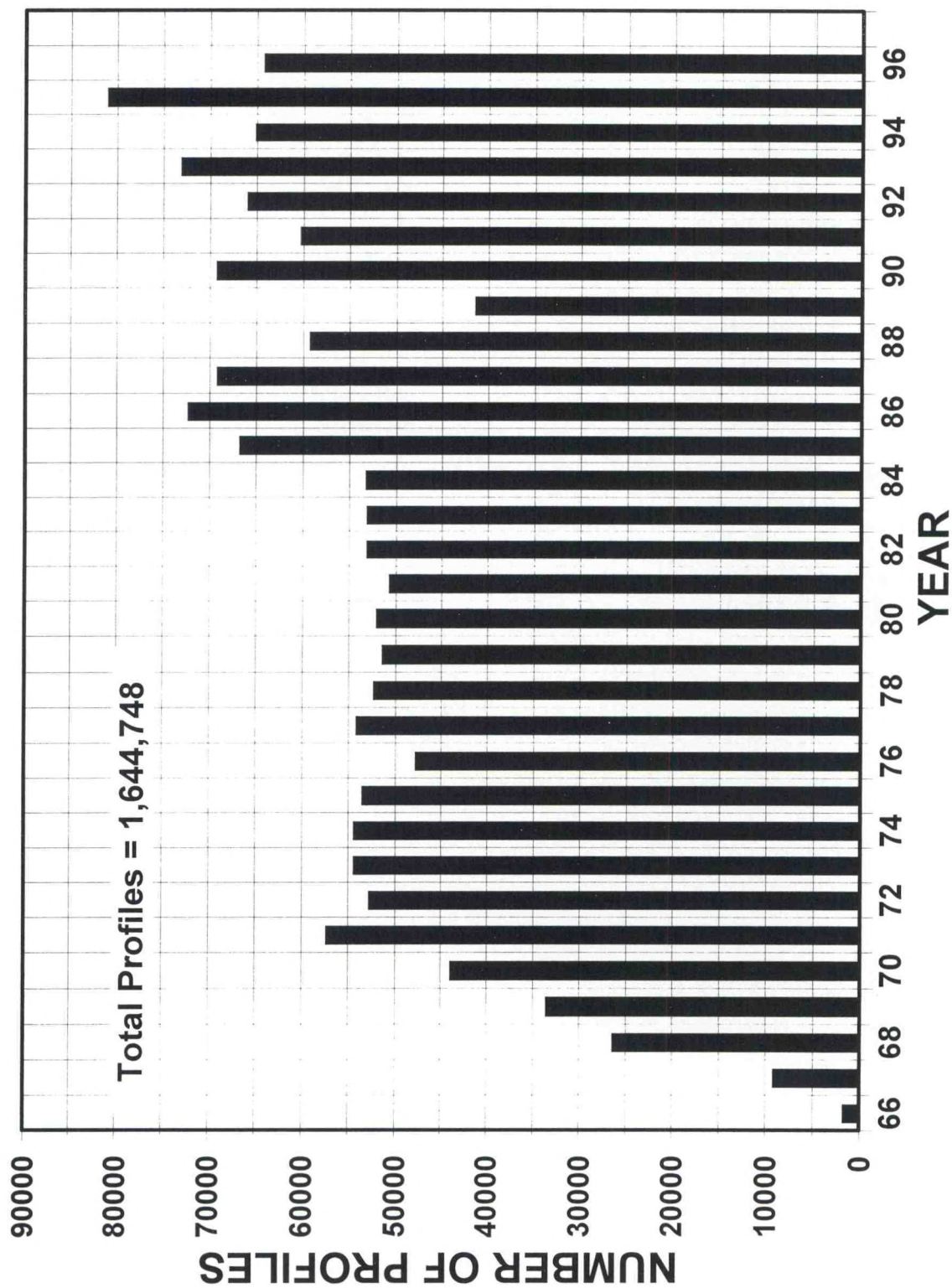
* does not include 163 profiles for the pre-1966 period. Includes data for "fixed" platforms such as the TOGA-TAO array.

Table 3 The number of XBT profiles in WOD98 as a function of year for the southern hemisphere. The total number of profiles = 279,145

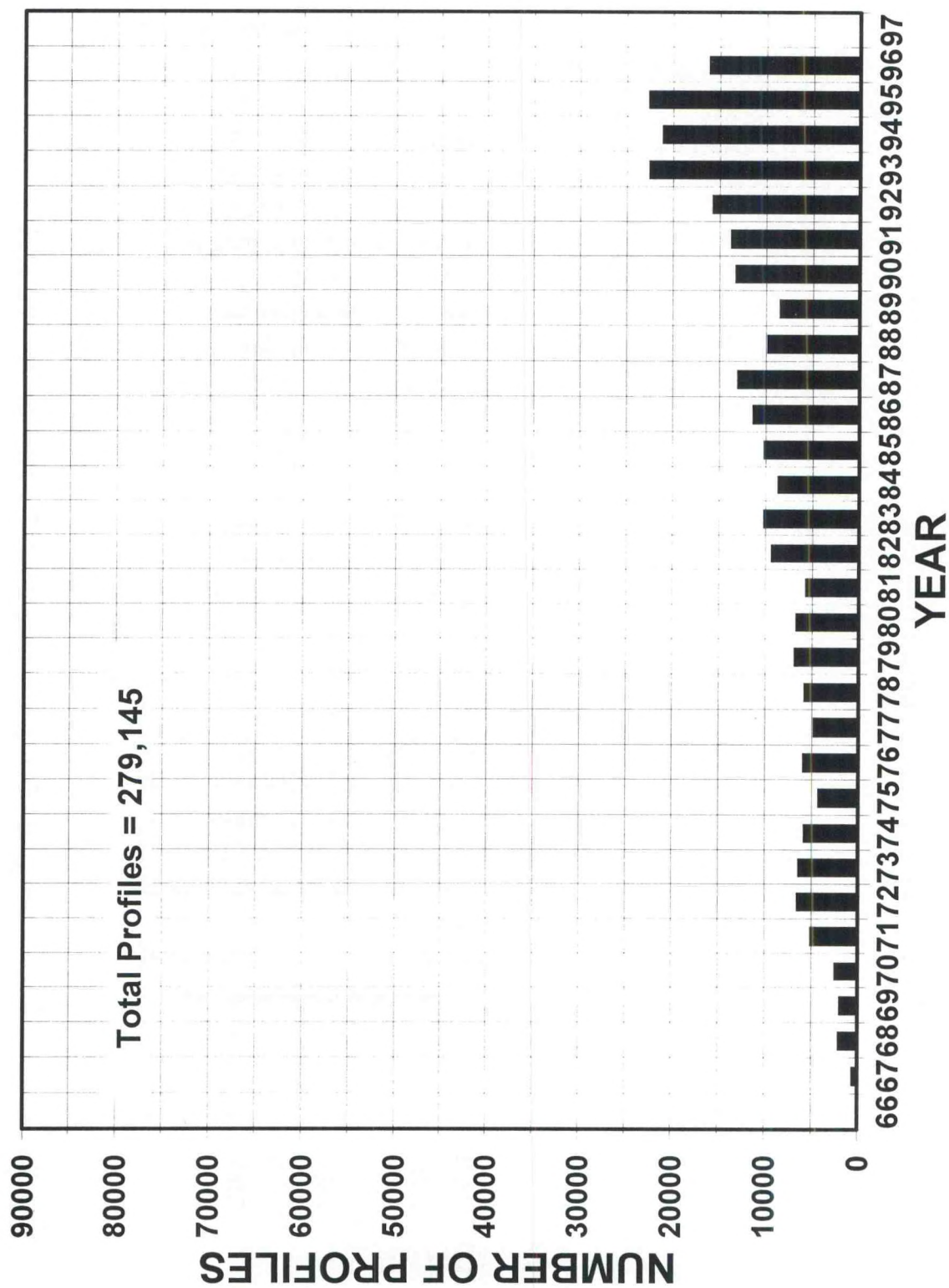
YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE
1966	168	1974	5884	1982	9404	1990	13320
1967	644	1975	4306	1983	10225	1991	13799
1968	2136	1976	5983	1984	8760	1992	15795
1969	2033	1977	4883	1985	10234	1993	22594
1970	2561	1978	5861	1986	11413	1994	21190
1971	5163	1979	6911	1987	13062	1995	22675
1972	6548	1980	6744	1988	9890	1996	16187
1973	6426	1981	5740	1989	8606		

Table 4 The number of XBT profiles in WOD98 as a function of year for the northern hemisphere. The total number of profiles = 1,365,603

YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE
1966	1579	1974	48616	1982	43756	1990	55964
1967	8615	1975	49286	1983	42922	1991	46528
1968	24346	1976	41832	1984	44502	1992	50238
1969	31596	1977	49360	1985	56583	1993	50560
1970	41446	1978	46528	1986	60945	1994	43998
1971	52187	1979	44522	1987	56181	1995	58380
1972	46267	1980	45374	1988	49423	1996	48116
1973	48036	1981	44994	1989	32923		



**Fig. 1 Time series of XBT Profiles in WOD98
for the world ocean as a function of year**



**Fig. 2 Time series of XBT Profiles in WOD98
for the southern hemisphere as a function of year**

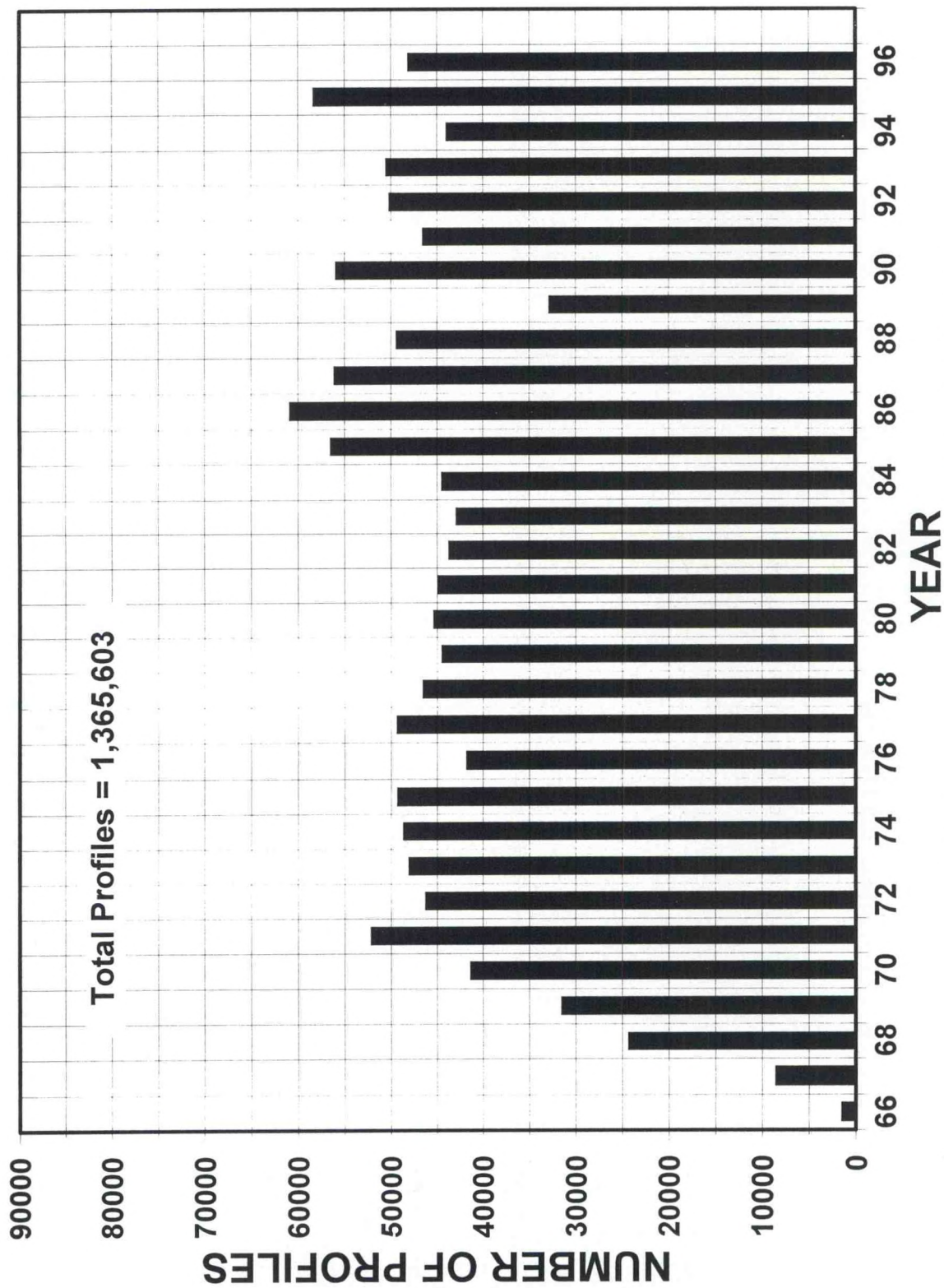


Fig. 3 Time series of XBT Profiles in WOD98
for the northern hemisphere as a function of year

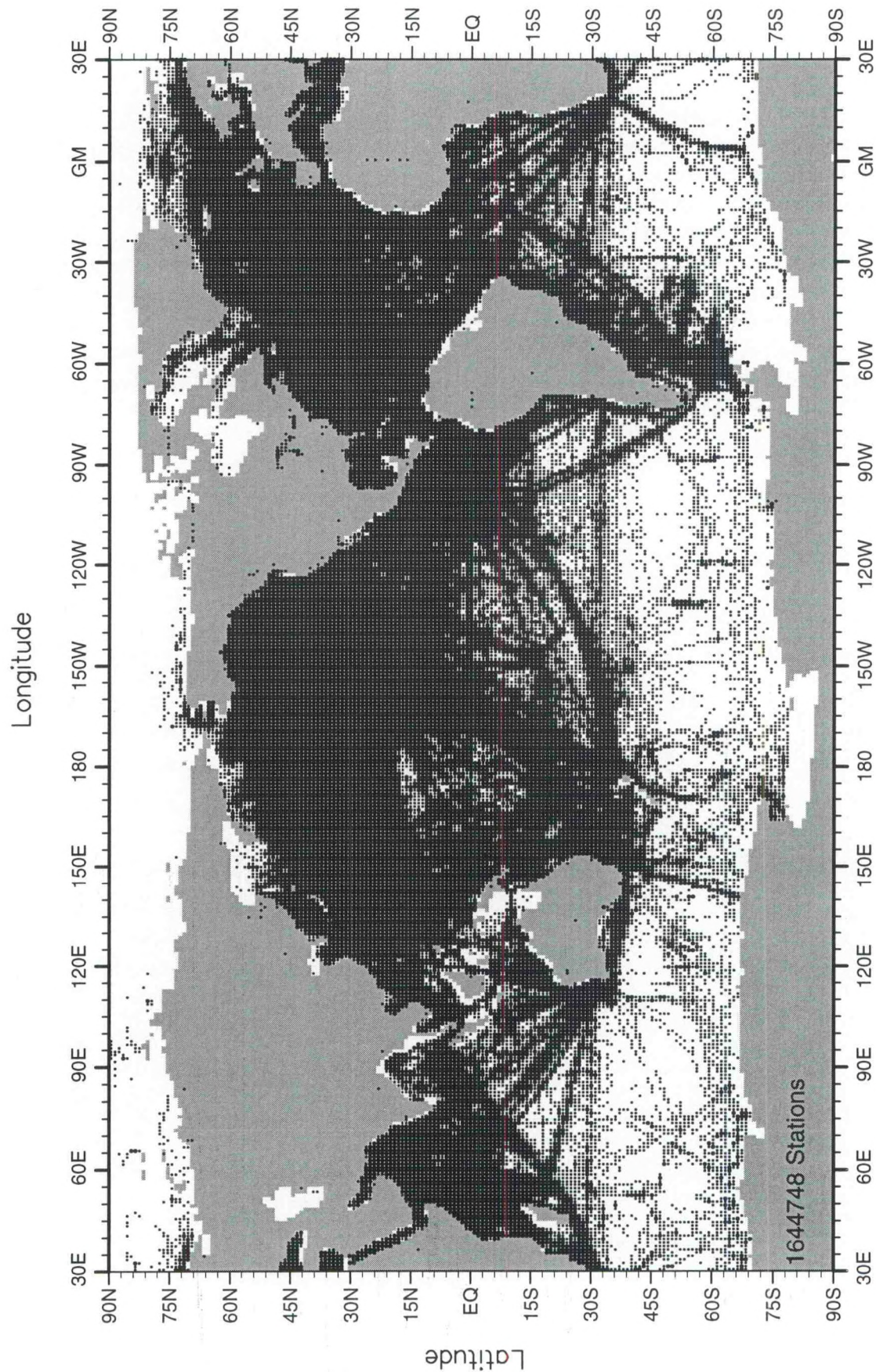


Fig. 4 Distribution of all profiles in the XBT files of WOD98

5. APPENDIX A: DISTRIBUTIONS FOR INDIVIDUAL YEARS OF ALL XBT PROFILES IN WOD98

This appendix contains yearly data distributions of all XBT profile data contained in WOD98. These maps provide some history of the observational progress of the field of oceanography. They also serve as indicators of whether or not a particular data set from a scientist or institution is part of the NODC/WDC-A archive. The exchange of information provided by the publication of such maps has provided us with valuable information about deficiencies in the database. The locations of all WOD98 XBT profiles are plotted including profiles that may be erroneously located over land. However, WOD98 contains some profiles from various lakes so care should be exercised in the use of these profiles and the determination as to whether they represent errors in locations.

For all figures in Appendix A, a small dot indicates a one-degree square containing from one to four profiles and a large dot indicates five or more profiles.

