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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 CO_2 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 GTSPP 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 2: Temporal Distribution of Mechanical Bathythermograph Profiles

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ABSTRACT

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

1. INTRODUCTION

The Mechanical Bathythermograph (MBT) is an instrument developed during the late-1930's (Spilhaus, 1938) that can be dropped from either a stationary or moving ship to produce an upper ocean temperature profile. This instrument was a substantial improvement of an instrument known as the "oceanograph" which was designed by Dr. Carl Rossby and Dr. Karl Lange (Rossby and Montgomery, 1934) for the purpose of studying the upper ocean thermal structure. The introduction of the MBT into usage allowed ships to make synoptic surveys of oceanographic regions and for discovery of fine structure of the ocean's thermal structure. Spilhaus (1941) used the instrument to identify "fine" structure (in the horizontal) from temperature profiles near the edge of the Gulf Stream. Pressure is determined from a pressure sensitive tube known as a Bourdon tube. A temperature sensitive element in the nose of the MBT enables the instrument to trace temperature as a function of depth.

Different versions of the MBT have different maximum depth ranges with 295 m being the deepest depth measured from any U.S. version. Earlier versions of the instrument were limited to making measurements in the upper 140 m of the water column. A review of the development of the MBT is given by Spilhaus (1987). Another more comprehensive review is provided by Couper and LaFond (1970).

The Digital Bathythermograph (DBT) instrument is a version of the MBT that reports data electronically rather than mechanically and may reach depths deeper than 295 m. DBT profiles are included in the MBT files.

2. MBT ACCURACY

The accuracy of the MBT has been the subject of several studies. Leipper and Burt (1948) report the results of comparisons between MBT temperature measurements and near simultaneous reversing thermometer measurements which were made by D. Pritchard of the U.S. Navy Electronics Laboratory in Lake Meade. By comparing the temperature traces on the up and down casts of the MBT it was inferred that there was " an almost complete absence of internal waves of large amplitude and short period, hysteresis of the instruments, or rapid temperature changes due to advection". These results are reproduced in Table 1 given below. Clearly there is good agreement between the reversing thermometer measurements (which typically had an accuracy of 0.02 °C at this period of time and the MBT measurements. However, there is a problem with interpreting the results from Table 1 because it is not clearly stated in the table or the text of the technical report of Leipper and Burt, what temperature units were used. Throughout their report, Leipper and Burt use the Fahrenheit scale. If this scale applies to the results in Table 1, then the agreement is impressive. If the results are in degrees centigrade, the agreement is less impressive but the data are still useful for many scientific purposes. Other studies attribute an accuracy of about 0.5 °F to the MBT instrument (This figure is comparable to the accuracy of Expendable Bathythermograph (XBT) probes for which the thermistor sensing element is not calibrated (Tabata, 1978)). Although both MBT and XBT probes are an order of magnitude less precise than reversing thermometers, the *standard error of the mean* of any estimate based on these temperature measurements decreases with the increase in number of data used. This applies to random errors. Hence, historical bathythermograph measurements provide valuable information when estimating mean features for by averaging over many measurements in space and/or time.

In many countries and institutions the use of the MBT has been replaced by the XBT but in other countries and institutes MBT measurements continue to be made and transferred to oceanographic data centers.

3. MBT PROFILE DISTRIBUTIONS

Figure 1 shows the number of MBT 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 2,077,200 MBT profiles for the entire World Ocean with 226,874 profiles (10.9%) measured in the southern hemisphere and 1,850,326 profiles (89.1%) measured in the northern hemisphere. Table 1 provides the exact number of MBT profiles included in WOD98 as a function of year. Substantial numbers of MBT profiles were made by the U.S. Navy during World War II. All the WWII Pacific and Indian Ocean MBT profiles were digitized during the past several years as part of the NODC Data Archaeology and Rescue (NODAR) project with support from the NOAA CGC (Climate and Global Change) program and the NOAA ESDIM (Environmental Sciences and Information Management program). These data have been stored at the Scripps Institute of Oceanography. A more complete description of the data in this archive can be found in the report by Levitus *et al.* (1998). The geographic distribution of MBT profiles for individual years for 1941-1994 are shown in Figures A1-A54. The geographic distribution of MBT profiles for each season by individual years for 1941-1994 are

shown in Figures B1-B216. 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. Comparison of observations taken with bathythermographs and reversing thermometers reproduced from Leipper and Burt (1948).

TABLE I

OBSERVATIONS TAKEN WITH BATHYTHERMOGRAPHS AND REVERSING THERMOMETERS

BT	No. of stations	No. of thermometer observations	Standard Deviation of Temperature Differences*
# 1784A (Shallow)	9	20	0.15
# 1258A (Deep)	10	41	0.19
# 514A (Deep)	12	36	0.10

*We reproduce this table as it appeared in the work by Leipper and Burt (1948). Unfortunately, they did not specify whether the units of temperature were reported in degrees centigrade or Fahrenheit . However, all other citations of temperature in their report were given in units of degrees Fahrenheit. Even if these results are in units of degrees centigrade, the agreement is still good. For example, individual XBT probes are accurate to a few tenths of a degree Centigrade.

Table 2 National contributions of Mechanical Bathythermograph (MBT) profiles sorted by percent contribution of each country

*NODC Country Code	Country Name	MBT Count	% of Total
31	UNITED STATES	1052120	50.65
32	UNITED STATES	44564	2.15
33	UNITED STATES	20435	0.98
90	RUSSIA	344949	16.61
49	JAPAN	228425	11
18	CANADA	191691	9.23
74	UNITED KINGDOM	115940	5.58
9	AUSTRALIA	17817	0.86
8	ARGENTINA	13028	0.63
6	GERMANY, FED. REP.	7156	0.34
64	NETHERLANDS	7123	0.34
48	ITALY	6169	0.3
65	PERU	5212	0.25
20	CHILE	4158	0.2
99	UNKNOWN	3197	0.15
68	PORTUGAL	2920	0.14
35	FRANCE	2532	0.12
61	NEW ZEALAND	2436	0.12
RC	CONGO	1337	0.06
58	NORWAY	890	0.04
28	ECUADOR	885	0.04
24	KOREA, REP.OF	847	0.04
22	COLOMBIA	746	0.04
93	VENEZUELA	668	0.03
41	INDIA	540	0.03
55	MALAGASY REP.	405	0.02
SE	SENEGAL	247	0.01
29	SPAIN	195	0.01
SL	SIERRA LEONE	187	0.01
IC	IVORY COAST	100	0
NI	NIGERIA	89	0
14	BRAZIL	82	0
86	THAILAND	77	0
91	SOUTH AFRICA	20	0
GH	GHANA	12	0
	TOTAL	2077200	

*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 897 profiles reported for years prior to 1941. Some of these represent profiles with "incorrect" years because they predate the deployment of the MBT in 1937/1938.
The MBT profiles with the "early" dates are included in this table as well as in the WOD98 CD-ROMs.

Table 3 The number of MBT profiles* in WOD98 as a function of year for the World Ocean. The total number of profiles = 2,076,303

YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE
1941	9802	1955	42339	1969	49989	1982	18903
1942	6571	1956	45308	1970	40060	1983	20312
1943	16712	1957	56110	1971	35785	1984	33482
1944	36686	1958	64147	1972	34765	1985	26199
1945	40713	1959	59836	1973	25602	1986	28220
1946	23394	1960	65472	1974	29459	1987	25342
1947	28321	1961	71666	1975	22244	1988	21123
1948	29878	1962	79339	1976	28363	1989	11644
1949	34907	1963	84041	1977	25851	1990	11447
1950	48527	1964	81400	1978	25464	1991	4217
1951	49301	1965	86861	1979	32596	1992	893
1952	60418	1966	97440	1980	26276	1993	16
1953	57023	1967	85190	1981	20925	1994	73
1954	51441	1968	64210				

* does not include 897 profiles for the pre-1941 period

Table 4 The number of MBT profiles in WOD98 as a function of year for the southern hemisphere. The total number of profiles = 227,079

YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE
1941	10	1954	1106	1967	14083	1979	5181
1942	1384	1955	2957	1968	10059	1980	5000
1943	2567	1956	4195	1969	5312	1981	3487
1944	3388	1957	8396	1970	4882	1982	3105
1945	1003	1958	10448	1971	5639	1983	4140
1946	913	1959	9092	1972	4480	1984	6811
1947	2159	1960	9832	1973	3269	1985	3707
1948	125	1961	6899	1974	3077	1986	4167
1949	550	1962	9522	1975	1615	1987	3487
1950	310	1963	11489	1976	3992	1988	1879
1951	468	1964	9950	1977	4254	1989	1279
1952	2761	1965	10053	1978	3092	1990	722
1953	878	1966	9905				

Table 5 The number of MBT profiles in WOD98 as a function of year for the northern hemisphere. The total number of profiles = 1,849,224

YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE	YEAR	PROFILE
1941	9792	1955	39382	1969	44677	1982	15798
1942	5187	1956	41113	1970	35178	1983	16172
1943	14145	1957	47714	1971	30146	1984	26671
1944	33298	1958	53699	1972	30285	1985	22492
1945	39710	1959	50744	1973	22333	1986	24053
1946	22481	1960	55640	1974	26382	1987	21855
1947	26162	1961	64767	1975	20629	1988	19244
1948	29753	1962	69817	1976	24371	1989	10365
1949	34357	1963	72552	1977	21597	1990	10725
1950	48217	1964	71450	1978	22372	1991	4217
1951	48833	1965	76808	1979	27415	1992	893
1952	57657	1966	87535	1980	21276	1993	16
1953	56145	1967	71107	1981	17438	1994	73
1954	50335	1968	54151				

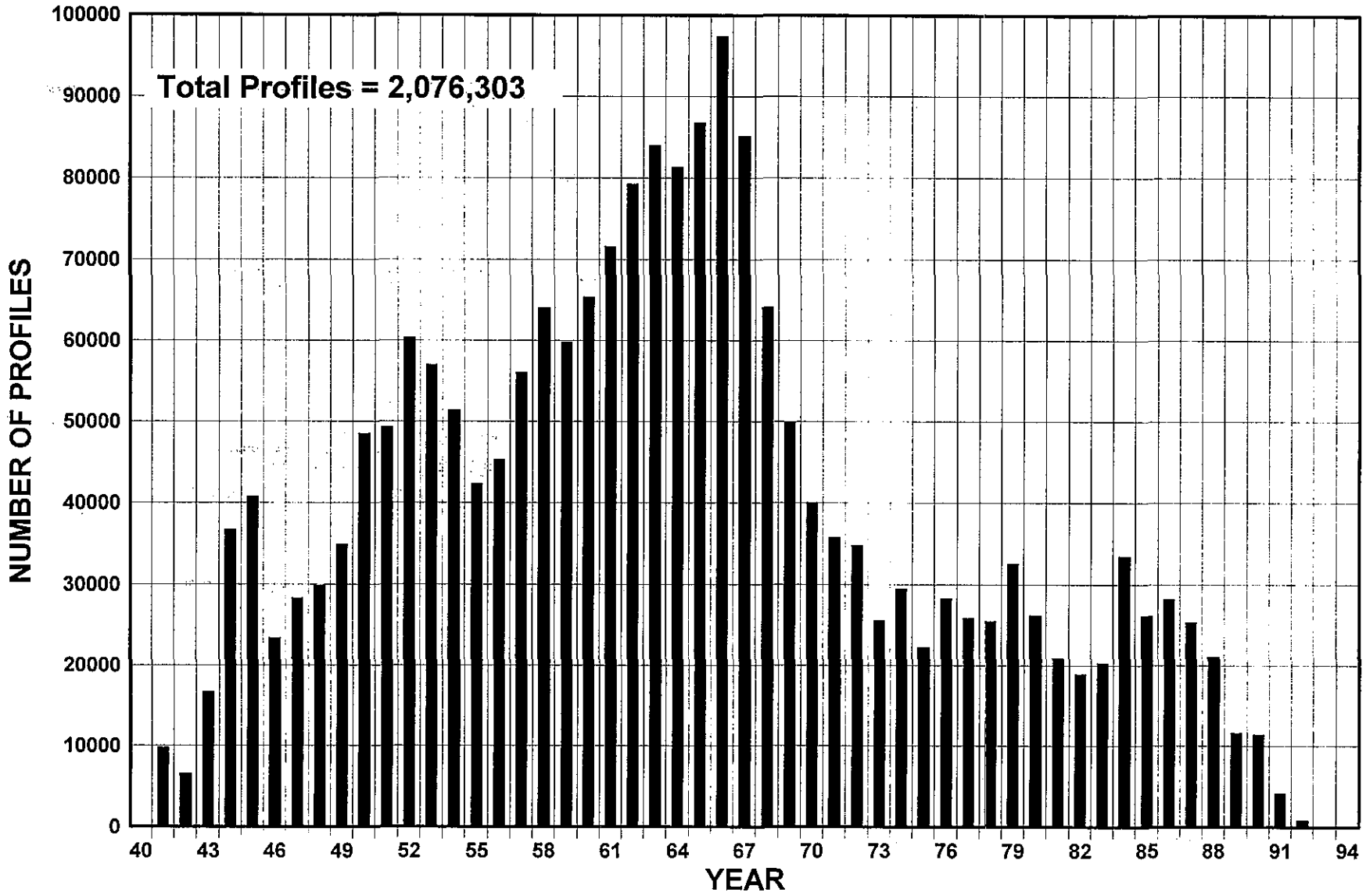

Fig. 1 Time series of MBT Profiles in WOD98 for the world ocean as a function of year

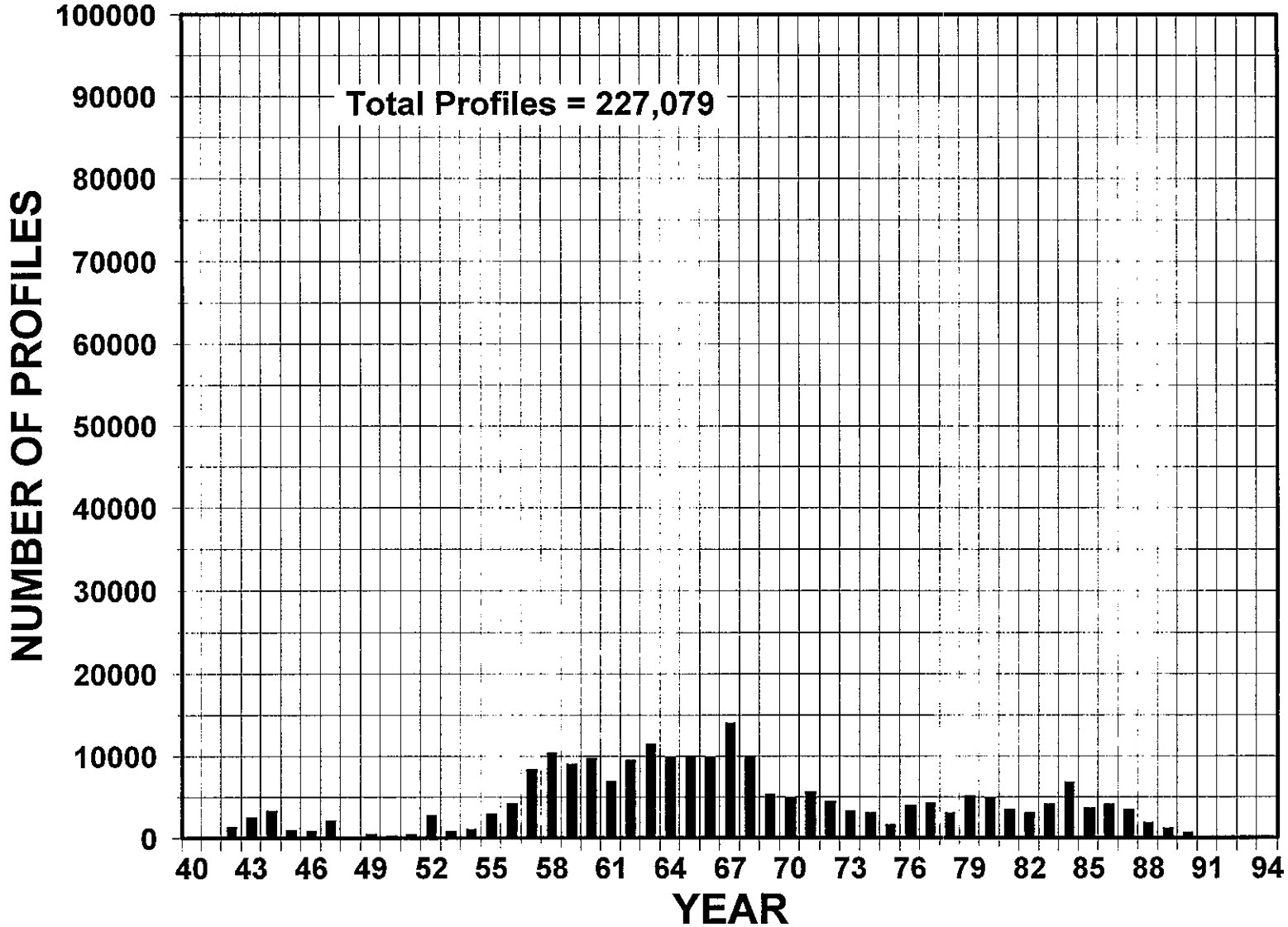

Fig. 2 Time series of MBT Profiles in WOD98 for the southern hemisphere as a function of year

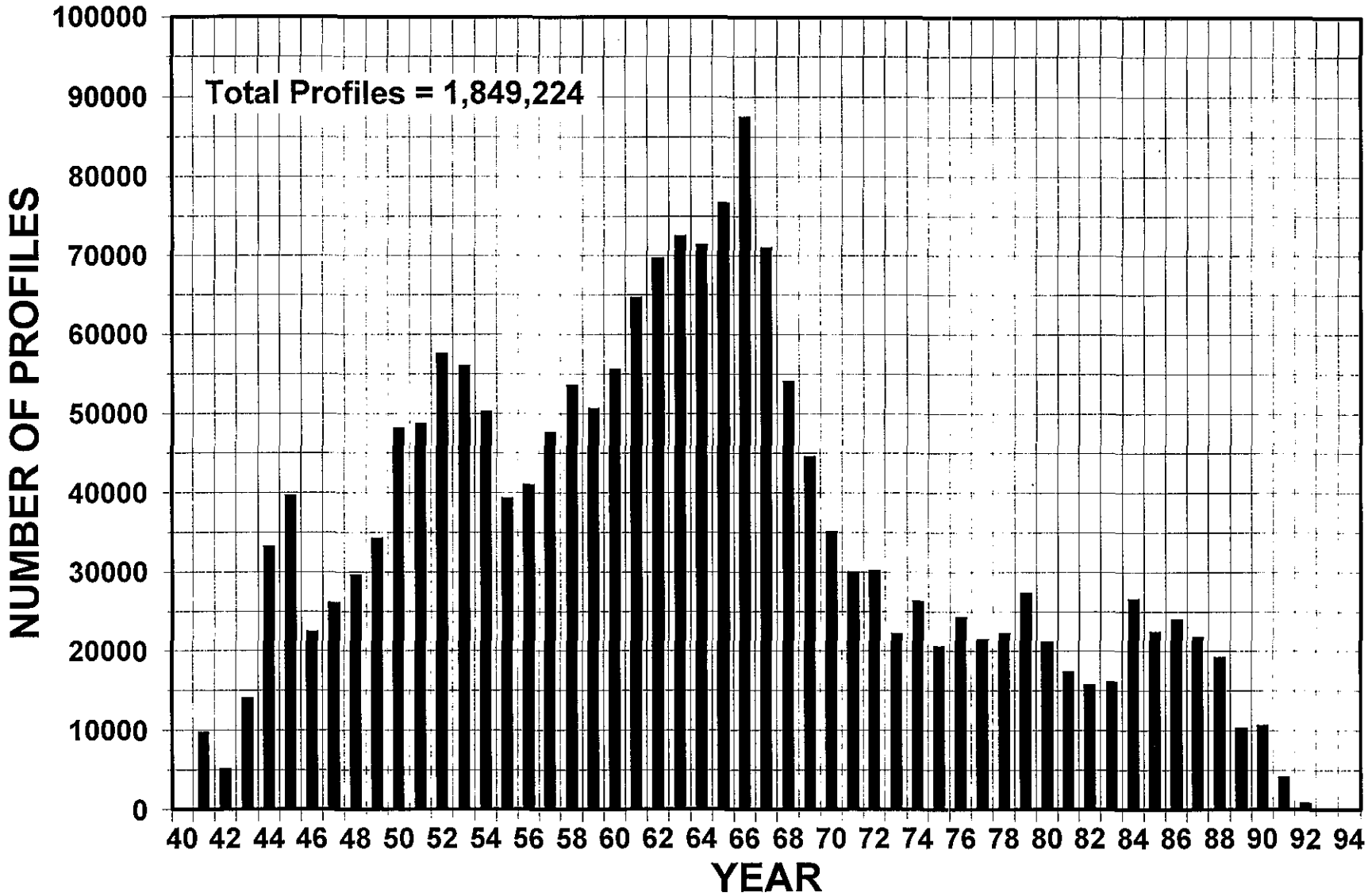

Fig. 3 Time series of MBT Profiles in WOD98 for the northern hemisphere as a function of year

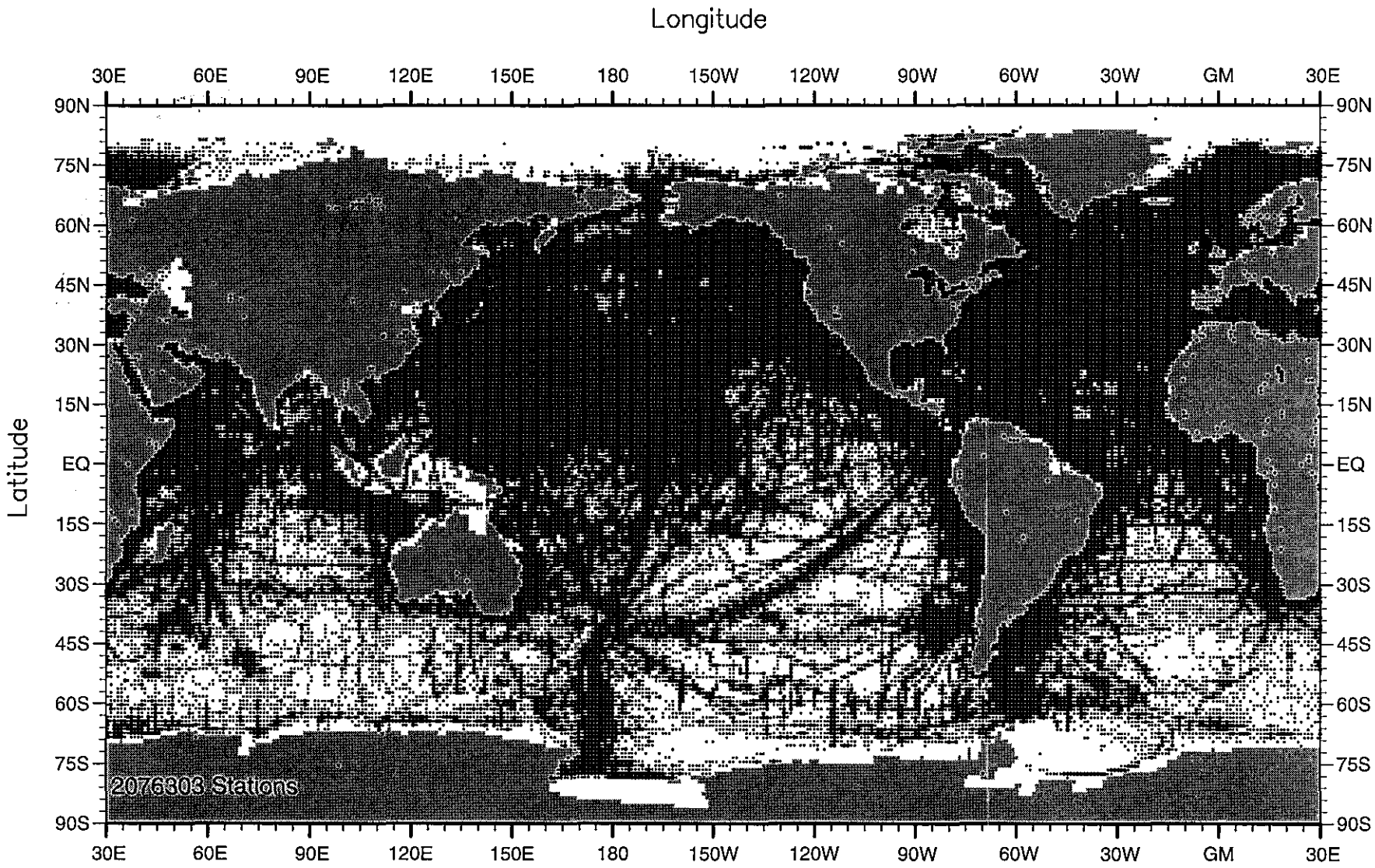

Fig. 4 Distribution of all profiles in the MBT files of WOD98

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

This appendix contains yearly data distributions of all MBT 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 MBT 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.