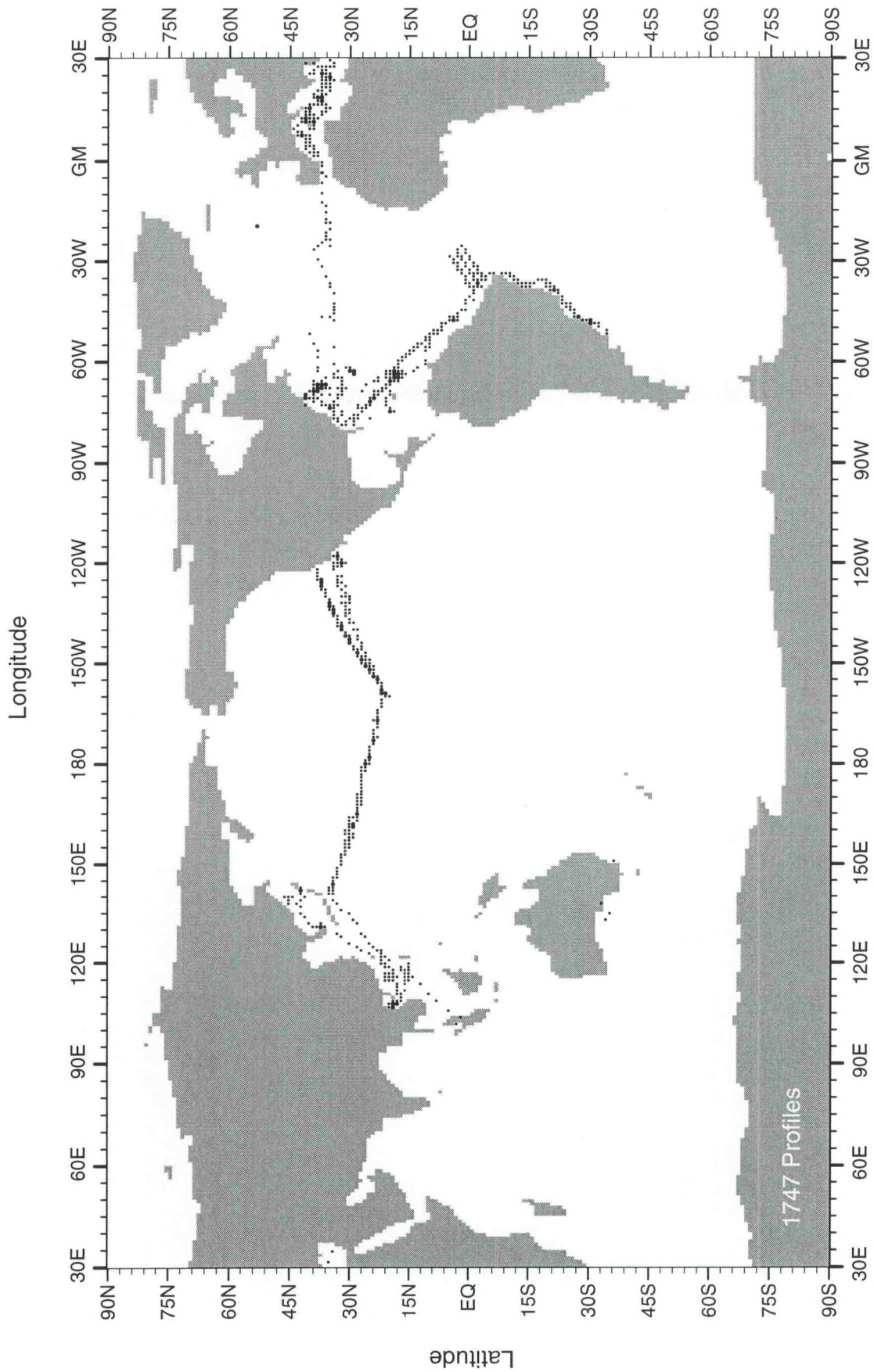


Fig. A1 WOD98 XBT profile distribution for 1966

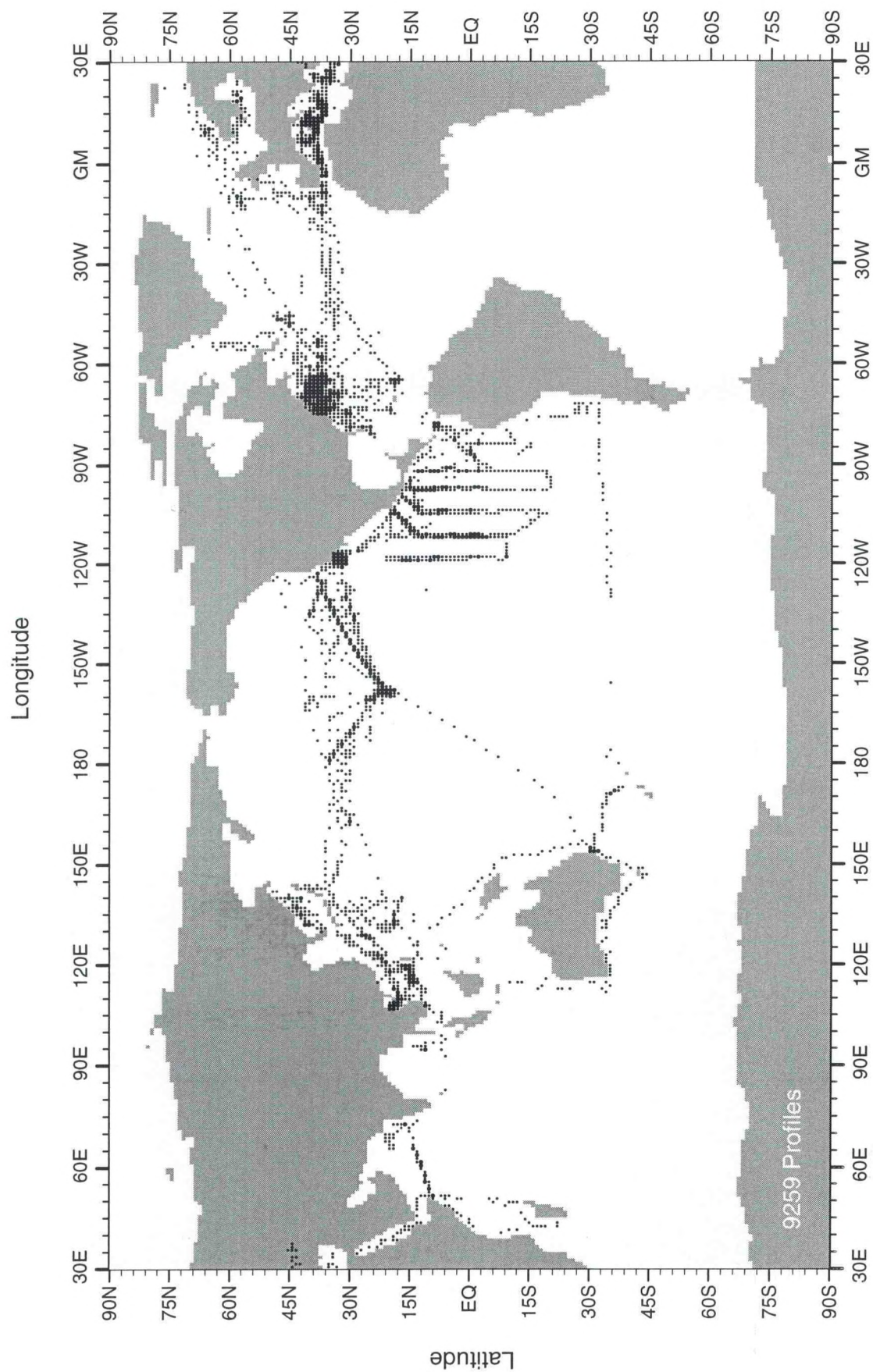


Fig. A2 WOD98 XBT profile distribution for 1967

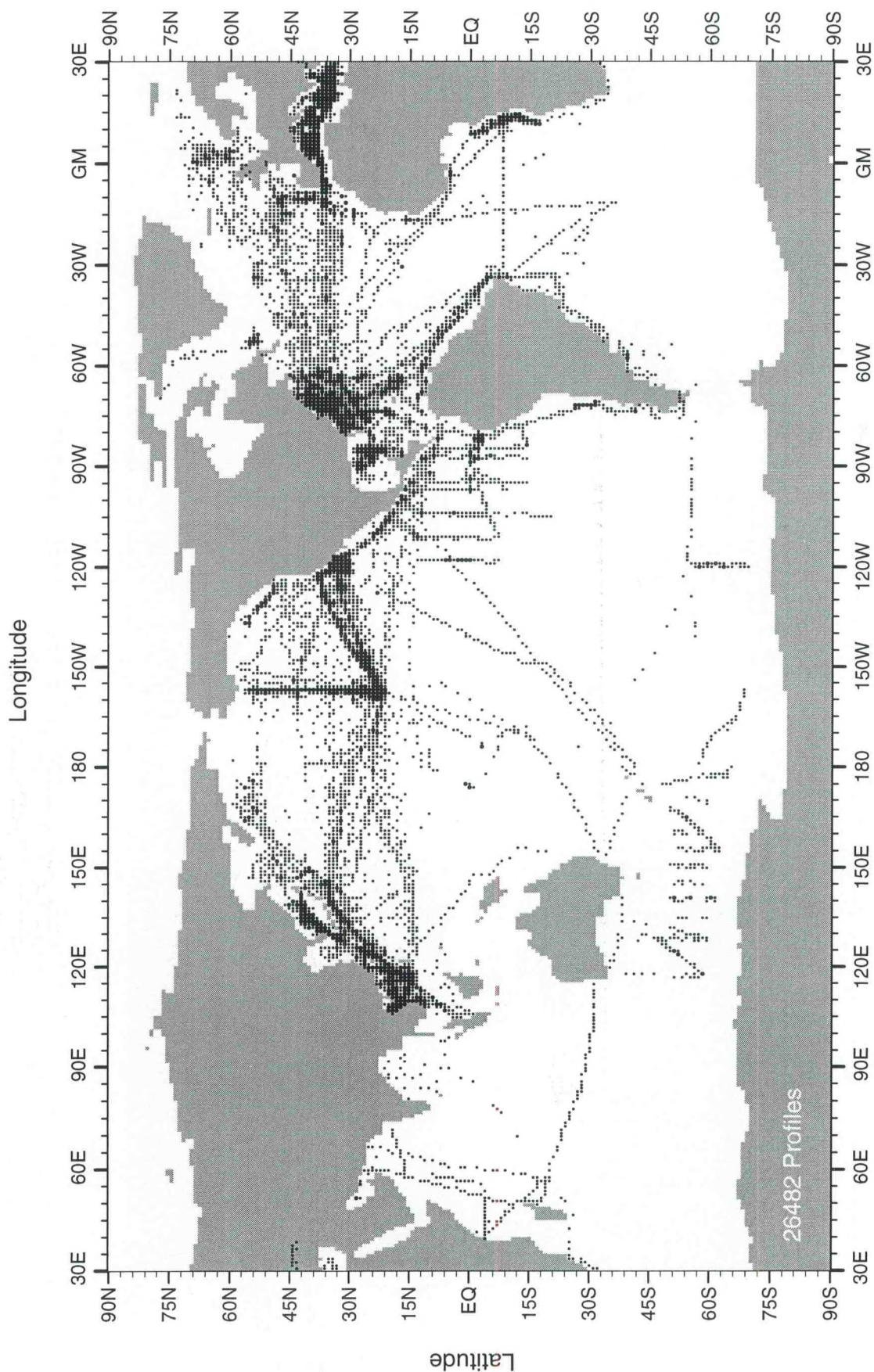


Fig. A3 WOD98 XBT profile distribution for 1968

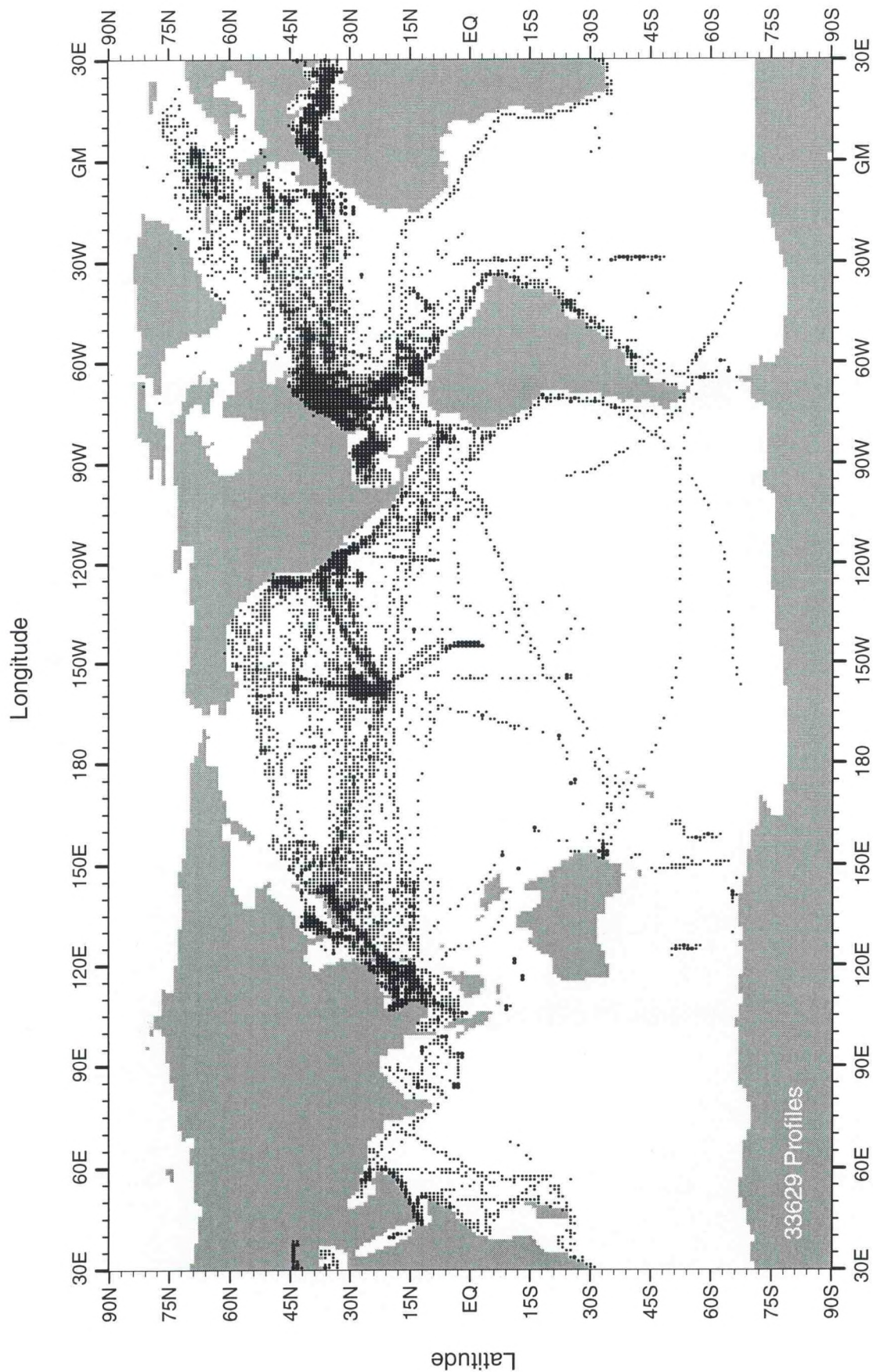


Fig. A4 WOD98 XBT profile distribution for 1969

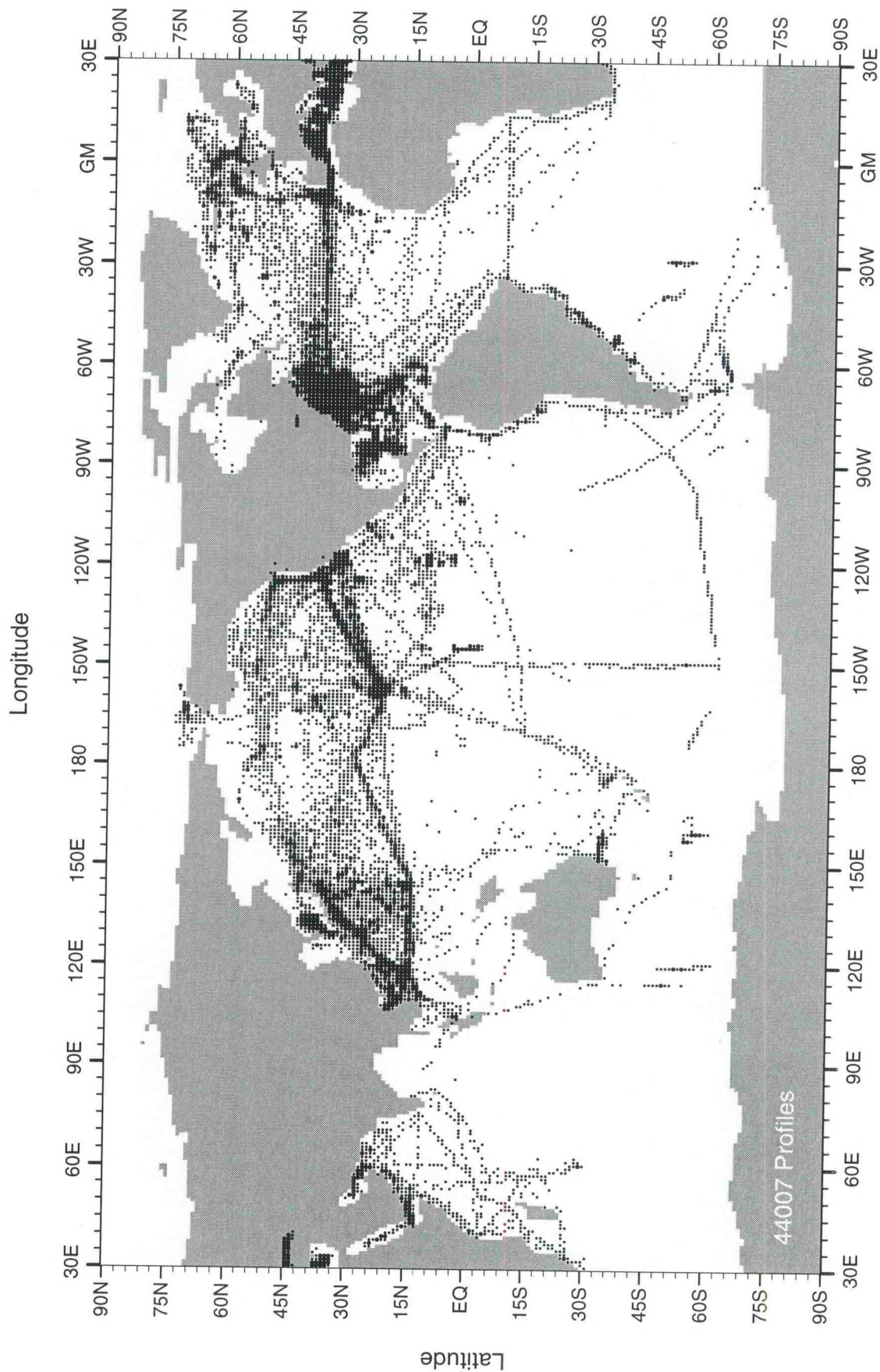


Fig. A5 WOD98 XBT profile distribution for 1970

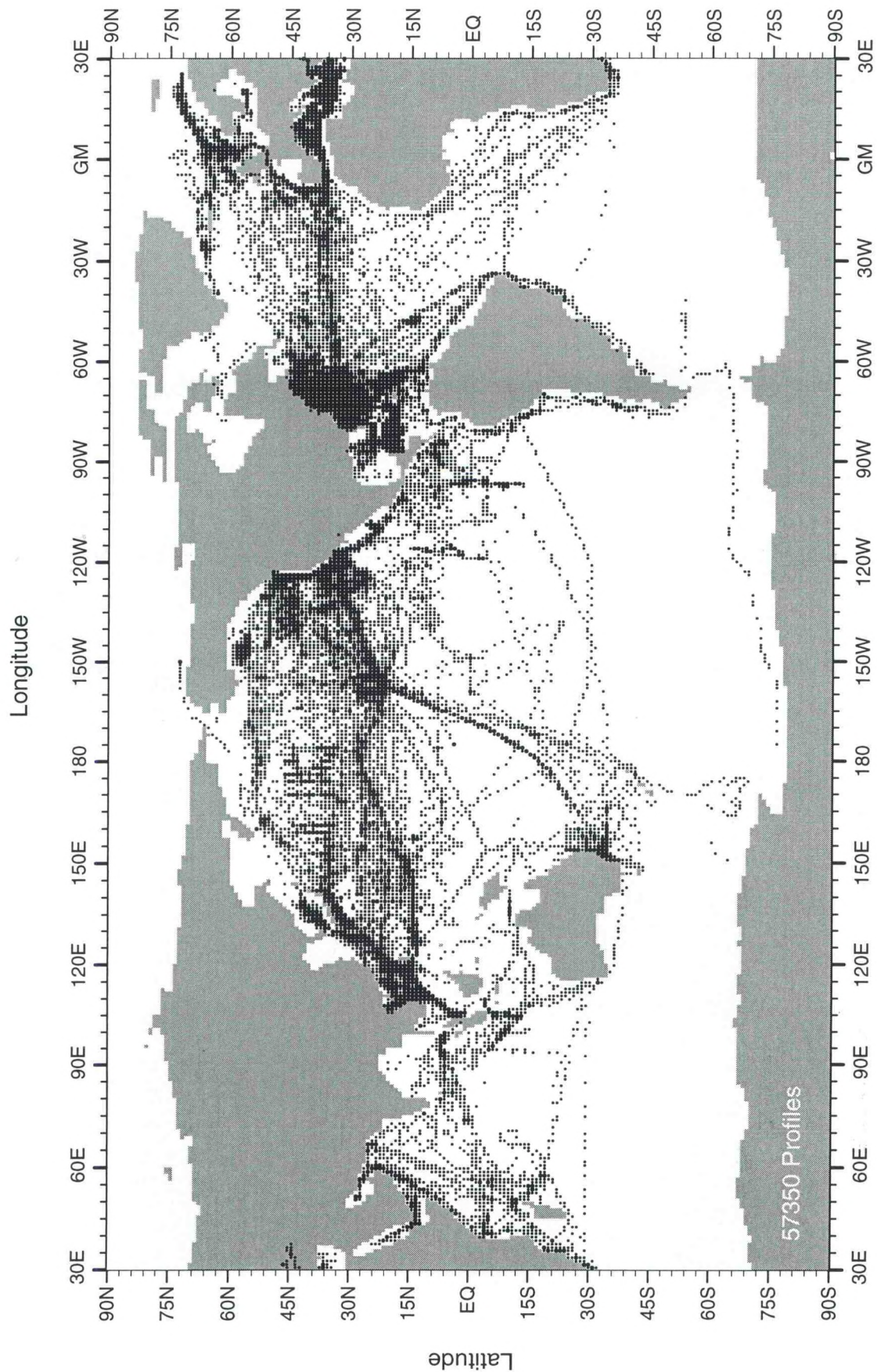


Fig. A6 WOD98 XBT profile distribution for 1971

Longitude

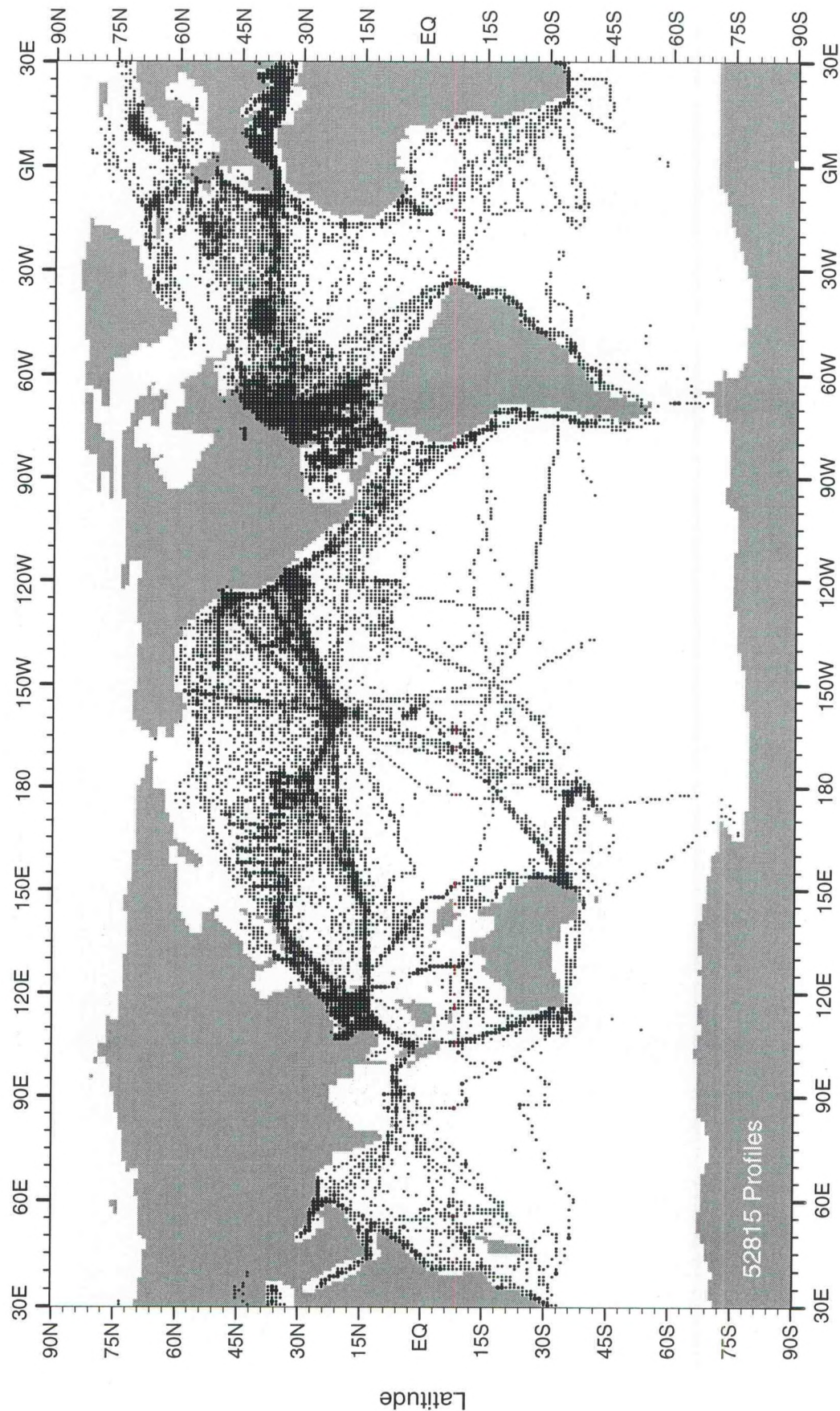


Fig. A7 WOD98 XBT profile distribution for 1972

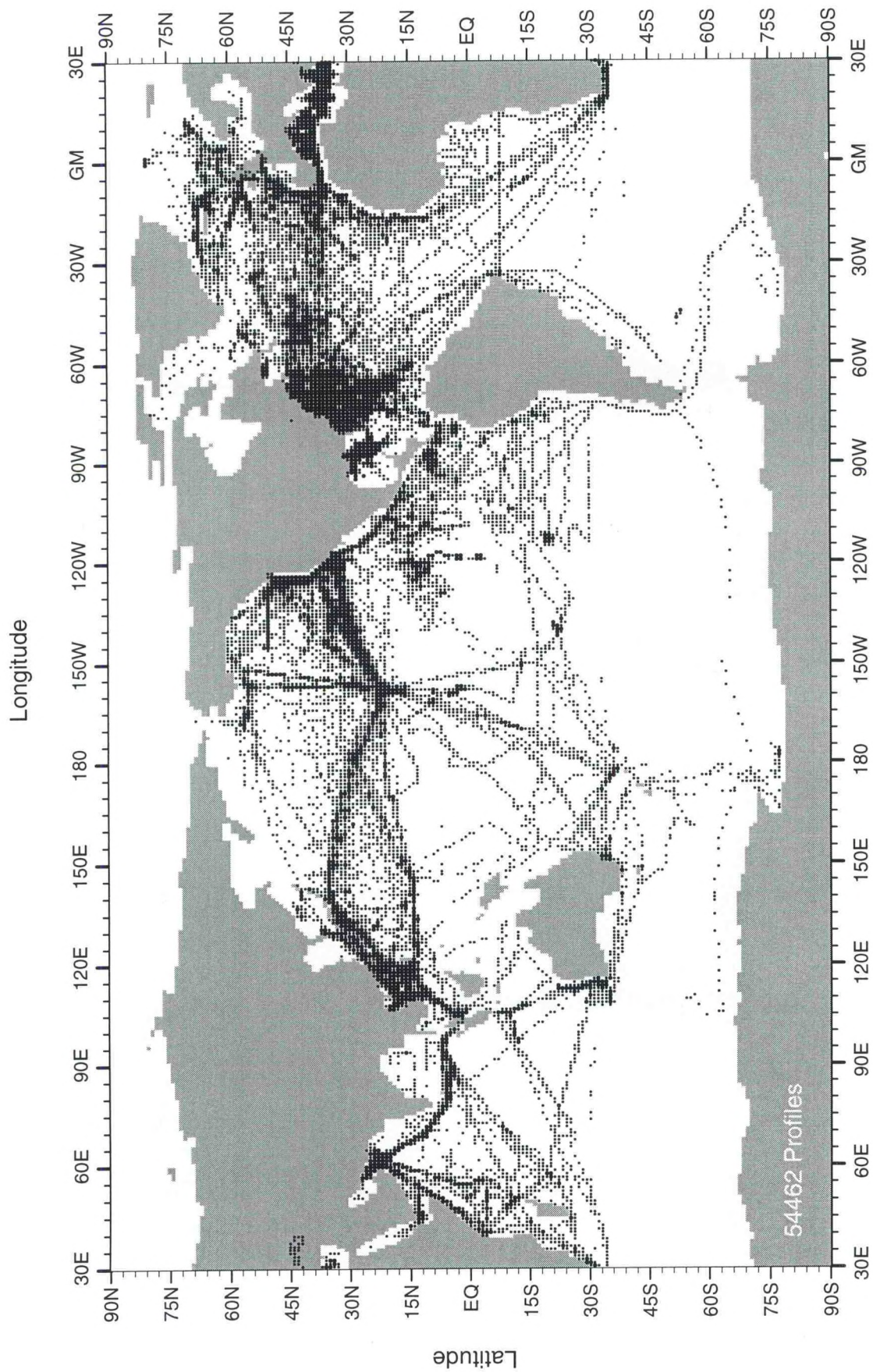


Fig. A8 WOD98 XBT profile distribution for 1973

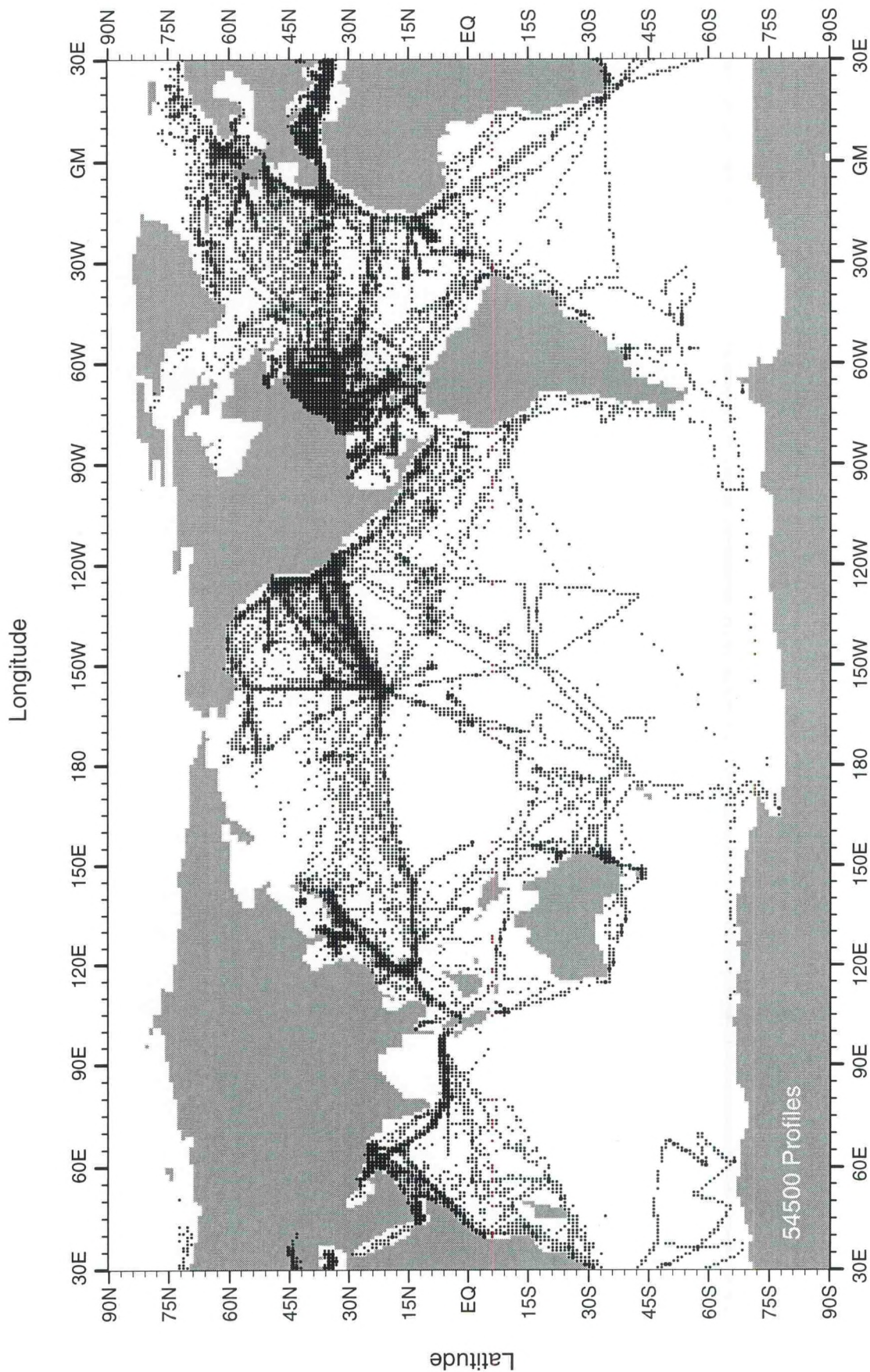


Fig. A9 WOD98 XBT profile distribution for 1974

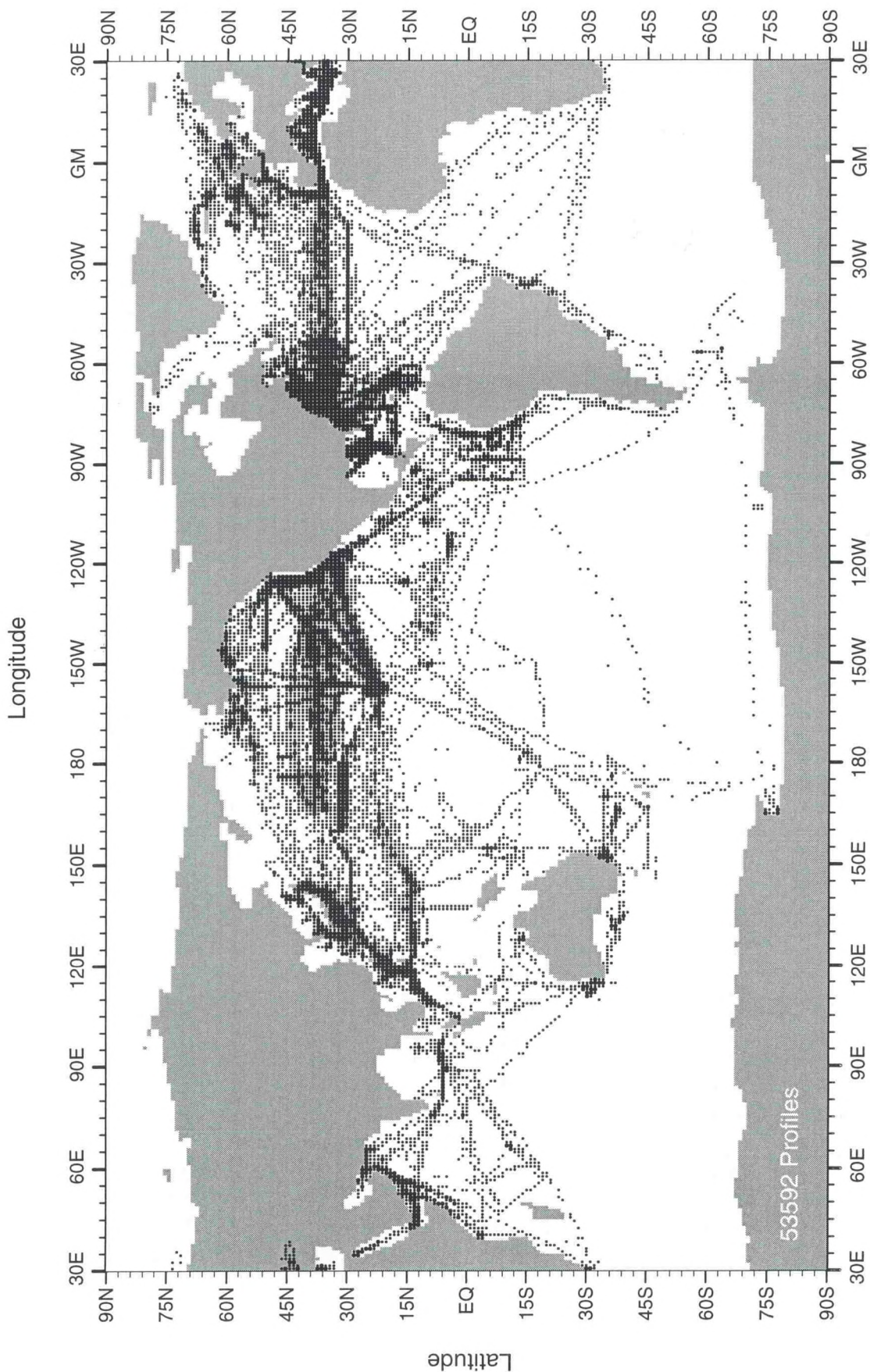


Fig. A10 WOD98 XBT profile distribution for 1975

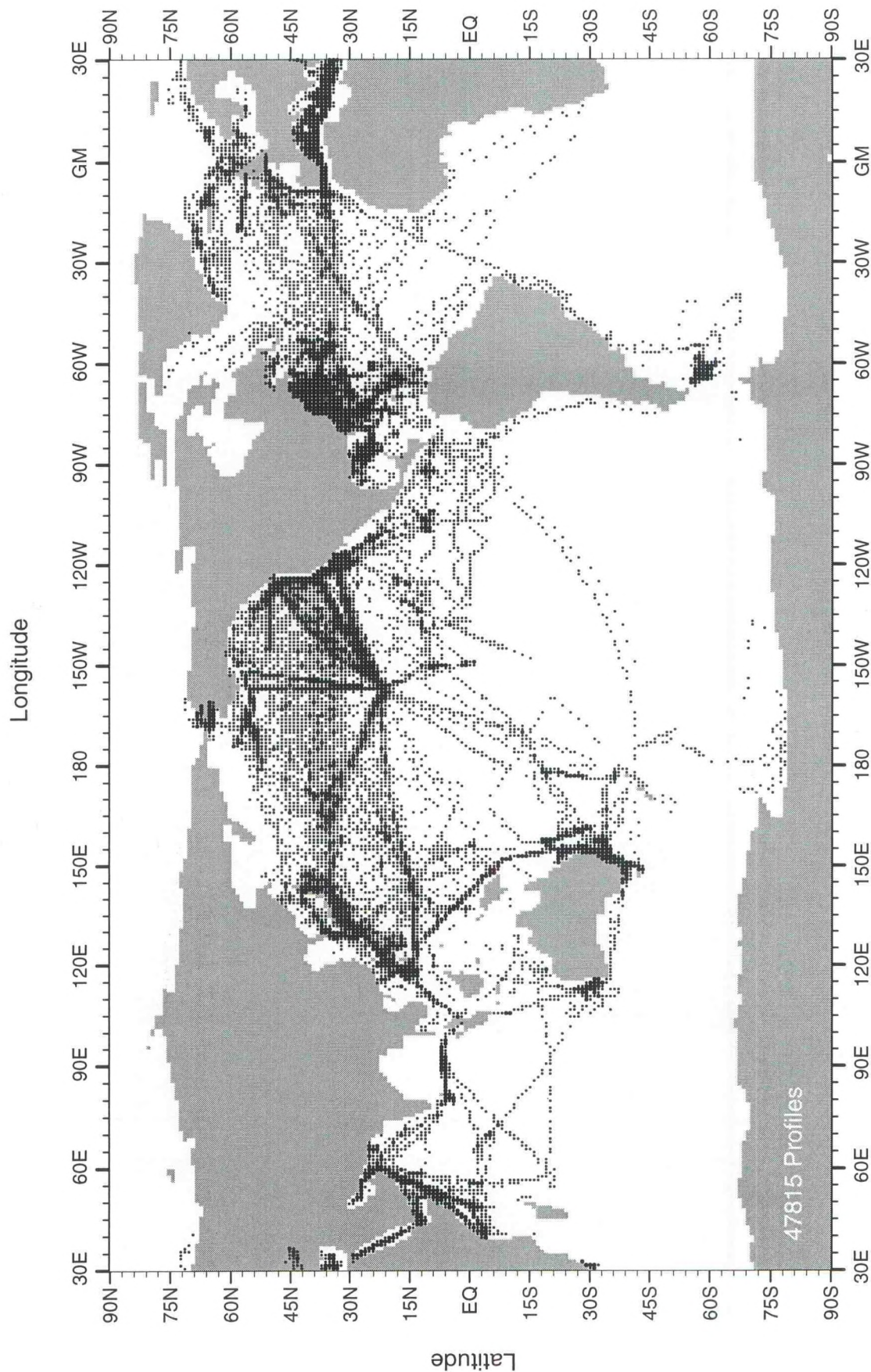


Fig. A11 WOD98 XBT profile distribution for 1976

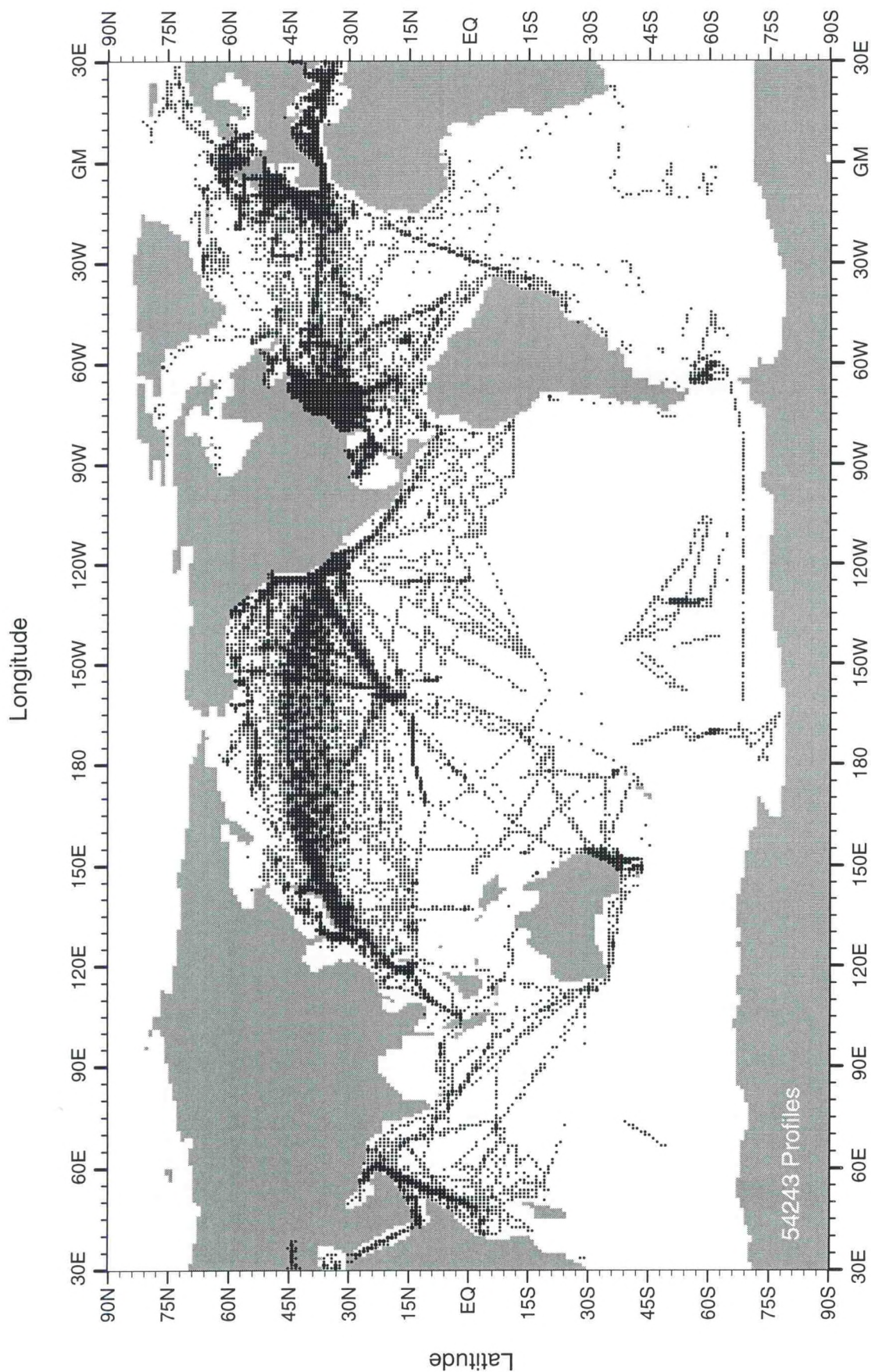


Fig. A12 WOD98 XBT profile distribution for 1977

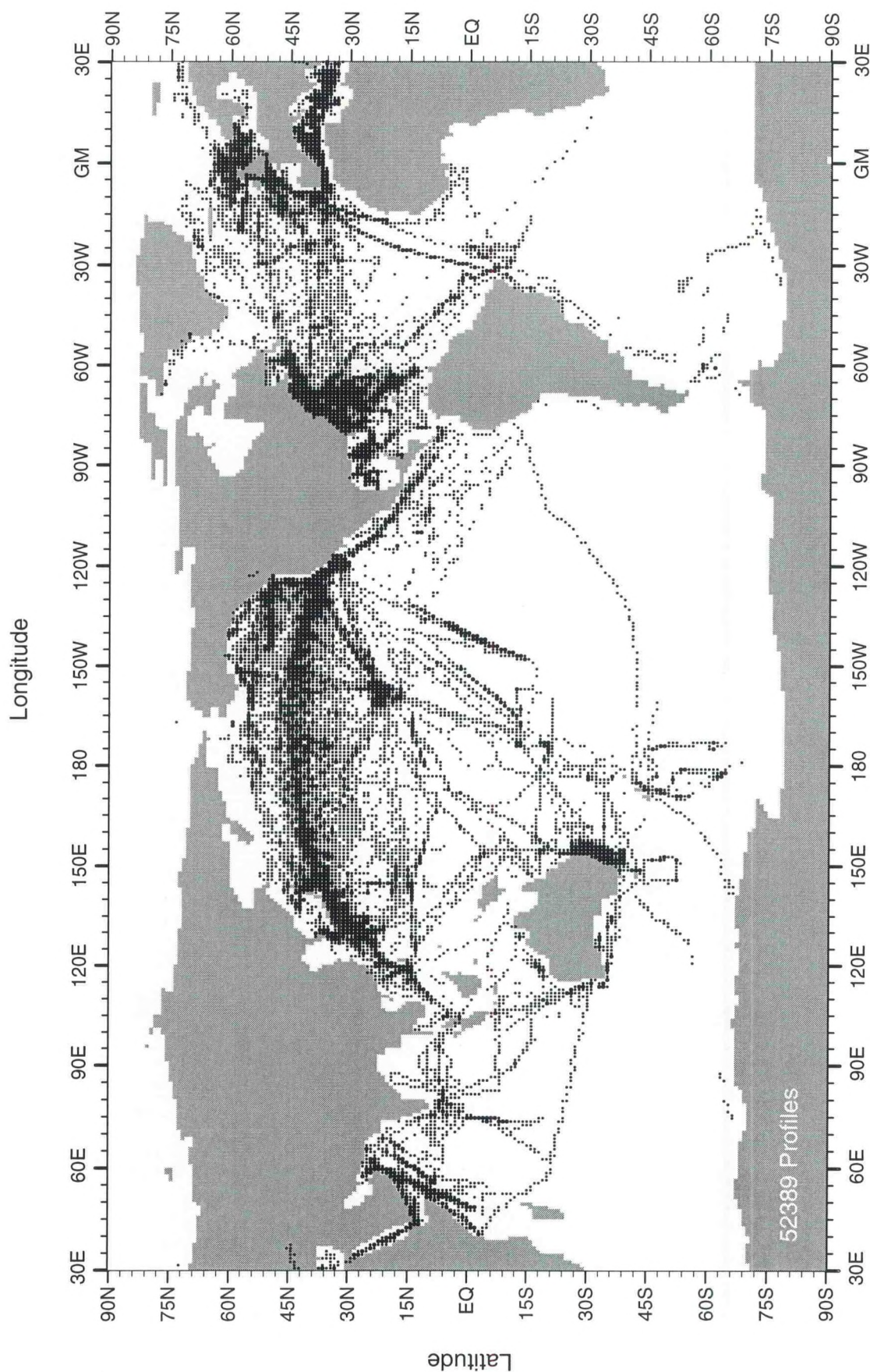


Fig. A13 WOD98 XBT profile distribution for 1978

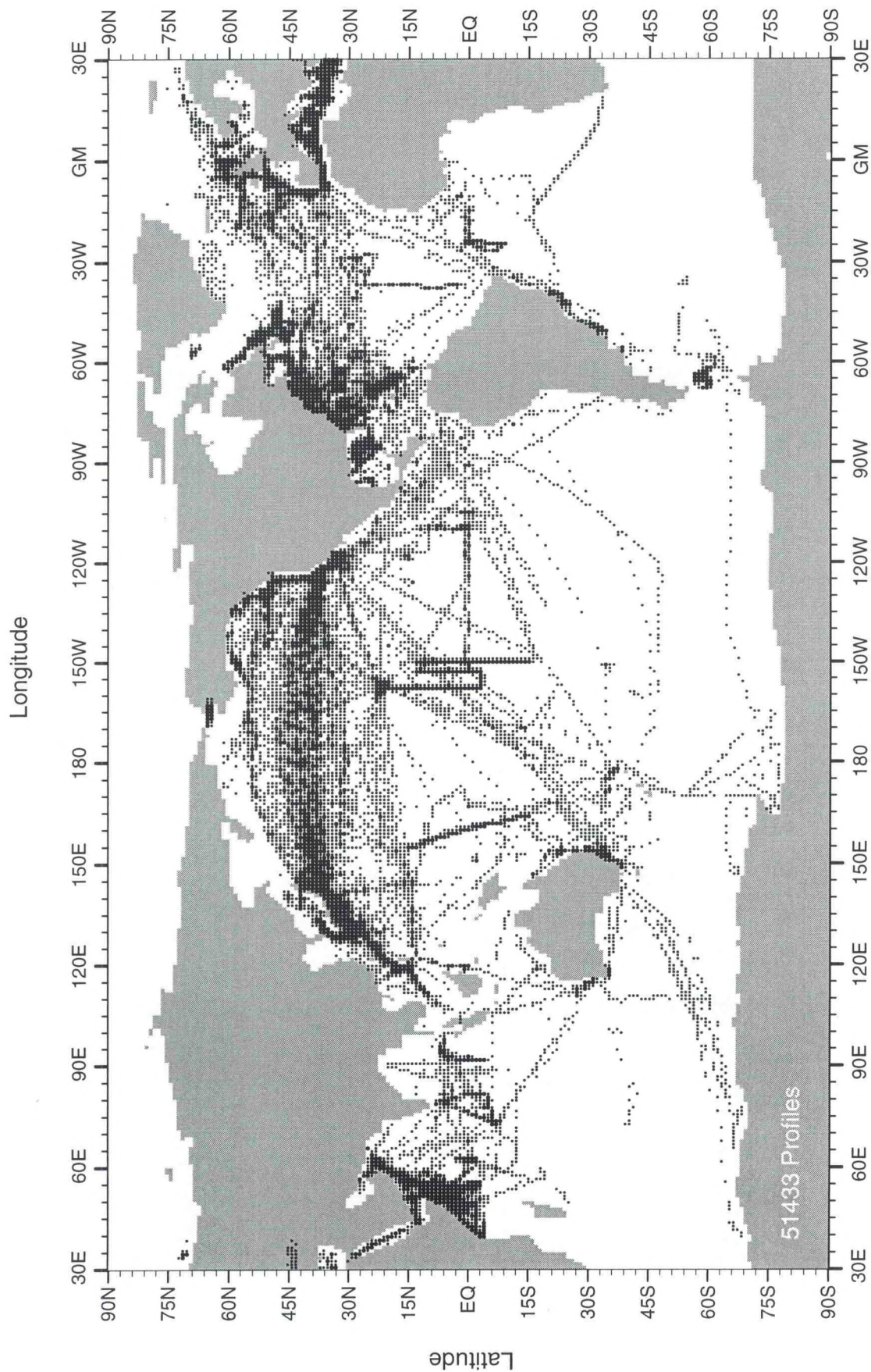


Fig. A14 WOD98 XBT profile distribution for 1979

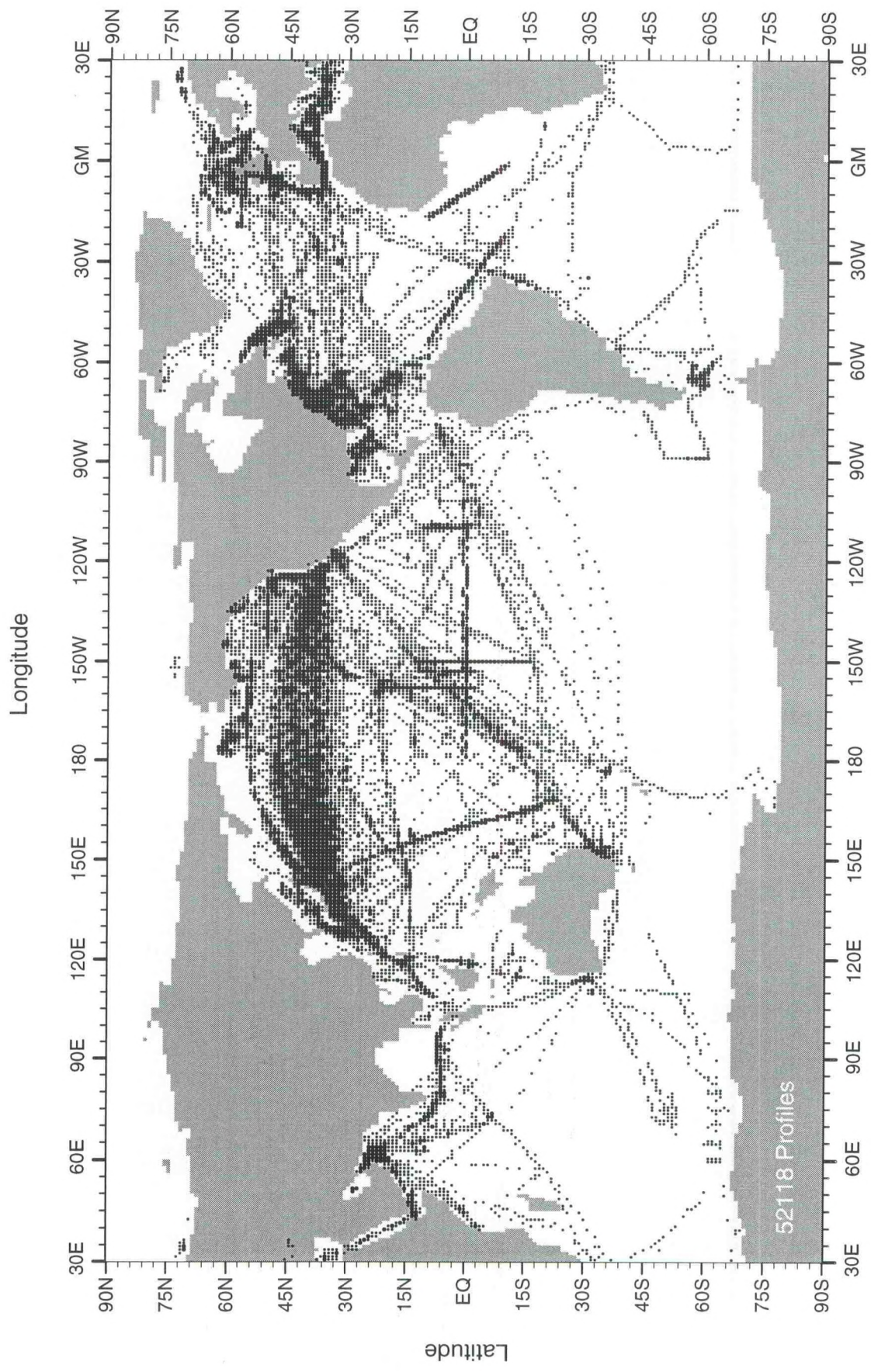


Fig. A15 WOD98 XBT profile distribution for 1980

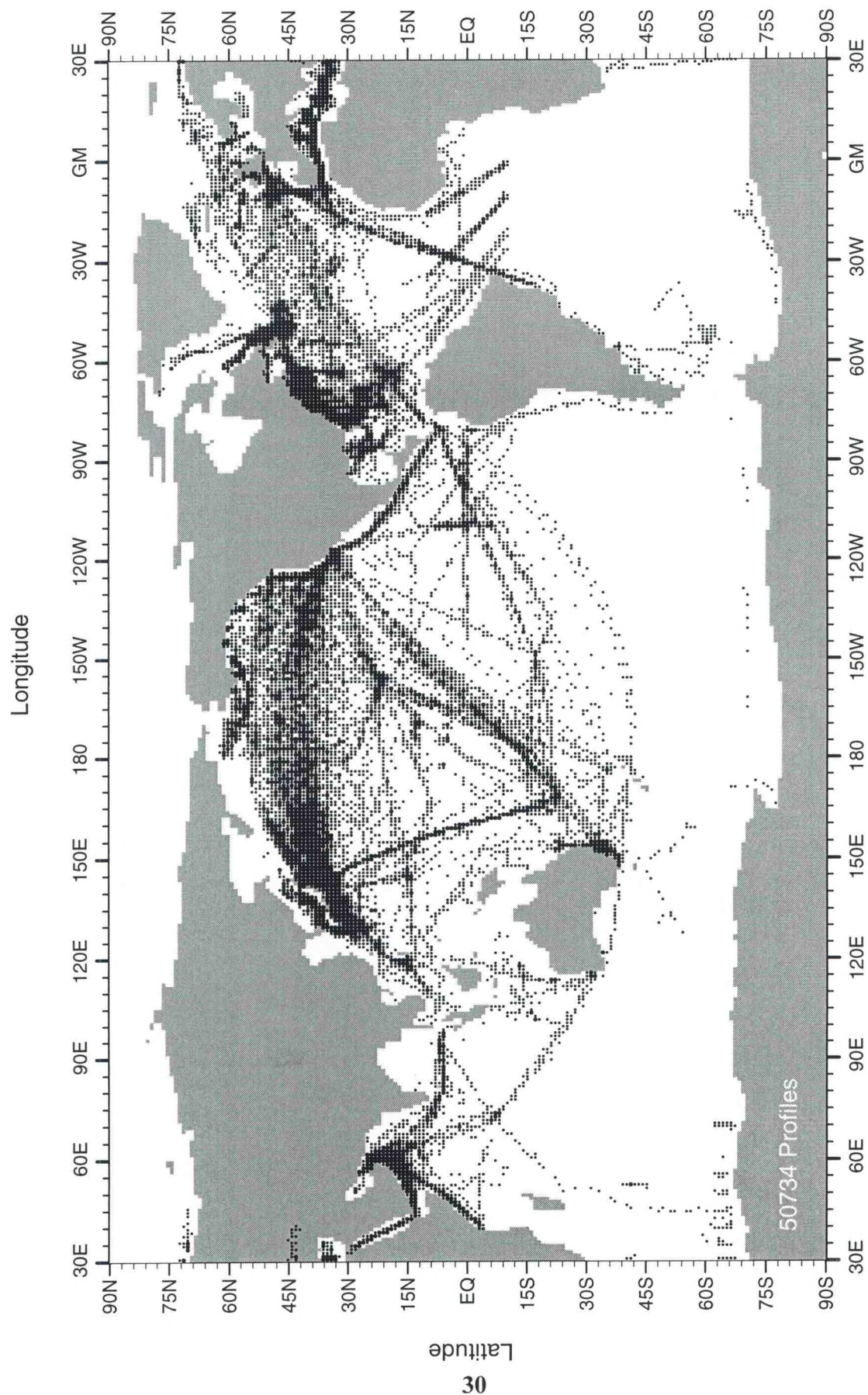


Fig. A16 WOD98 XBT profile distribution for 1981

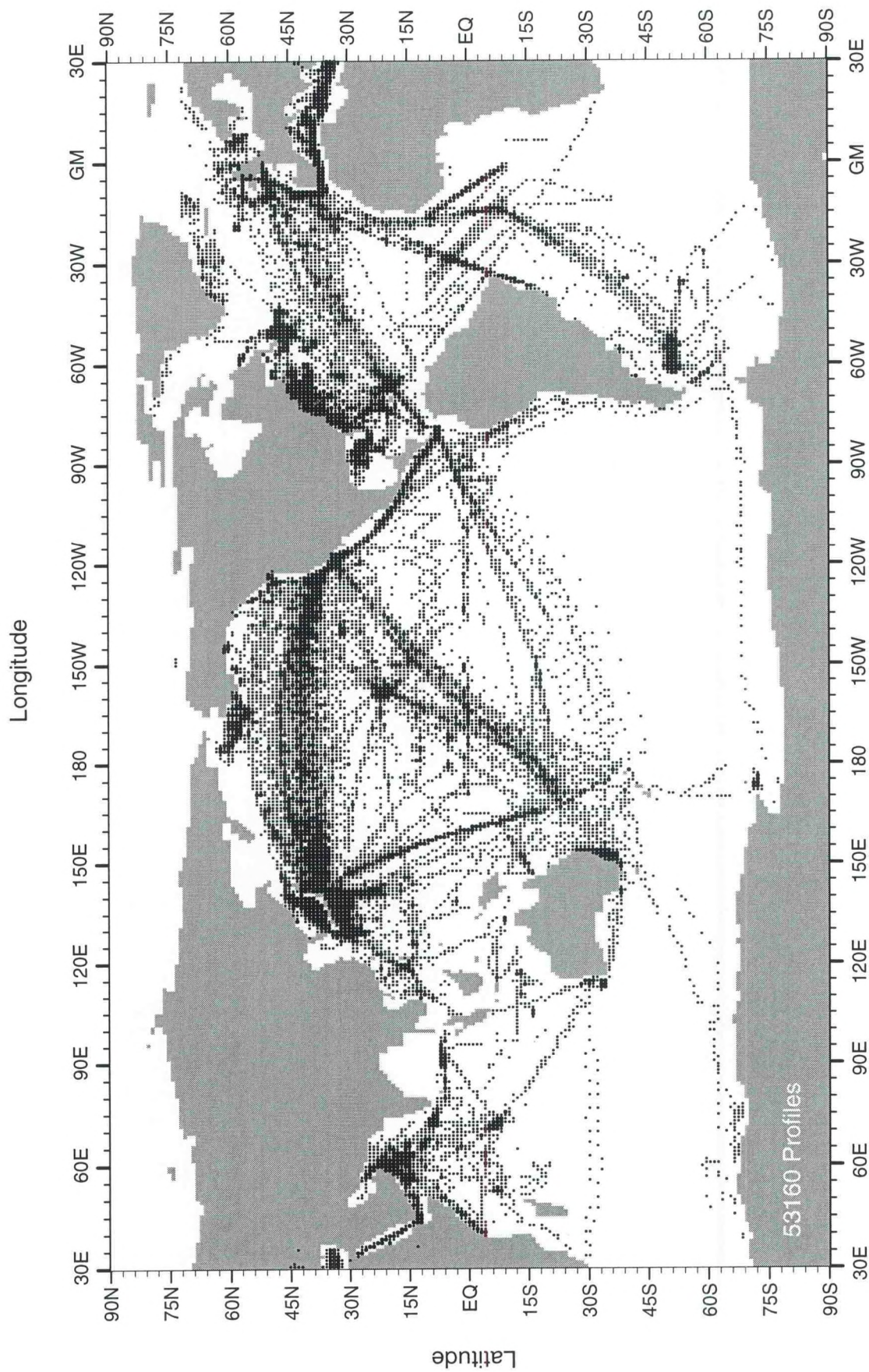


Fig. A17 WOD98 XBT profile distribution for 1982

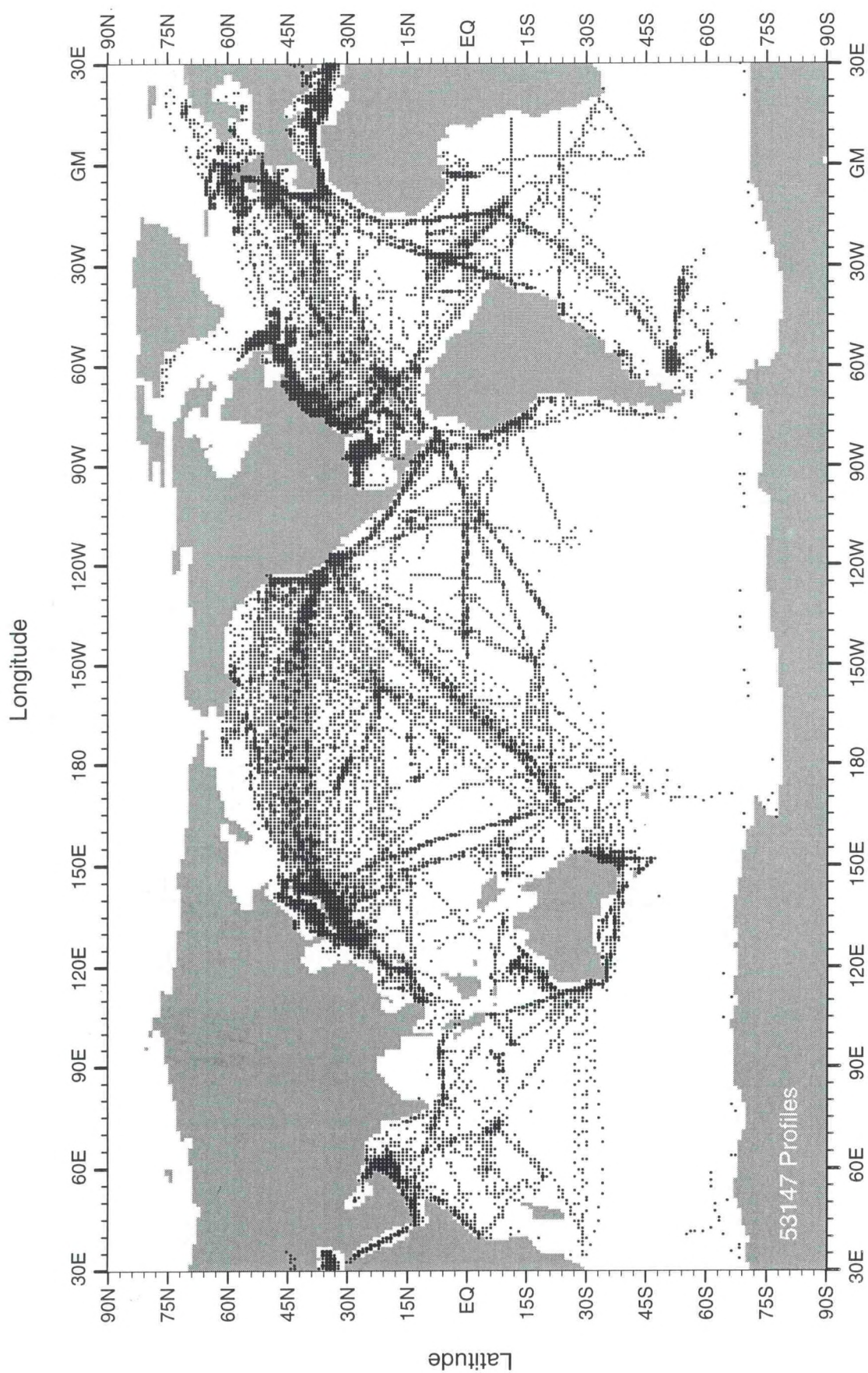


Fig. A18 WOD98 XBT profile distribution for 1983

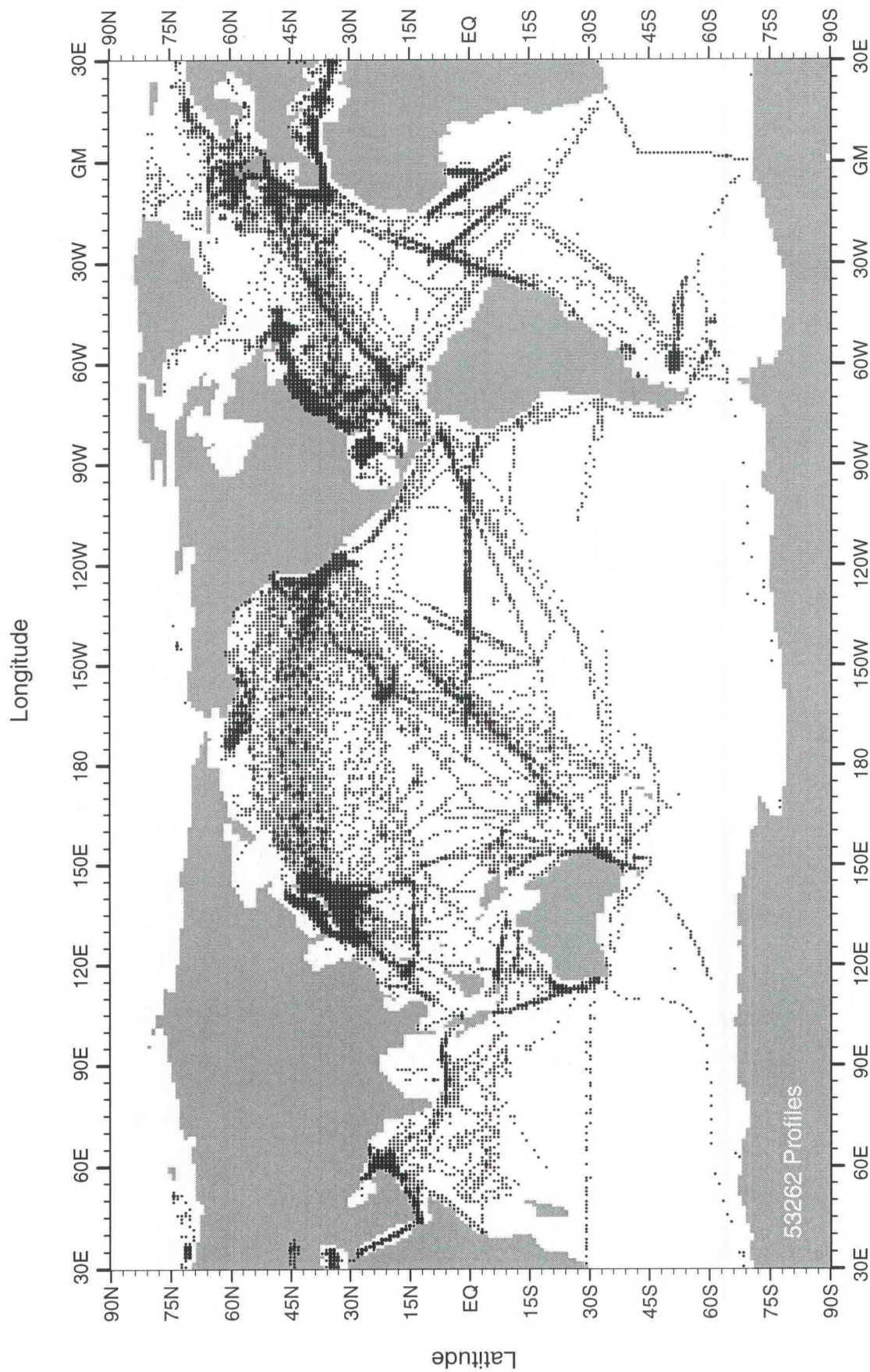


Fig. A19 WOD98 XBT profile distribution for 1984

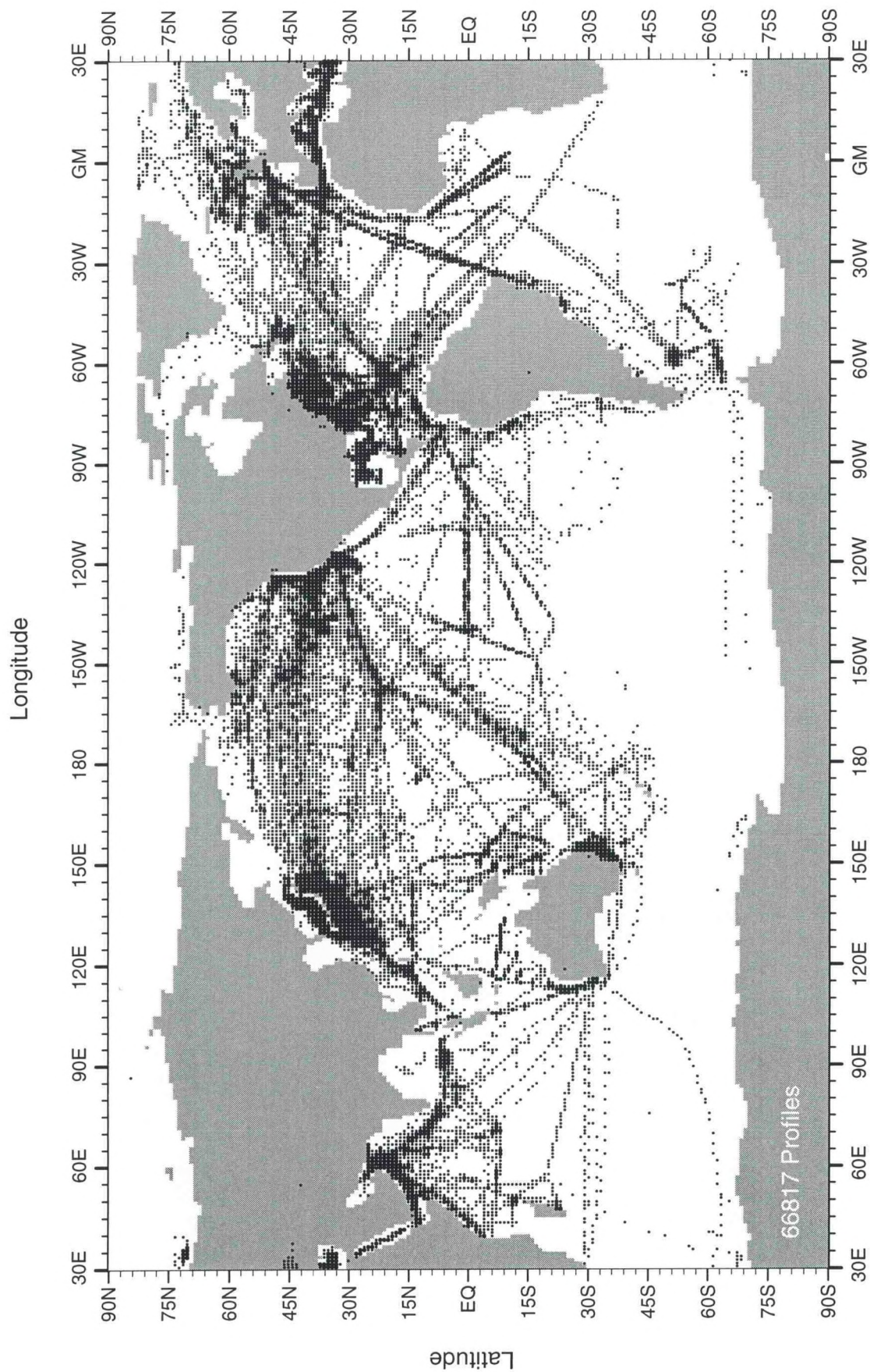


Fig. A20 WOD98 XBT profile distribution for 1985

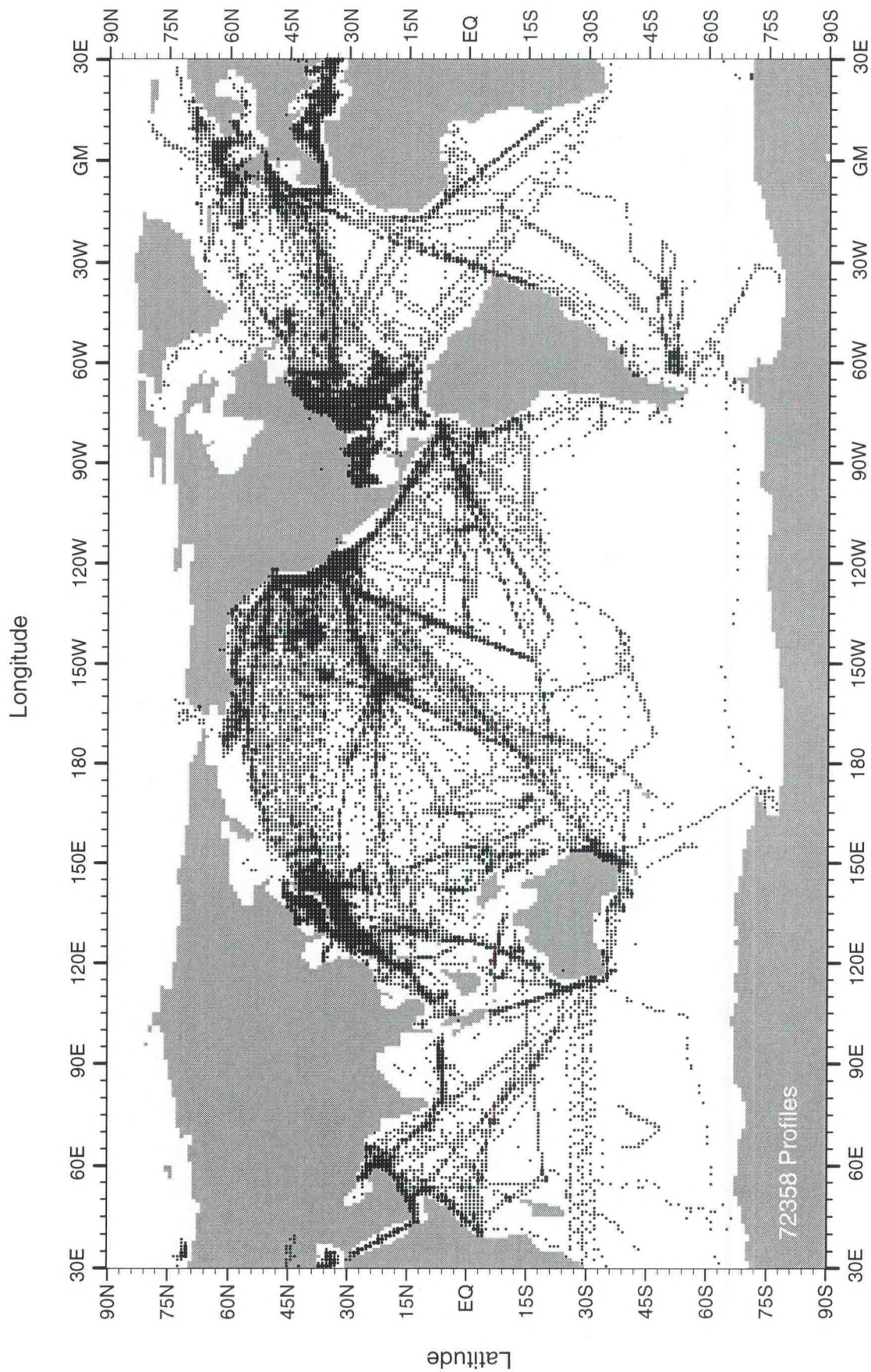


Fig. A21 WOD98 XBT profile distribution for 1986

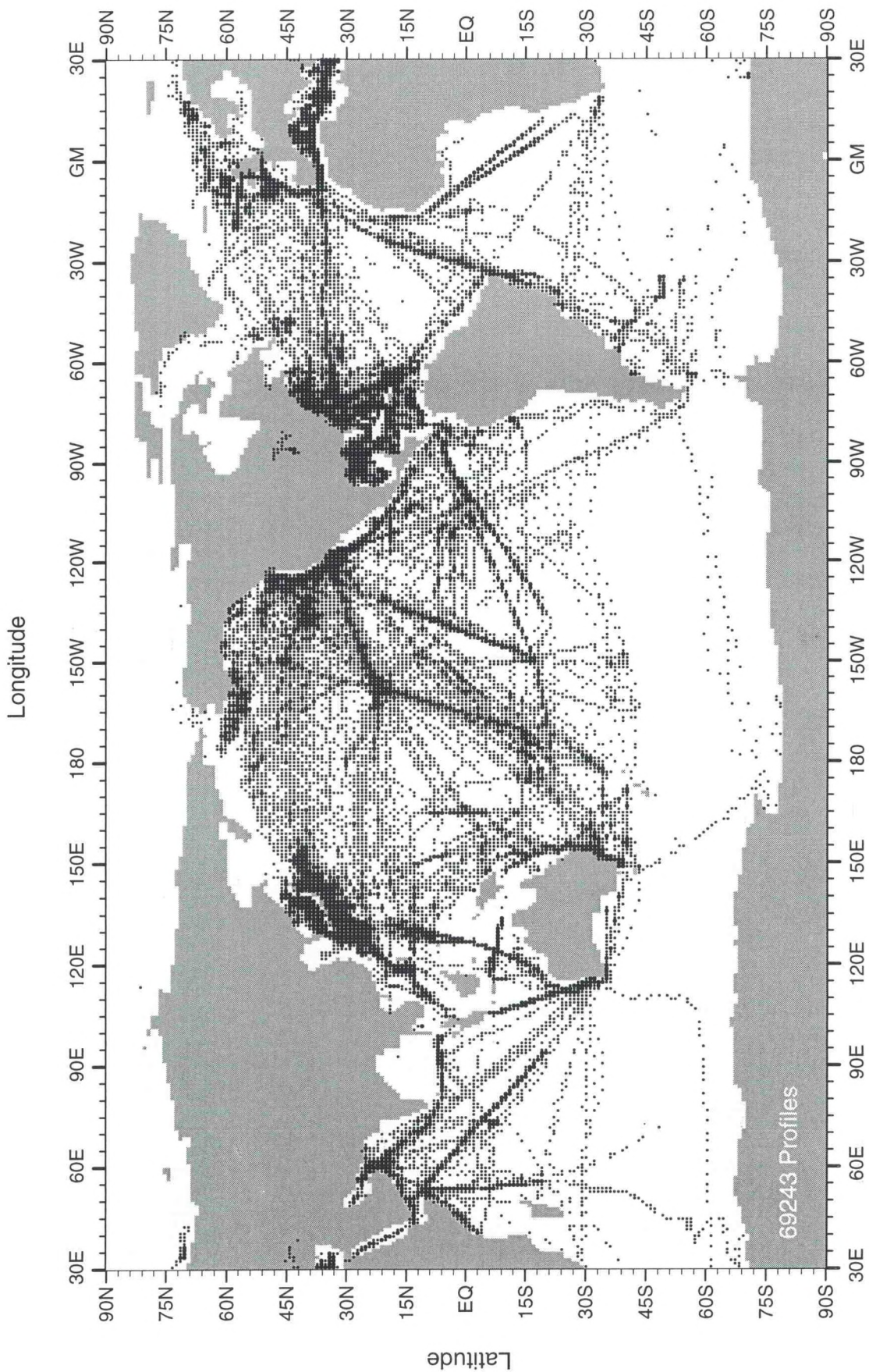


Fig. A22 WOD98 XBT profile distribution for 1987

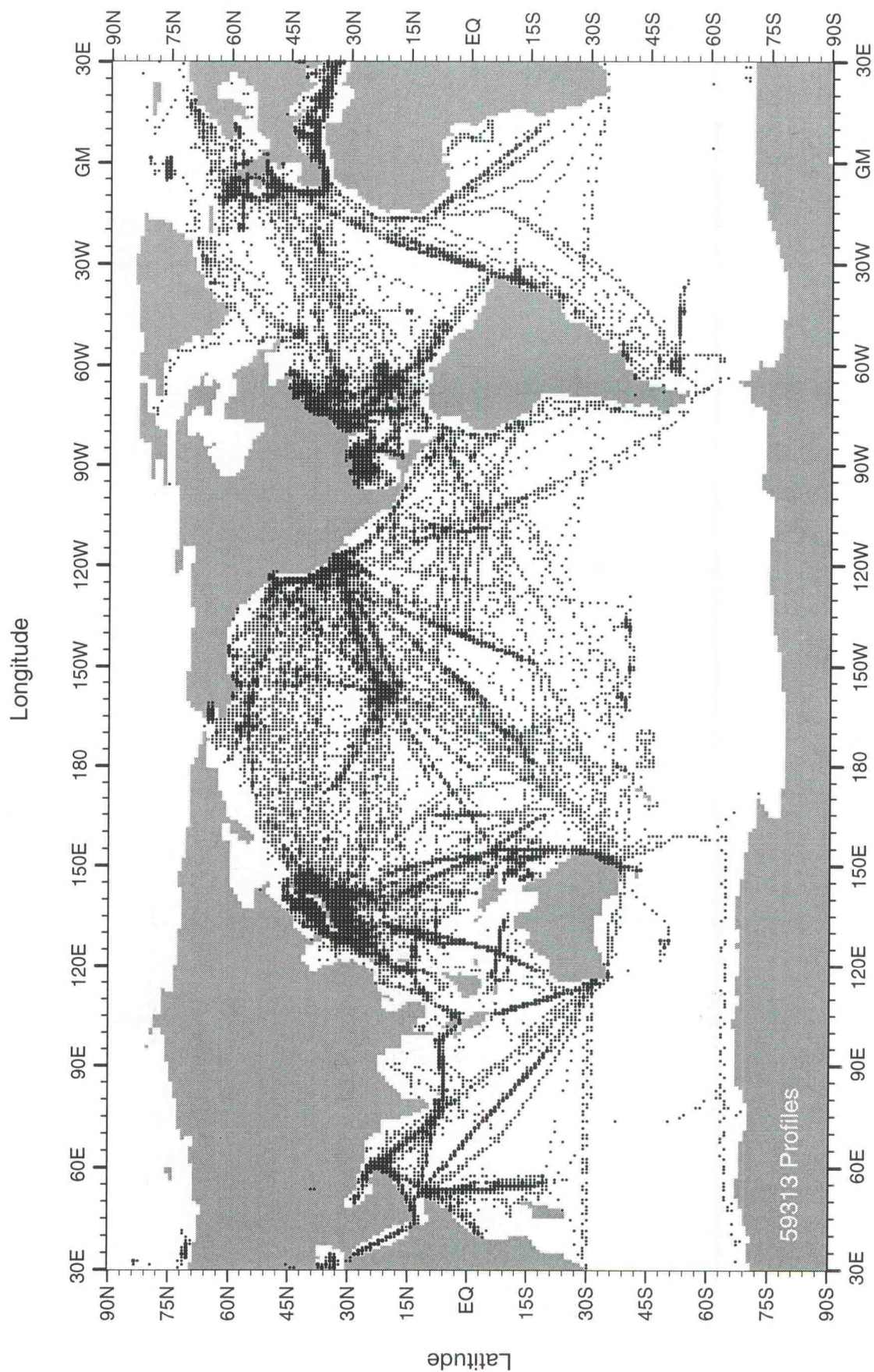


Fig. A23 WOD98 XBT profile distribution for 1988

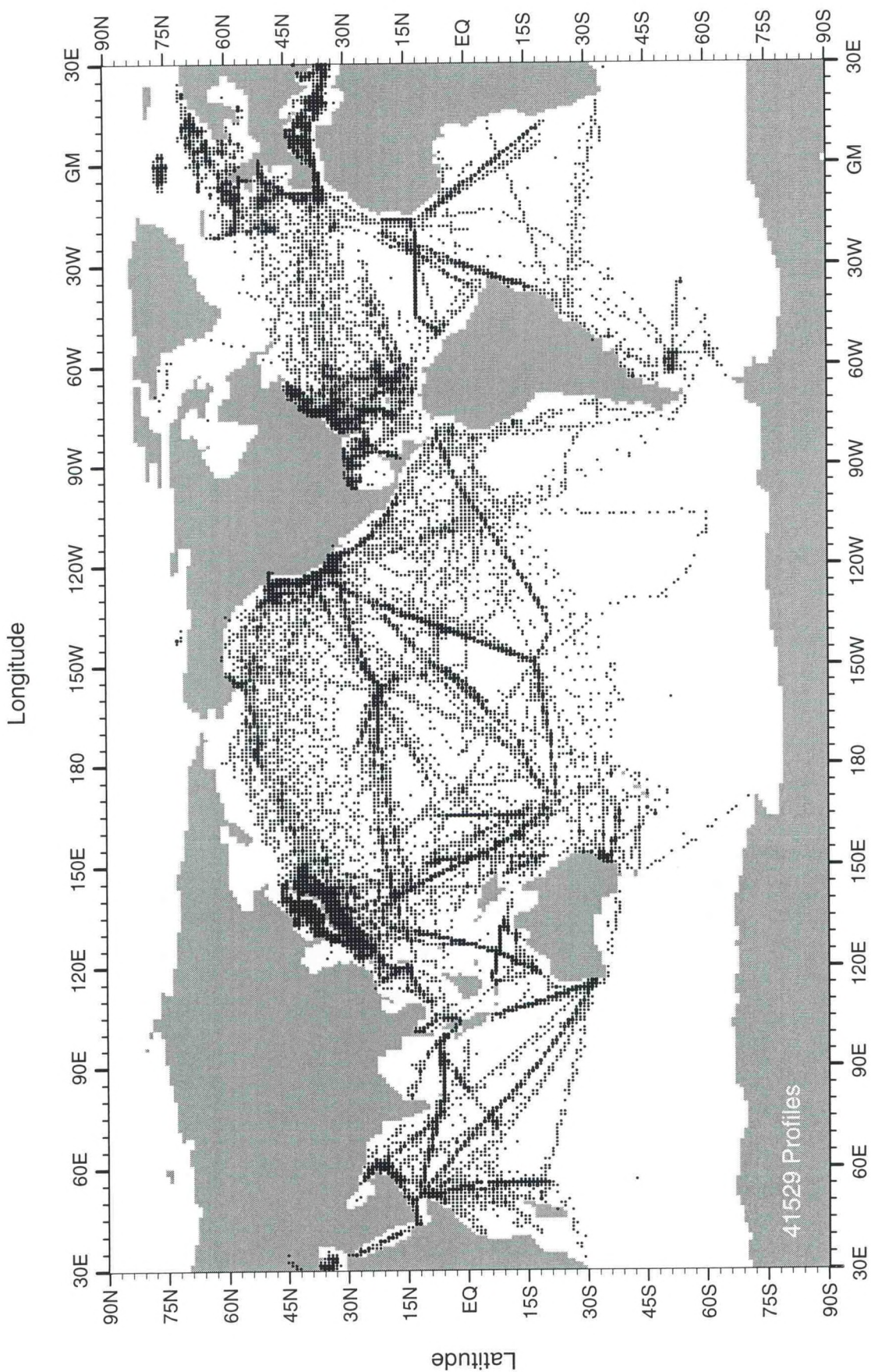


Fig. A24 WOD98 XBT profile distribution for 1989

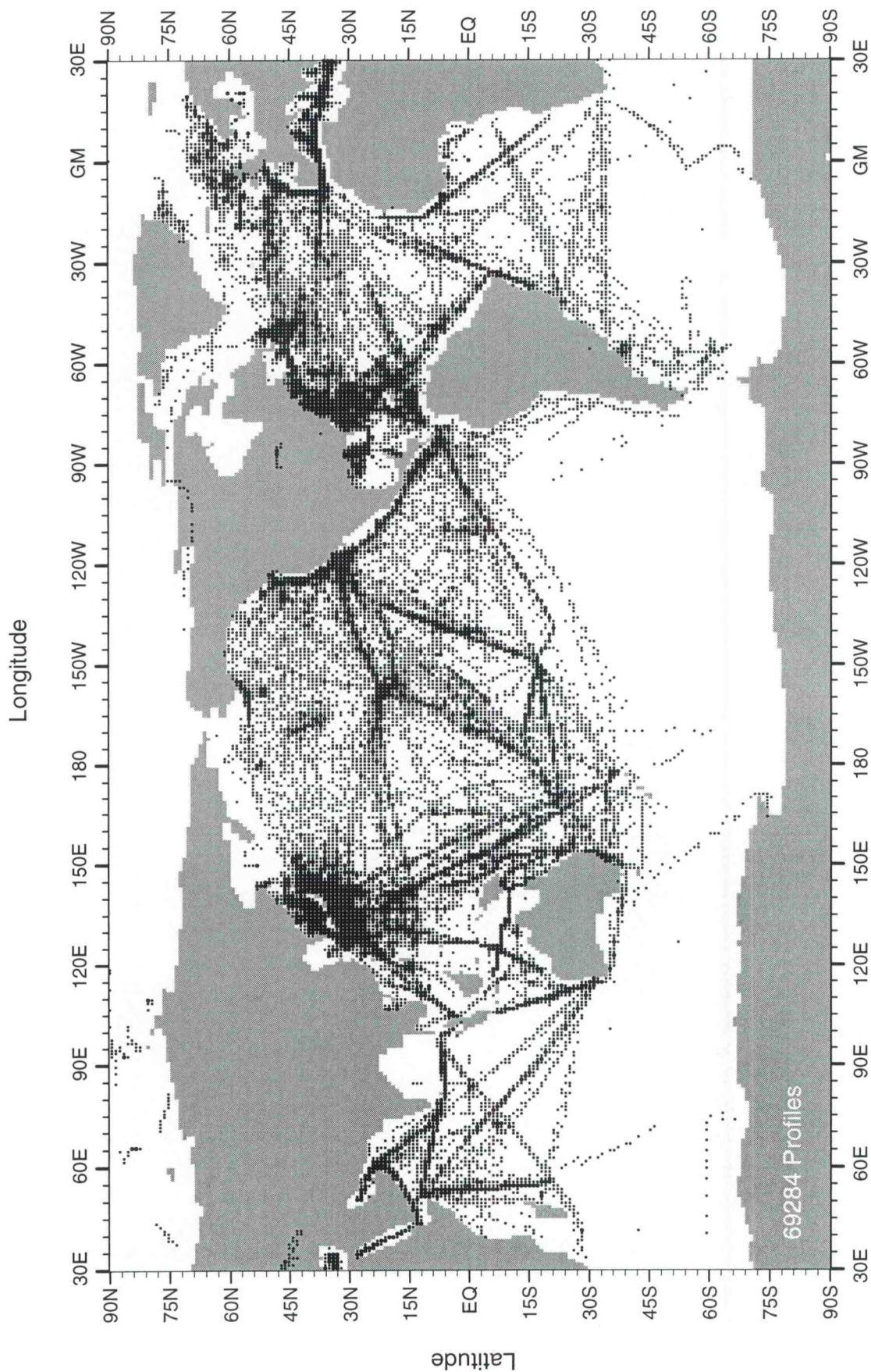


Fig. A25 WOD98 XBT and TAO profile distribution for 1990

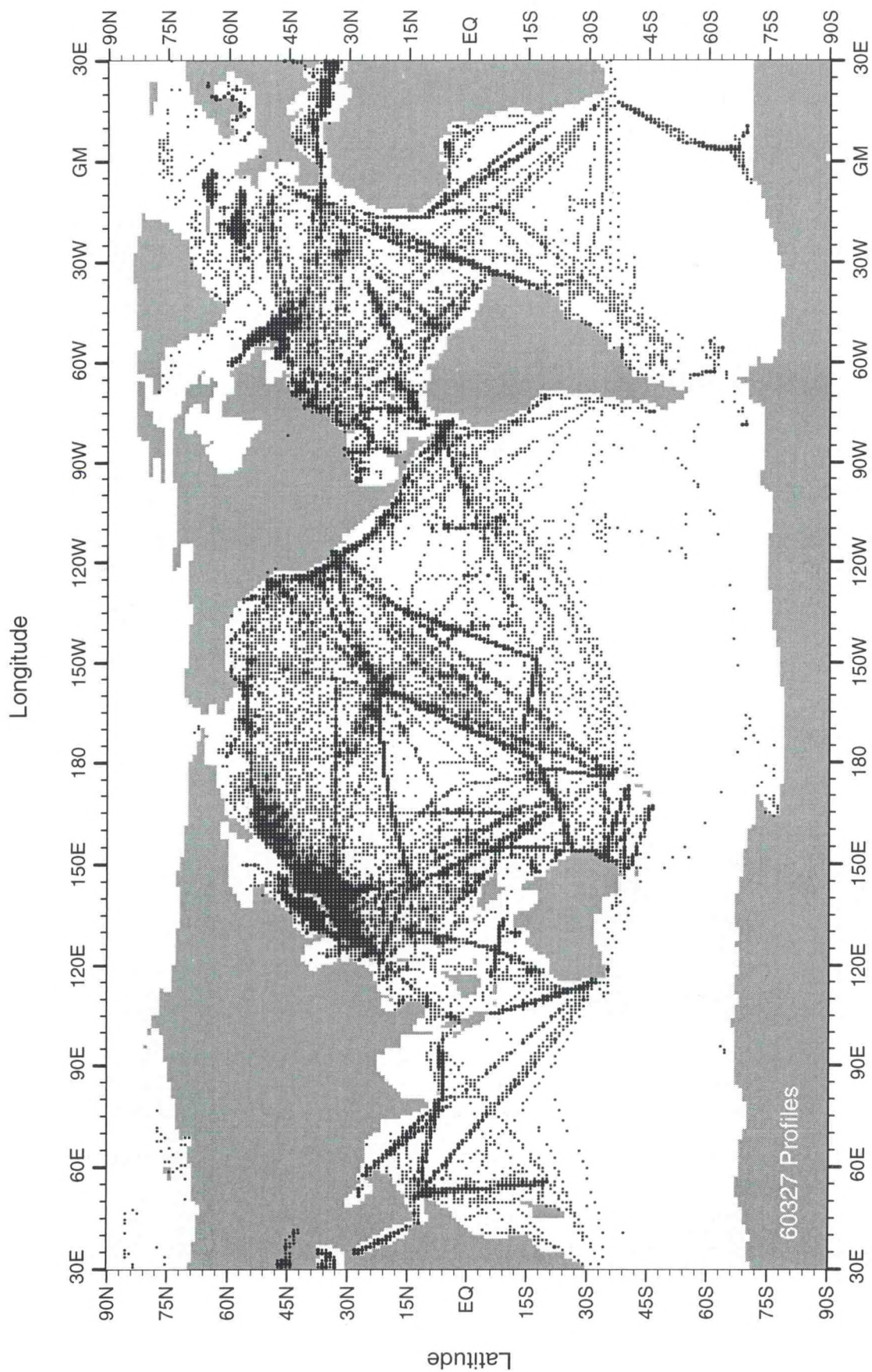


Fig. A26 WOD98 XBT and TAO profile distribution for 1991

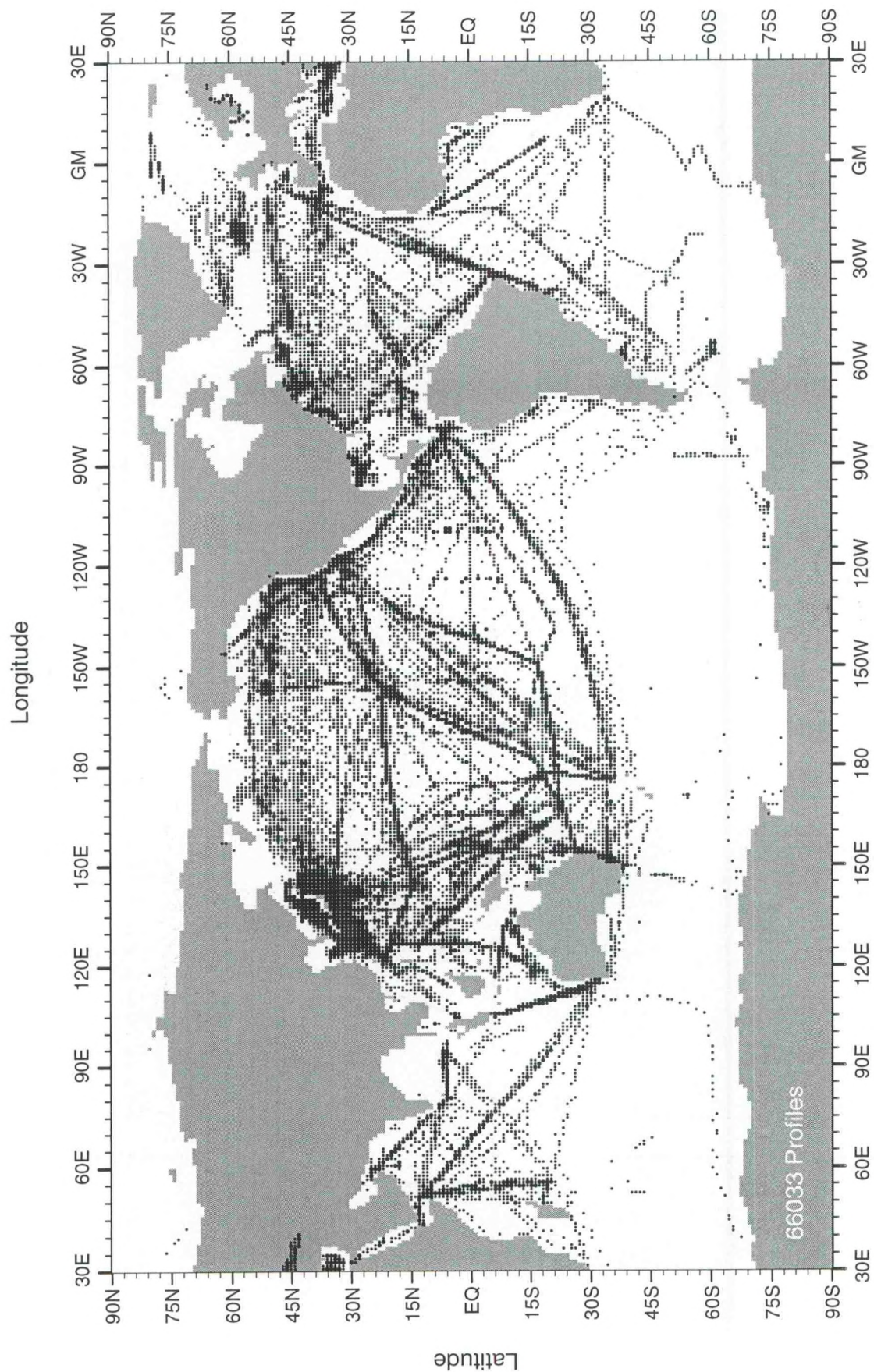


Fig. A27 WOD98 XBT and TAO profile distribution for 1992

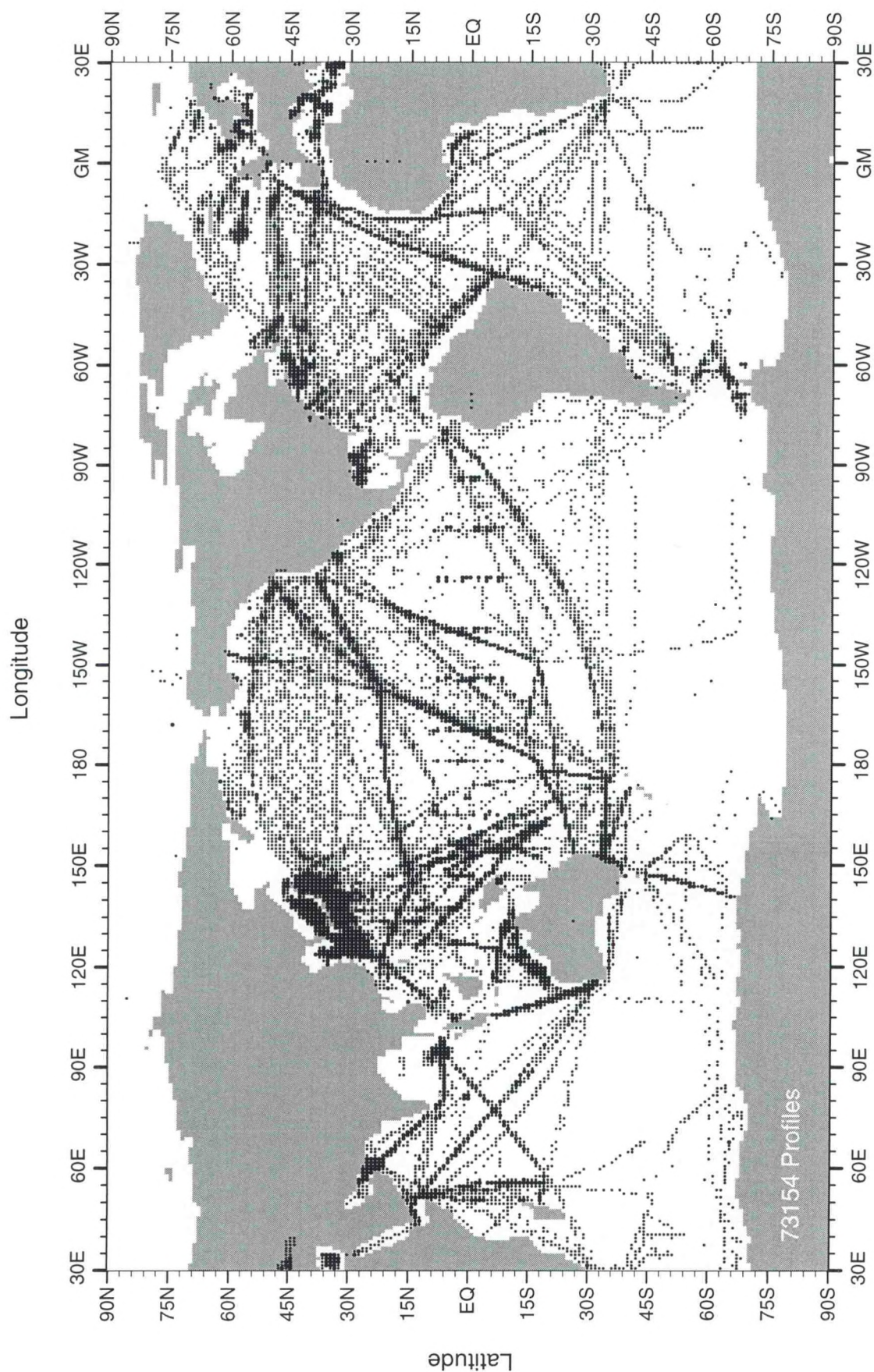


Fig. A28 WOD98 XBT and TAO profile distribution for 1993

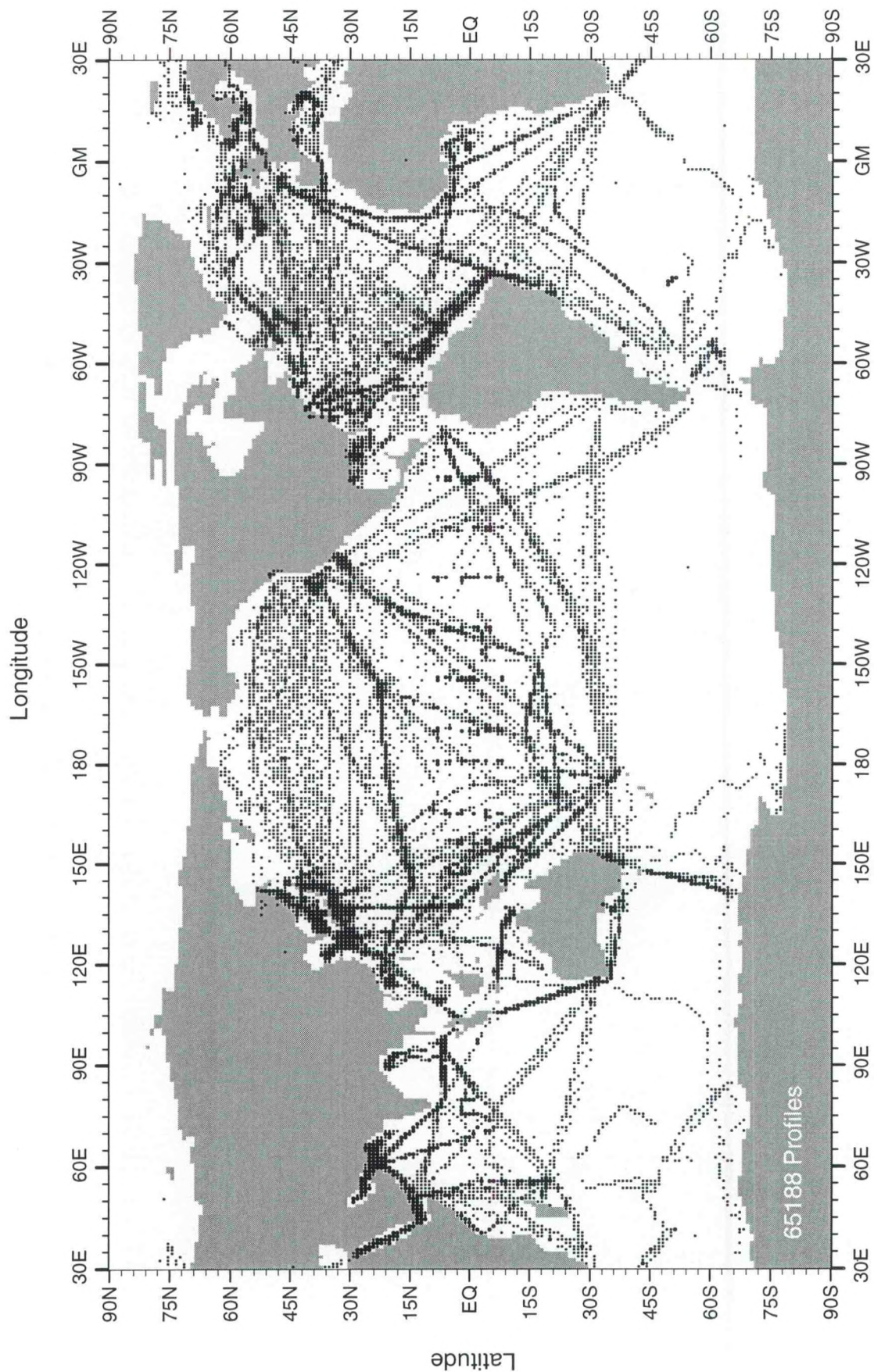


Fig. A29 WOD98 XBT and TAO profile distribution for 1994

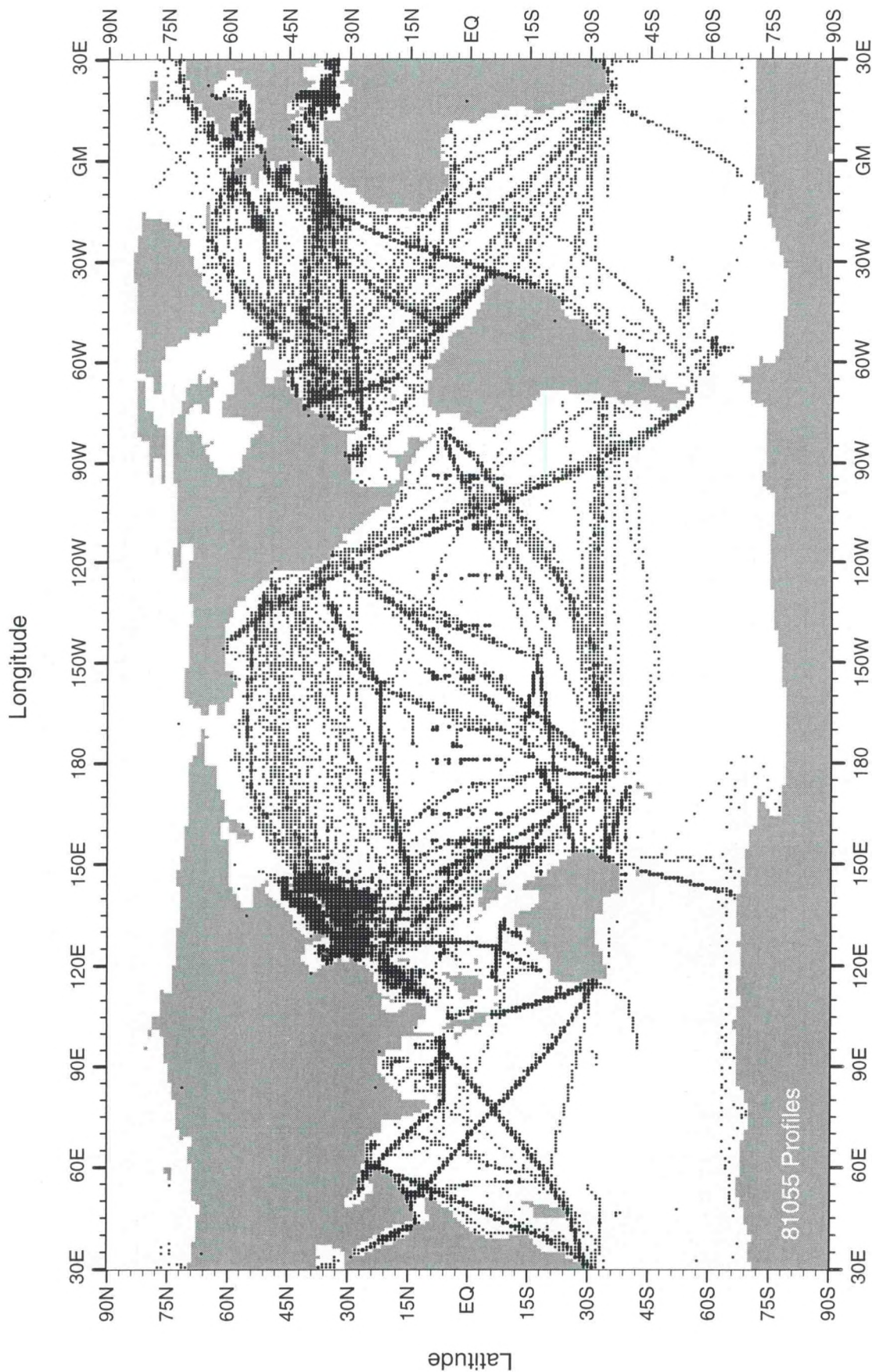


Fig. A30 WOD98 XBT and TAO profile distribution for 1995

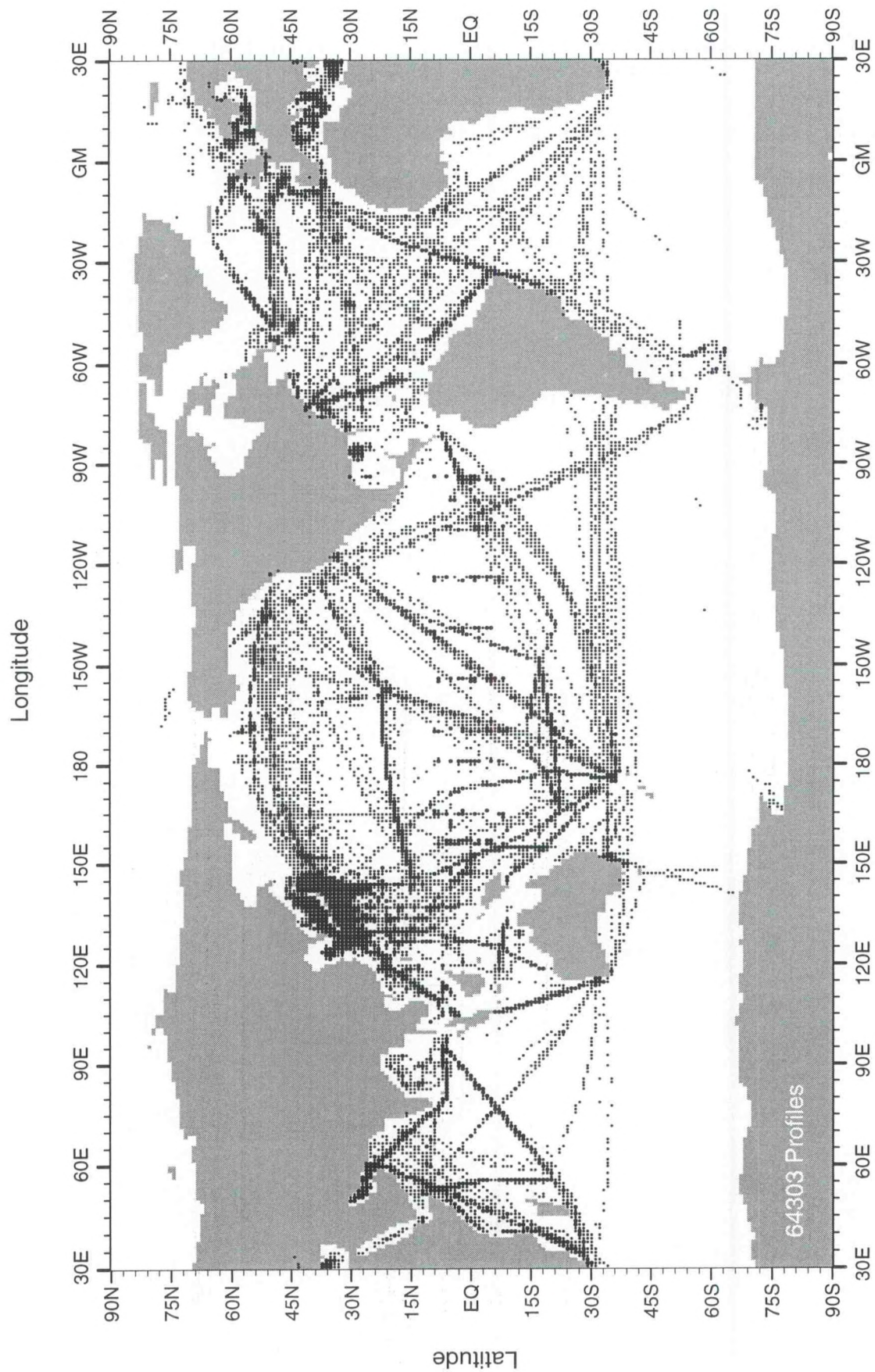


Fig. A31 WOD98 XBT and TAO profile distribution for 1996

6. APPENDIX B: SEASONAL DISTRIBUTIONS FOR INDIVIDUAL YEARS OF ALL XBT PROFILES IN WOD98

This appendix contains seasonal distributions for individual years of all XBT profile data contained in WOD98.

For all figures in Appendix B, a small dot indicates a one-degree square containing from one to four profiles and a large dot indicates five or more profiles.