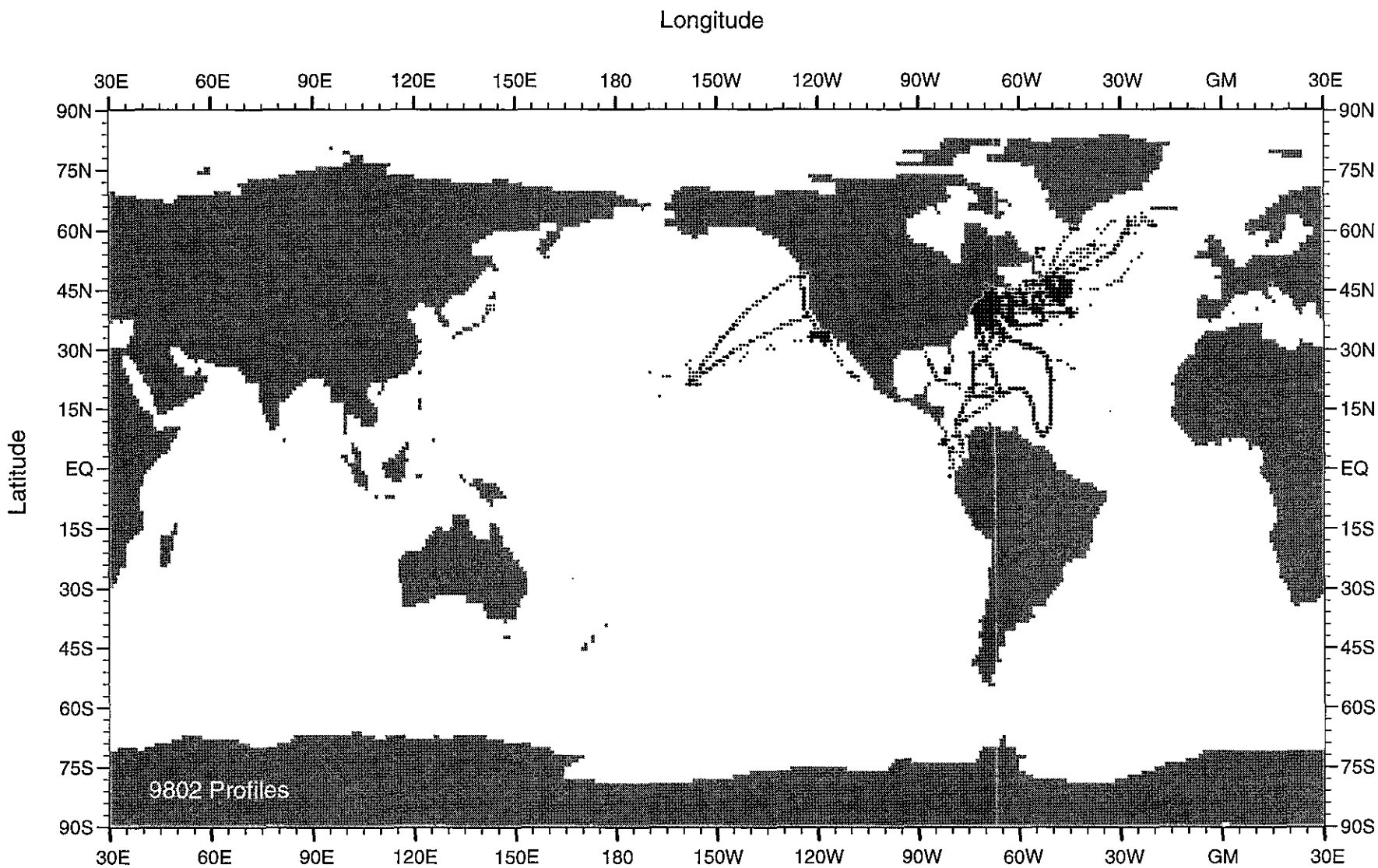

Fig. A1 WOD98 MBT profile distribution for 1941

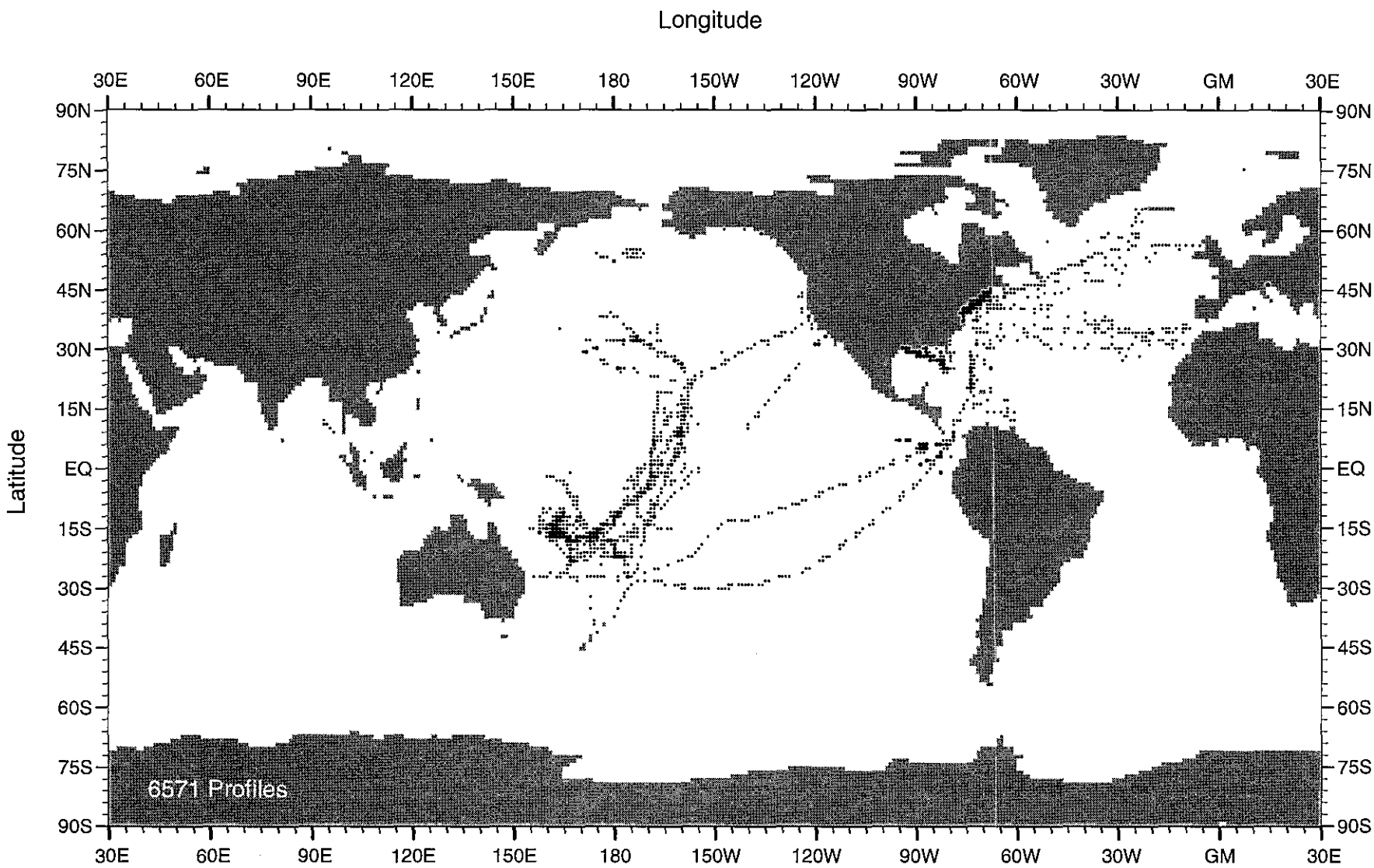

Fig. A2 WOD98 MBT profile distribution for 1942

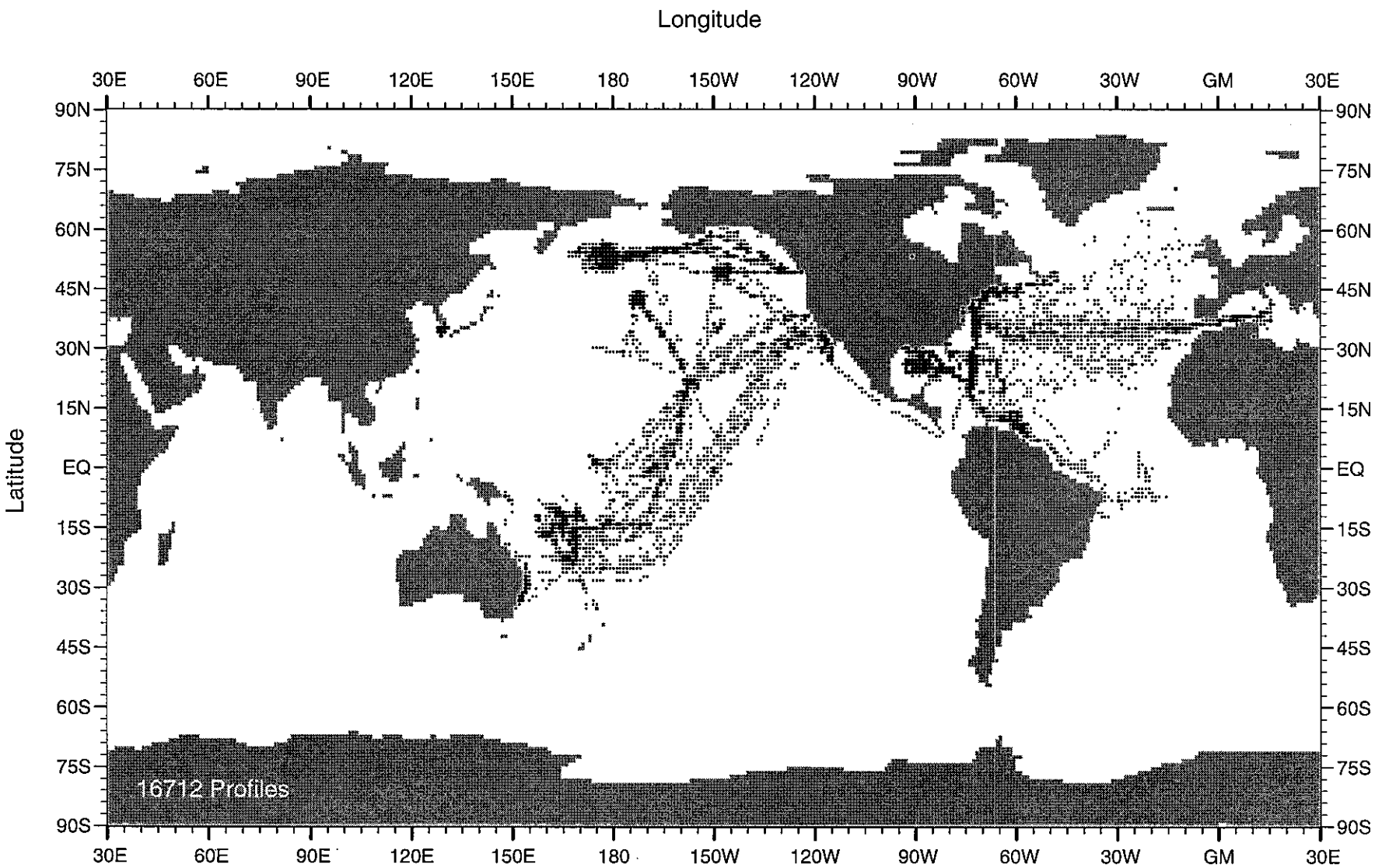

Fig. A3 WOD98 MBT profile distribution for 1943

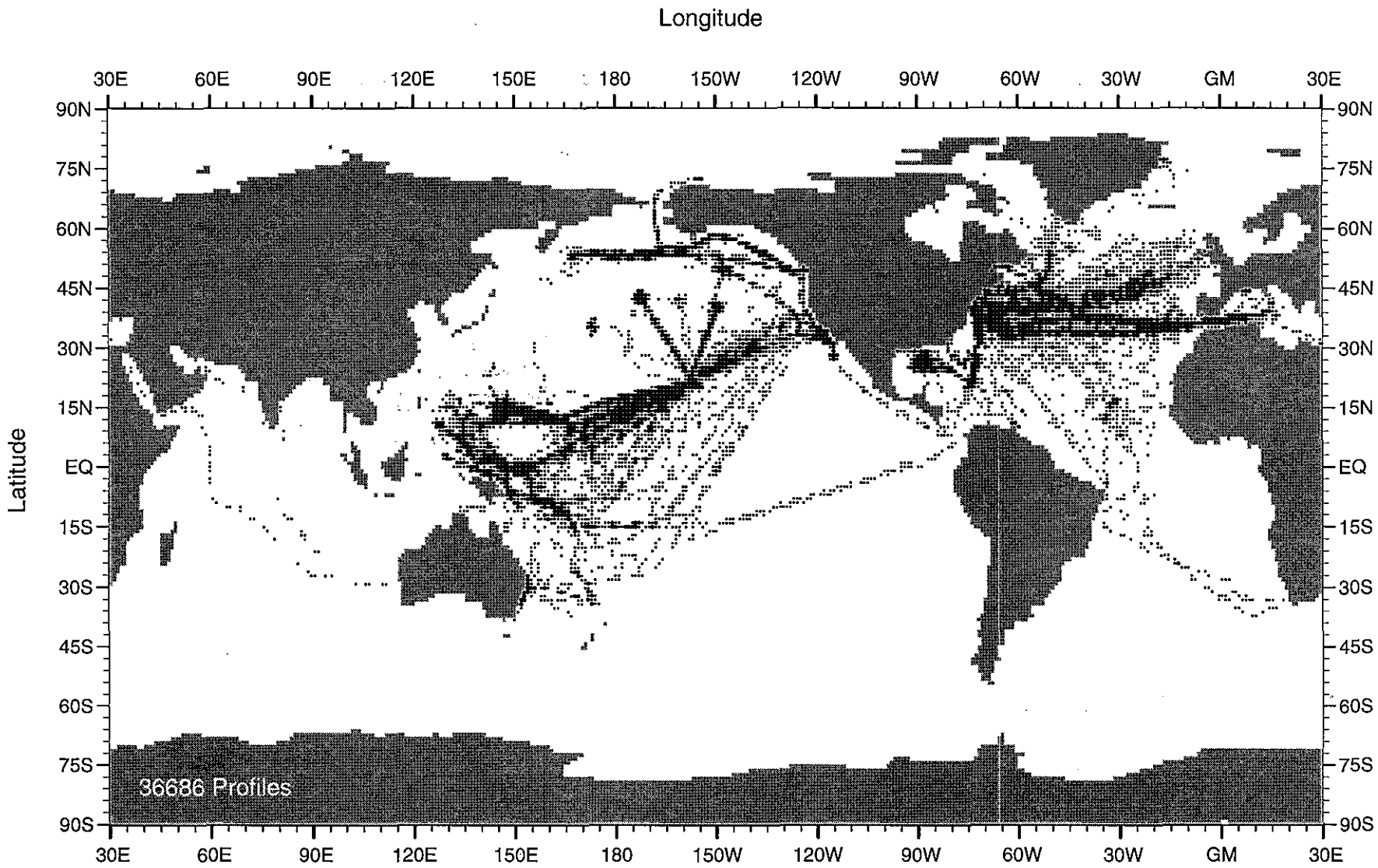

Fig. A4 WOD98 MBT profile distribution for 1944

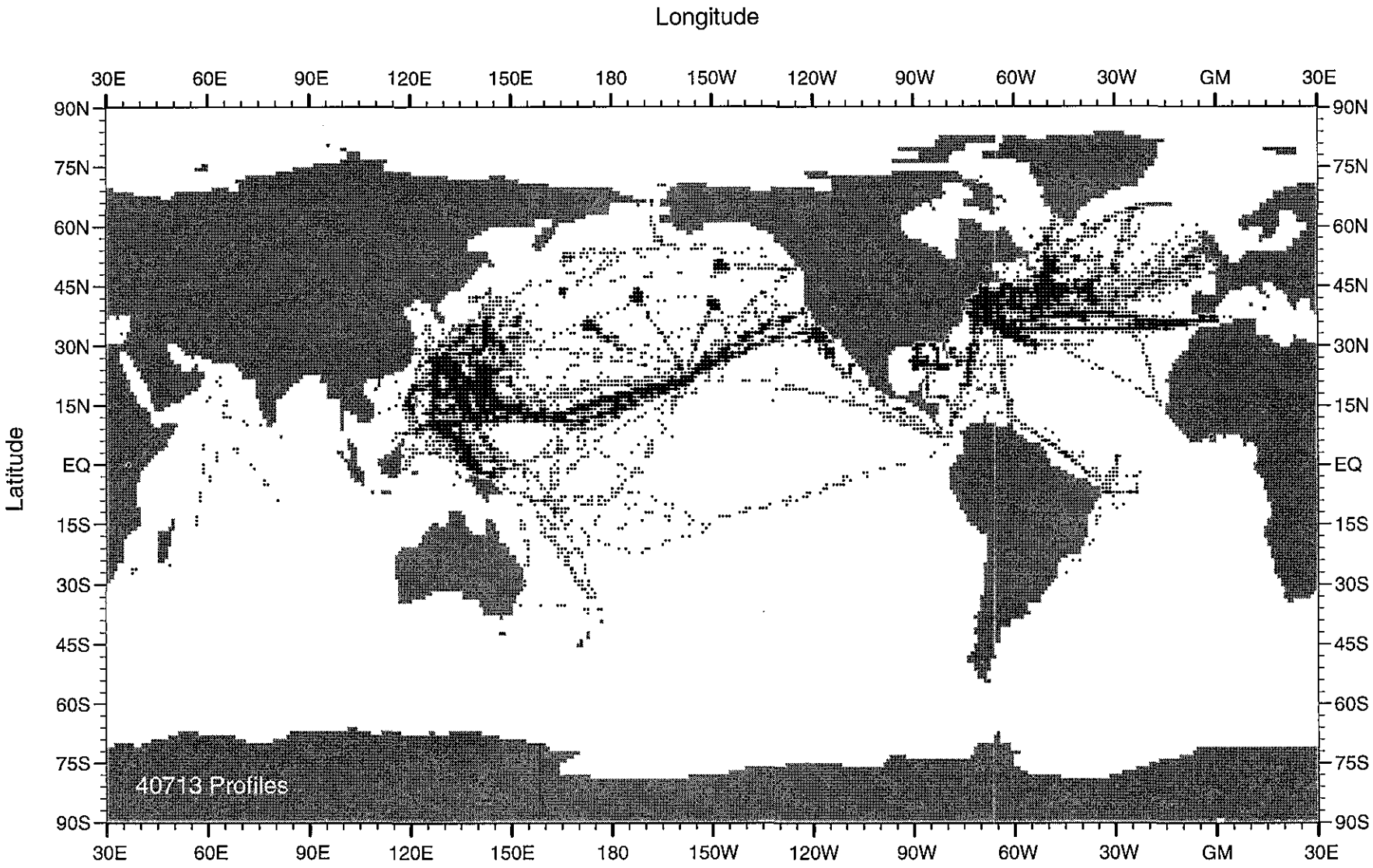

Fig. A5 WOD98 MBT profile distribution for 1945

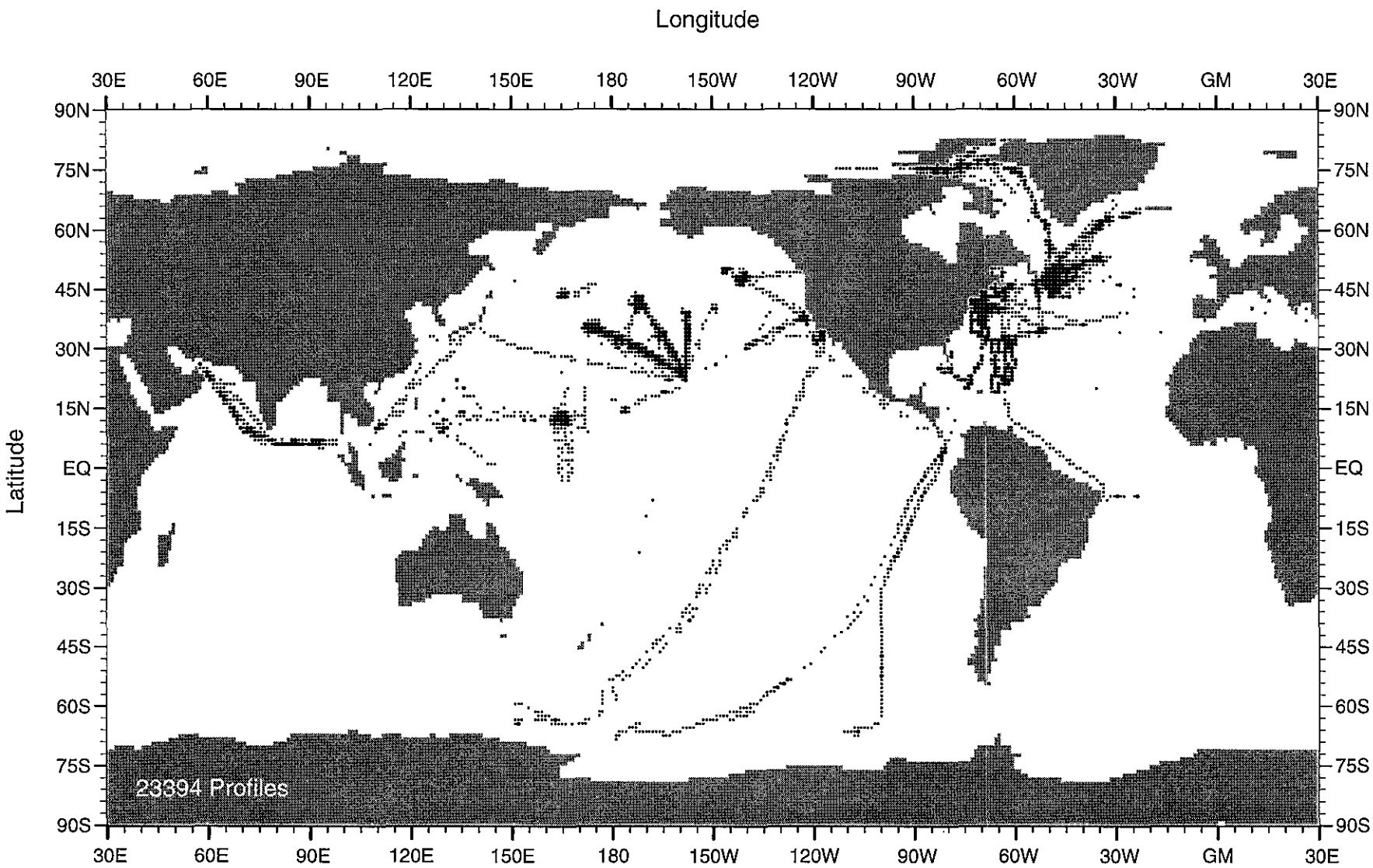

Fig. A6 WOD98 MBT profile distribution for 1946

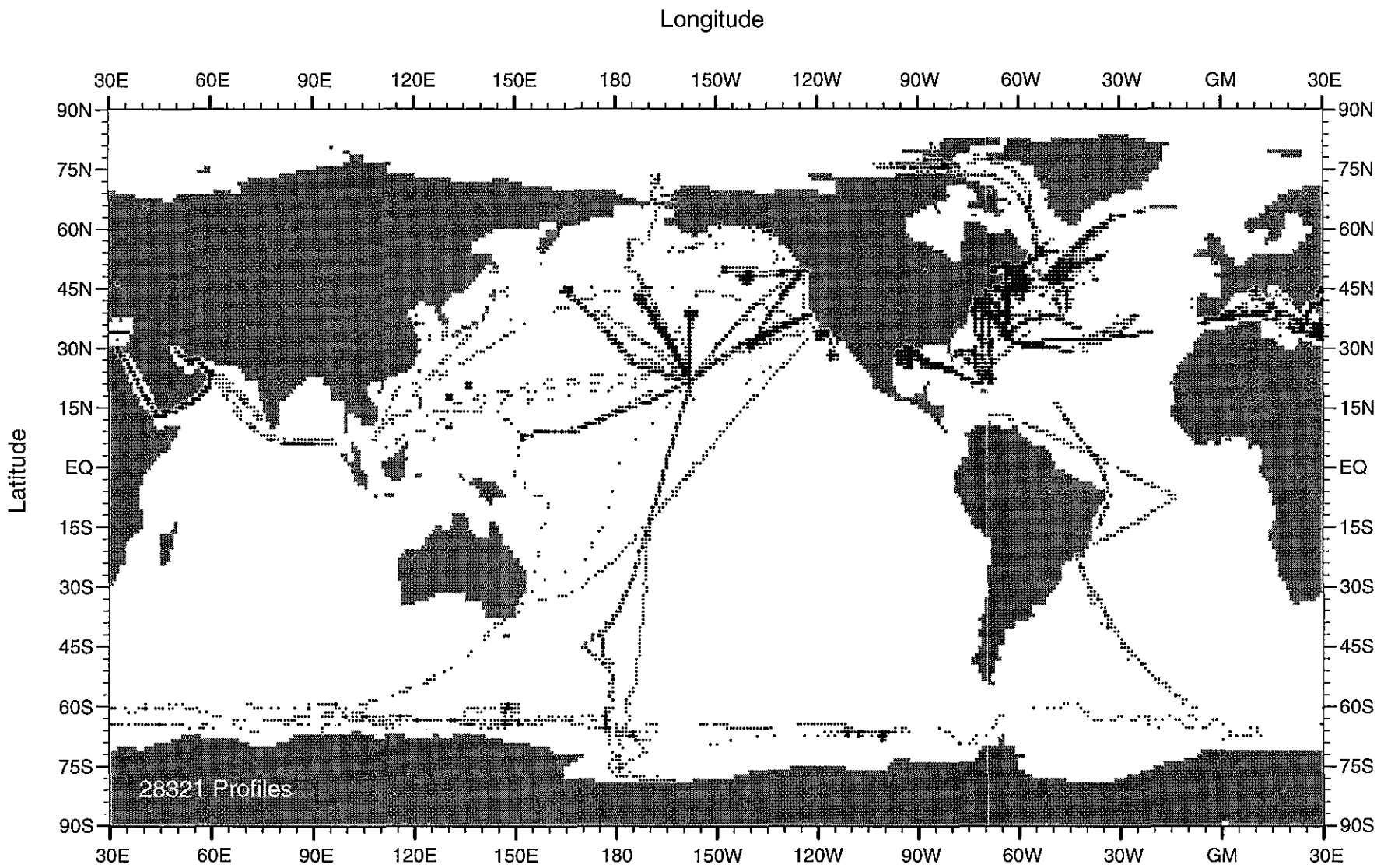

Fig. A7 WOD98 MBT profile distribution for 1947

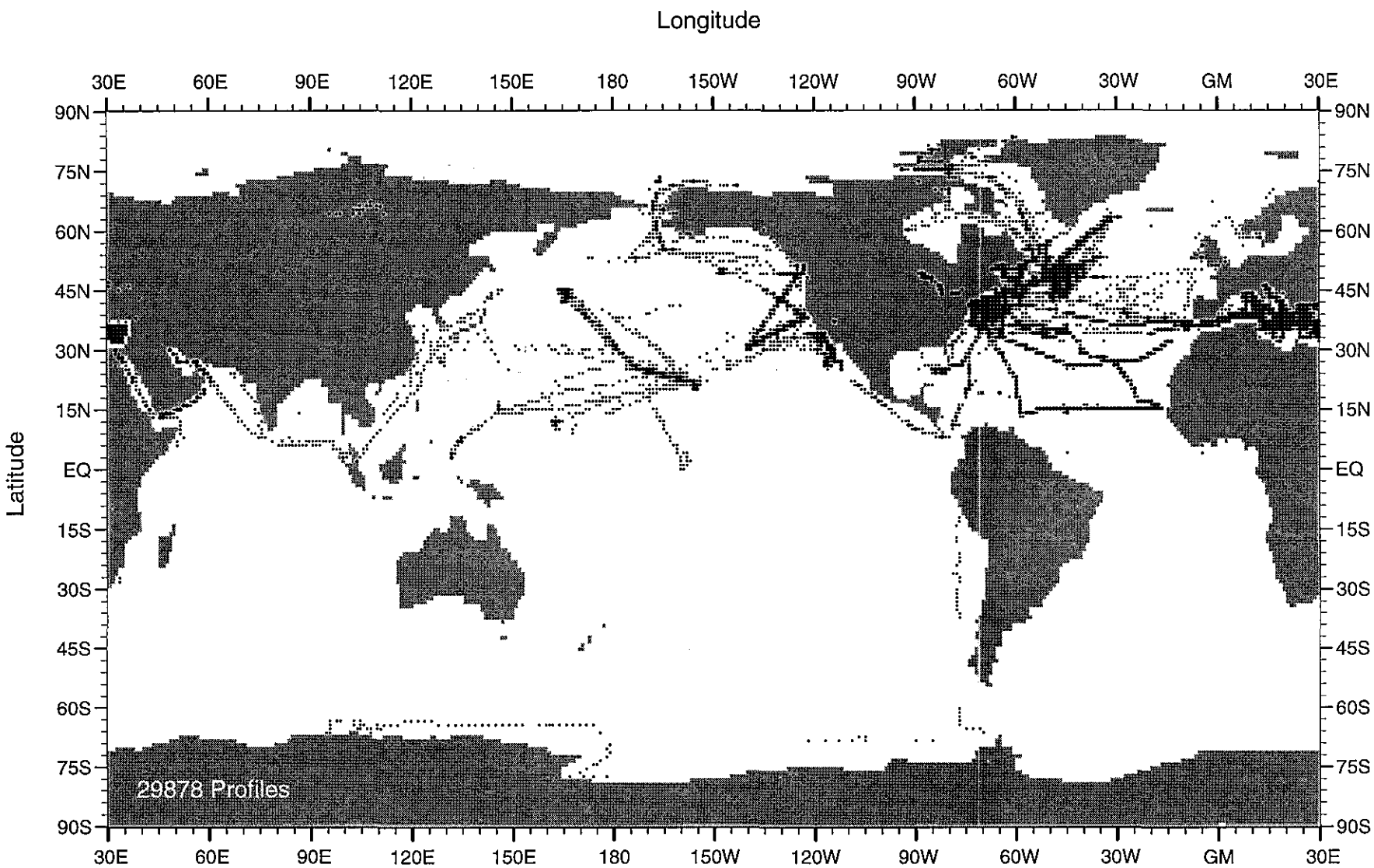

Fig. A8 WOD98 MBT profile distribution for 1948

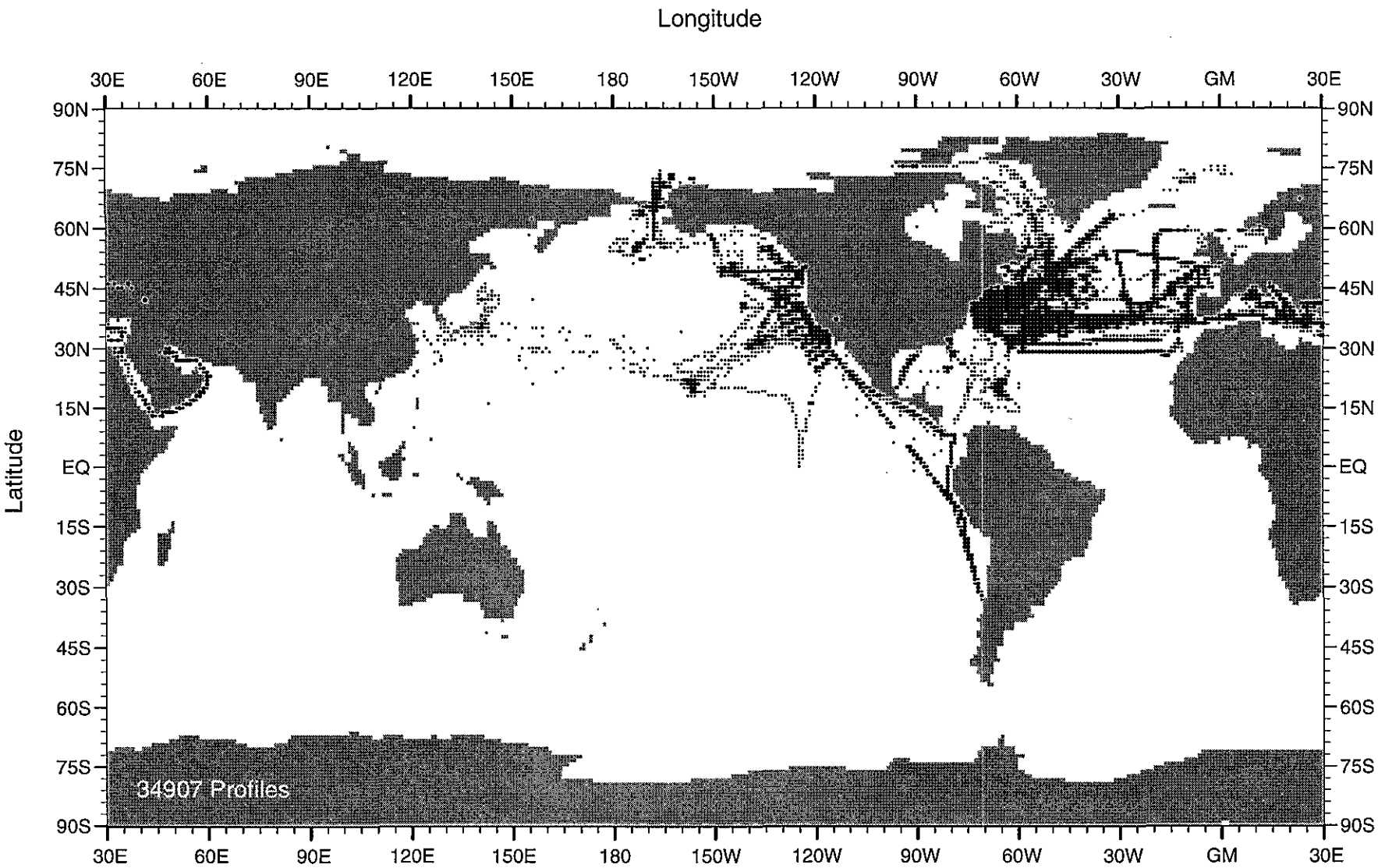

Fig. A9 WOD98 MBT profile distribution for 1949

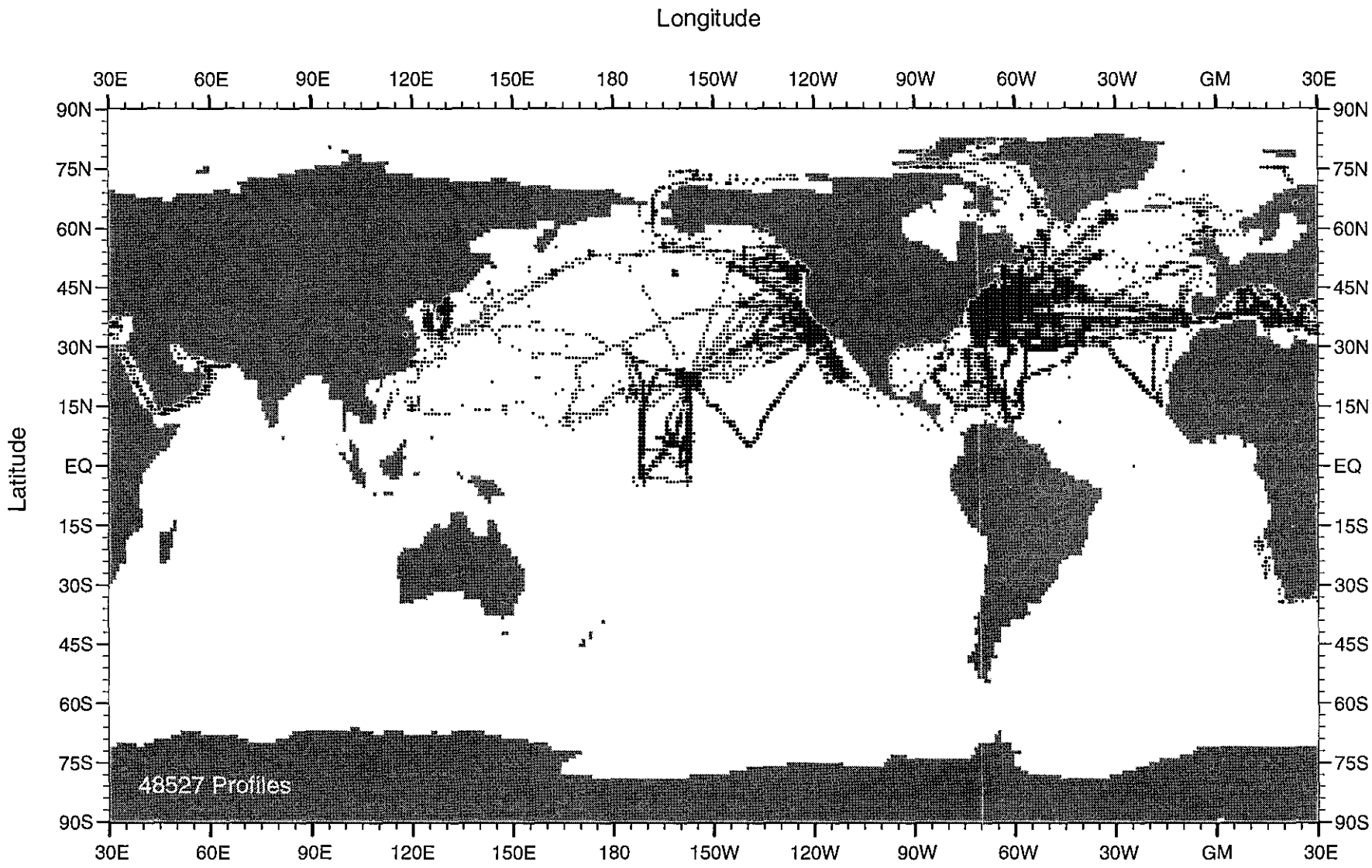

Fig. A10 WOD98 MBT profile distribution for 1950

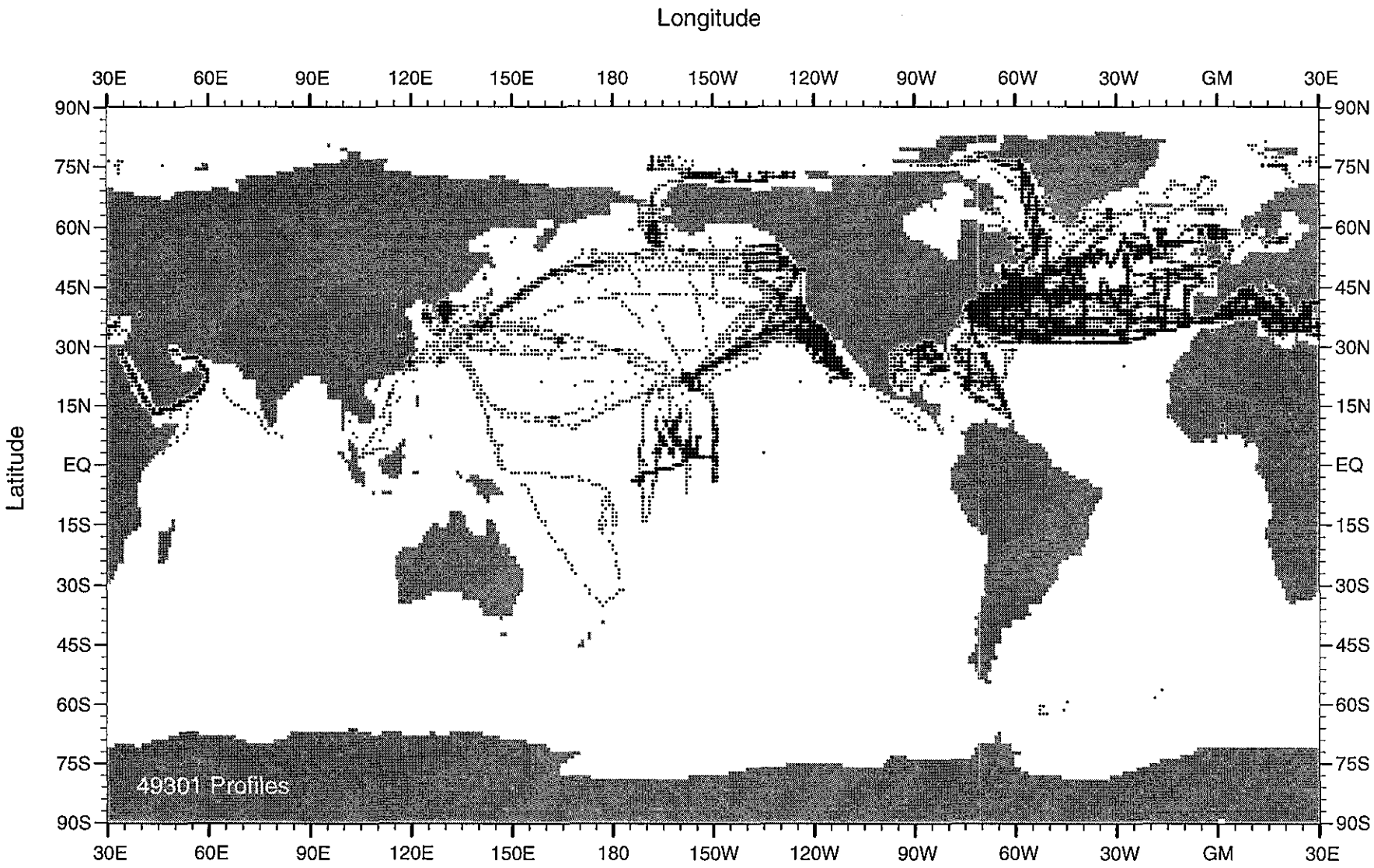

Fig. A11 WOD98 MBT profile distribution for 1951

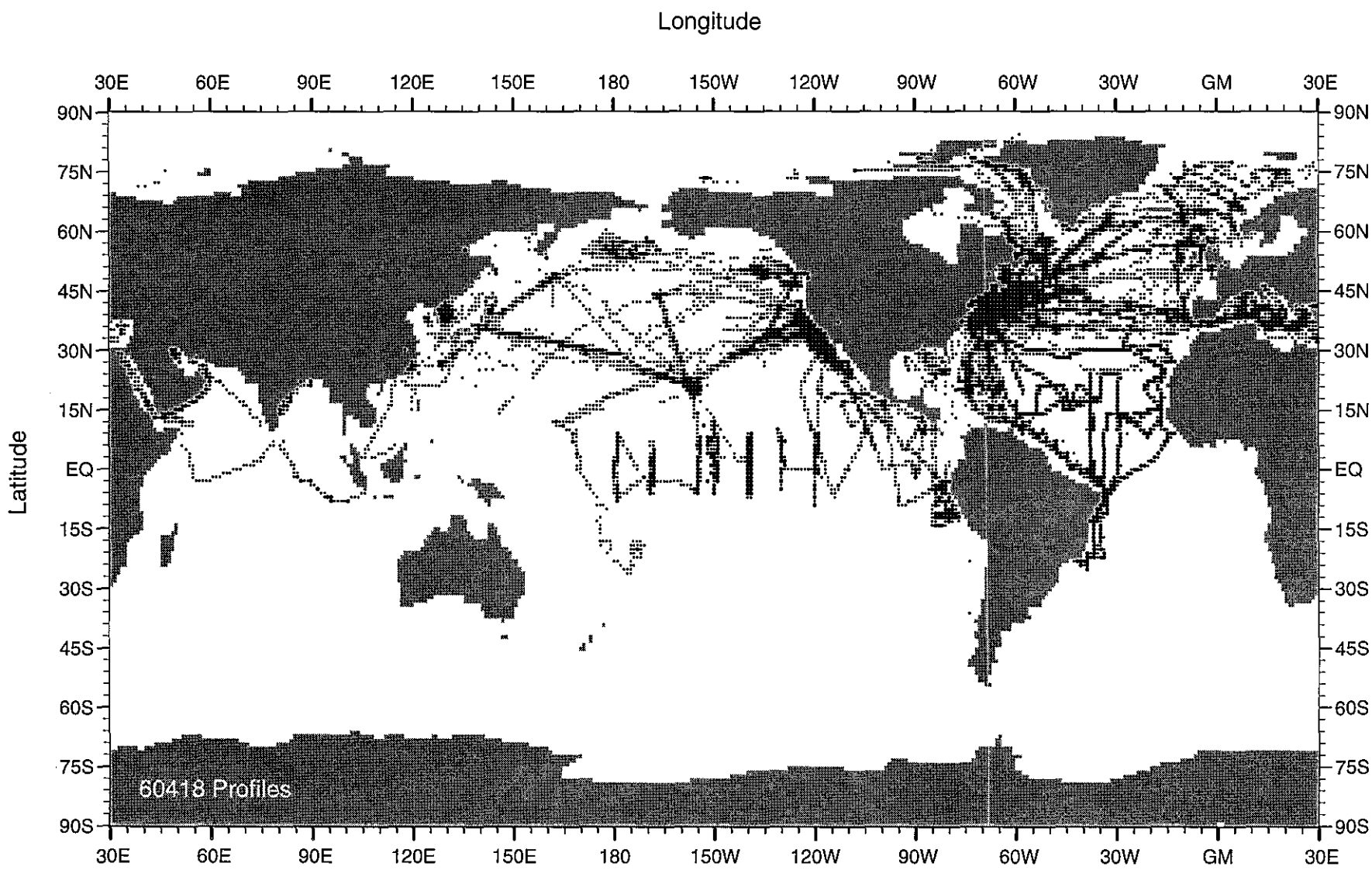

Fig. A12 WOD98 MBT profile distribution for 1952

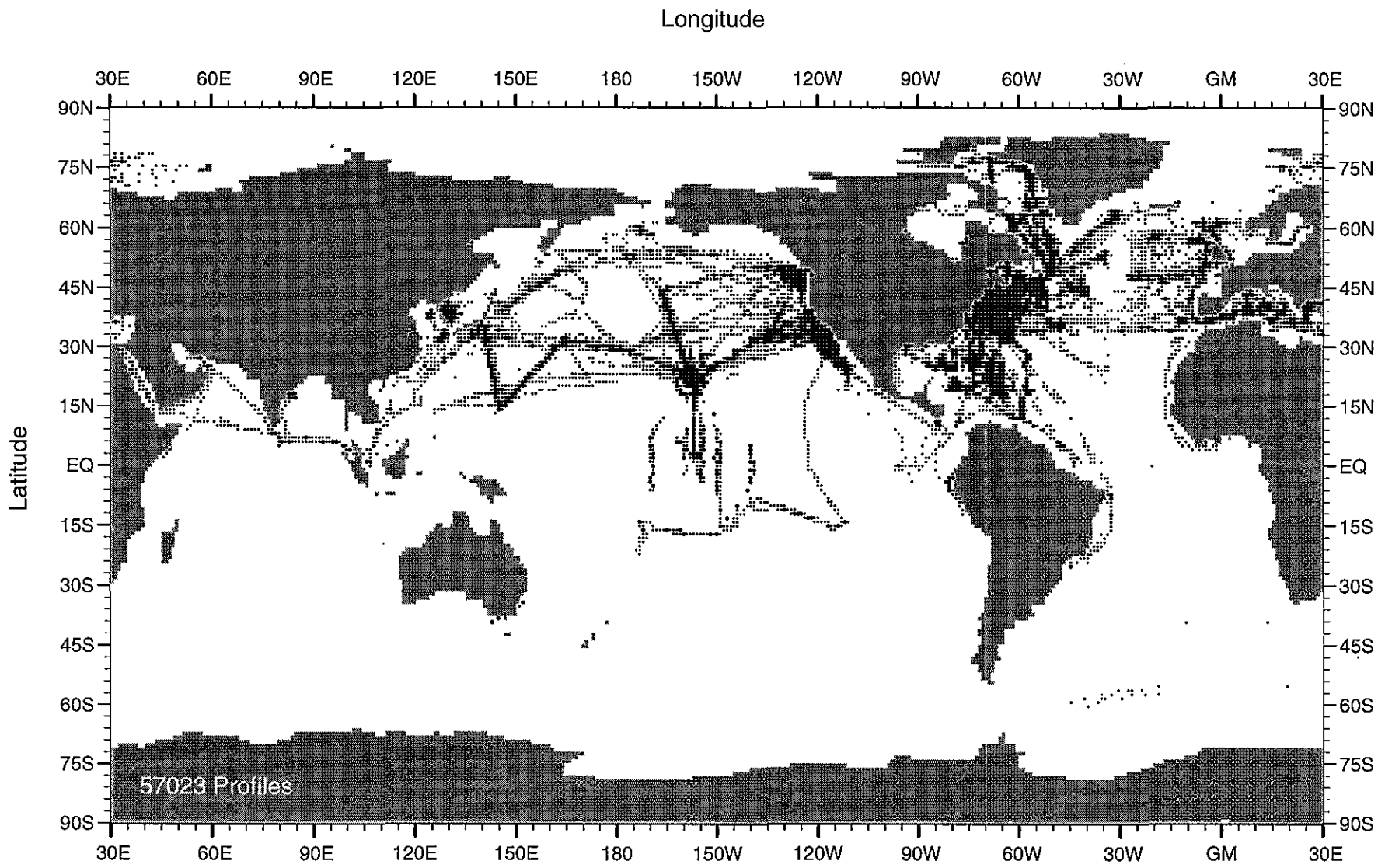

Fig. A13 WOD98 MBT profile distribution for 1953

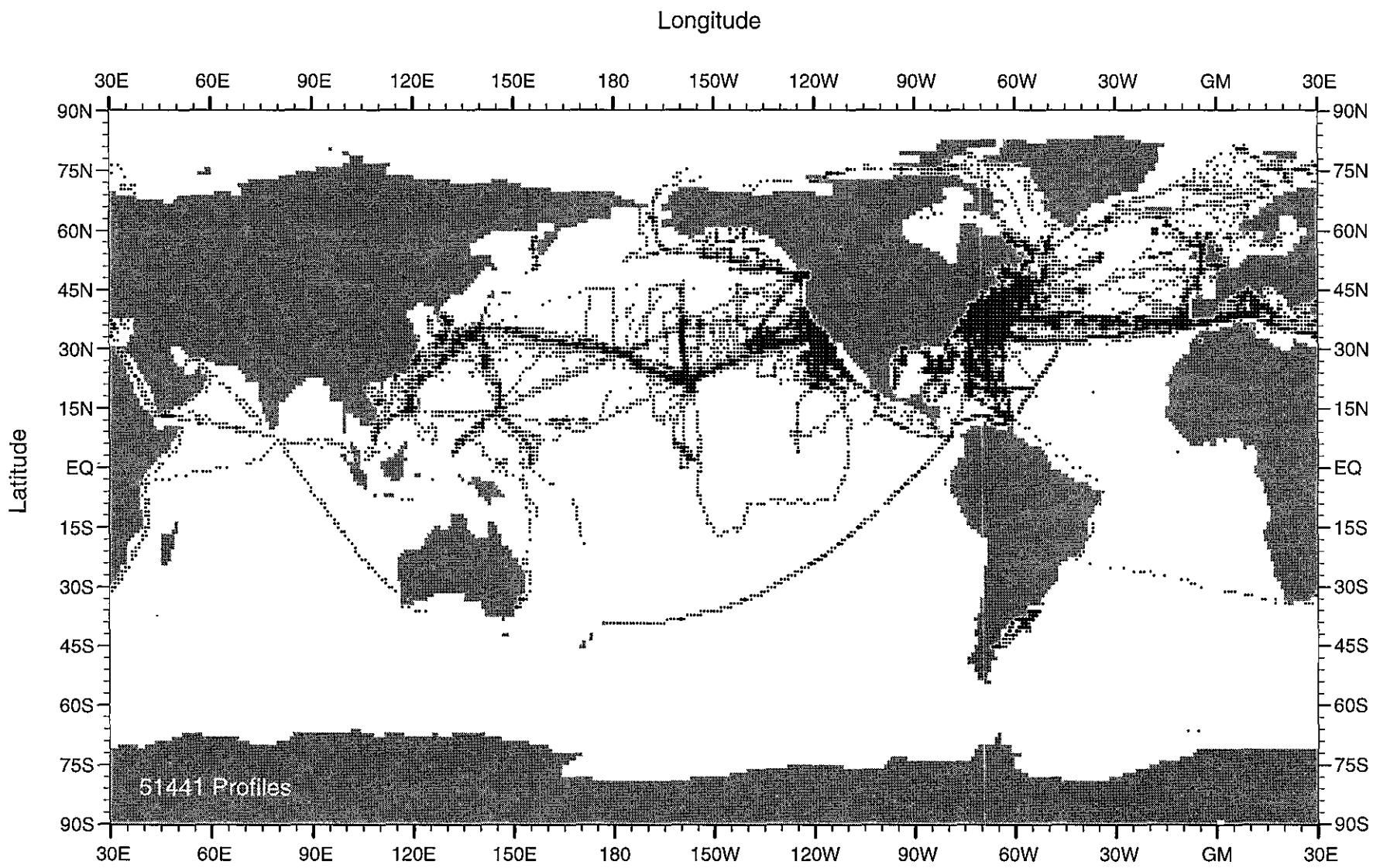

Fig. A14 WOD98 MBT profile distribution for 1954

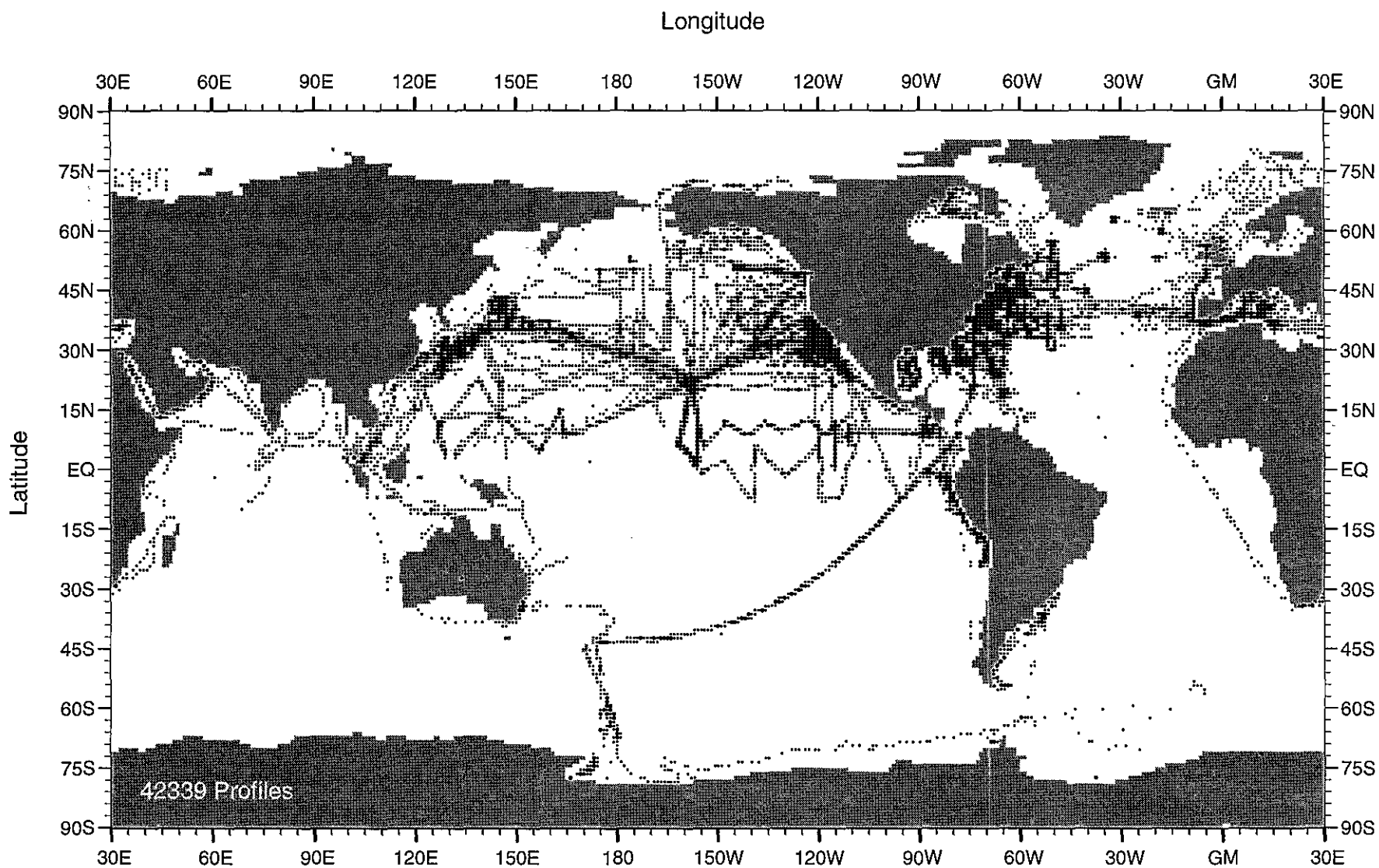

Fig. A15 WOD98 MBT profile distribution for 1955

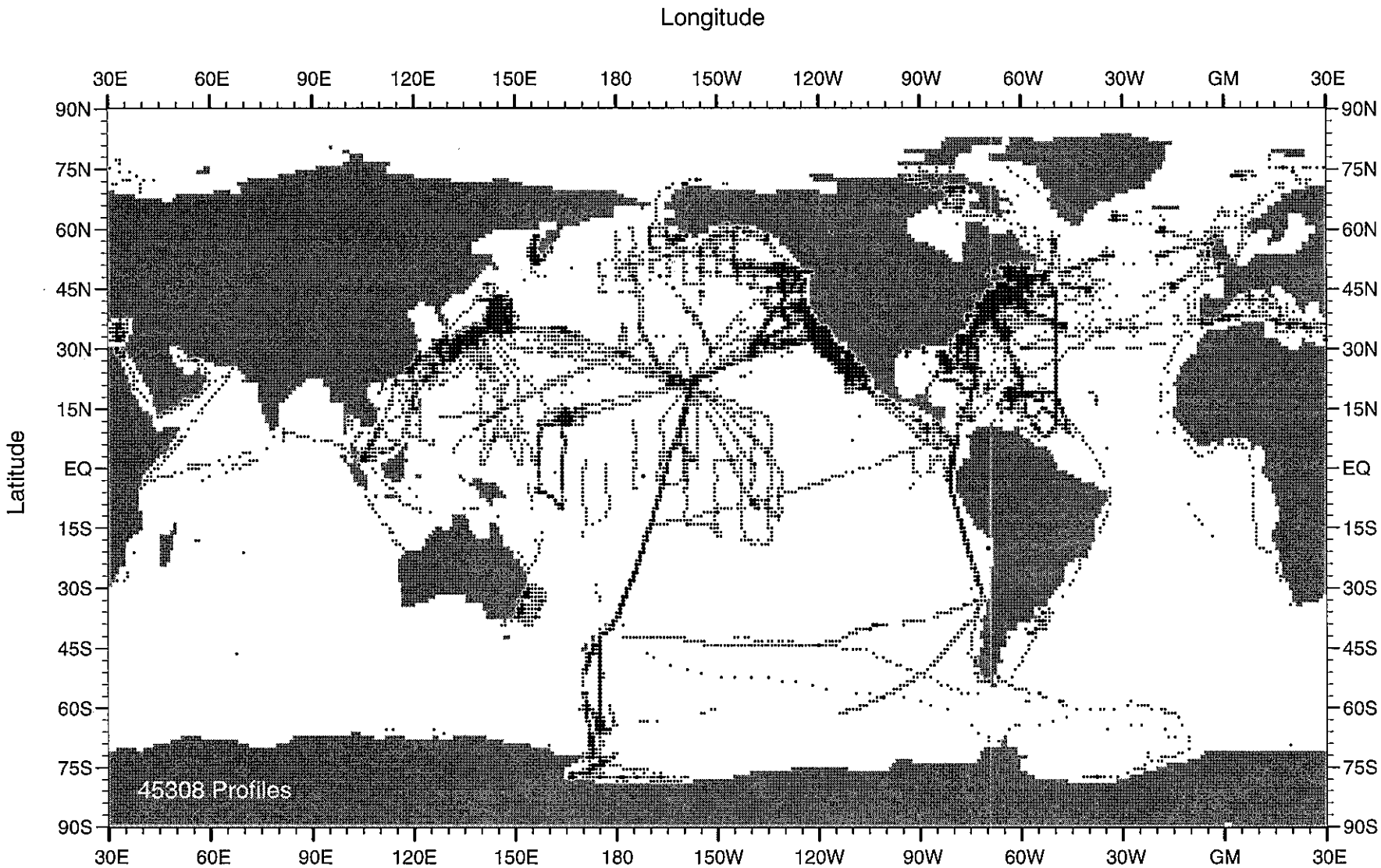

Fig. A16 WOD98 MBT profile distribution for 1956

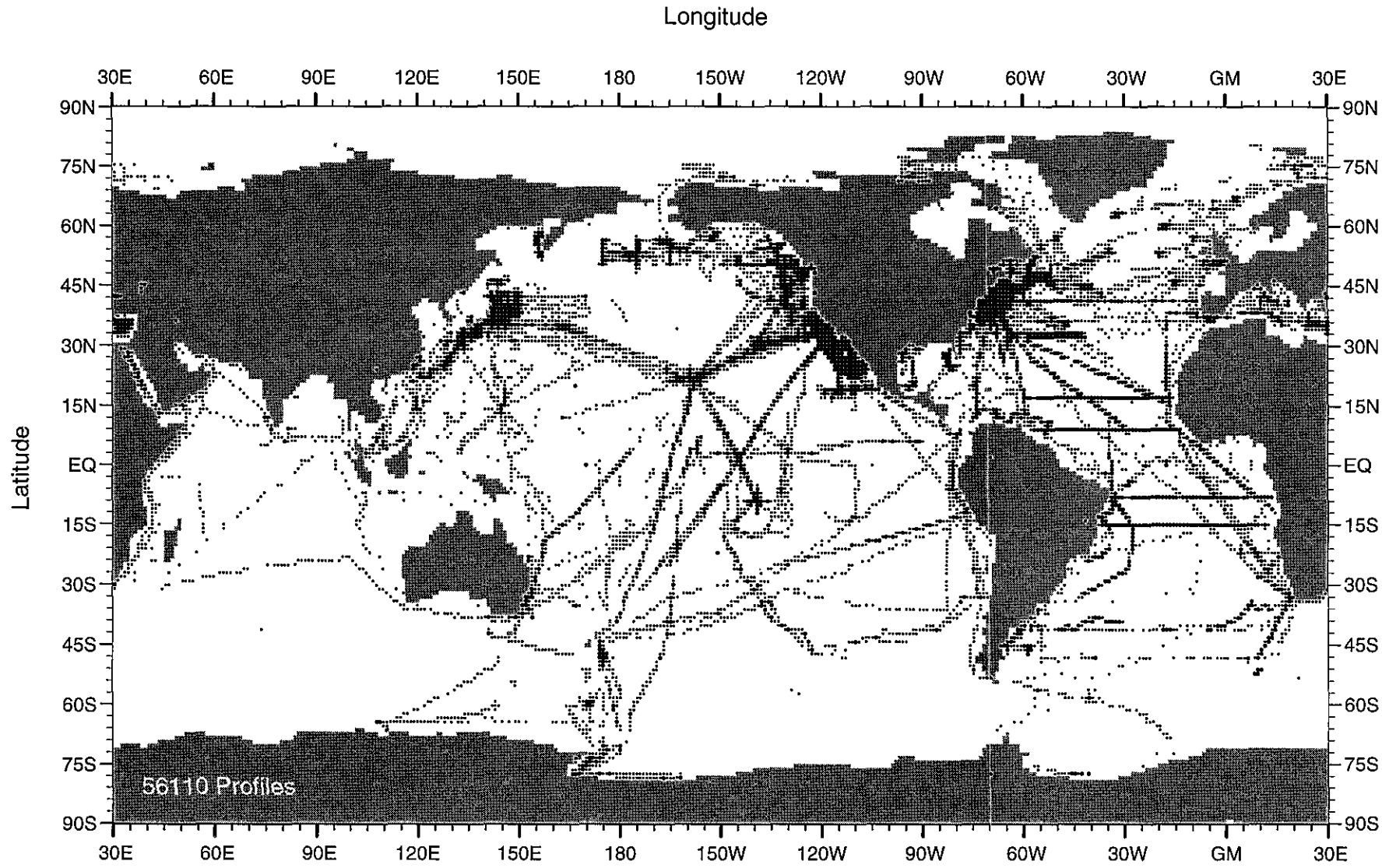

Fig. A17 WOD98 MBT profile distribution for 1957

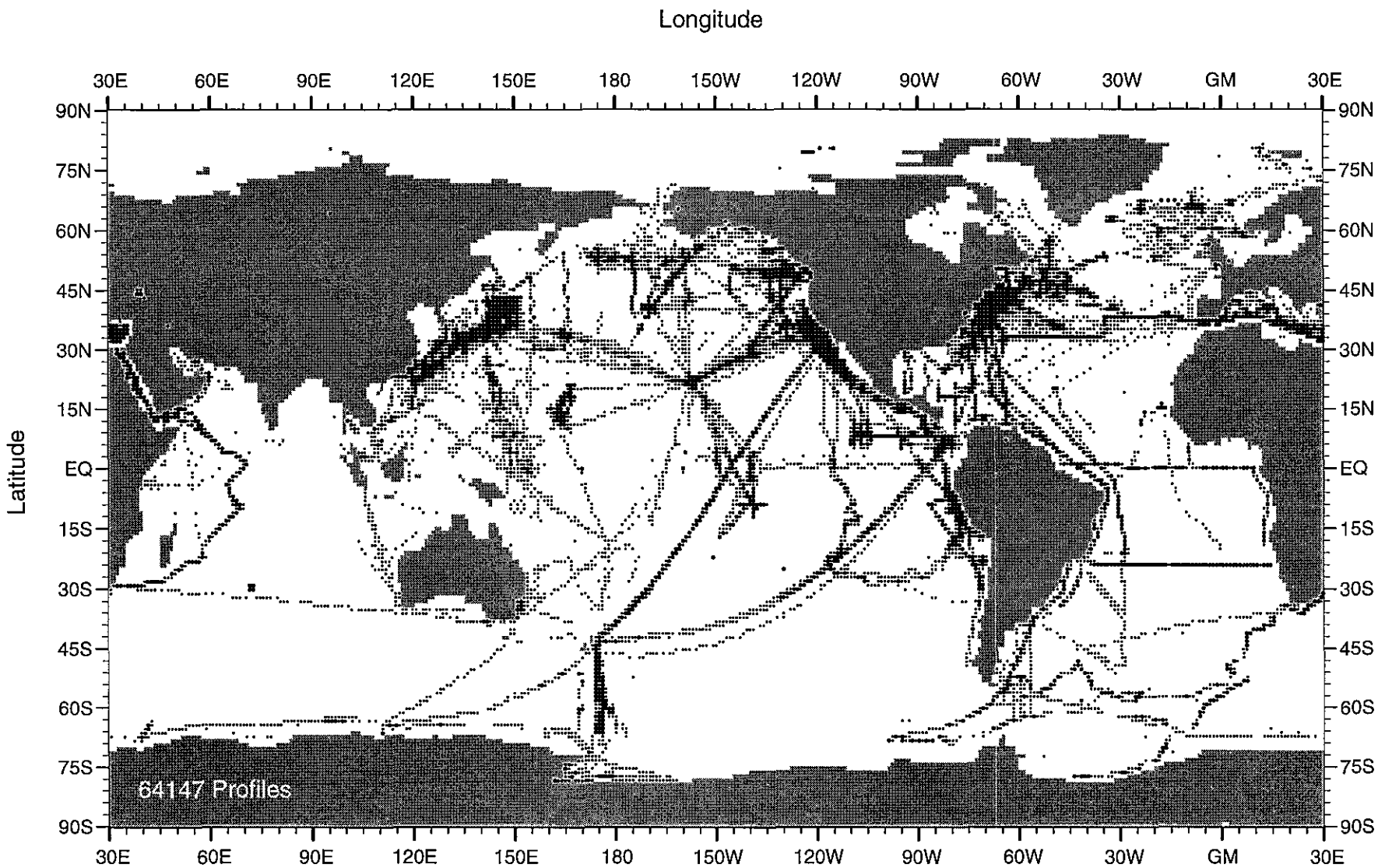

Fig. A18 WOD98 MBT profile distribution for 1958

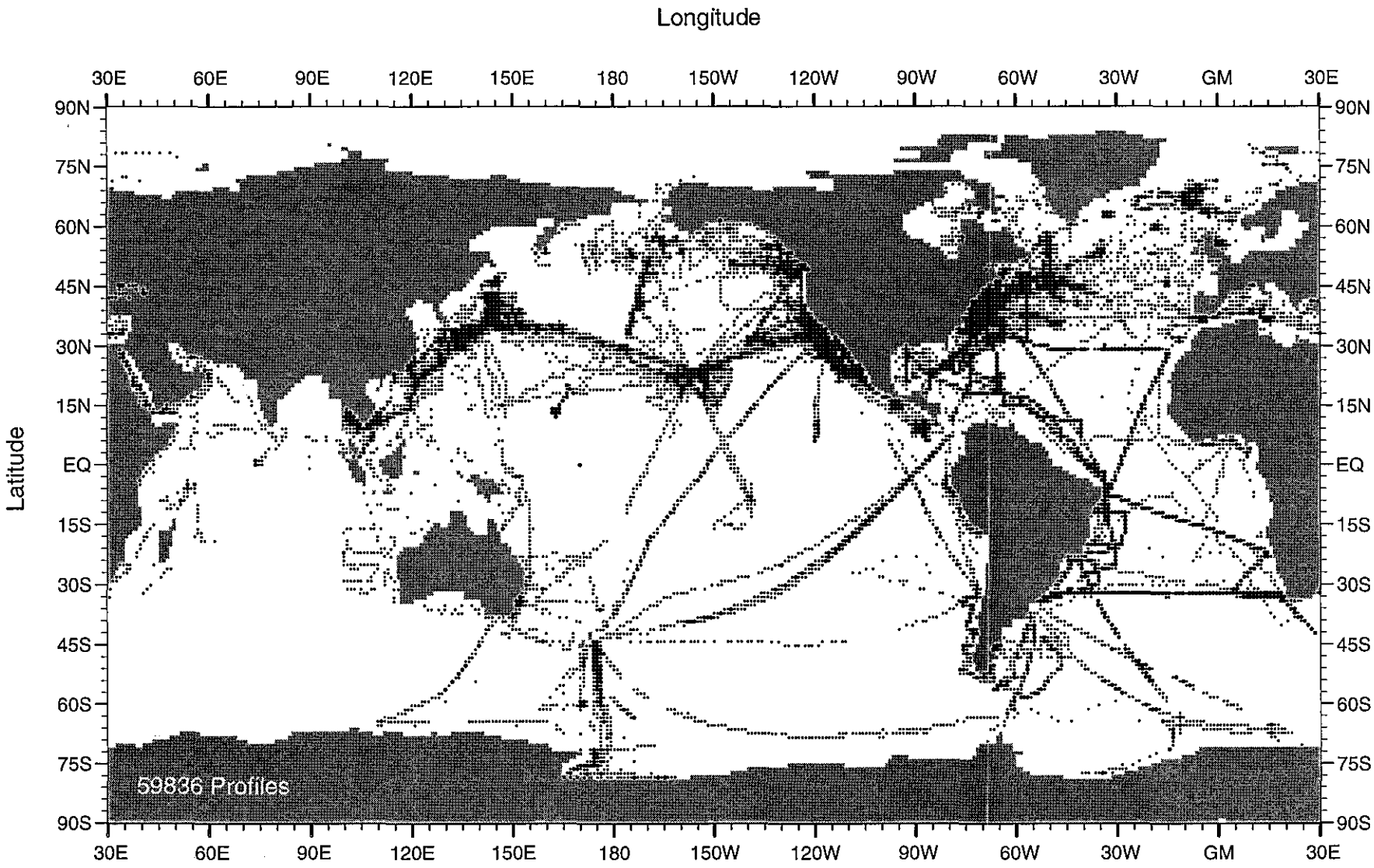

Fig. A19 WOD98 MBT profile distribution for 1959