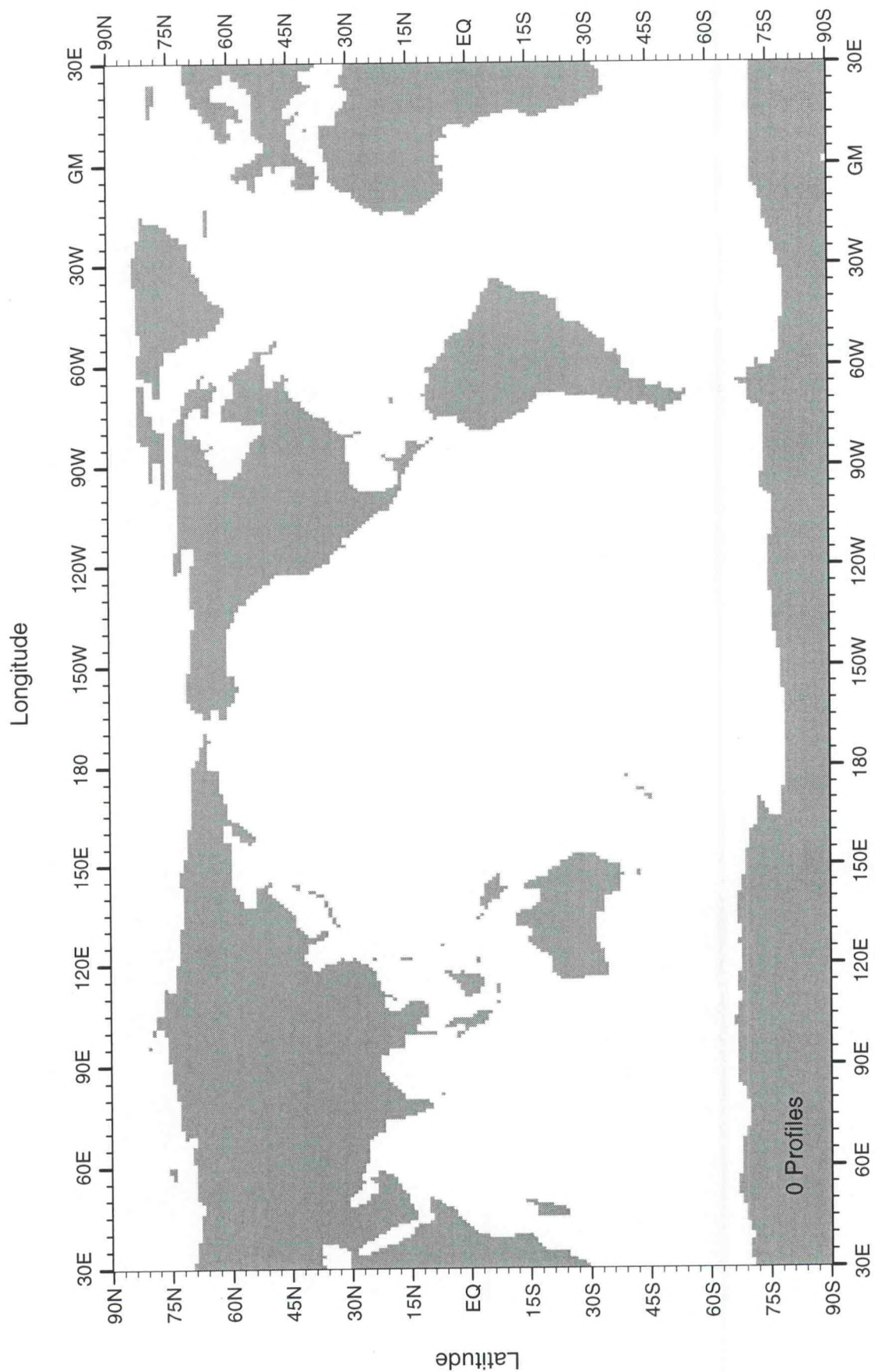


Fig. B1 WOD98 XBT profile distribution for January-March for 1966

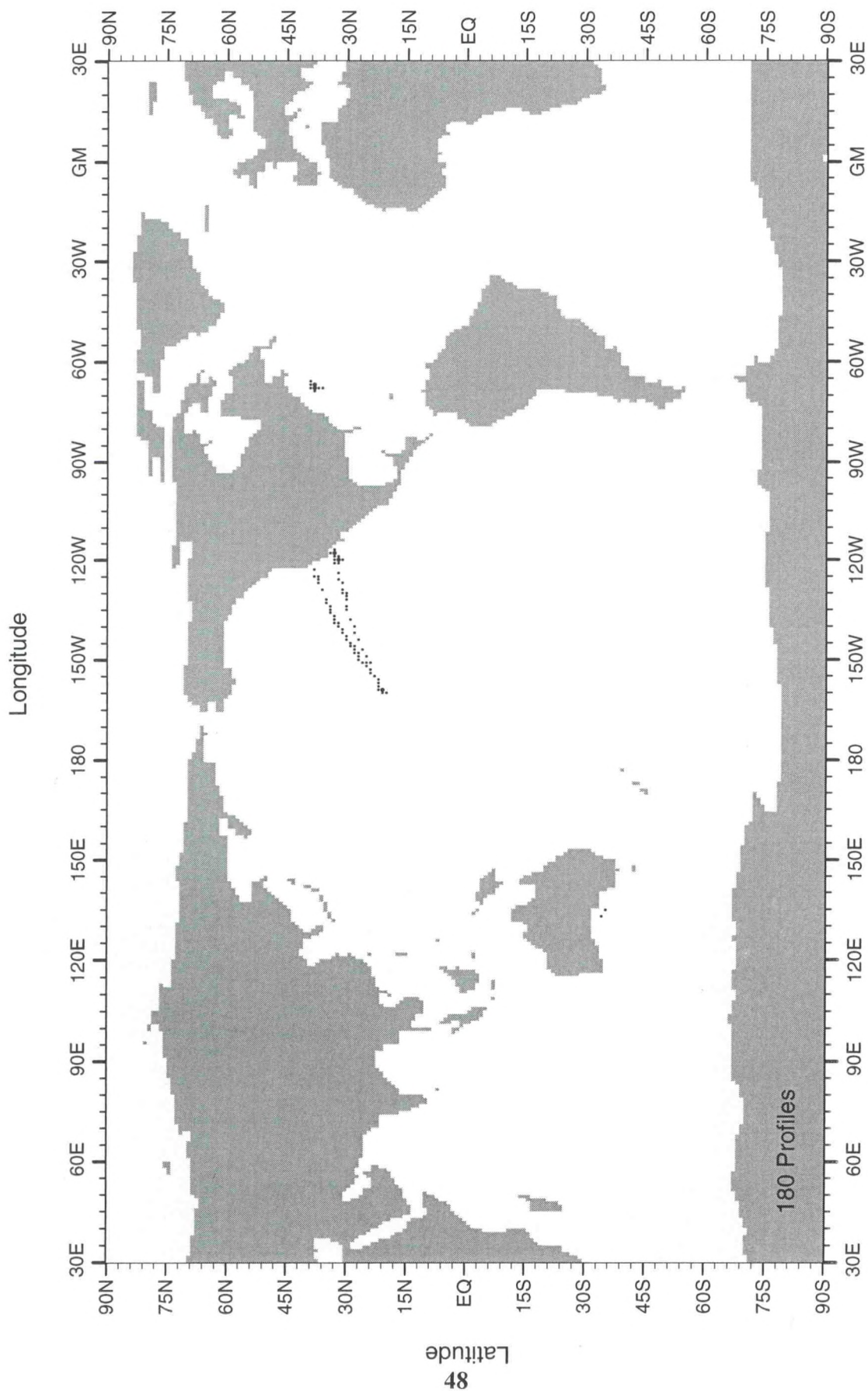


Fig. B2 WOD98 XBT profile distribution for April-June for 1966

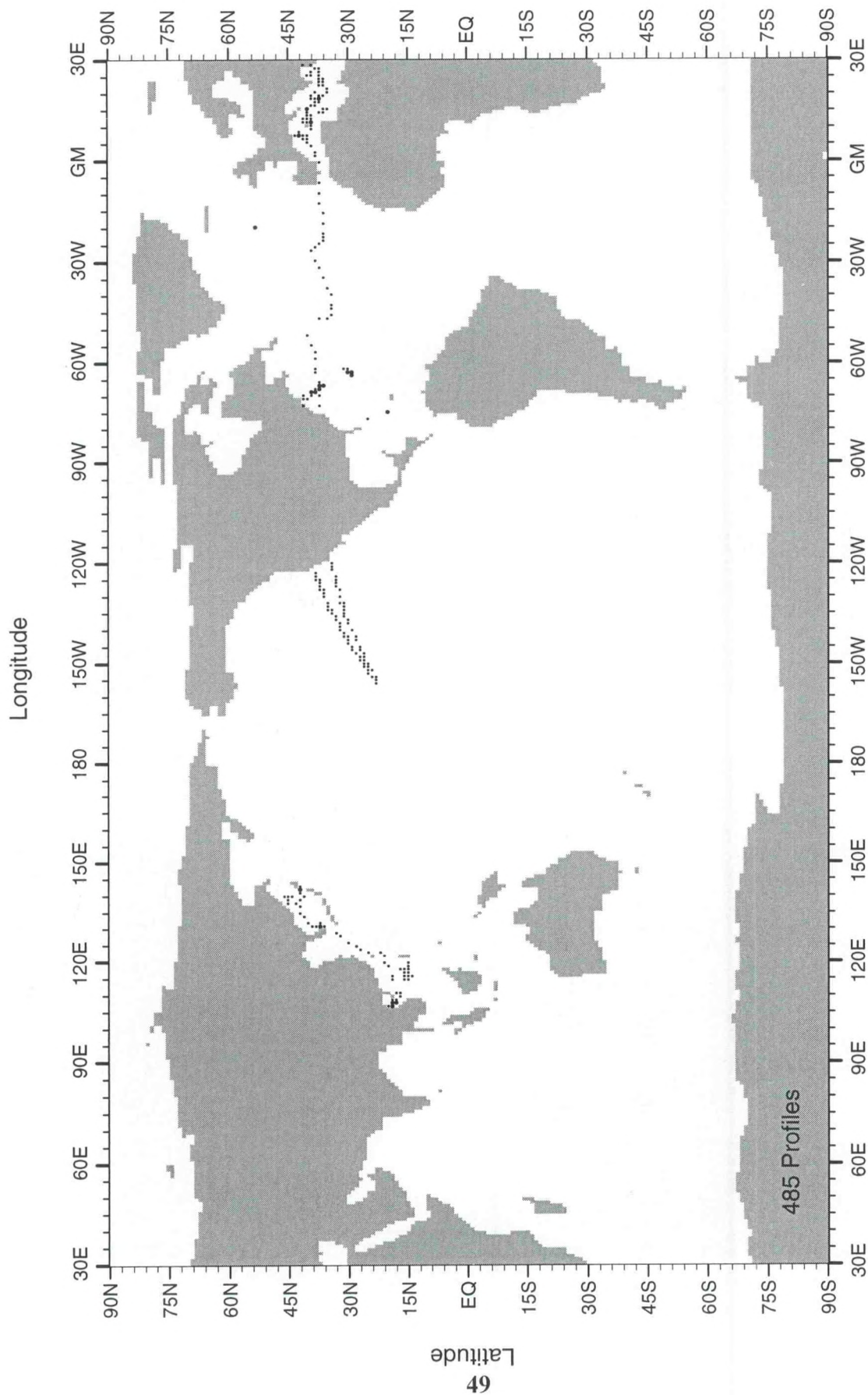


Fig. B3 WOD98 XBT profile distribution for July-September for 1966

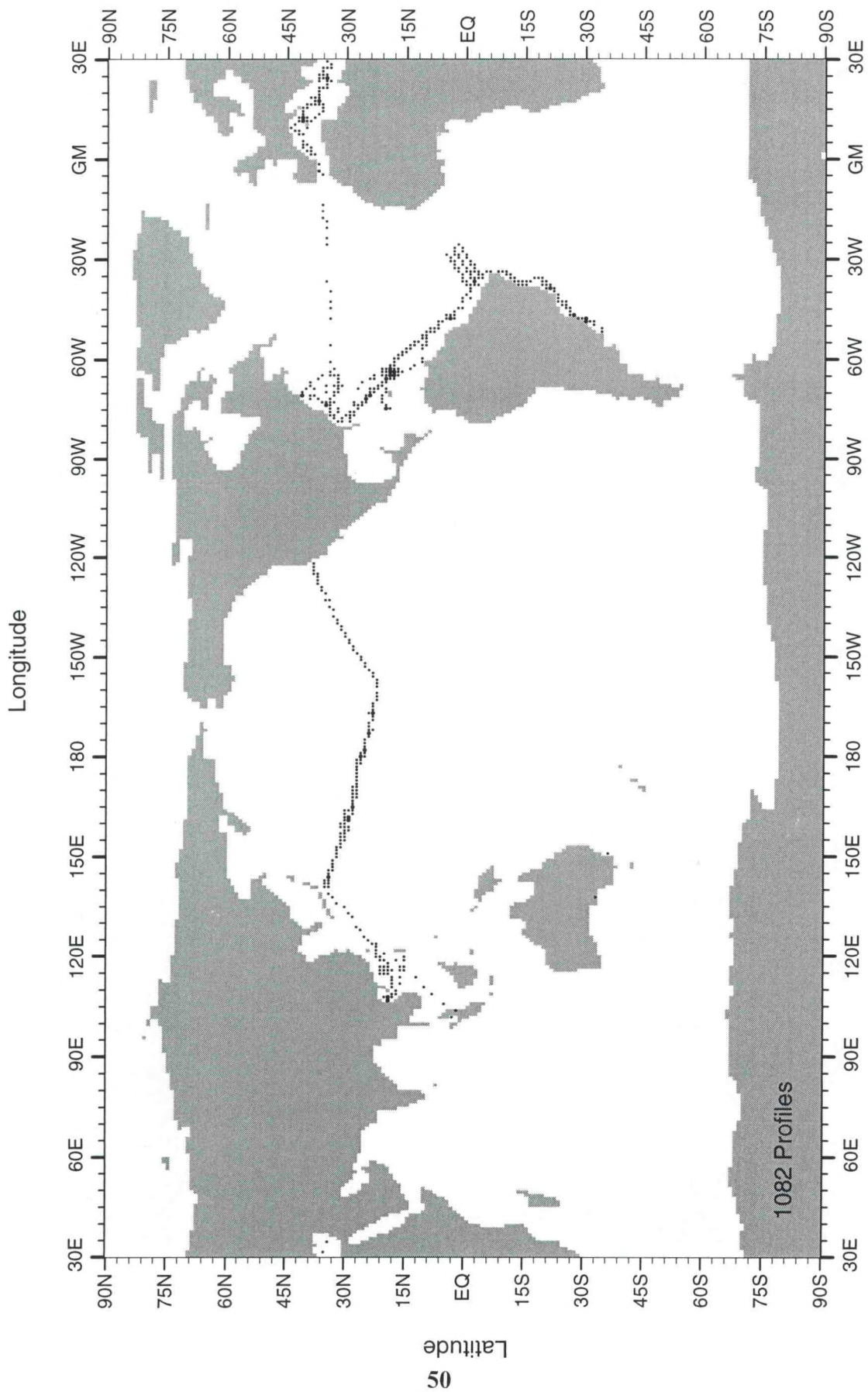


Fig. B4 WOD98 XBT profile distribution for October-December for 1966

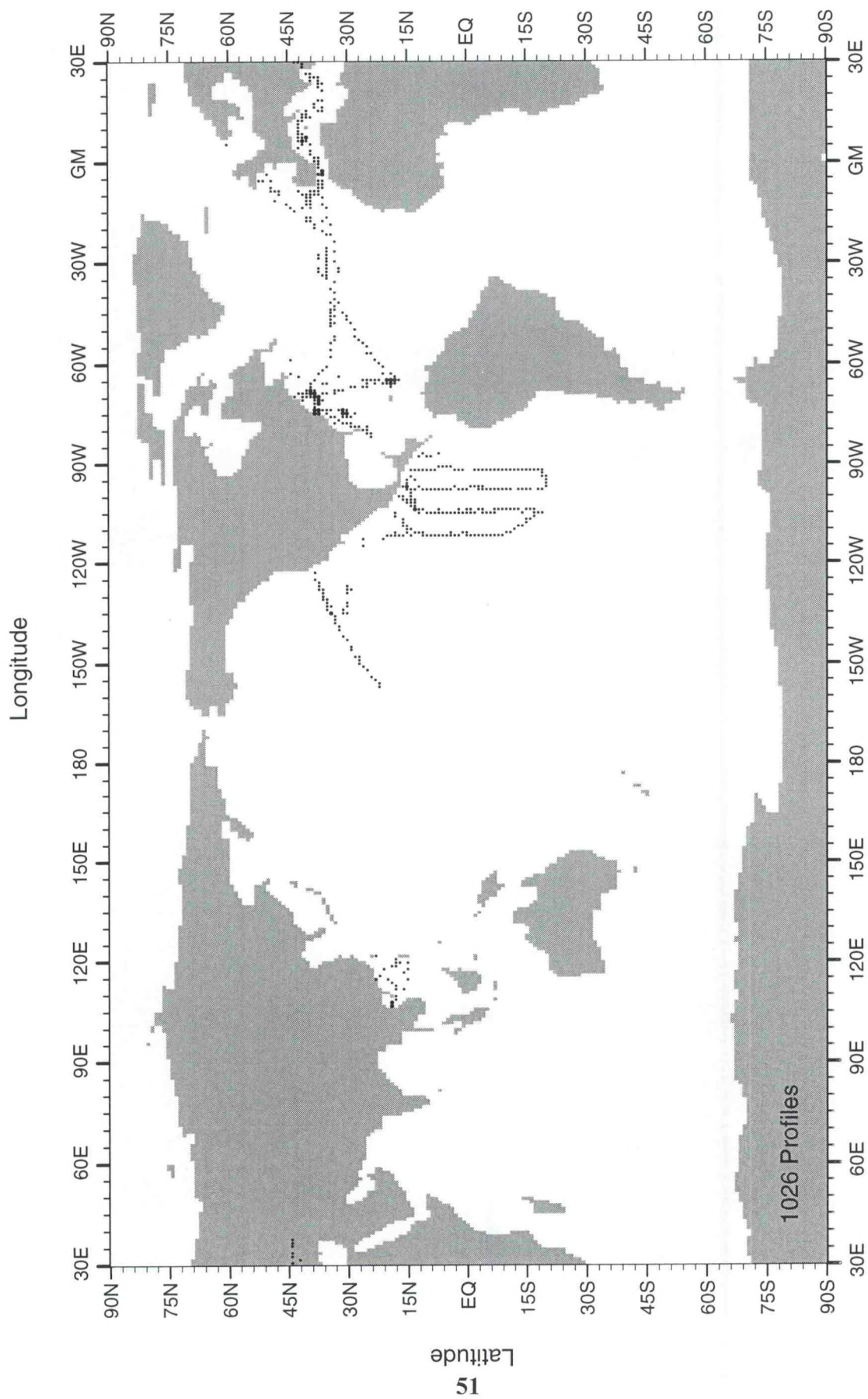


Fig. B5 WOD98 XBT profile distribution for January-March for 1967

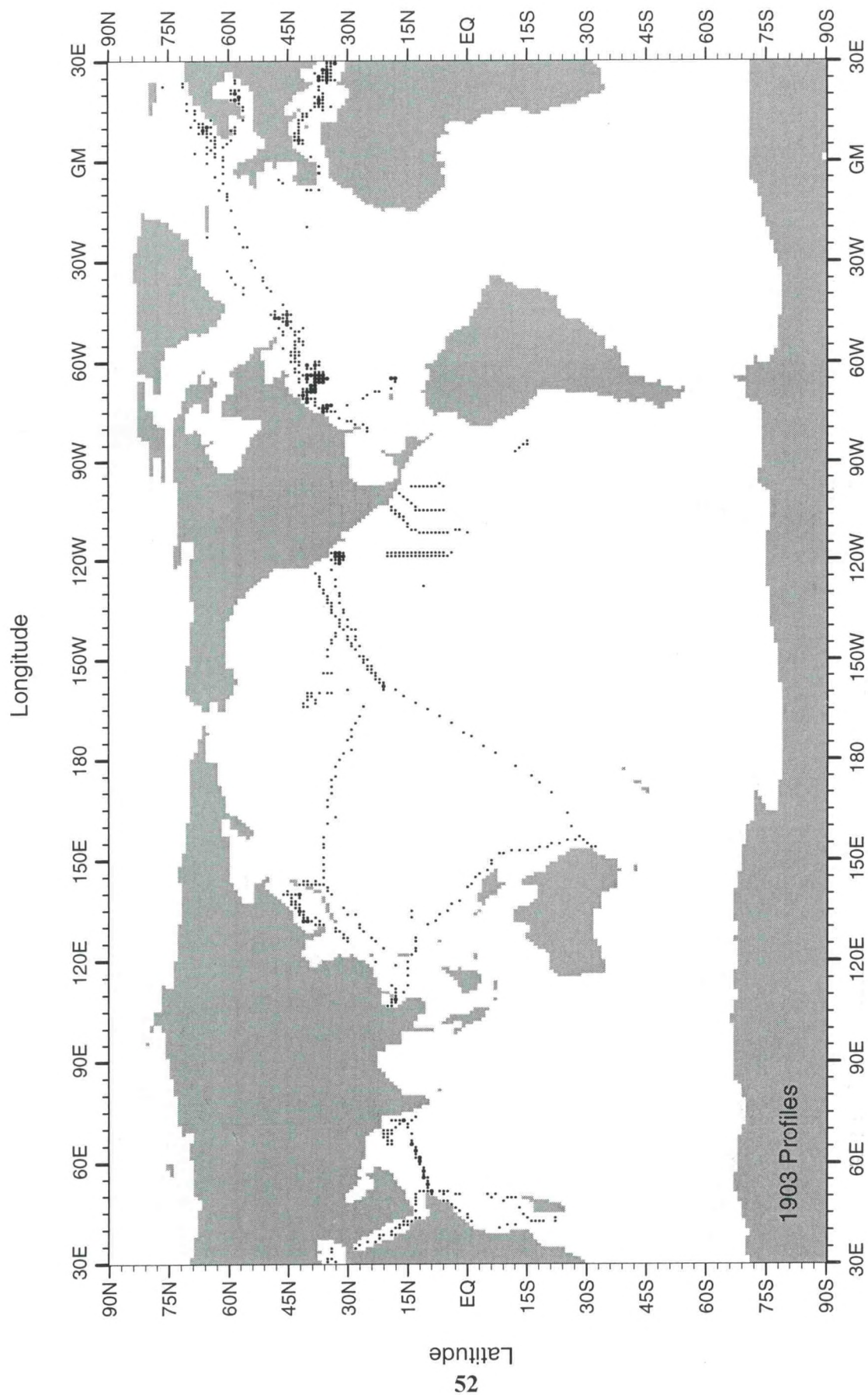


Fig. B6 WOD98 XBT profile distribution for April-June for 1967

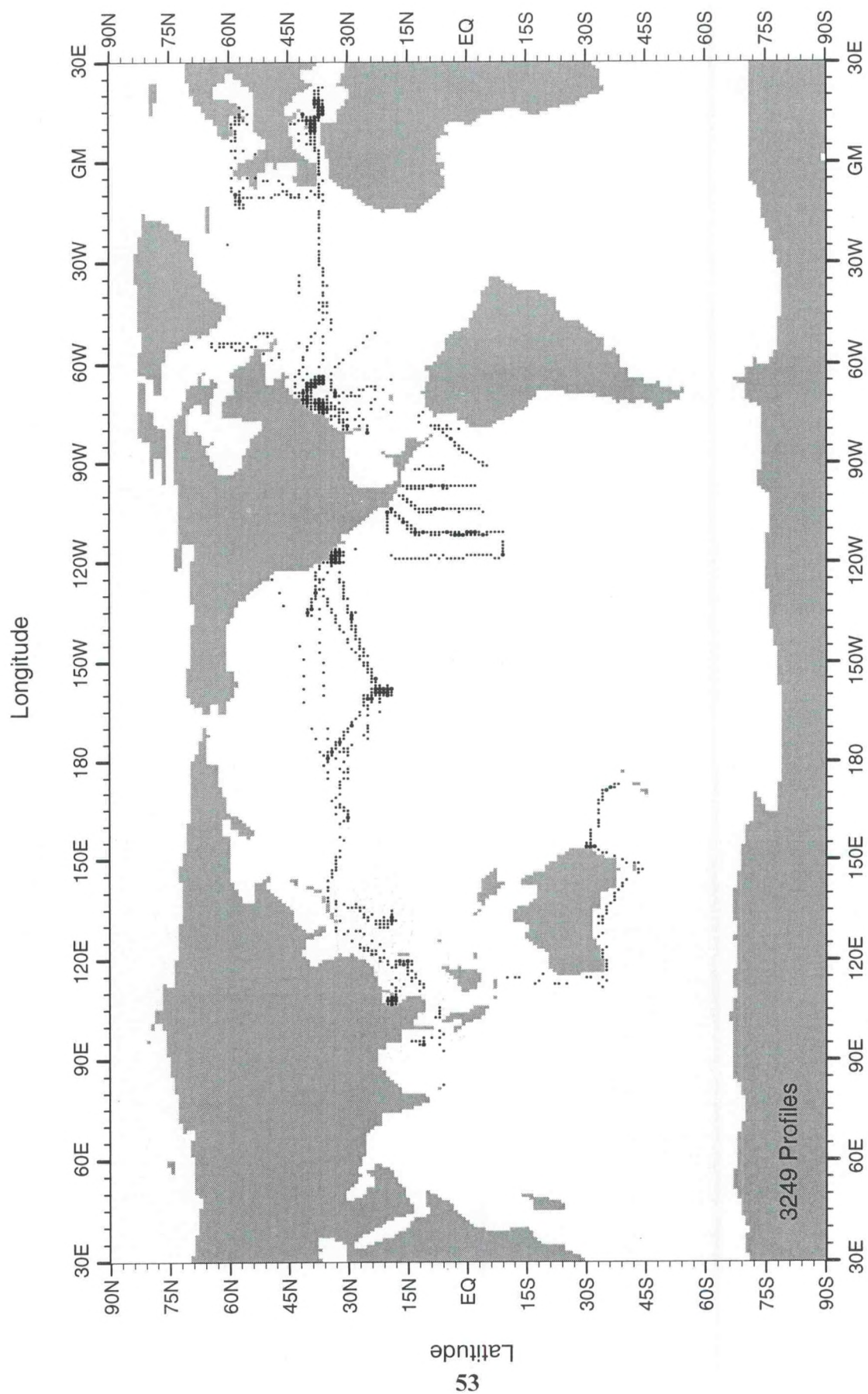


Fig. B7 WOD98 XBT profile distribution for July-September for 1967

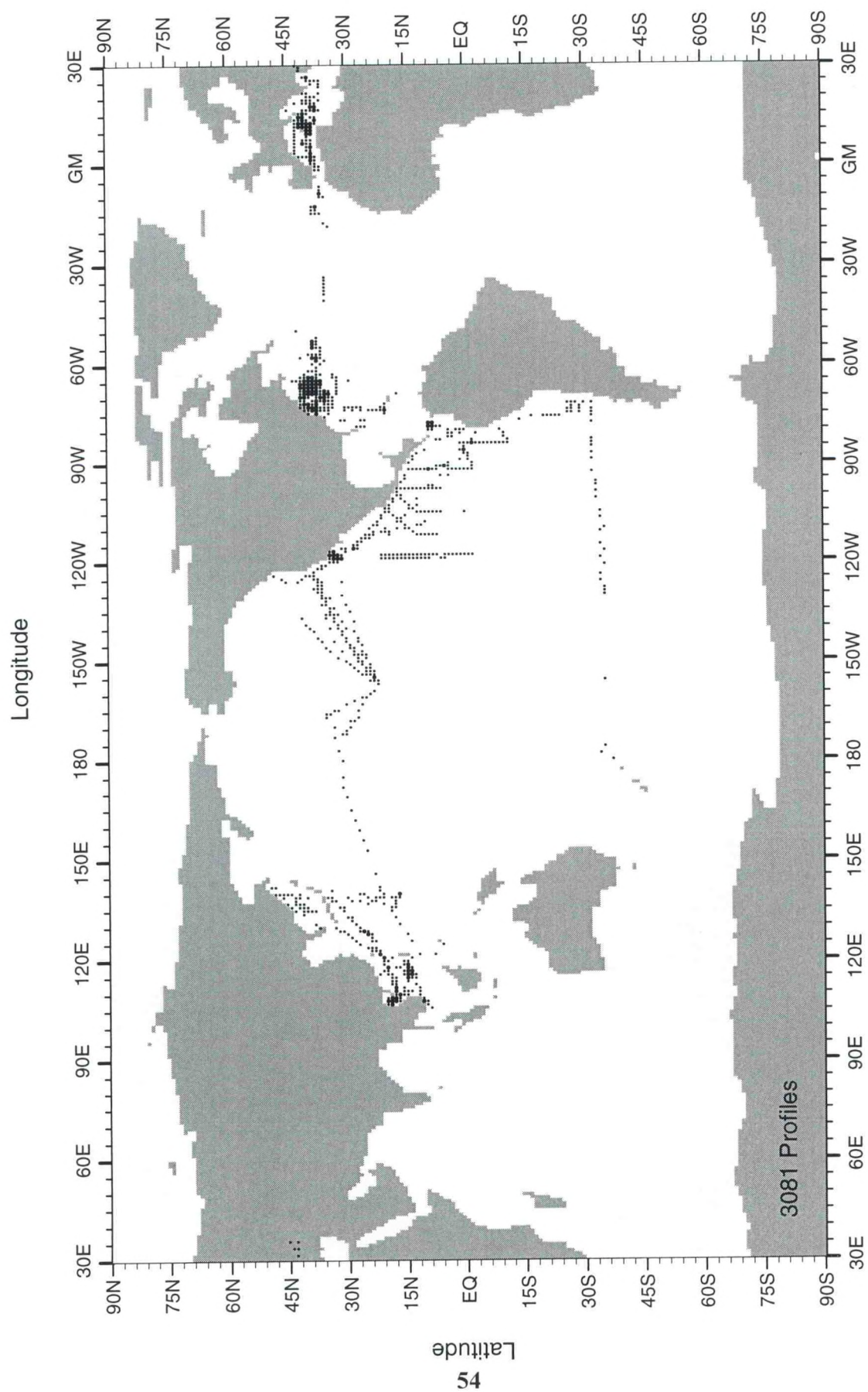


Fig. B8 WOD98 XBT profile distribution for October-December for 1967

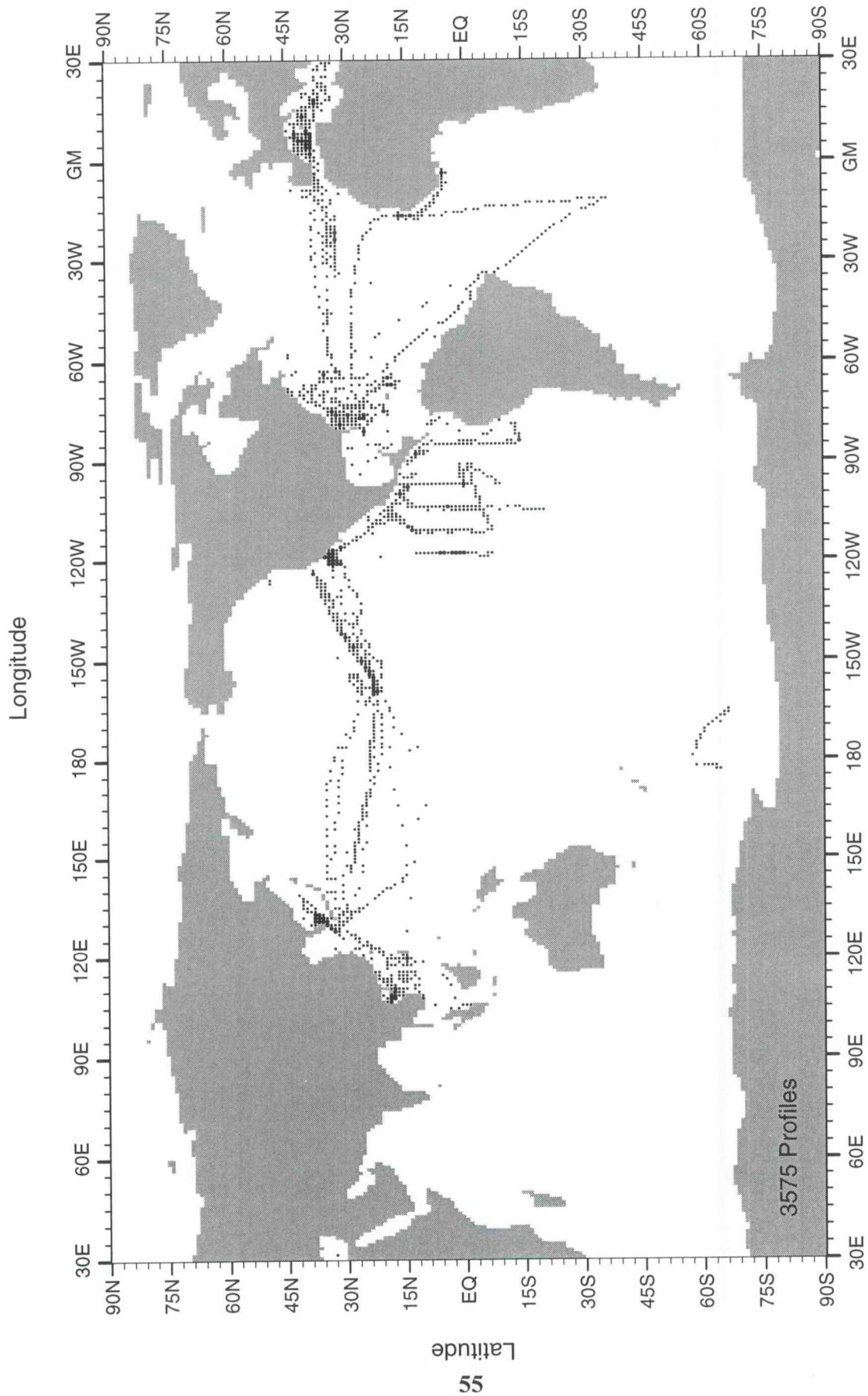


Fig. B9 WOD98 XBT profile distribution for January-March for 1968

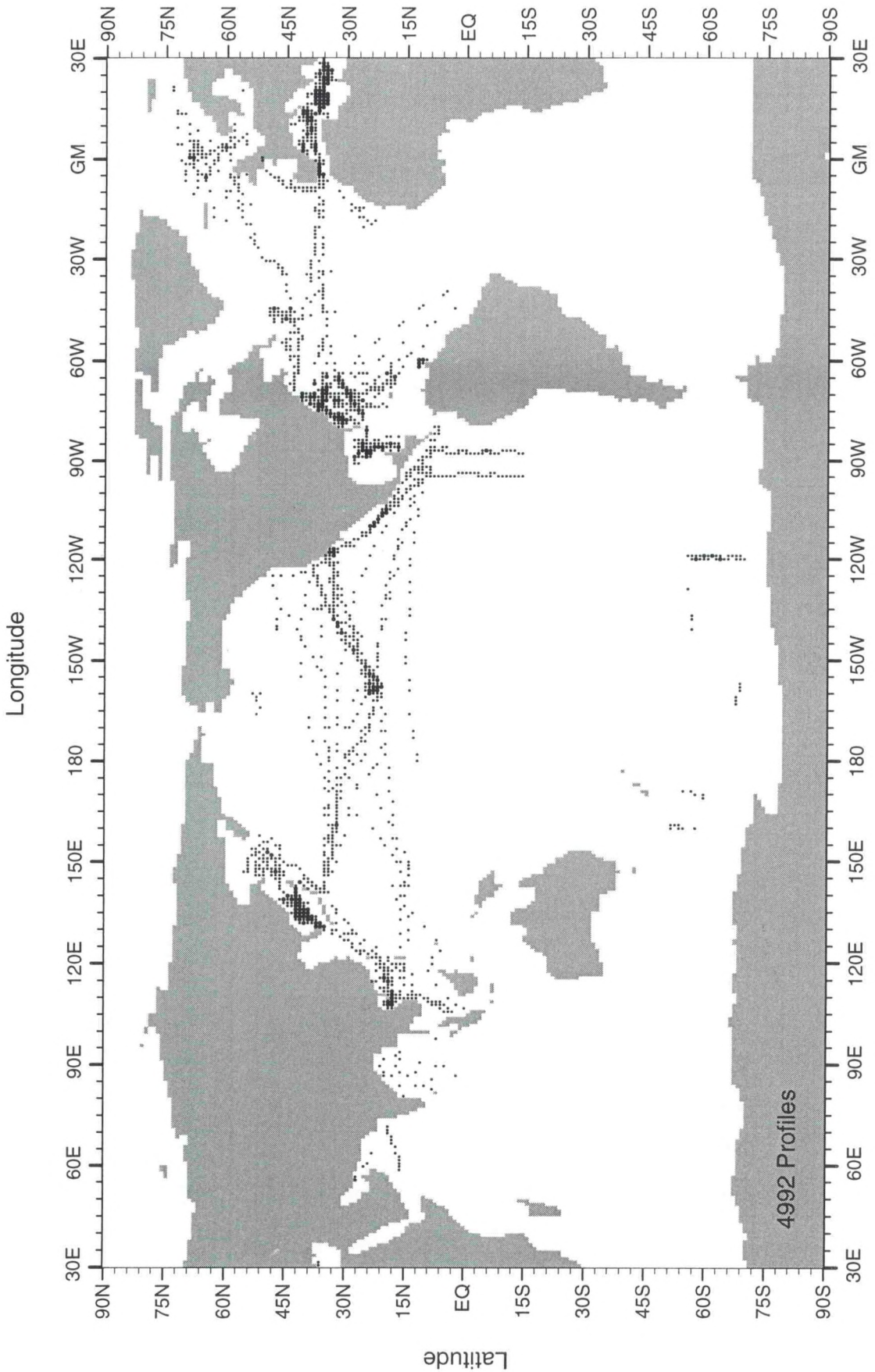


Fig. B10 WOD98 XBT profile distribution for April-June for 1968

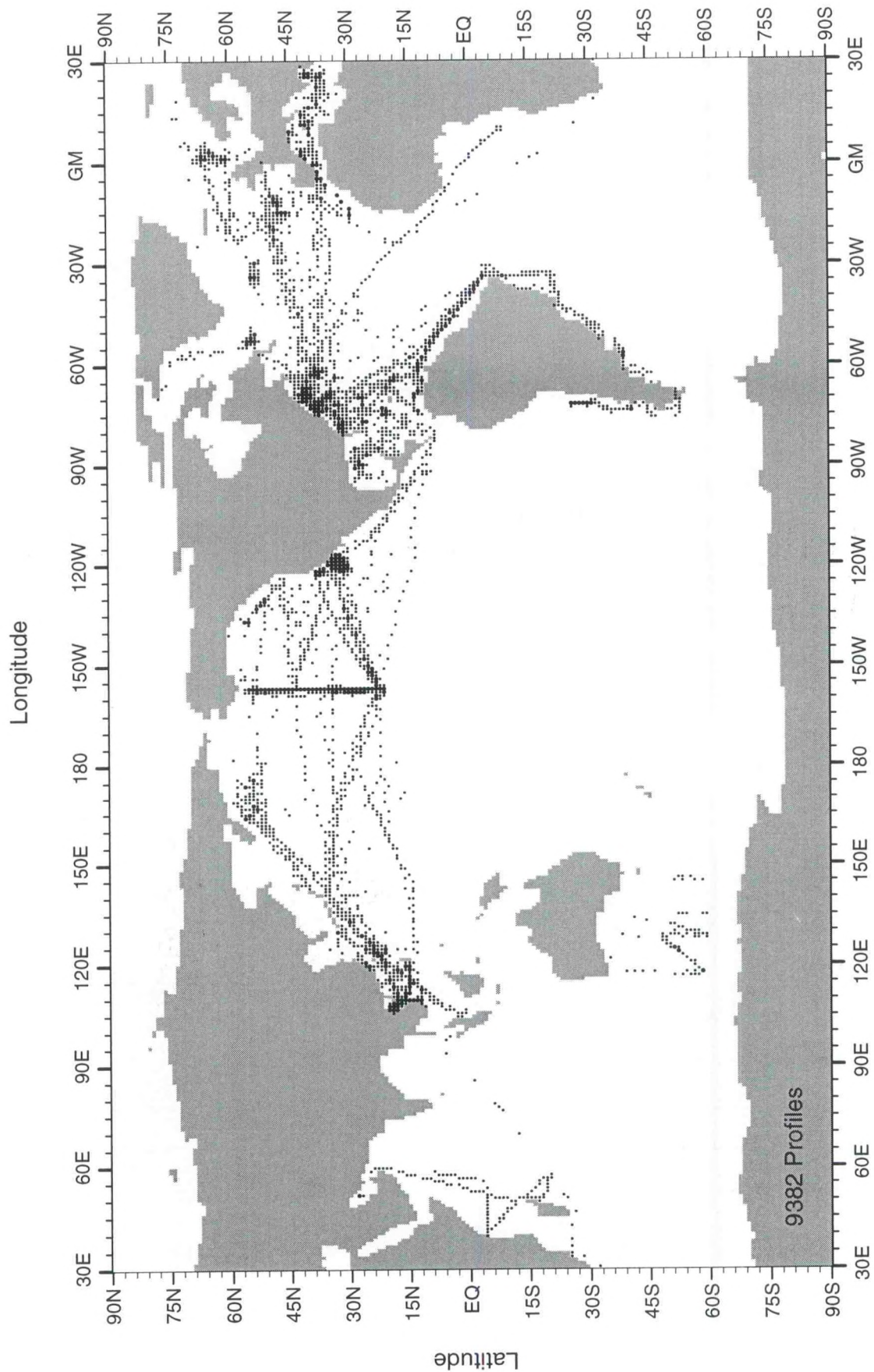
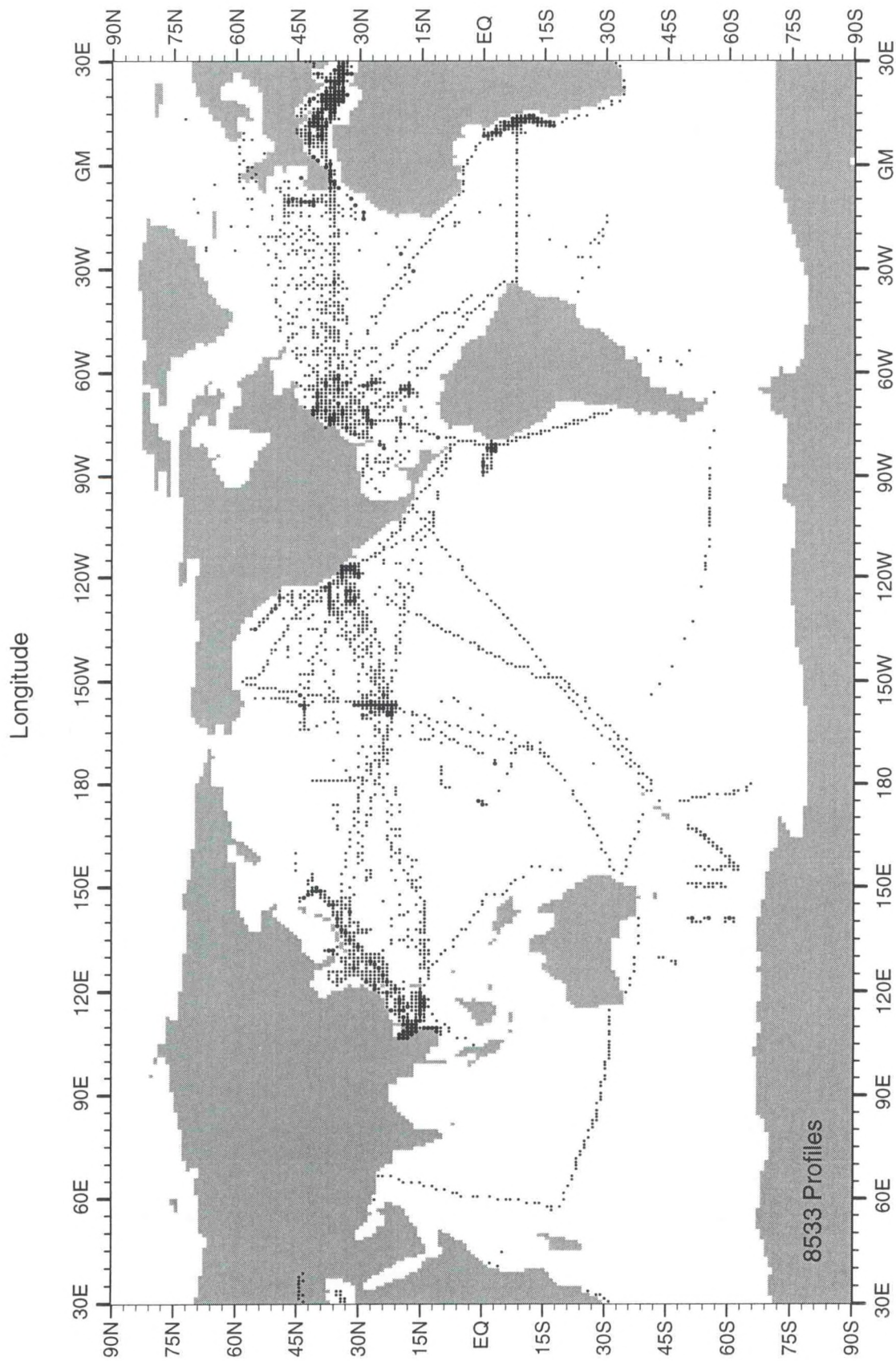