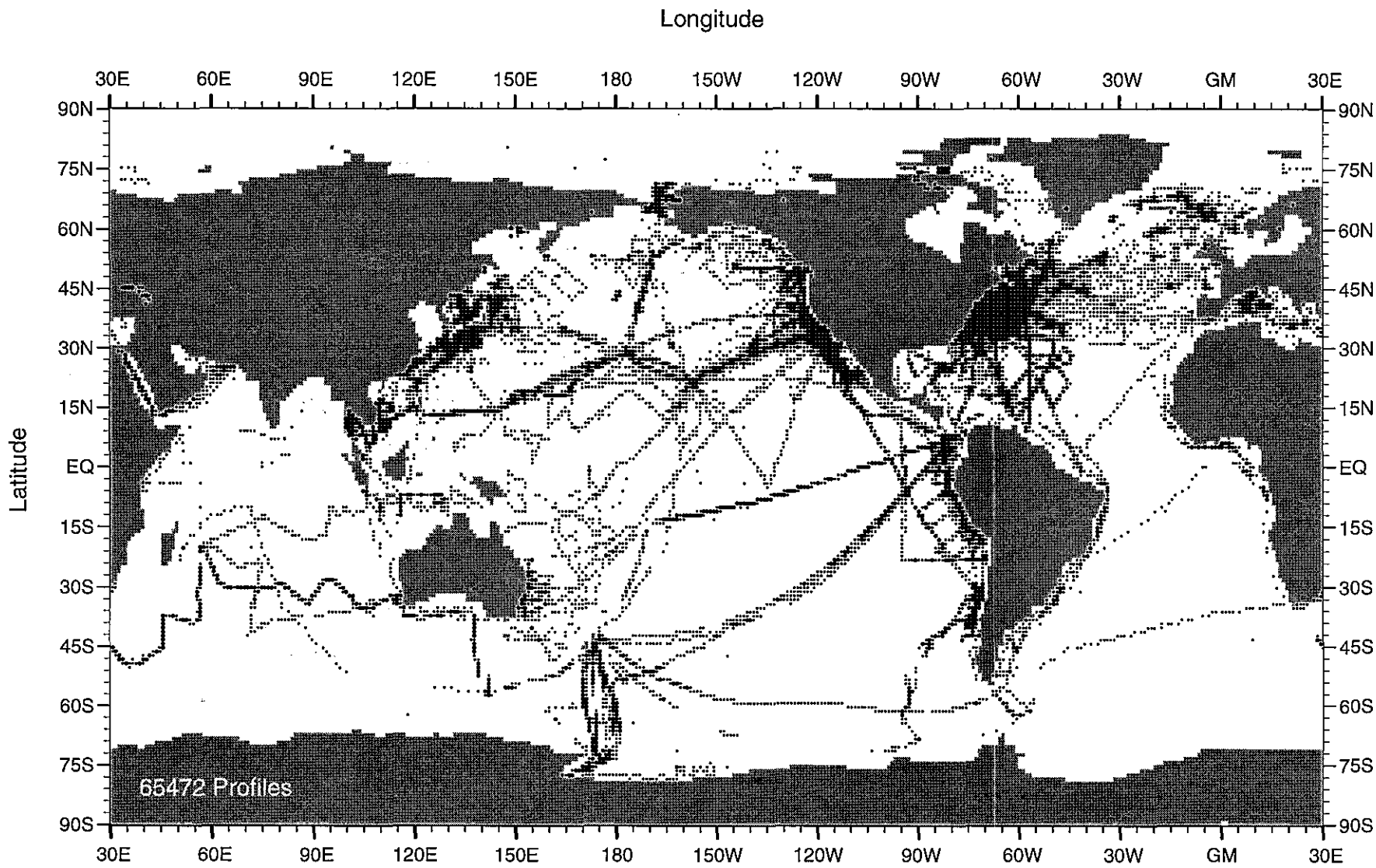

Fig. A20 WOD98 MBT profile distribution for 1960

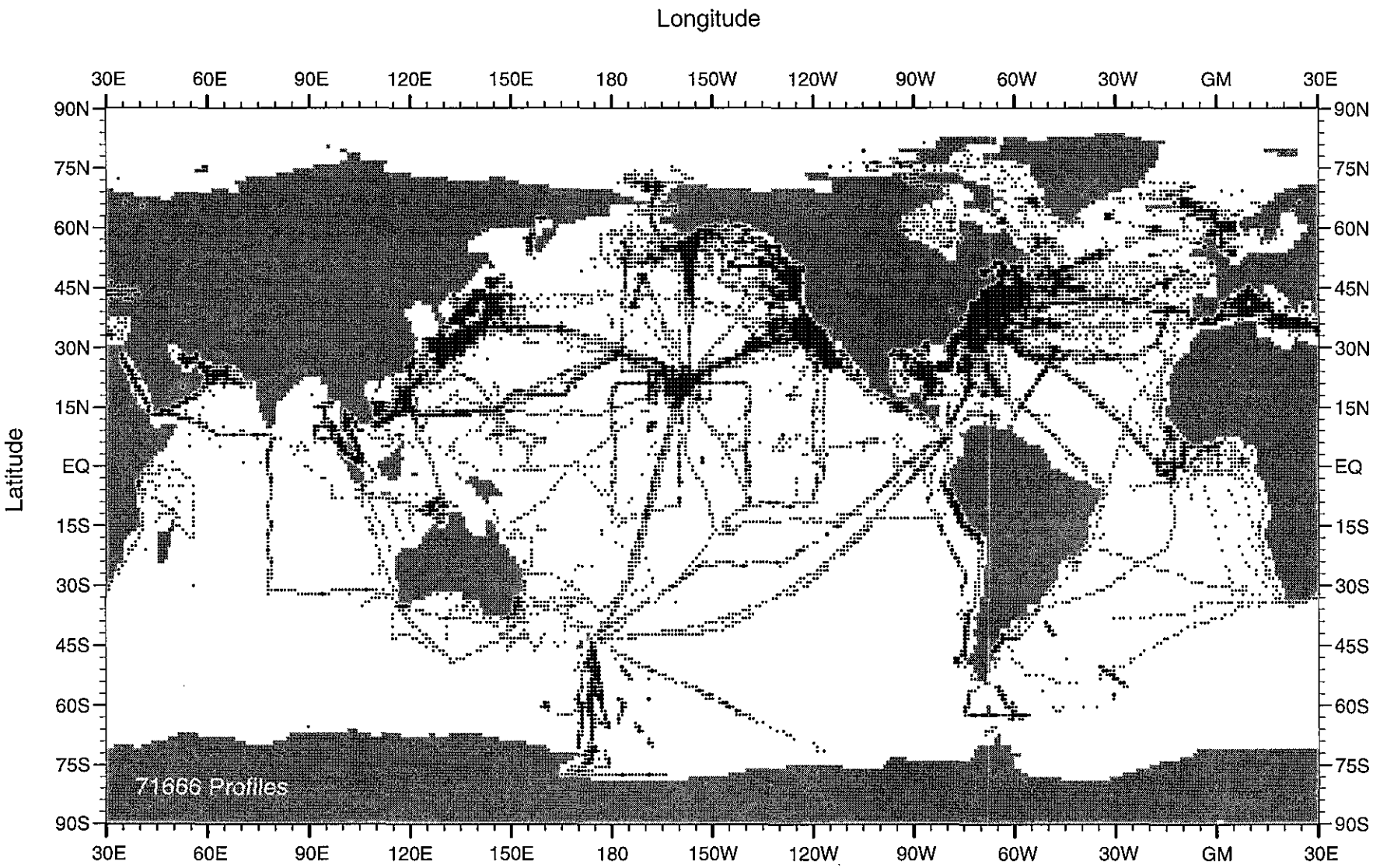

Fig. A21 WOD98 MBT profile distribution for 1961

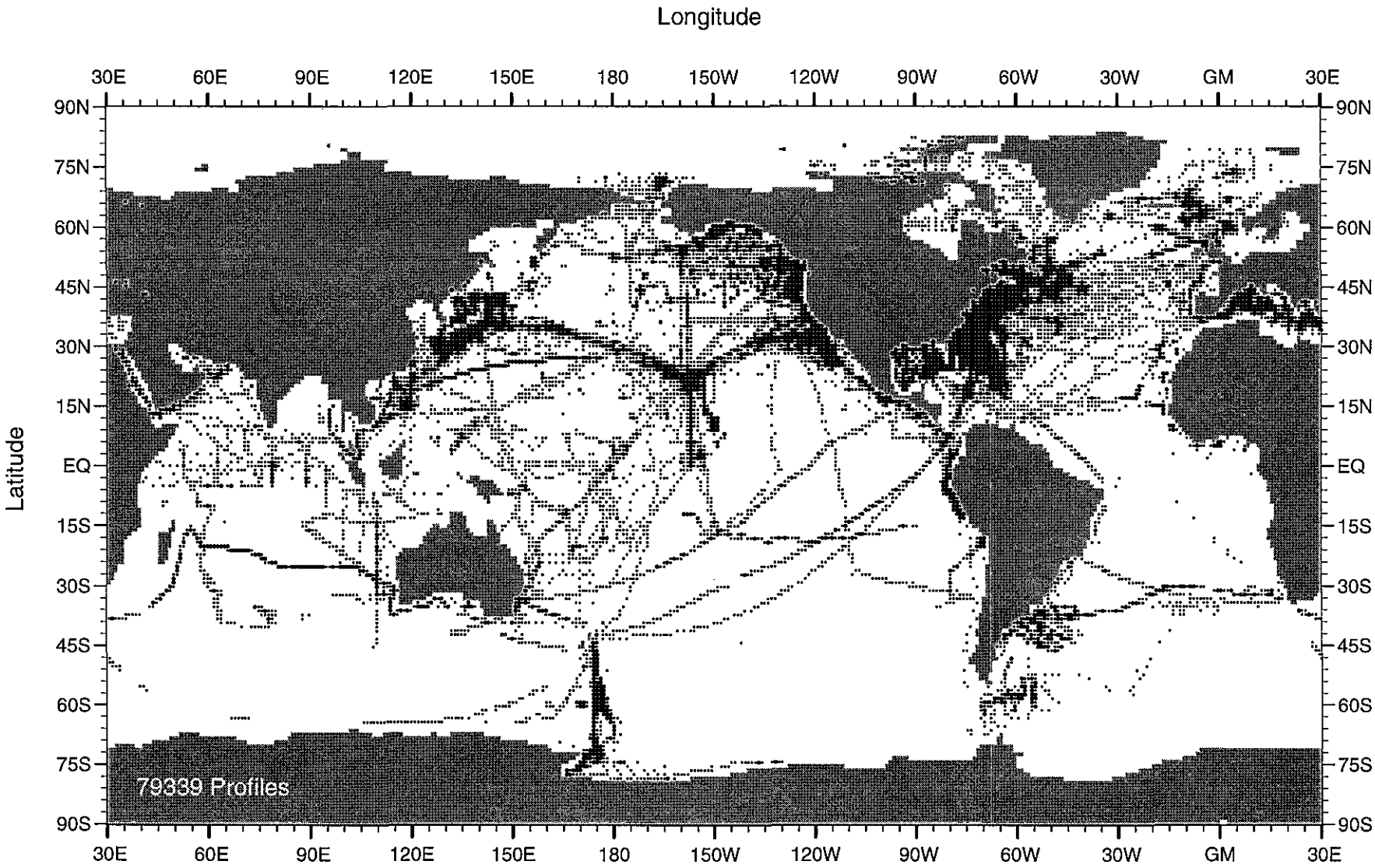

Fig. A22 WOD98 MBT profile distribution for 1962

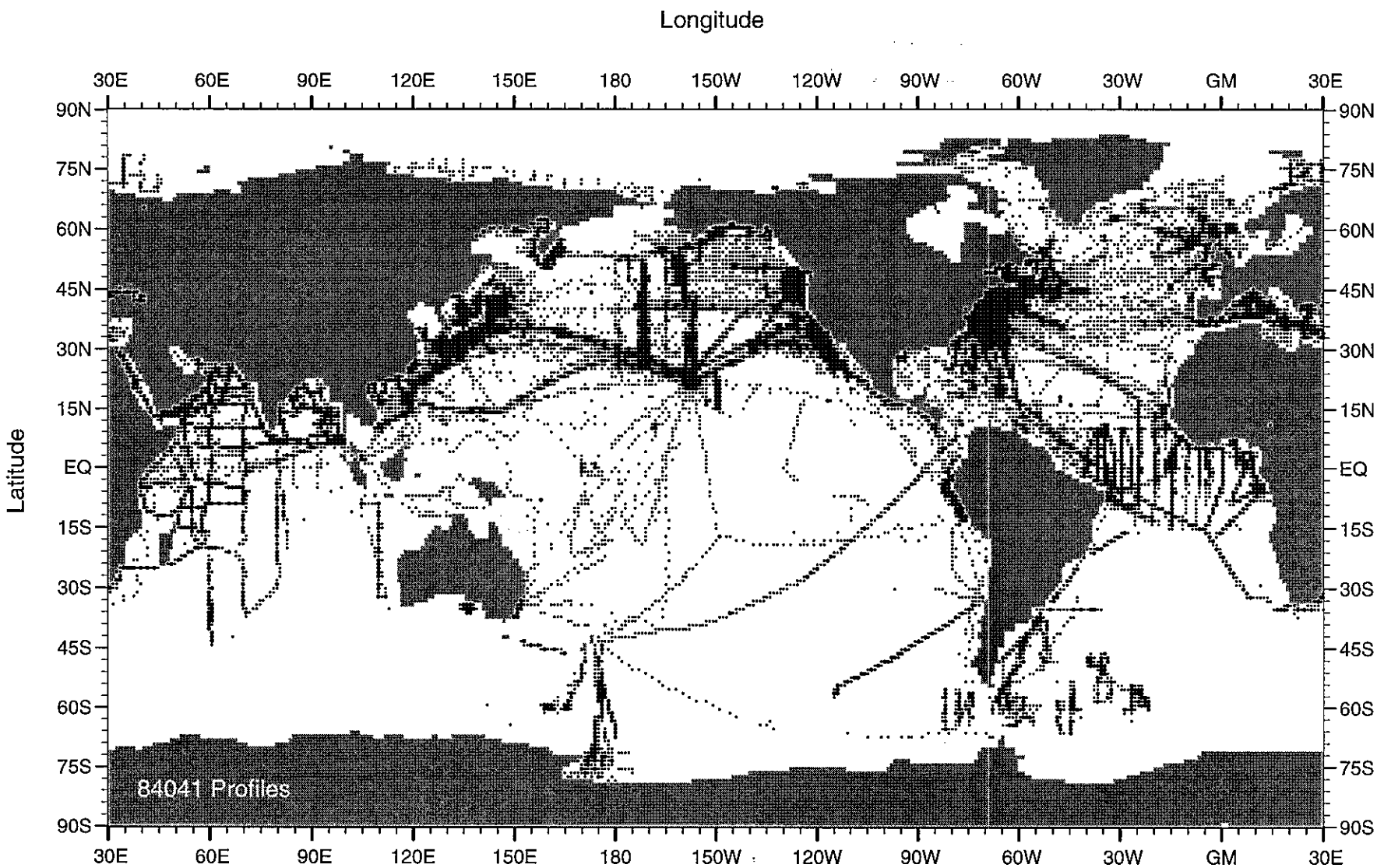

Fig. A23 WOD98 MBT profile distribution for 1963

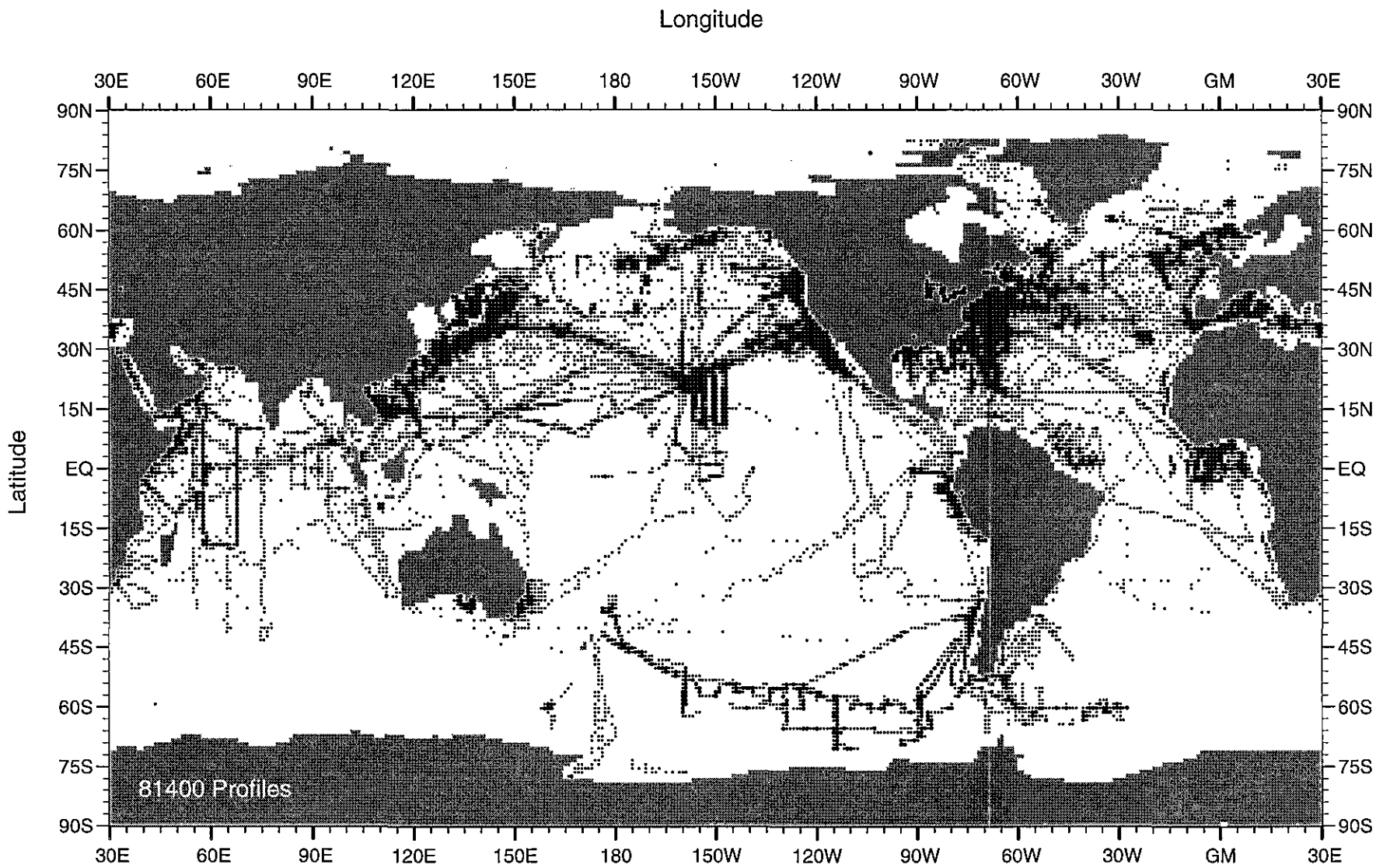

Fig. A24 WOD98 MBT profile distribution for 1964

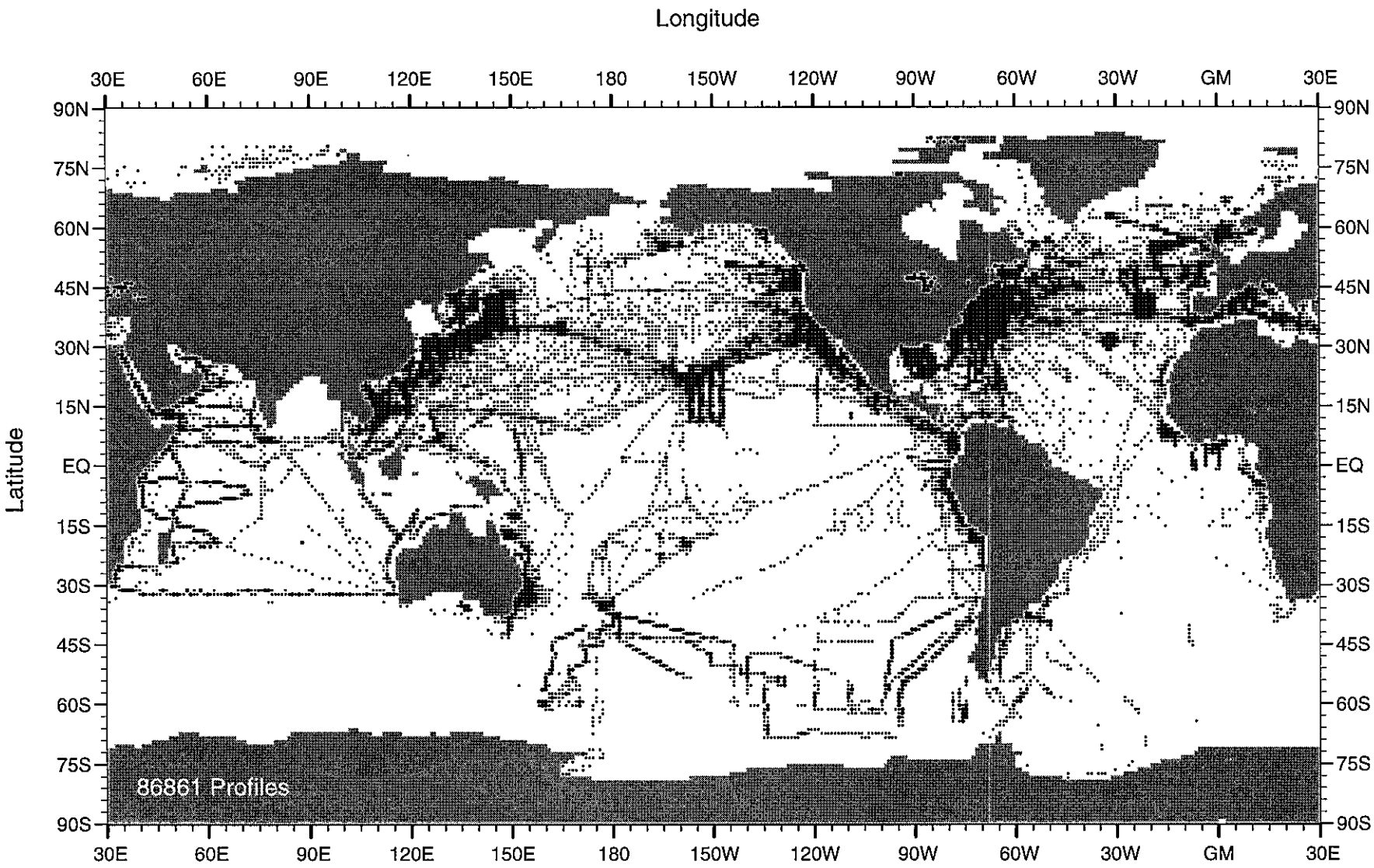

Fig. A25 WOD98 MBT profile distribution for 1965

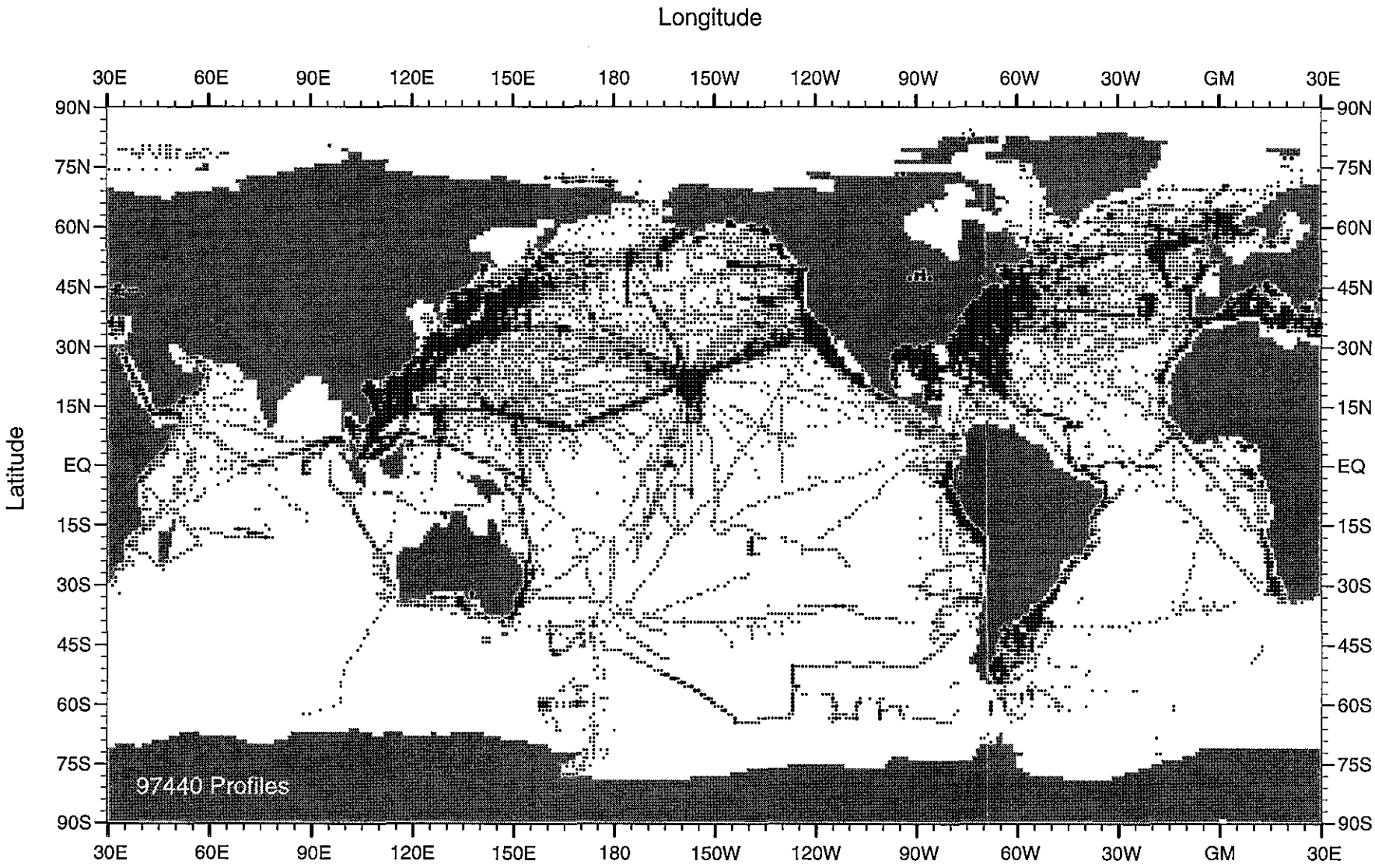

Fig. A26 WOD98 MBT profile distribution for 1966

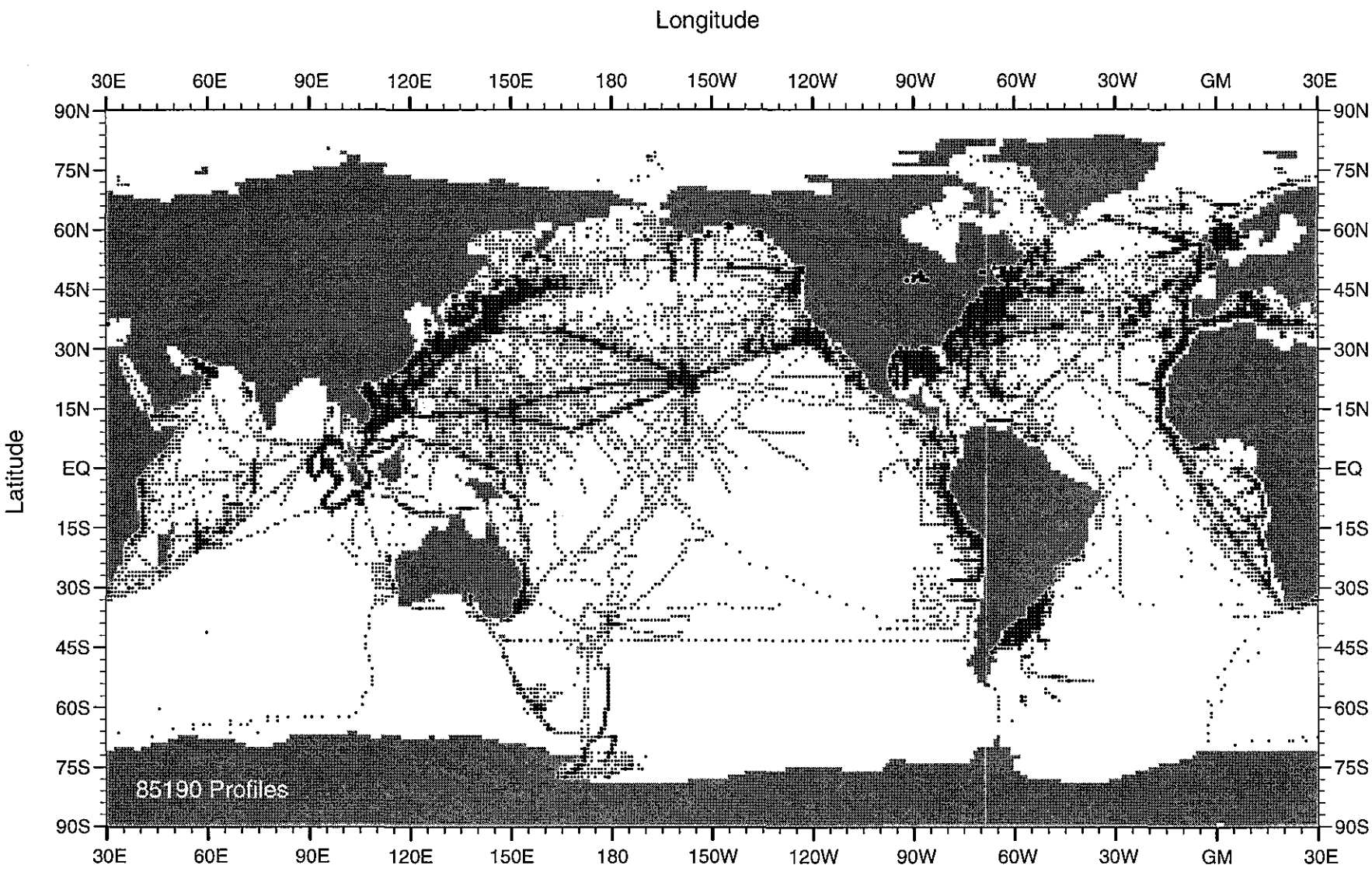

Fig. A27 WOD98 MBT profile distribution for 1967

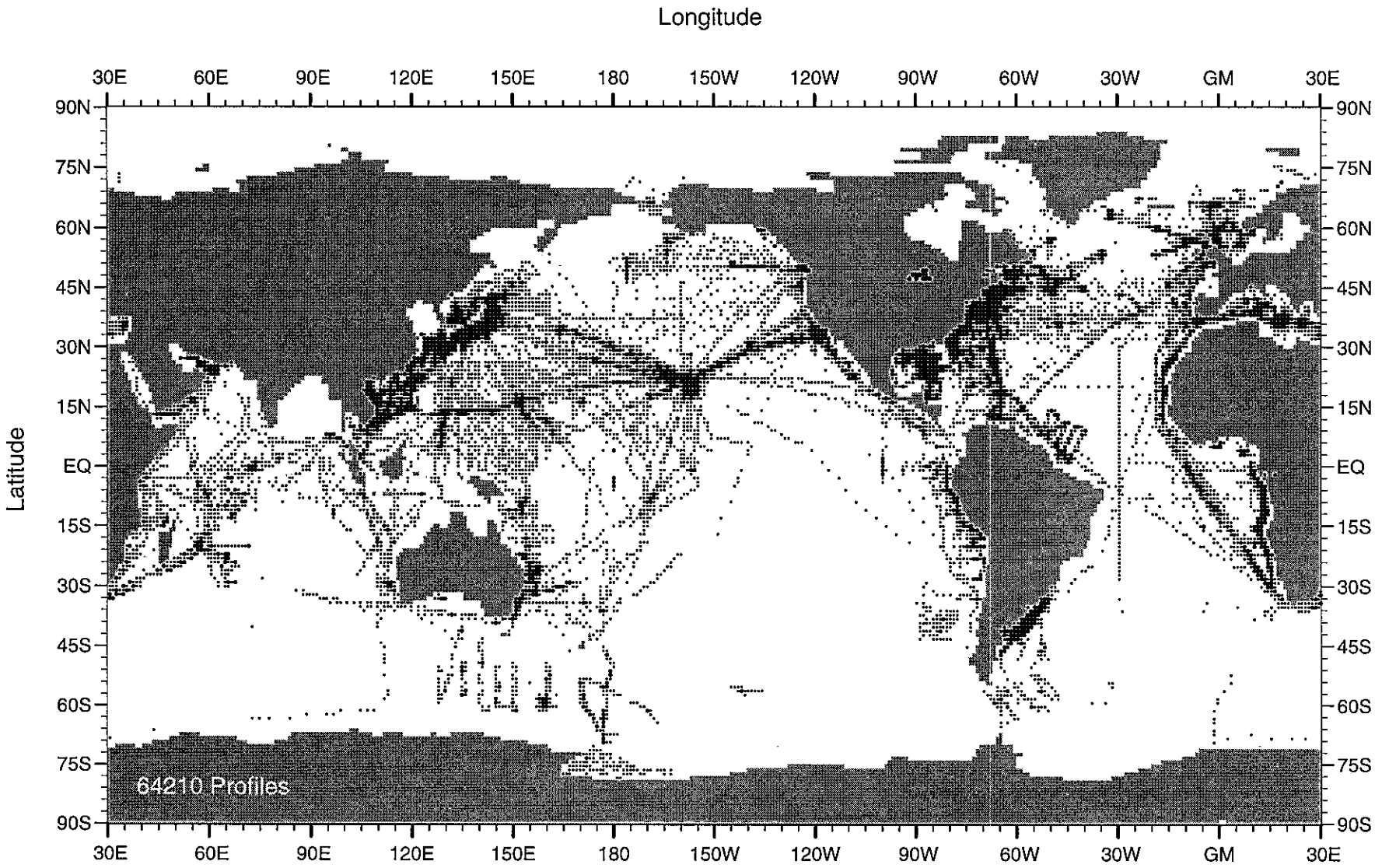

Fig. A28 WOD98 MBT profile distribution for 1968