Fig. B11 WOD98 XBT profile distribution for July-September for 1968



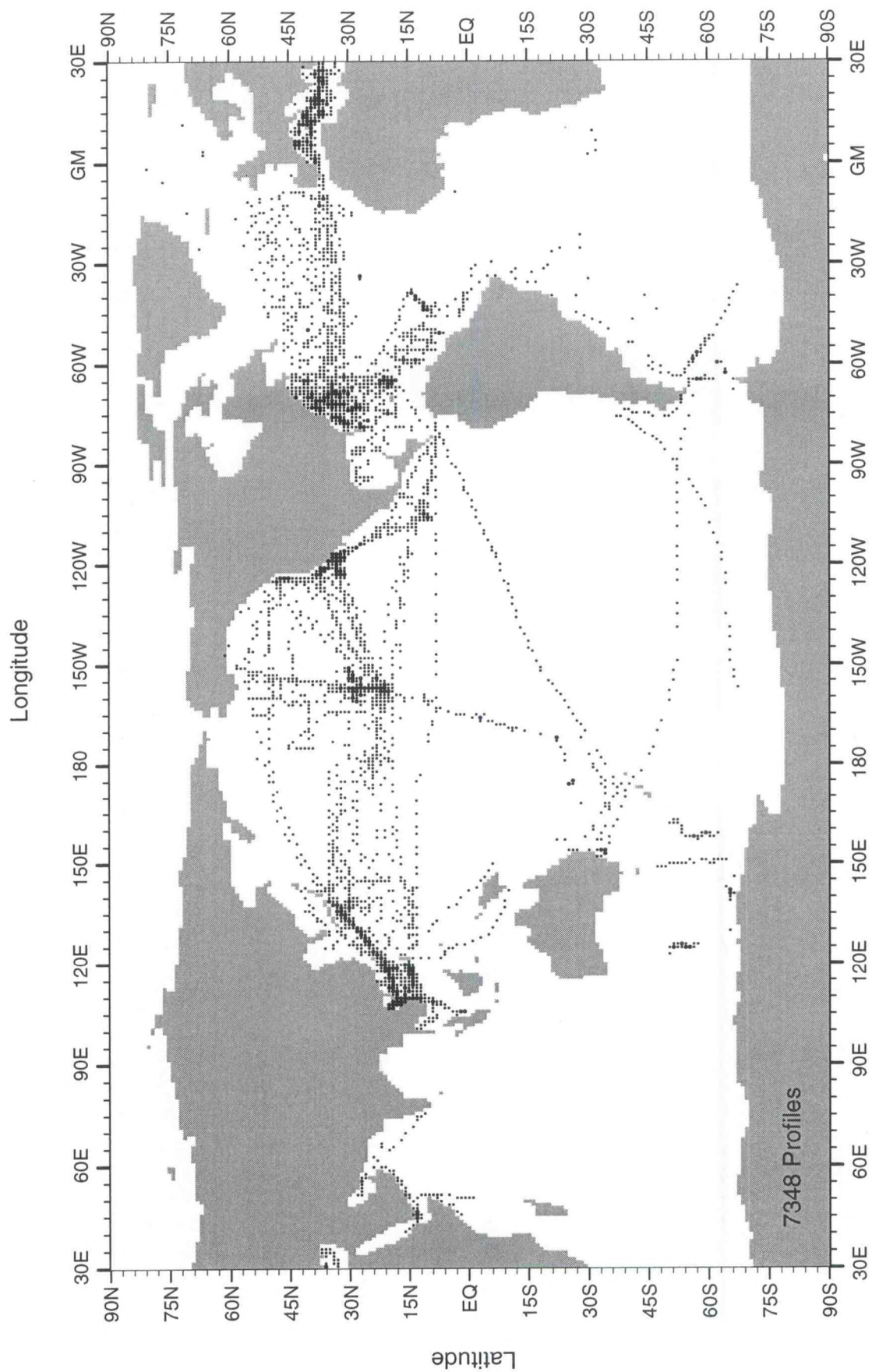


Fig. B13 WOD98 XBT profile distribution for January-March for 1969

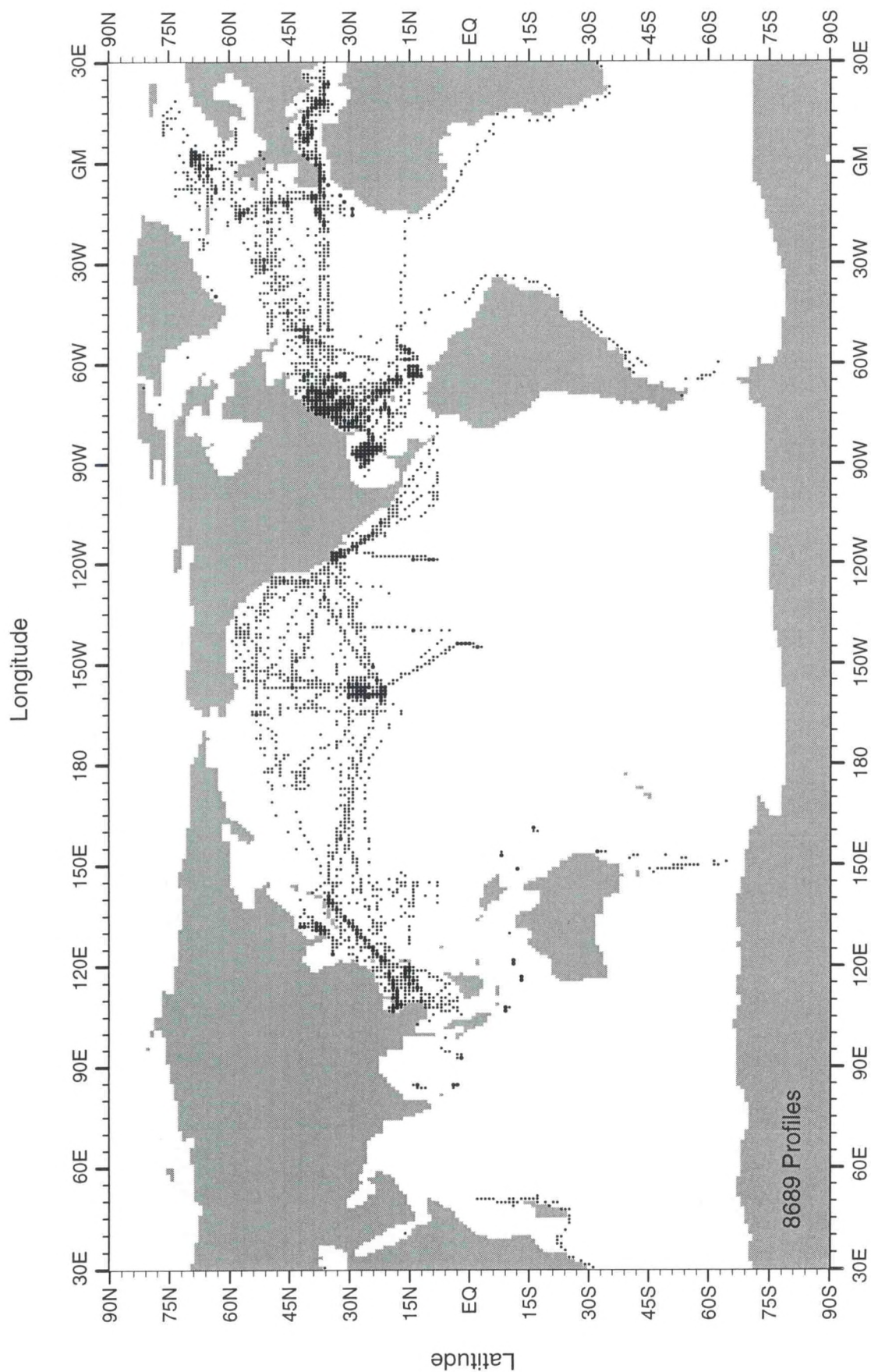


Fig. B14 WOD98 XBT profile distribution for April-June for 1969

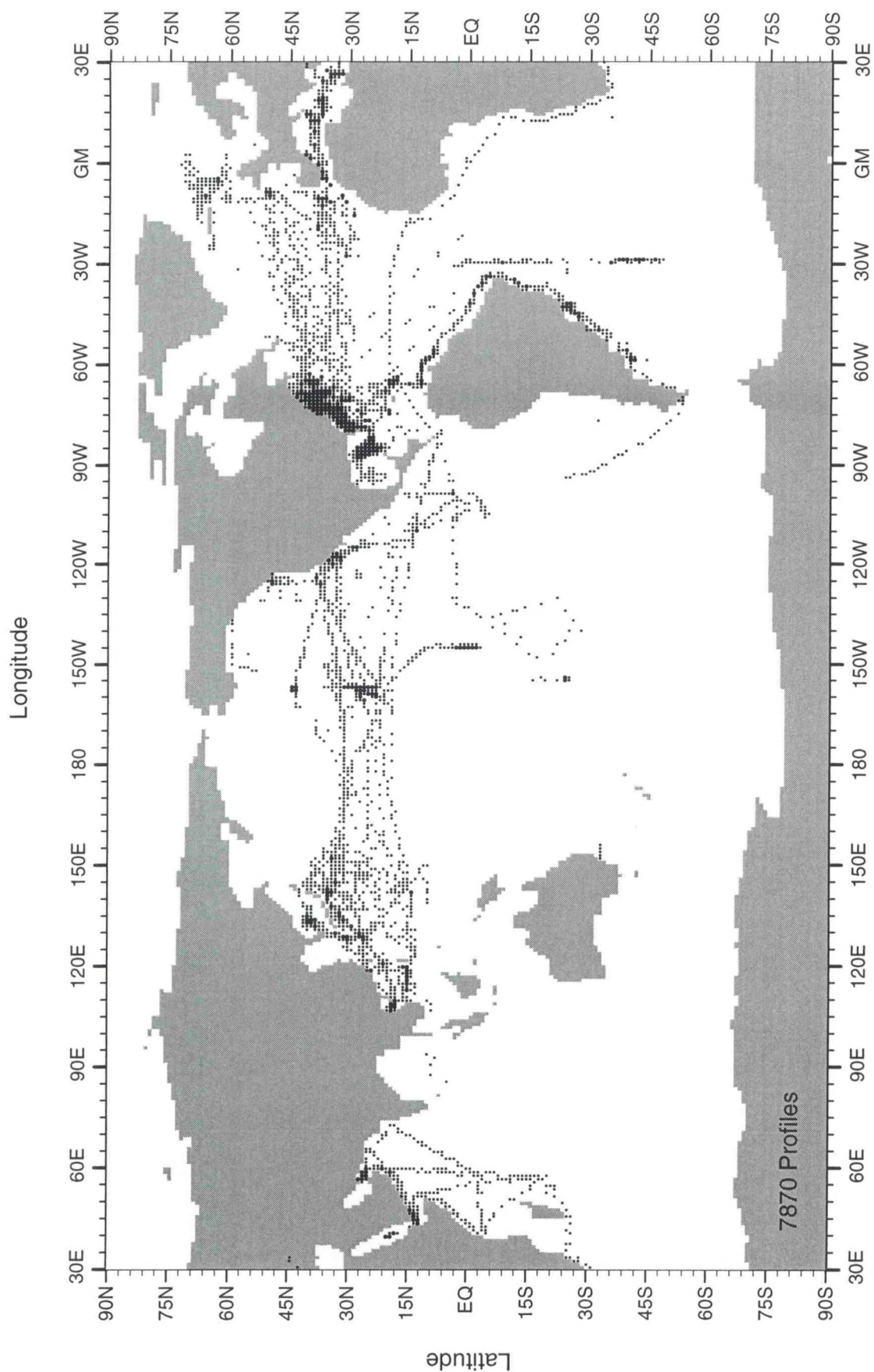


Fig. B16 WOD98 XBT profile distribution for October-December for 1969

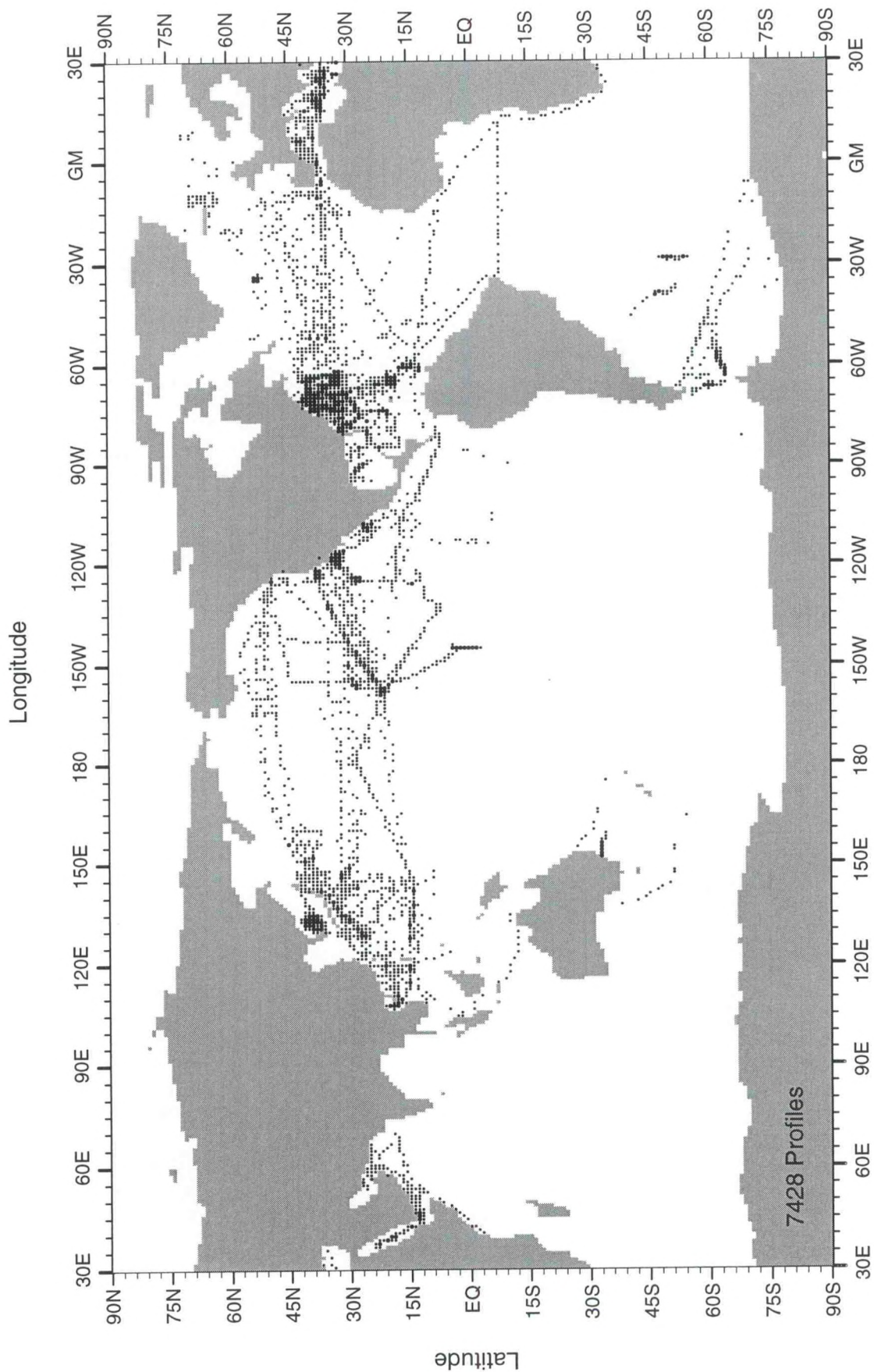


Fig. B17 WOD98 XBT profile distribution for January-March for 1970

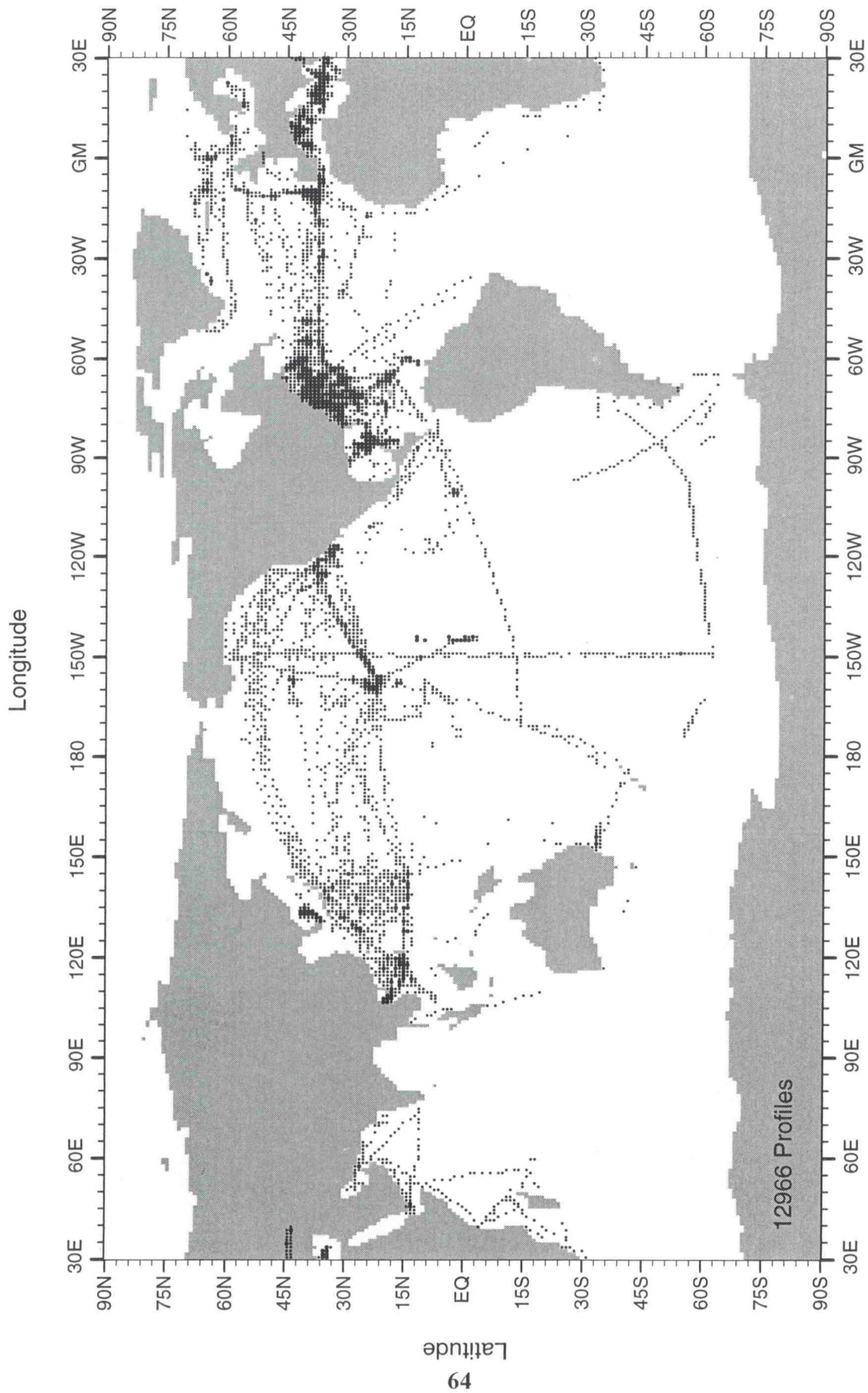


Fig. B18 WOD98 XBT profile distribution for April-June for 1970

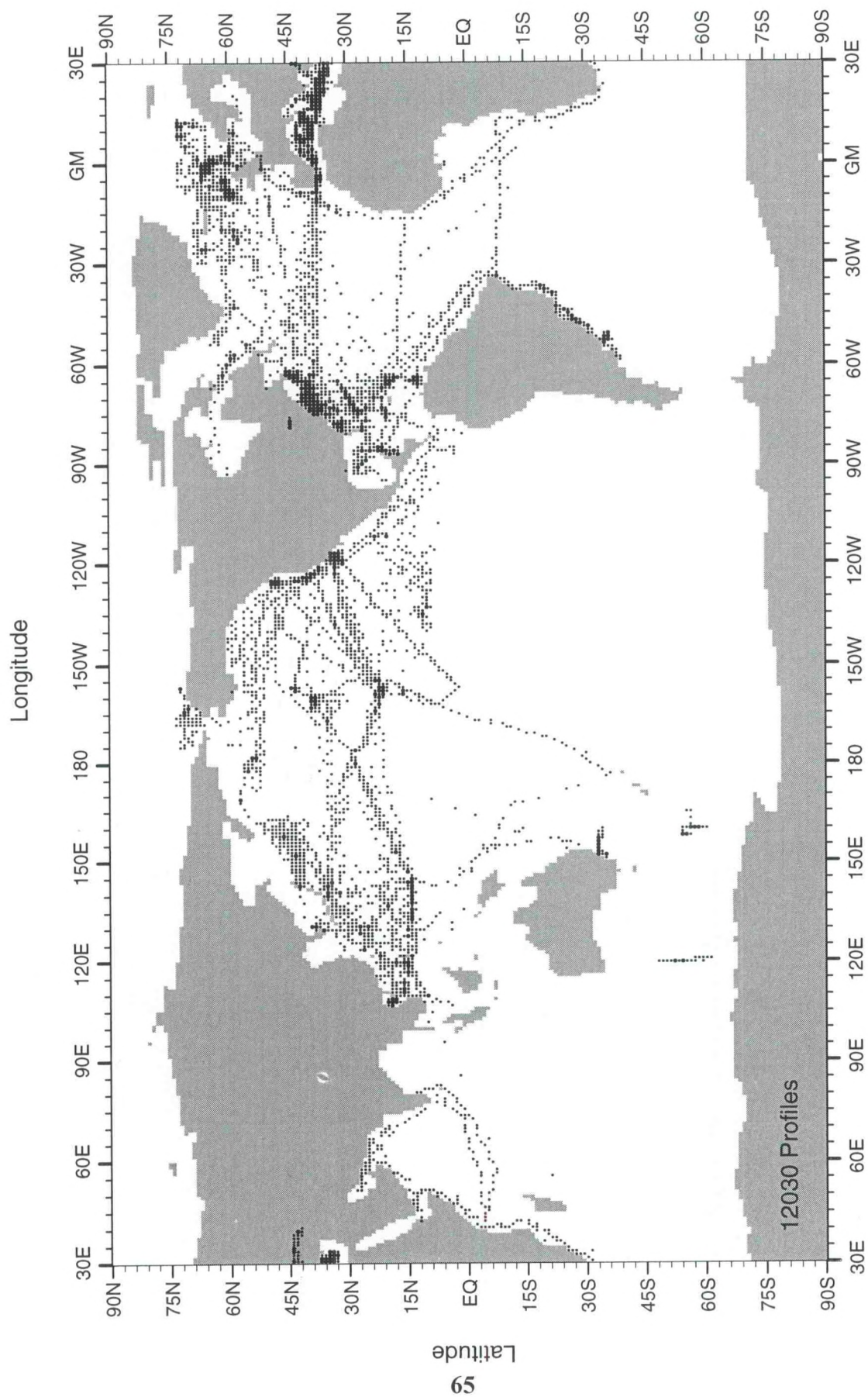


Fig. B19 WOD98 XBT profile distribution for July-September for 1970

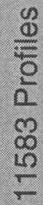


Fig. B20 WOD98 XBT profile distribution for October-December for 1970

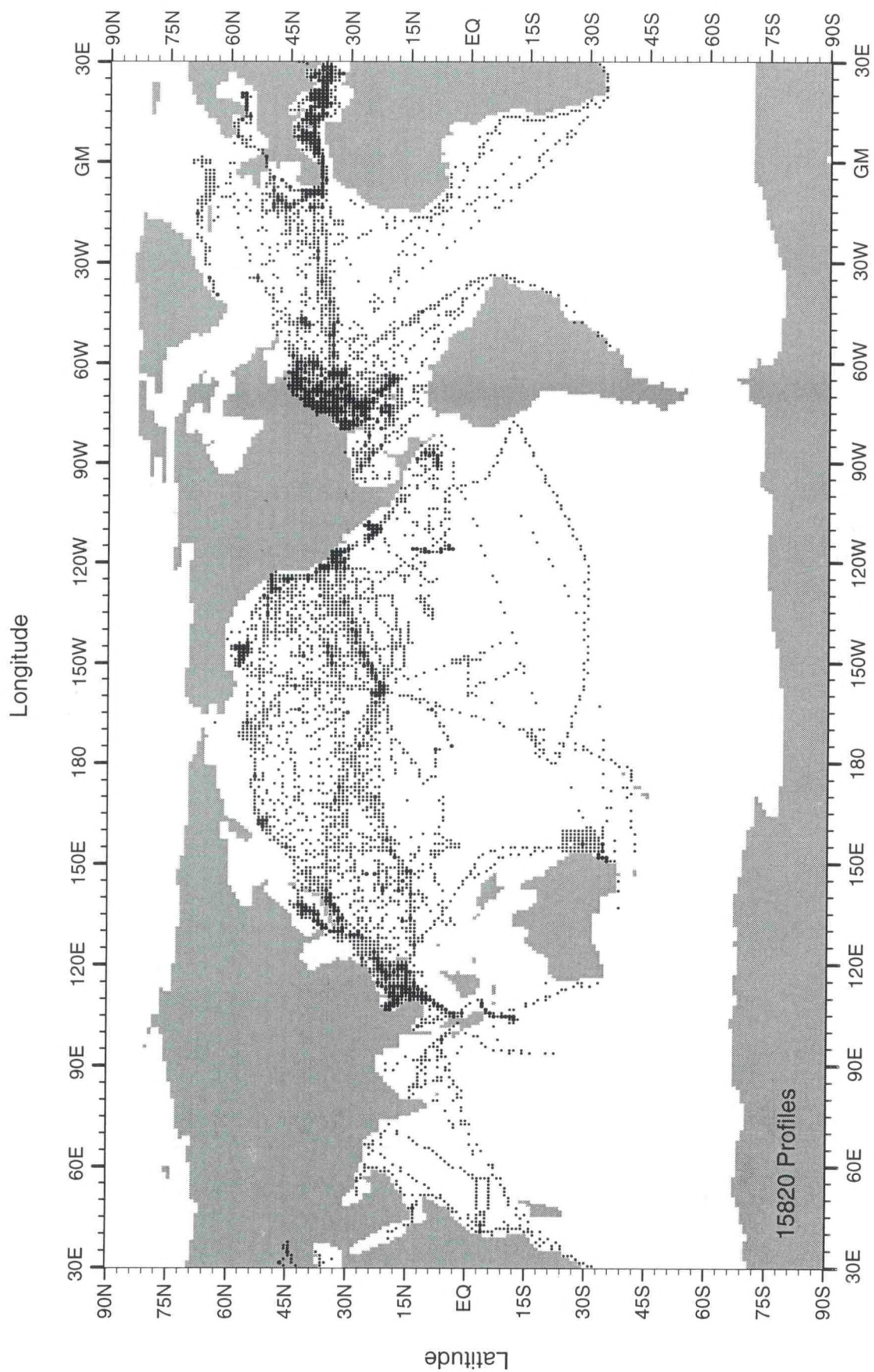


Fig. B22 WOD98 XBT profile distribution for April-June for 1971

Longitude

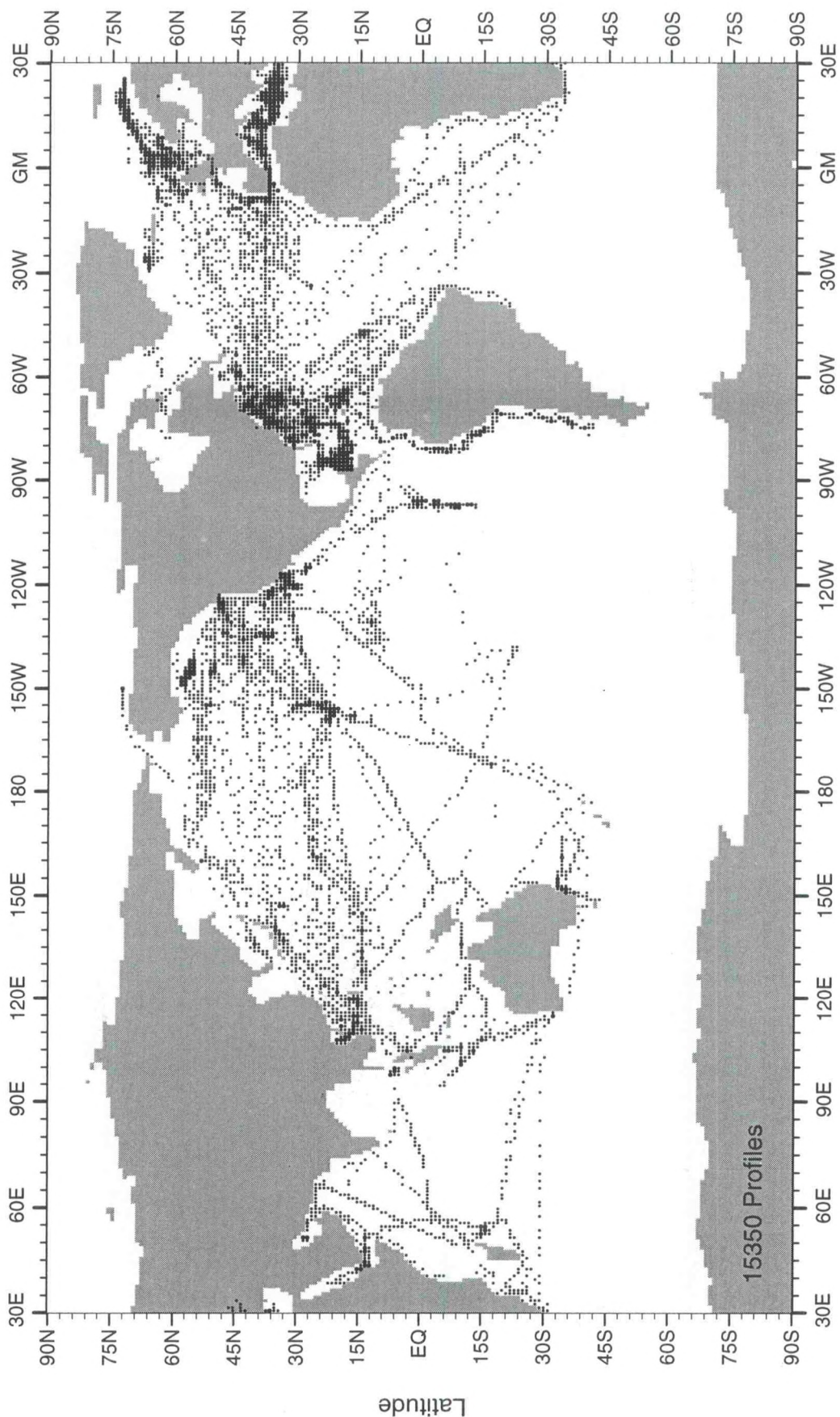


Fig. B23 WOD98 XBT profile distribution for July-September for 1971

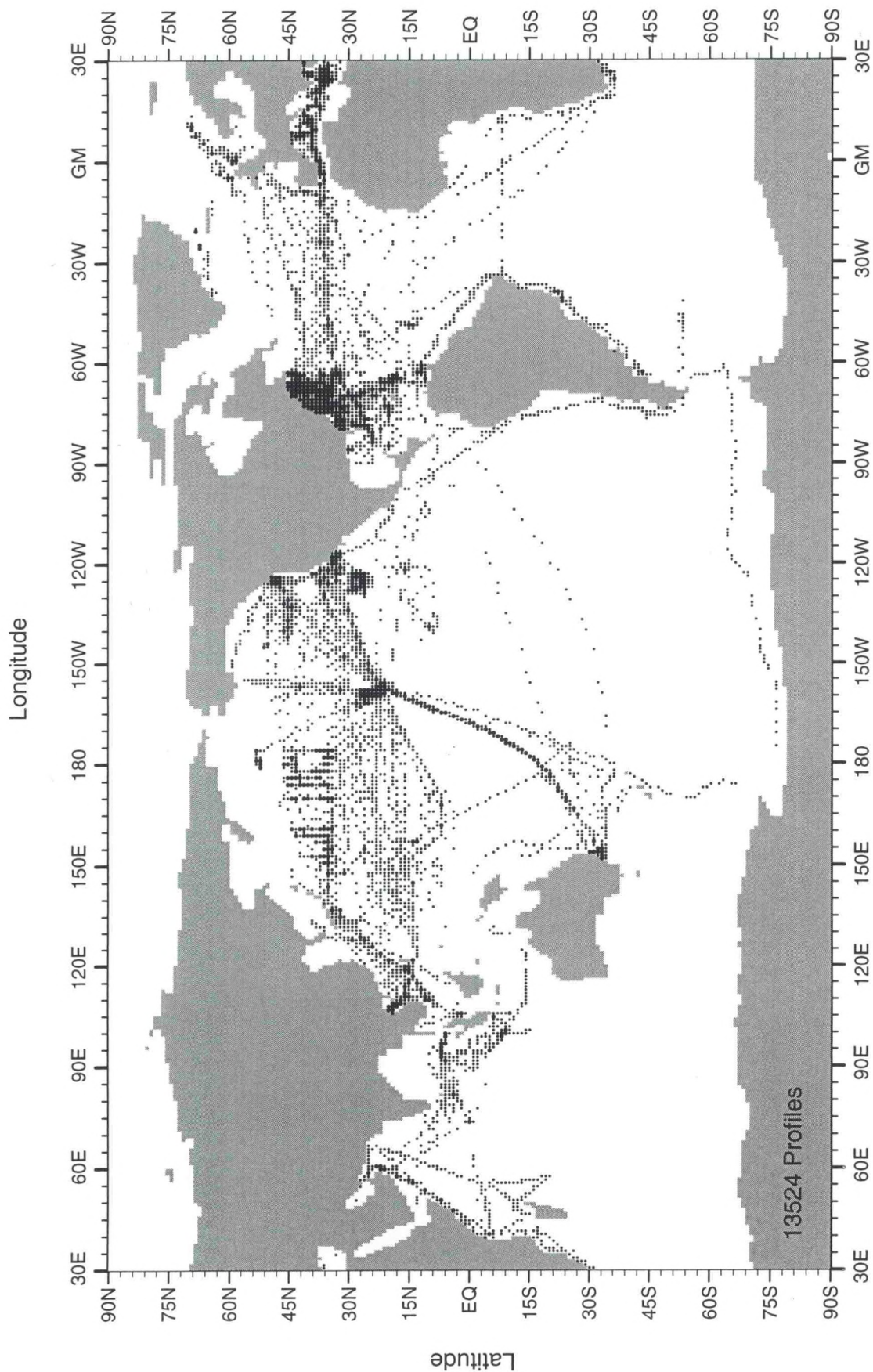


Fig. B24 WOD98 XBT profile distribution for October-December for 1971

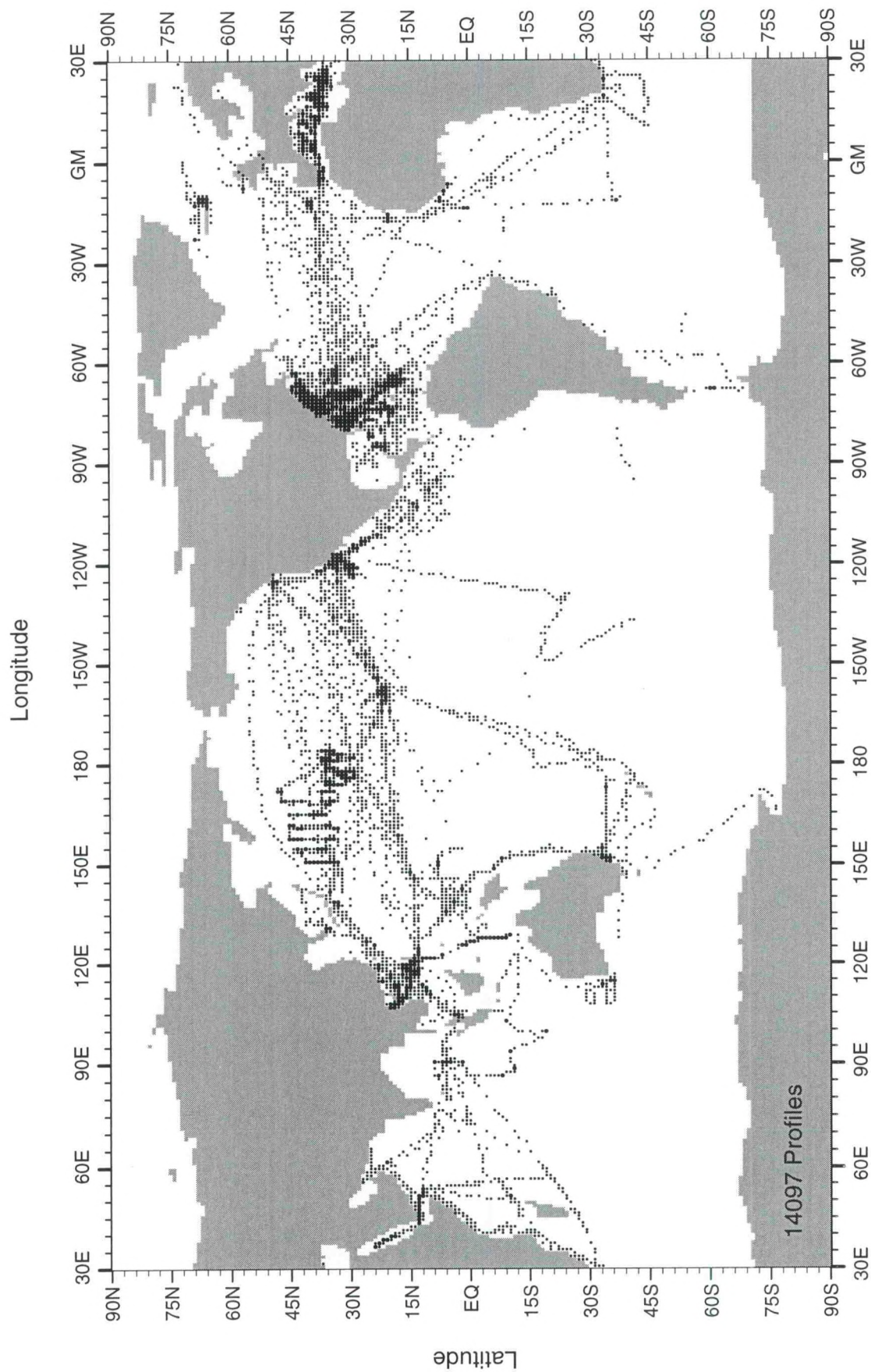


Fig. B25 WOD98 XBT profile distribution for January-March for 1972

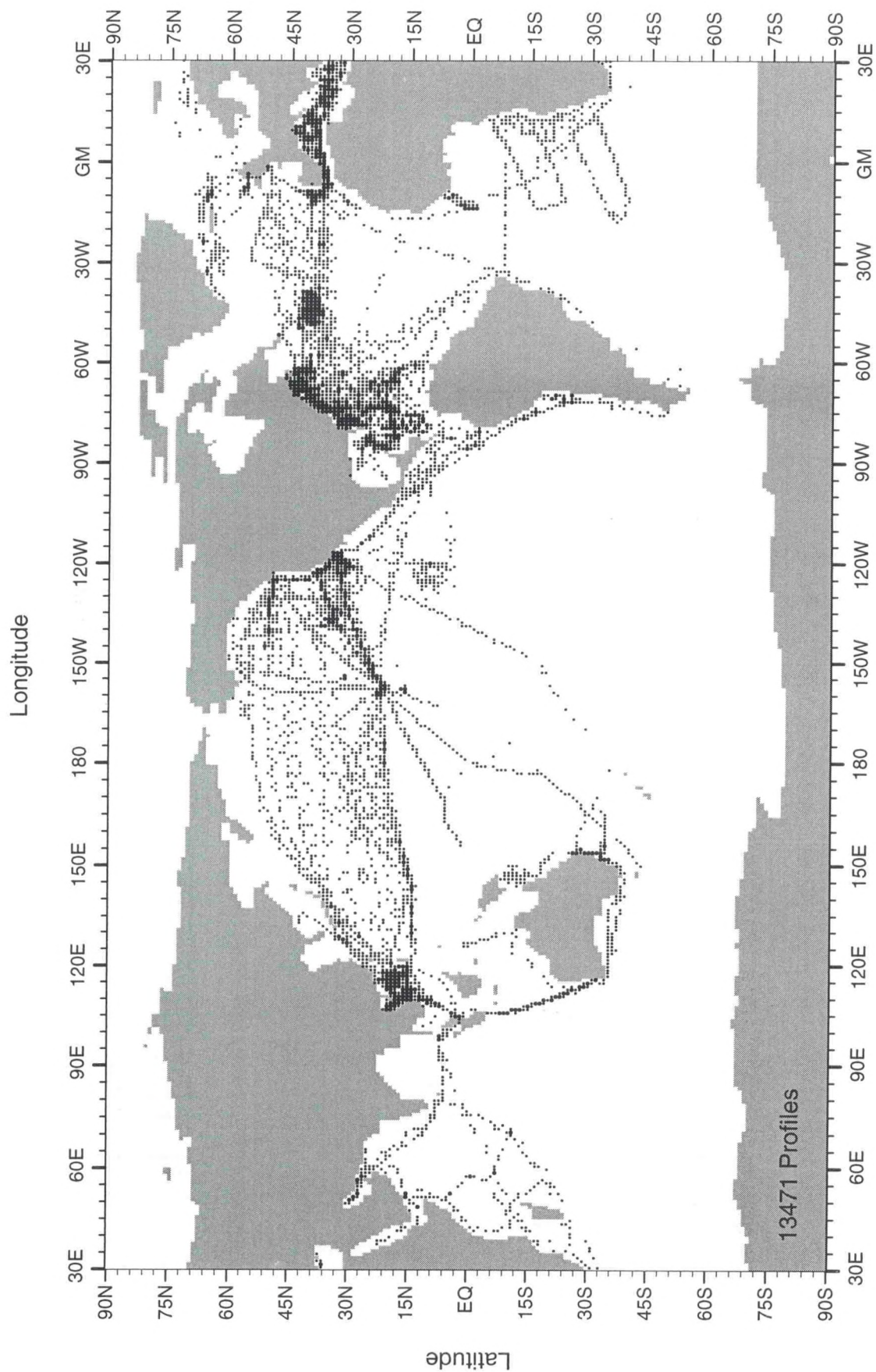


Fig. B26 WOD98 XBT profile distribution for April-June for 1972

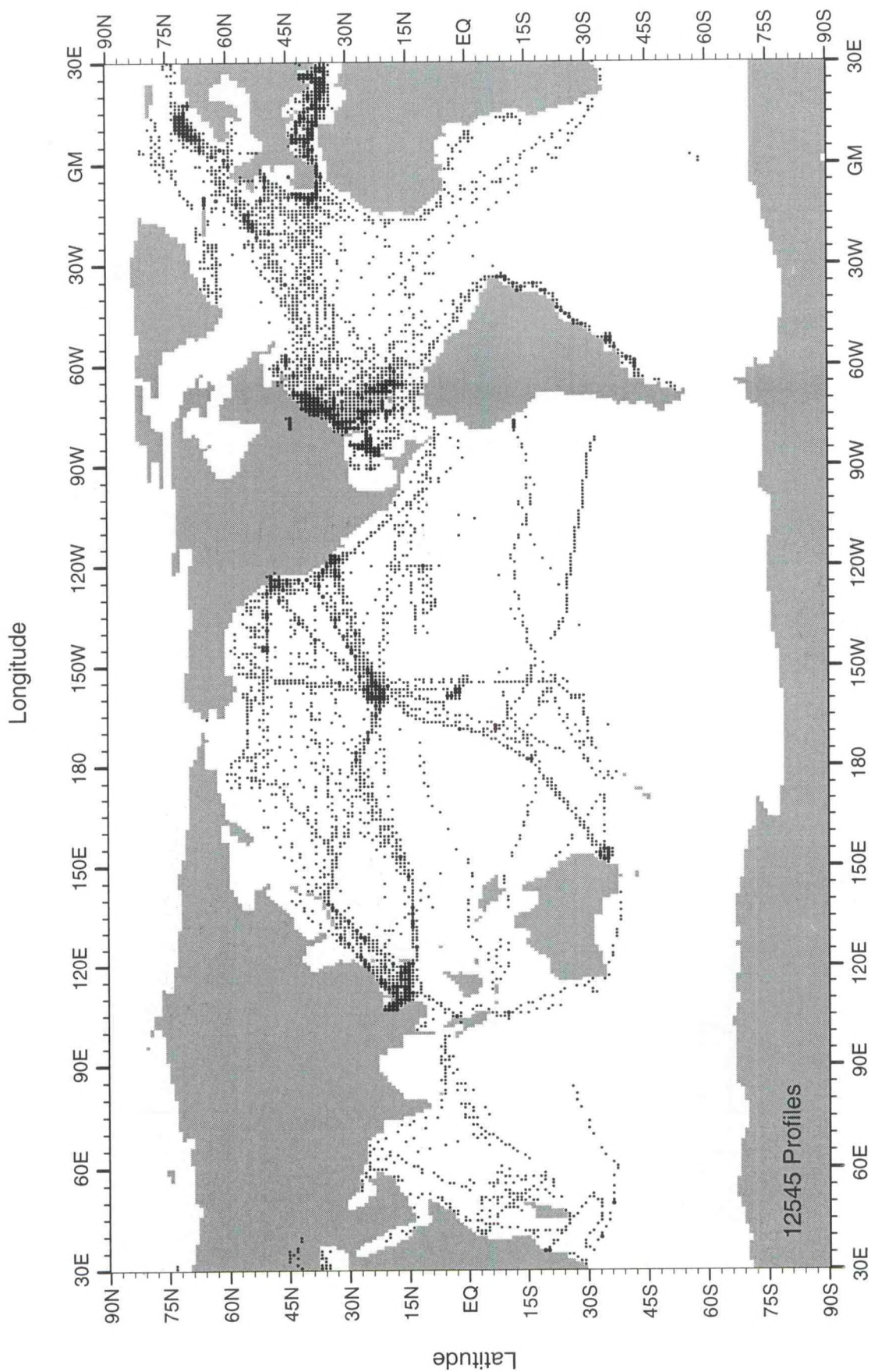


Fig. B27 WOD98 XBT profile distribution for July-September for 1972

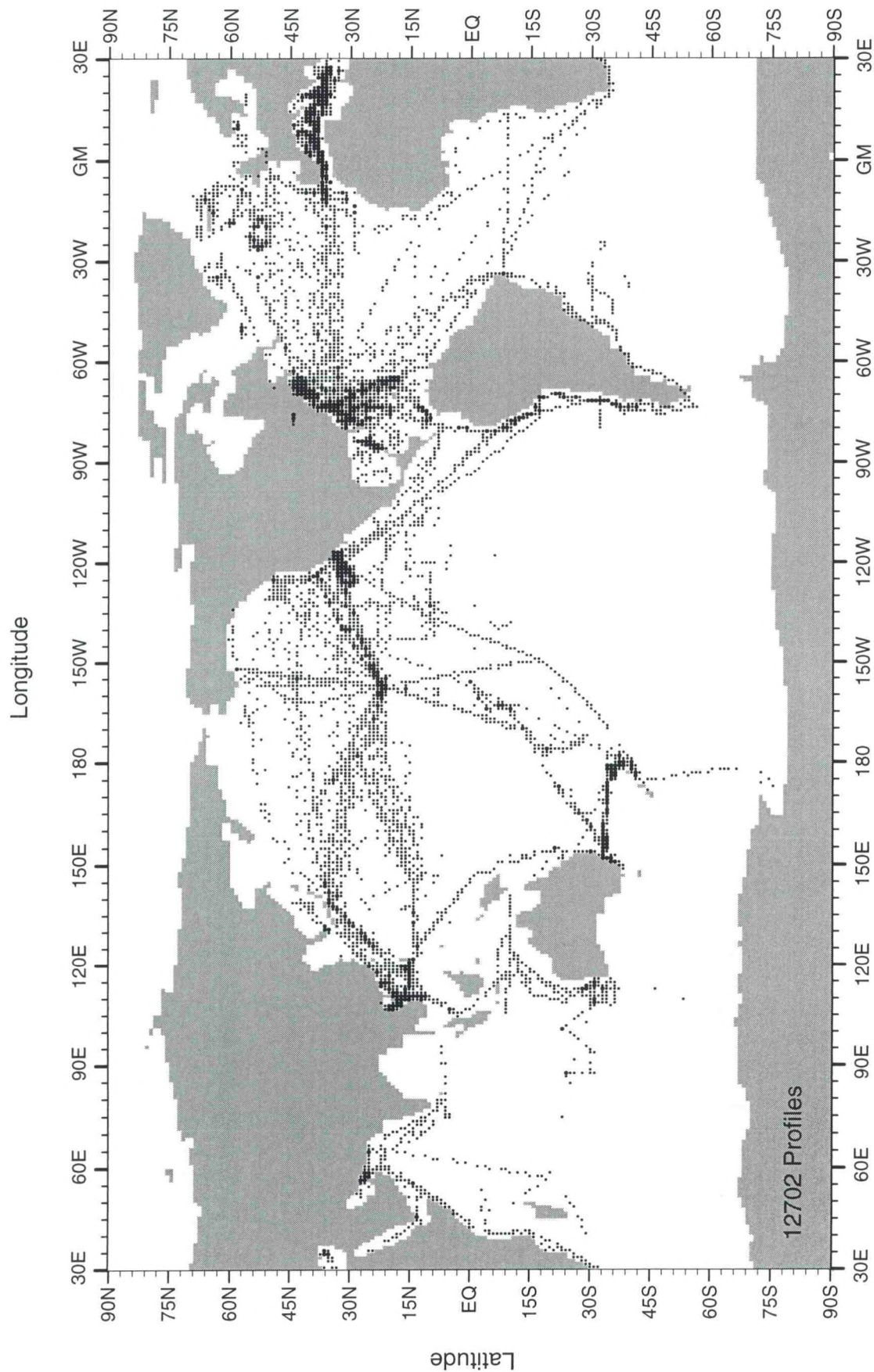


Fig. B28 WOD98 XBT profile distribution for October-December for 1972

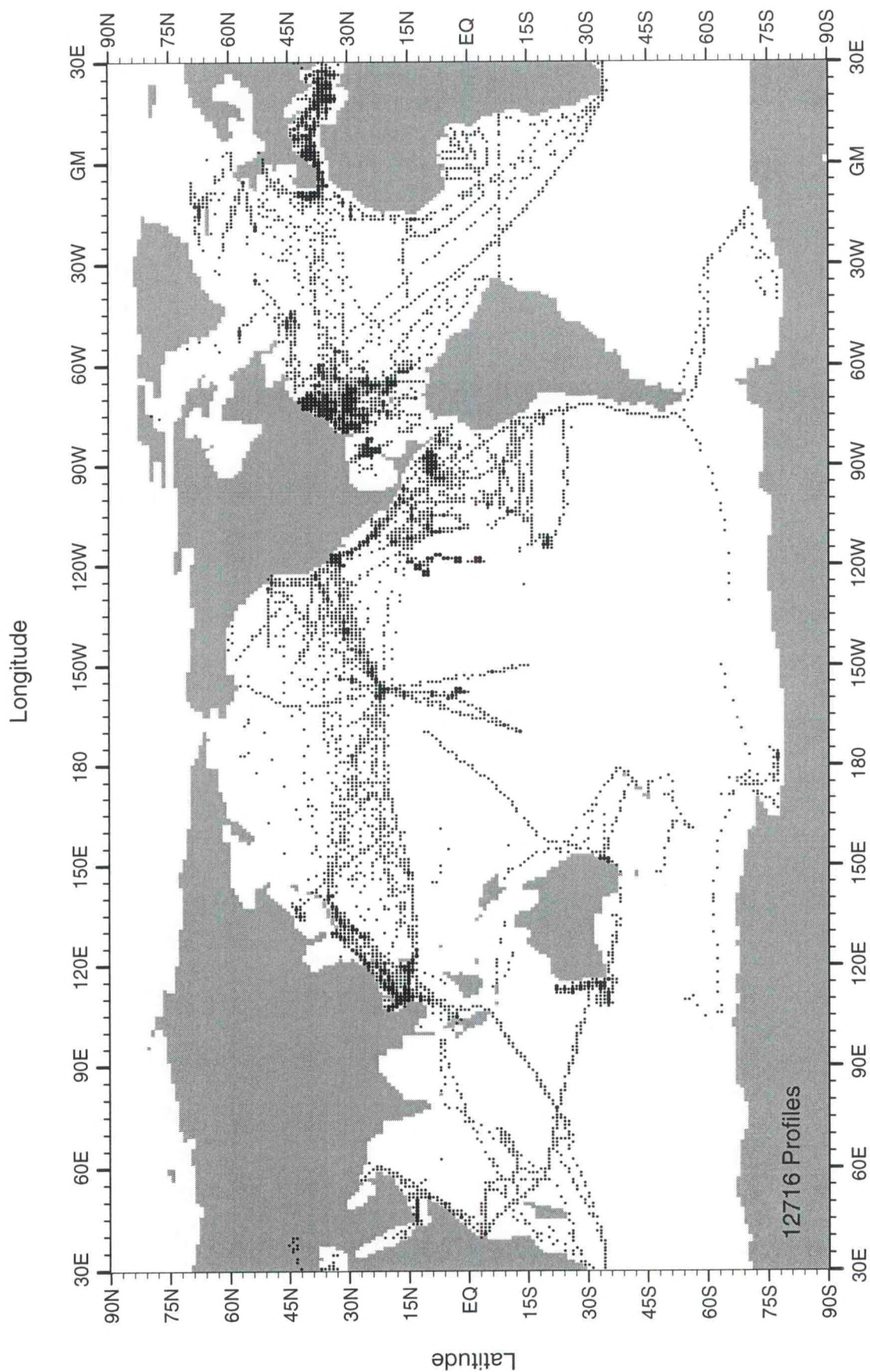


Fig. B29 WOD98 XBT profile distribution for January-March for 1973

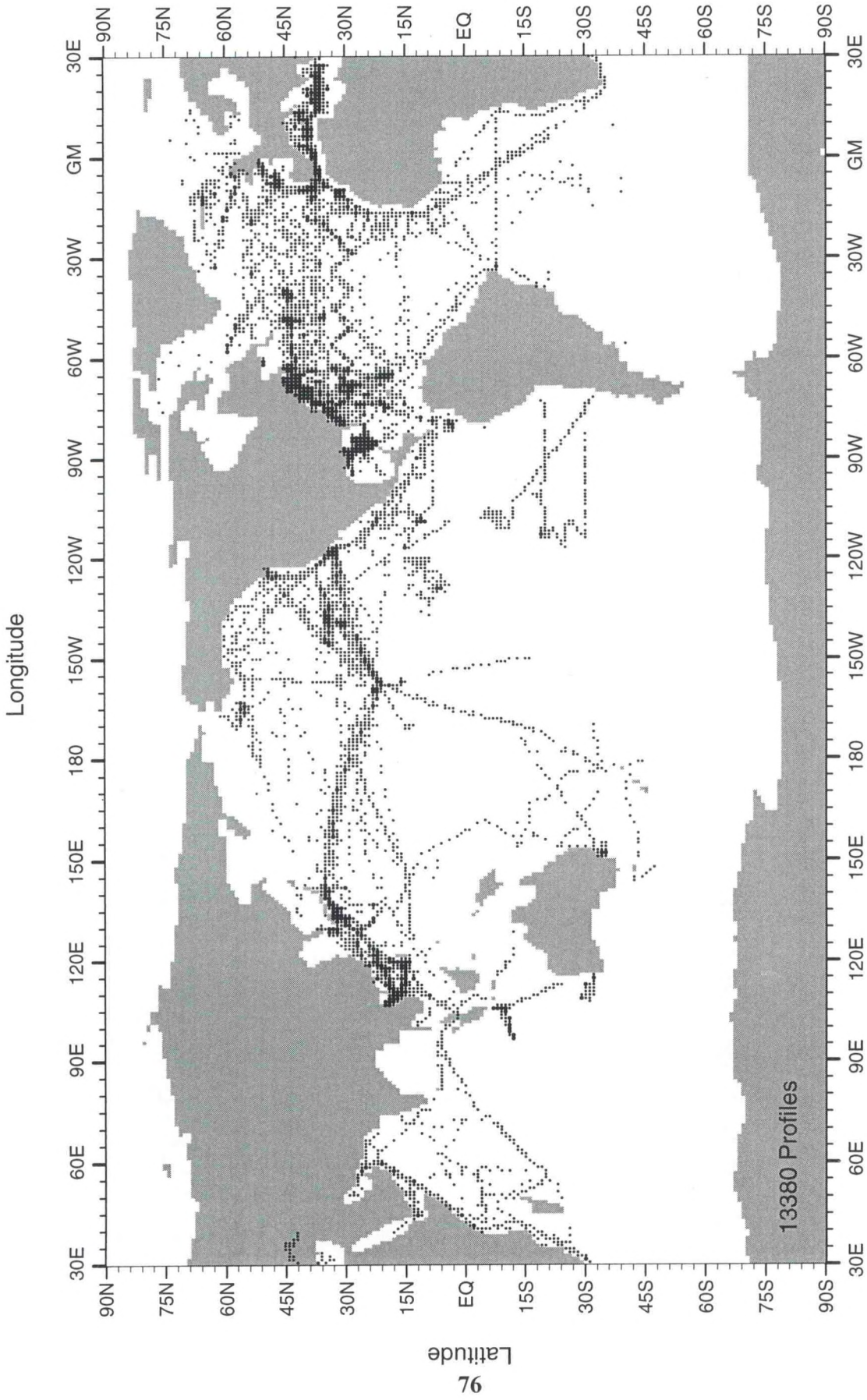


Fig. B30 WOD98 XBT profile distribution for April-June for 1973

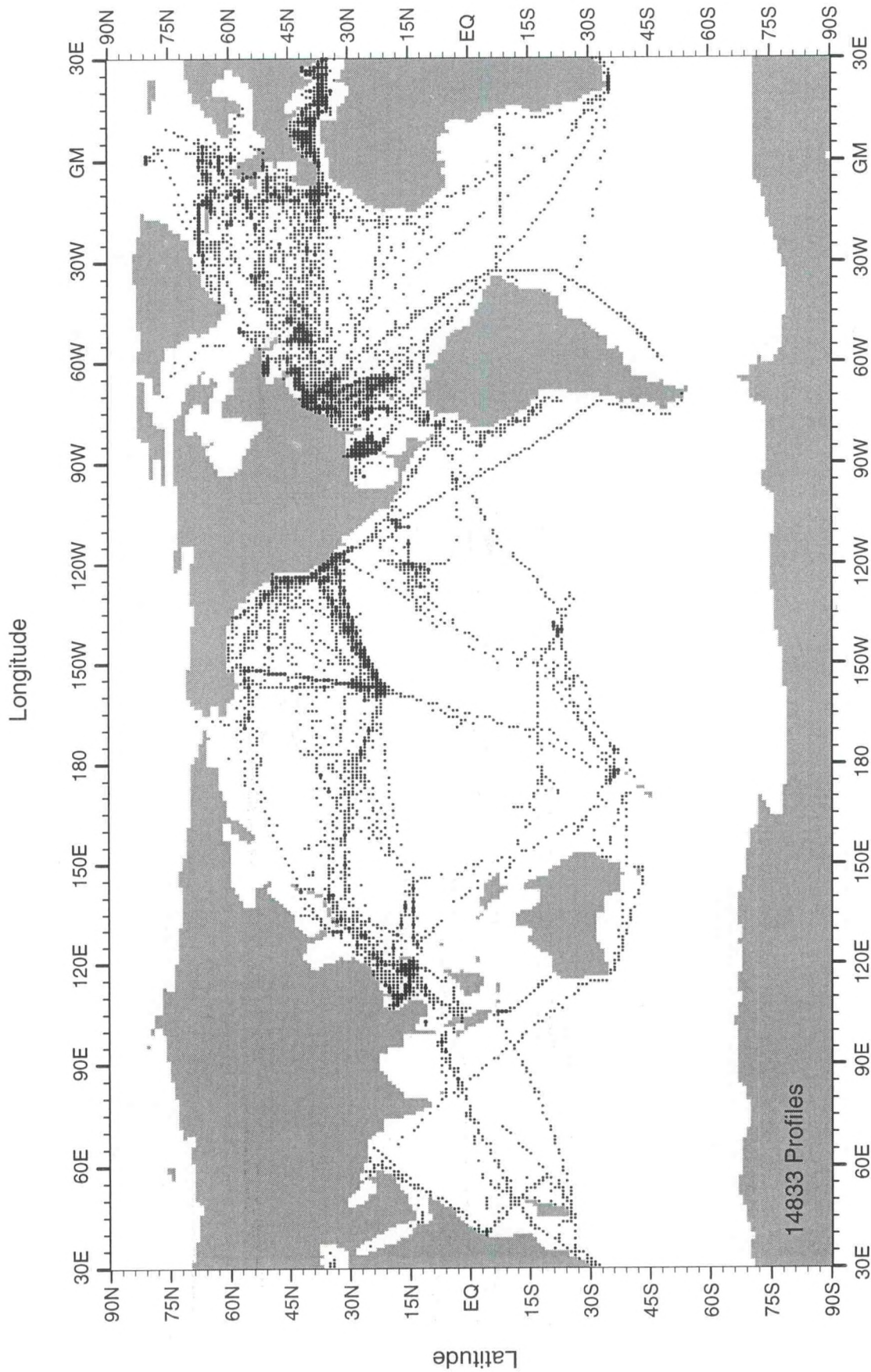


Fig. B31 WOD98 XBT profile distribution for July-September for 1973

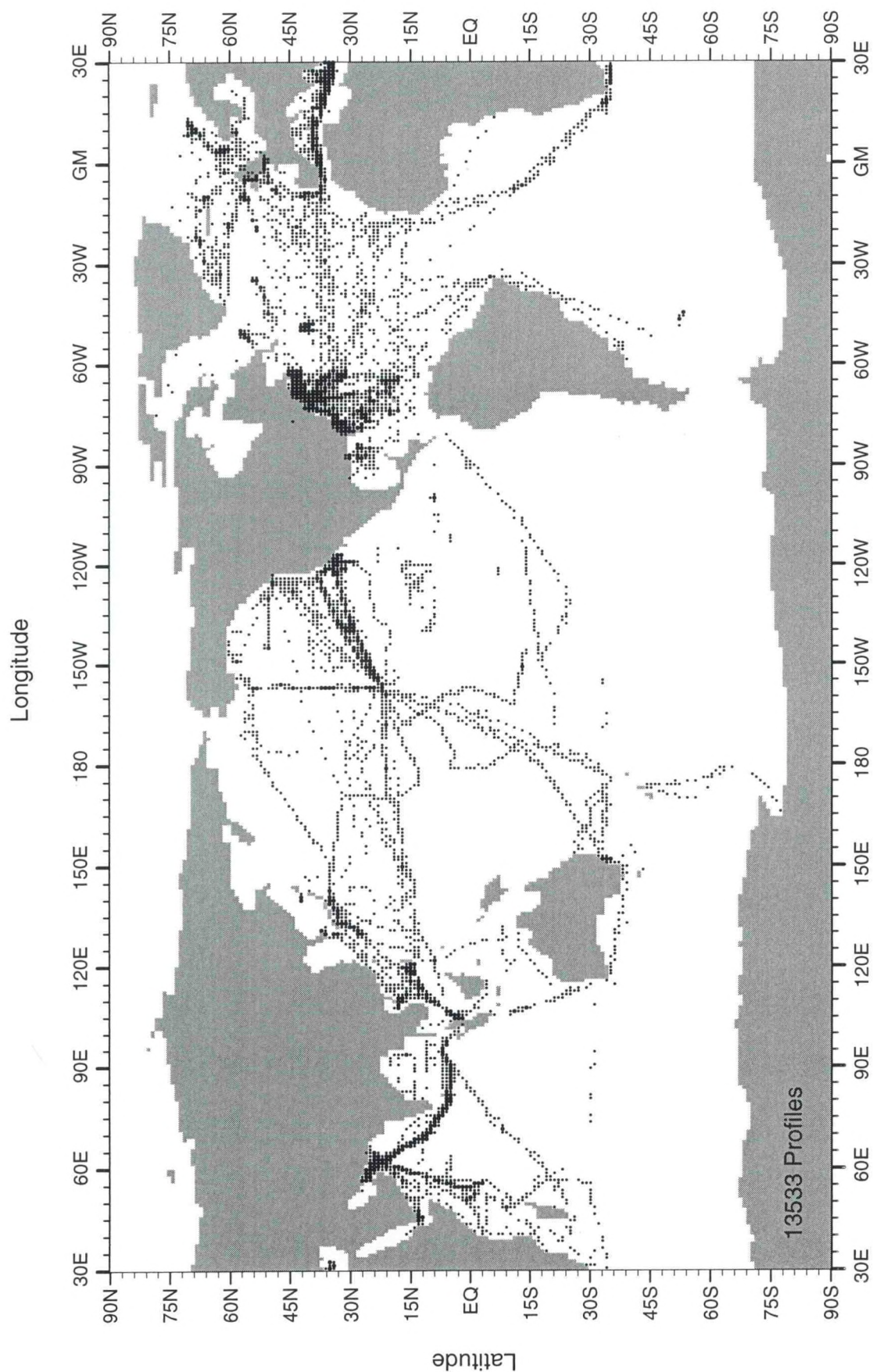


Fig. B32 WOD98 XBT profile distribution for October-December for 1973

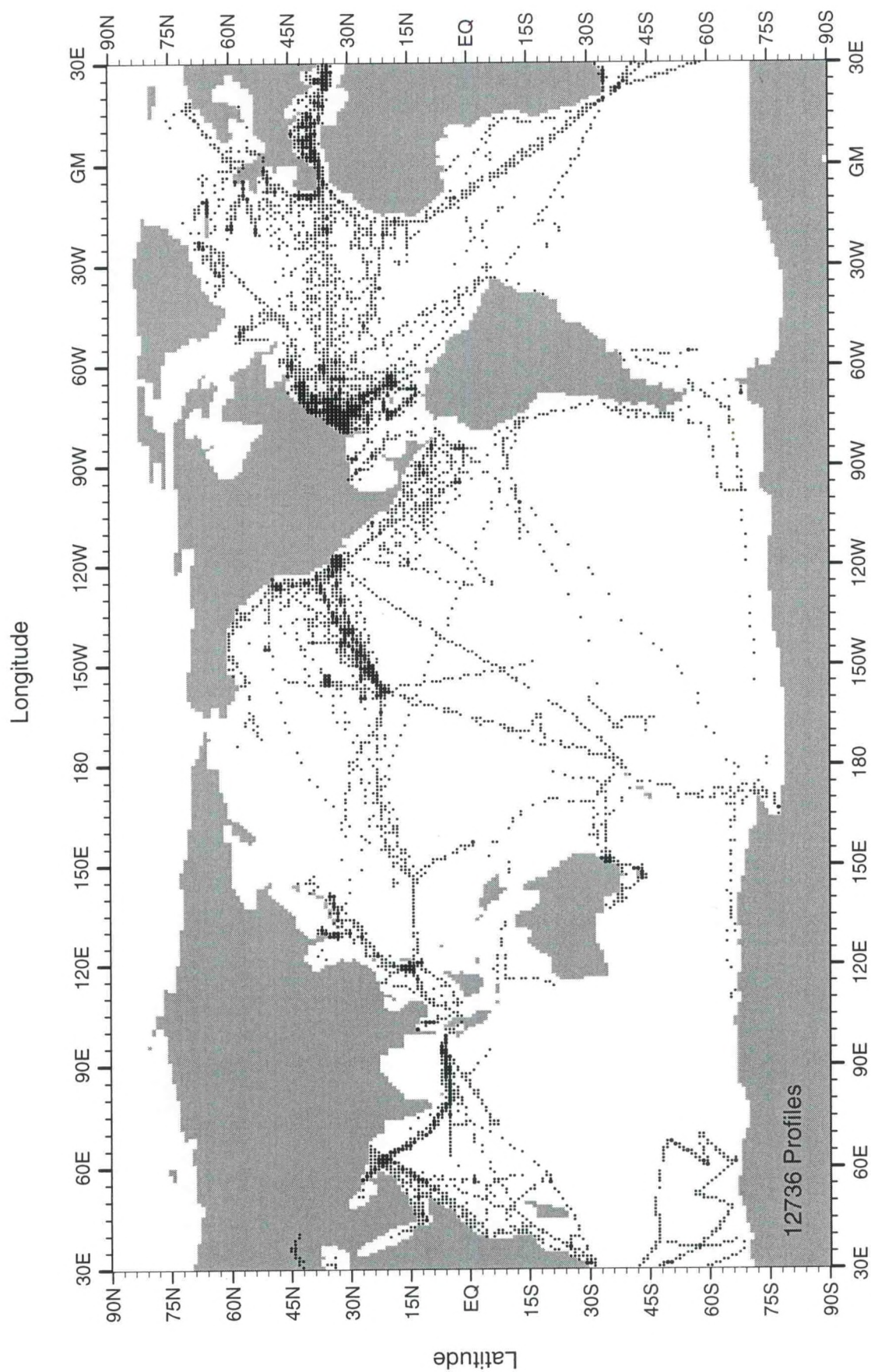


Fig. B33 WOD98 XBT profile distribution for January-March for 1974

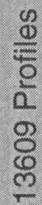


Fig. B34 WOD98 XBT profile distribution for April-June for 1974

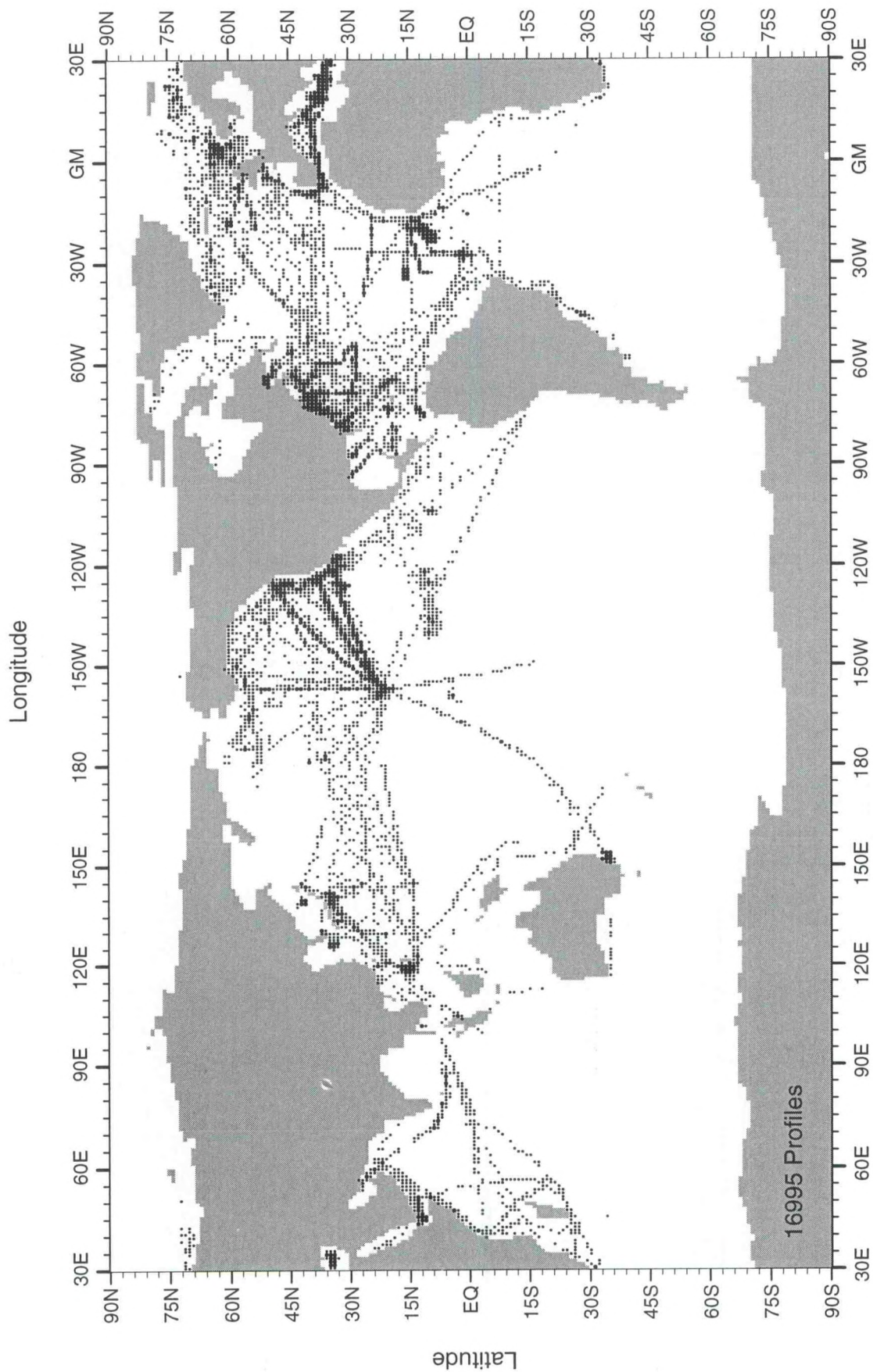


Fig. B35 WOD98 XBT profile distribution for July-September for 1974

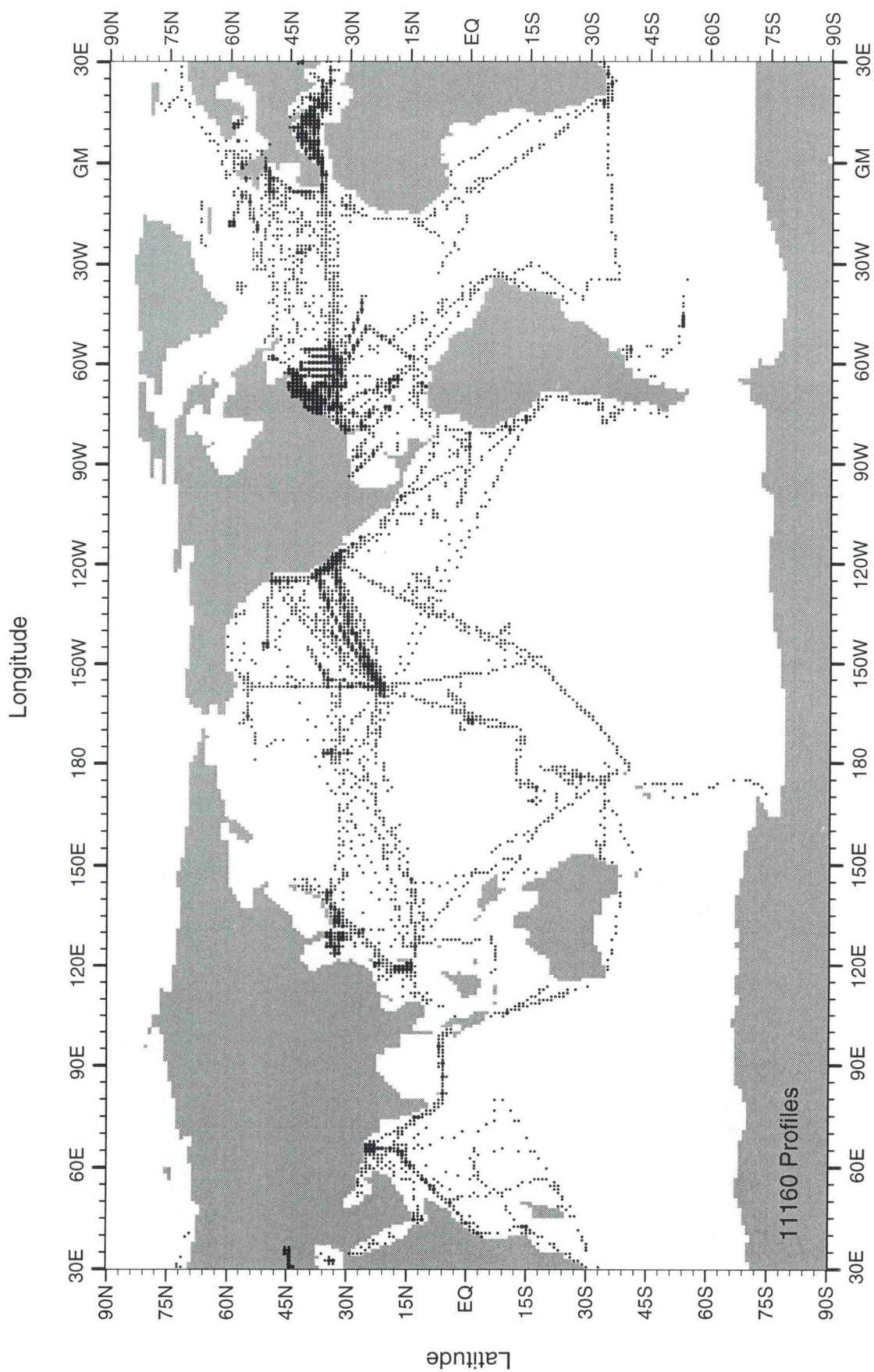


Fig. B36 WOD98 XBT profile distribution for October-December for 1974

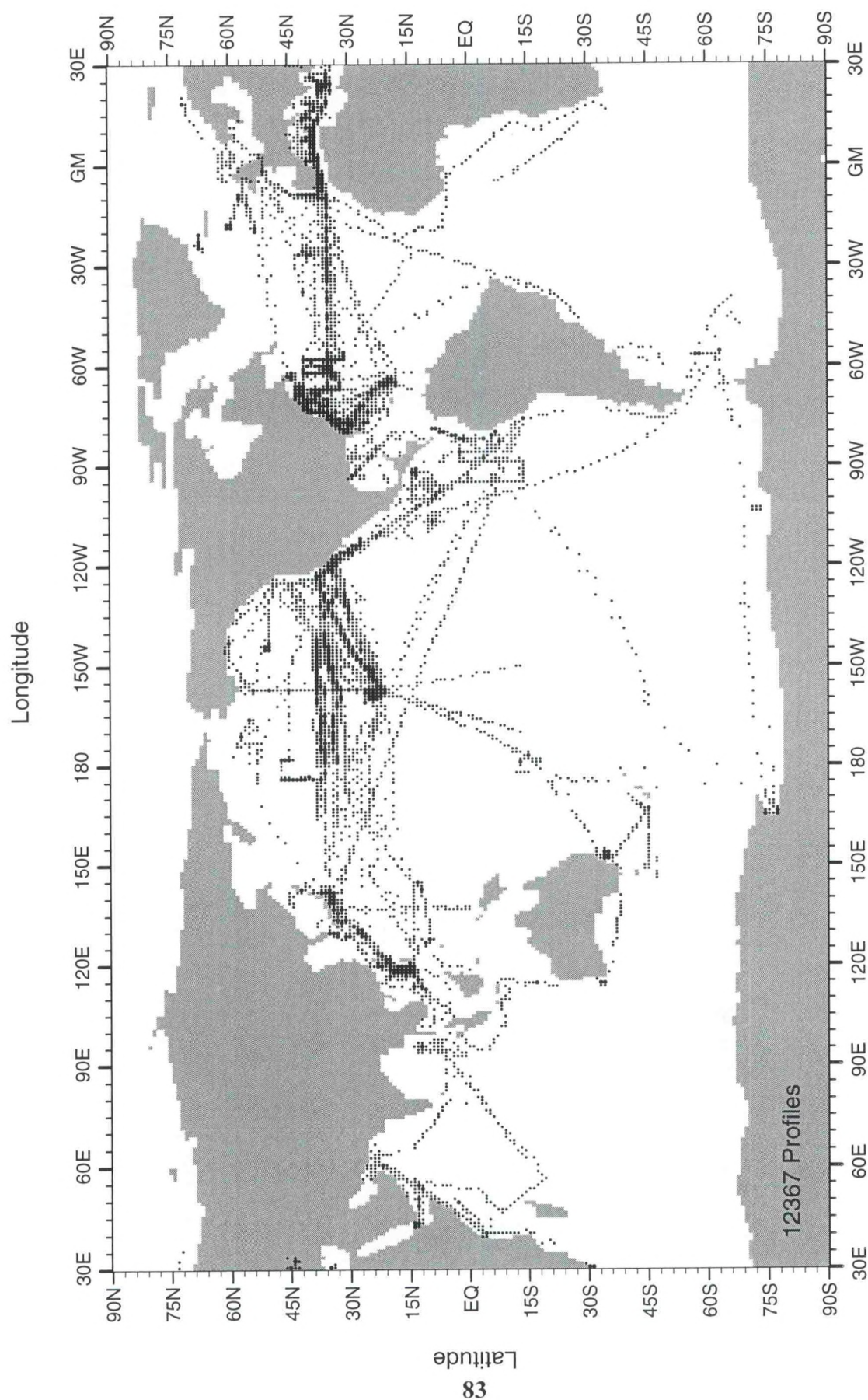


Fig. B37 WOD98 XBT profile distribution for January-March for 1975