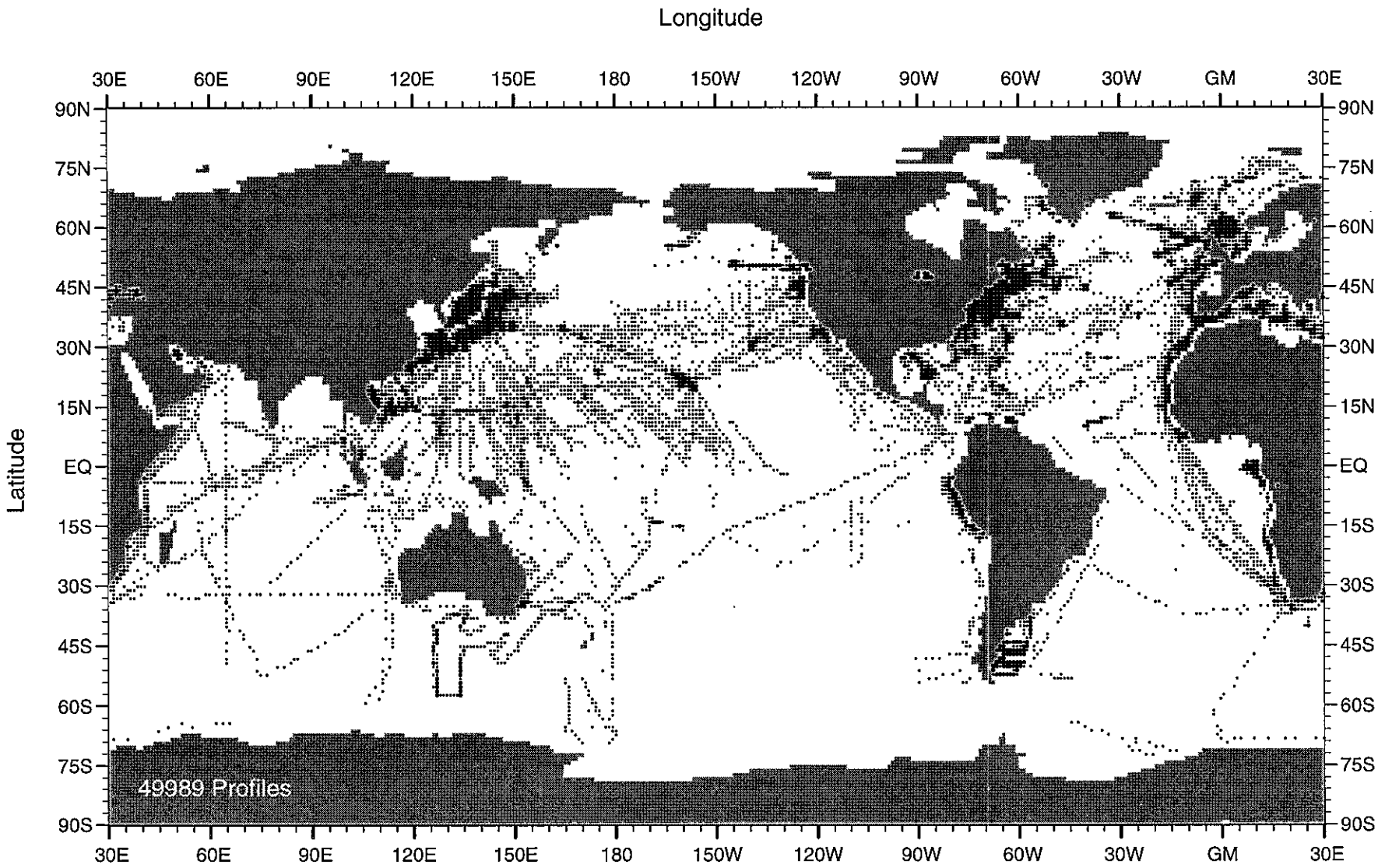

Fig. A29 WOD98 MBT profile distribution for 1969

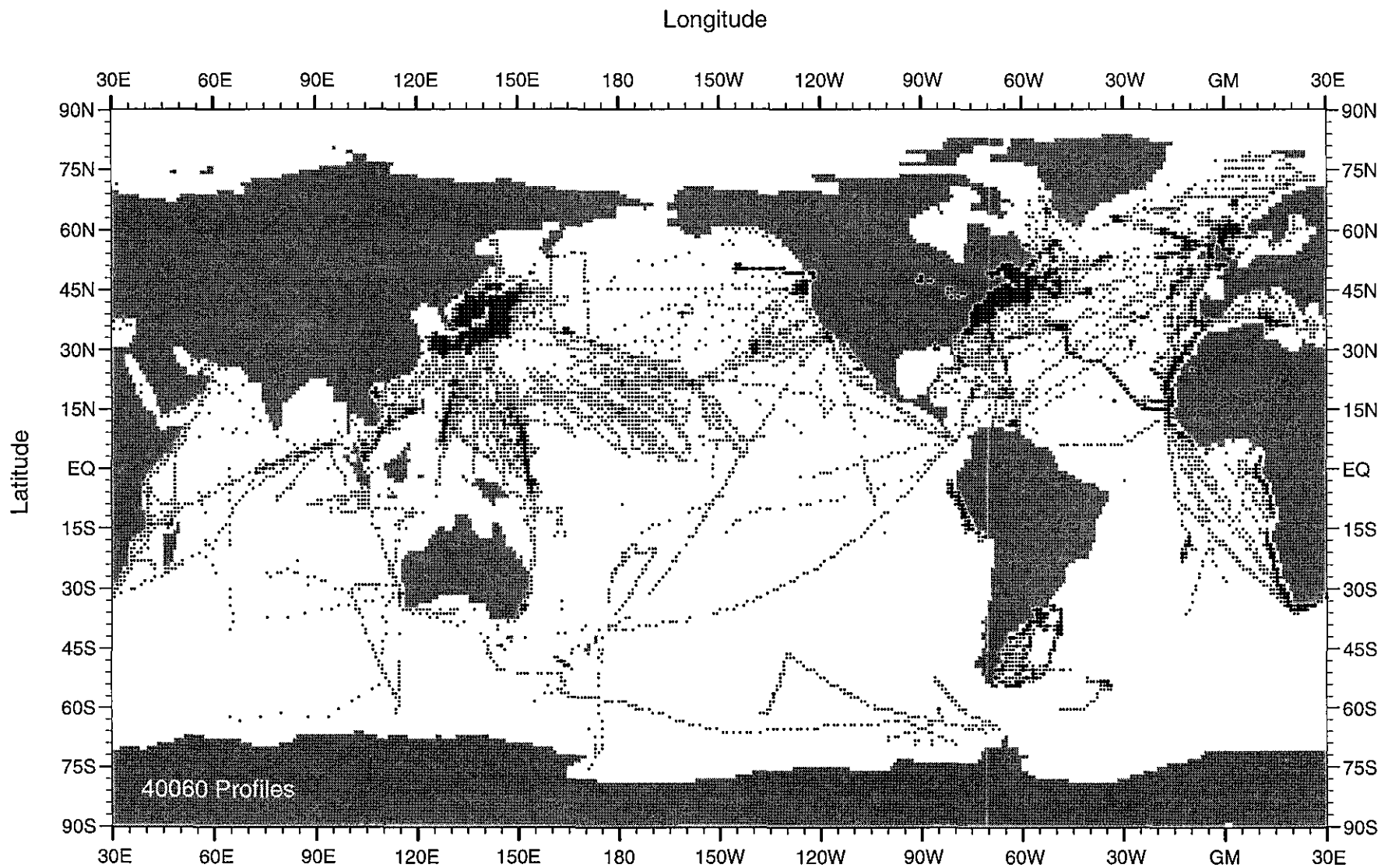

Fig. A30 WOD98 MBT profile distribution for 1970

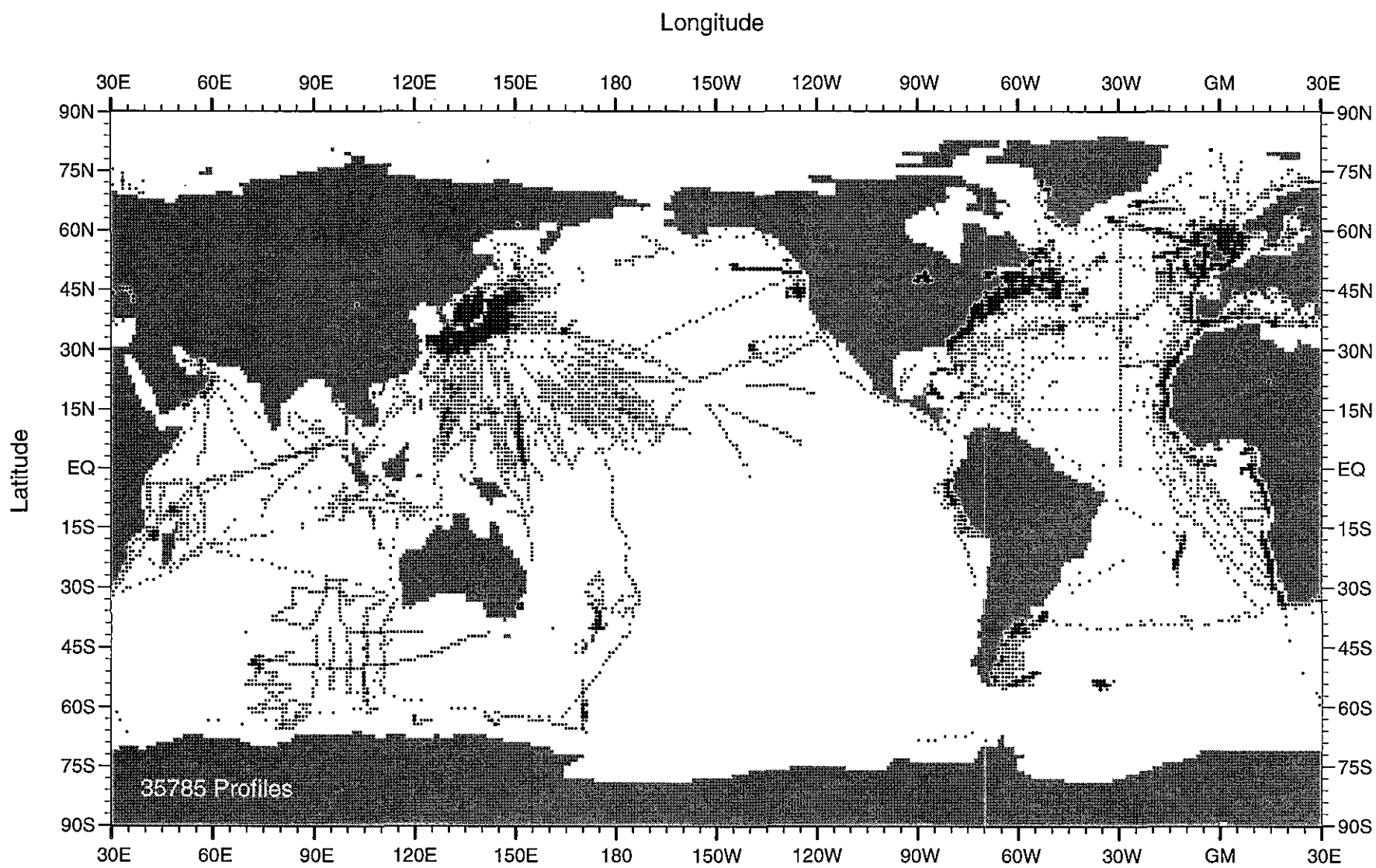

Fig. A31 WOD98 MBT profile distribution for 1971

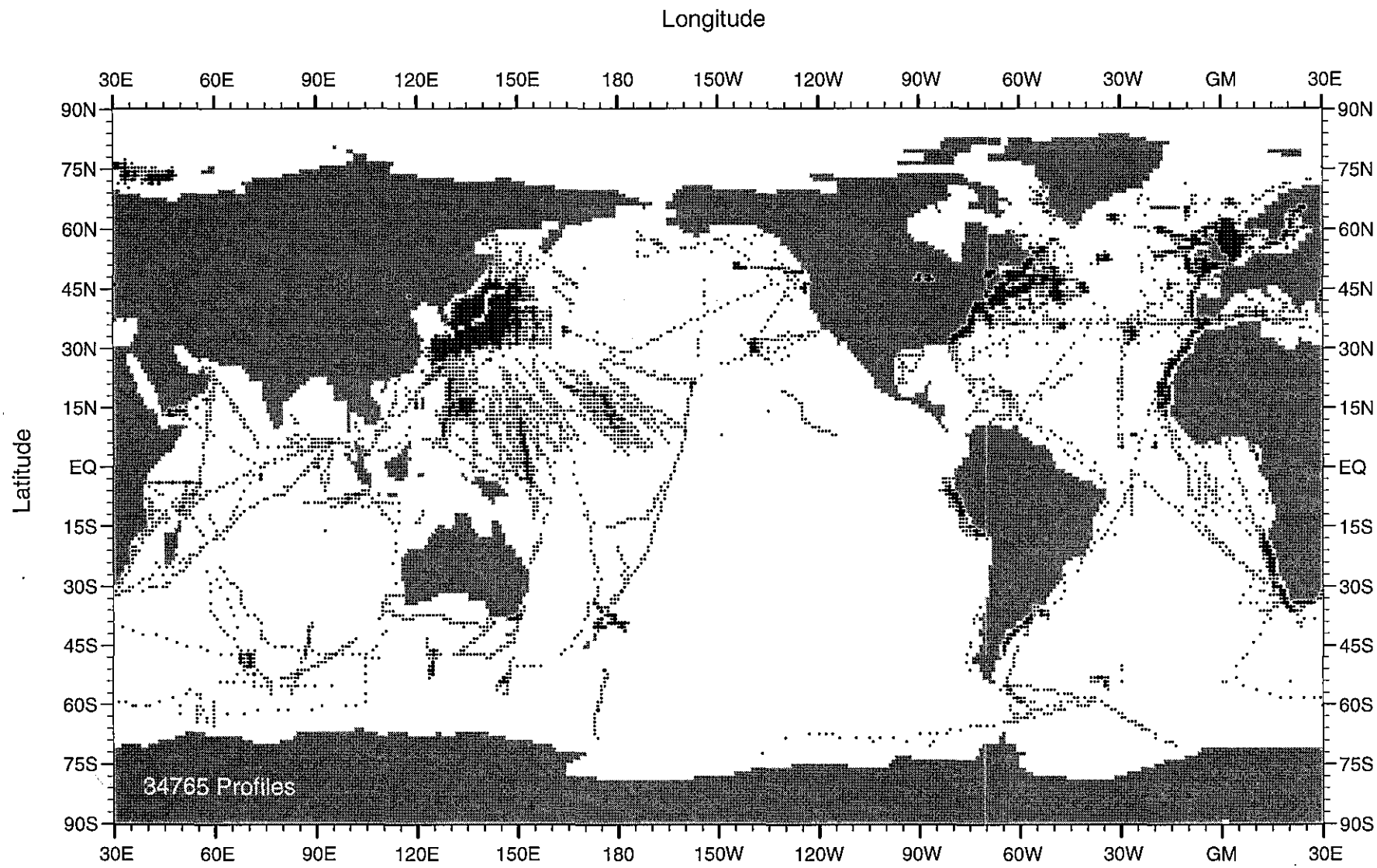

Fig. A32 WOD98 MBT profile distribution for 1972

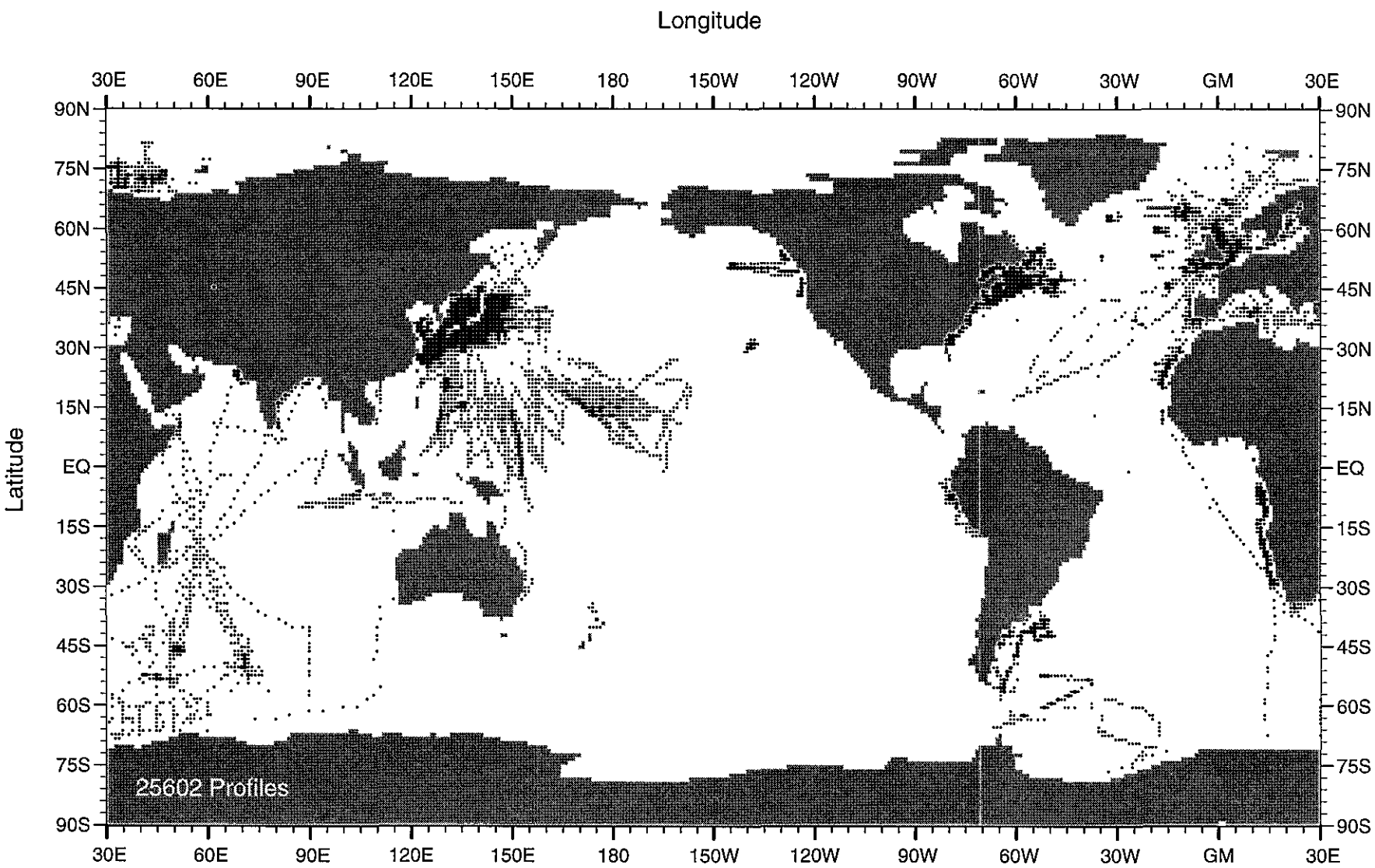

Fig. A33 WOD98 MBT profile distribution for 1973

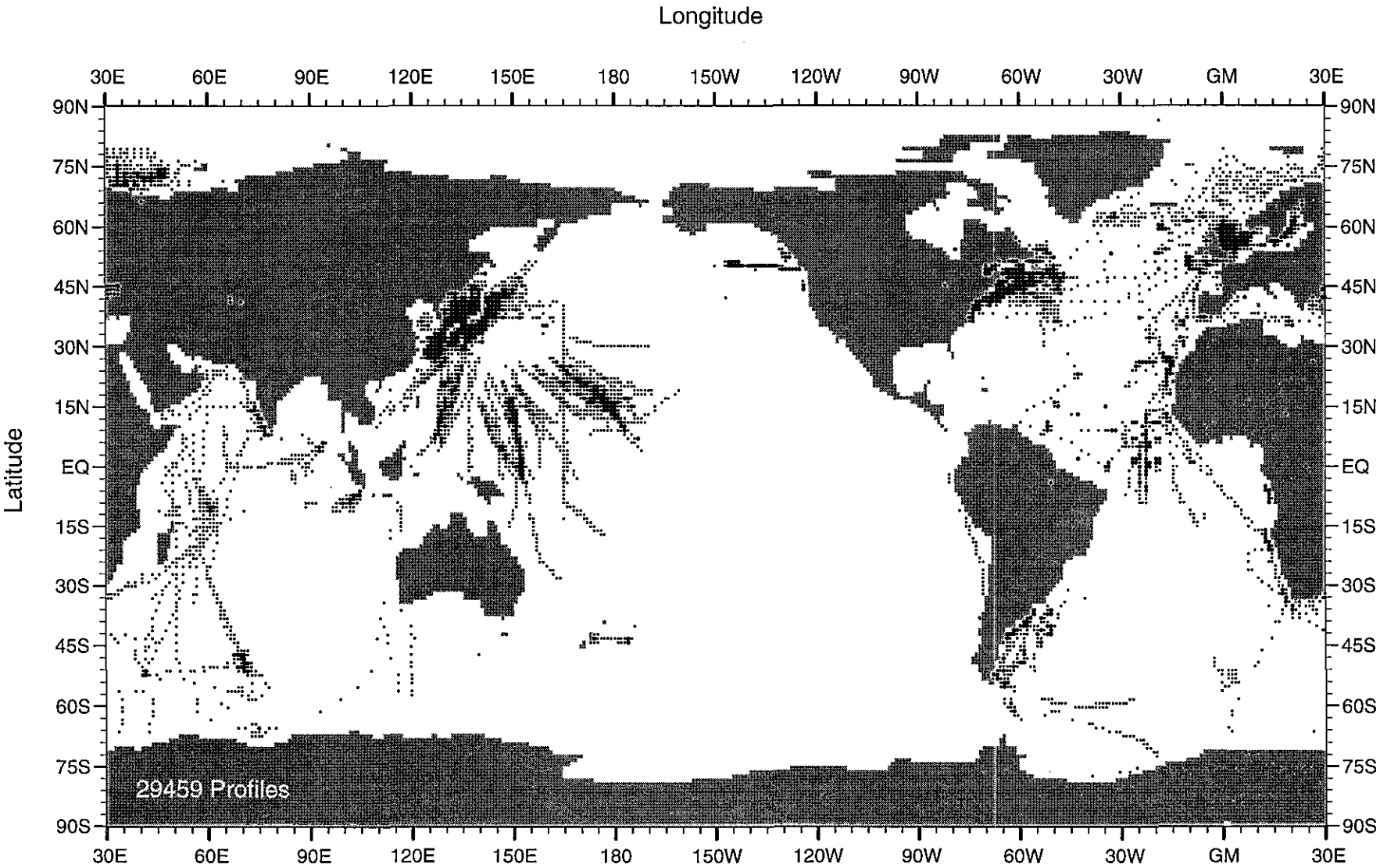

Fig. A34 WOD98 MBT profile distribution for 1974

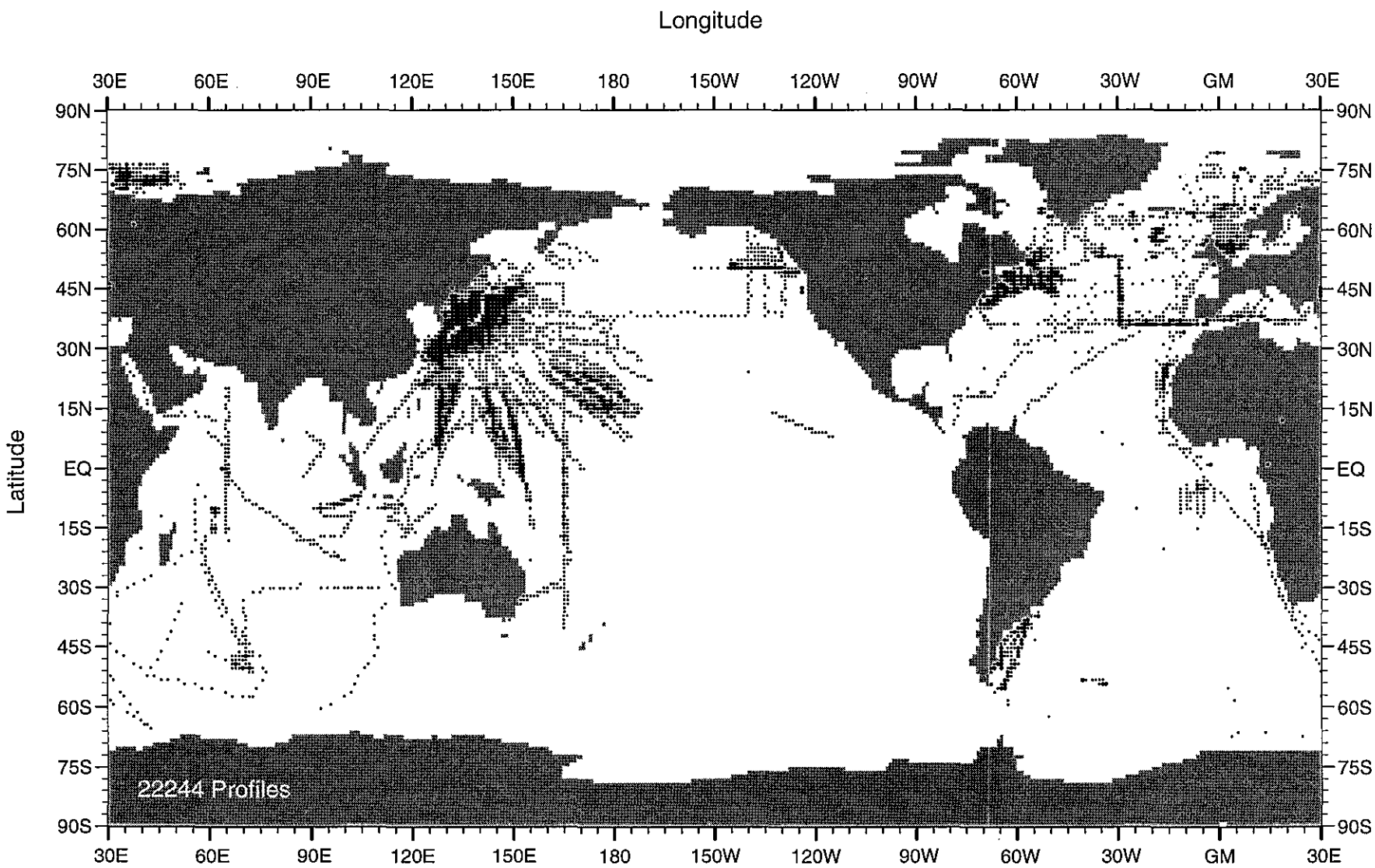

Fig. A35 WOD98 MBT profile distribution for 1975

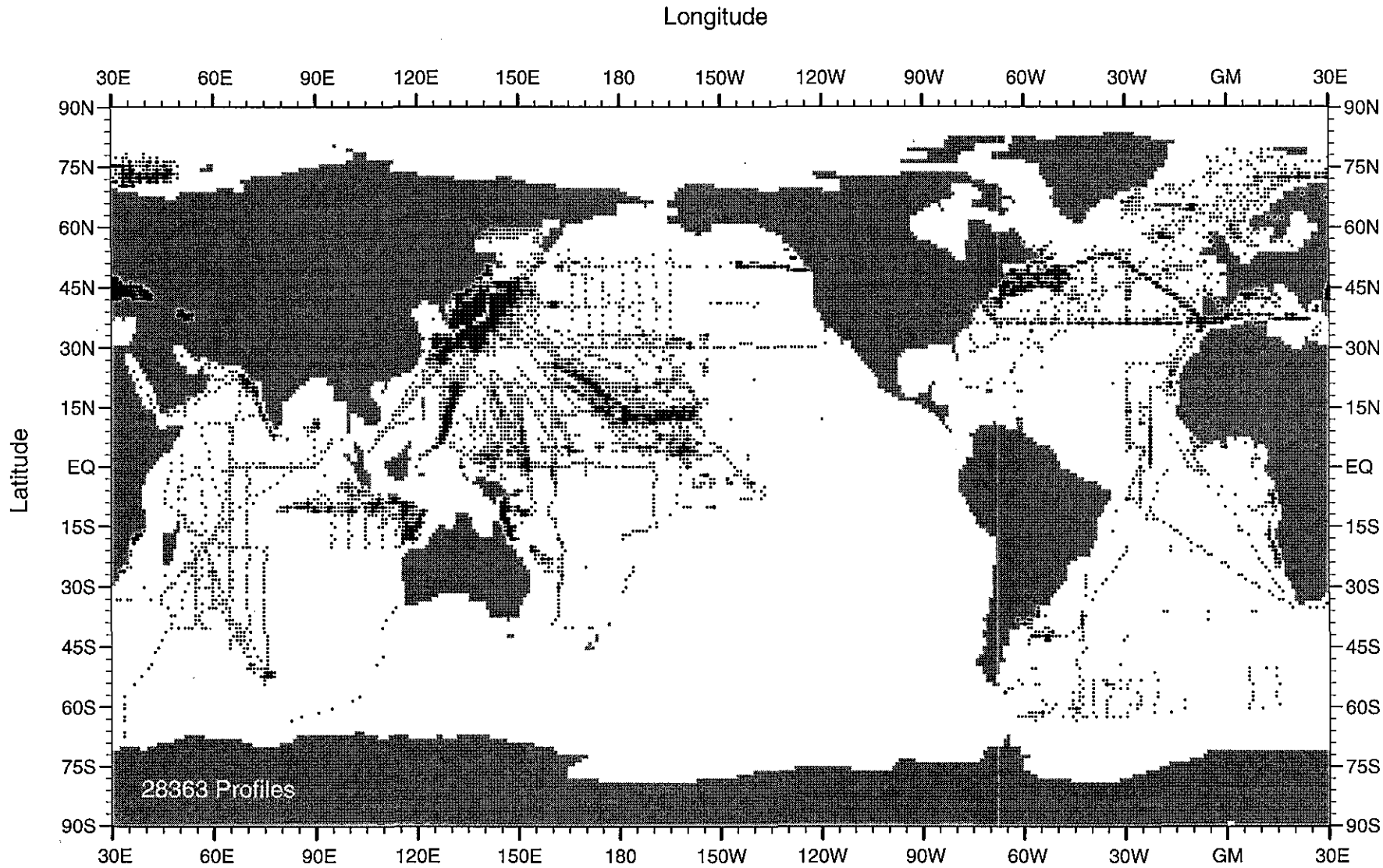

Fig. A36· WOD98 MBT profile distribution for 1976

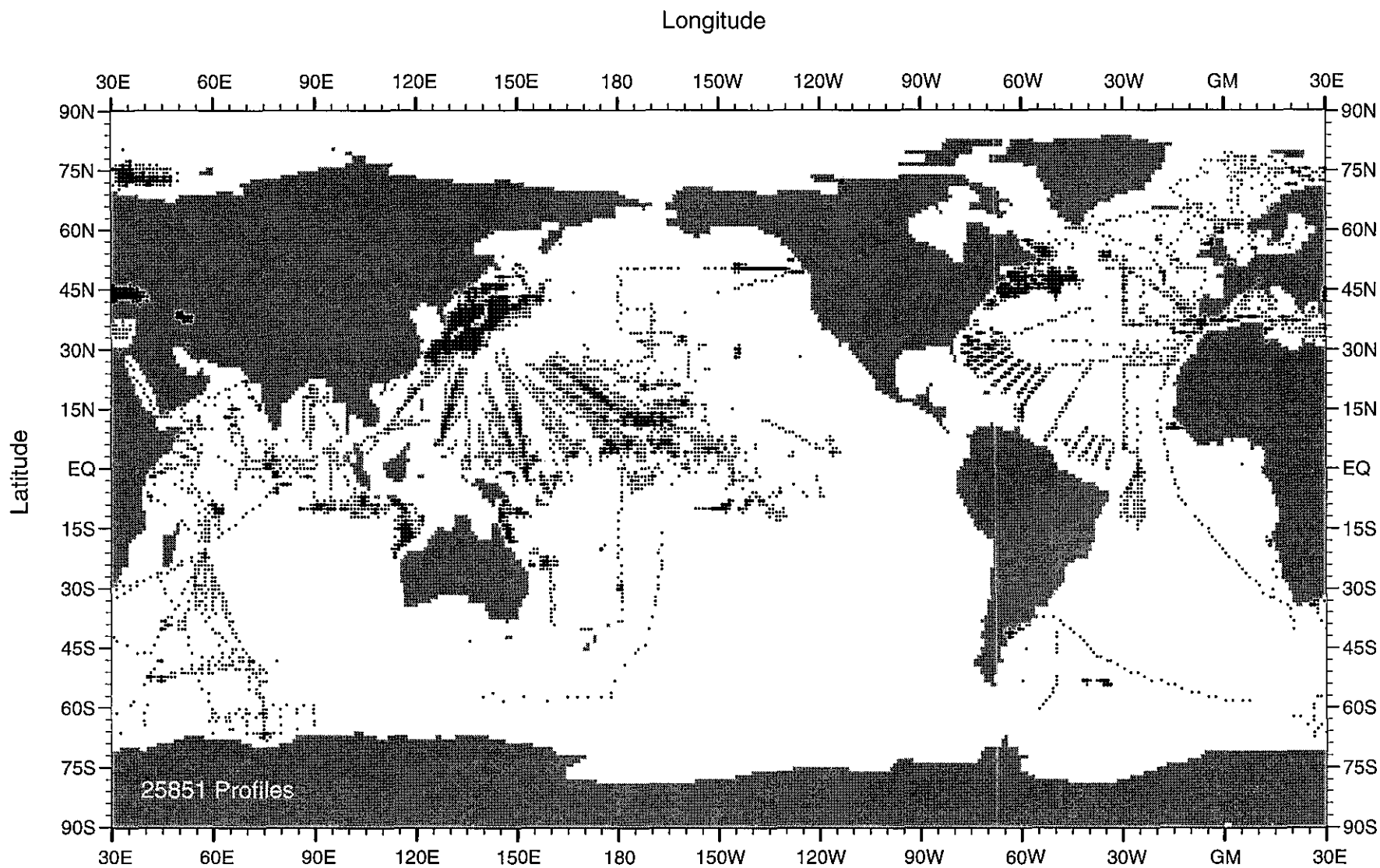

Fig. A37 WOD98 MBT profile distribution for 1977

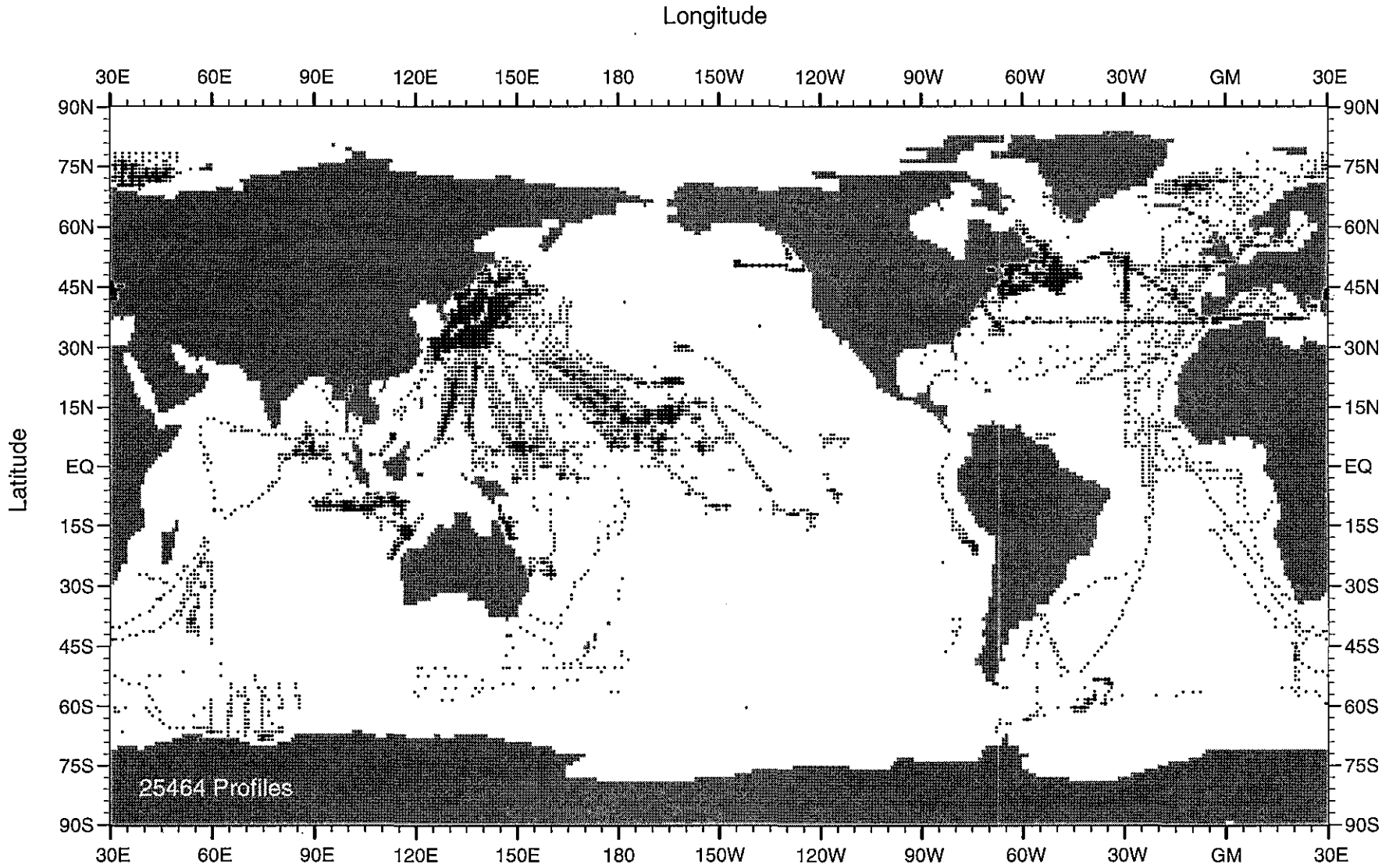