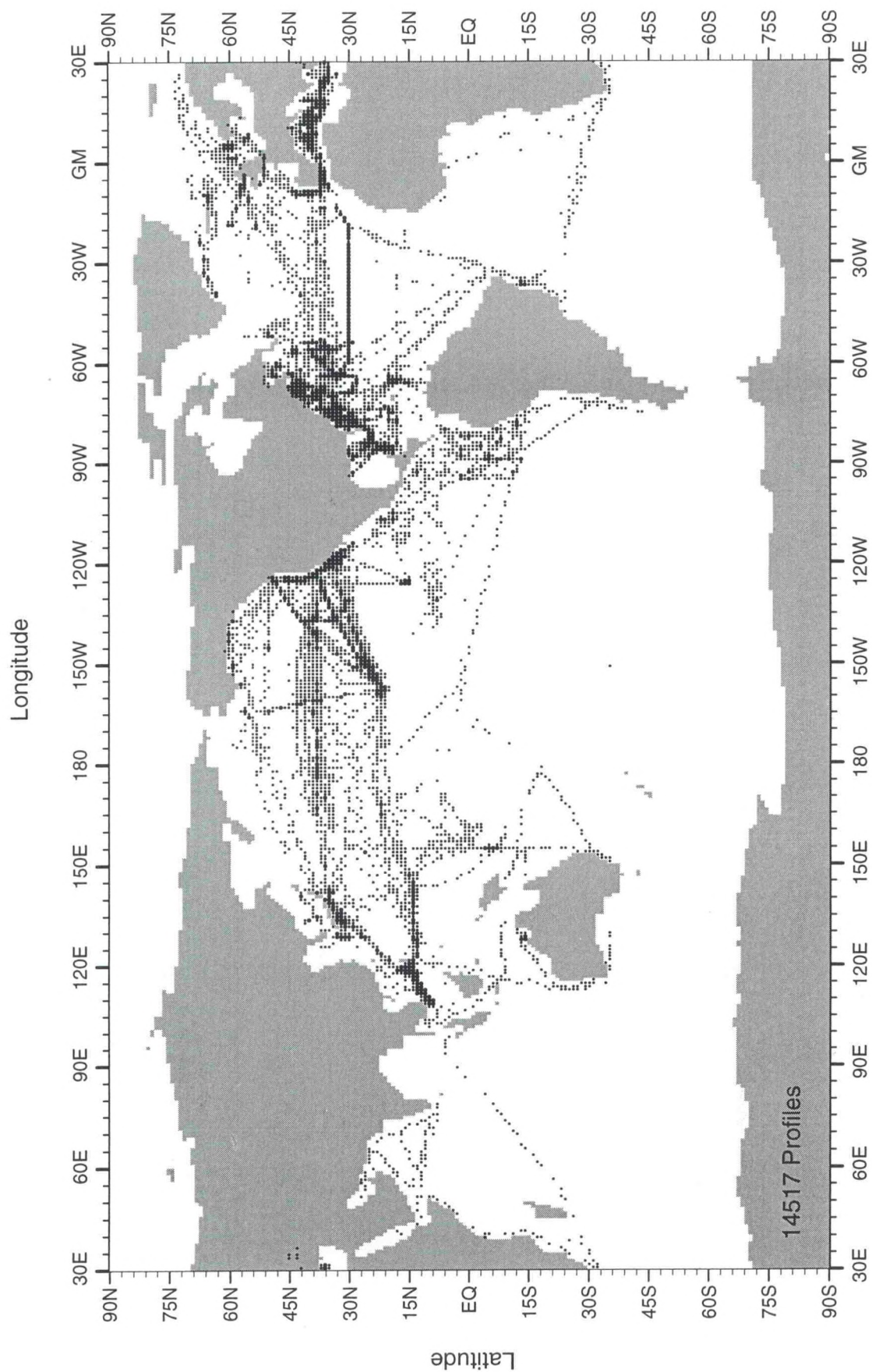


Fig. B38 WOD98 XBT profile distribution for April-June for 1975

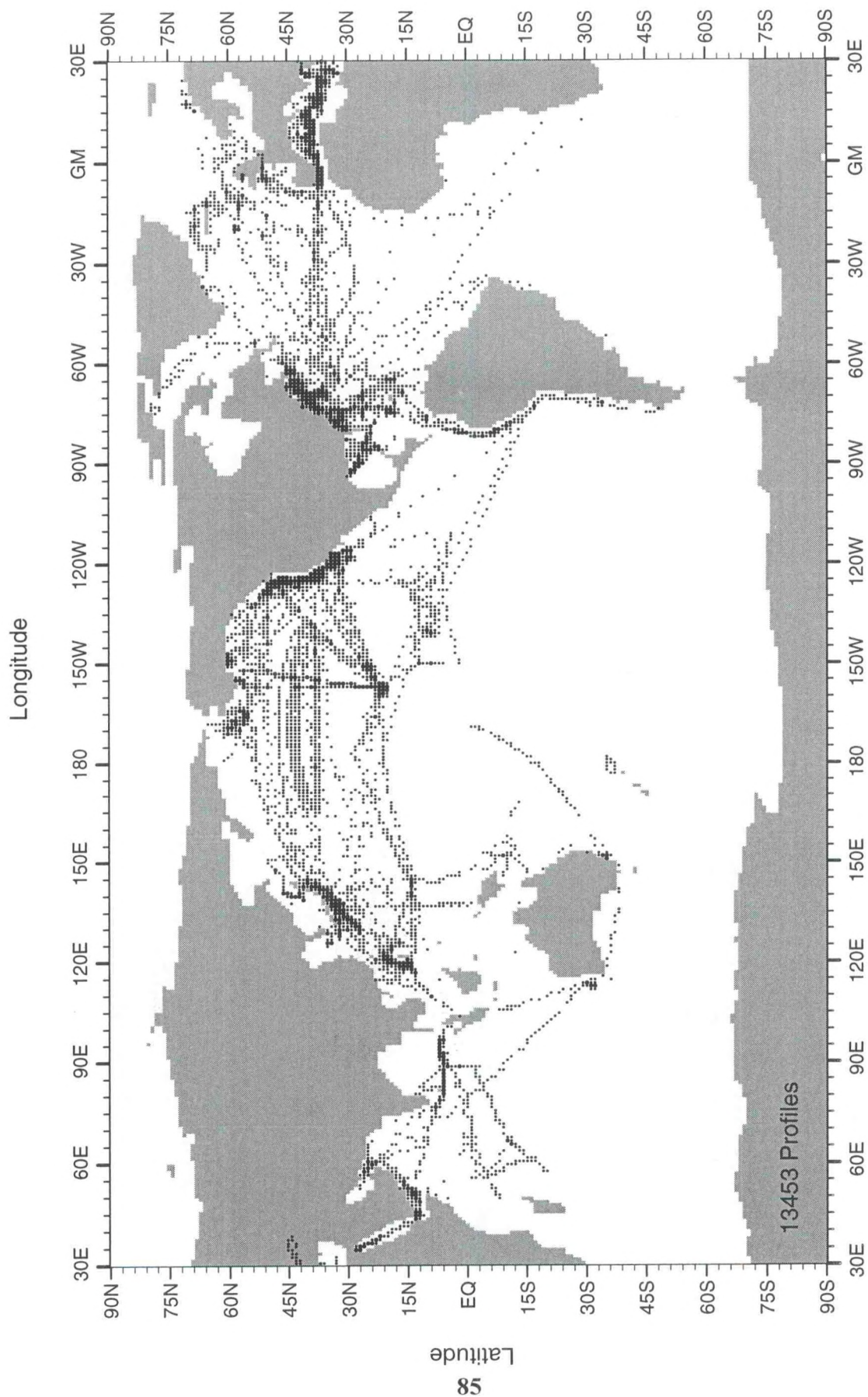


Fig. B39 WOD98 XBT profile distribution for July-September for 1975

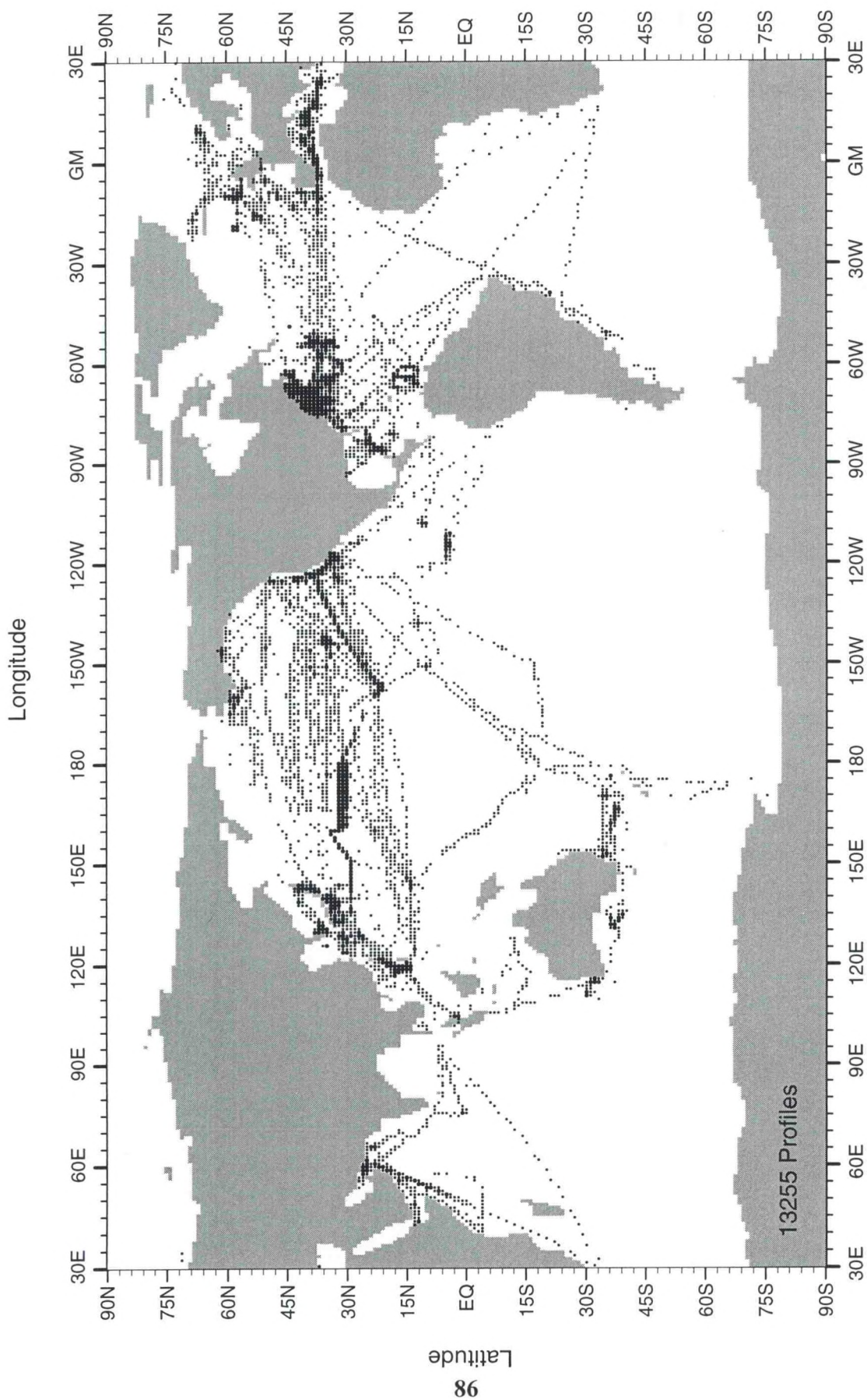


Fig. B40 WOD98 XBT profile distribution for October-December for 1975

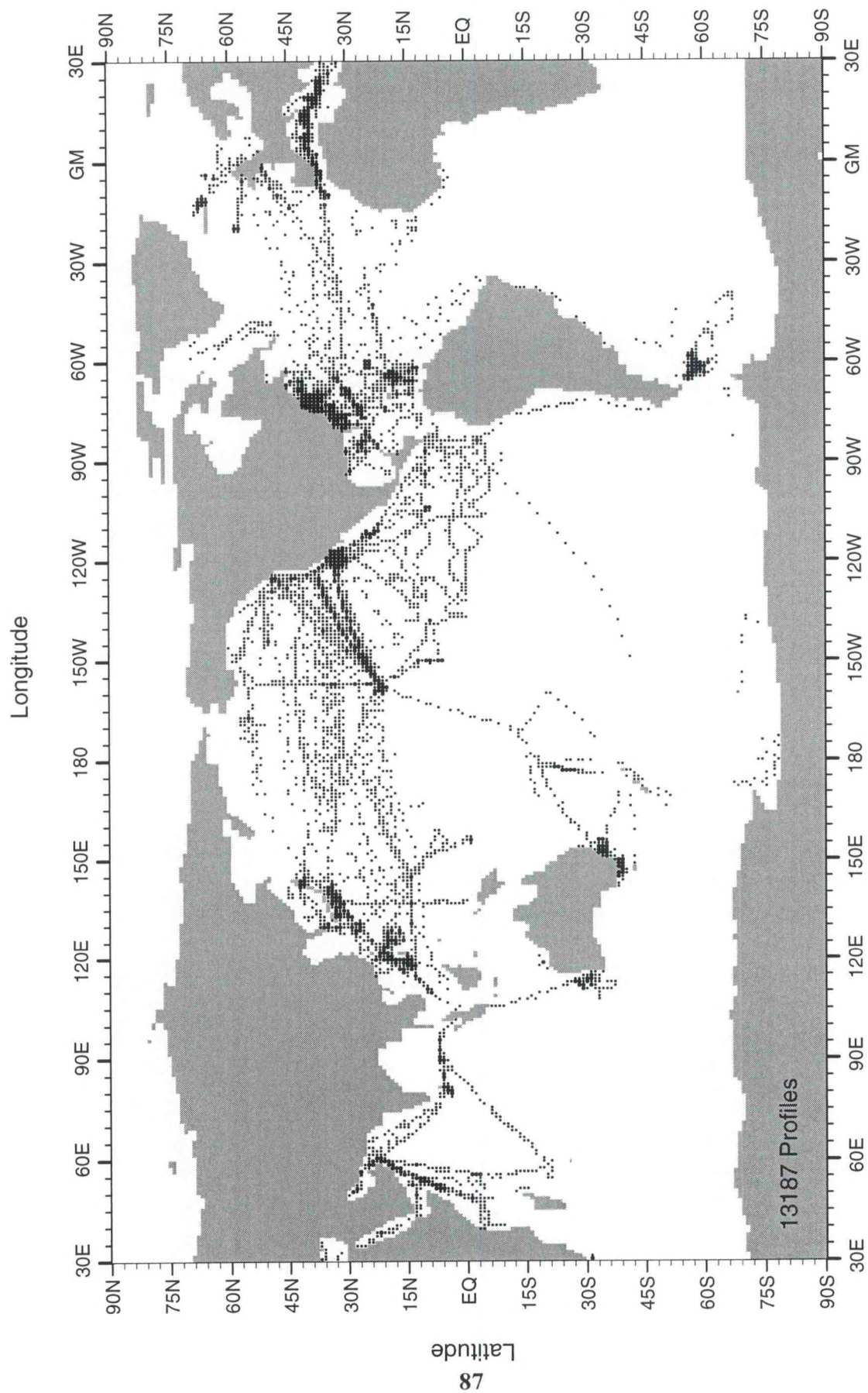


Fig. B41 WOD98 XBT profile distribution for January-March for 1976

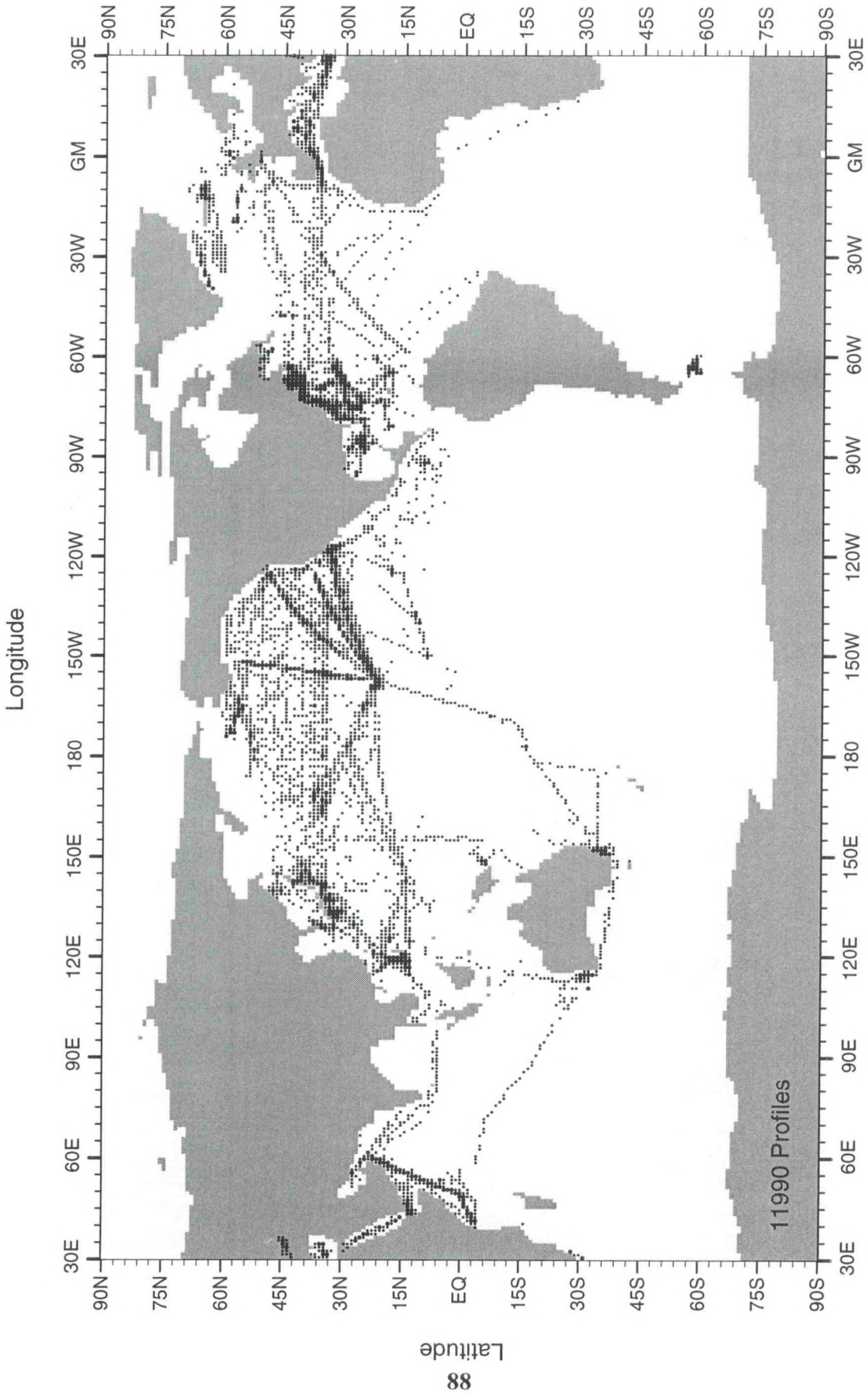


Fig. B42 WOD98 XBT profile distribution for April-June for 1976

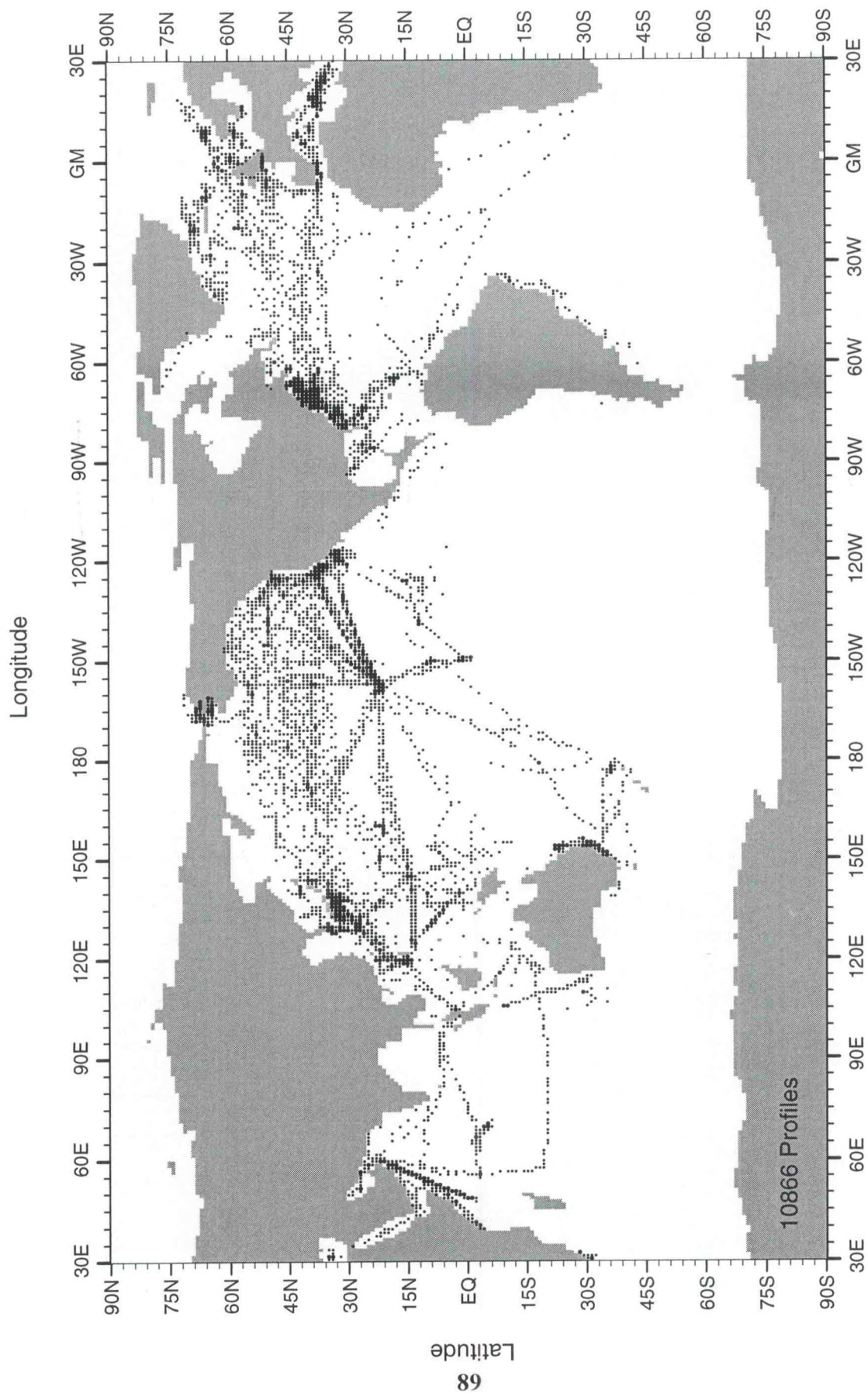


Fig. B43 WOD98 XBT profile distribution for July-September for 1976

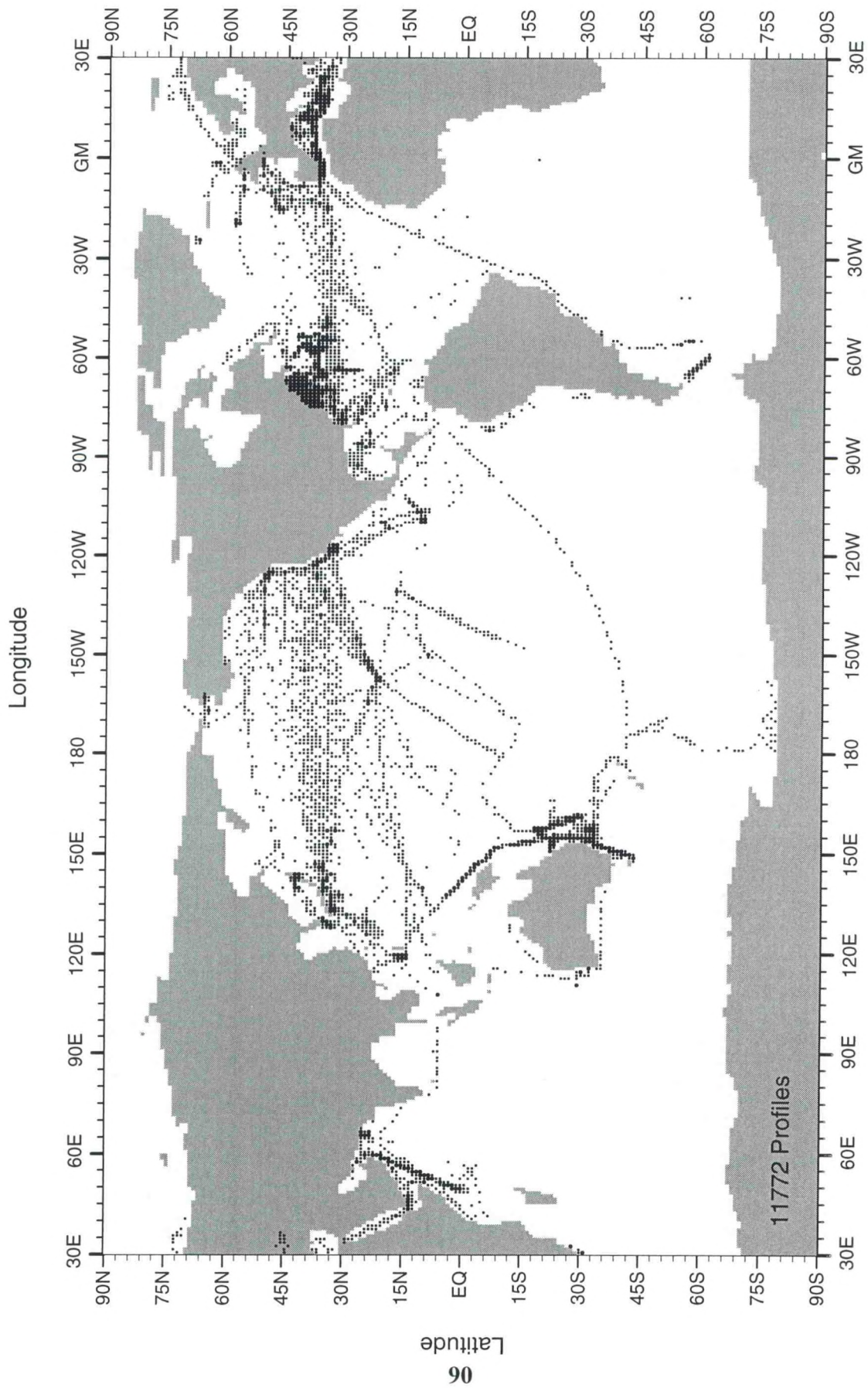


Fig. B44 WOD98 XBT profile distribution for October-December for 1976

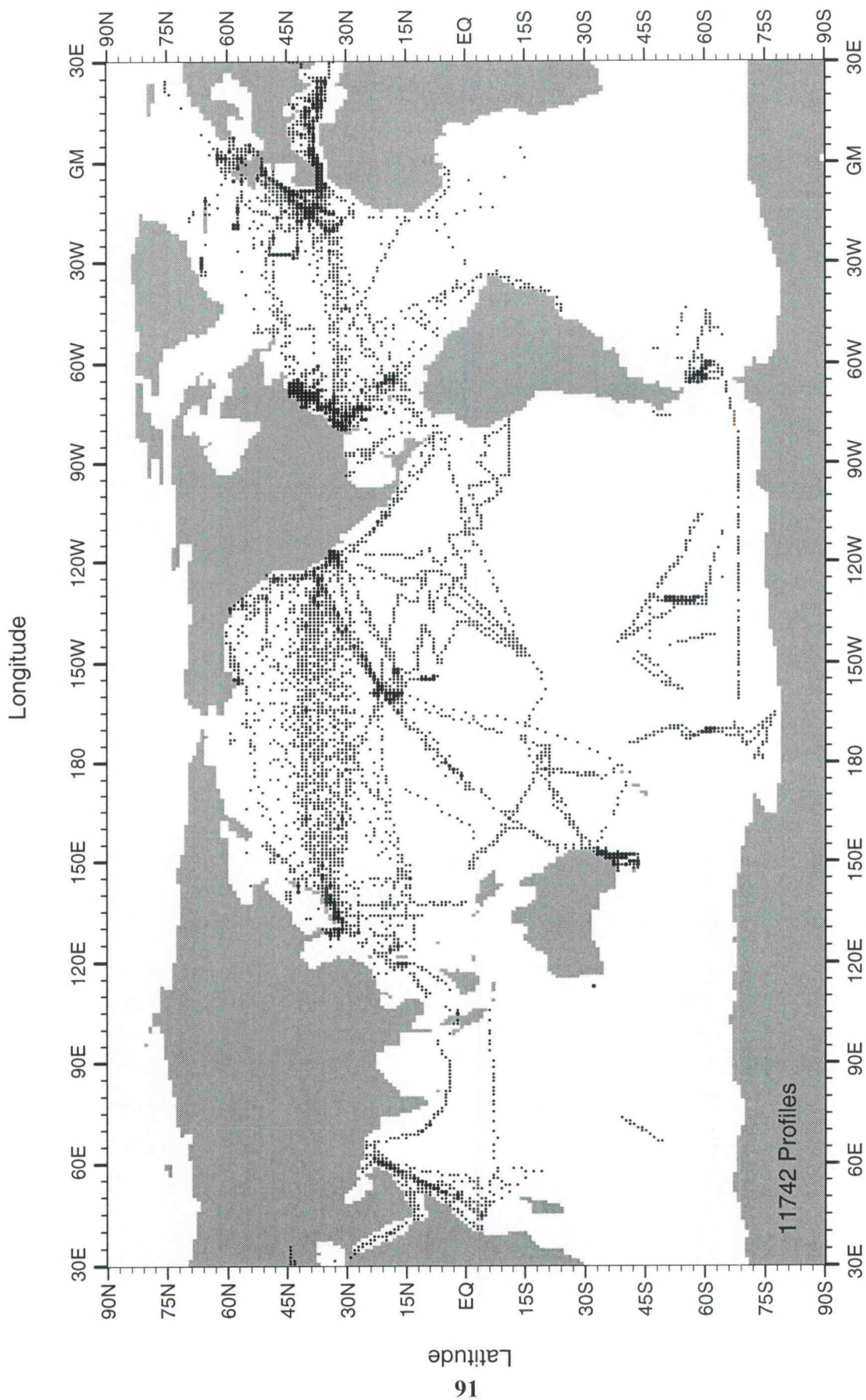


Fig. B45 WOD98 XBT profile distribution for January-March for 1977

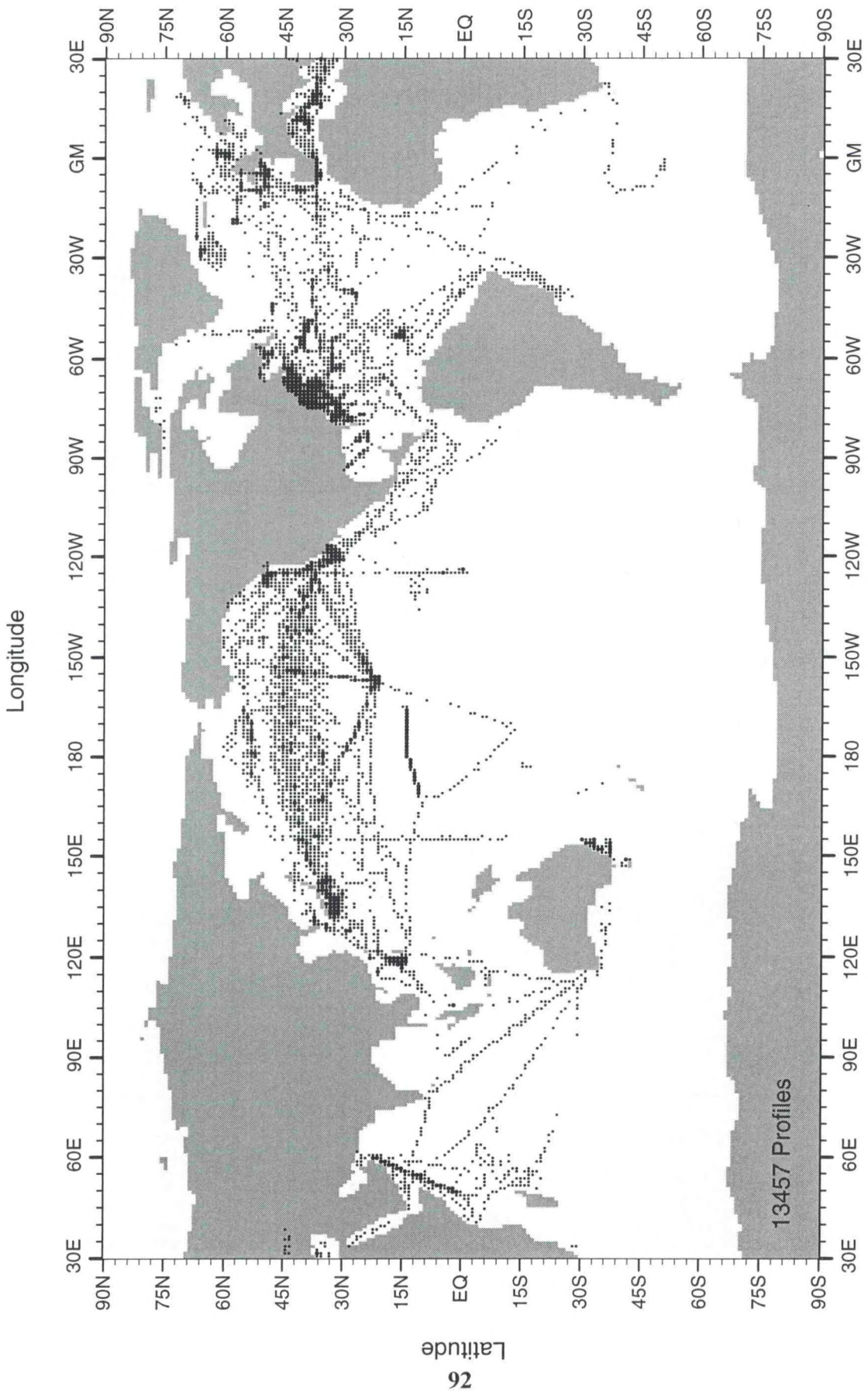


Fig. B46 WOD98 XBT profile distribution for April-June for 1977

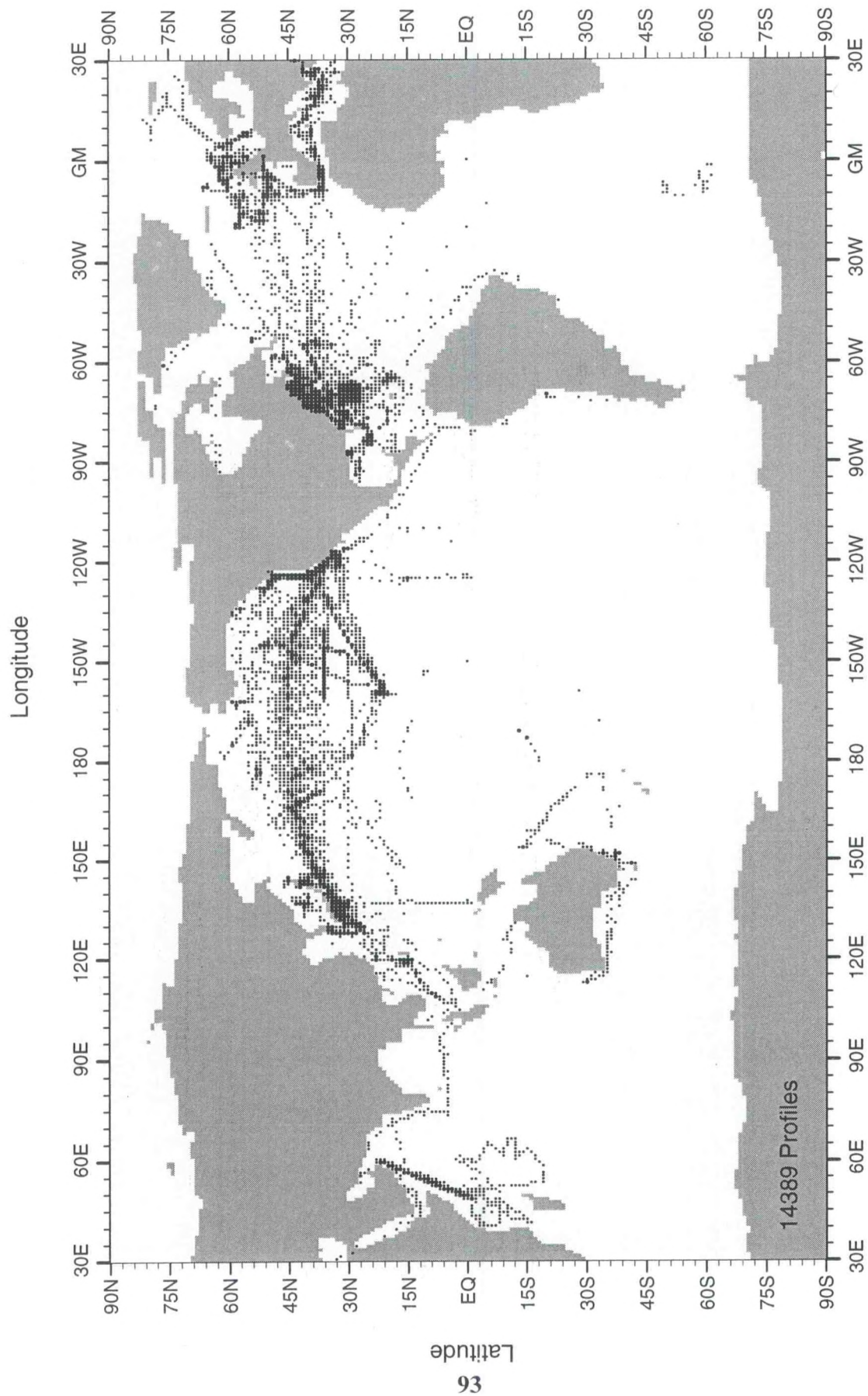


Fig. B47 WOD98 XBT profile distribution for July-September for 1977

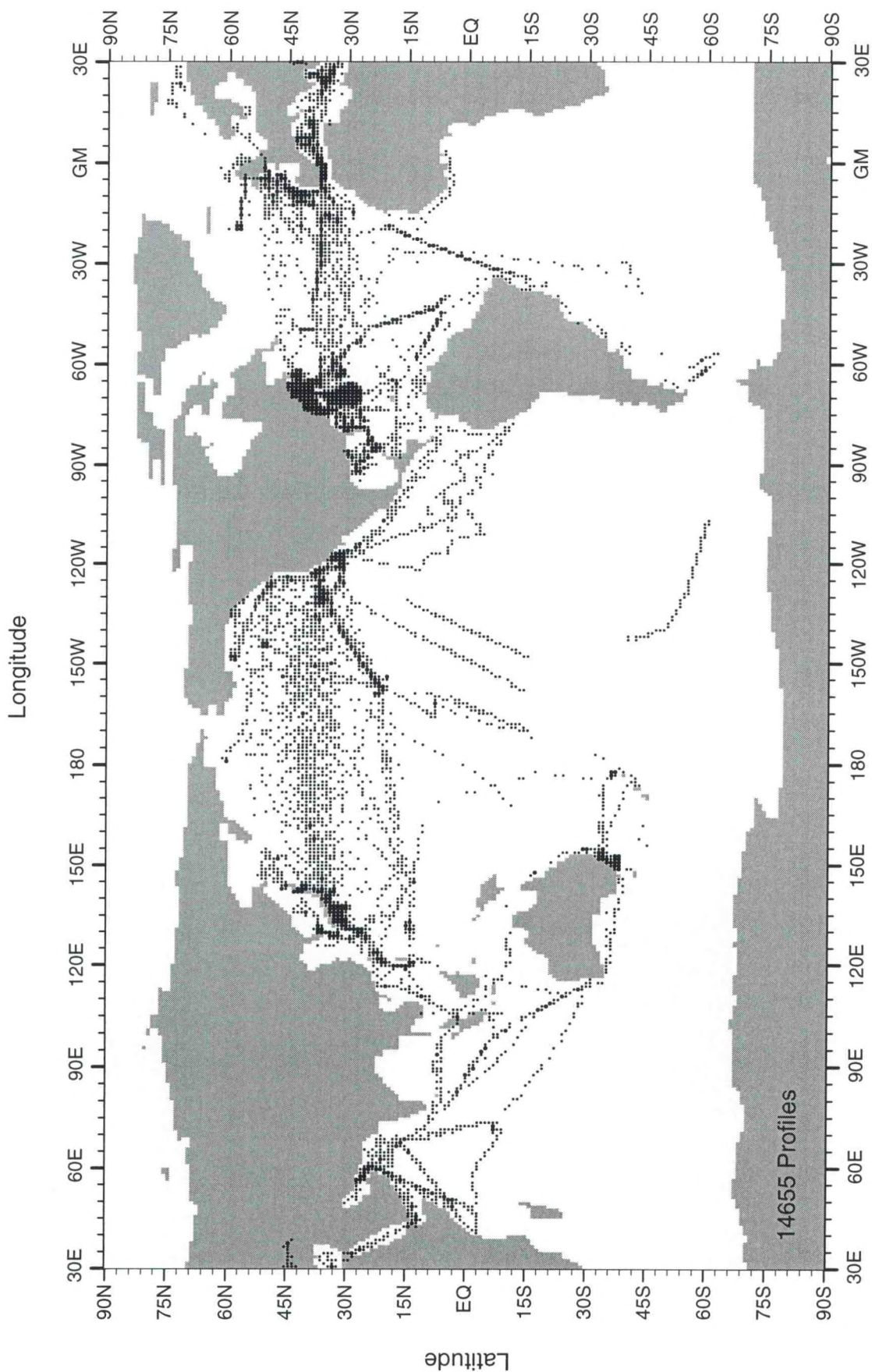


Fig. B48 WOD98 XBT profile distribution for October-December for 1977

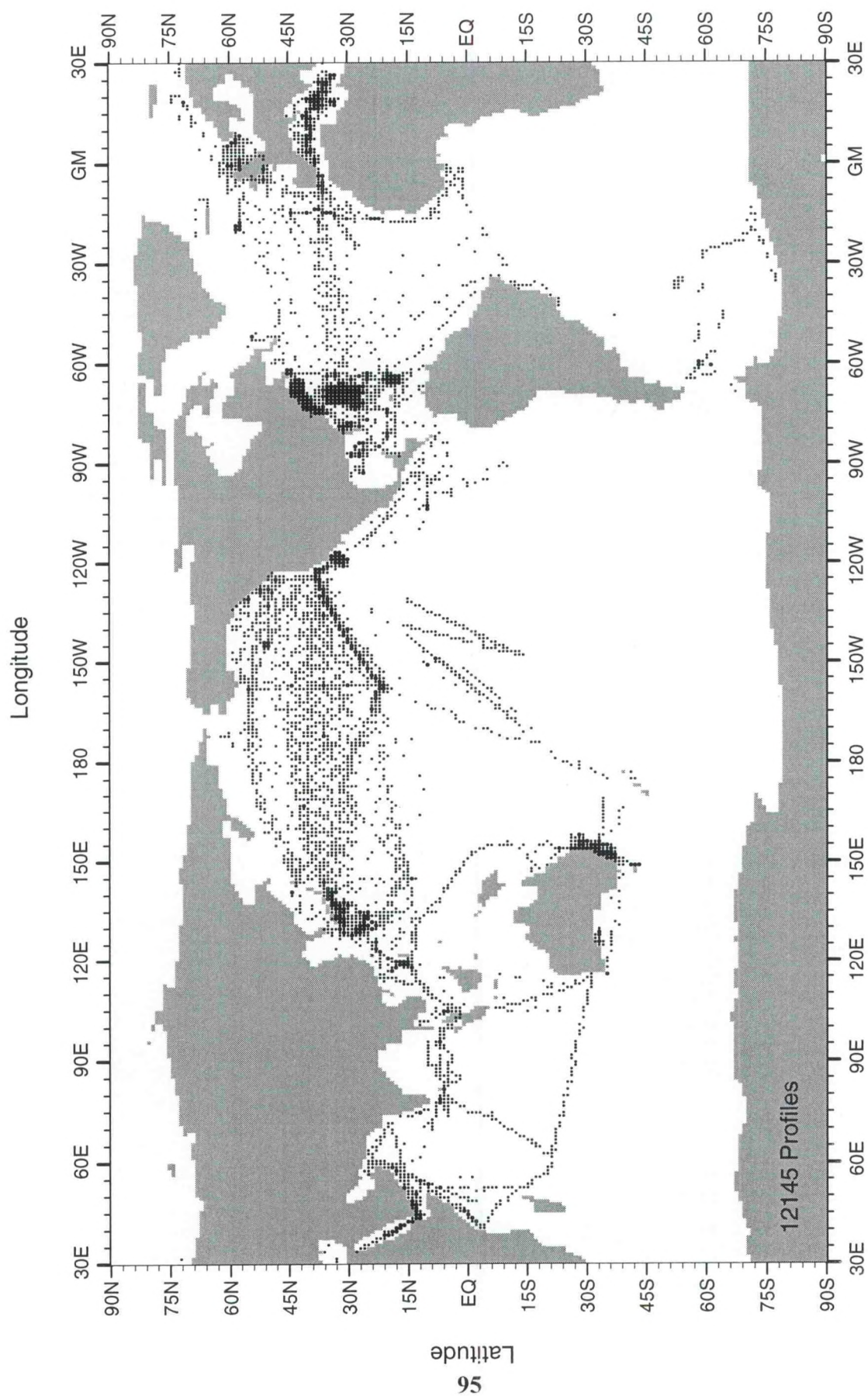


Fig. B49 WOD98 XBT profile distribution for January-March for 1978

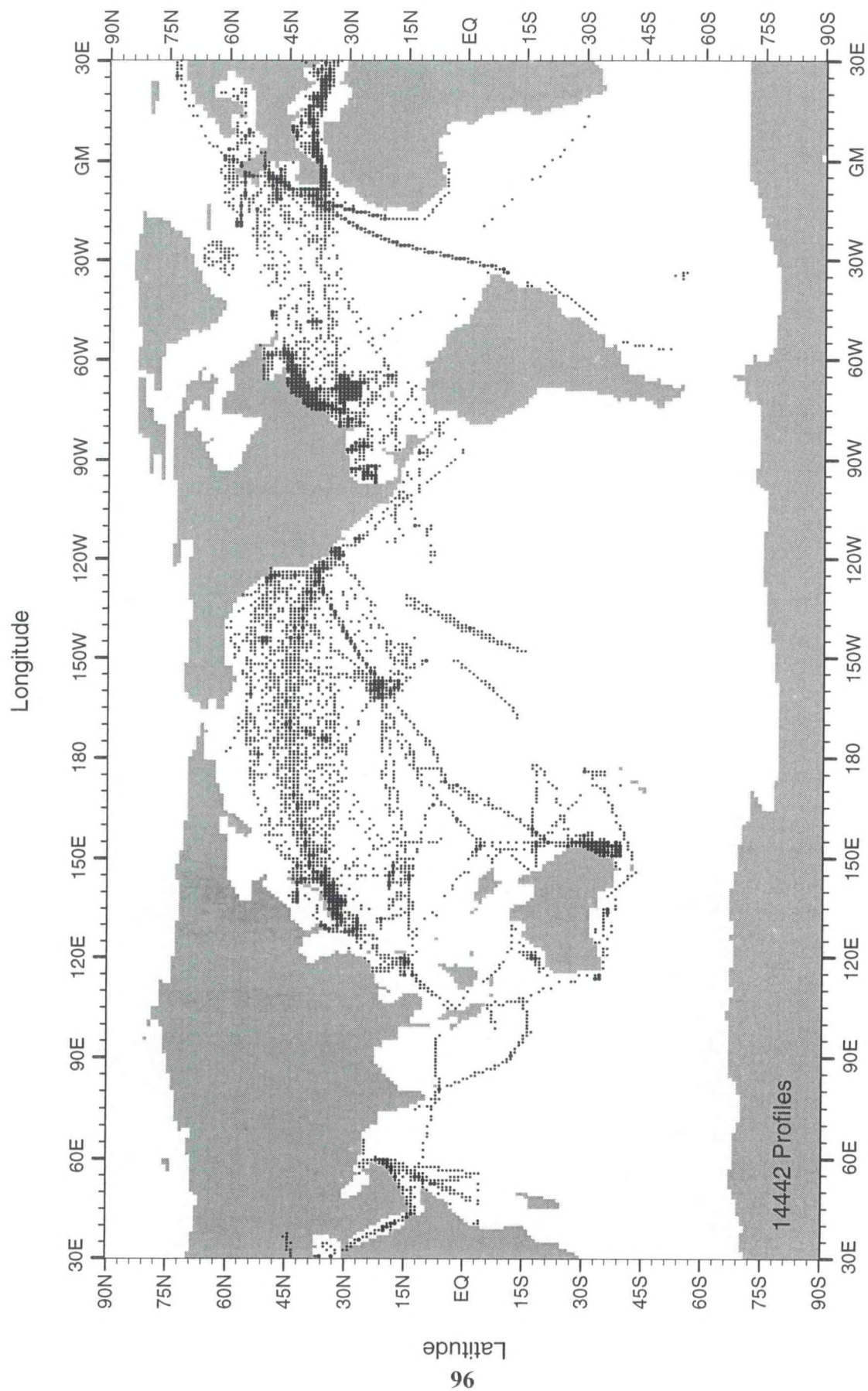


Fig. B50 WOD98 XBT profile distribution for April-June for 1978

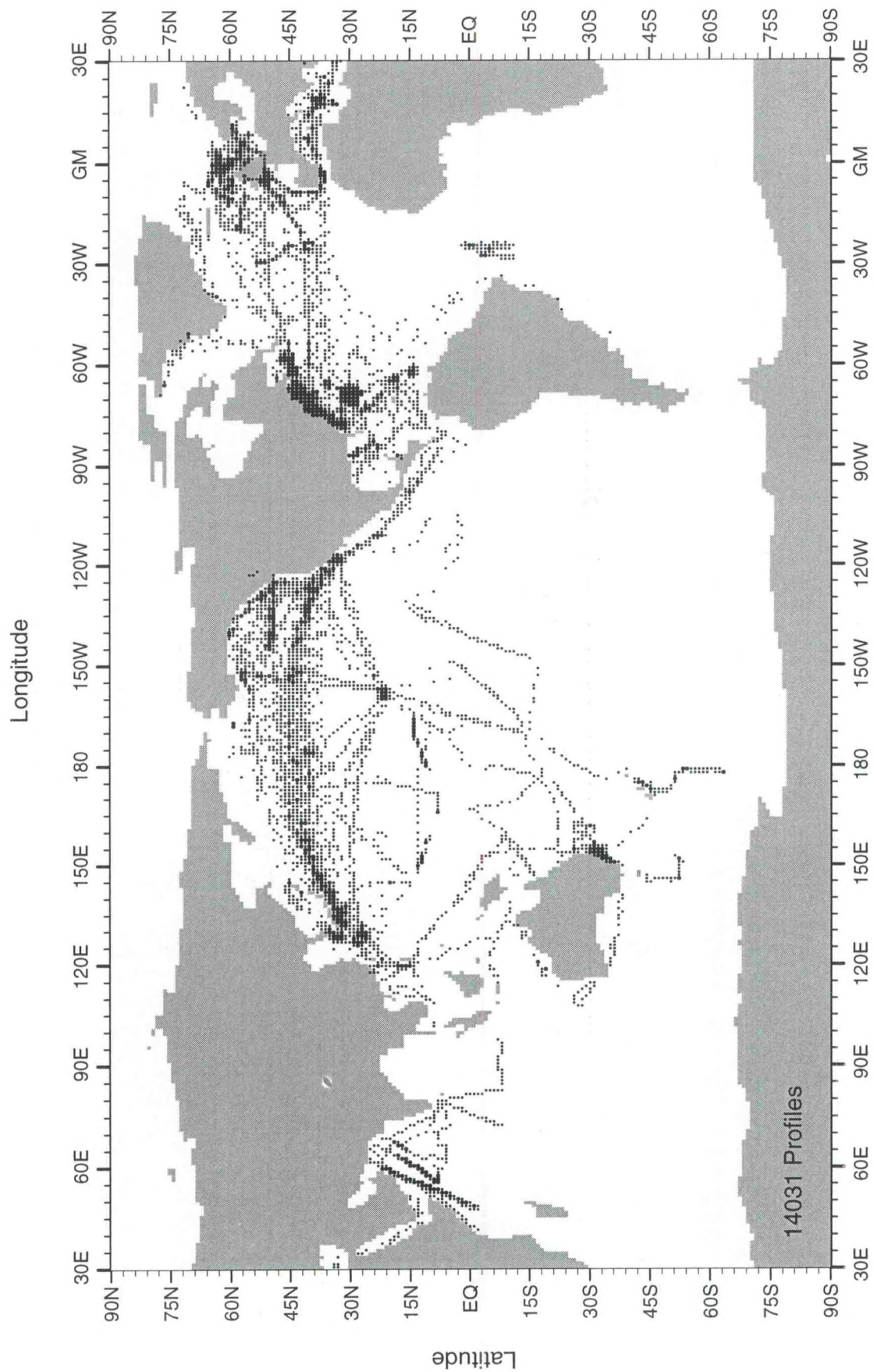


Fig. B51 WOD98 XBT profile distribution for July-September for 1978

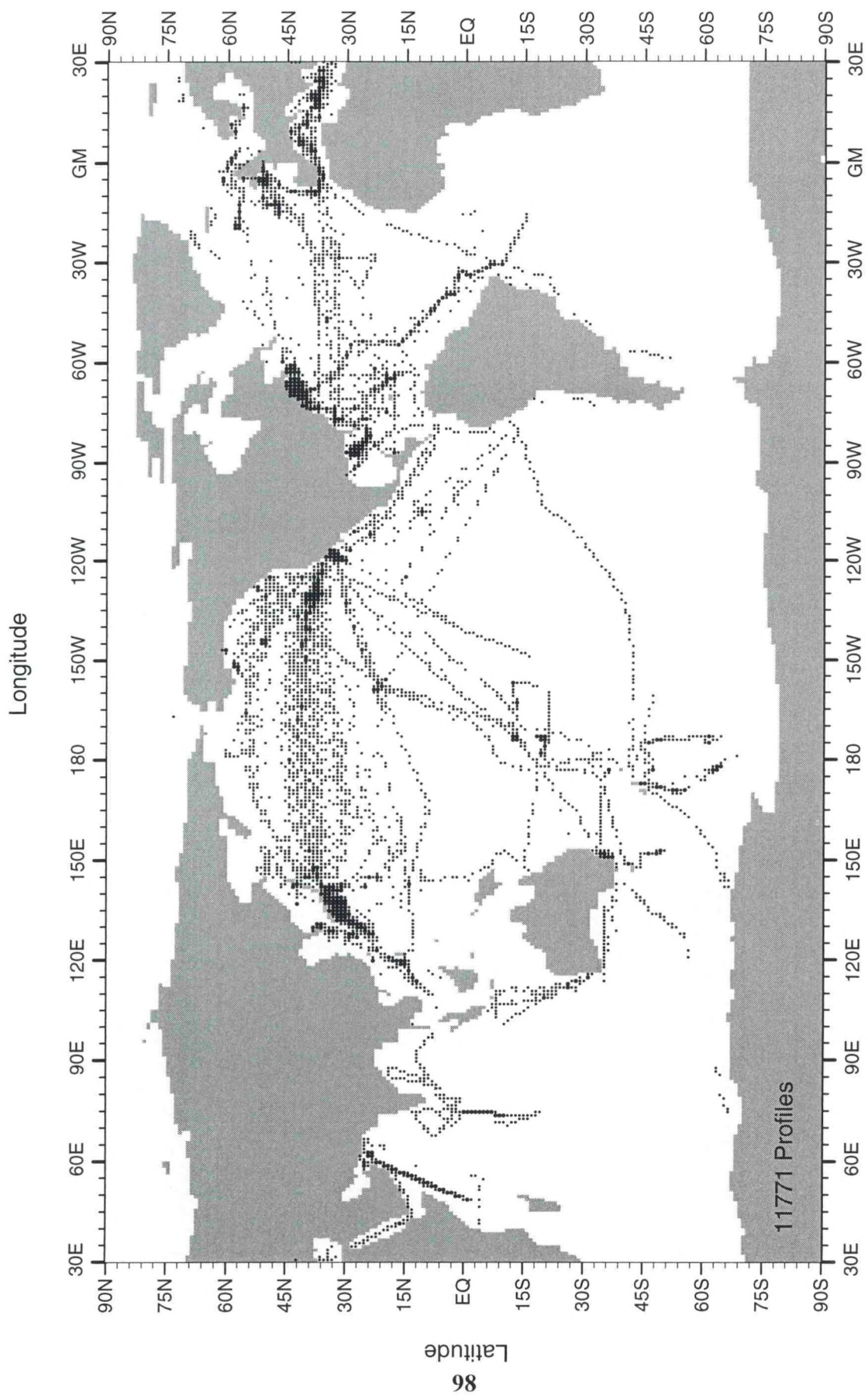


Fig. B52 WOD98 XBT profile distribution for October-December for 1978

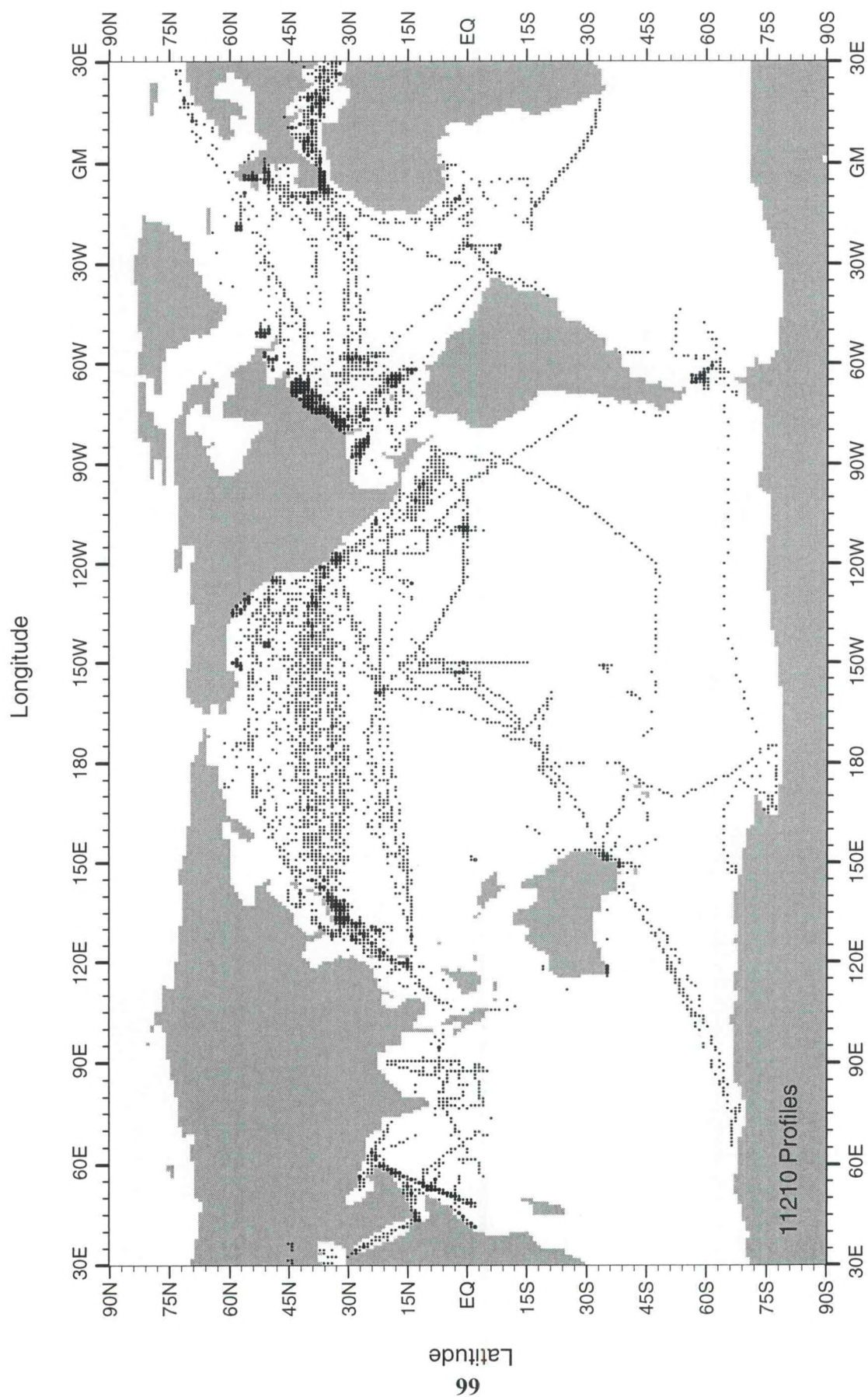


Fig. B53 WOD98 XBT profile distribution for January-March for 1979

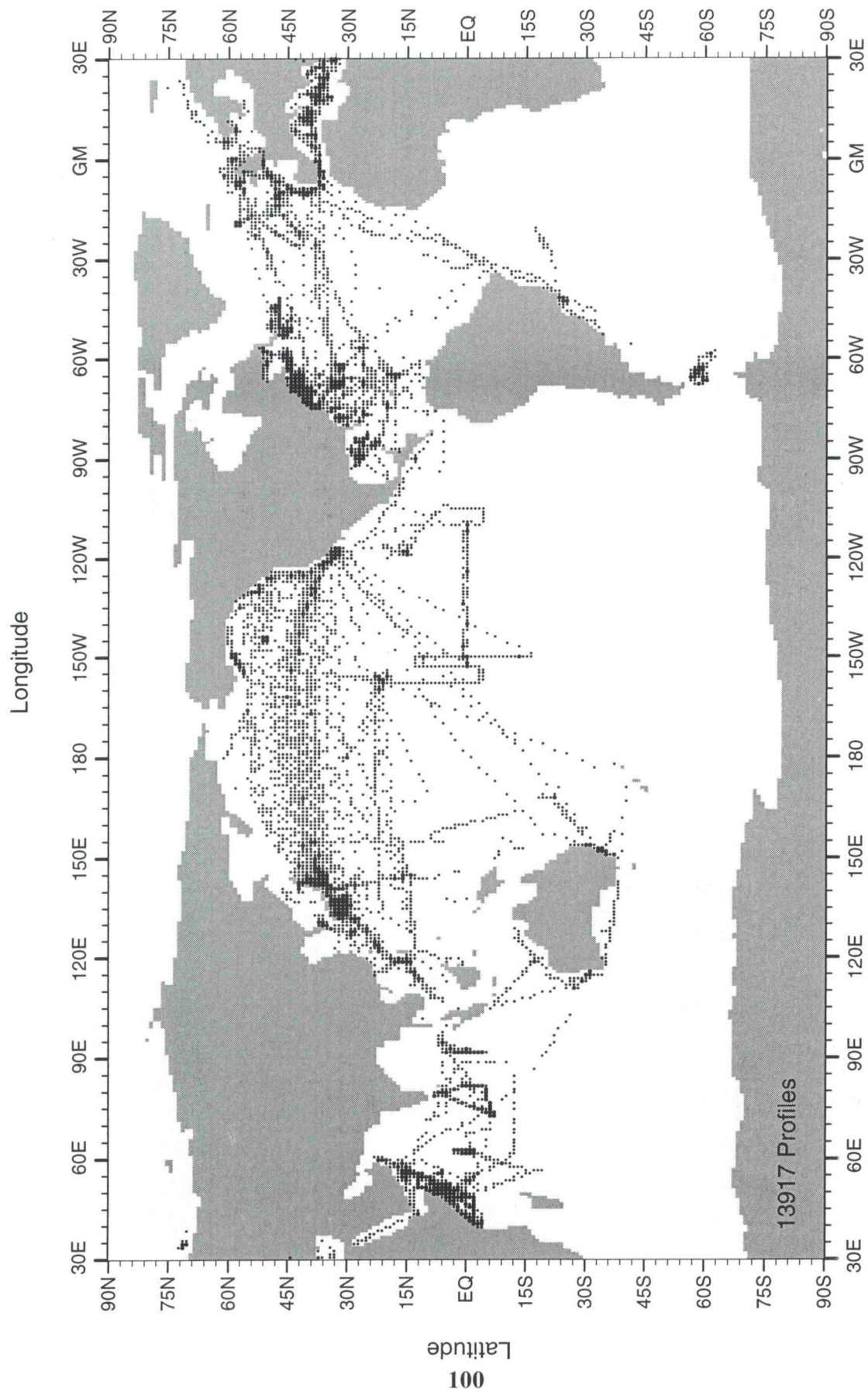


Fig. B54 WOD98 XBT profile distribution for April-June for 1979

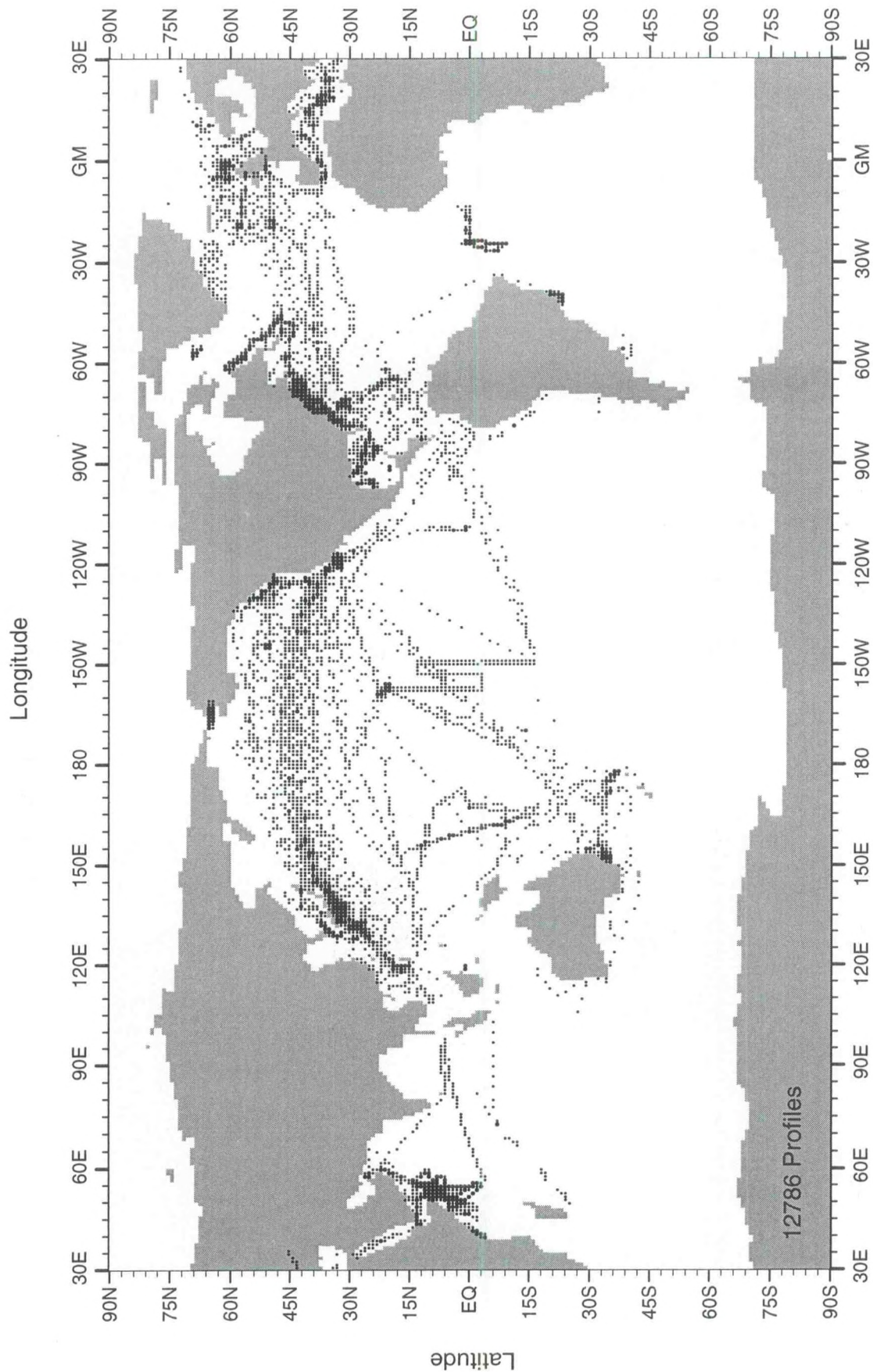


Fig. B55 WOD98 XBT profile distribution for July-September for 1979

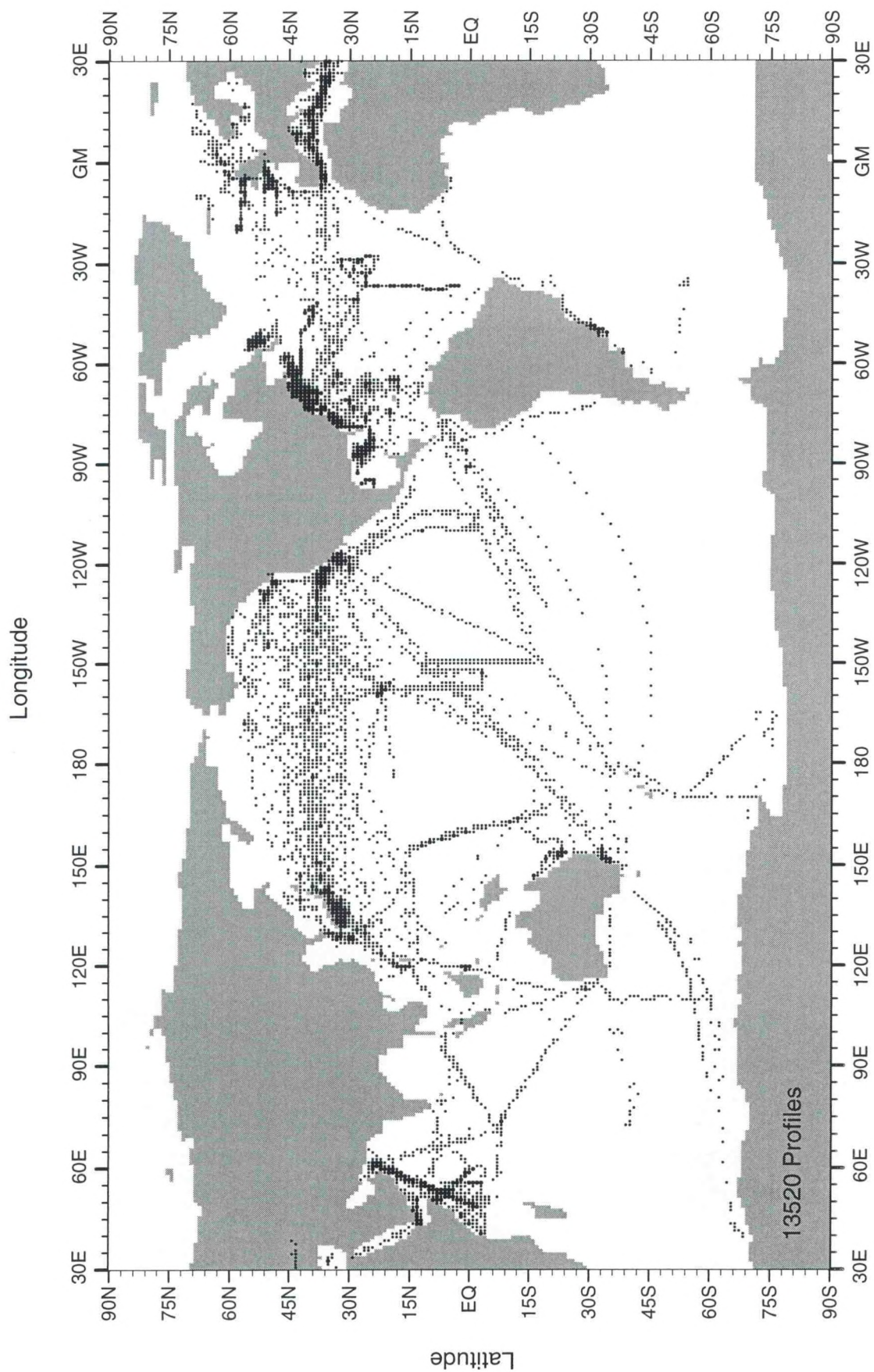


Fig. B56 WOD98 XBT profile distribution for October-December for 1979

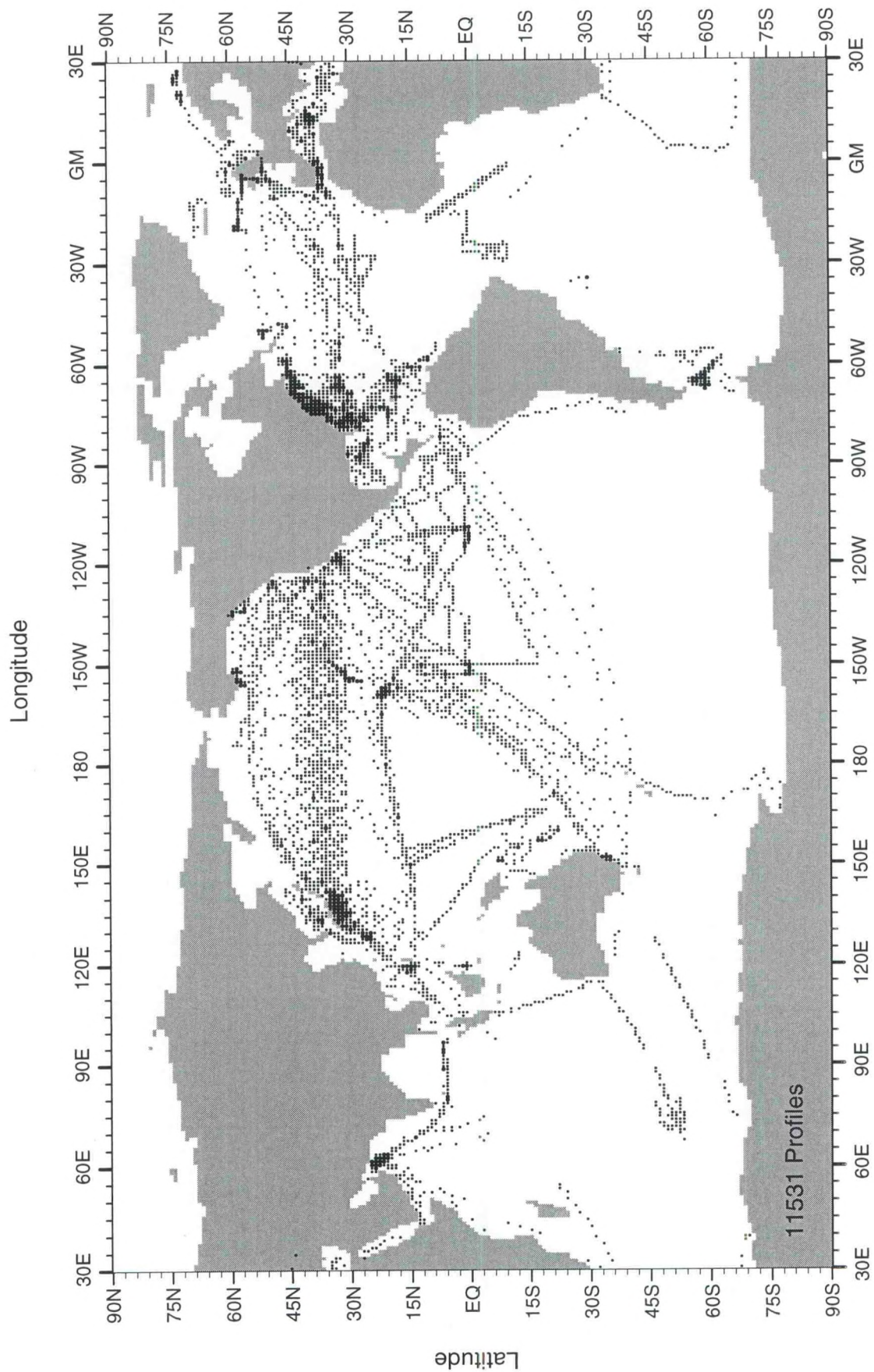


Fig. B57 WOD98 XBT profile distribution for January-March for 1980

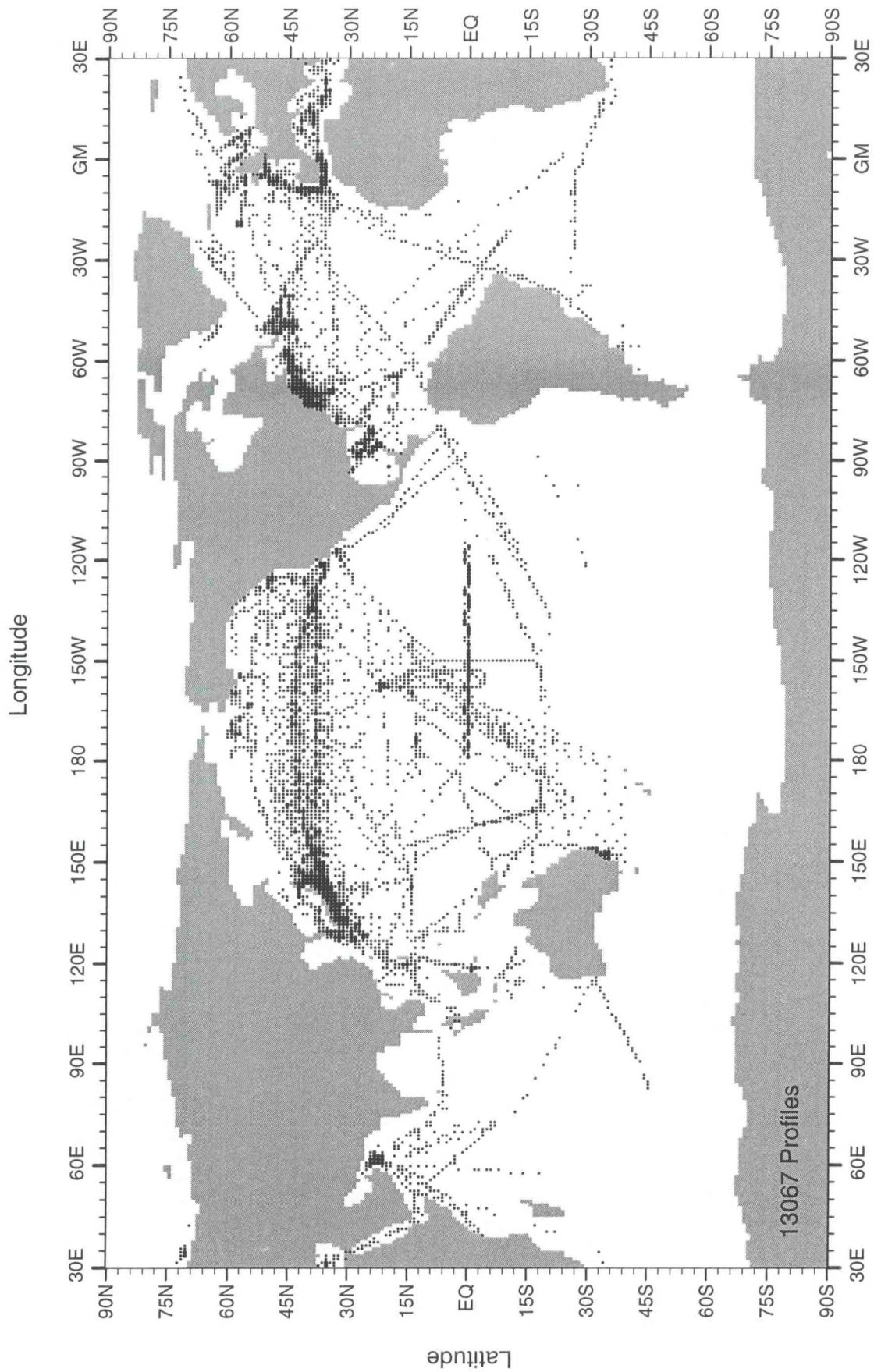


Fig. B58 WOD98 XBT profile distribution for April-June for 1980

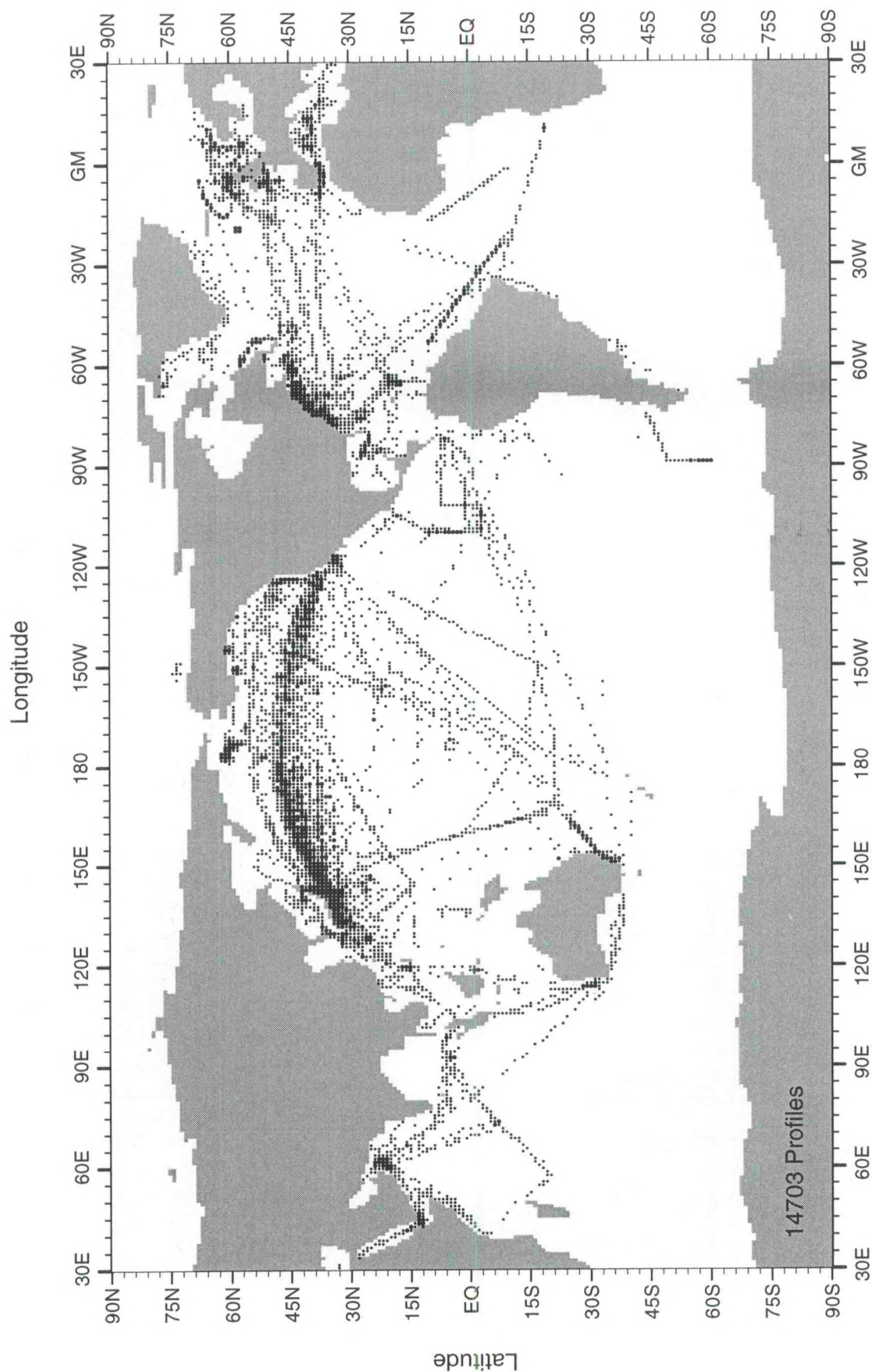


Fig. B59 WOD98 XBT profile distribution for July-September for 1980

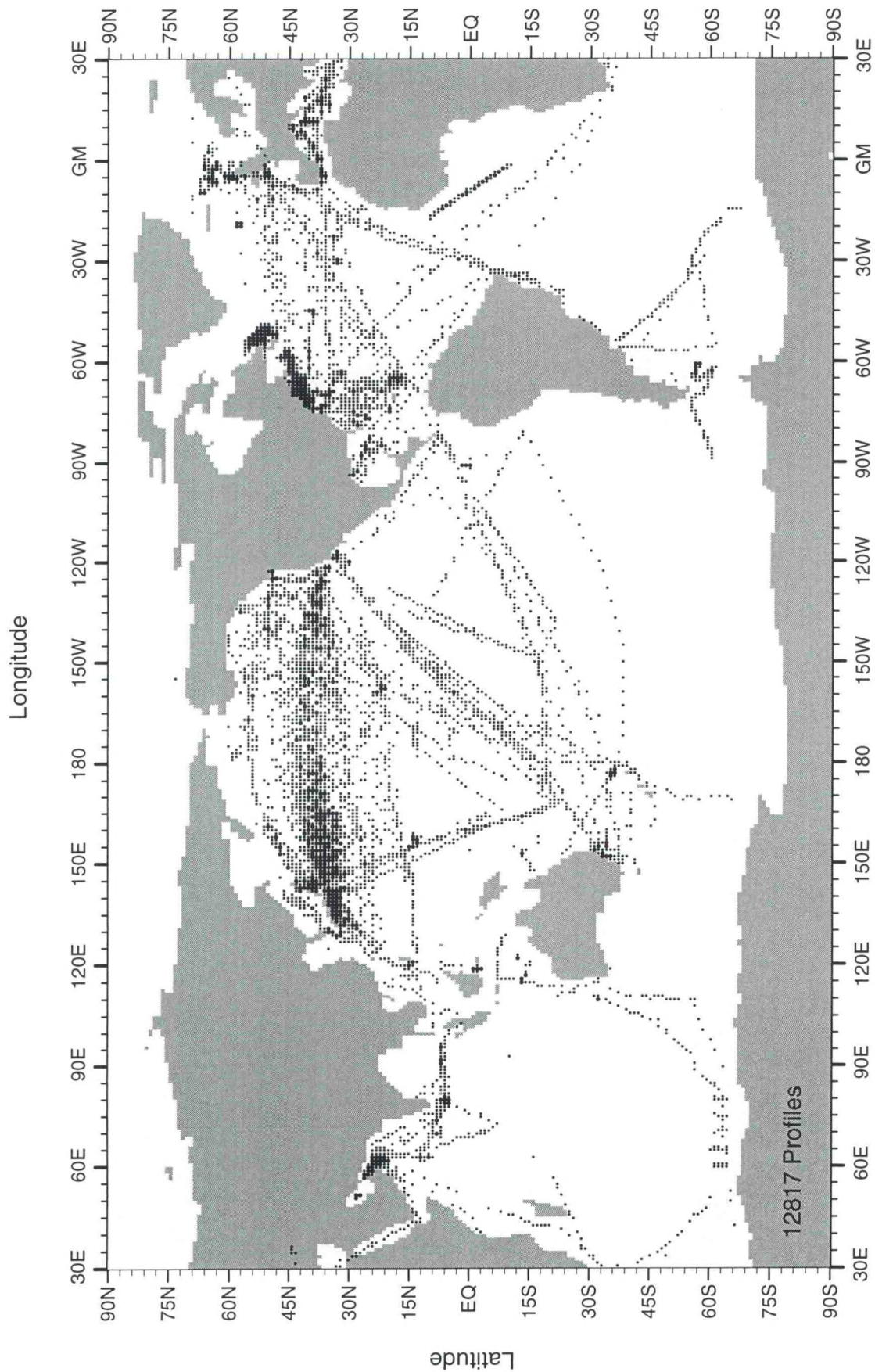


Fig. B60 WOD98 XBT profile distribution for October-December for 1980

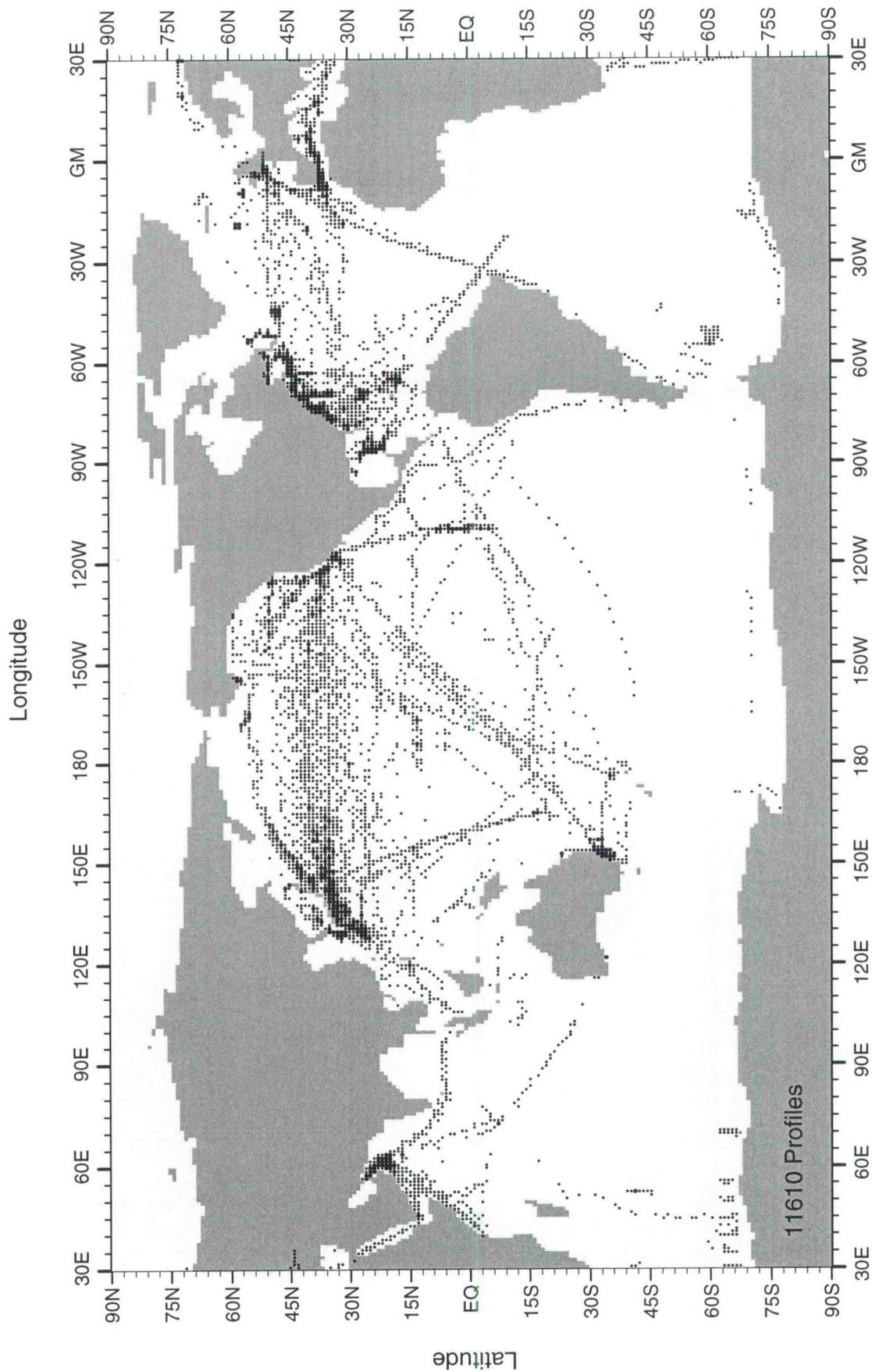


Fig. B61 WOD98 XBT profile distribution for January-March for 1981

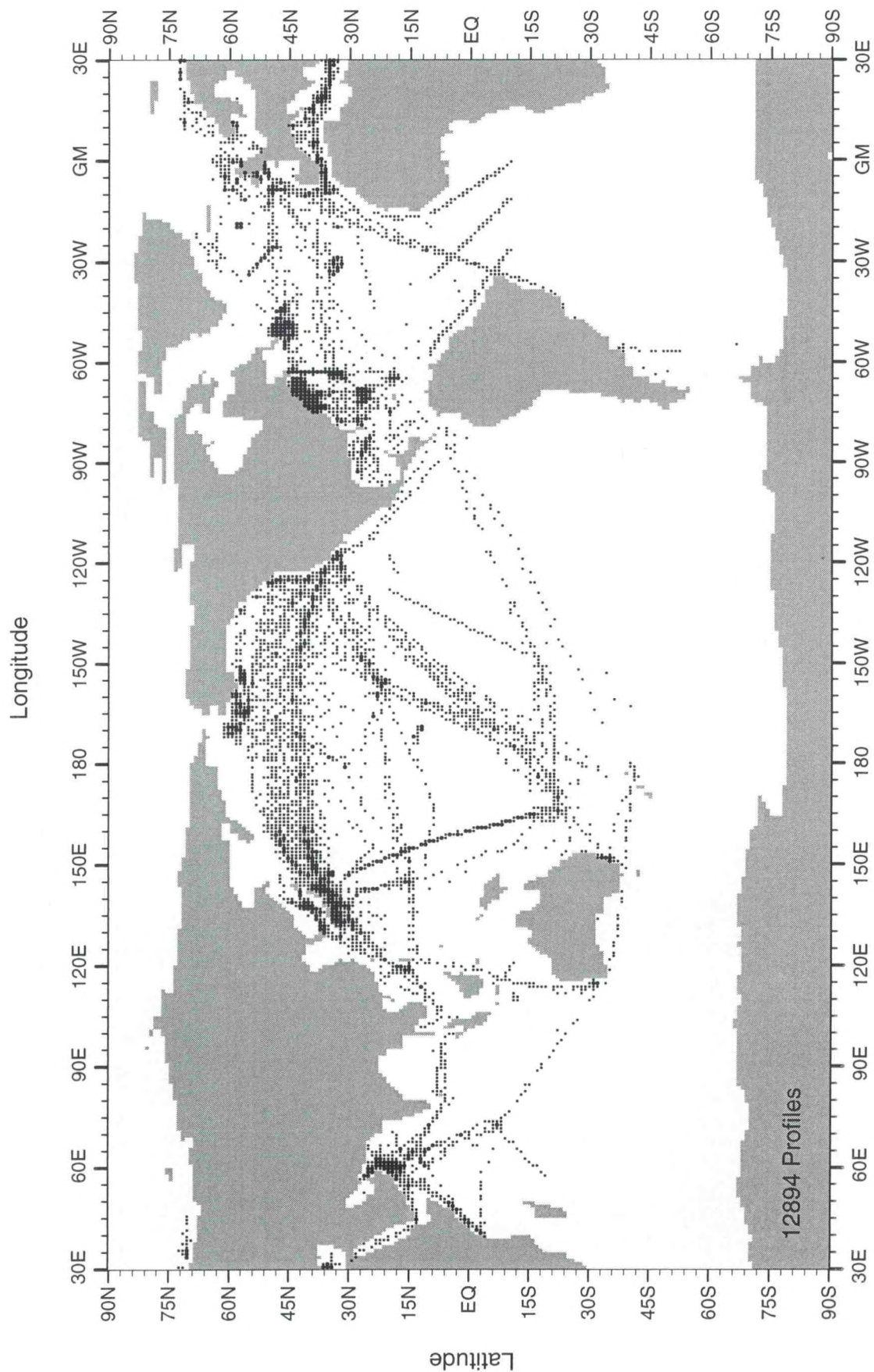


Fig. B62 WOD98 XBT profile distribution for April-June for 1981

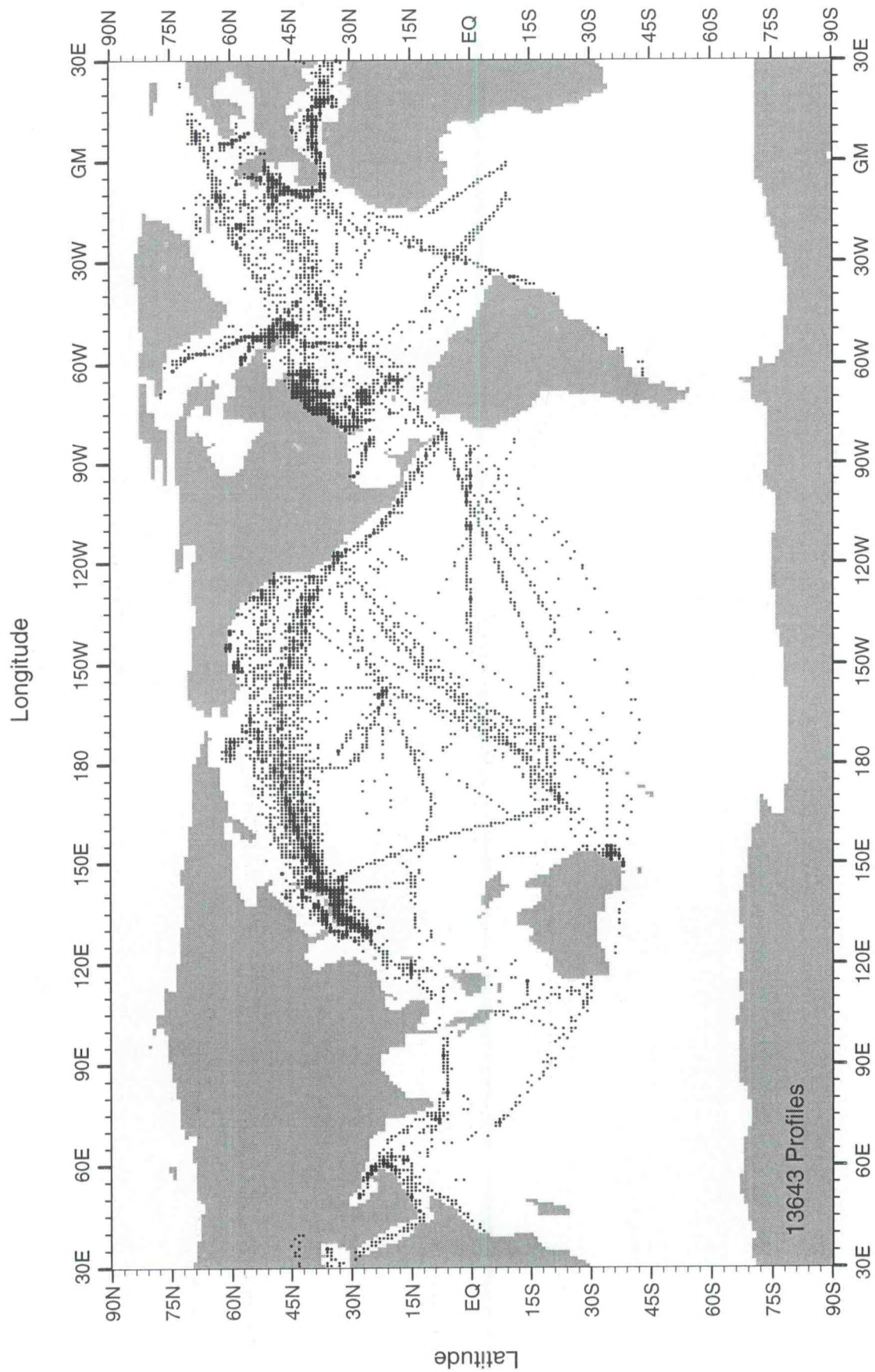


Fig. B63 WOD98 XBT profile distribution for July-September for 1981

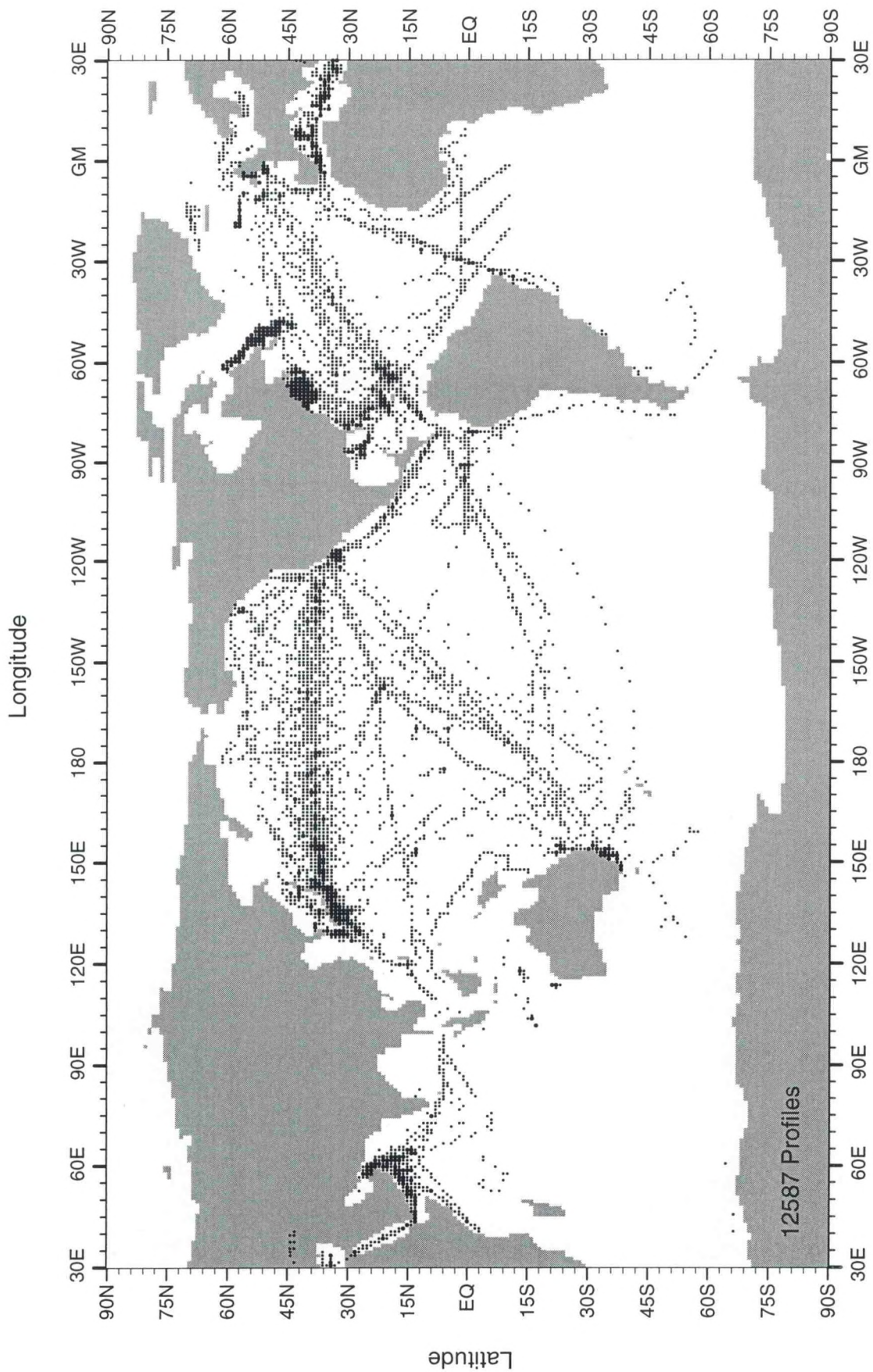


Fig. B64 WOD98 XBT profile distribution for October-December for 1981

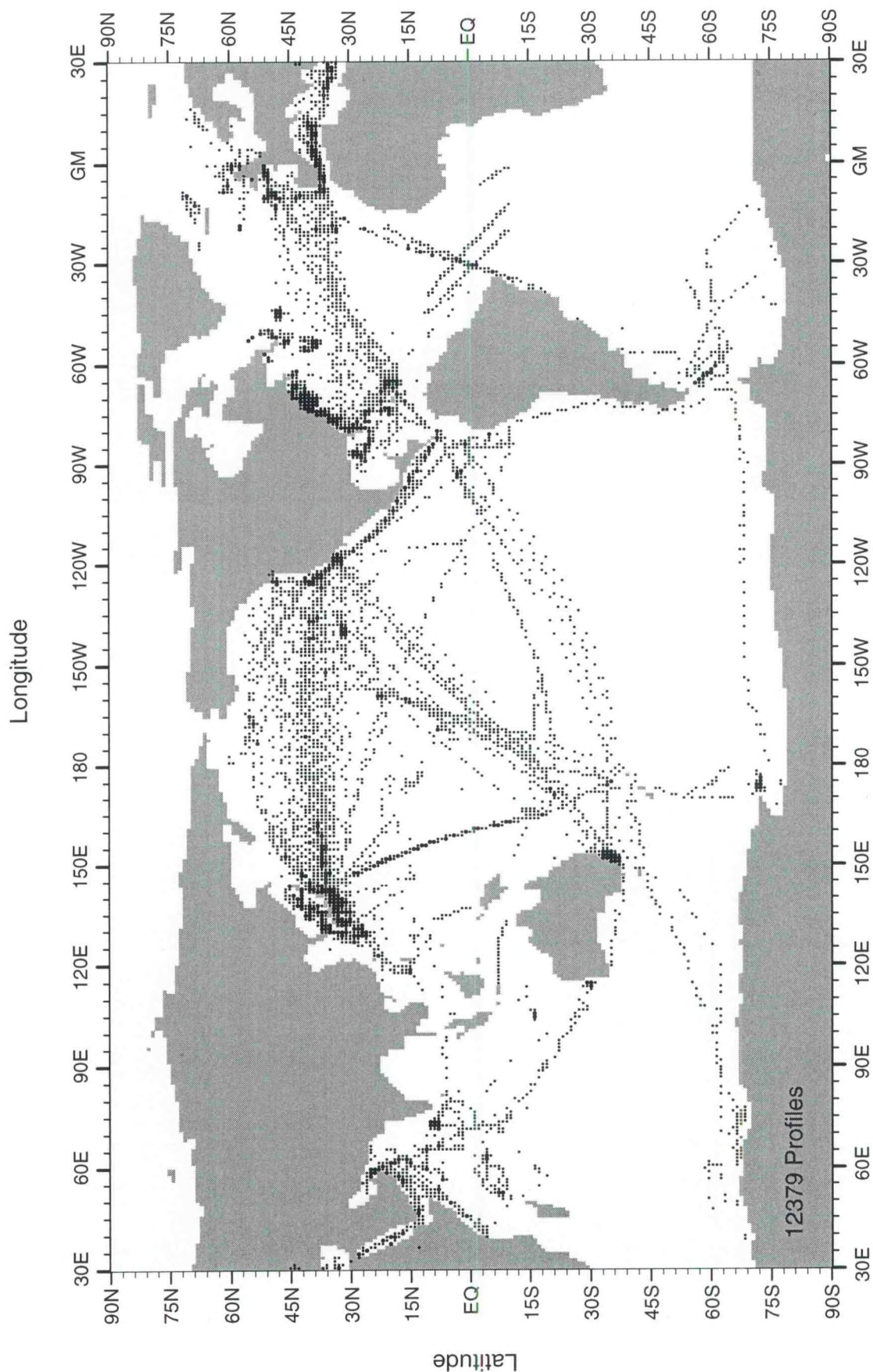


Fig. B65 WOD98 XBT profile distribution for January-March for 1982

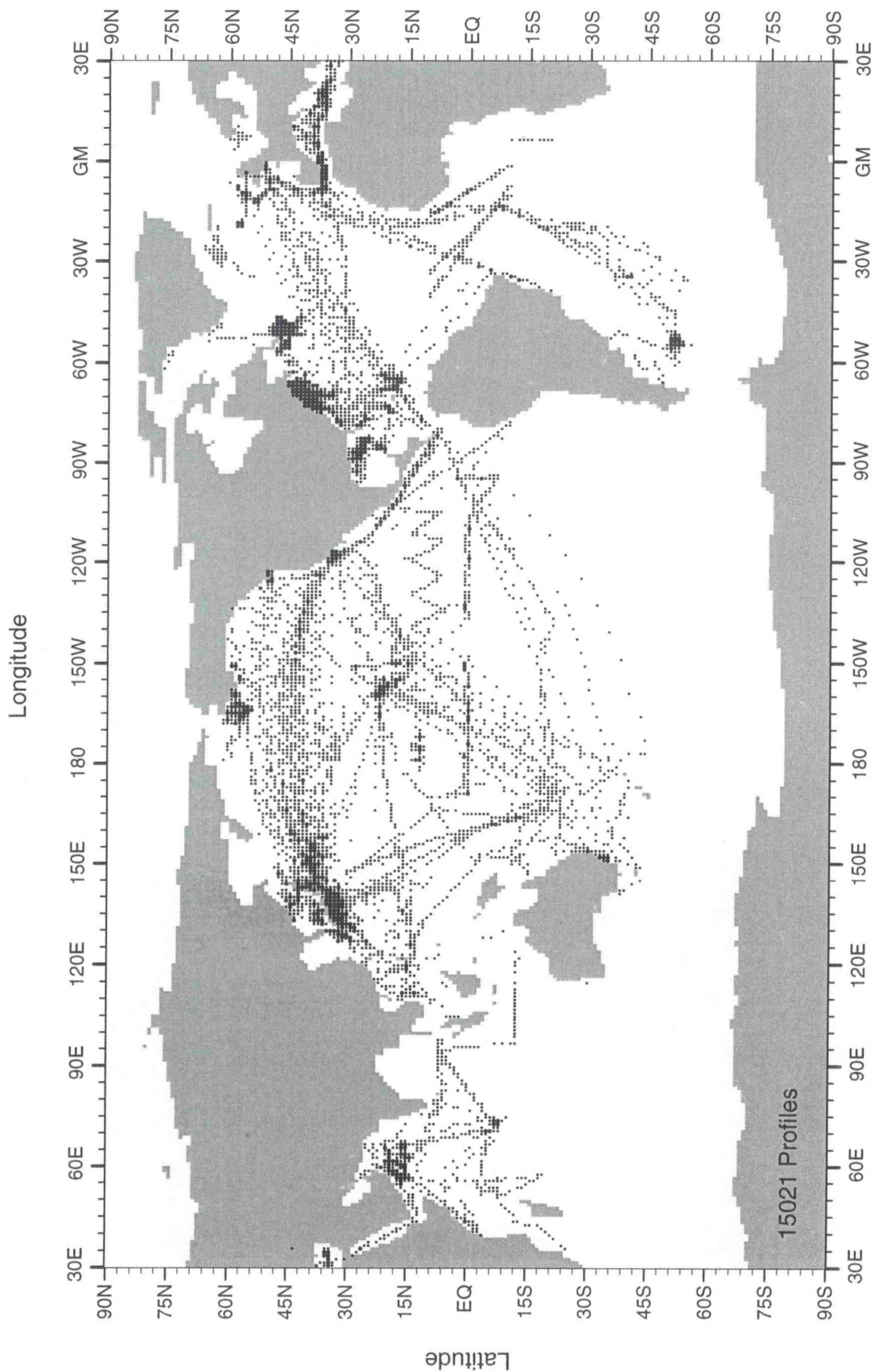


Fig. B66 WOD98 XBT profile distribution for April-June for 1982

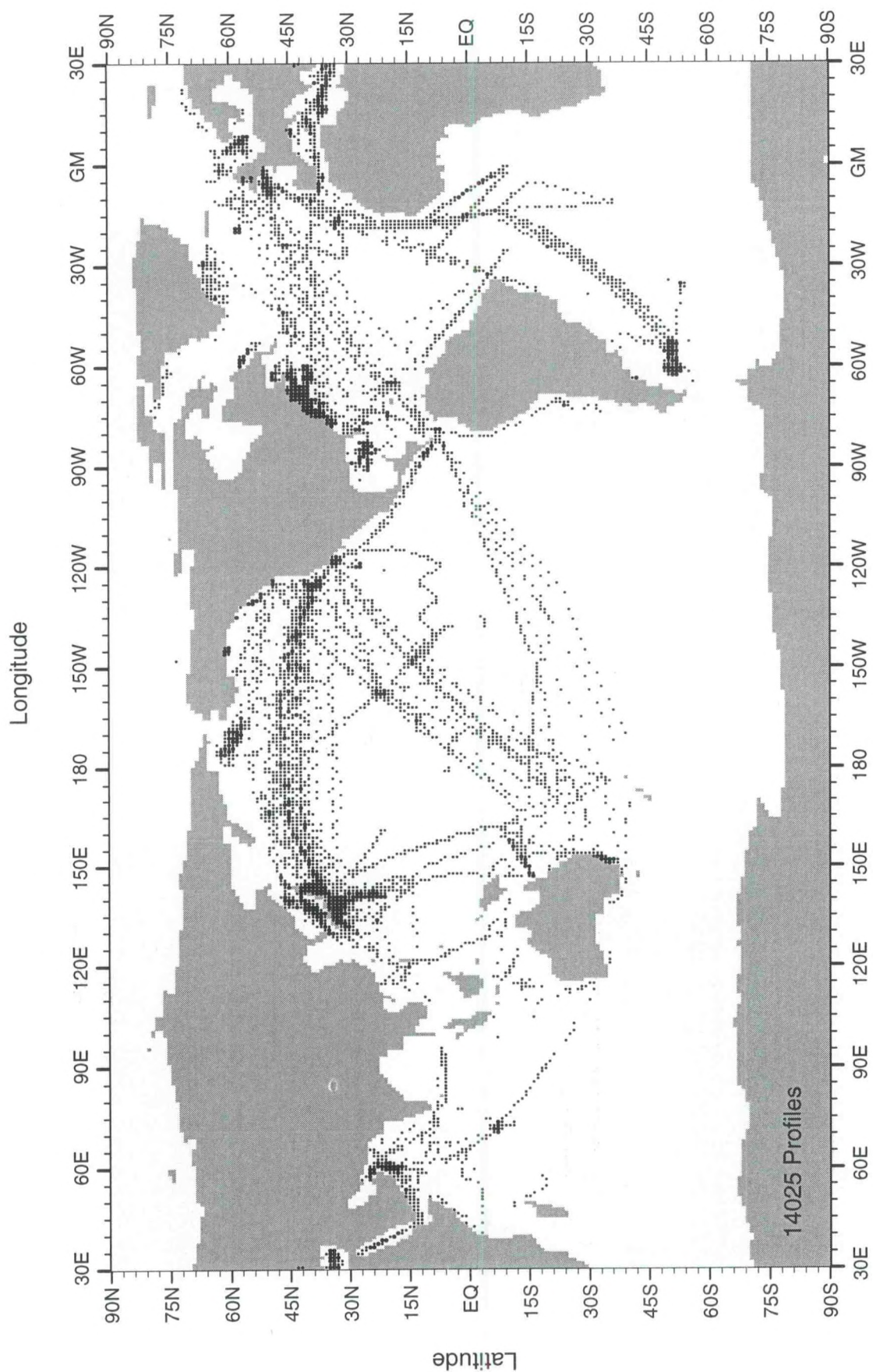


Fig. B67 WOD98 XBT profile distribution for July-September for 1982

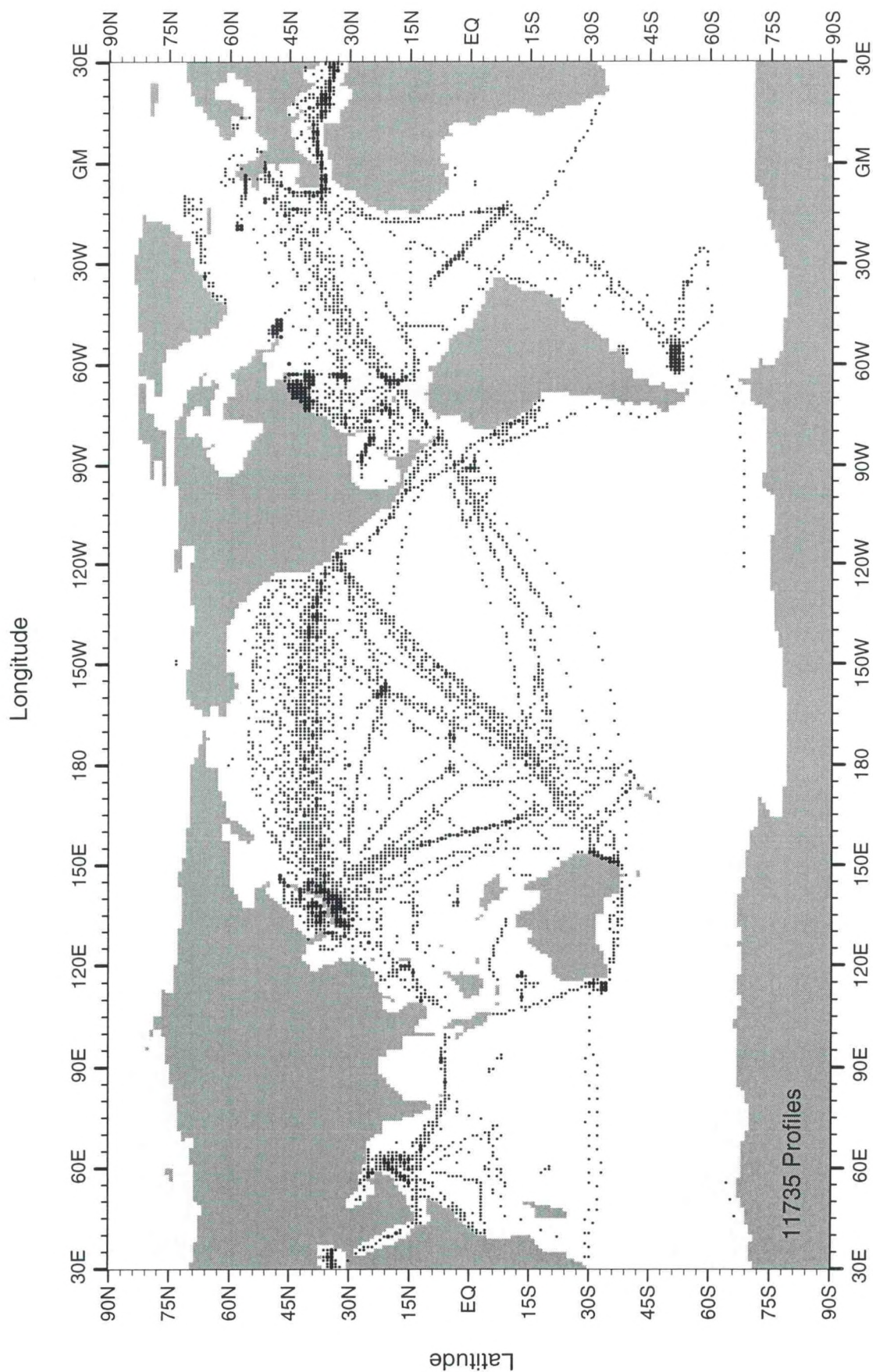


Fig. B68 WOD98 XBT profile distribution for October-December for 1982

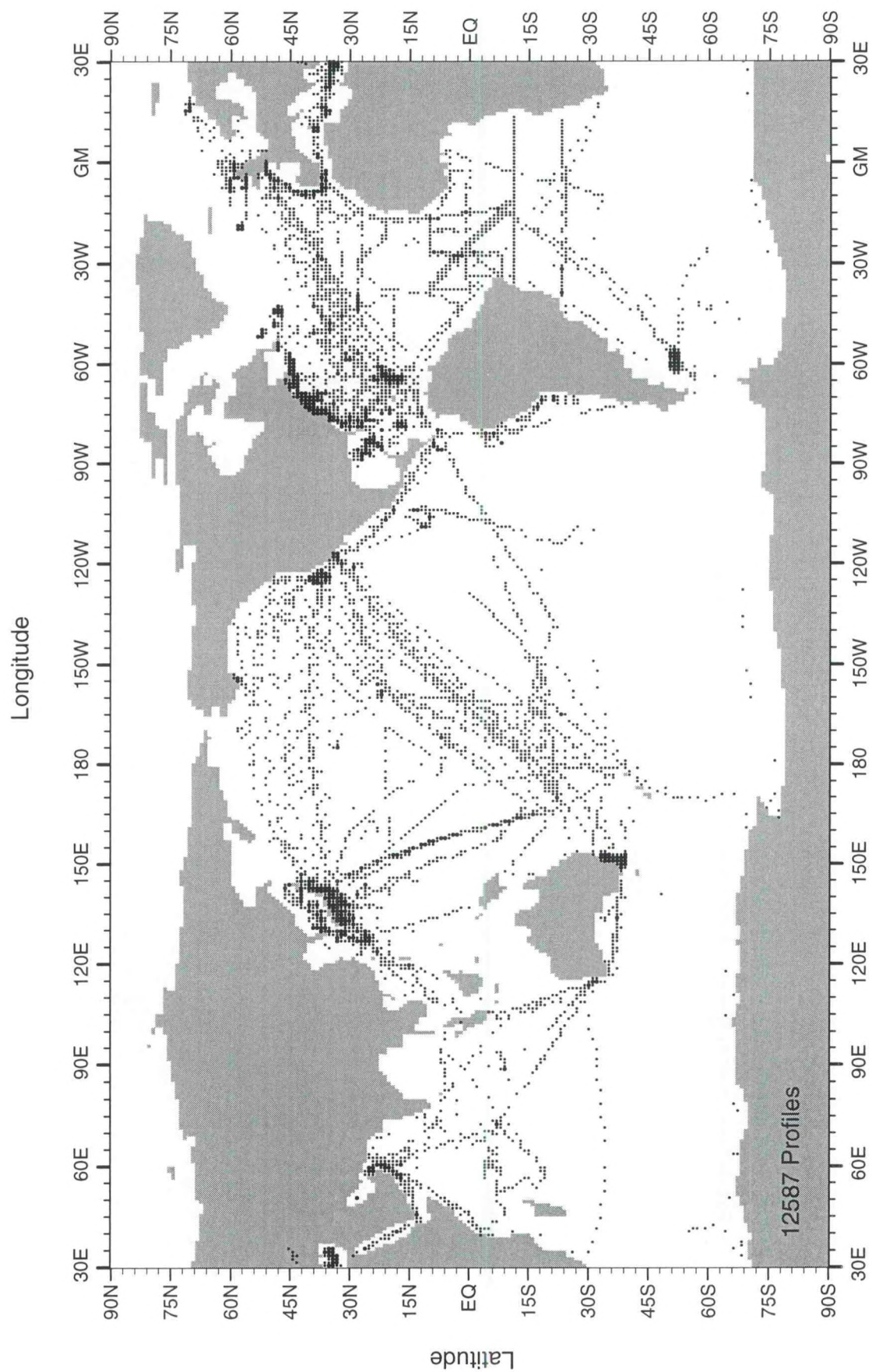


Fig. B69 WOD98 XBT profile distribution for January-March for 1983

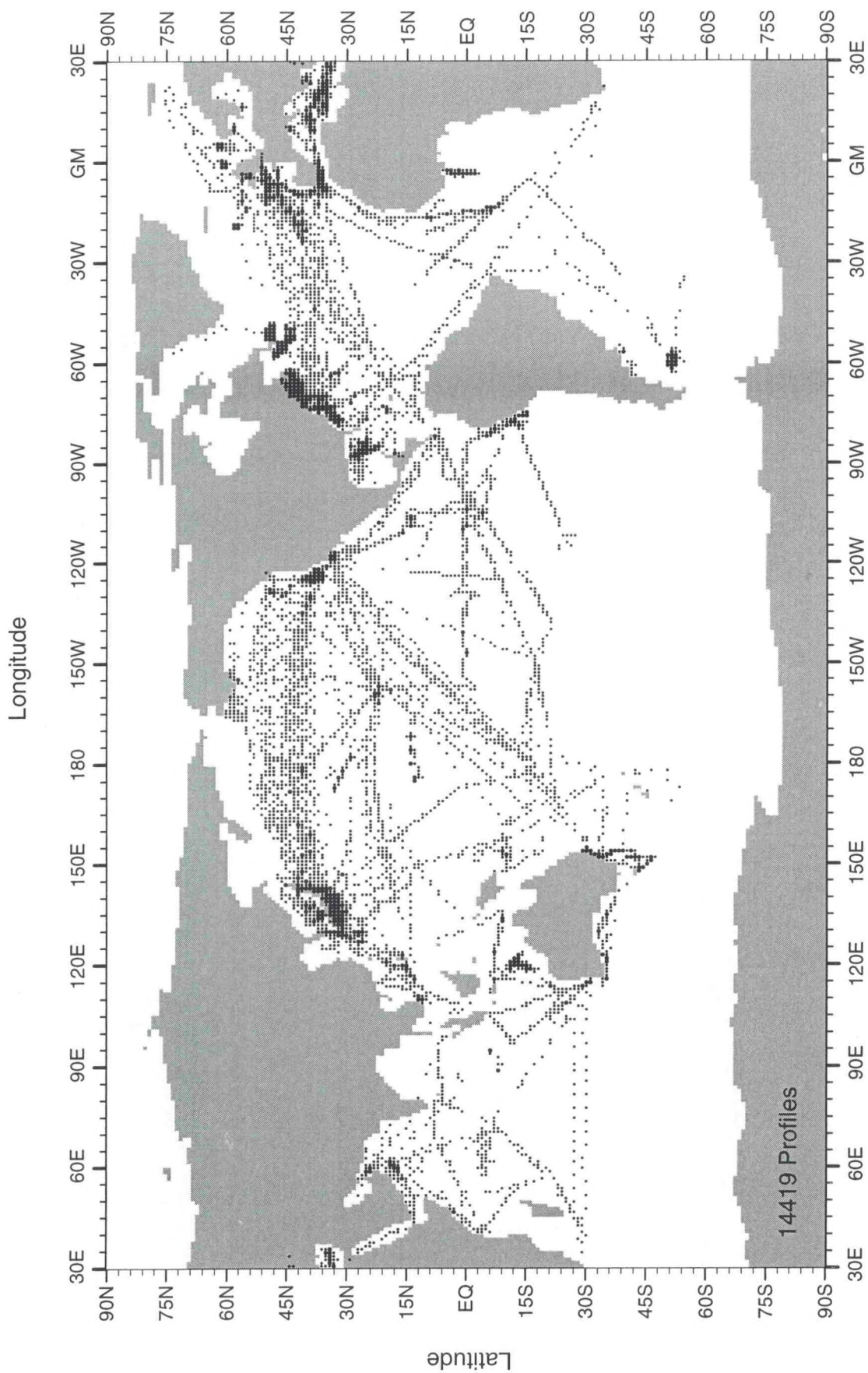


Fig. B70 WOD98 XBT profile distribution for April-June for 1983

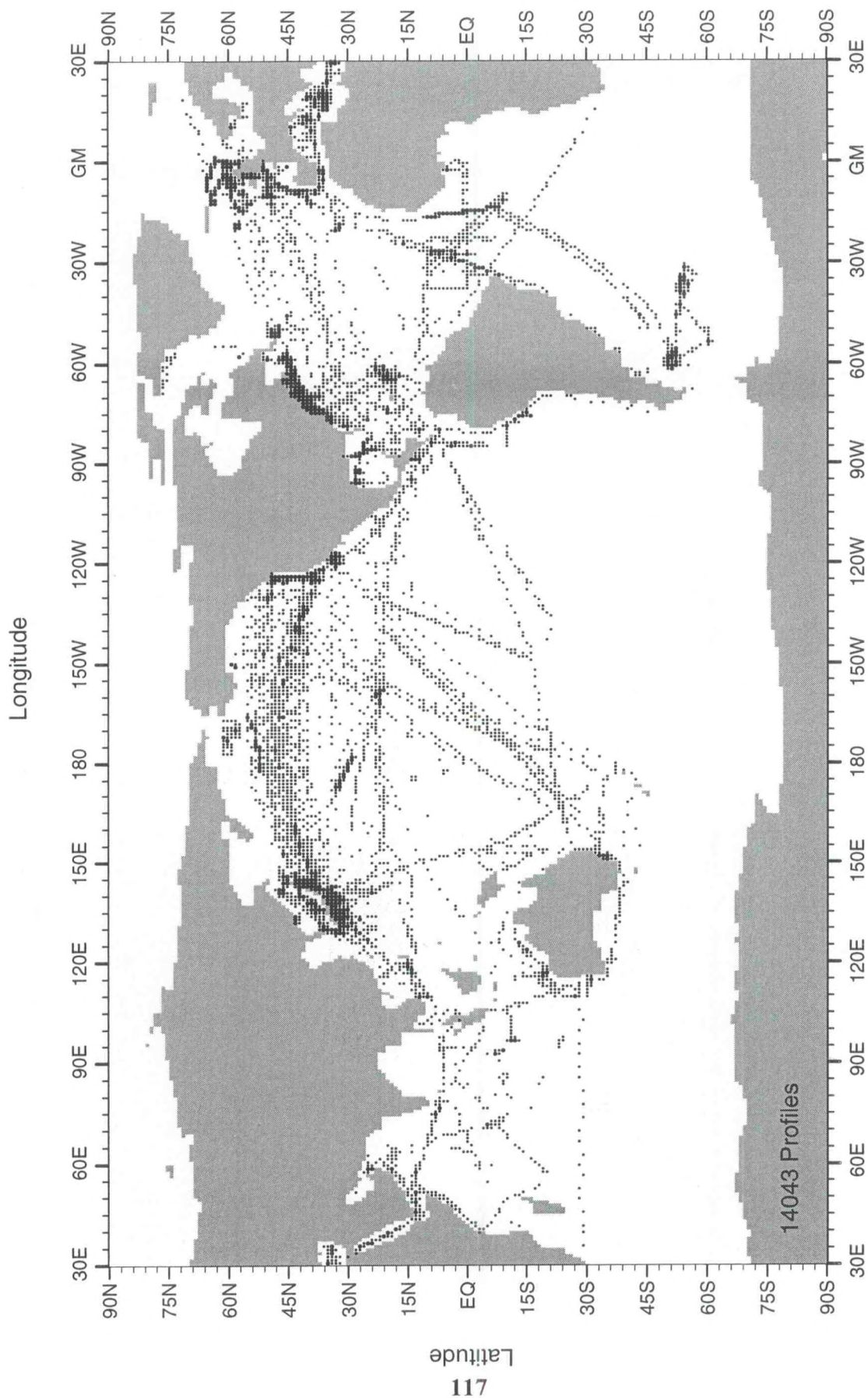


Fig. B71 WOD98 XBT profile distribution for July-September for 1983

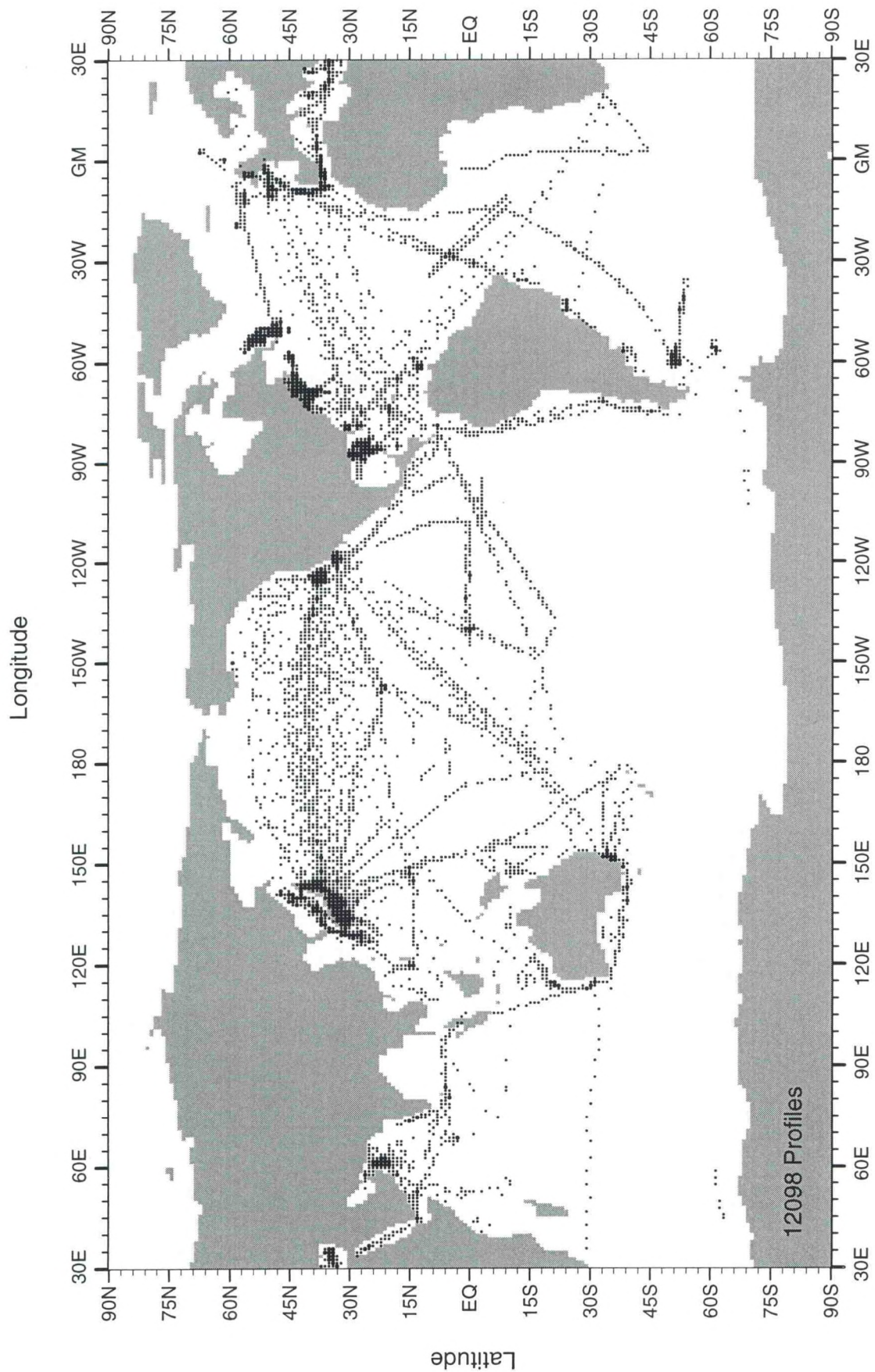


Fig. B72 WOD98 XBT profile distribution for October-December for 1983

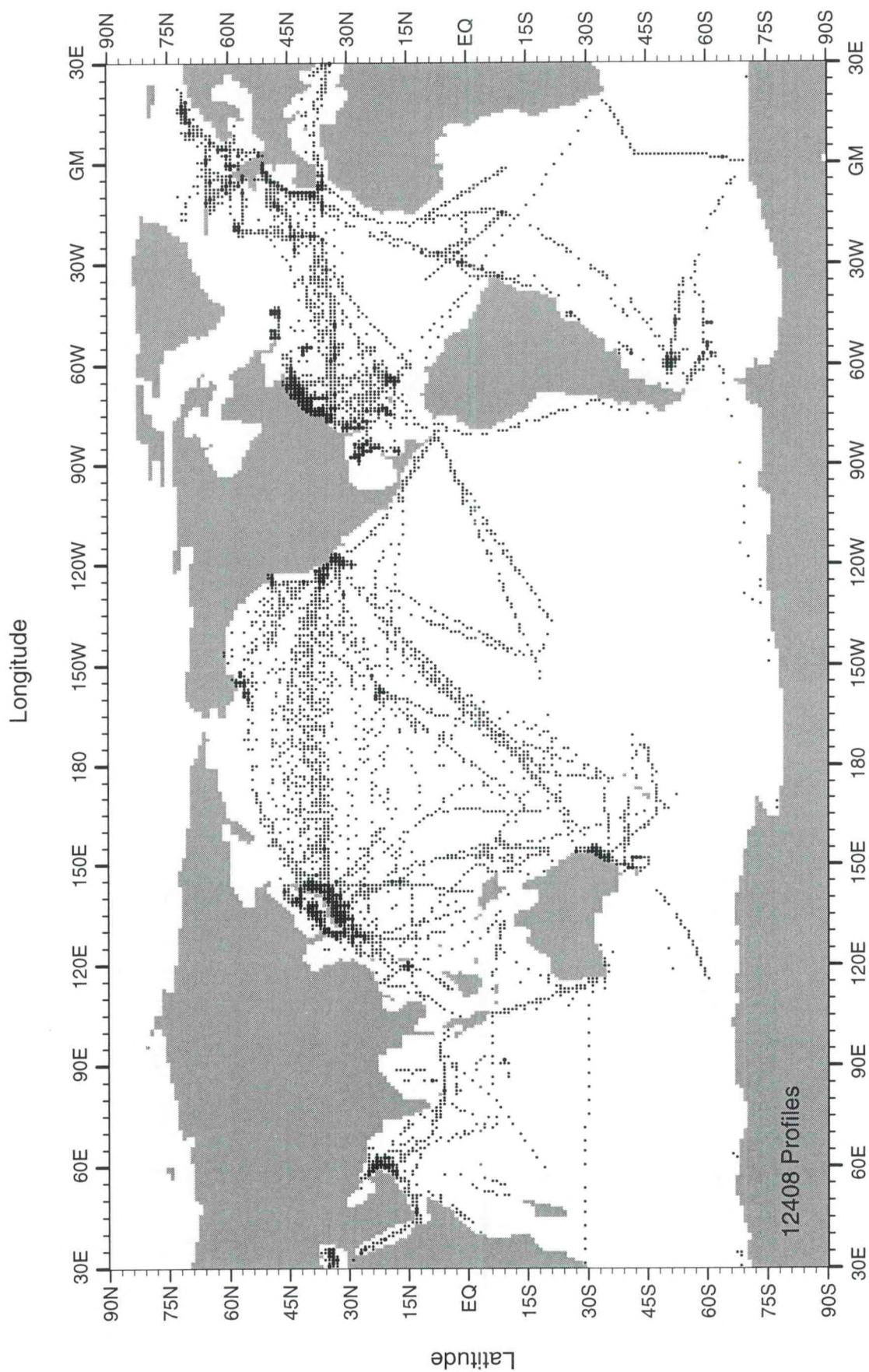


Fig. B73 WOD98 XBT profile distribution for January-March for 1984

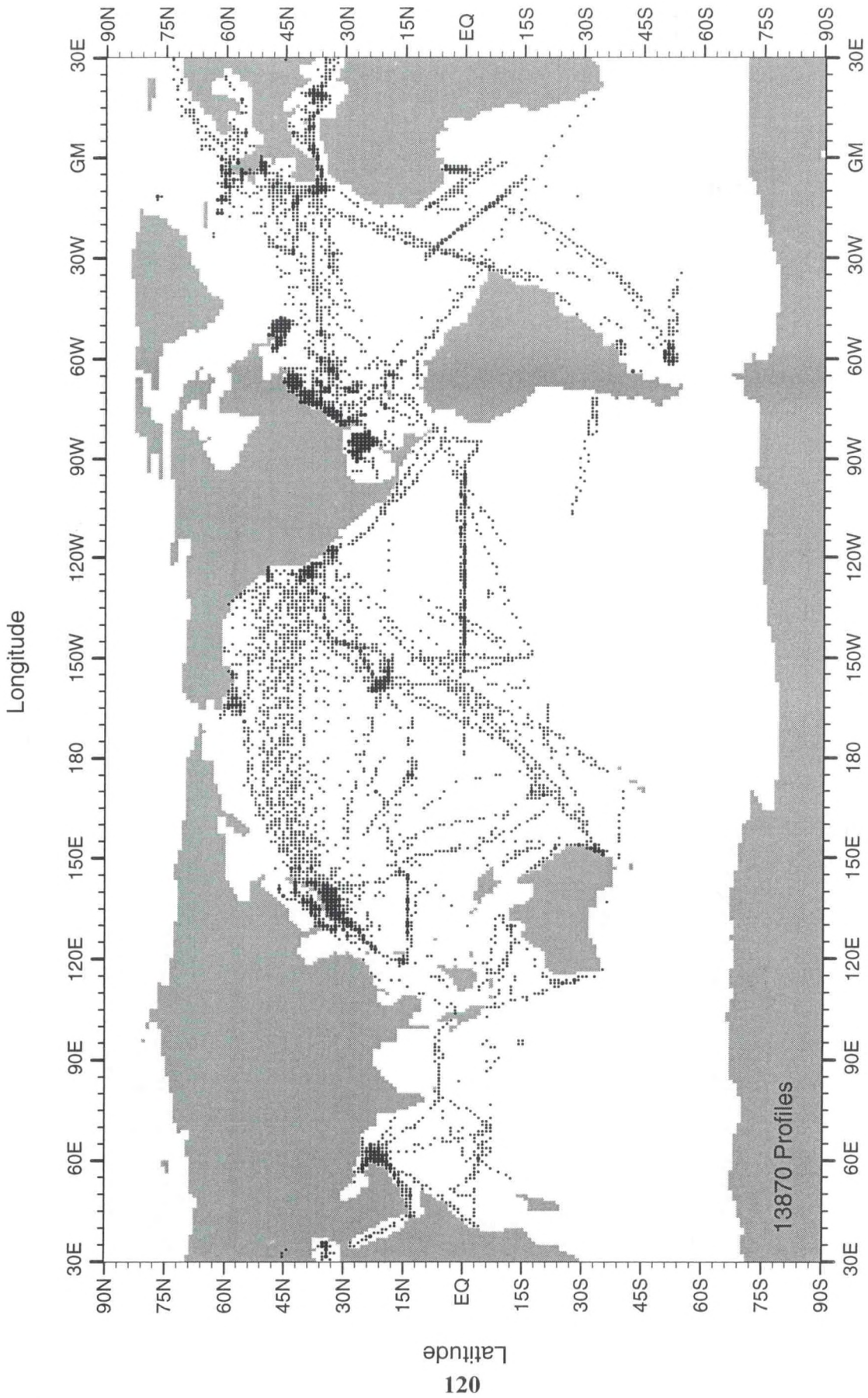


Fig. B74 WOD98 XBT profile distribution for April-June for 1984

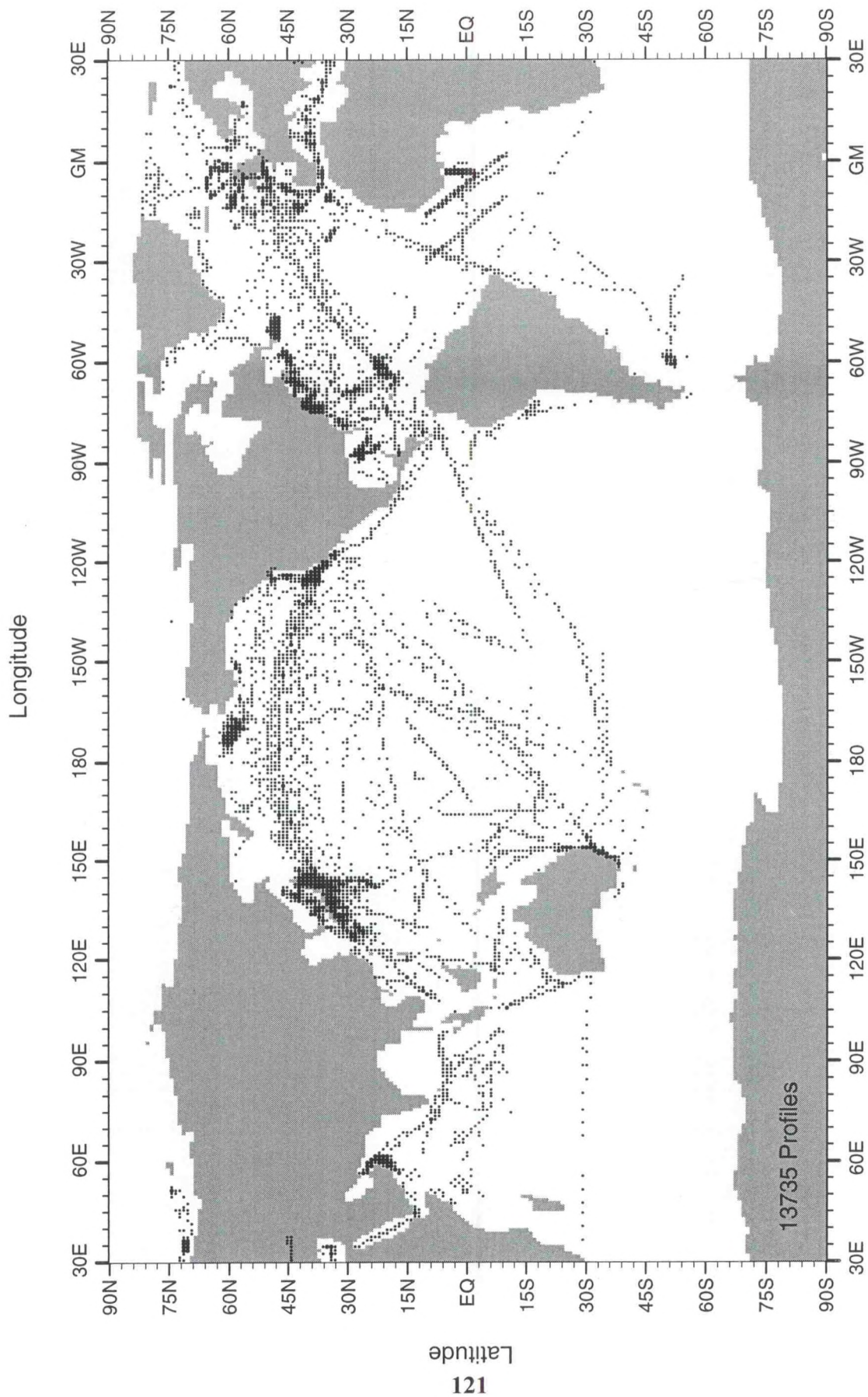


Fig. B75 WOD98 XBT profile distribution for July-September for 1984

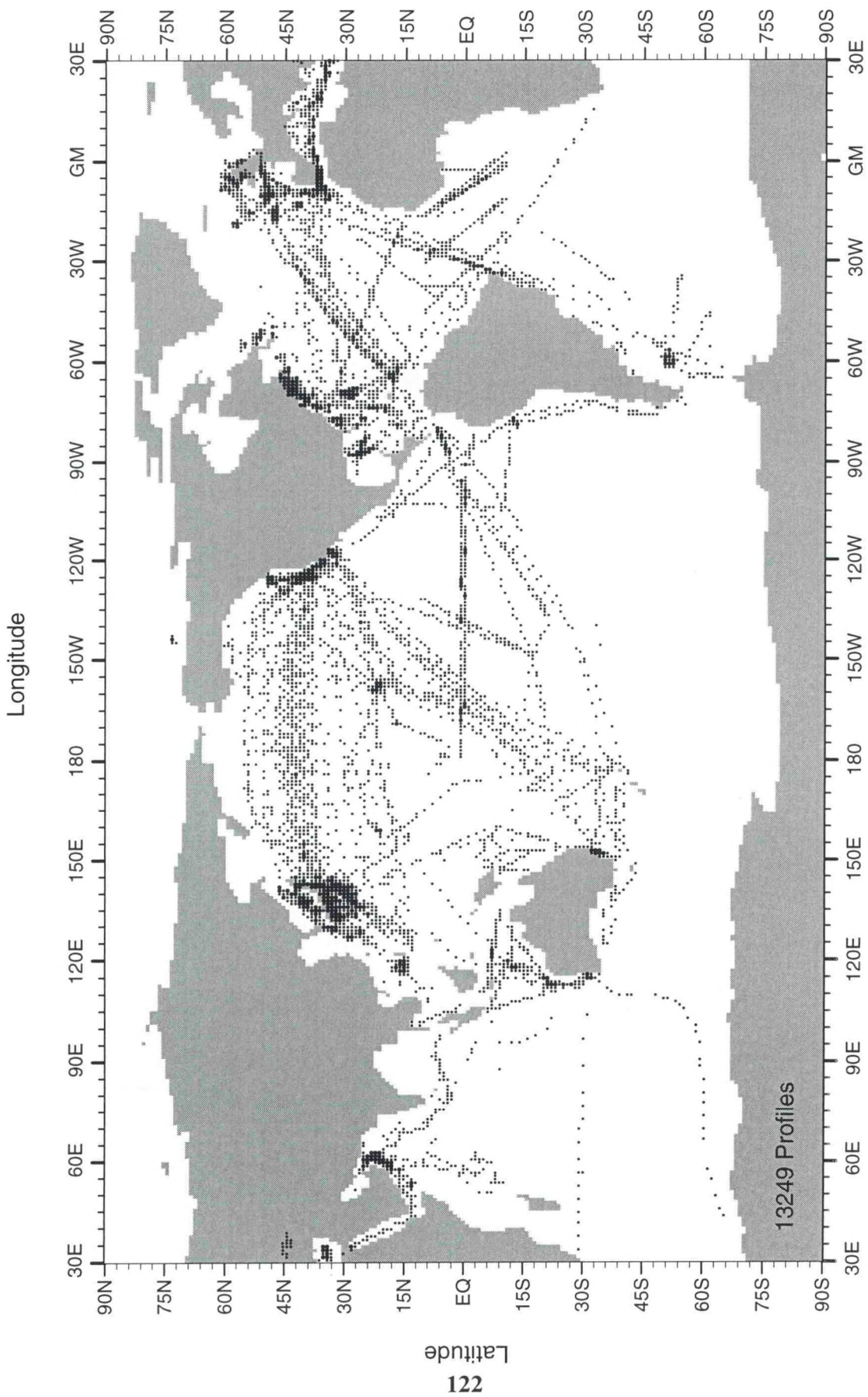


Fig. B76 WOD98 XBT profile distribution for October-December for 1984

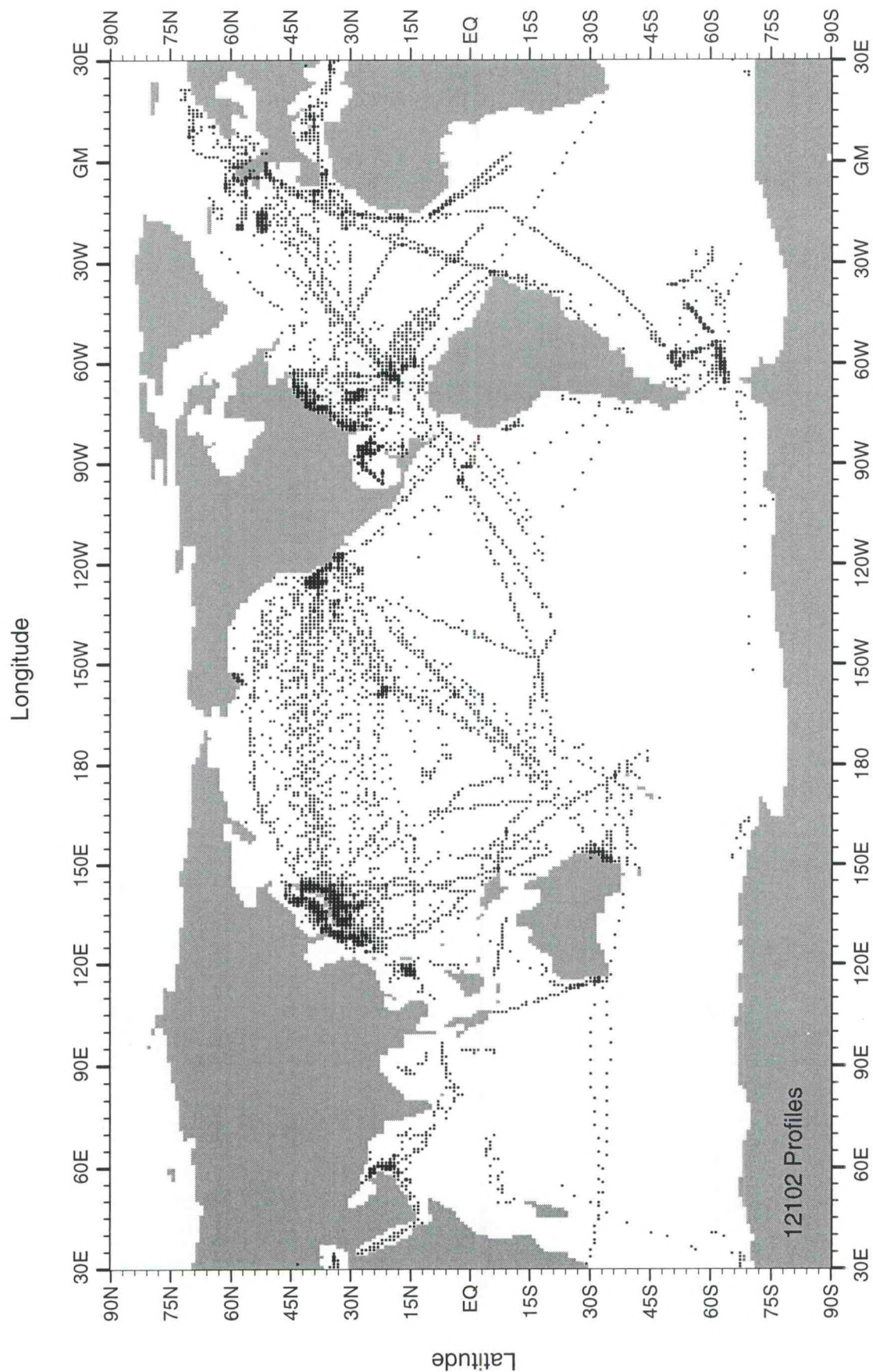


Fig. B77 WOD98 XBT profile distribution for January-March for 1985

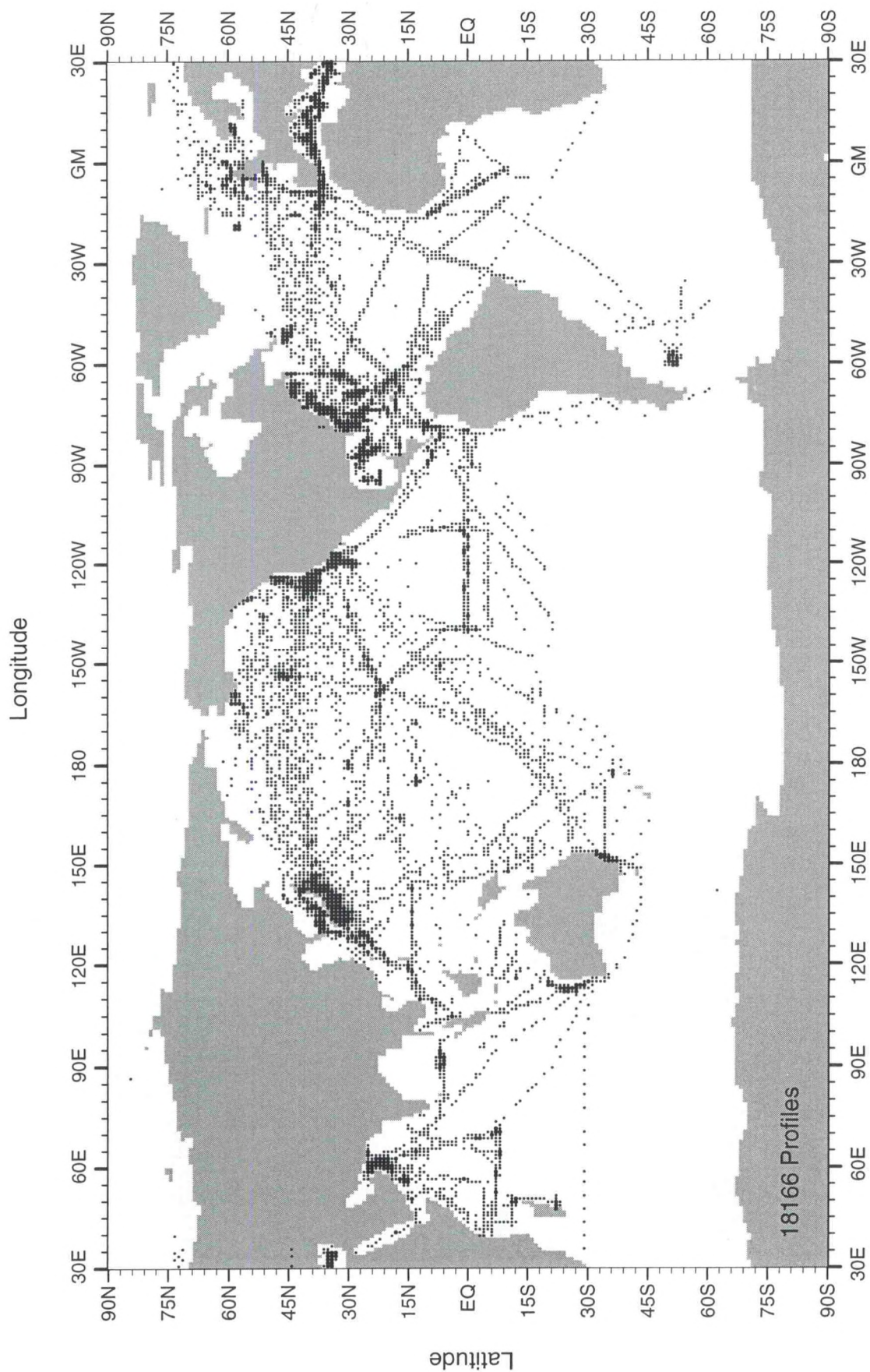


Fig. B78 WOD98 XBT profile distribution for April-June for 1985

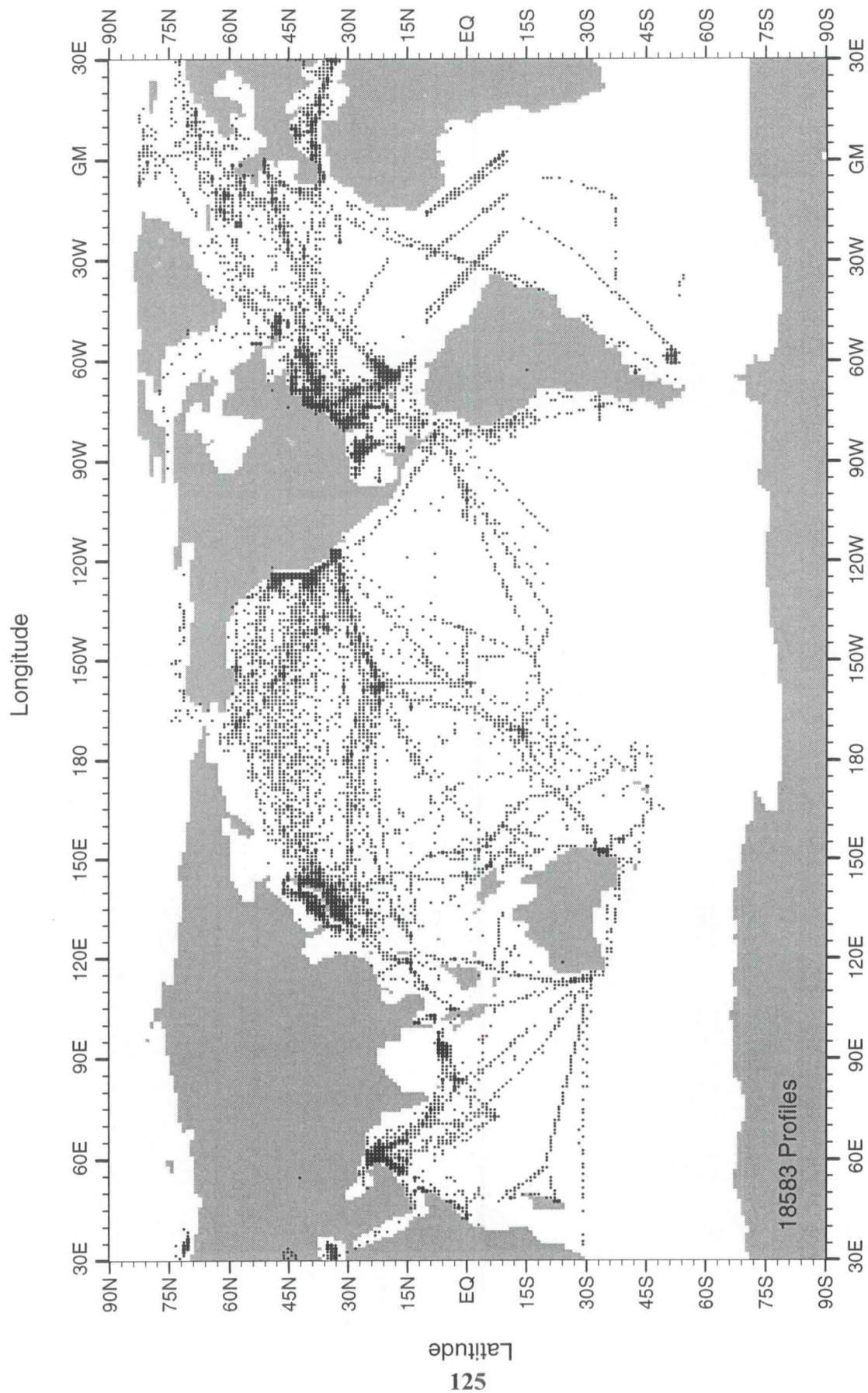


Fig. B79 WOD98 XBT profile distribution for July-September for 1985

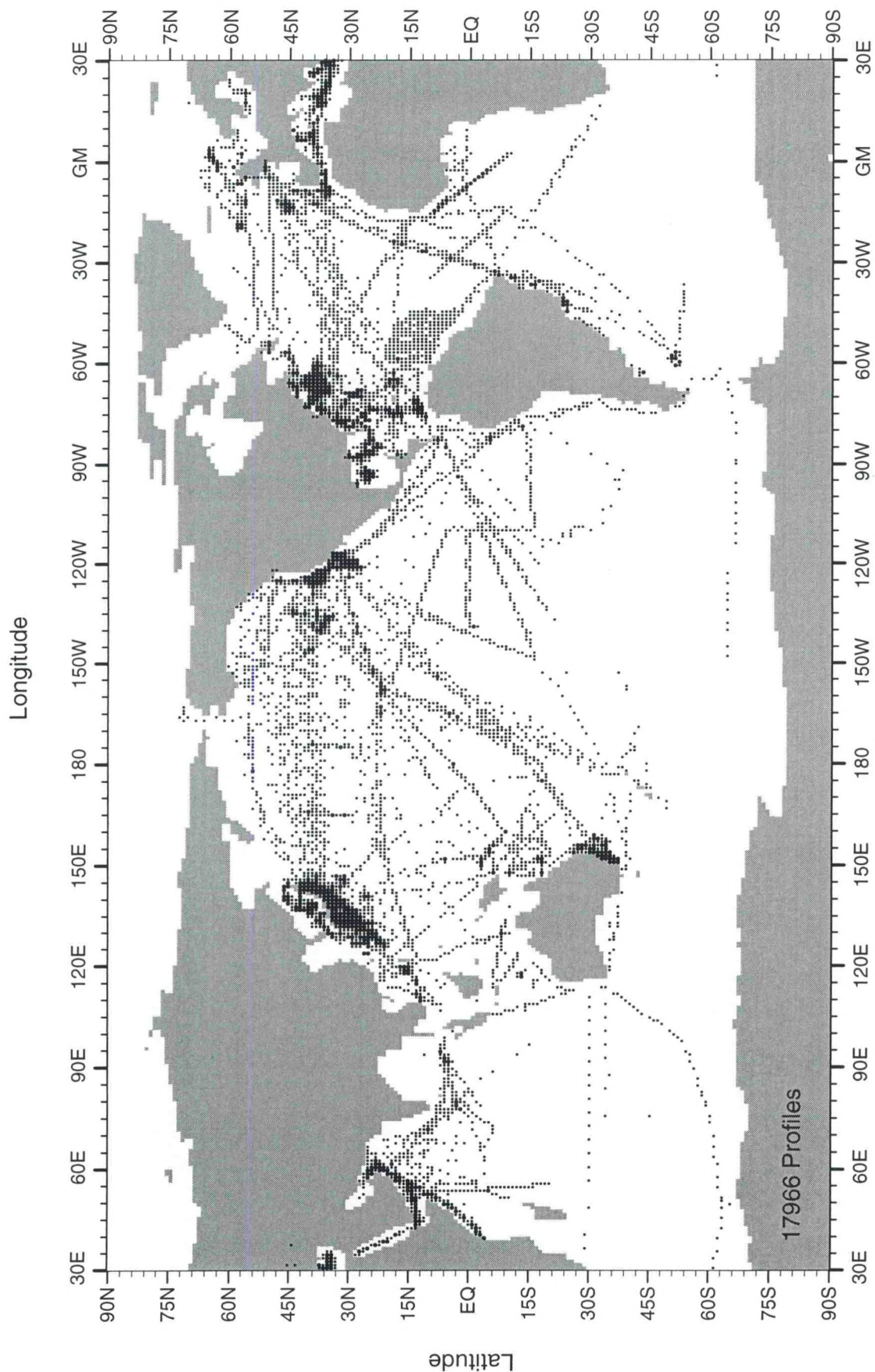


Fig. B80 WOD98 XBT profile distribution for October-December for 1985

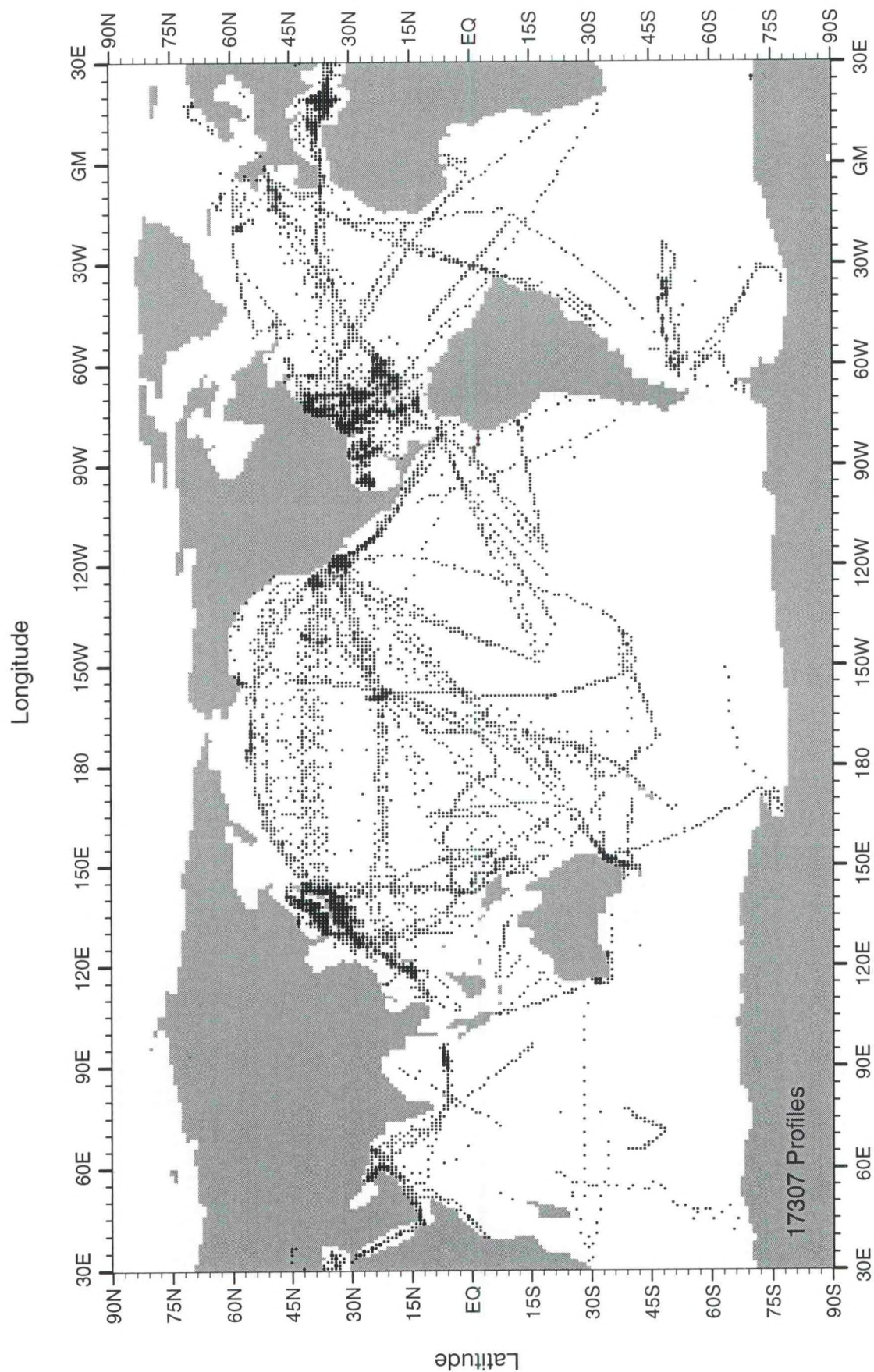


Fig. B81 WOD98 XBT profile distribution for January-March for 1986

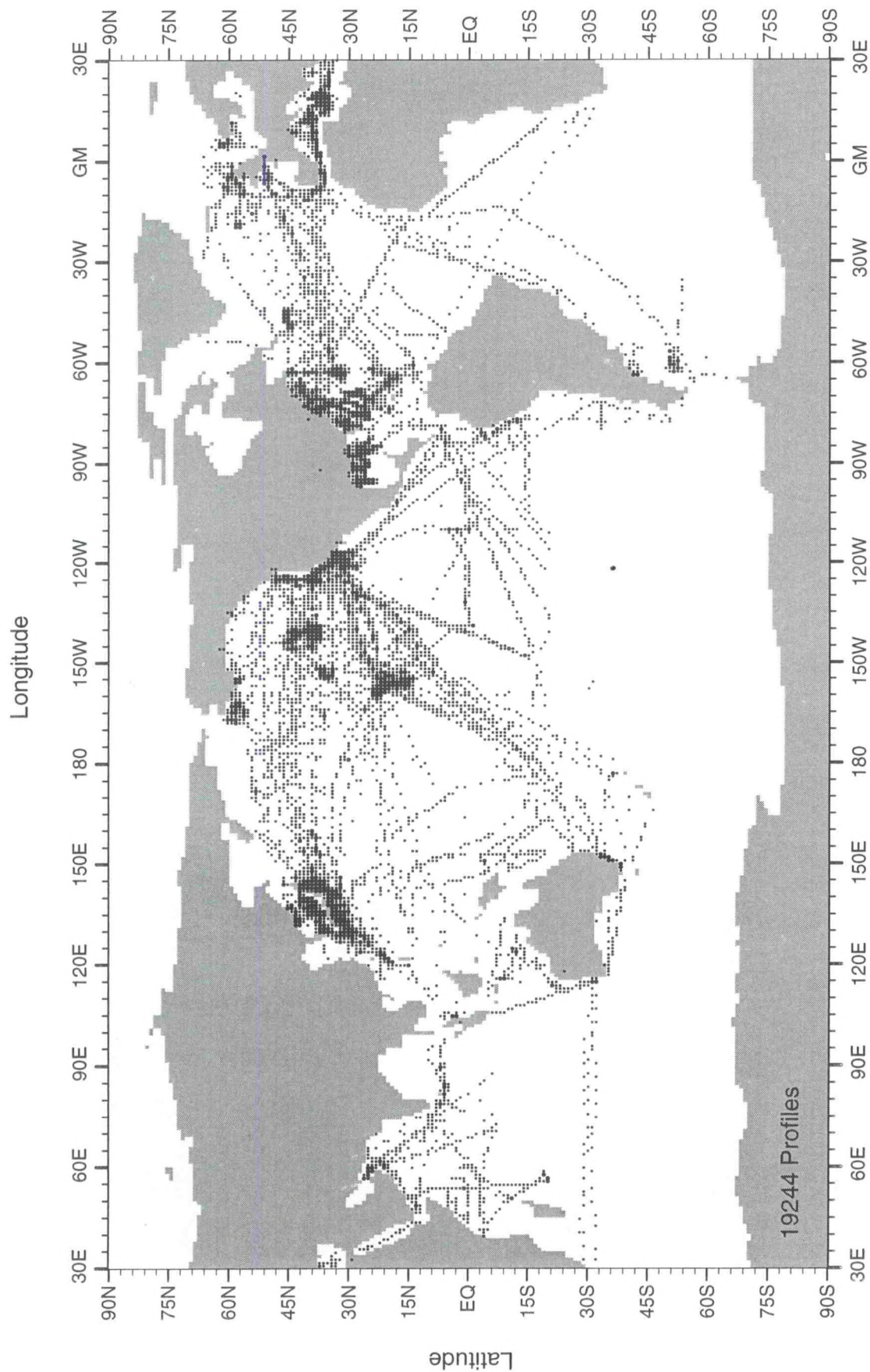


Fig. B82 WOD98 XBT profile distribution for April-June for 1986

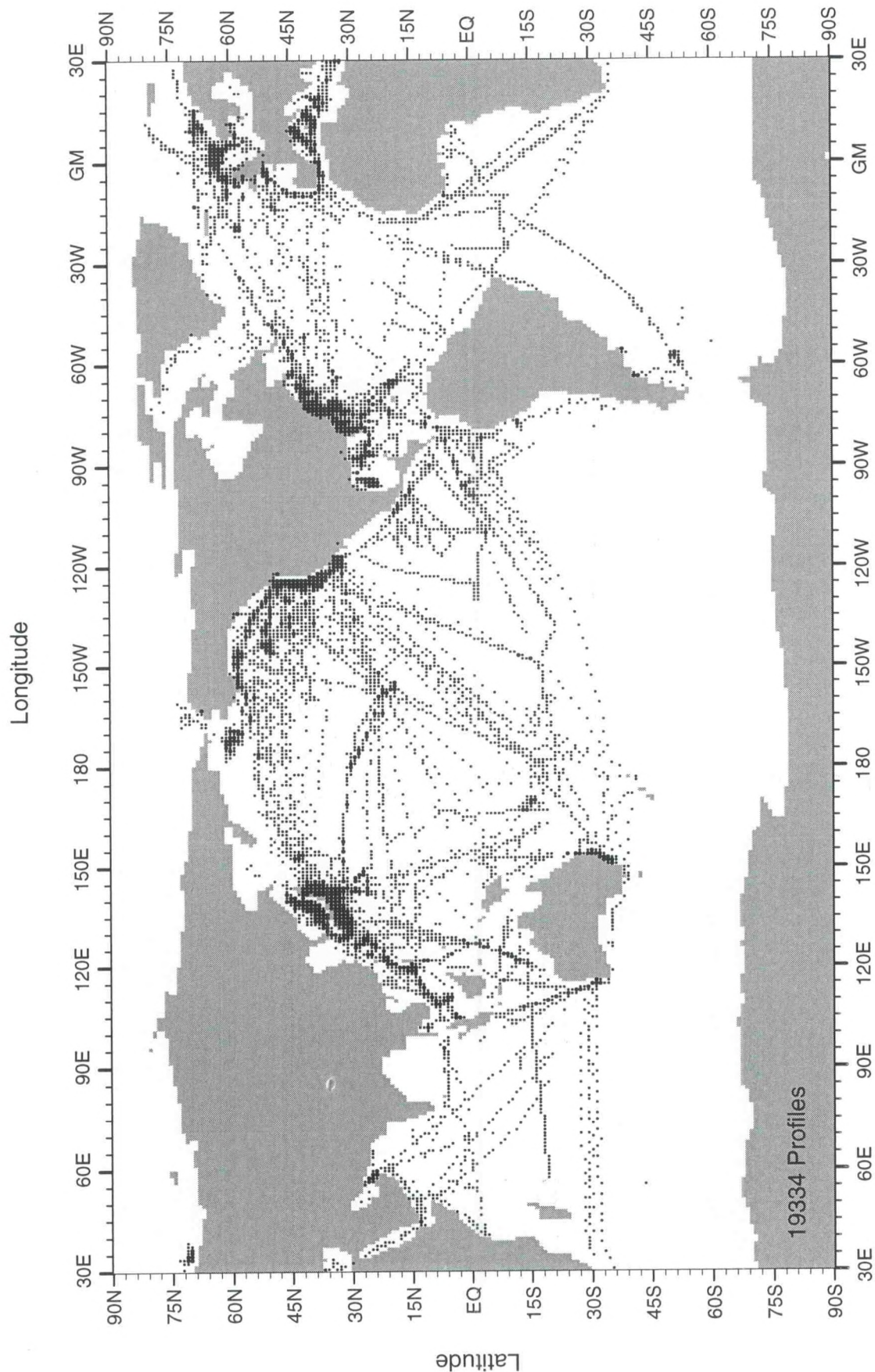


Fig. B83 WOD98 XBT profile distribution for July-September for 1986

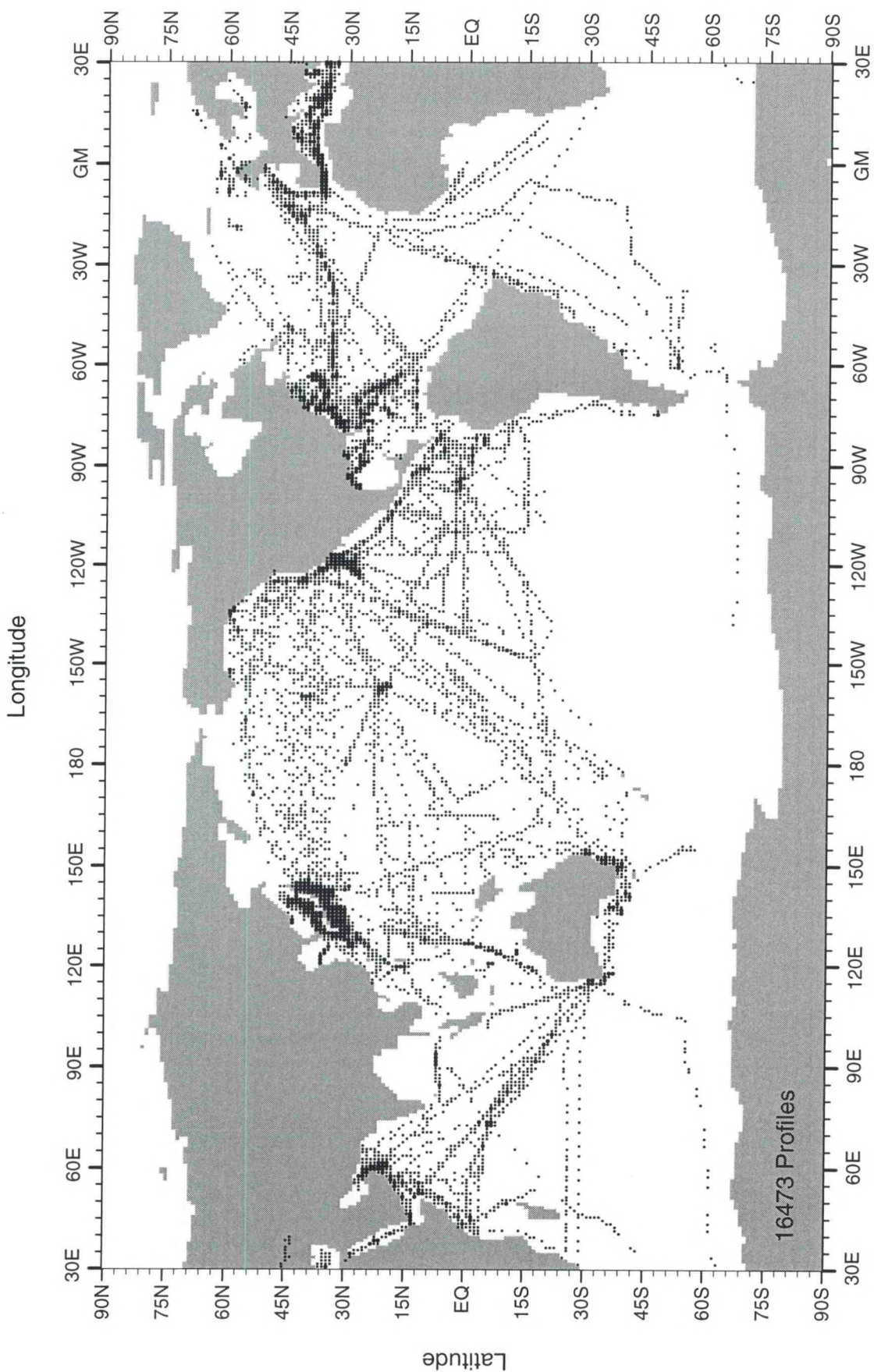


Fig. B84 WOD98 XBT profile distribution for October-December for 1986

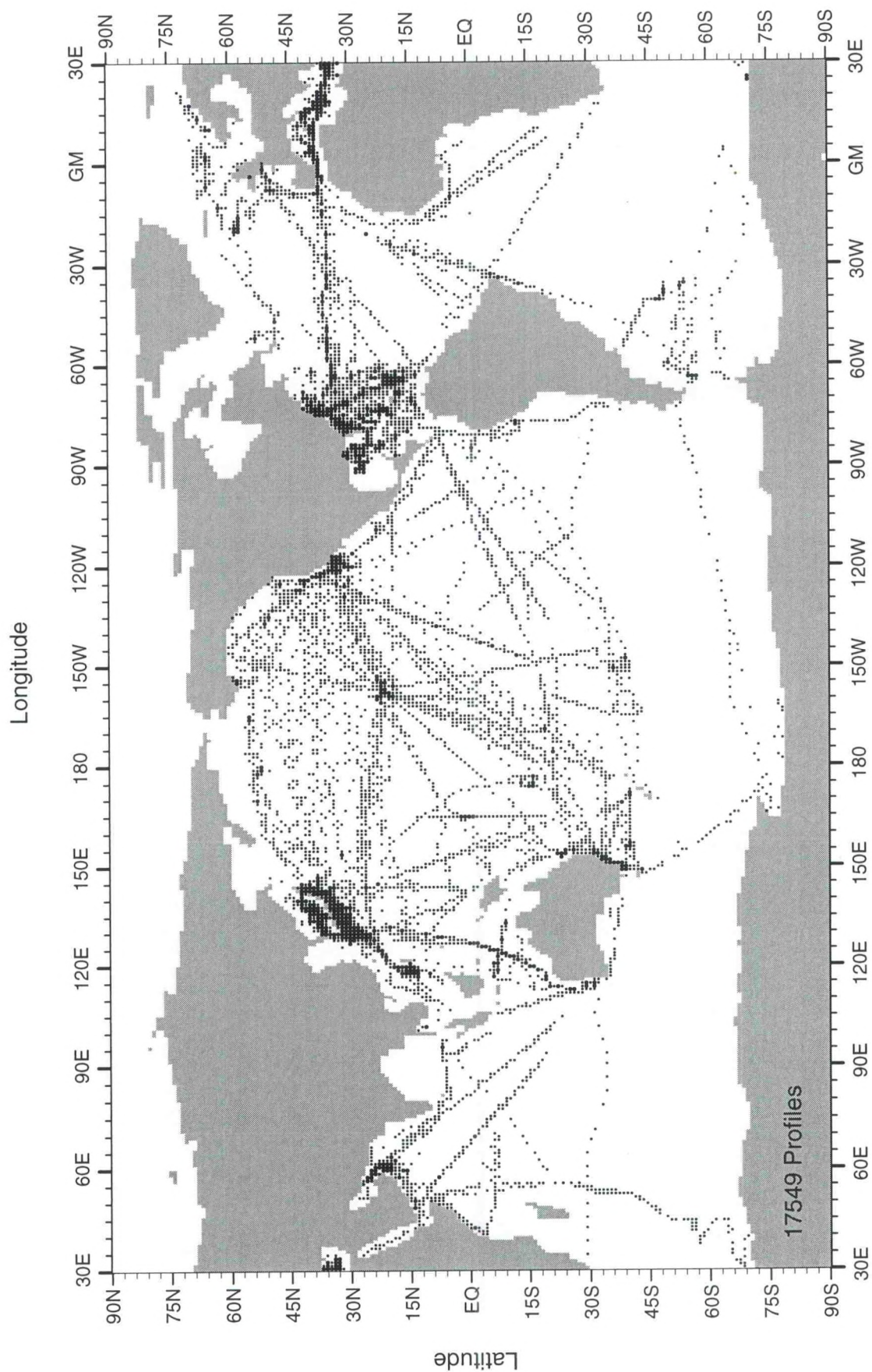
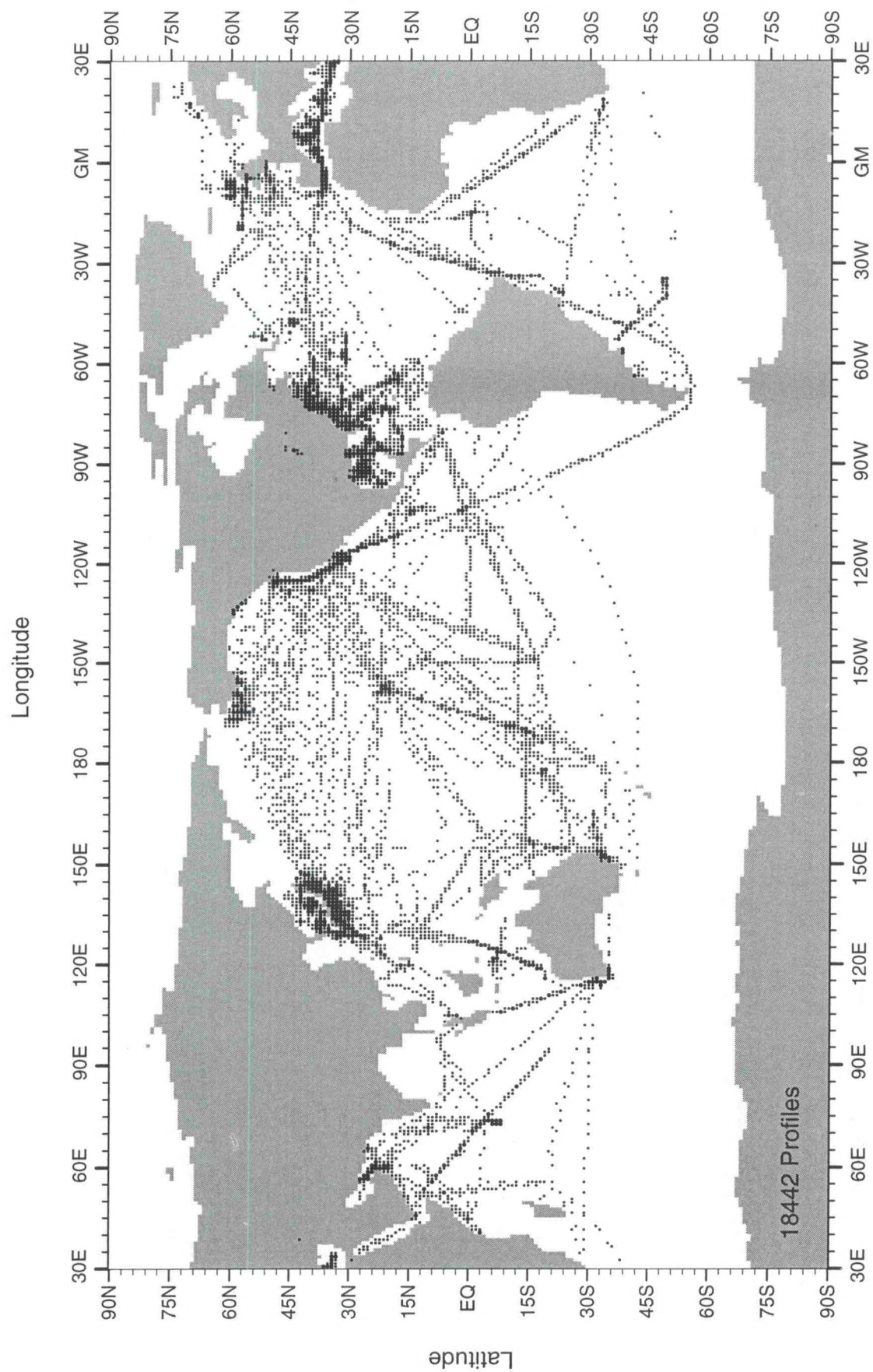