Fig. A38 WOD98 MBT profile distribution for 1978

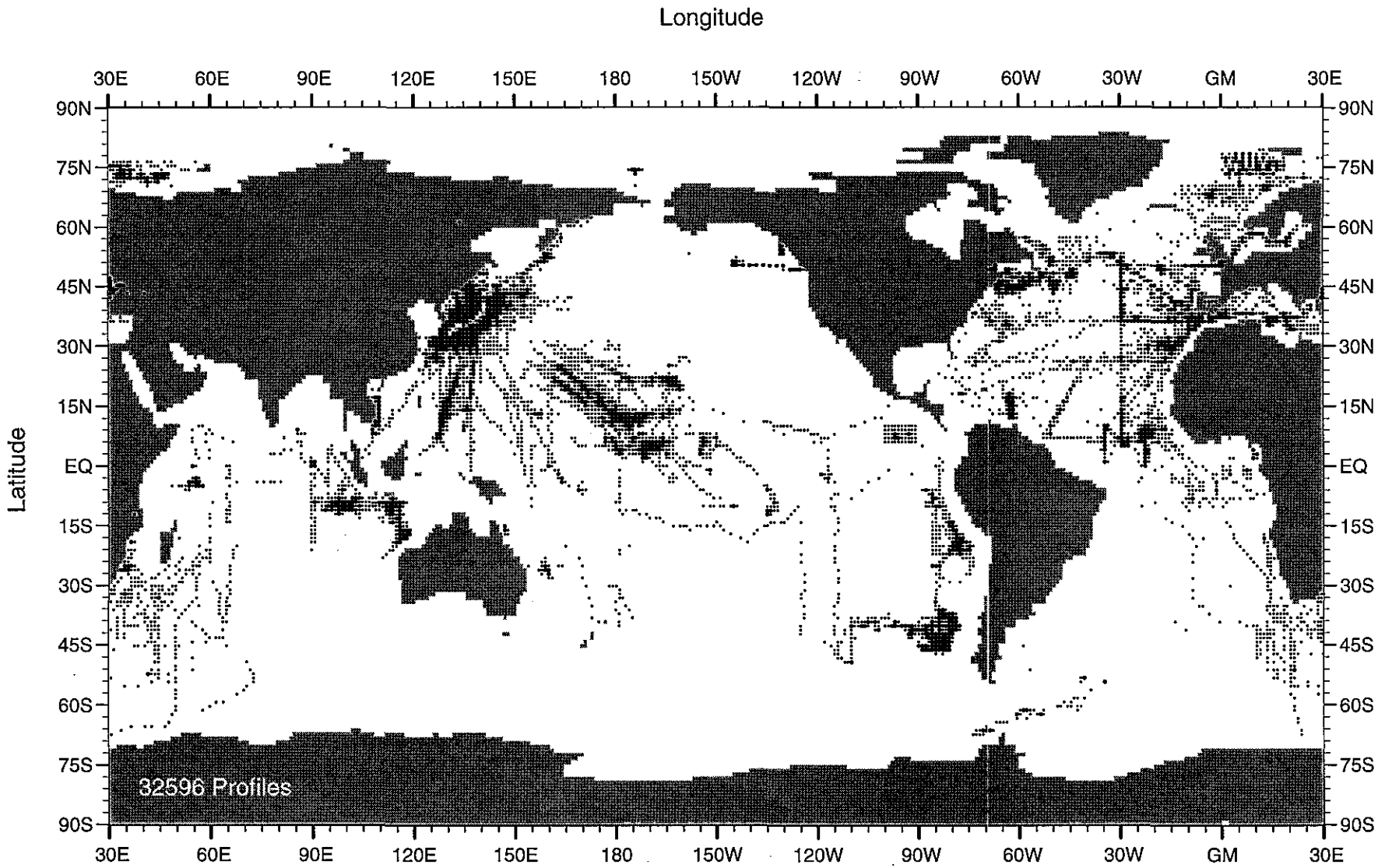

Fig. A39 WOD98 MBT profile distribution for 1979

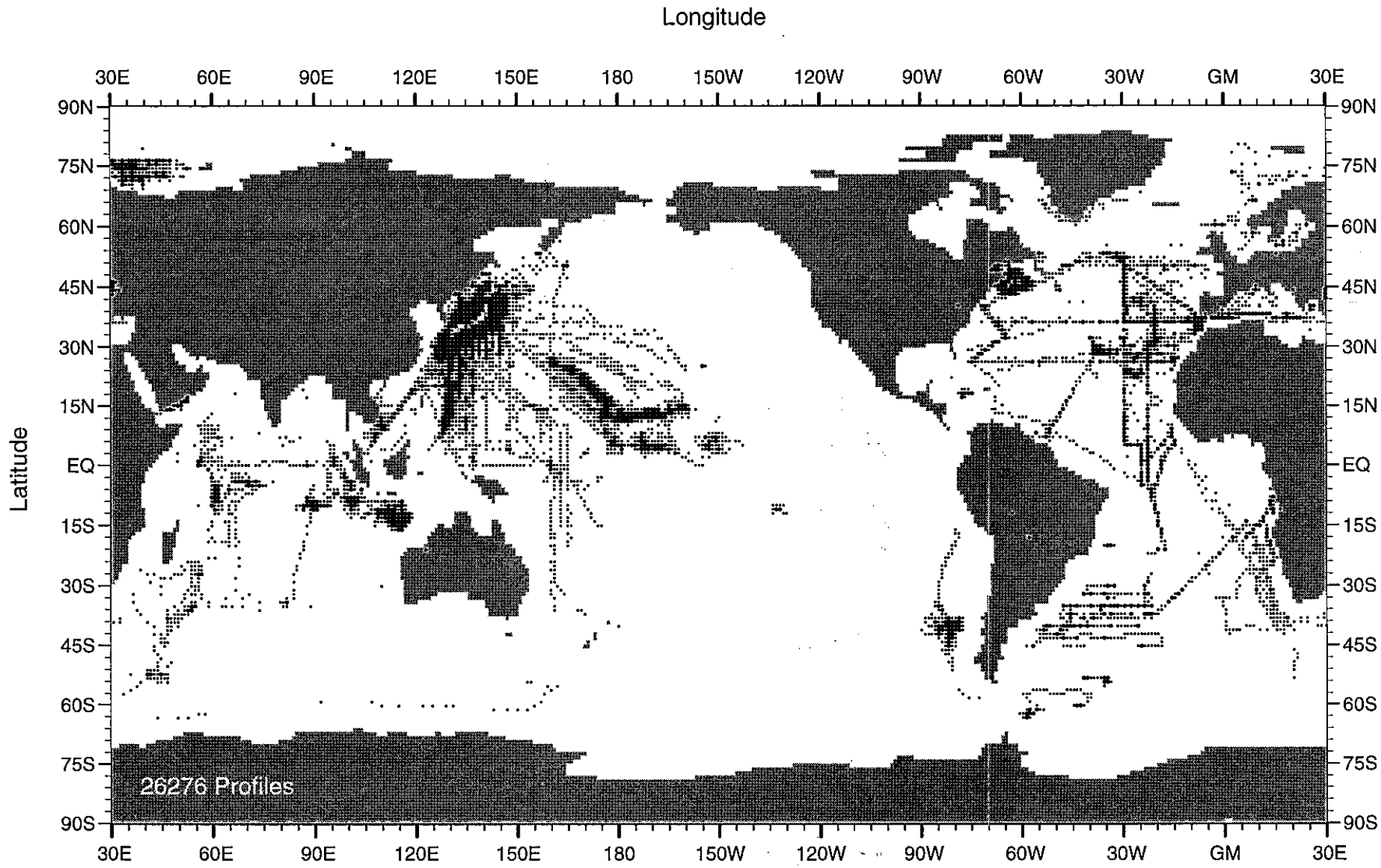

Fig. A40 WOD98 MBT profile distribution for 1980

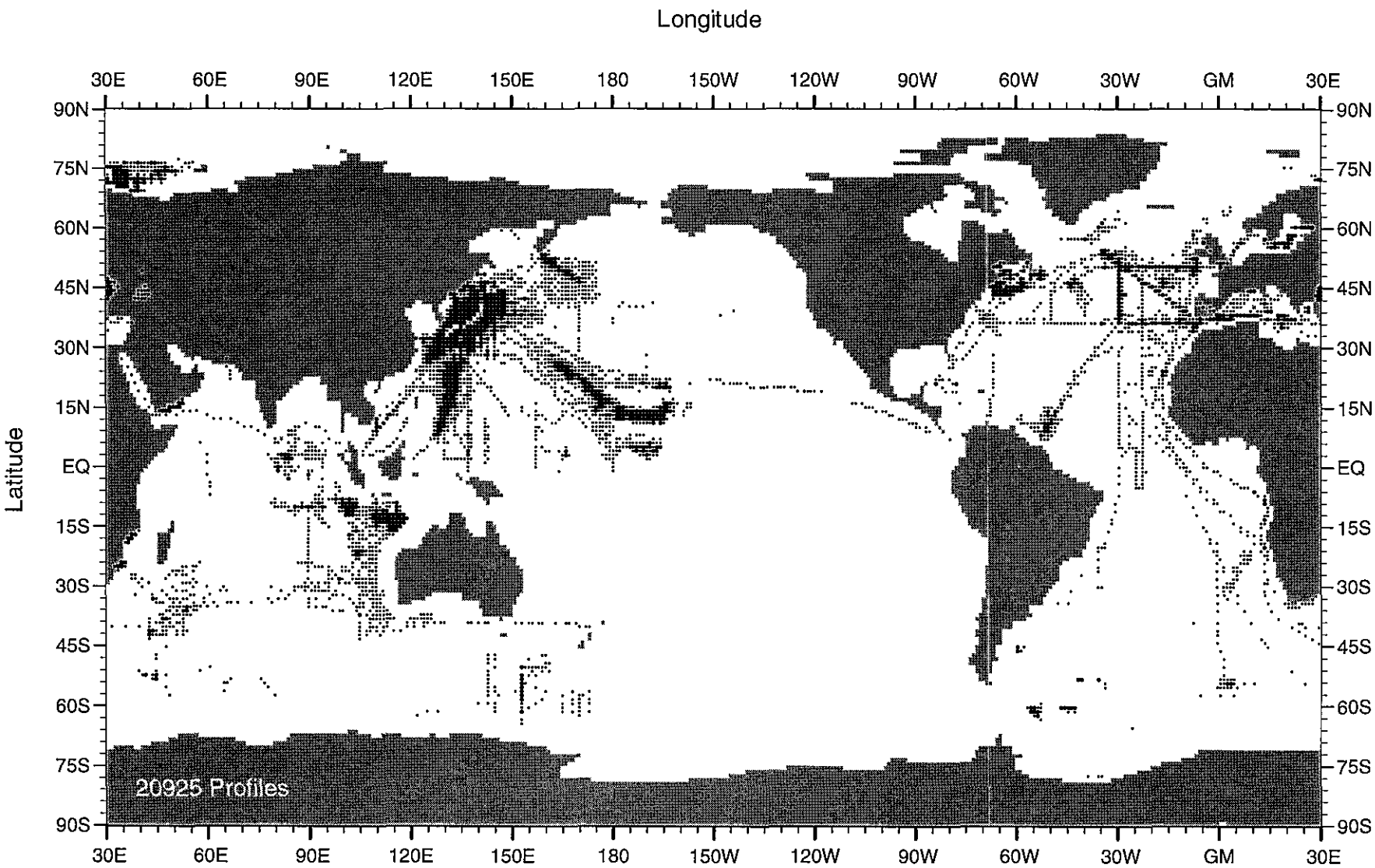

Fig. A41 WOD98 MBT profile distribution for 1981

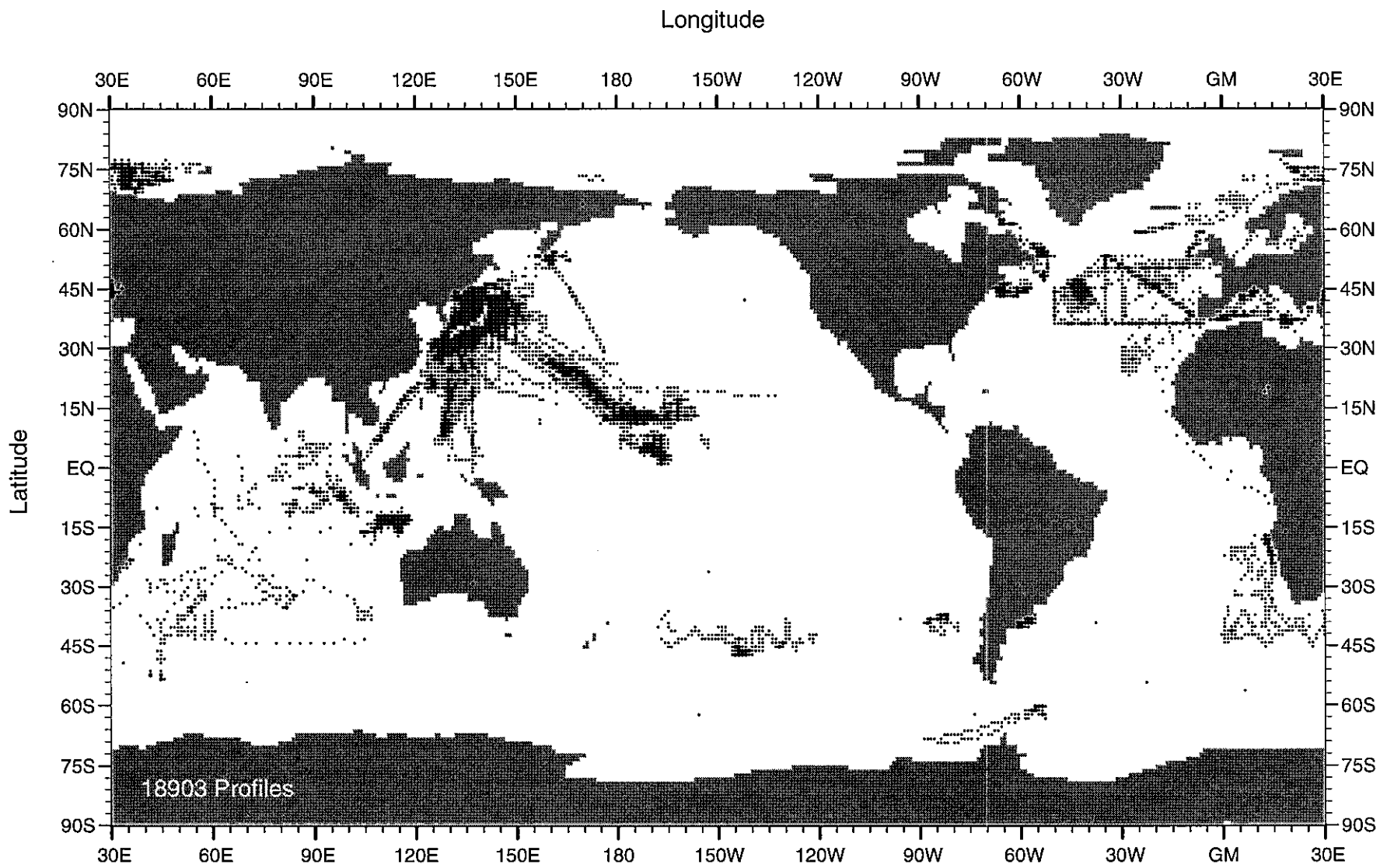

Fig. A42 WOD98 MBT profile distribution for 1982

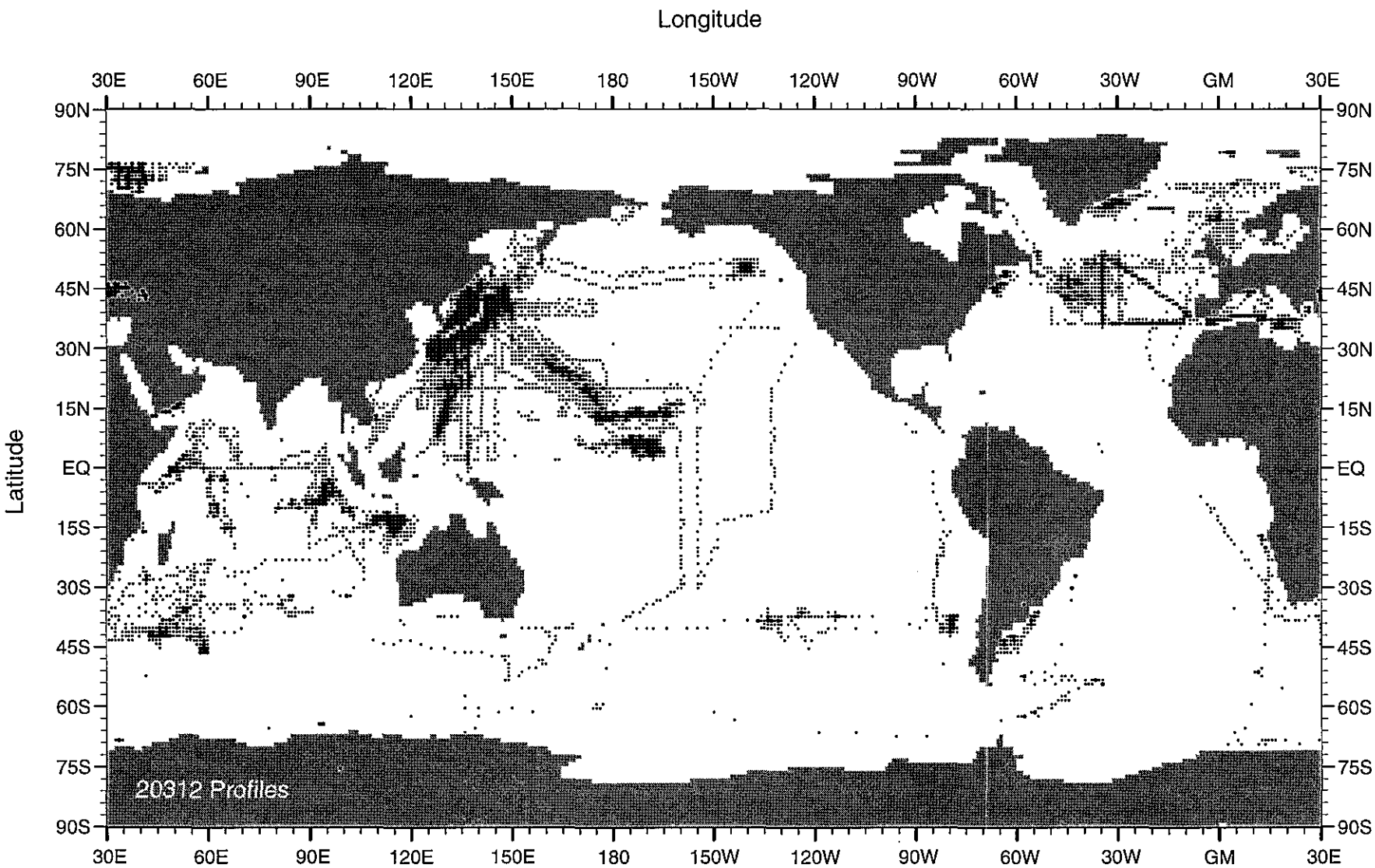

Fig. A43 WOD98 MBT profile distribution for 1983

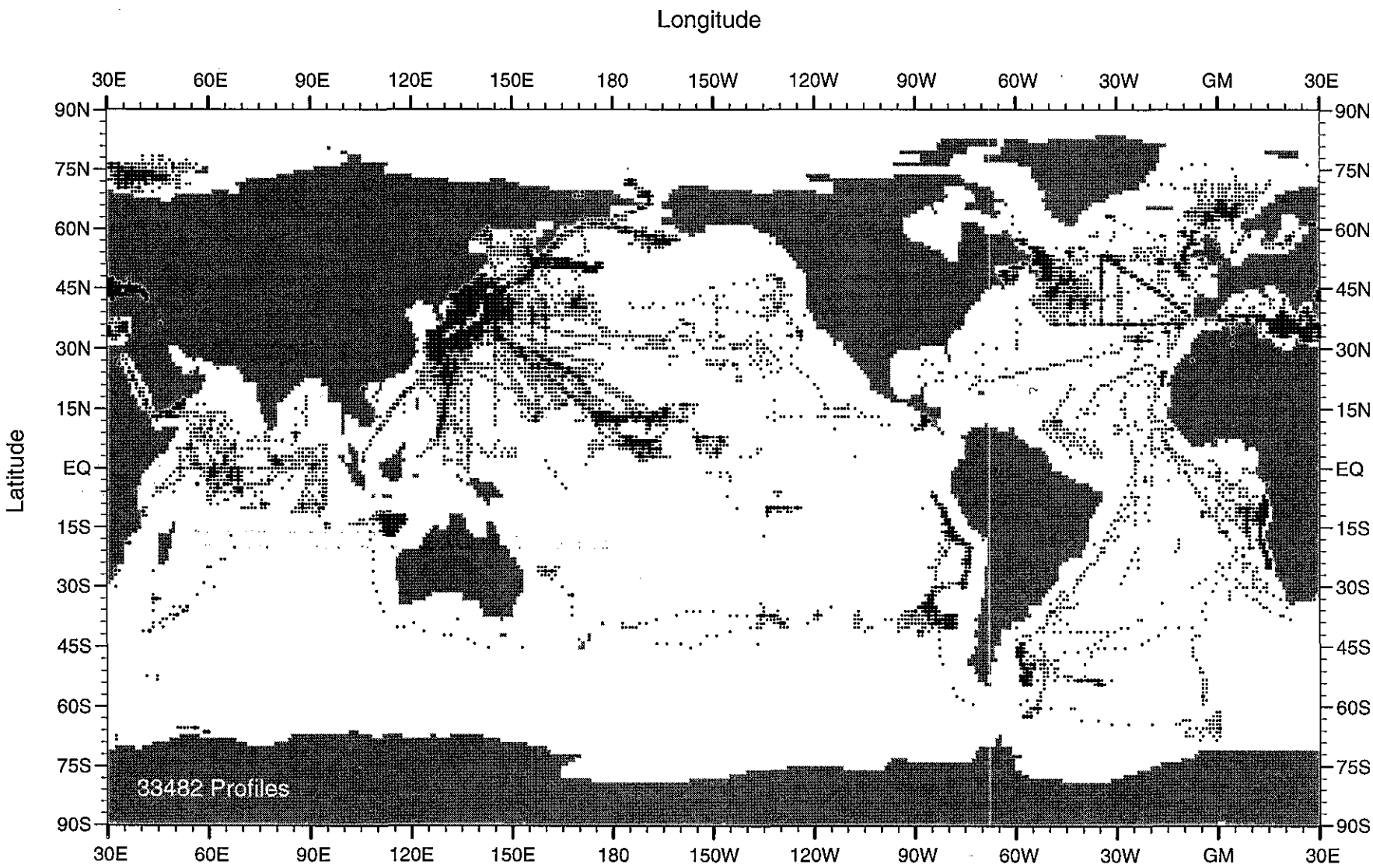

Fig. A44 WOD98 MBT profile distribution for 1984

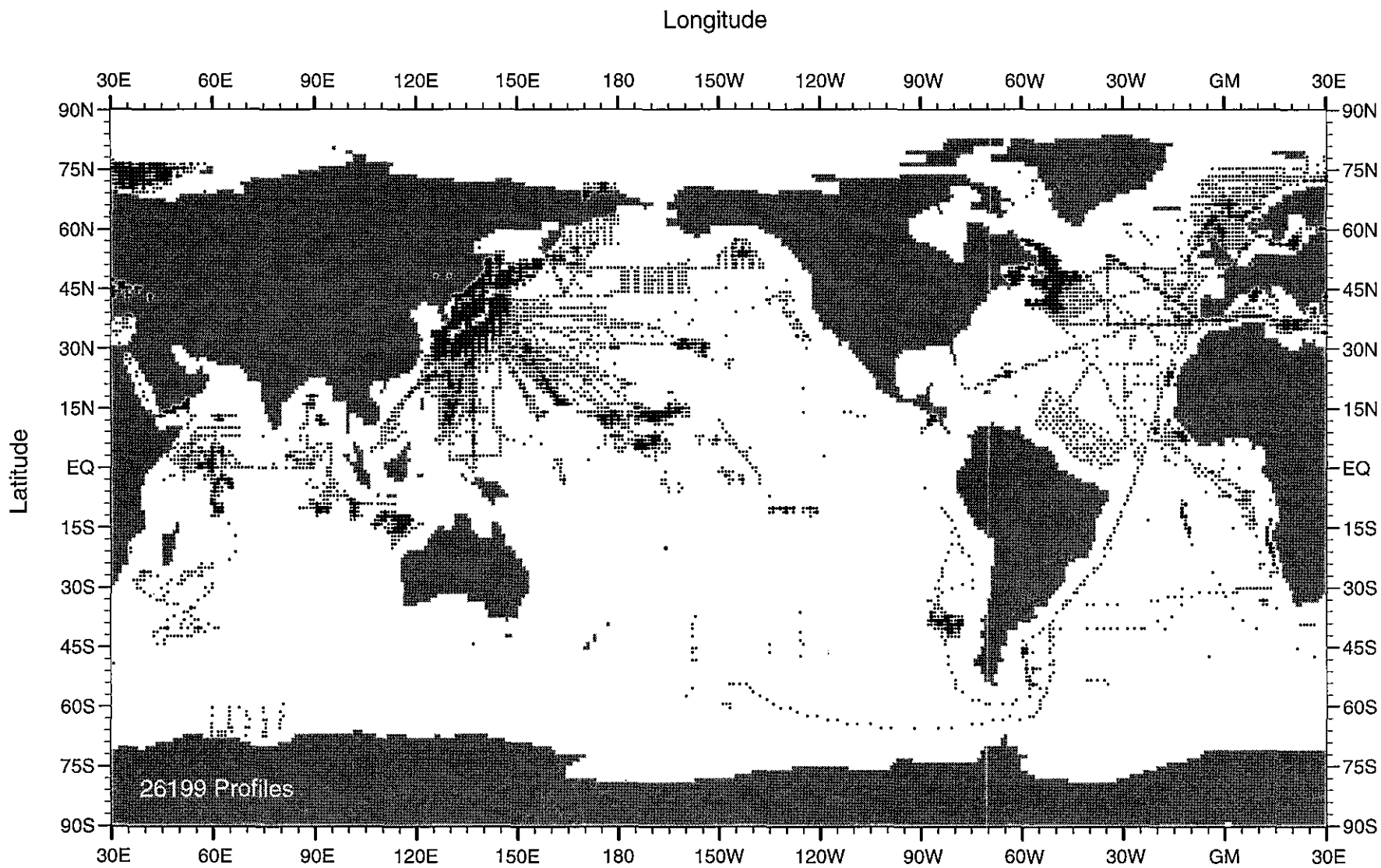

Fig. A45 WOD98 MBT profile distribution for 1985

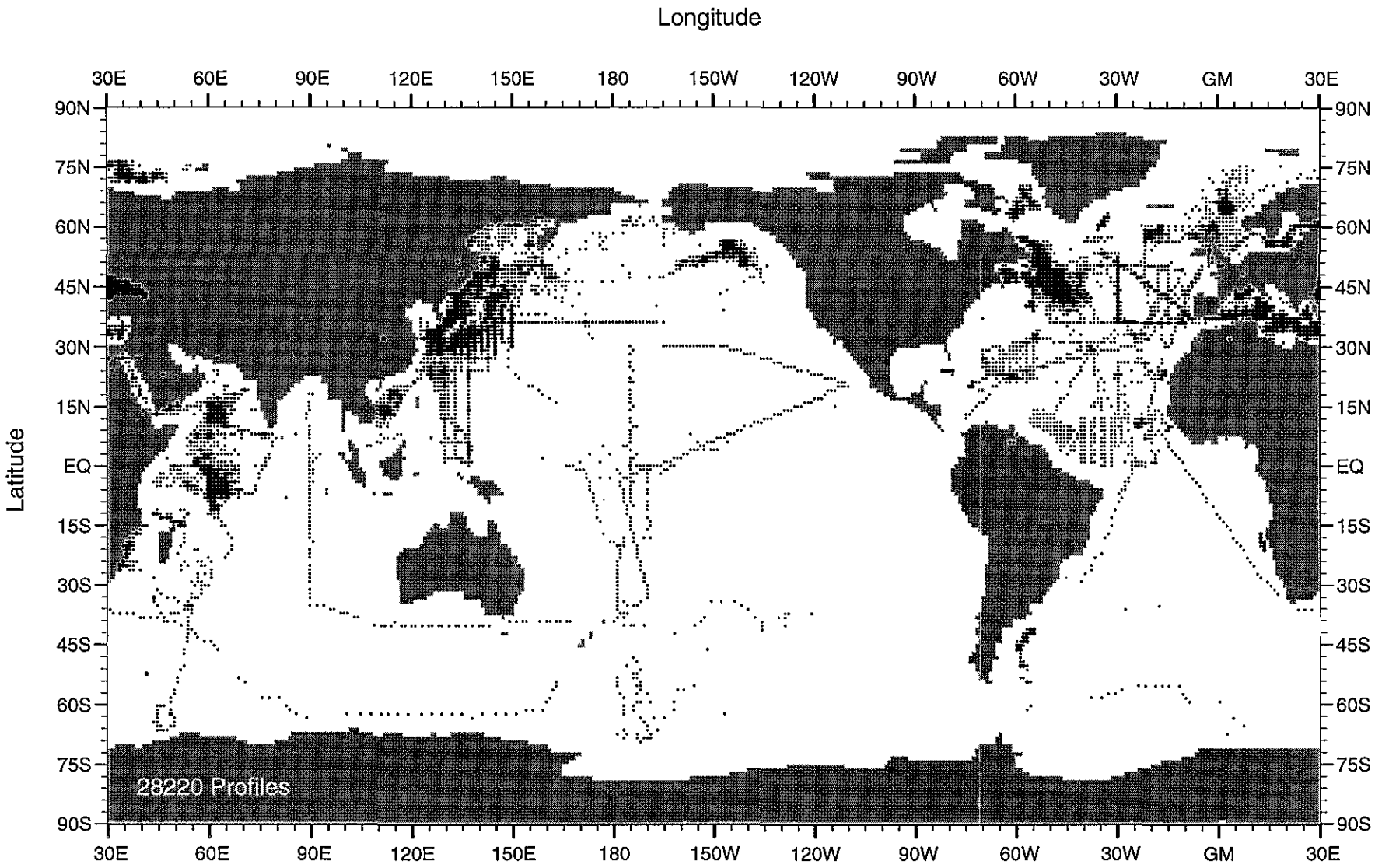

Fig. A46 WOD98 MBT profile distribution for 1986

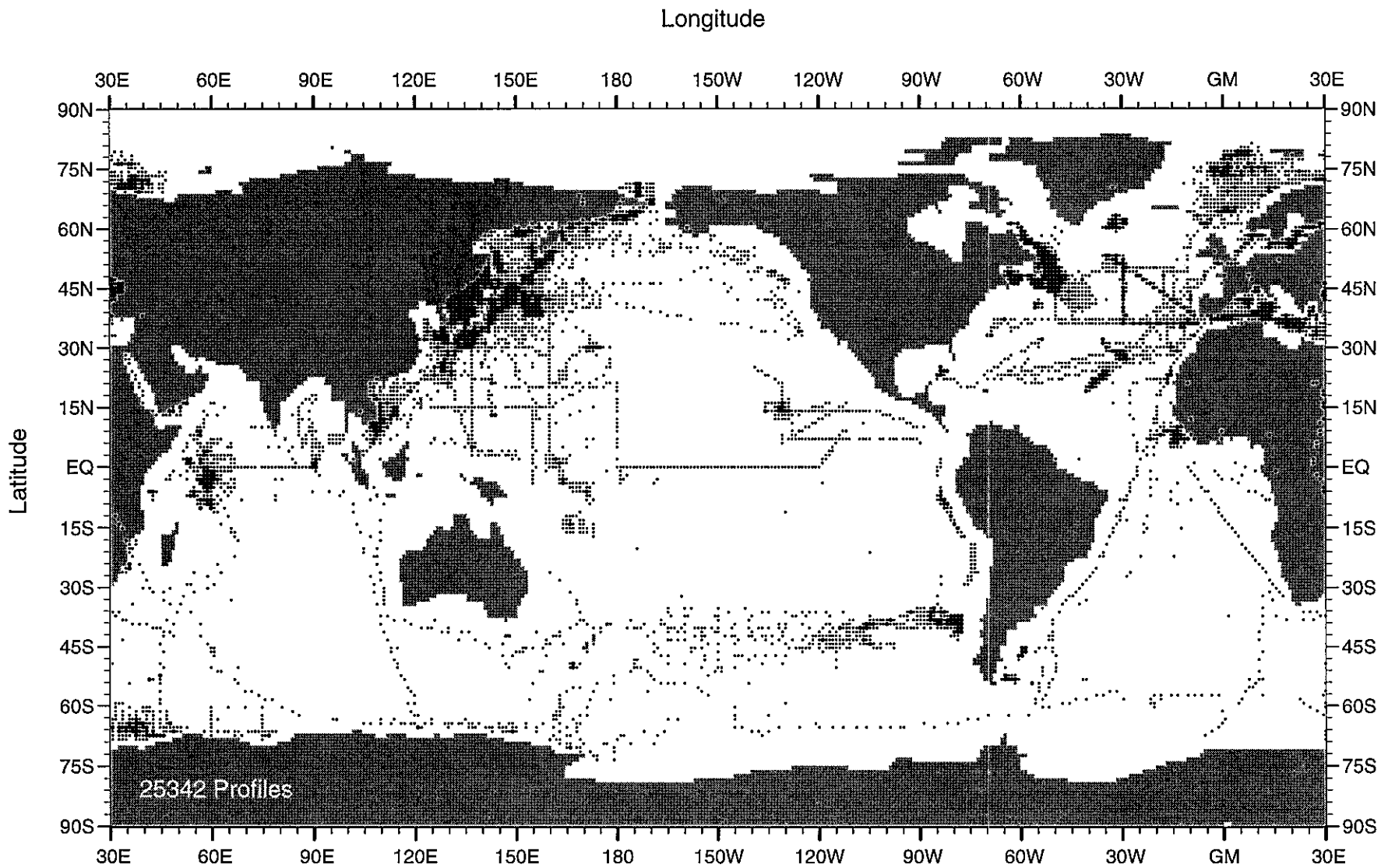