Fig. B85 WOD98 XBT profile distribution for January-March for 1987



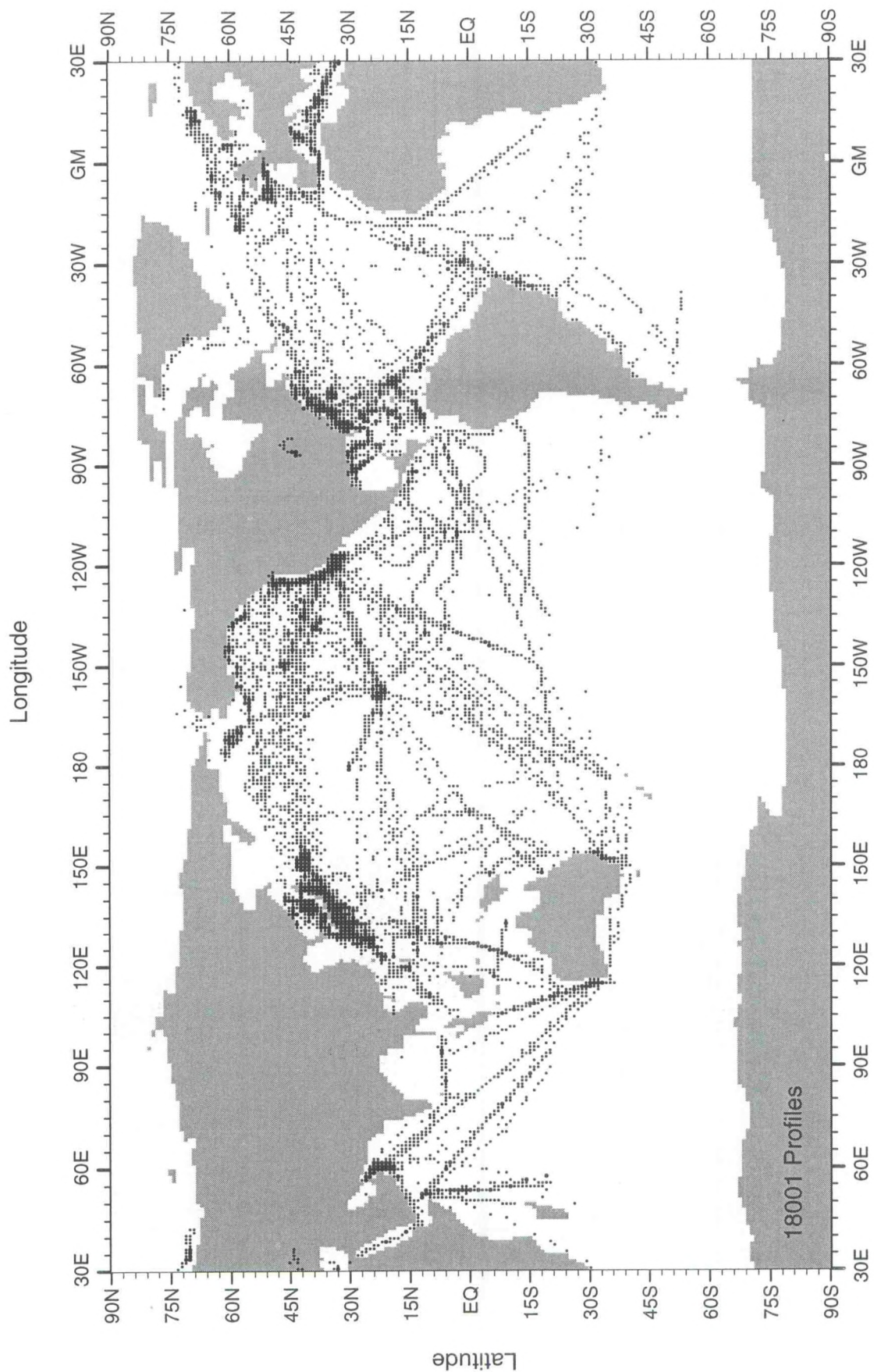


Fig. B87 WOD98 XBT profile distribution for July-September for 1987

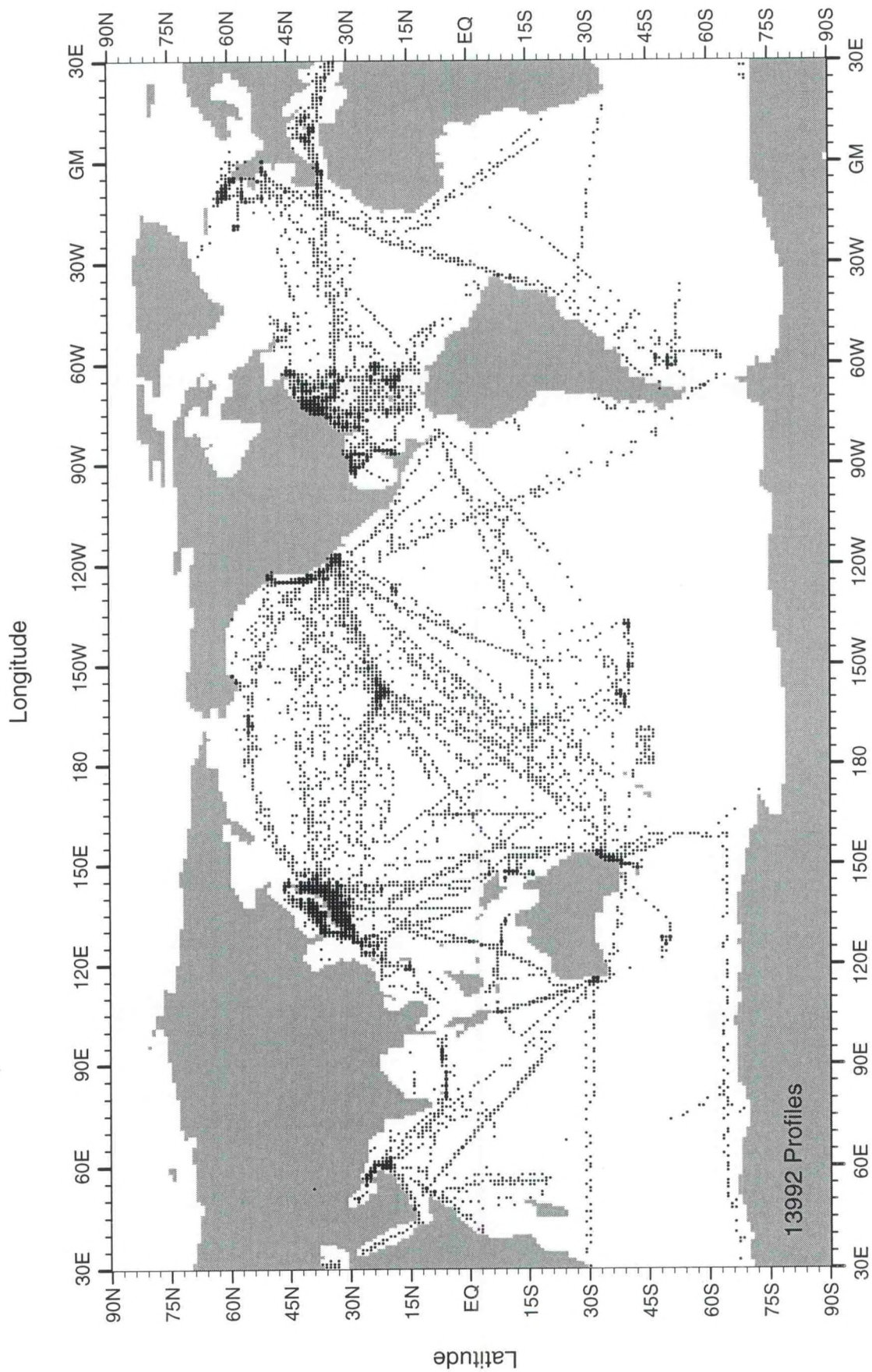


Fig. B89 WOD98 XBT profile distribution for January-March for 1988

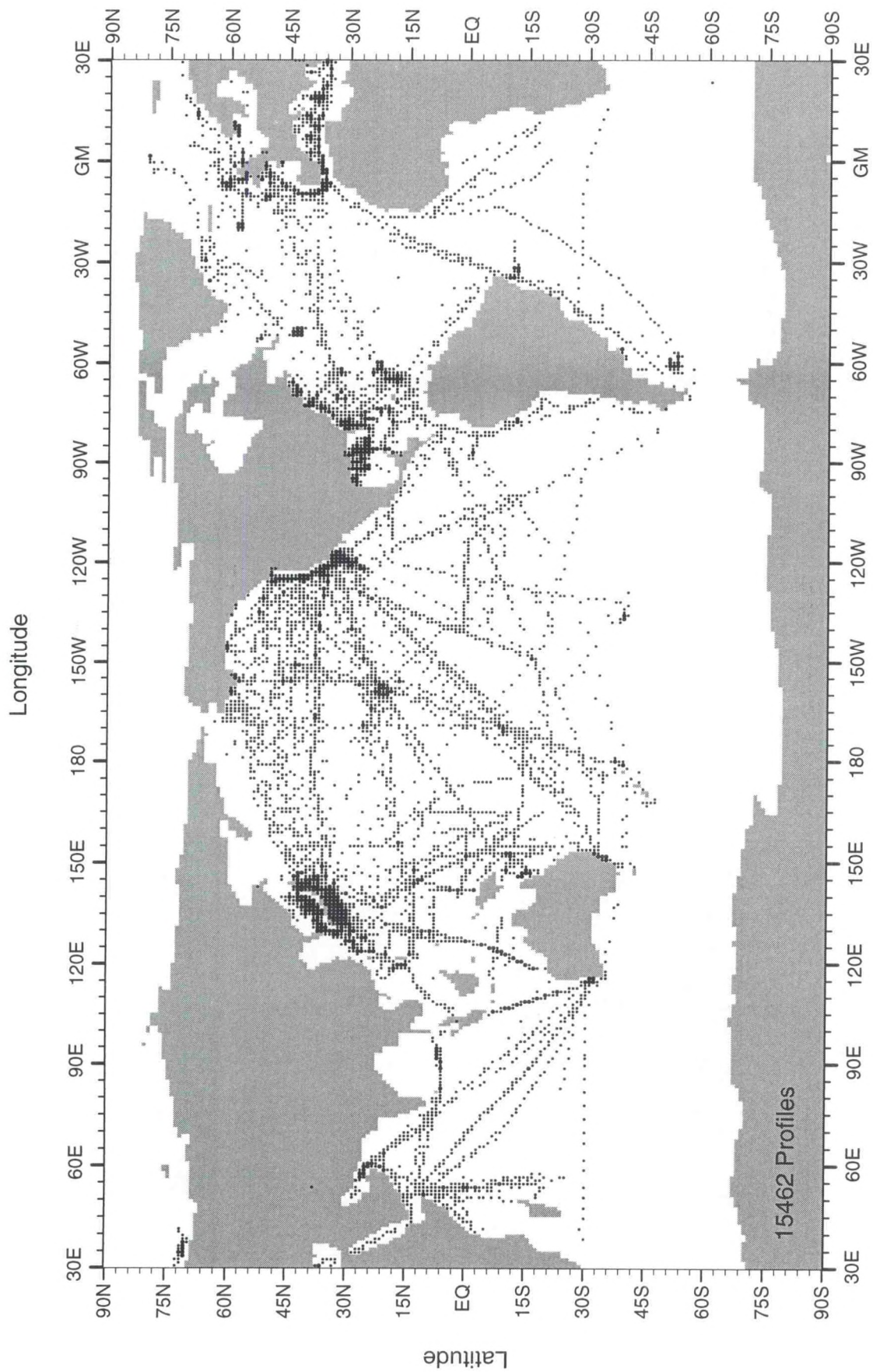


Fig. B90 WOD98 XBT profile distribution for April-June for 1988

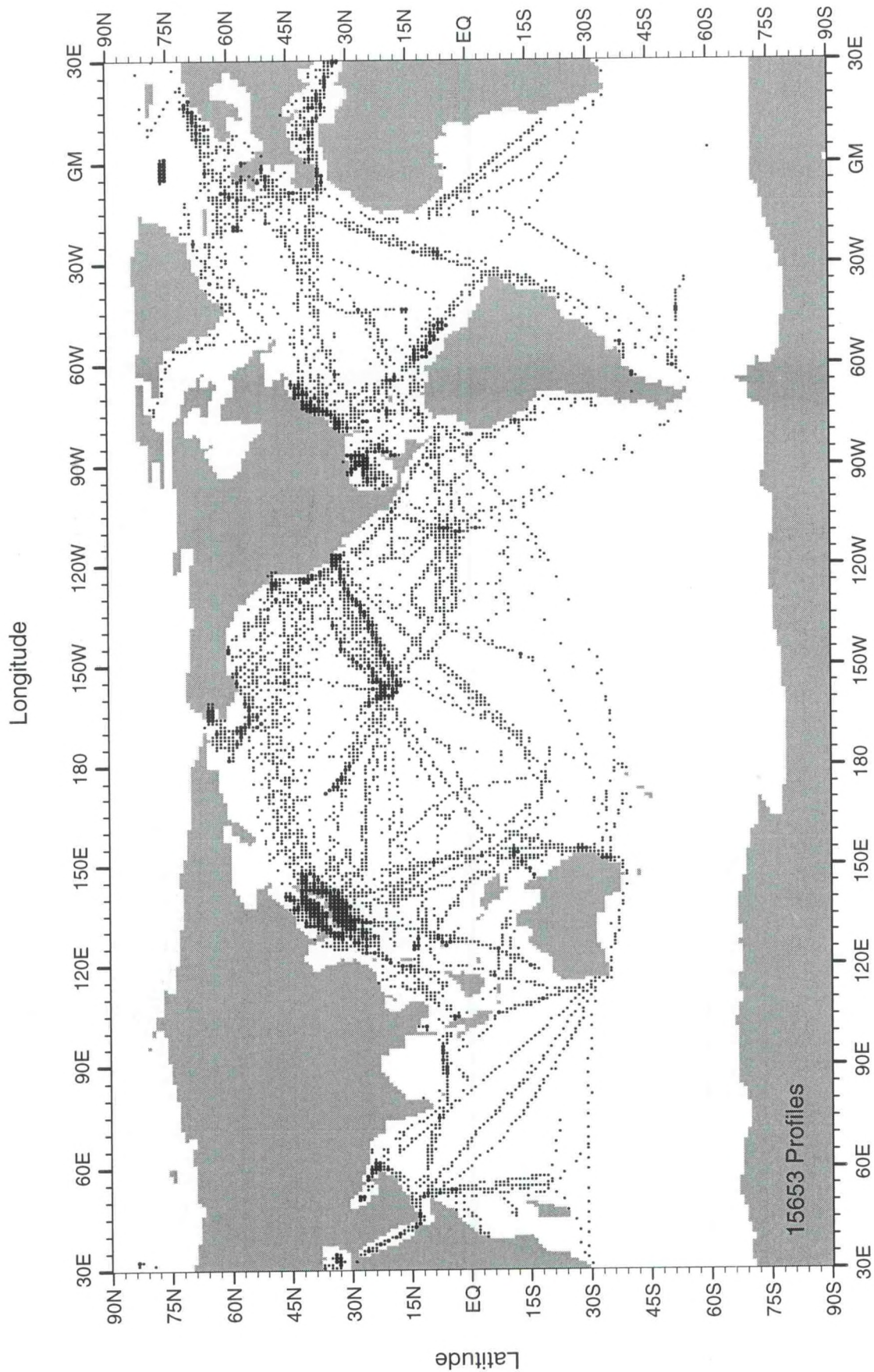


Fig. B91 WOD98 XBT profile distribution for July-September for 1988

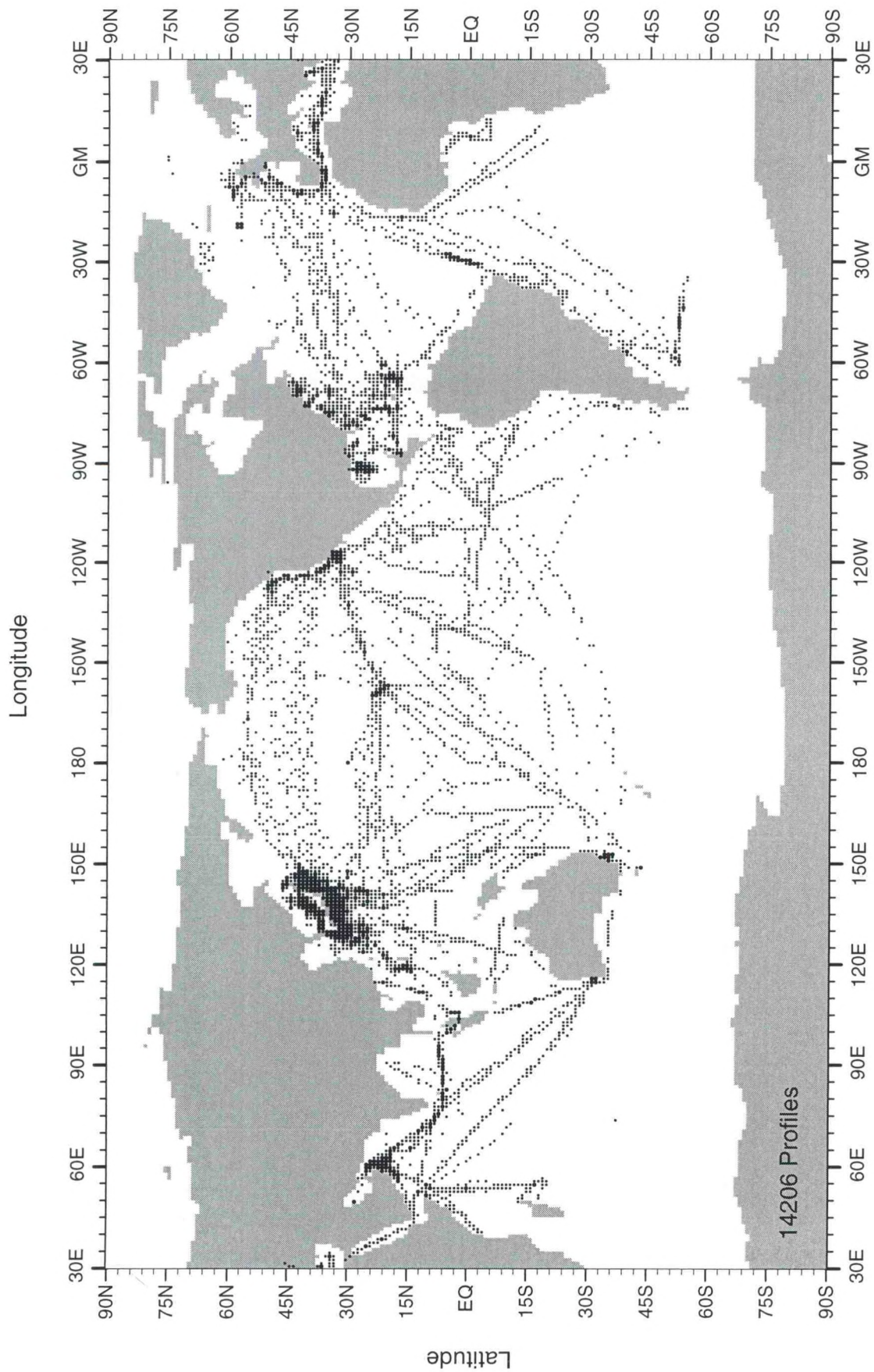


Fig. B92 WOD98 XBT profile distribution for October-December for 1988

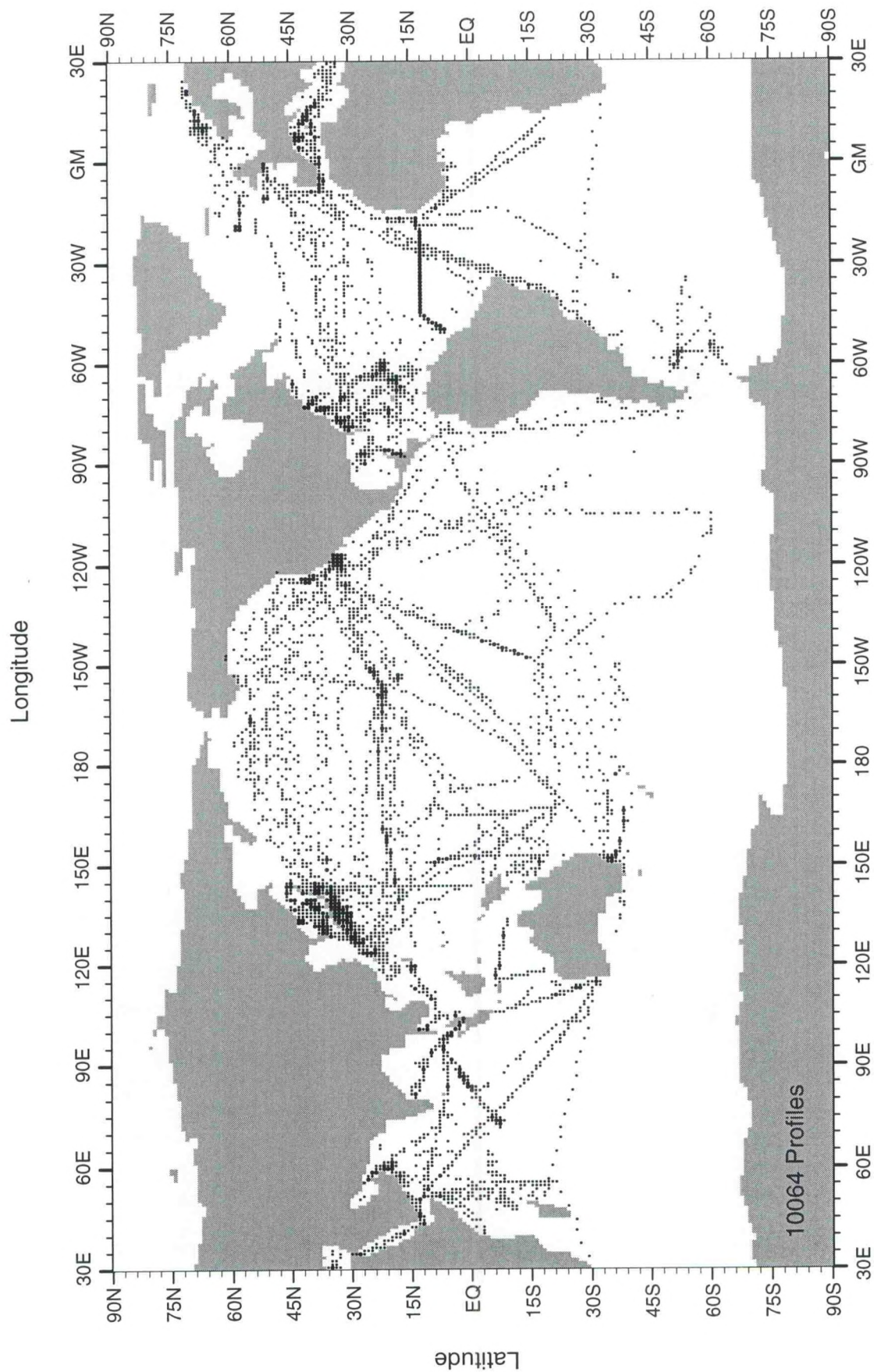


Fig. B93 WOD98 XBT profile distribution for January-March for 1989

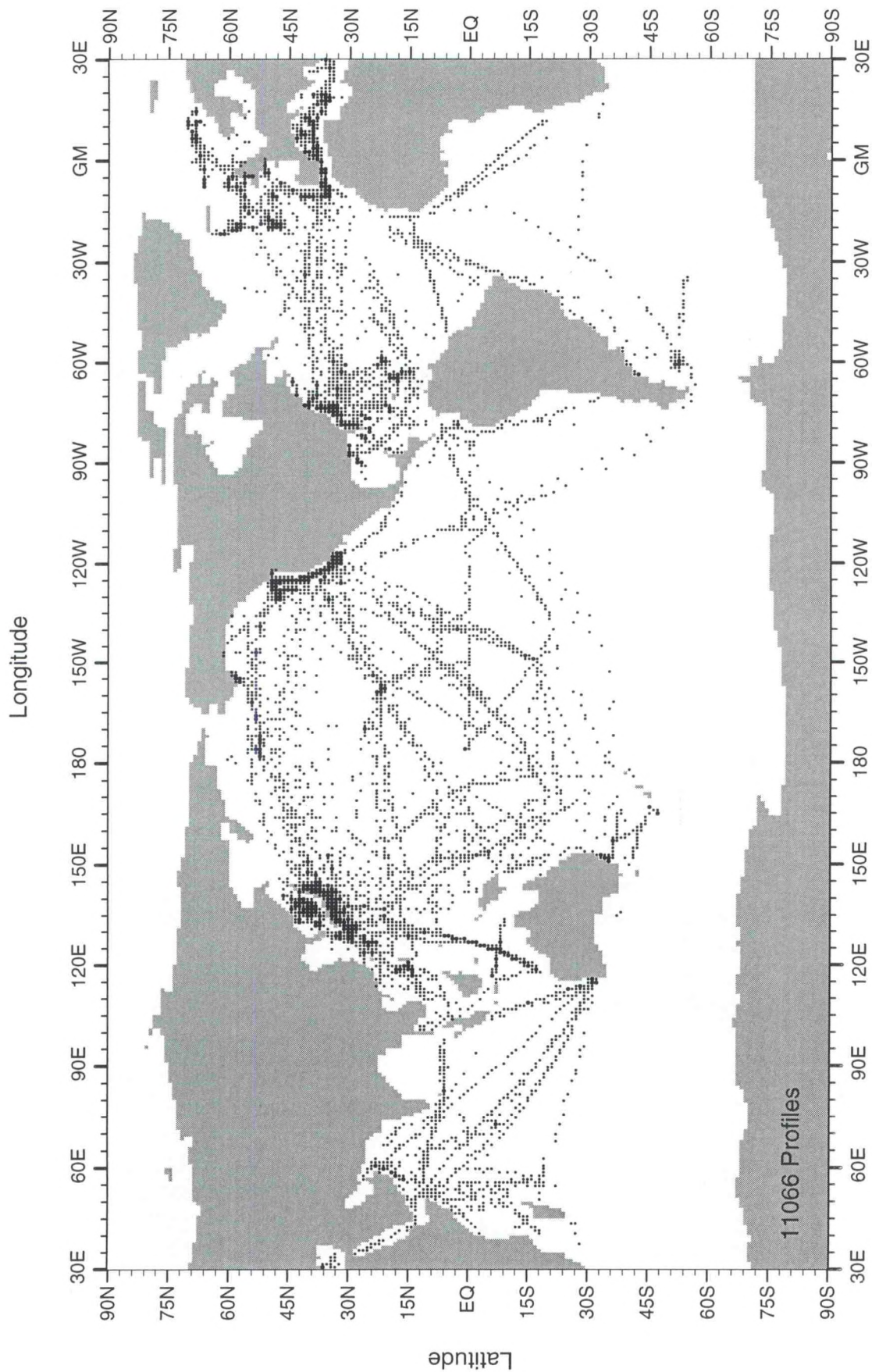


Fig. B94 WOD98 XBT profile distribution for April-June for 1989

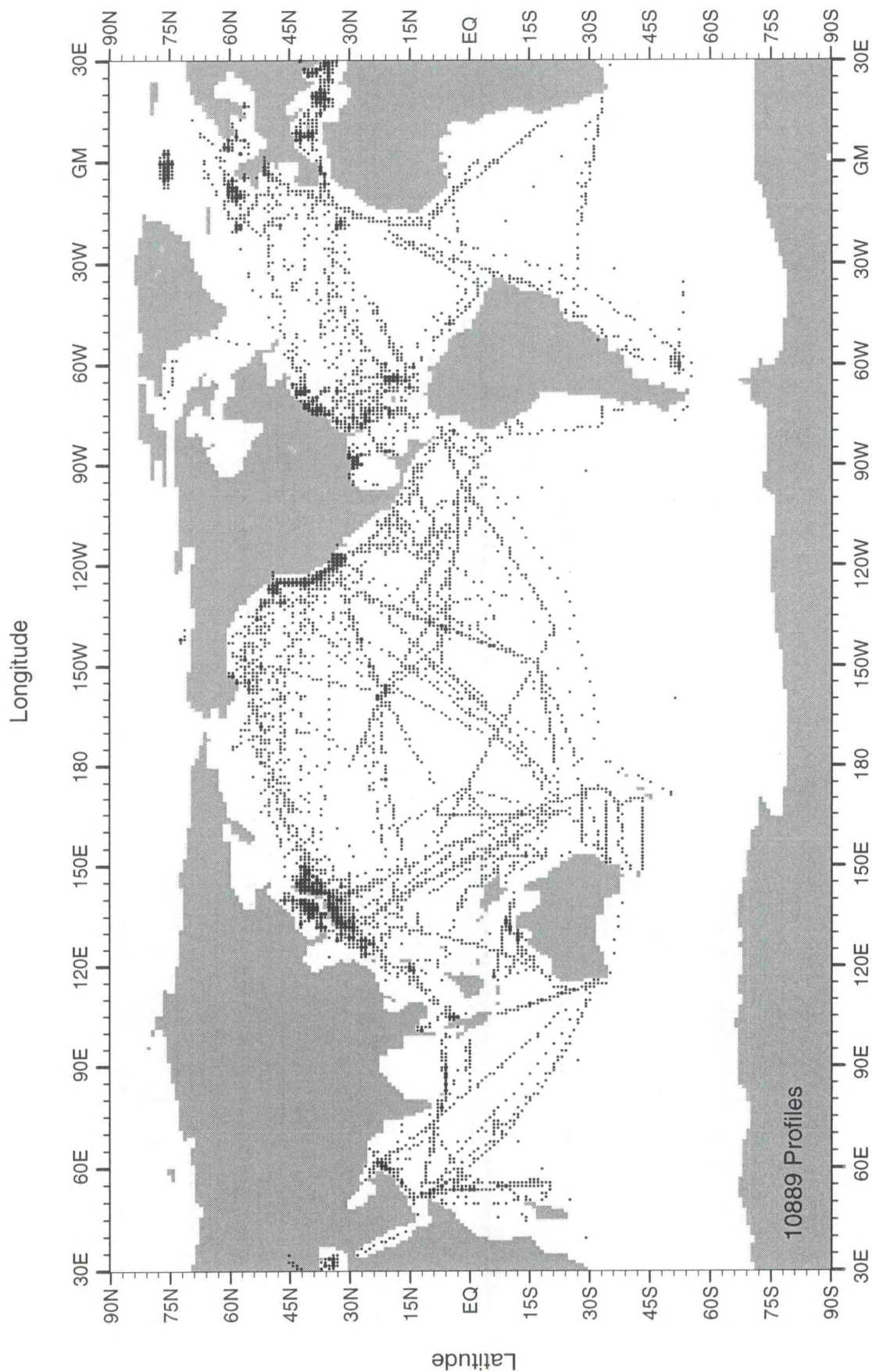


Fig. B95 WOD98 XBT profile distribution for July-September for 1989

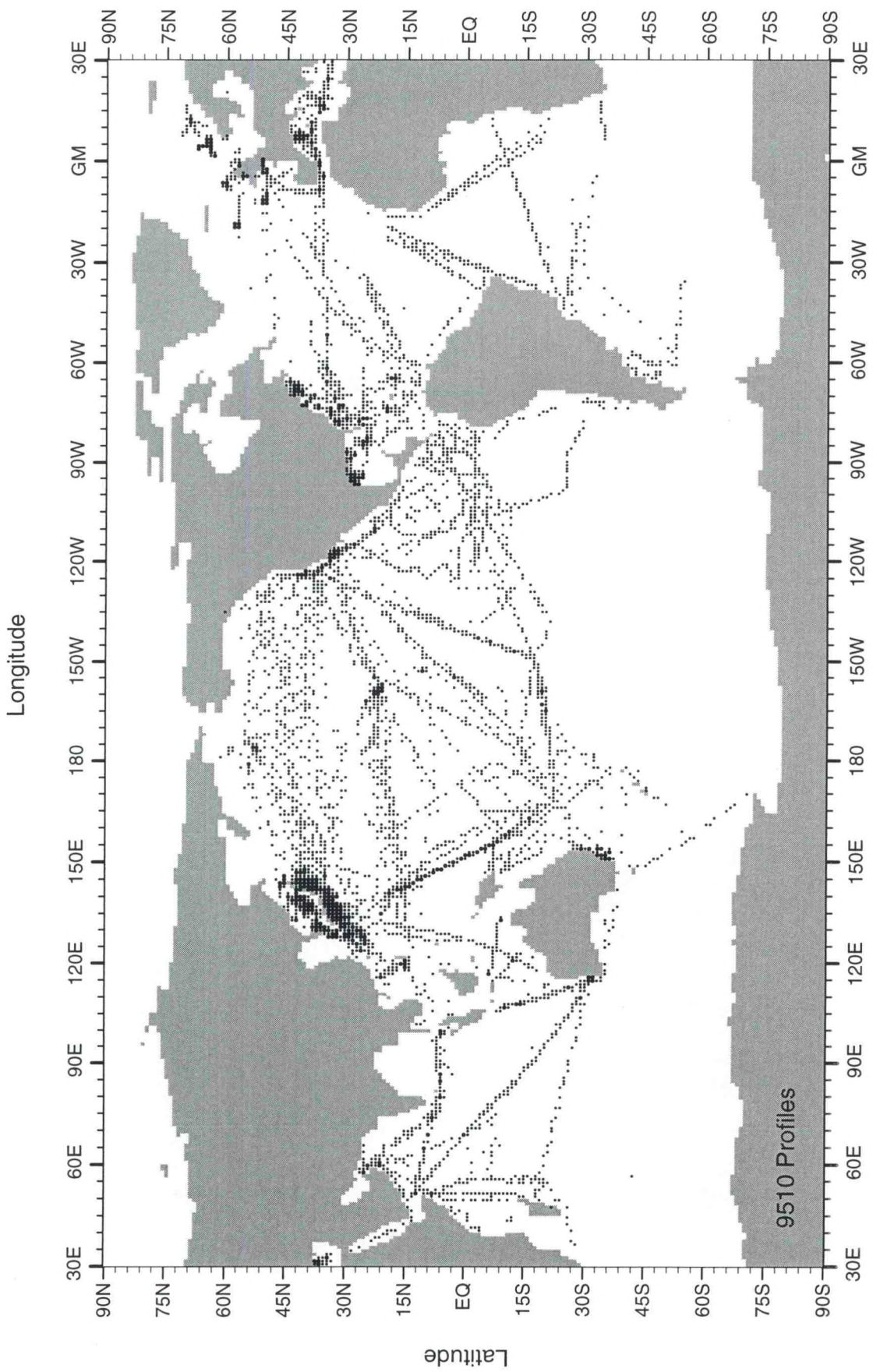


Fig. B96 WOD98 XBT profile distribution for October-December for 1989

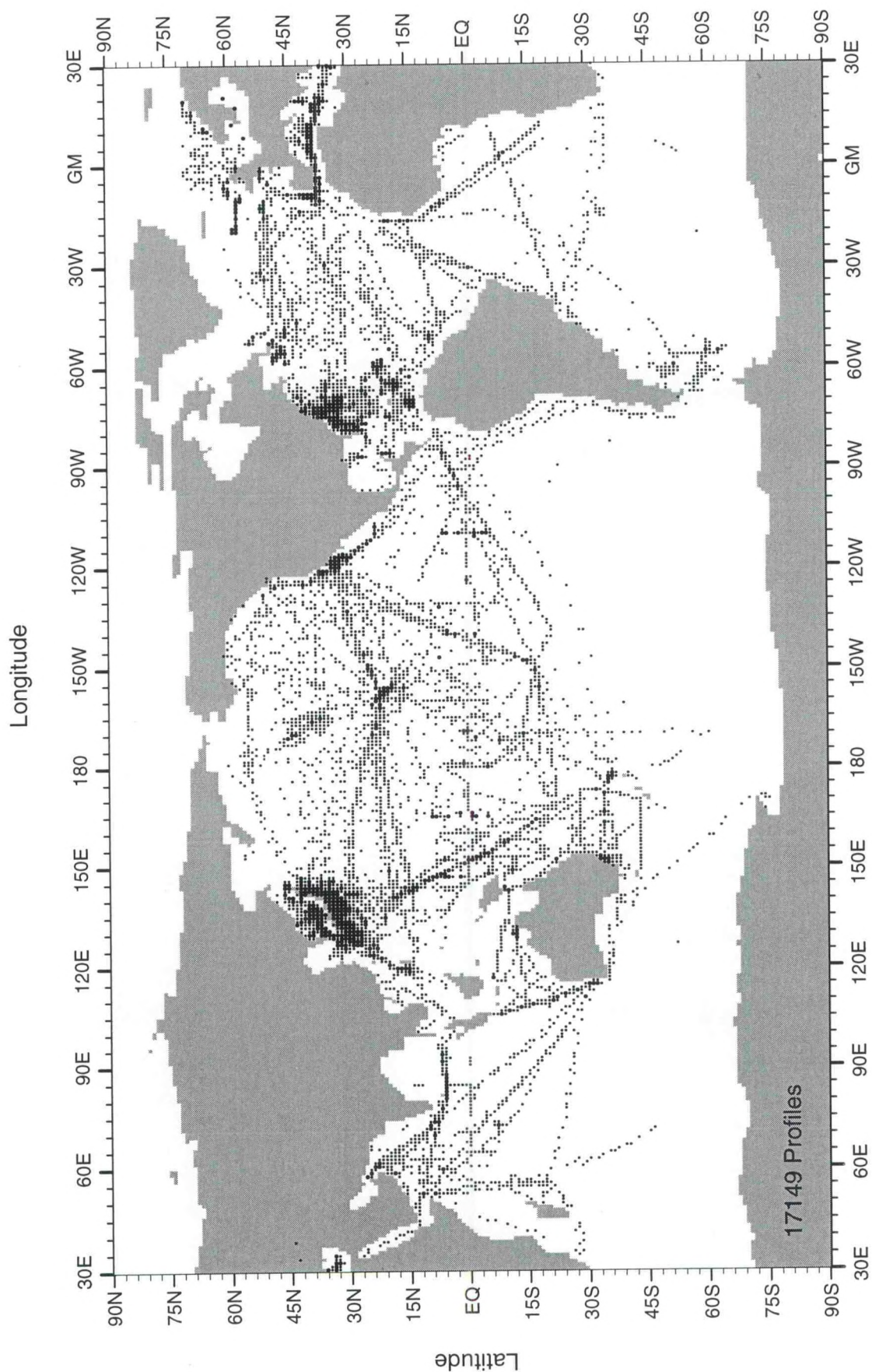


Fig. B97 WOD98 XBT and TAO profile distribution for January-March for 1990

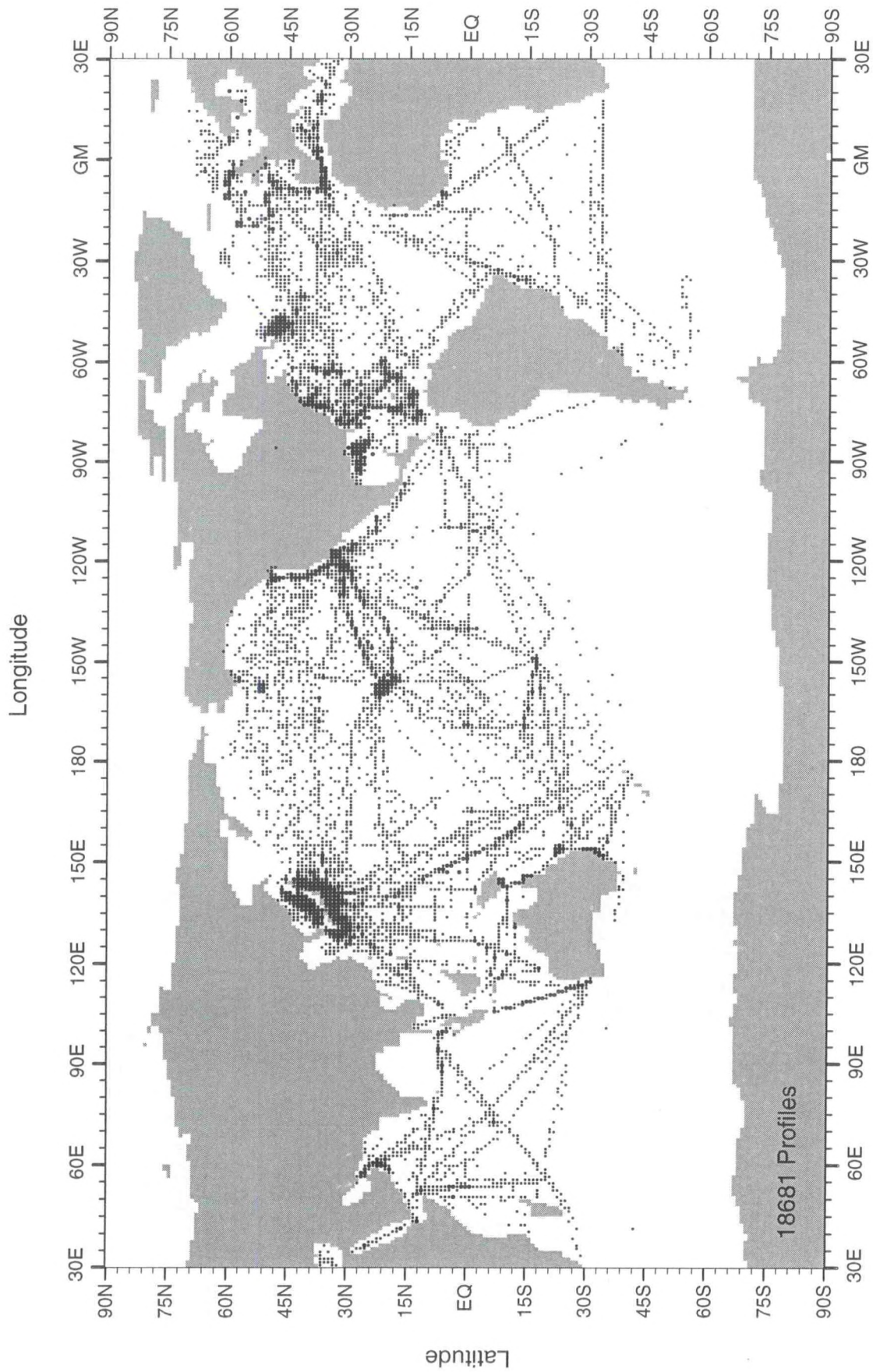


Fig. B98 WOD98 XBT and TAO profile distribution for April-June for 1990

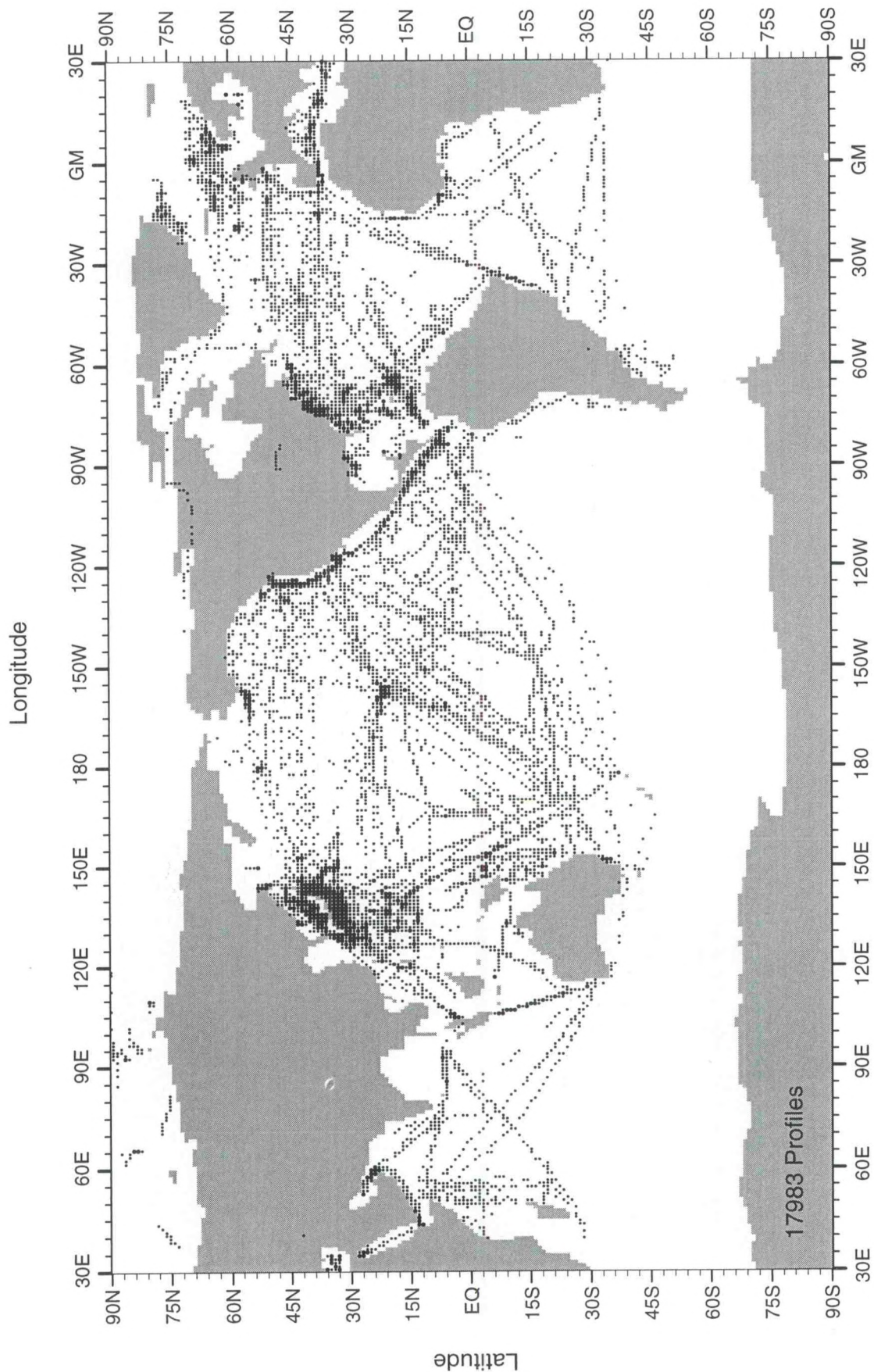


Fig. B99 WOD98 XBT and TAO profile distribution for July-September for 1990

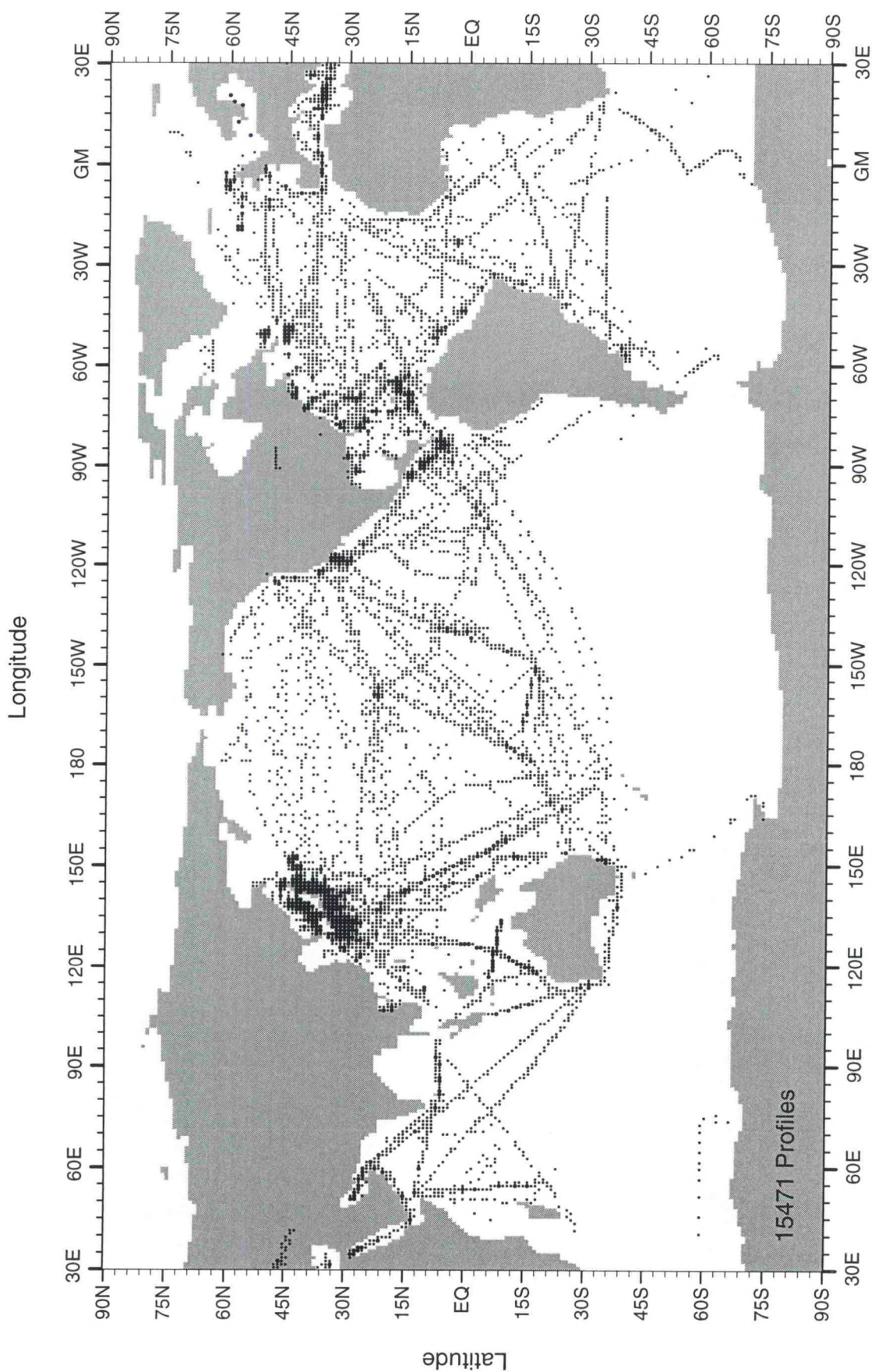


Fig. B100 WOD98 XBT and TAO profile distribution for October-December for 1990

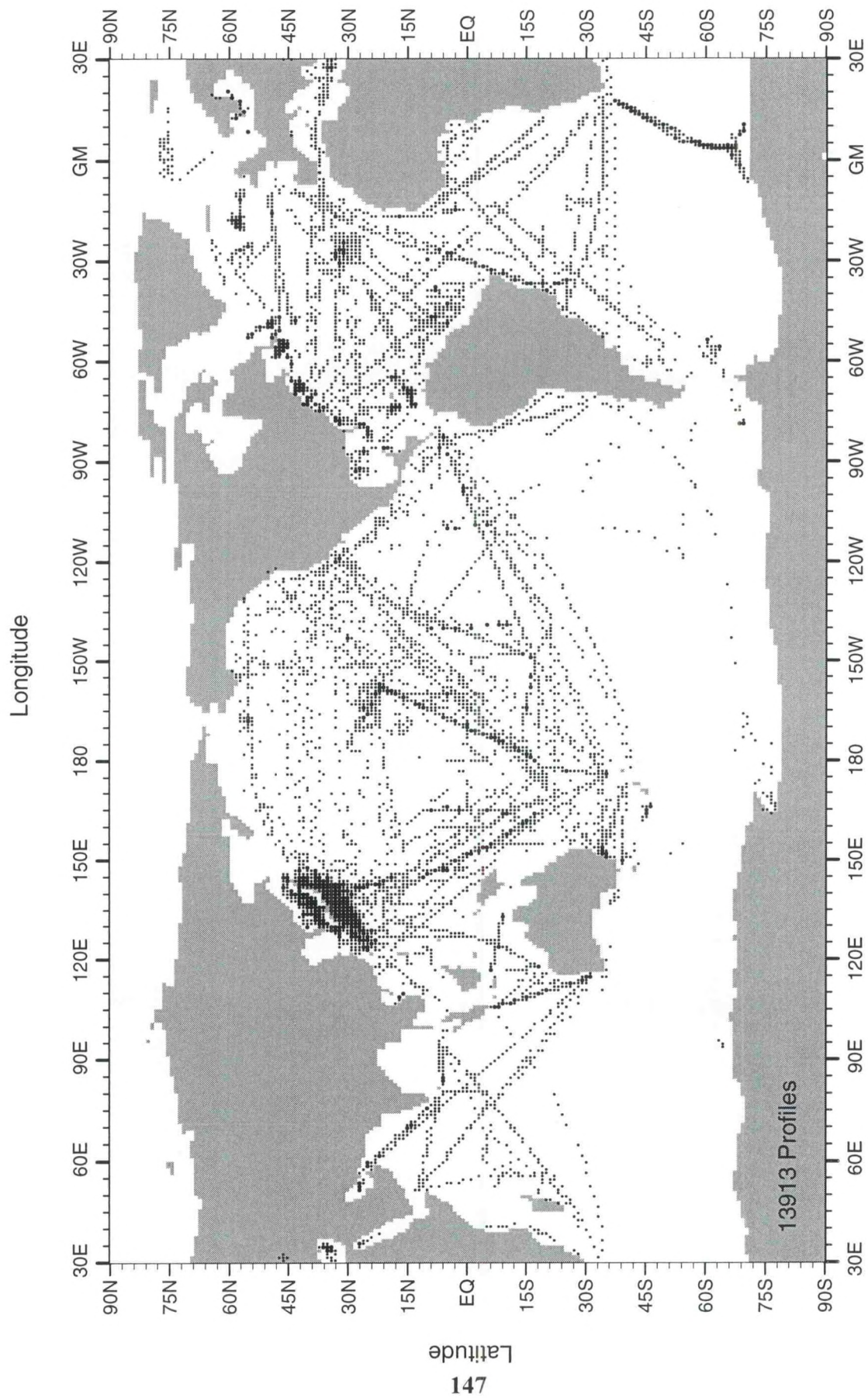


Fig. B101 WOD98 XBT and TAO profile distribution for January-March for 1991

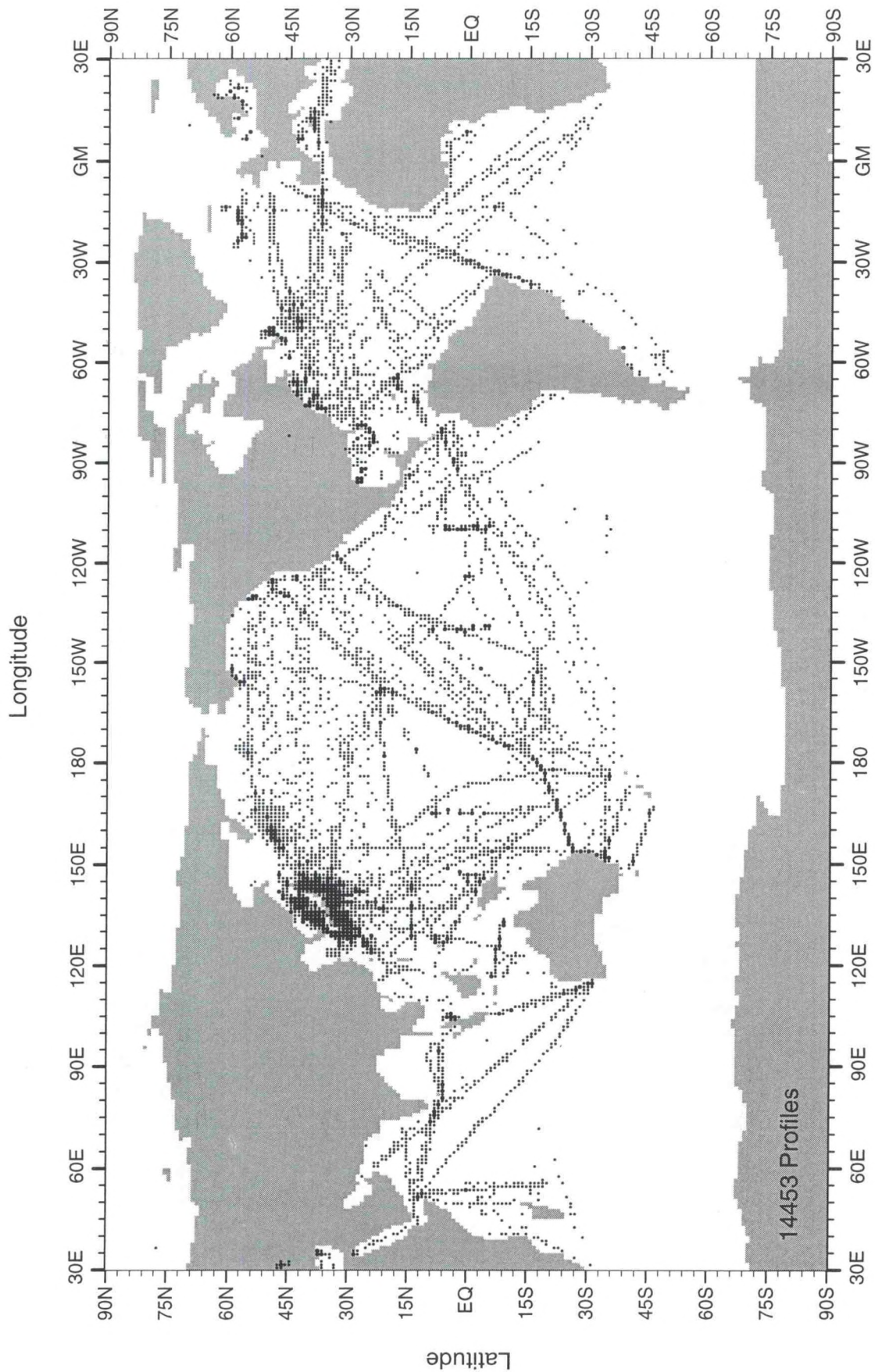


Fig. B102 WOD98 XBT and TAO profile distribution for April-June for 1991

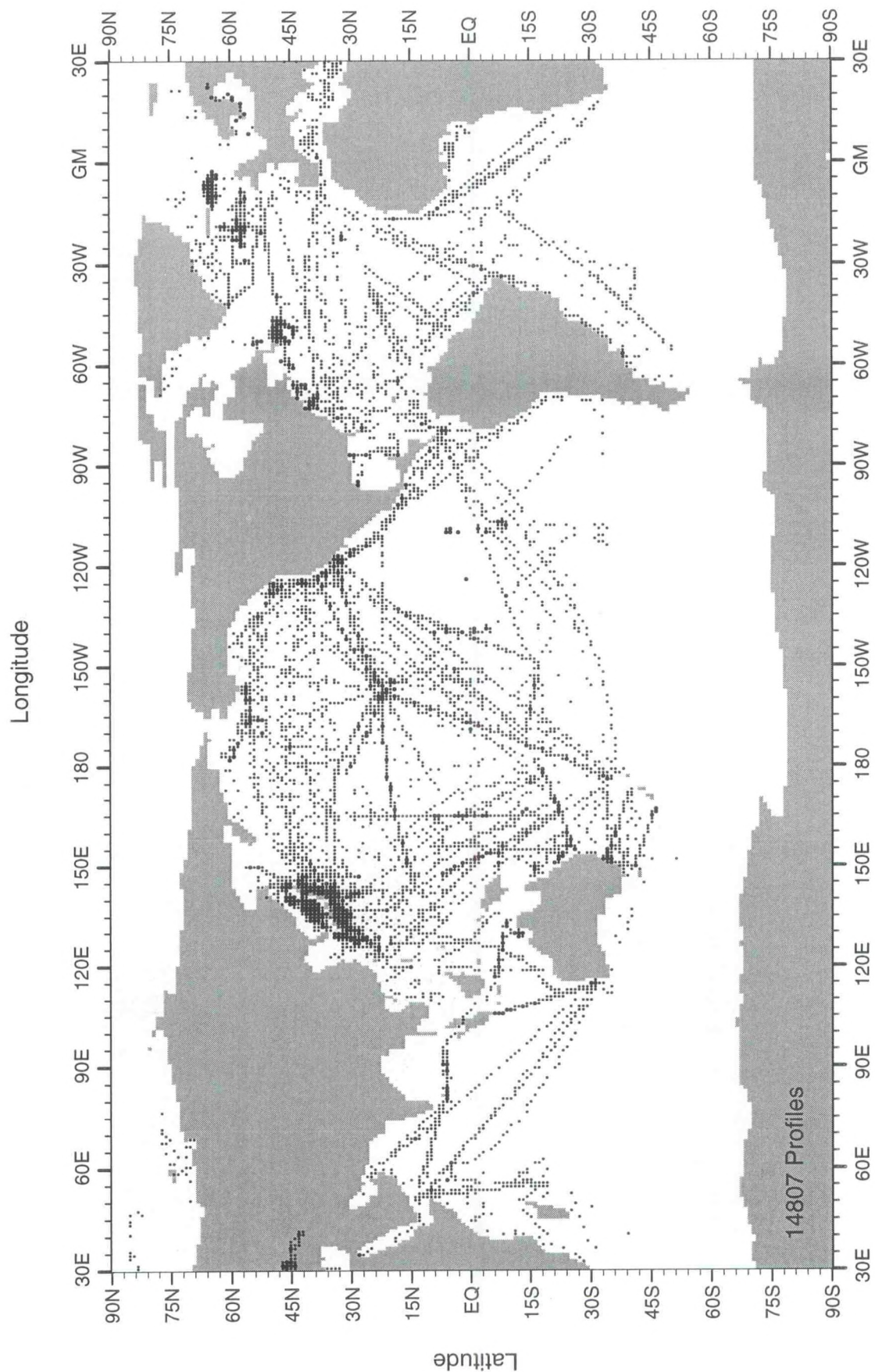


Fig. B103 WOD98 XBT and TAO profile distribution for July-September for 1991

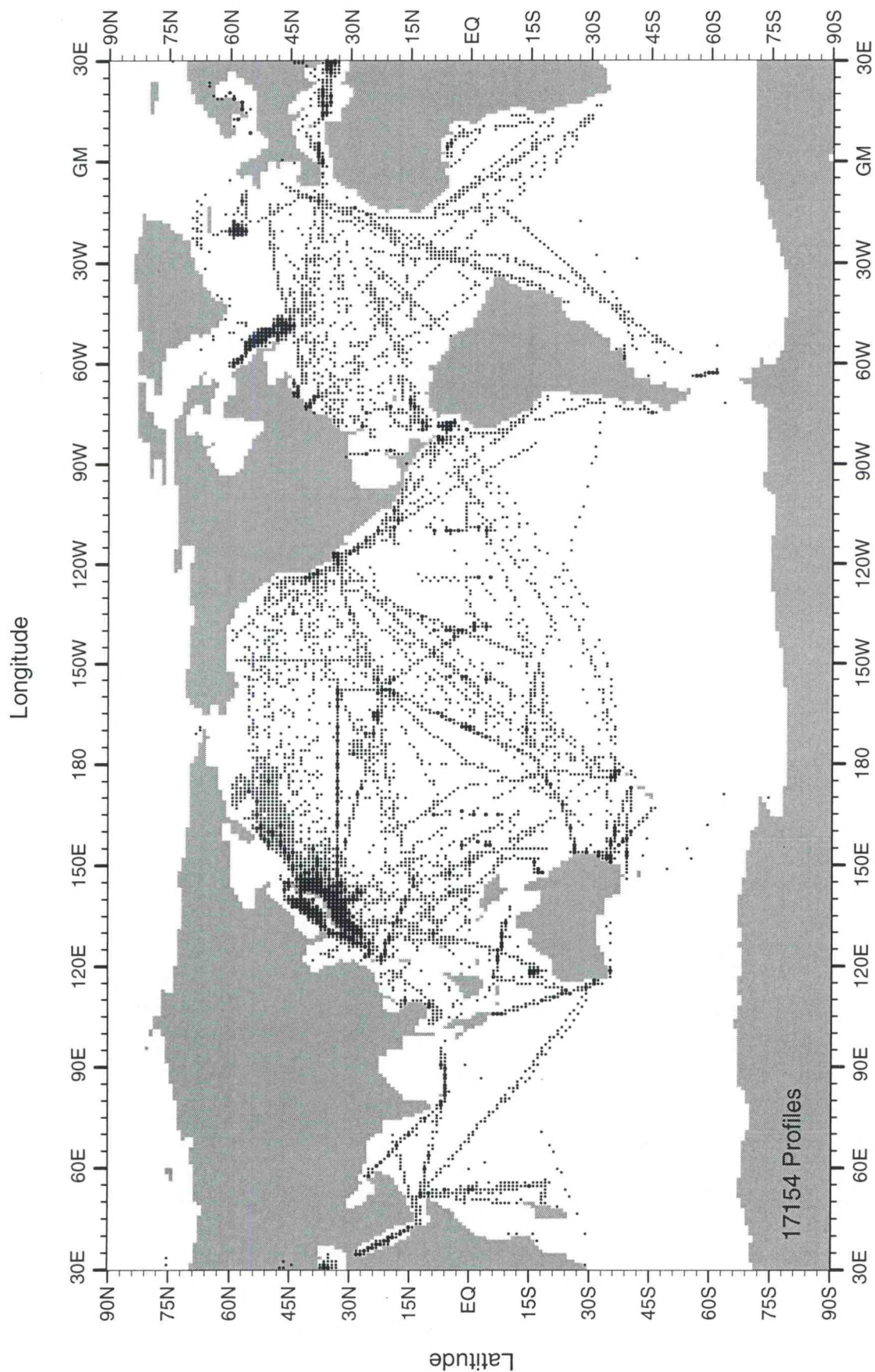


Fig. B104 WOD98 XBT and TAO profile distribution for October-December for 1991

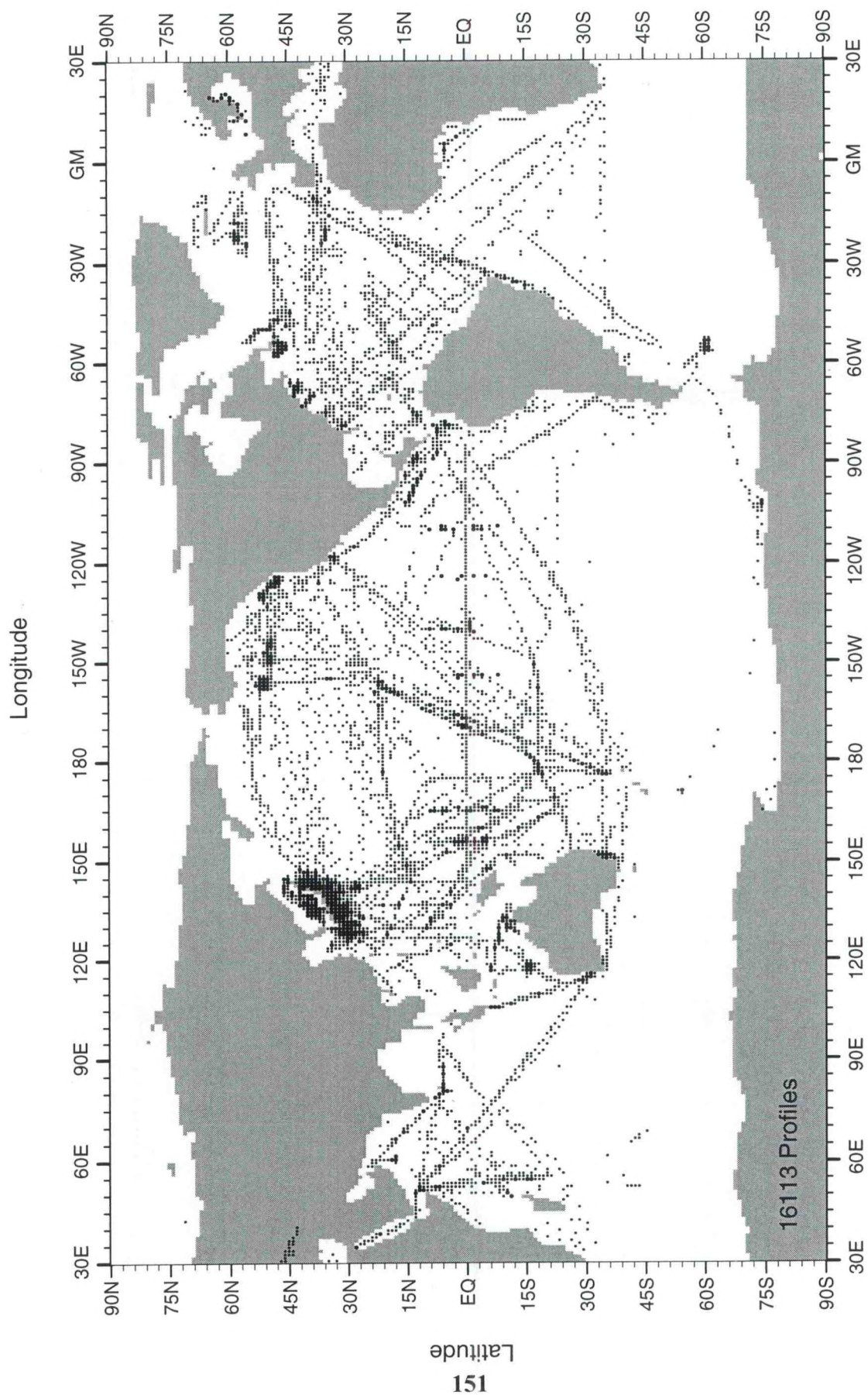
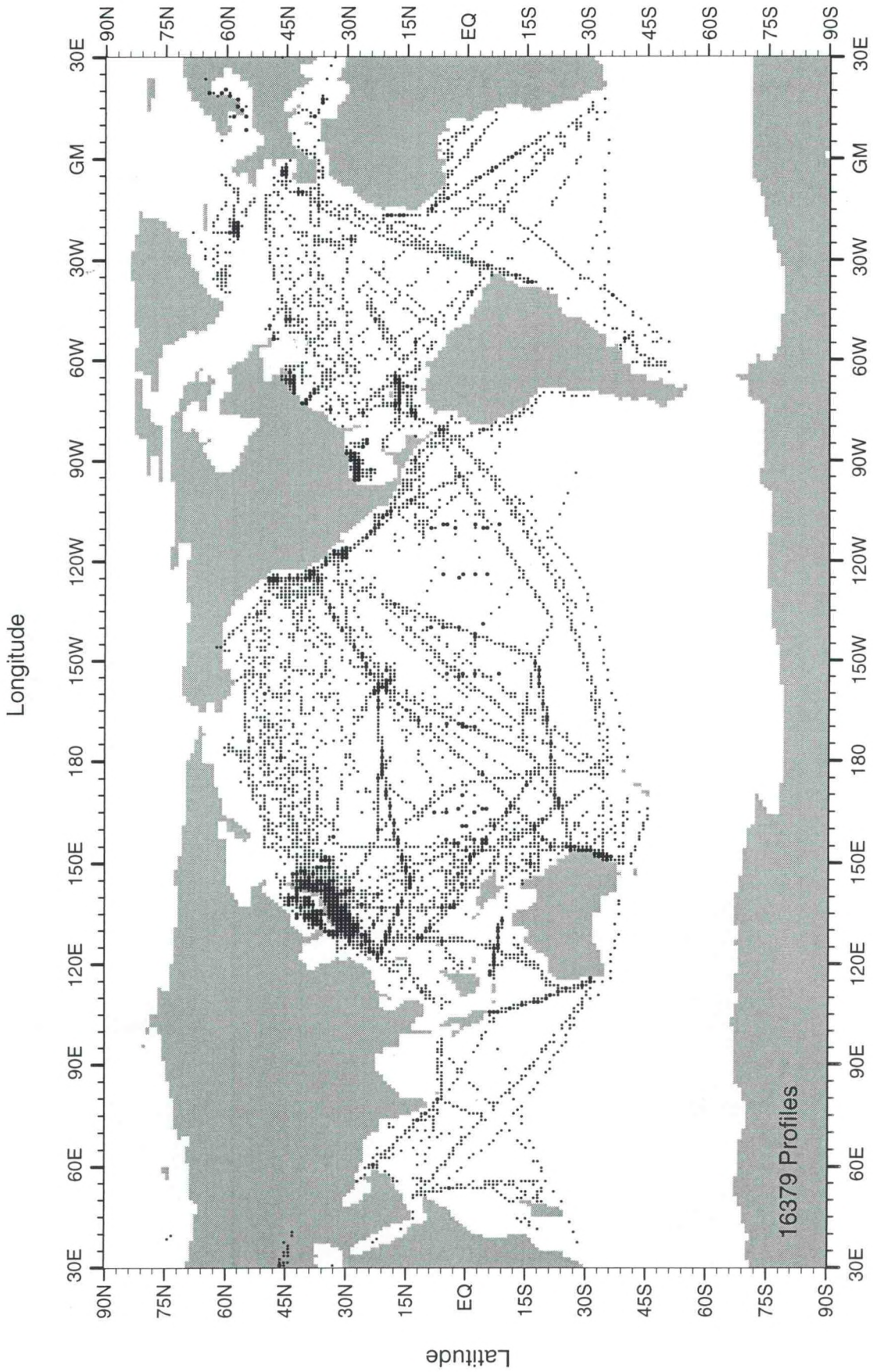


Fig. B105 WOD98 XBT and TAO profile distribution for January-March for 1992



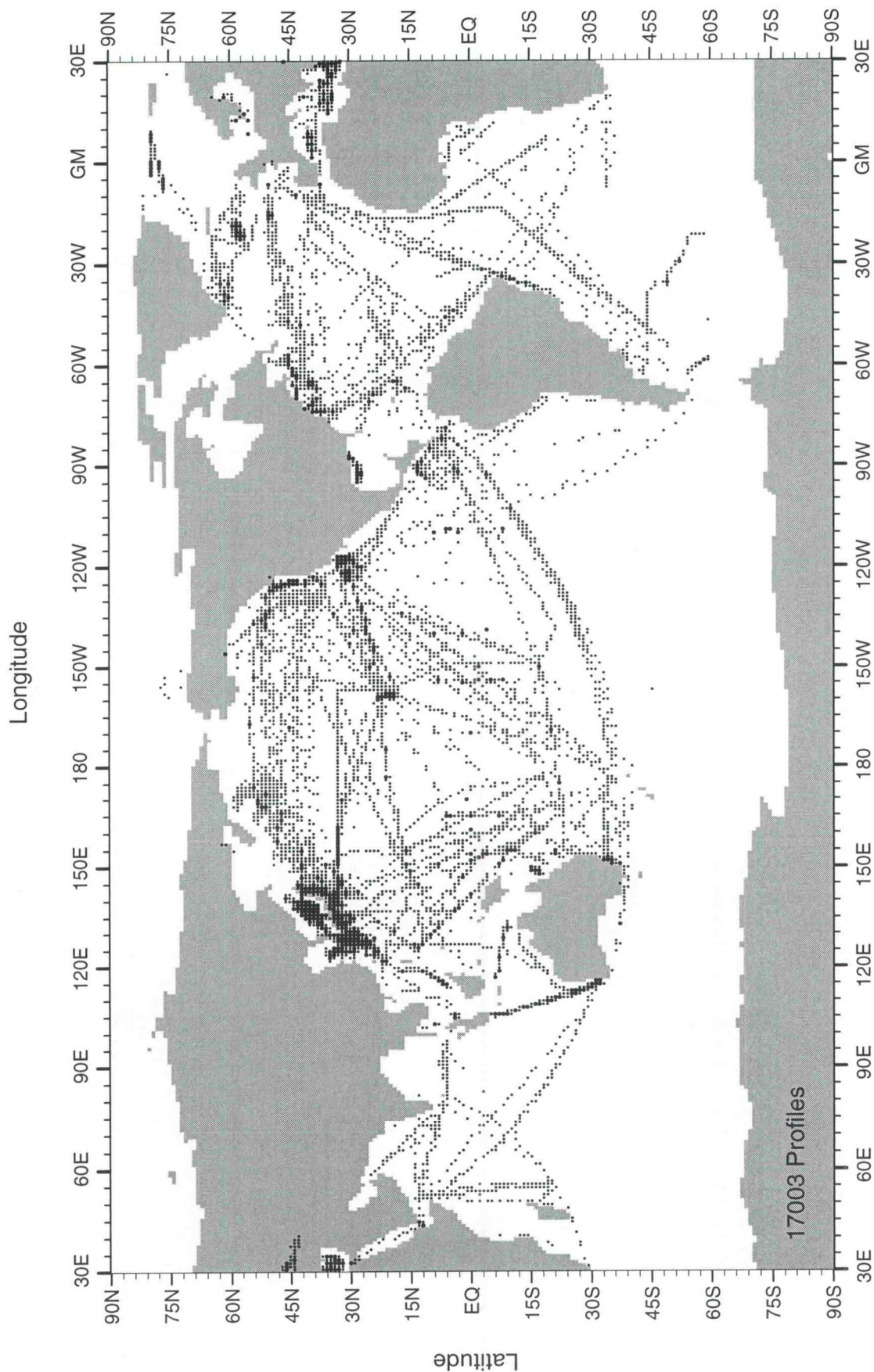


Fig. B107 WOD98 XBT and TAO profile distribution for July-September for 1992

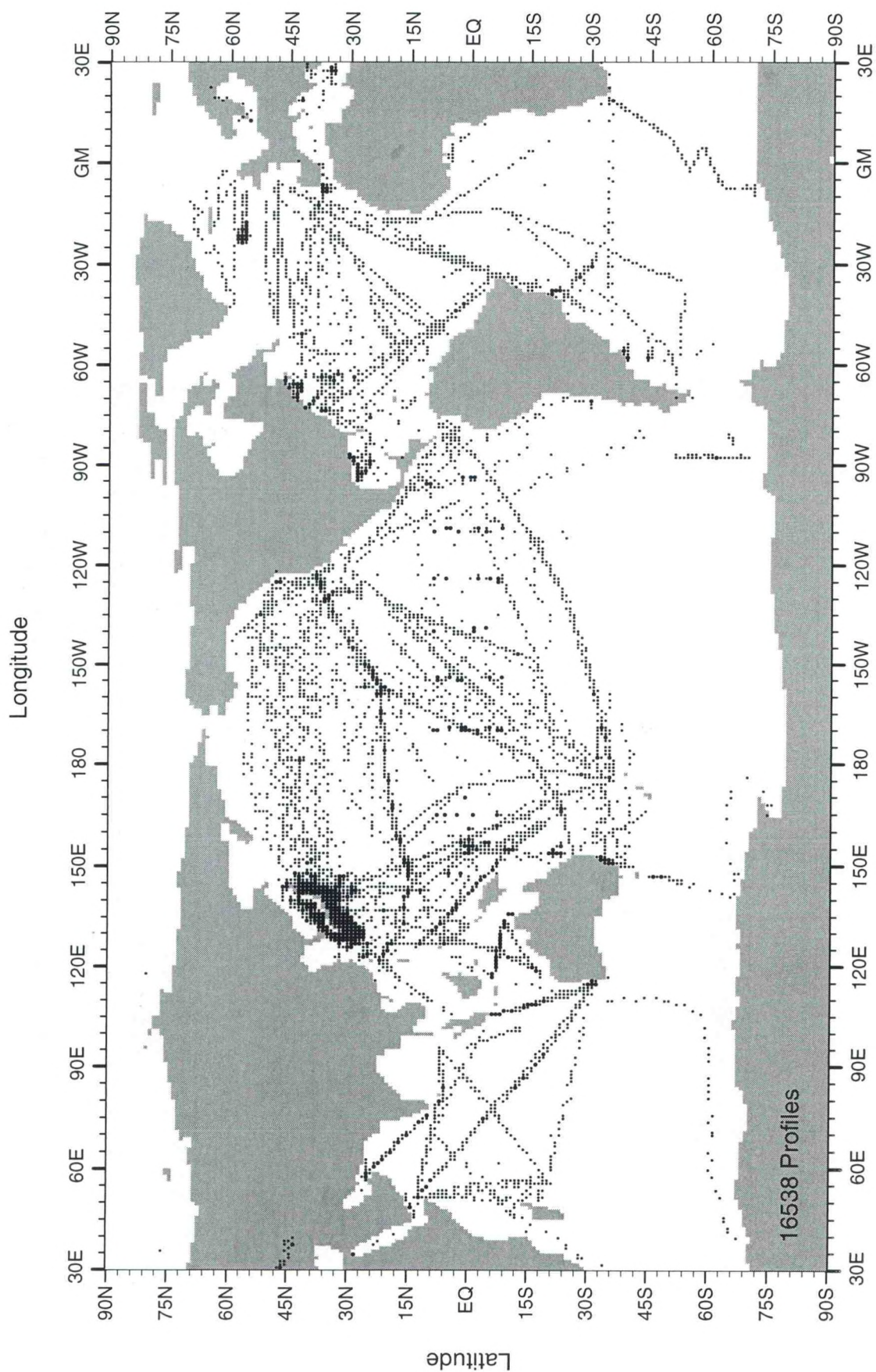


Fig. B108 WOD98 XBT and TAO profile distribution for October-December for 1992

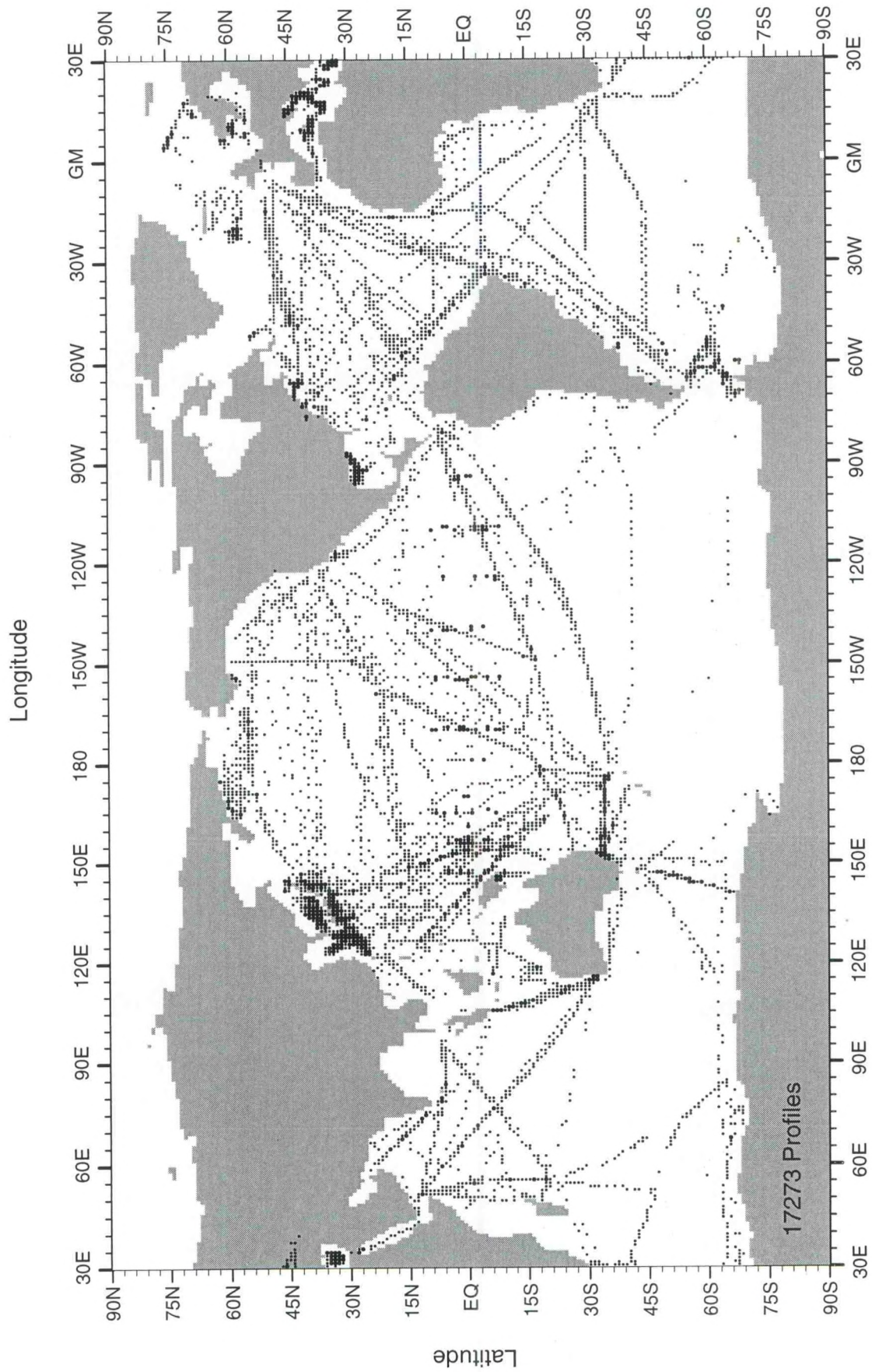


Fig. B109 WOD98 XBT and TAO profile distribution for January-March for 1993

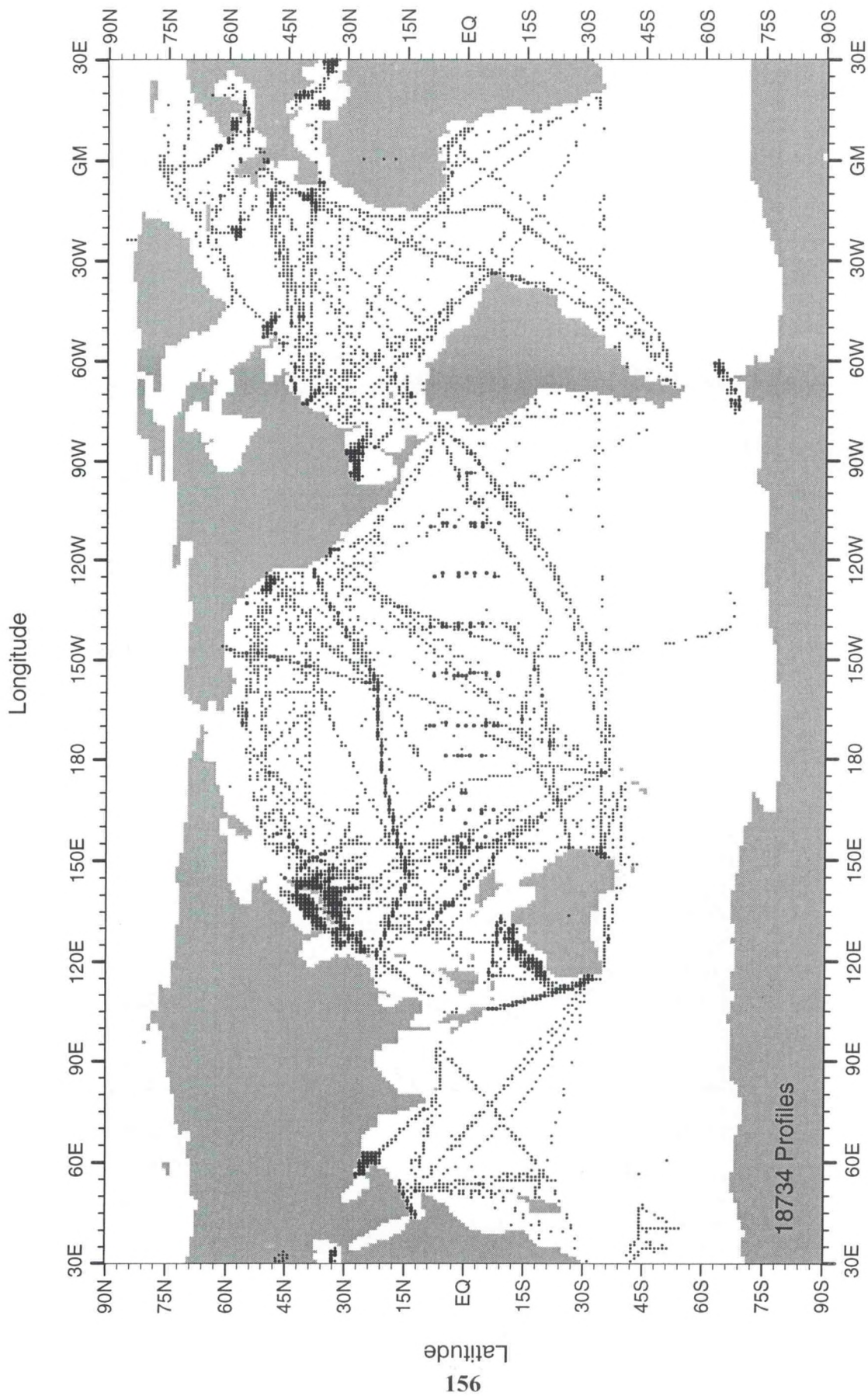


Fig. B110 WOD98 XBT and TAO profile distribution for April-June for 1993

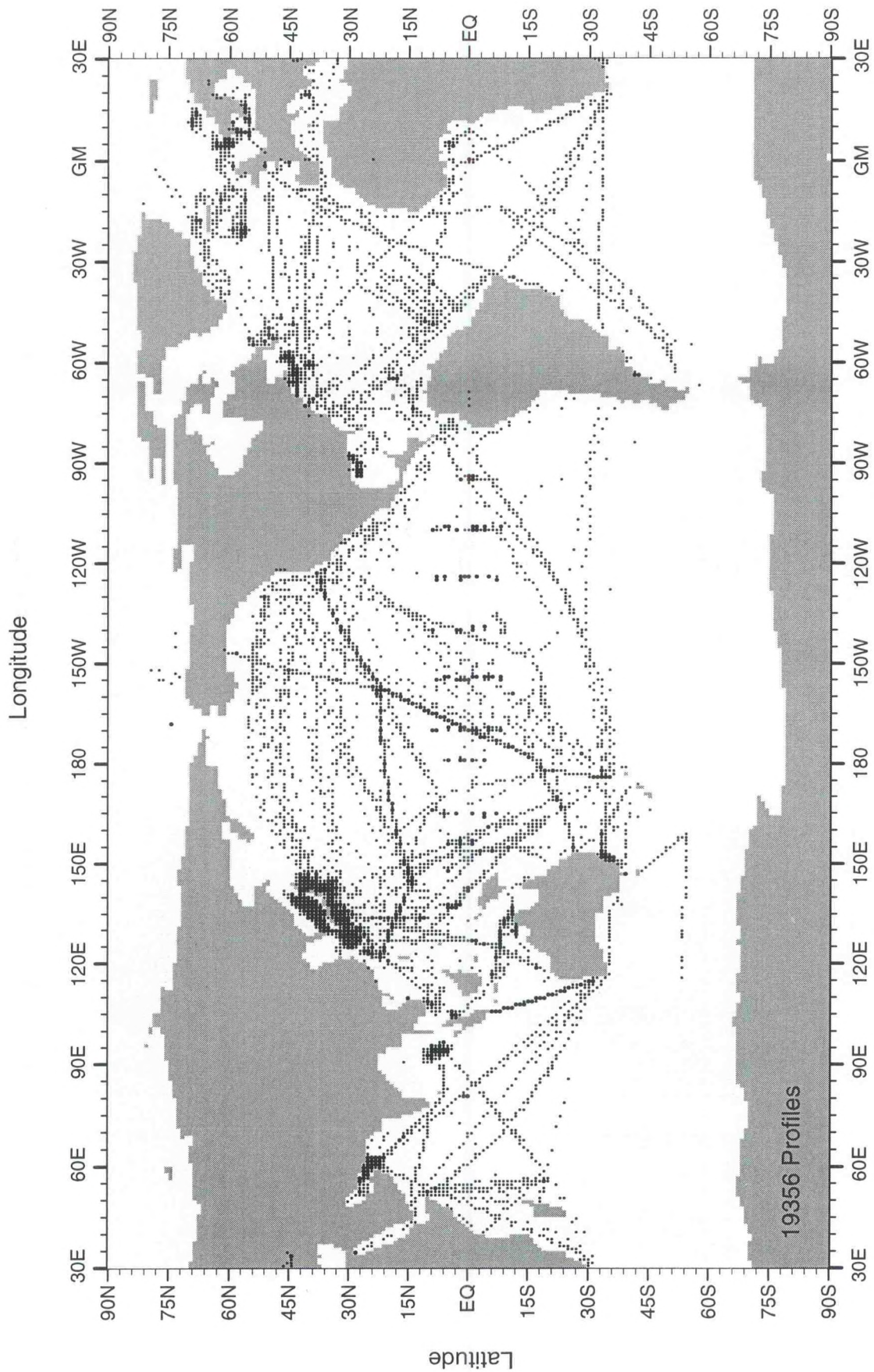


Fig. B111 WOD98 XBT and TAO profile distribution for July-September for 1993

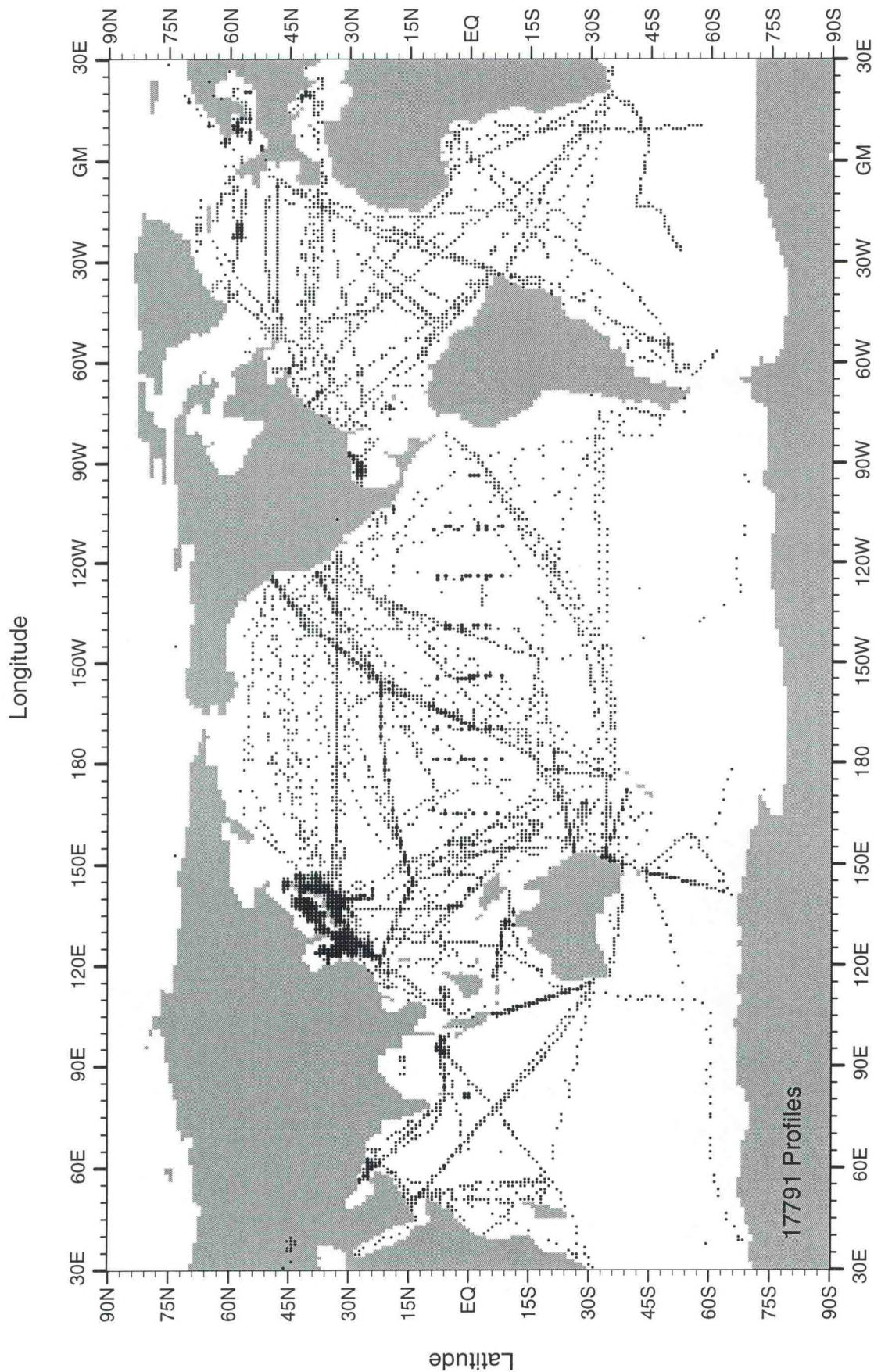


Fig. B112 WOD98 XBT and TAO profile distribution for October-December for 1993

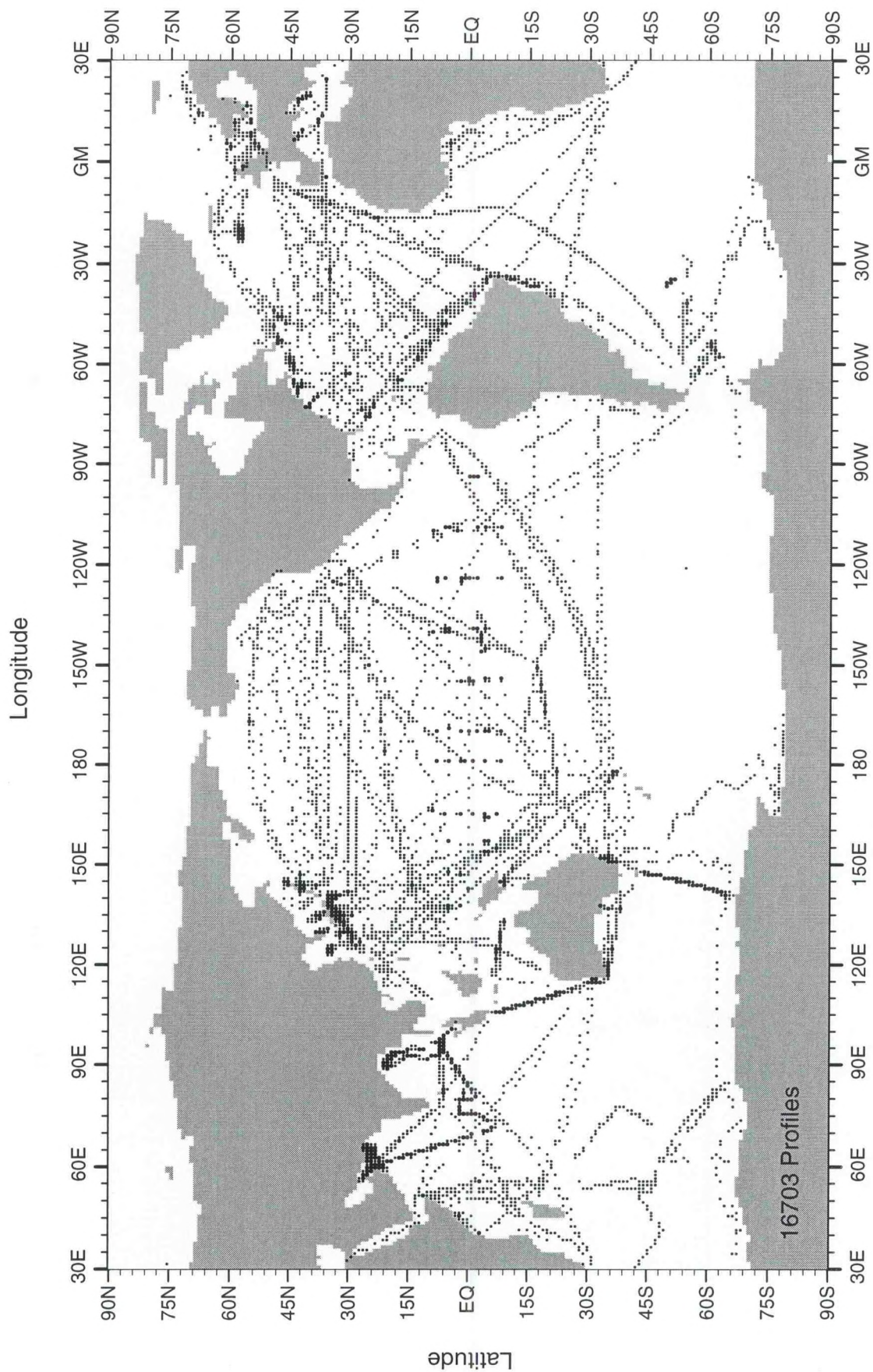


Fig. B113 WOD98 XBT and TAO profile distribution for January-March for 1994

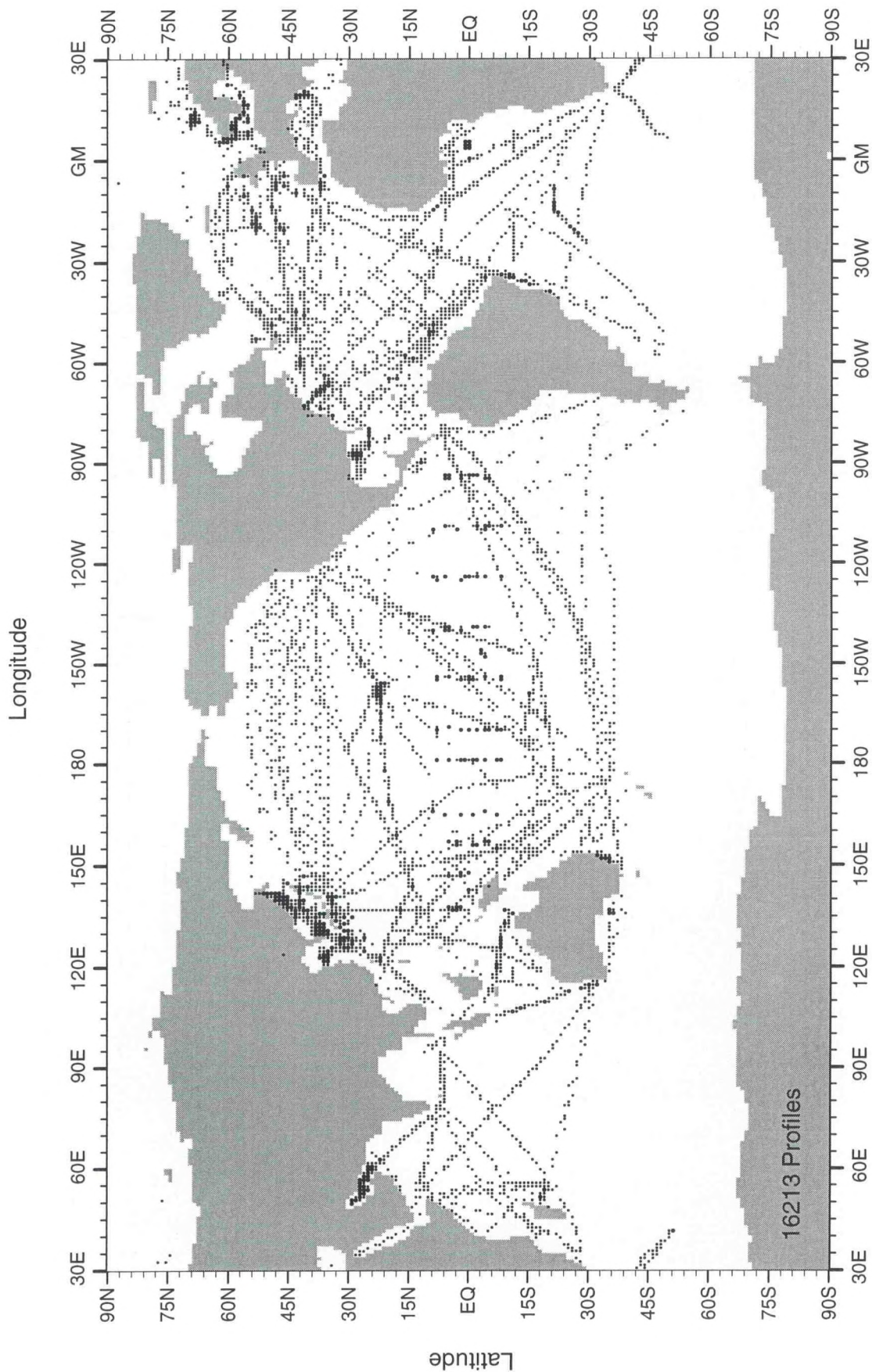


Fig. B114 WOD98 XBT and TAO profile distribution for April-June for 1994

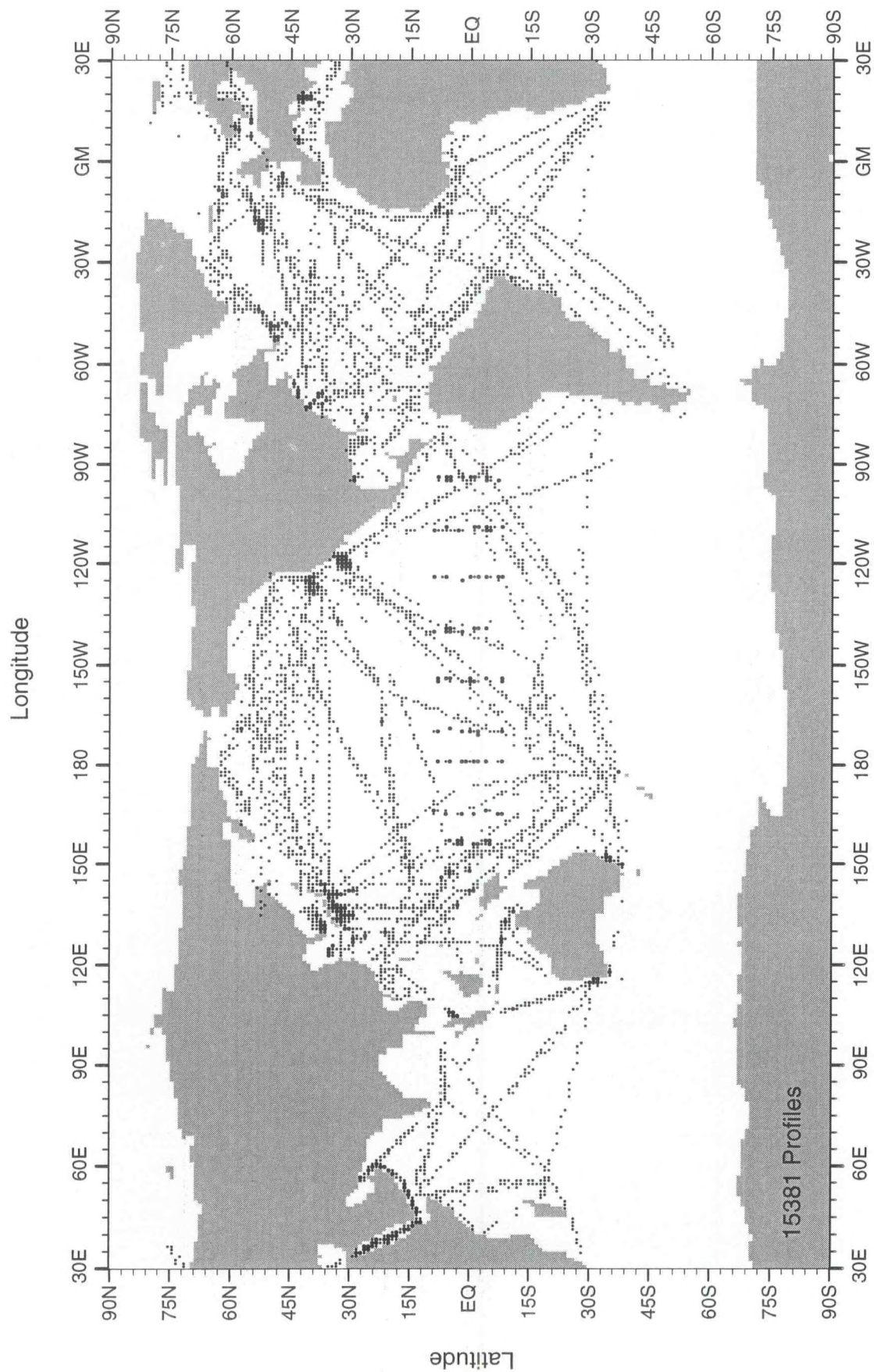


Fig. B115 WOD98 XBT and TAO profile distribution for July-September for 1994

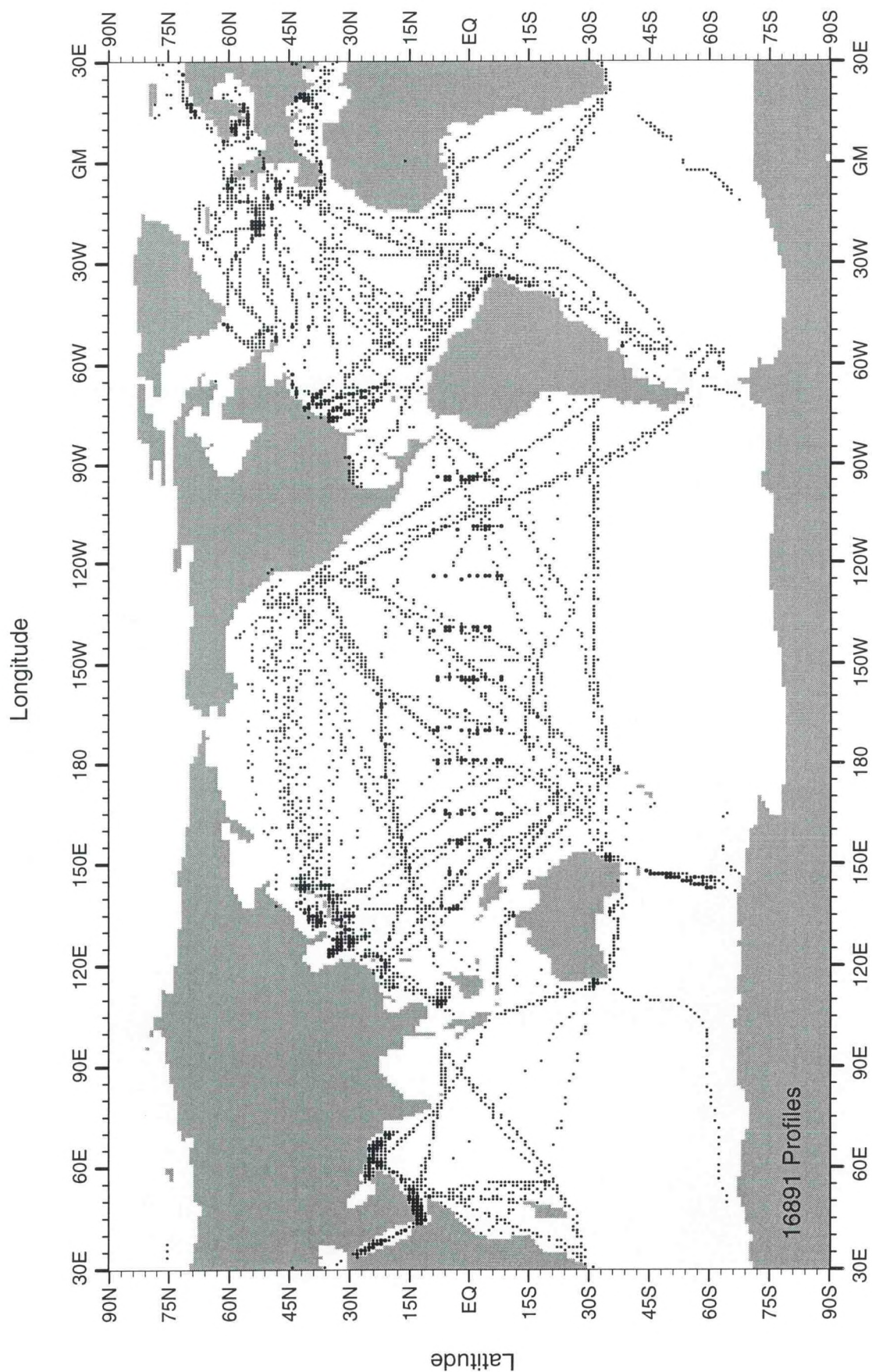


Fig. B116 WOD98 XBT and TAO profile distribution for October-December for 1994

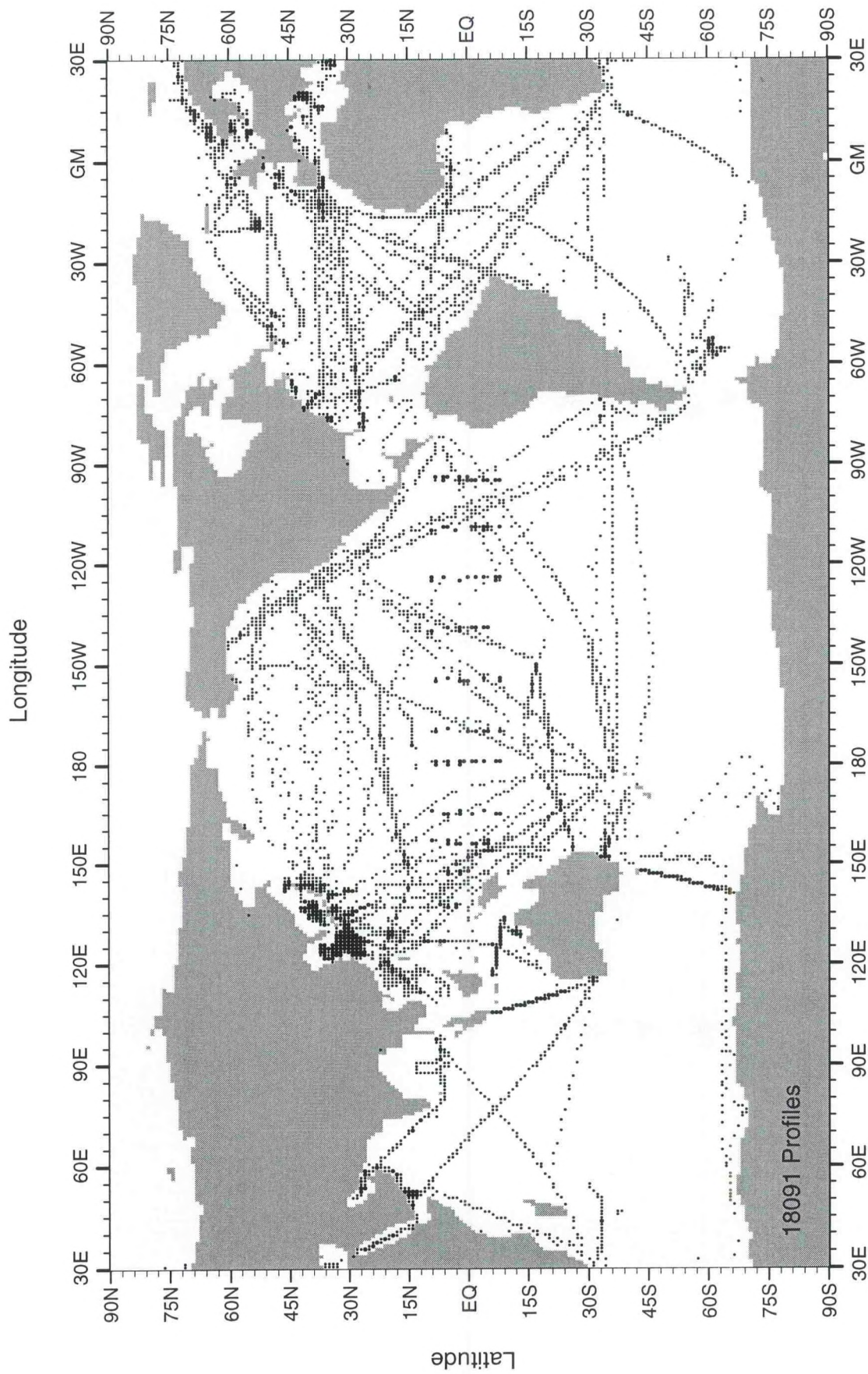


Fig. B117 WOD98 XBT and TAO profile distribution for January-March for 1995

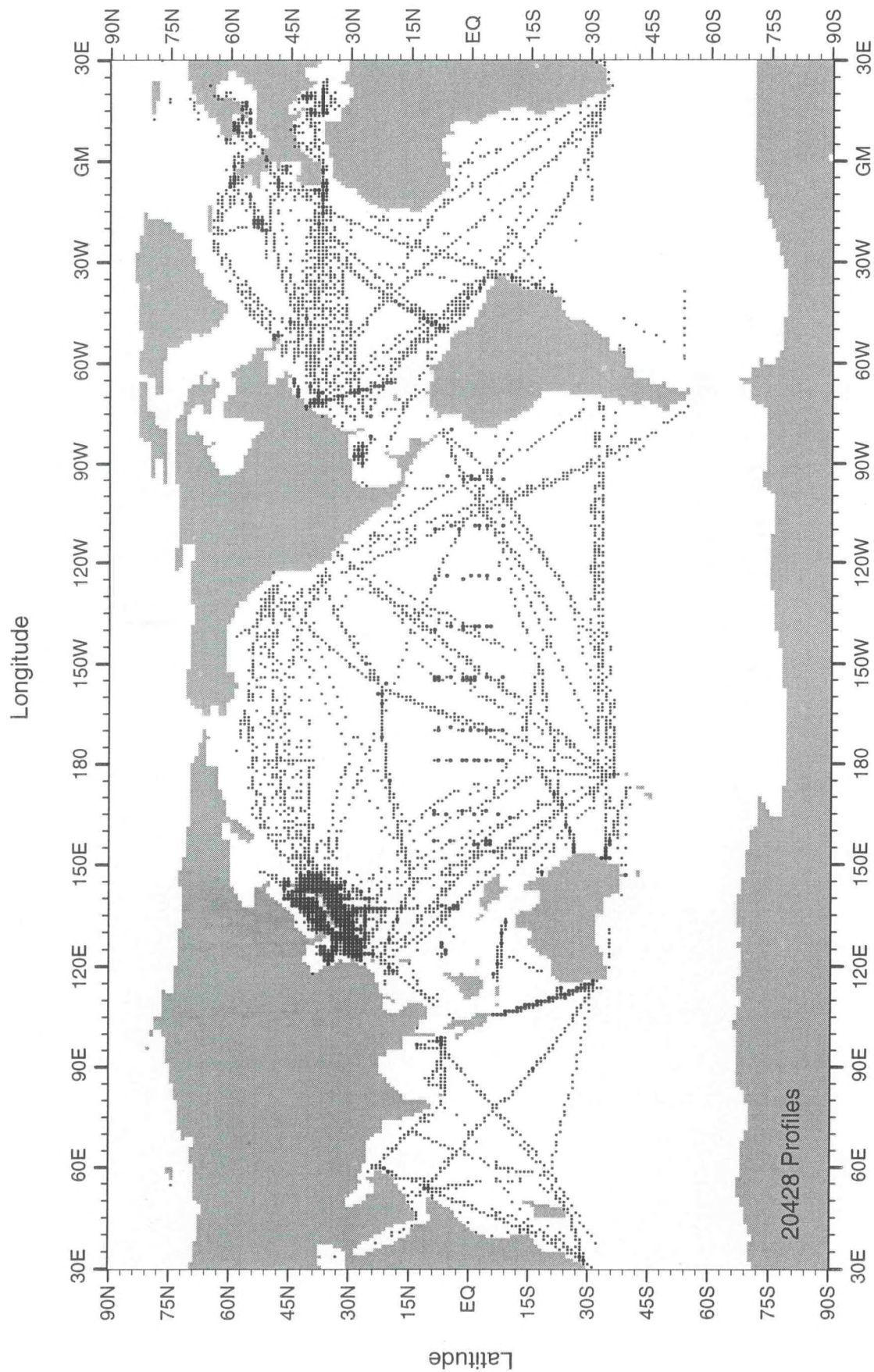


Fig. B118 WOD98 XBT and TAO profile distribution for April-June for 1995

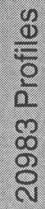


Fig. B119 WOD98 XBT and TAO profile distribution for July-September for 1995

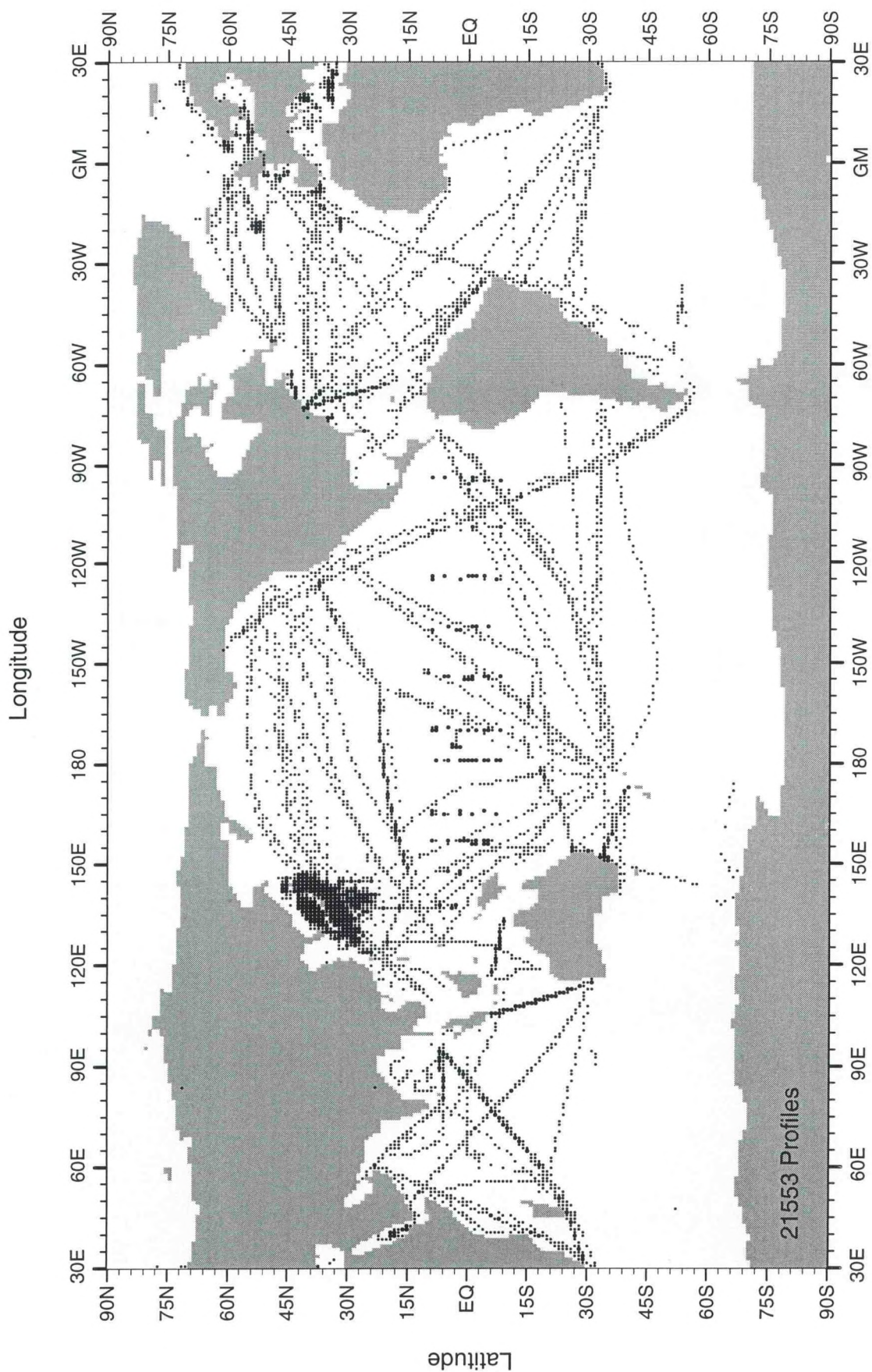


Fig. B120 WOD98 XBT and TAO profile distribution for October-December for 1995

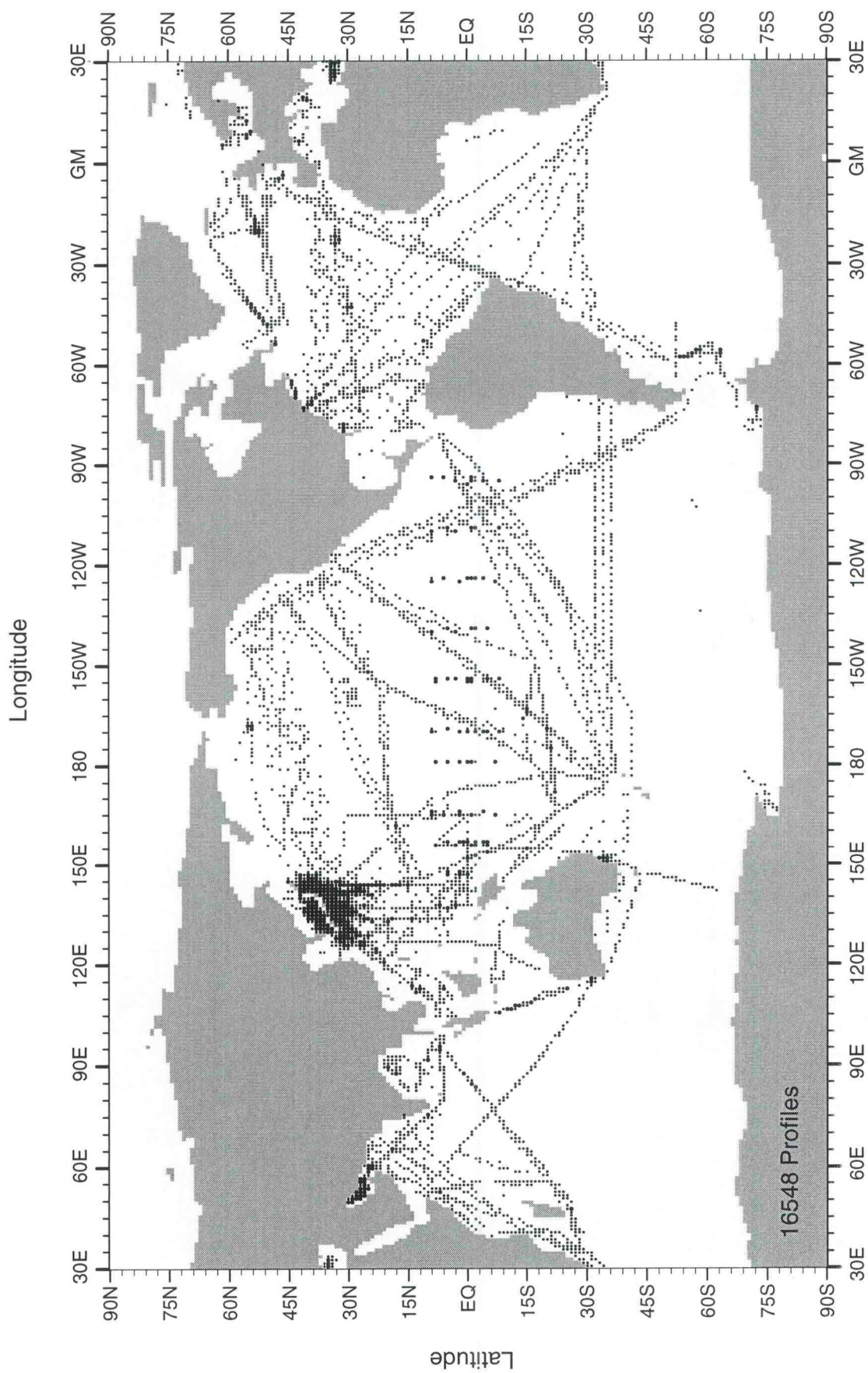


Fig. B121 WOD98 XBT and TAO profile distribution for January-March for 1996

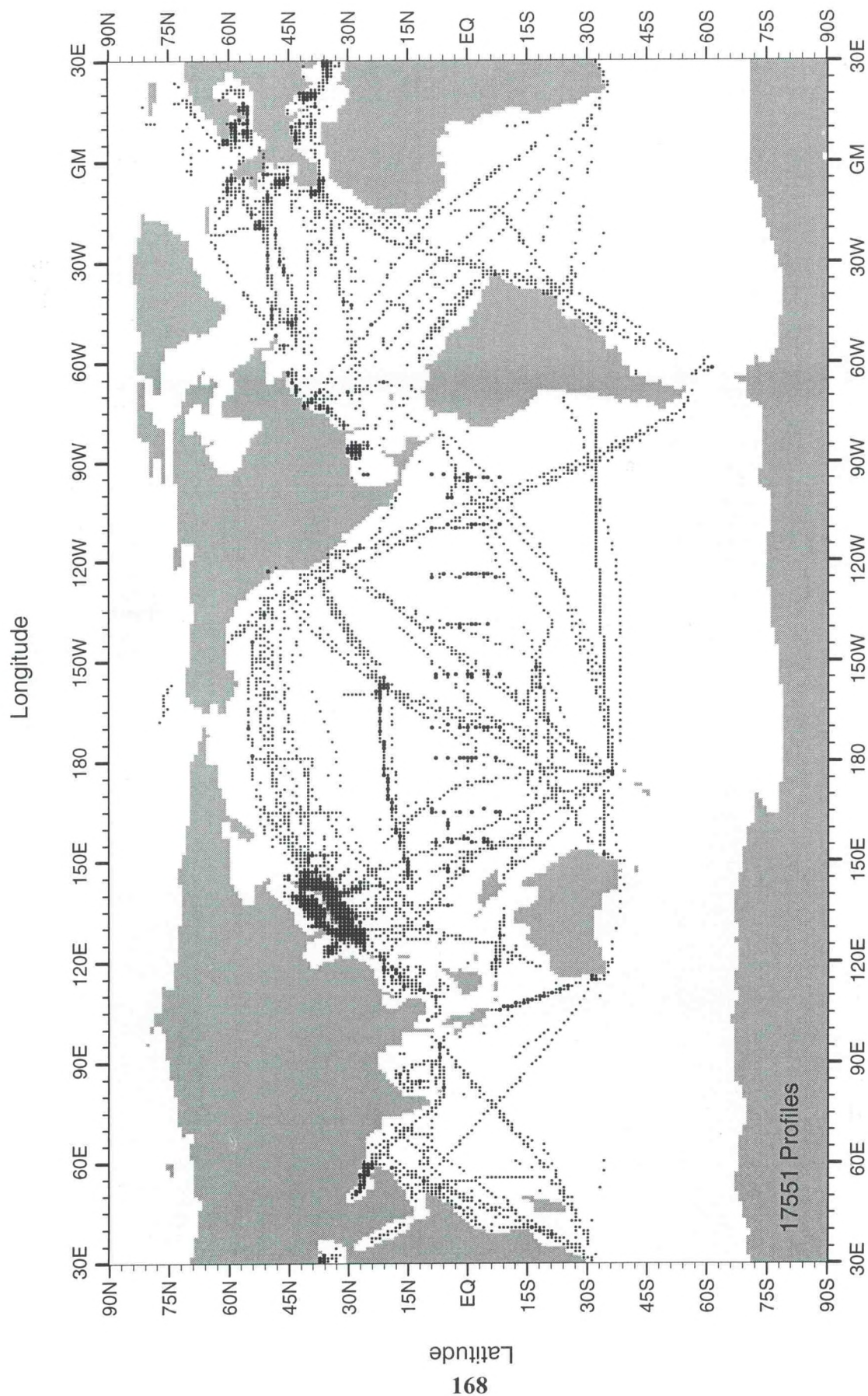


Fig. B122 WOD98 XBT and TAO profile distribution for April-June for 1996

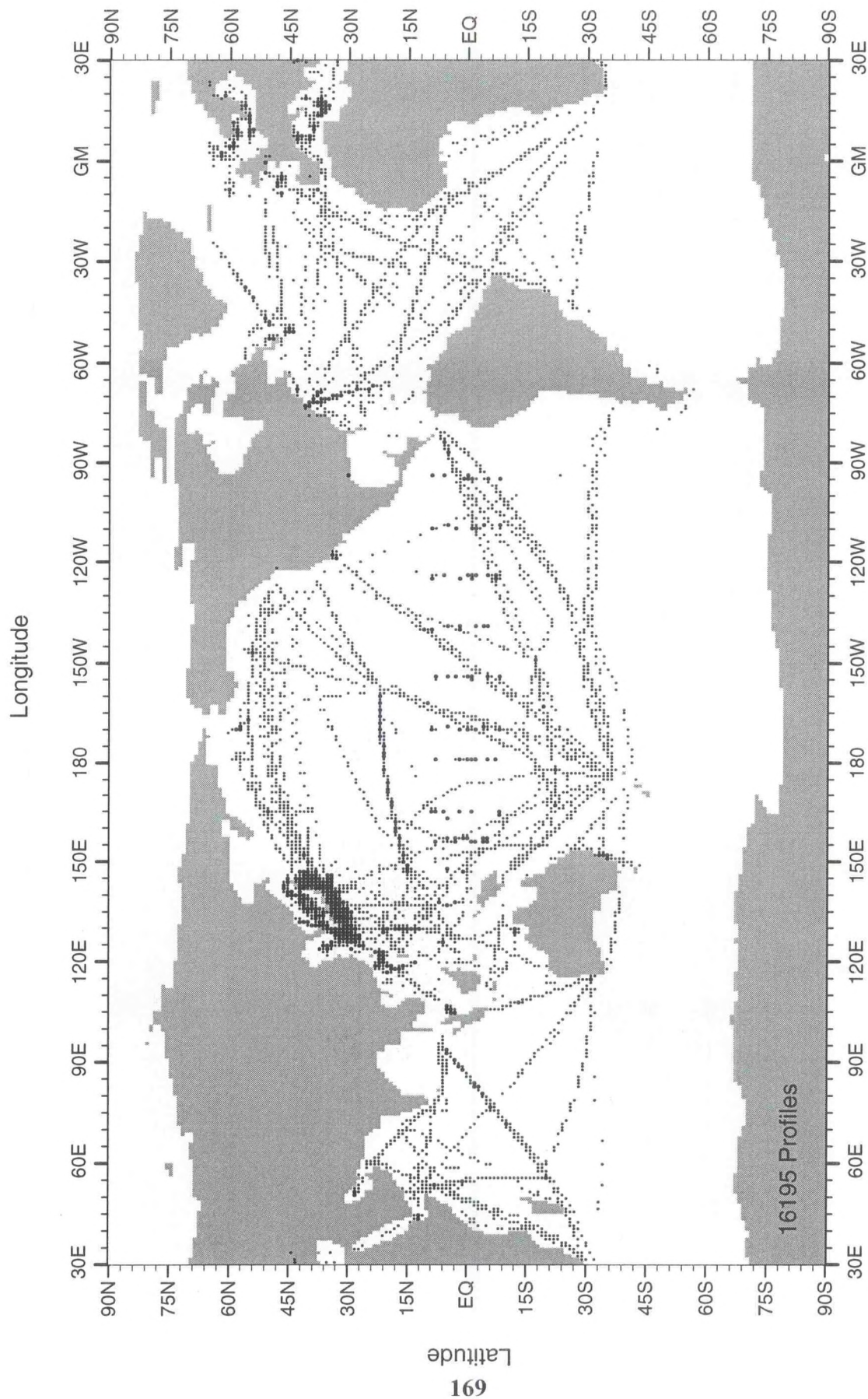


Fig. B123 WOD98 XBT and TAO profile distribution for July-September for 1996

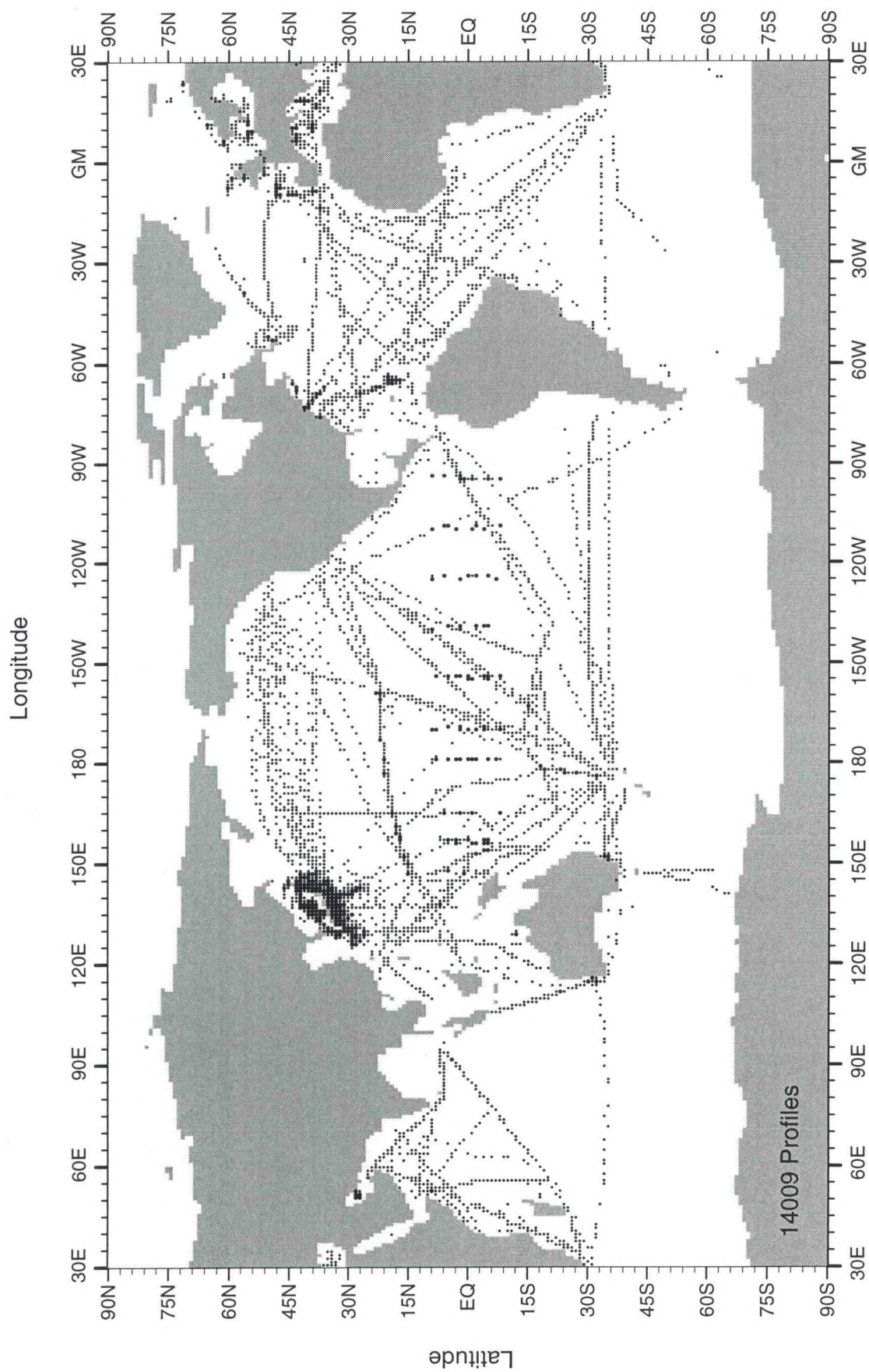


Fig. B124 WOD98 XBT and TAO profile distribution for October-December for 1996

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