Fig. A47 WOD98 MBT profile distribution for 1987

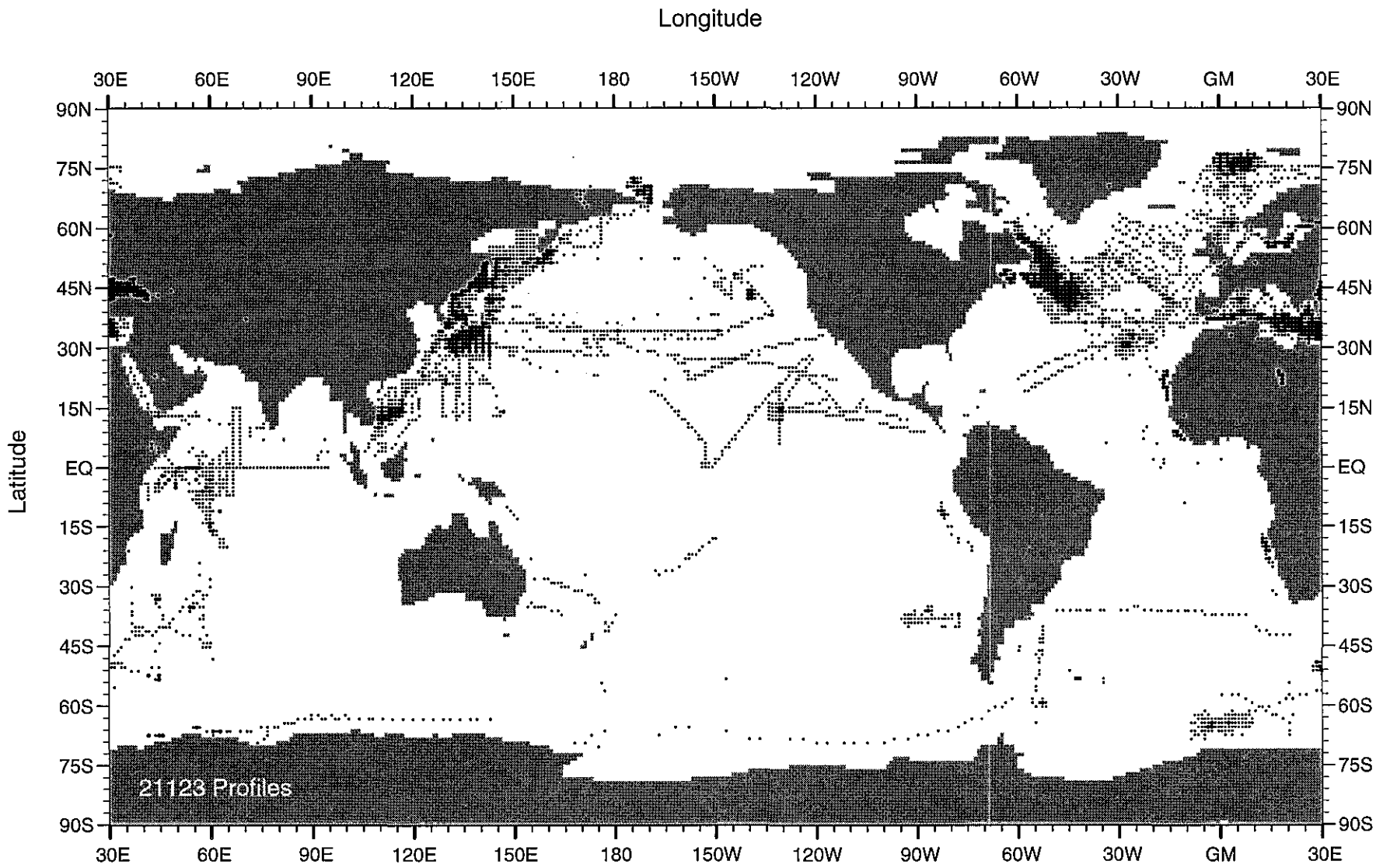

Fig. A48 WOD98 MBT profile distribution for 1988

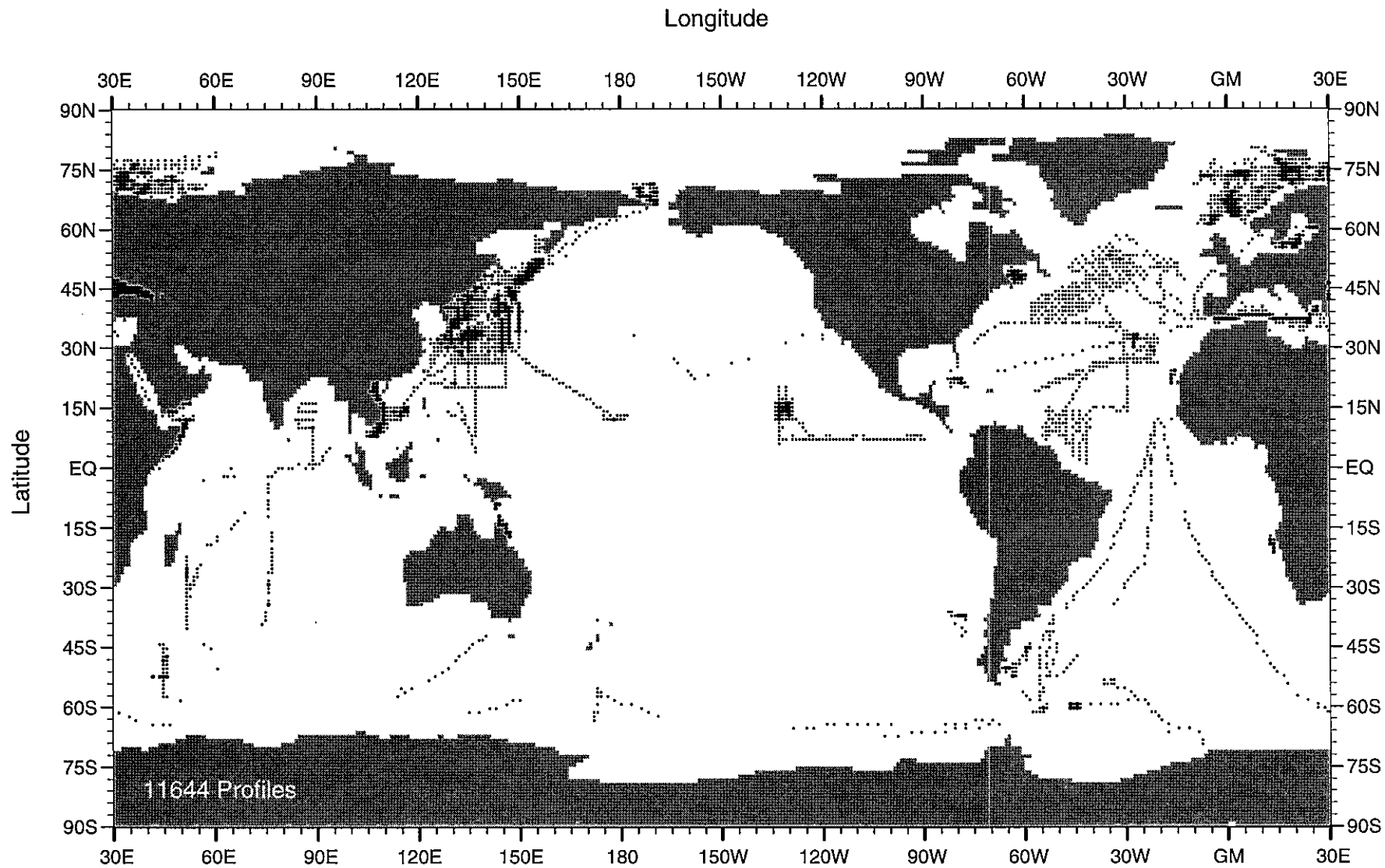

Fig. A49 WOD98 MBT profile distribution for 1989

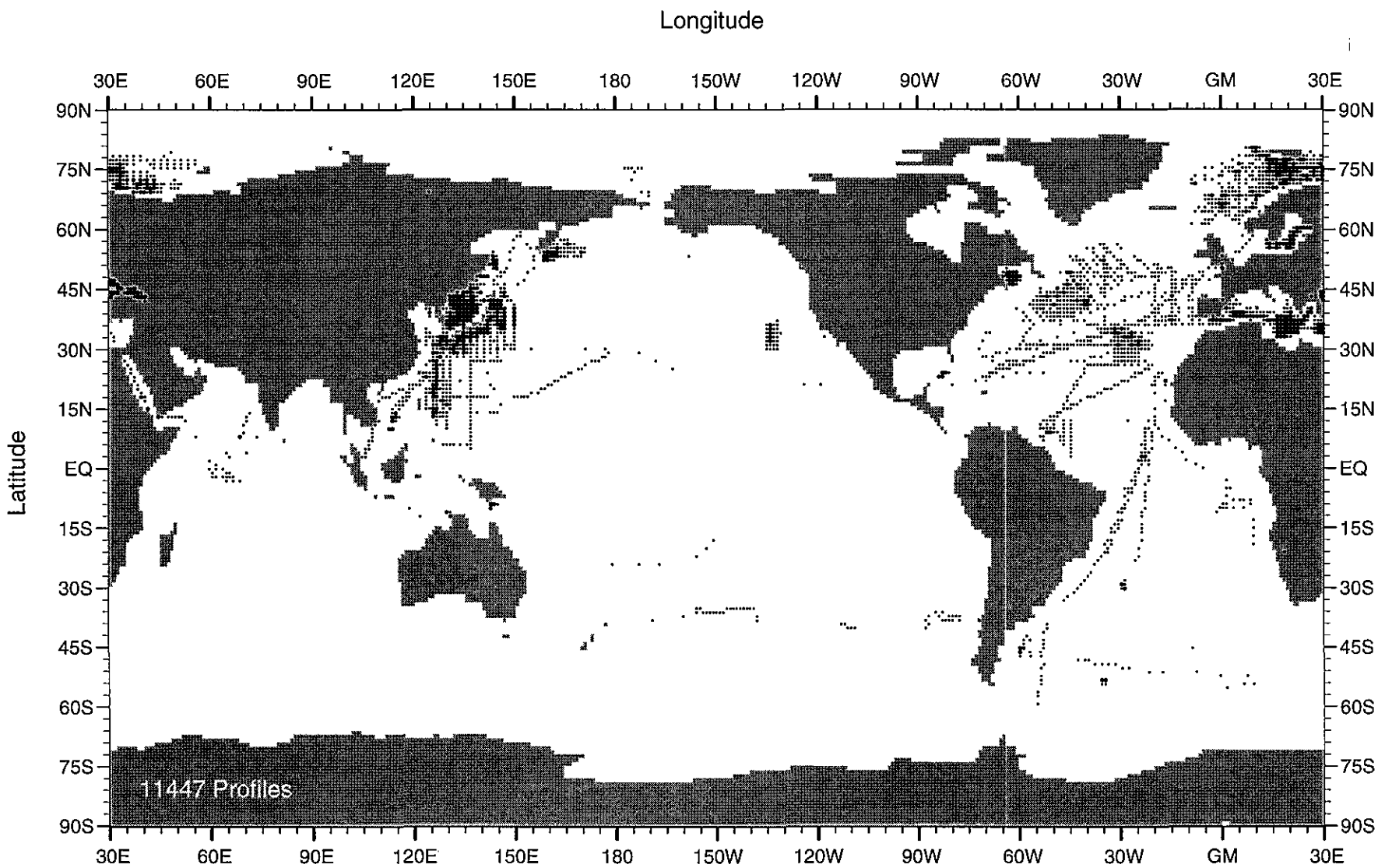

Fig. A50 WOD98 MBT profile distribution for 1990

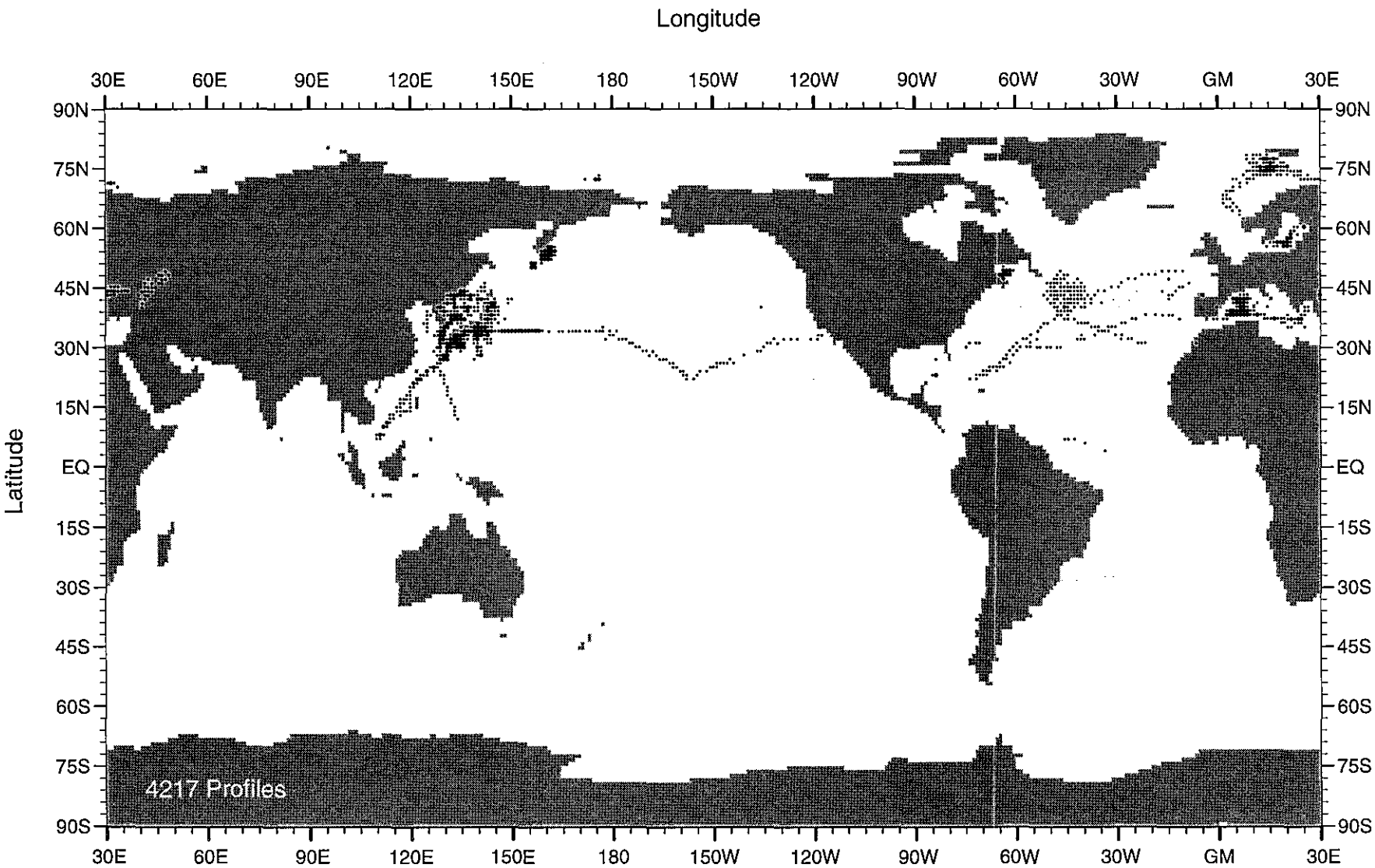

Fig. A51 WOD98 MBT profile distribution for 1991

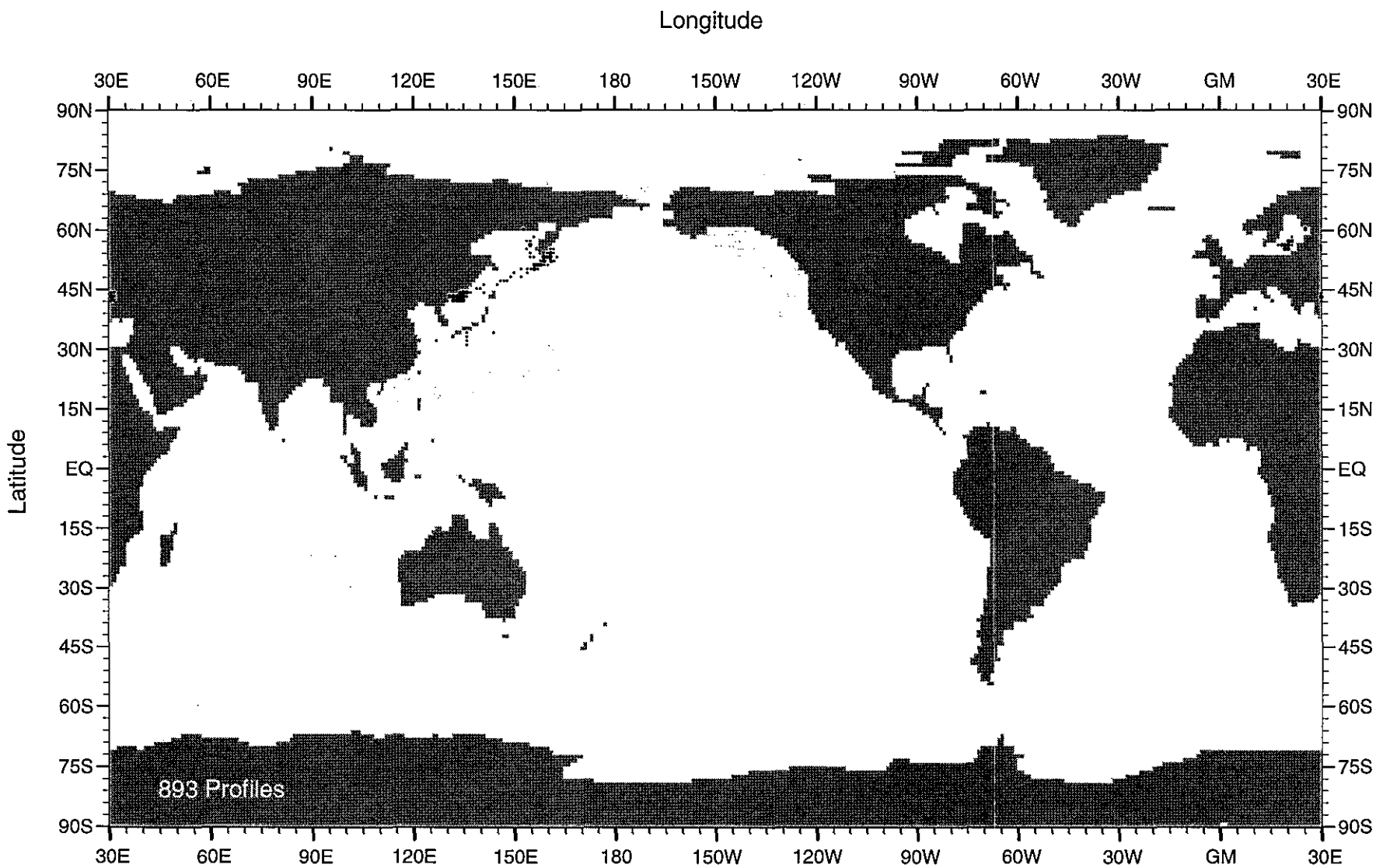

Fig. A52 WOD98 MBT profile distribution for 1992

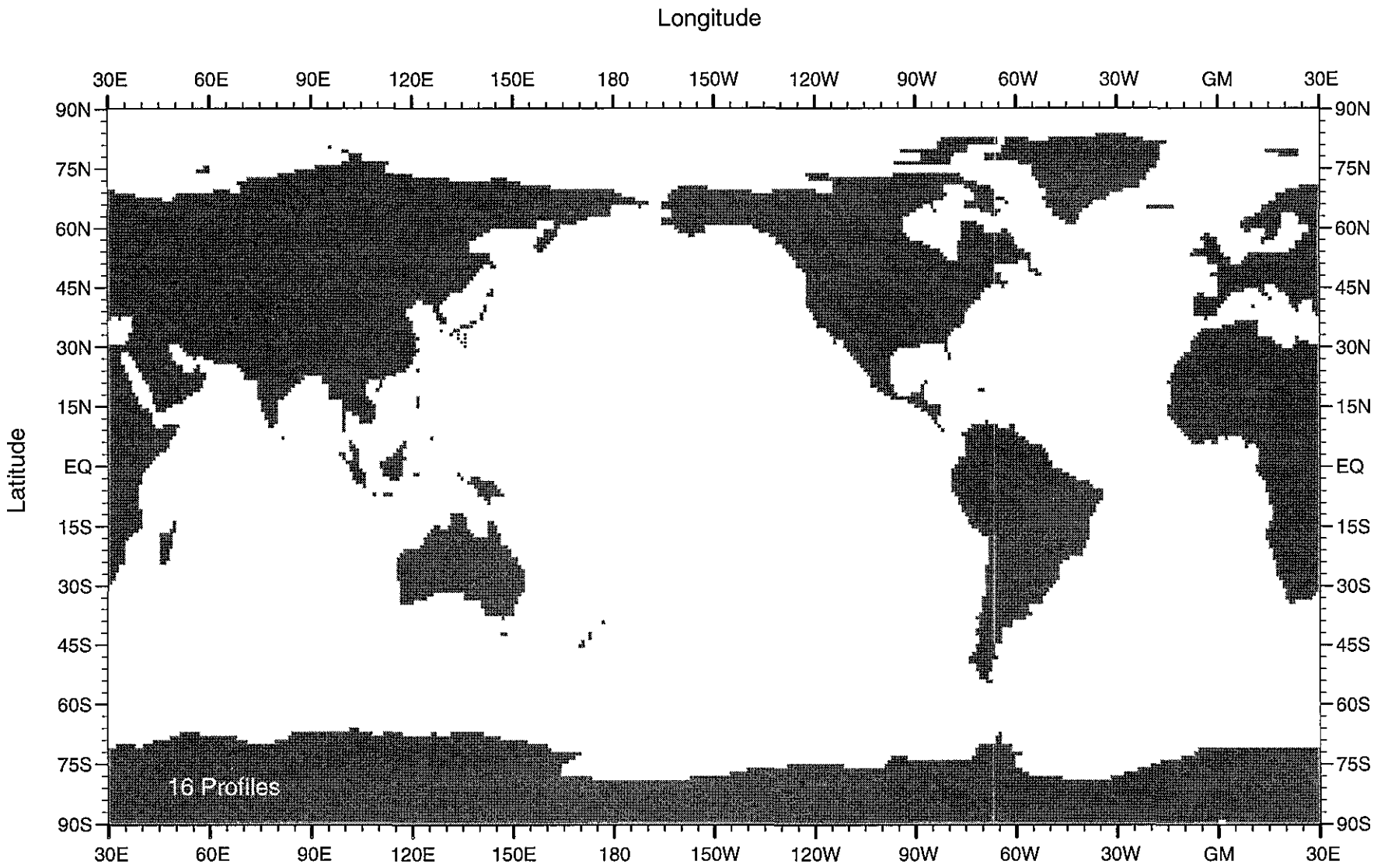

Fig. A53 WOD98 MBT profile distribution for 1993

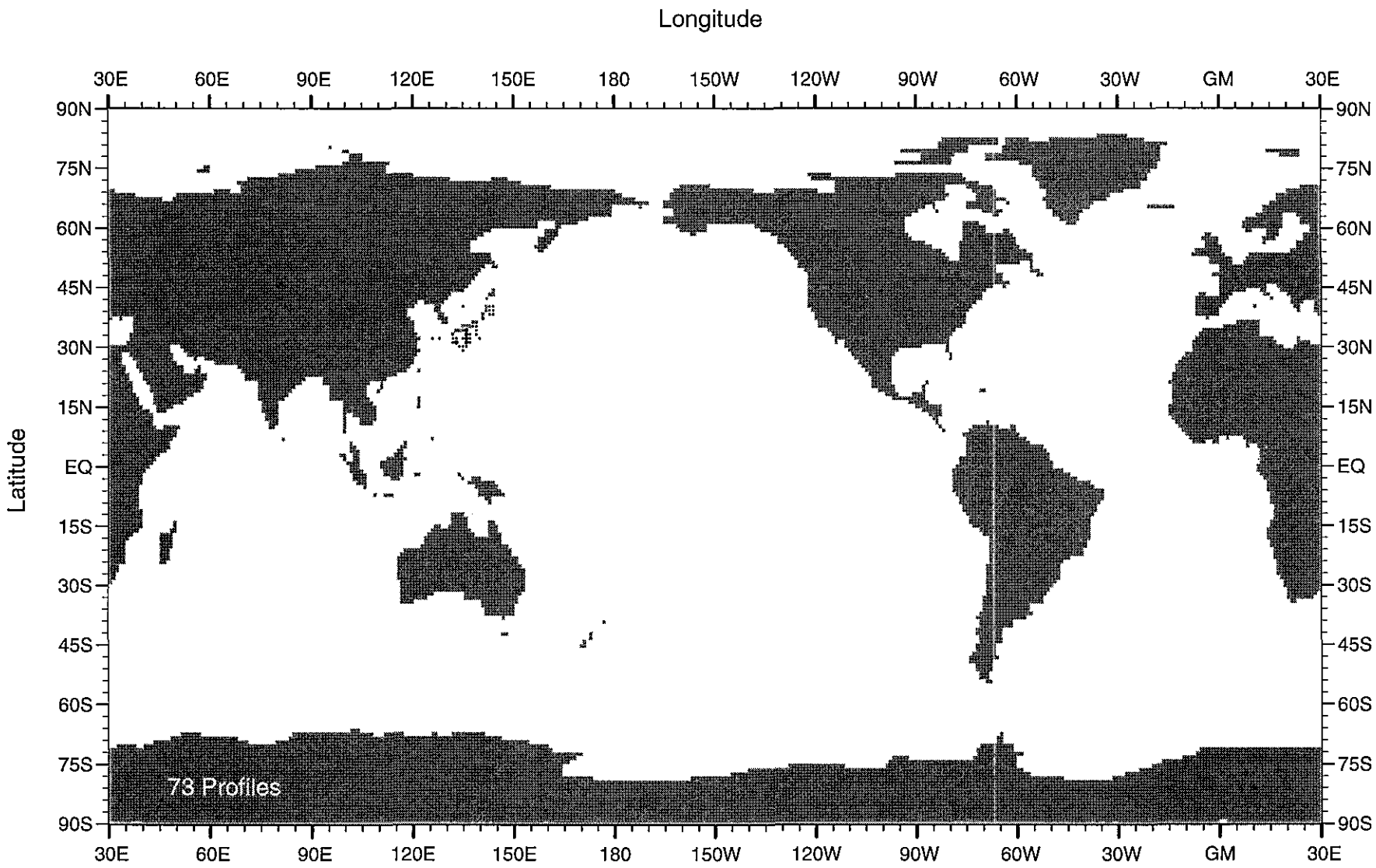

Fig. A54 WOD98 MBT profile distribution for 1994

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

This appendix contains seasonal distributions for individual years of all MBT 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.

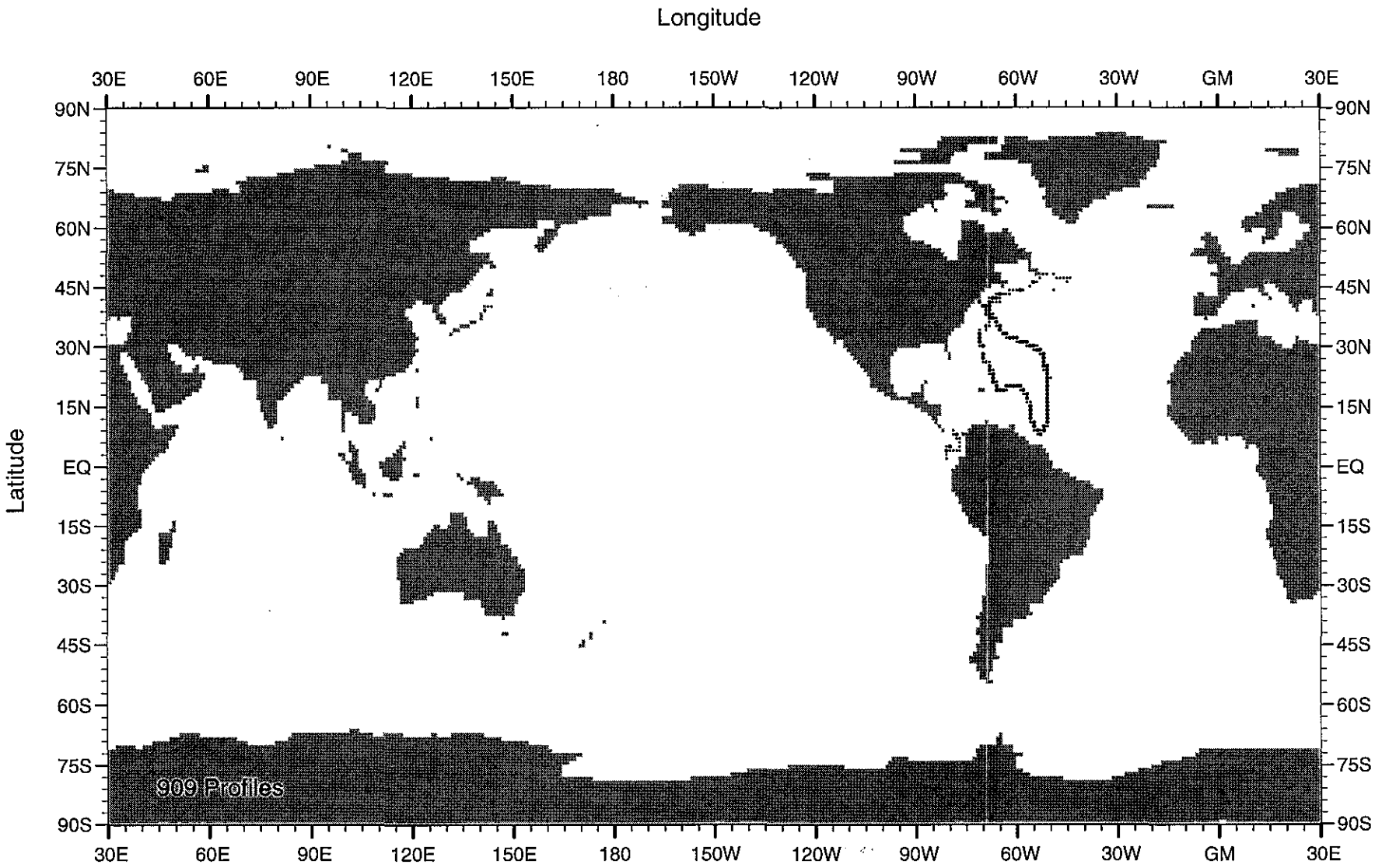

Fig. B1 WOD98 MBT profile distribution for January-March for 1941

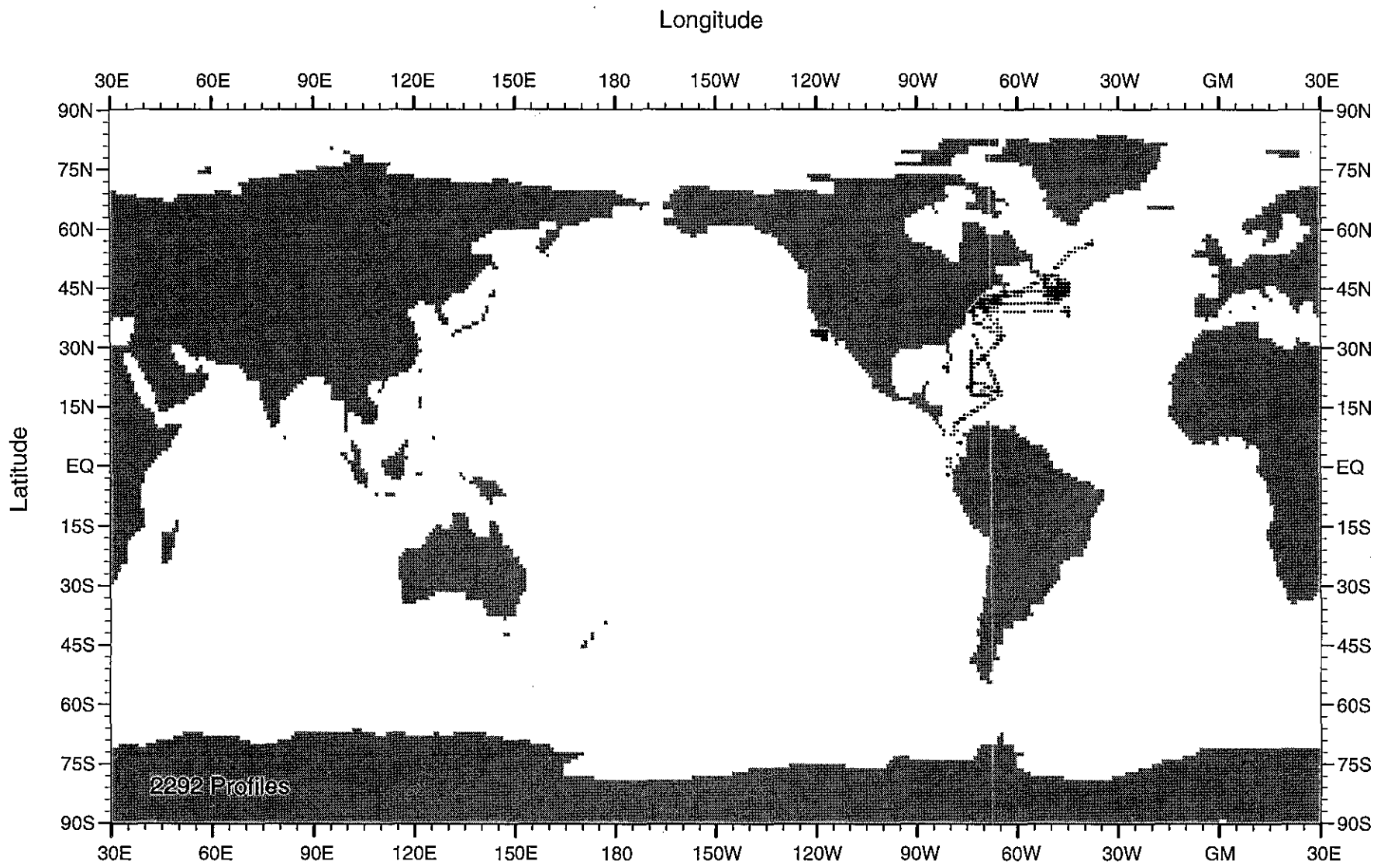

Fig. B2 WOD98 MBT profile distribution for April-June for 1941

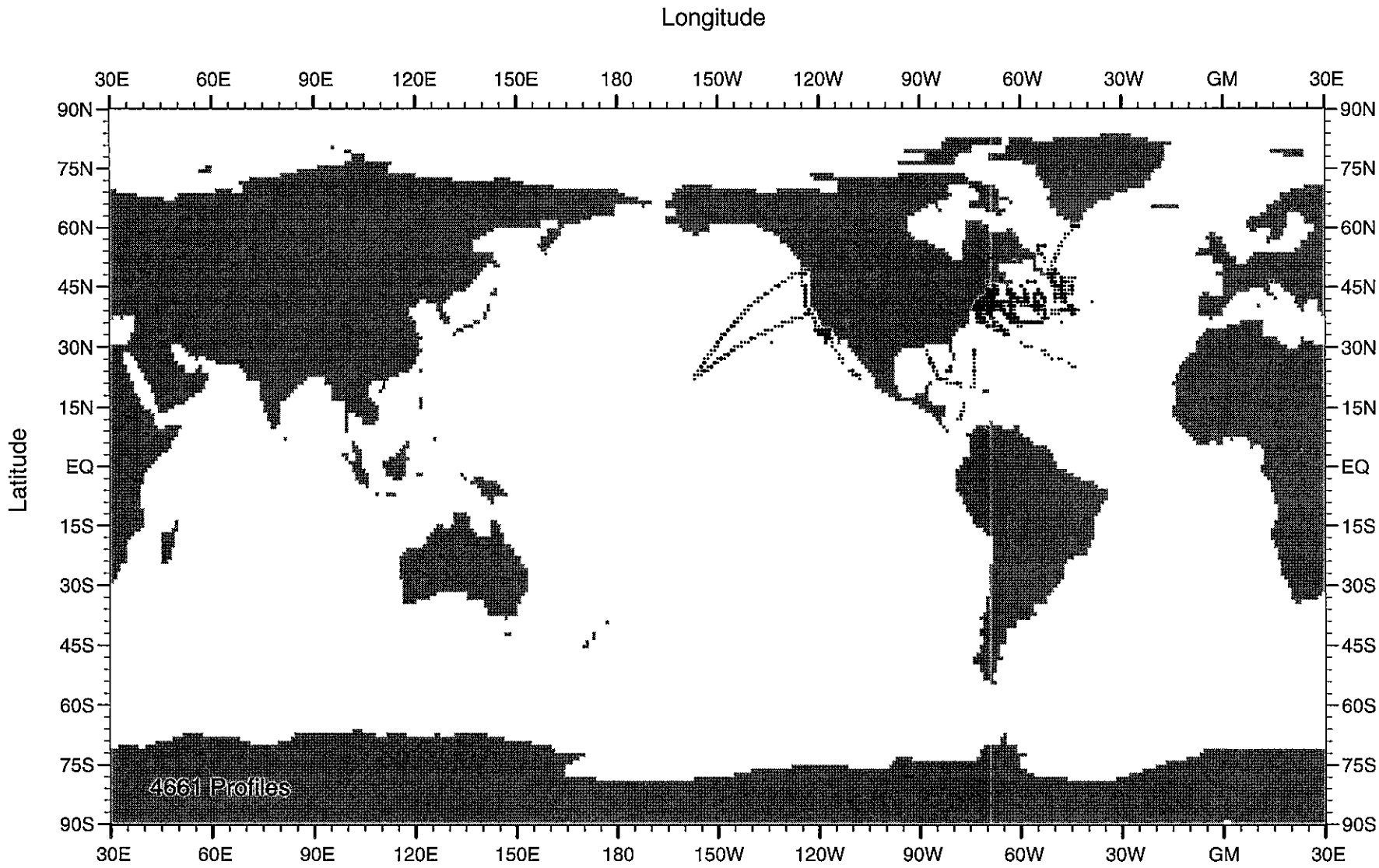

Fig. B3 WOD98 MBT profile distribution for July-September for 1941

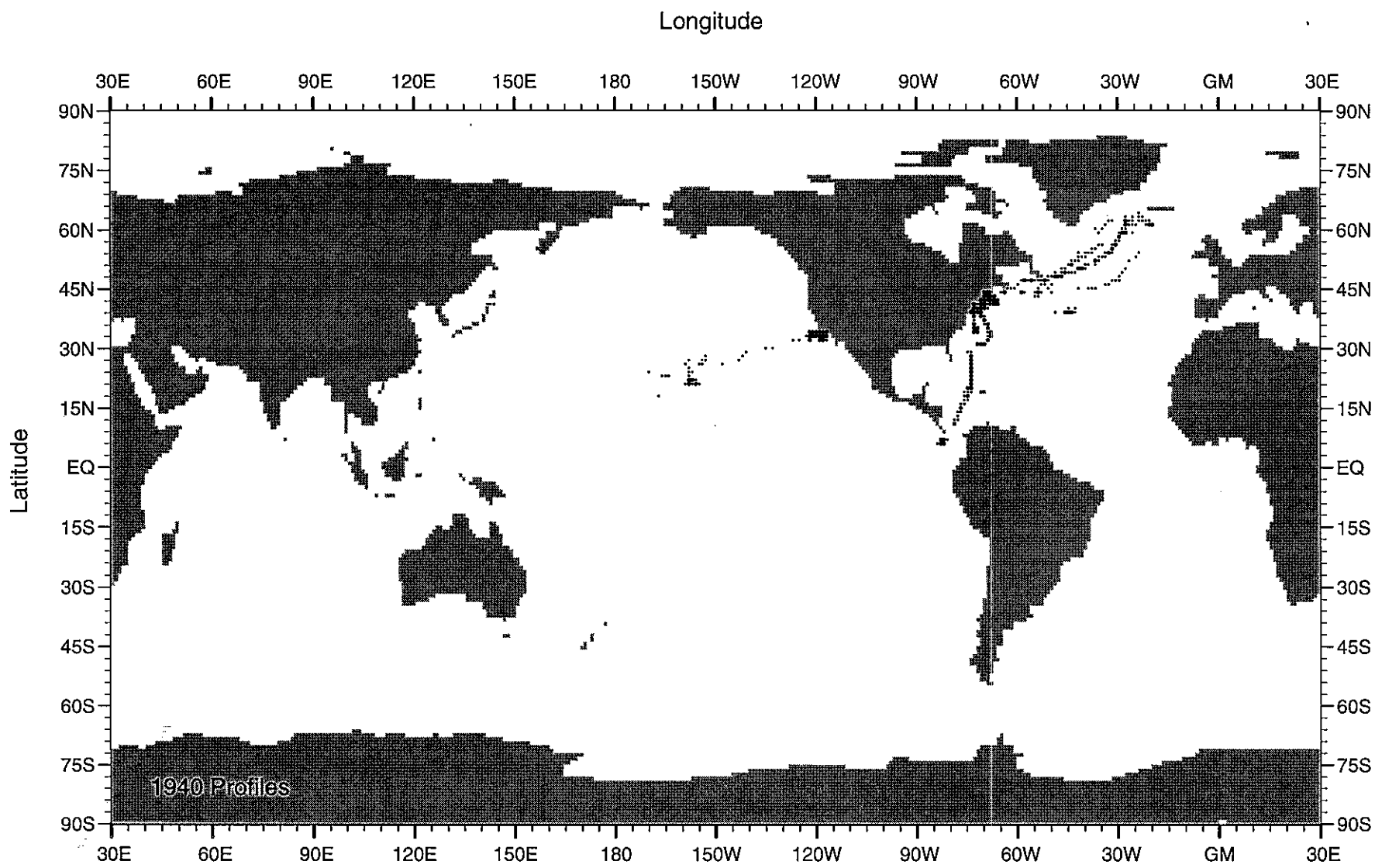

Fig. B4 WOD98 MBT profile distribution for October-December for 1941

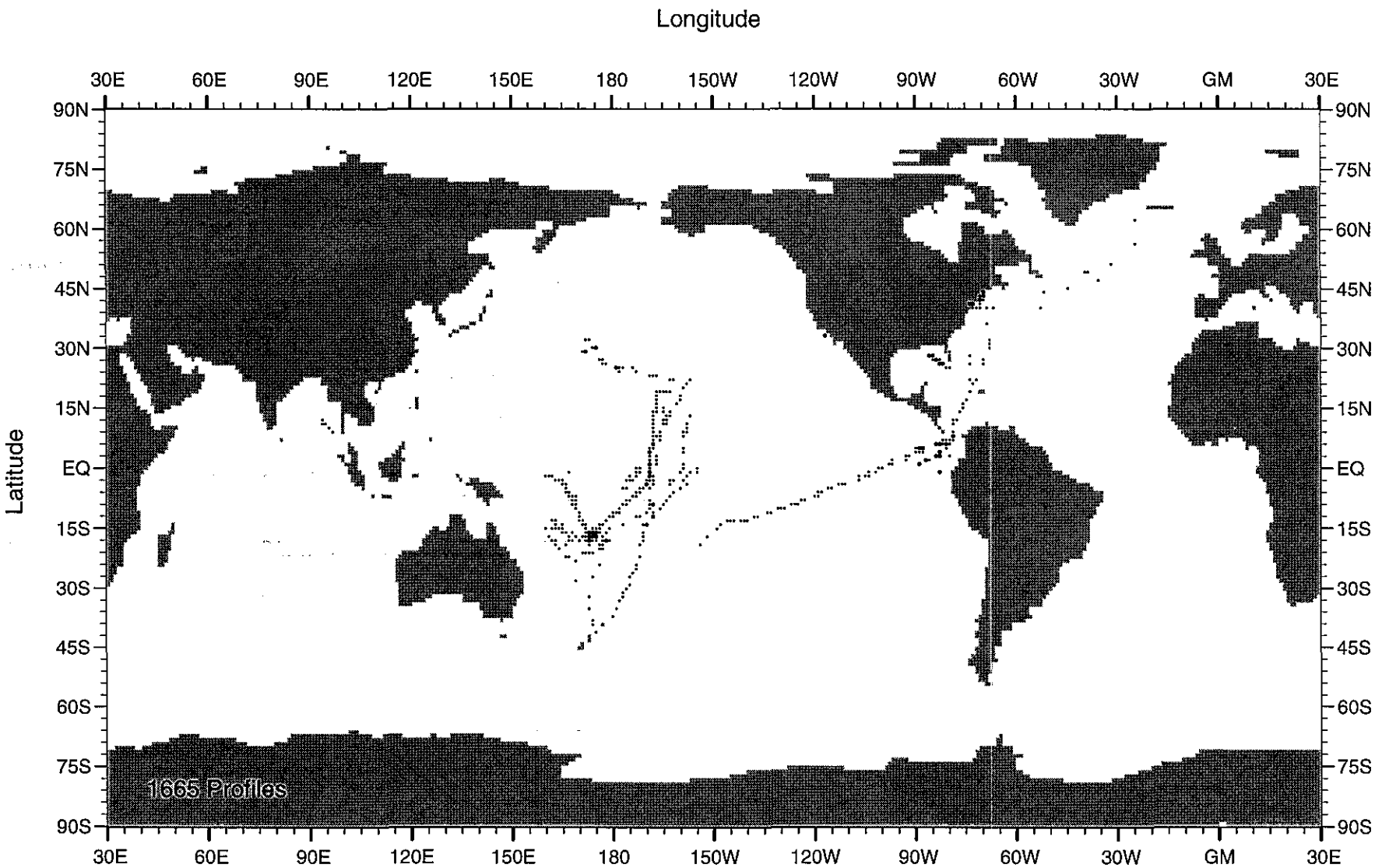

Fig. B5 WOD98 MBT profile distribution for January-March for 1942

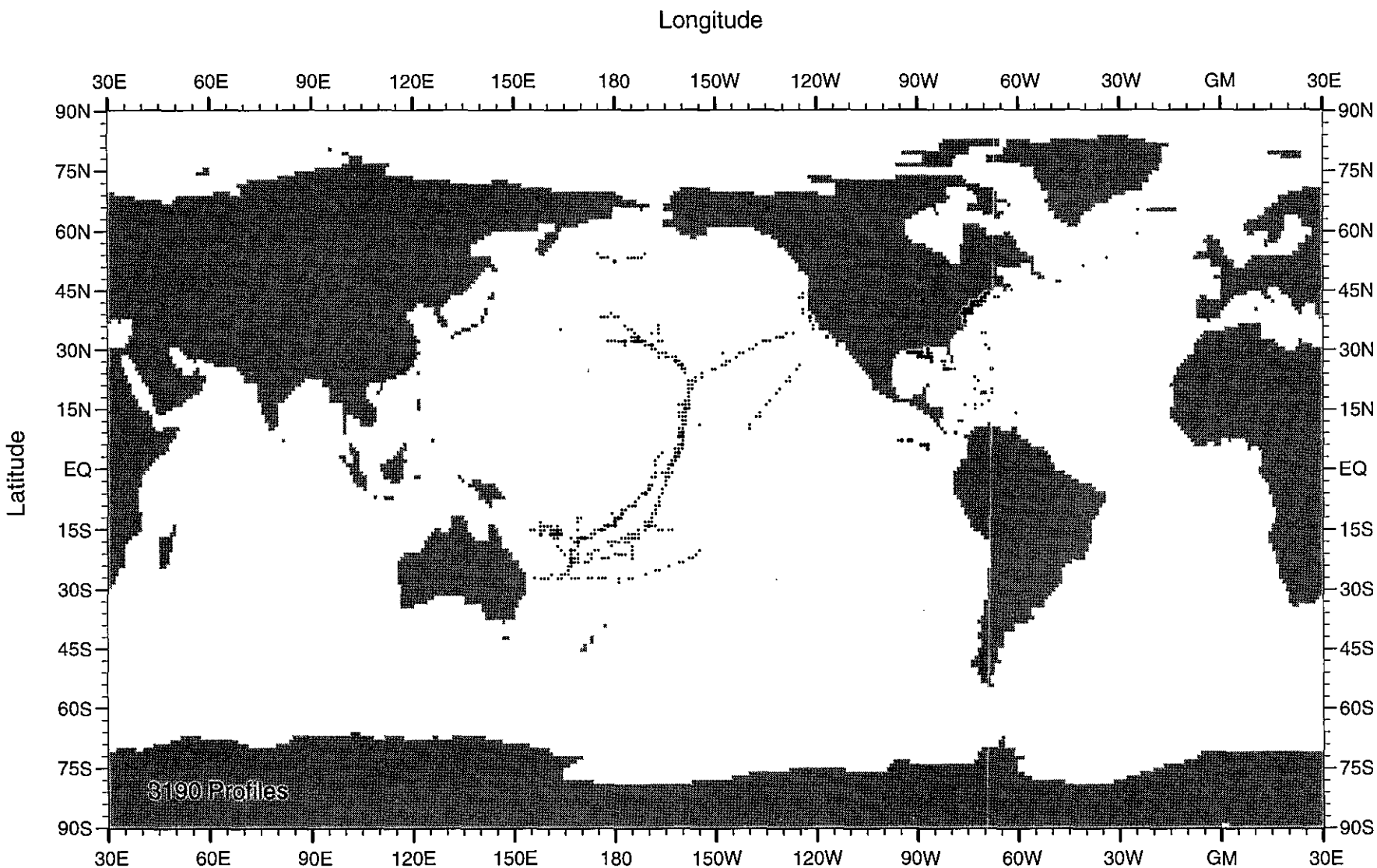

Fig. B6 WOD98 MBT profile distribution for April-June for 1942

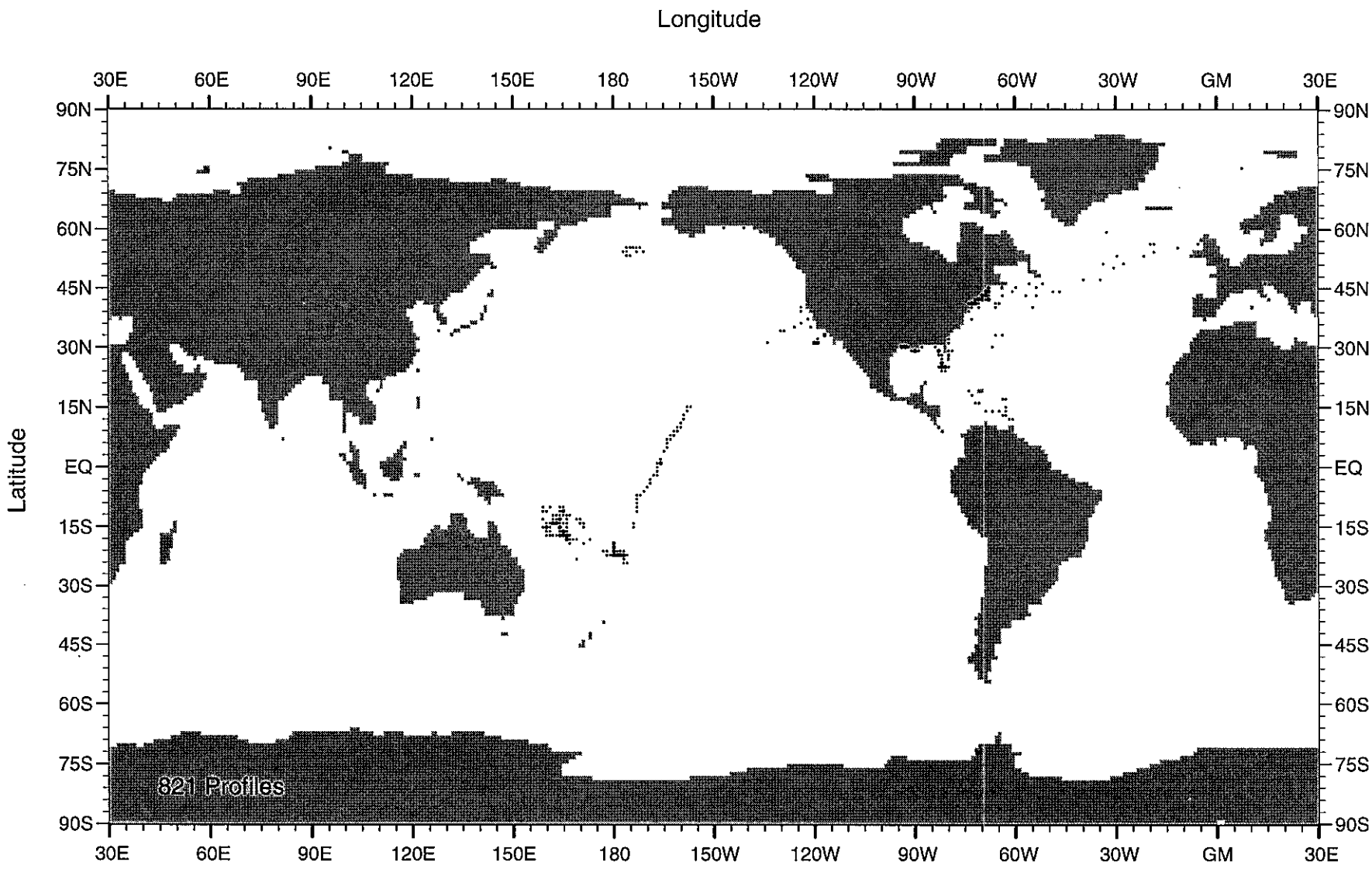

Fig. B7 WOD98 MBT profile distribution for July-September for 1942

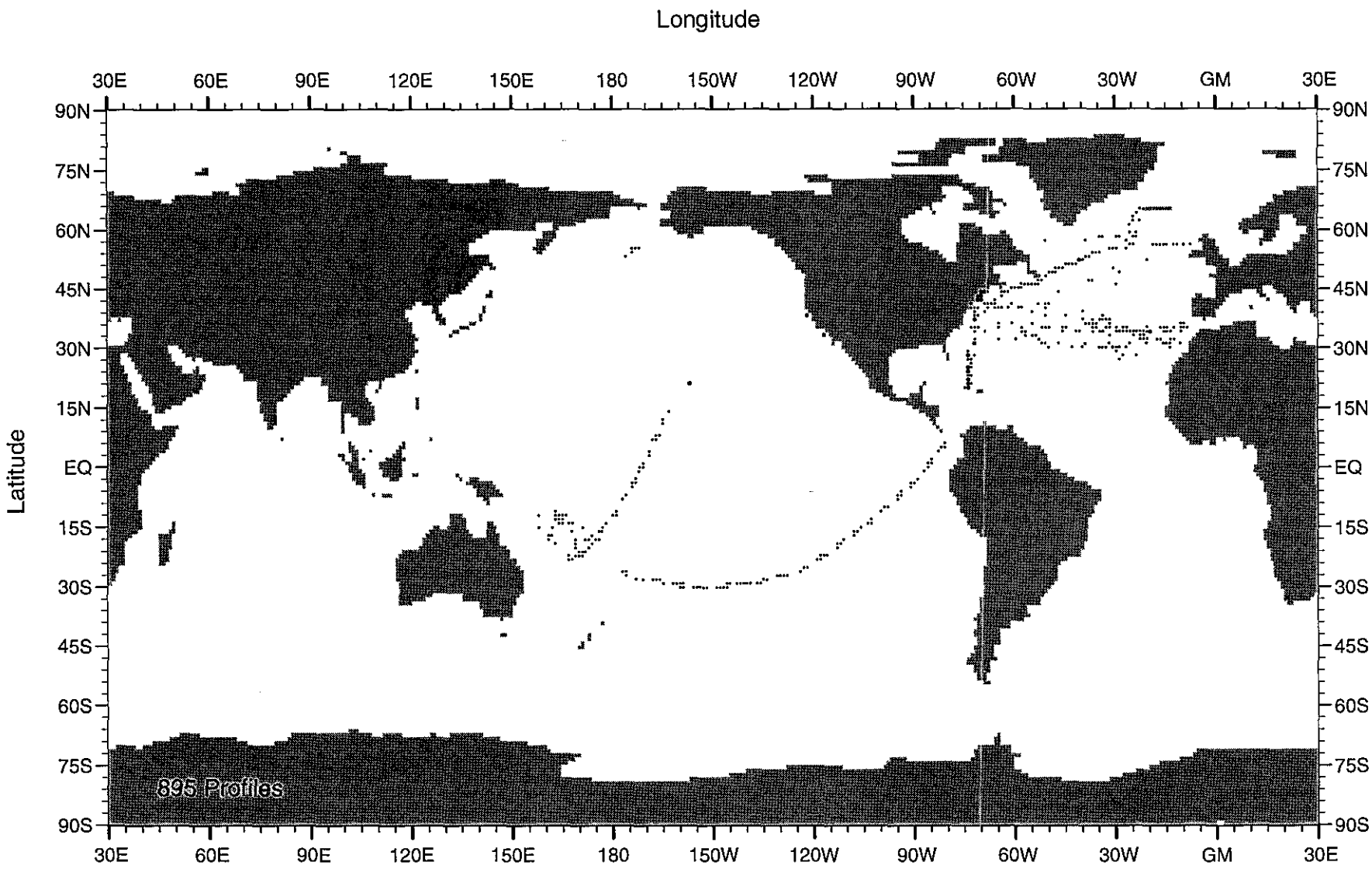

Fig. B8 WOD98 MBT profile distribution for October-December for 1942

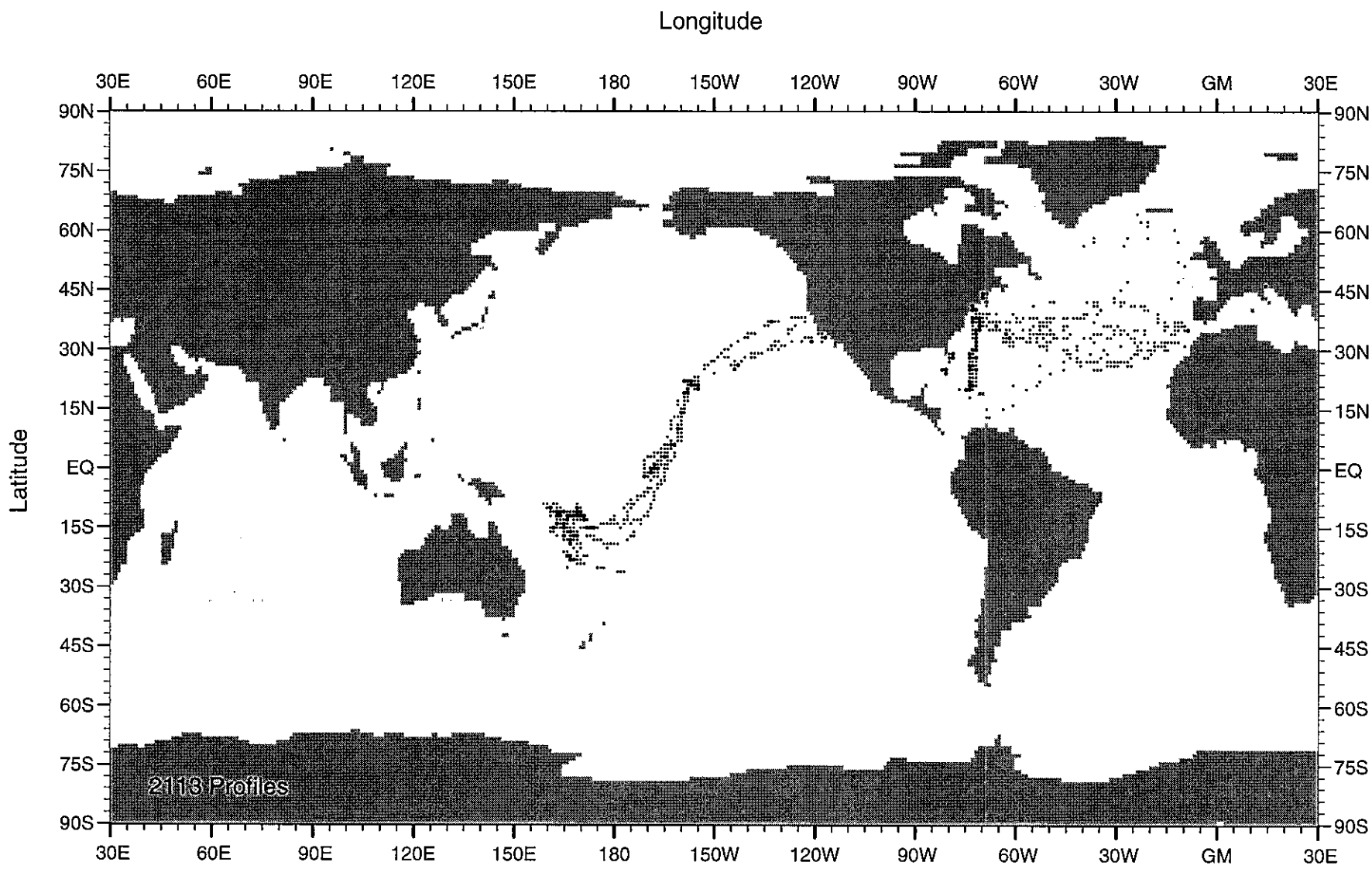

Fig. B9 WOD98 MBT profile distribution for January-March for 1943

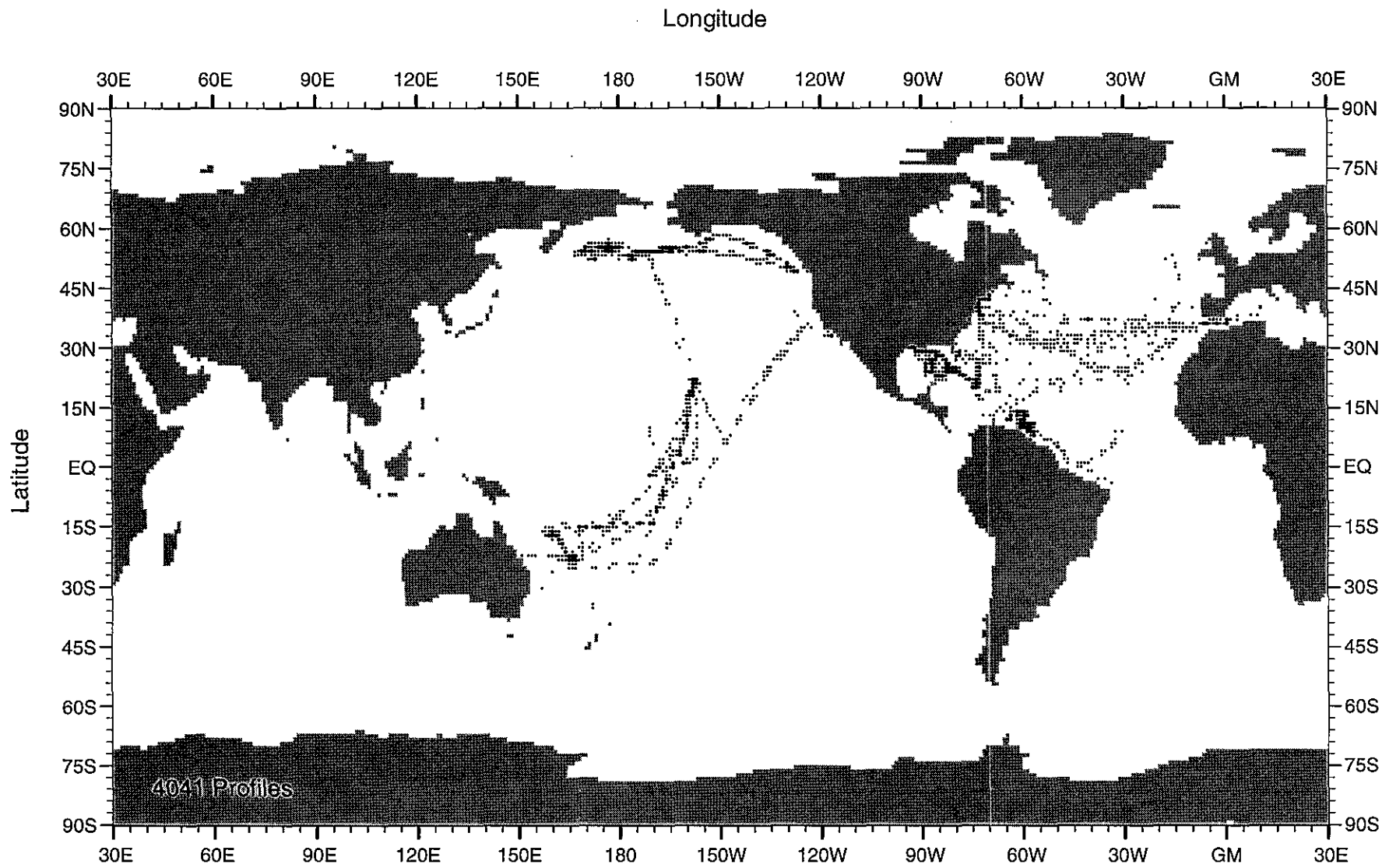

Fig. B10 WOD98 MBT profile distribution for April-June for 1943

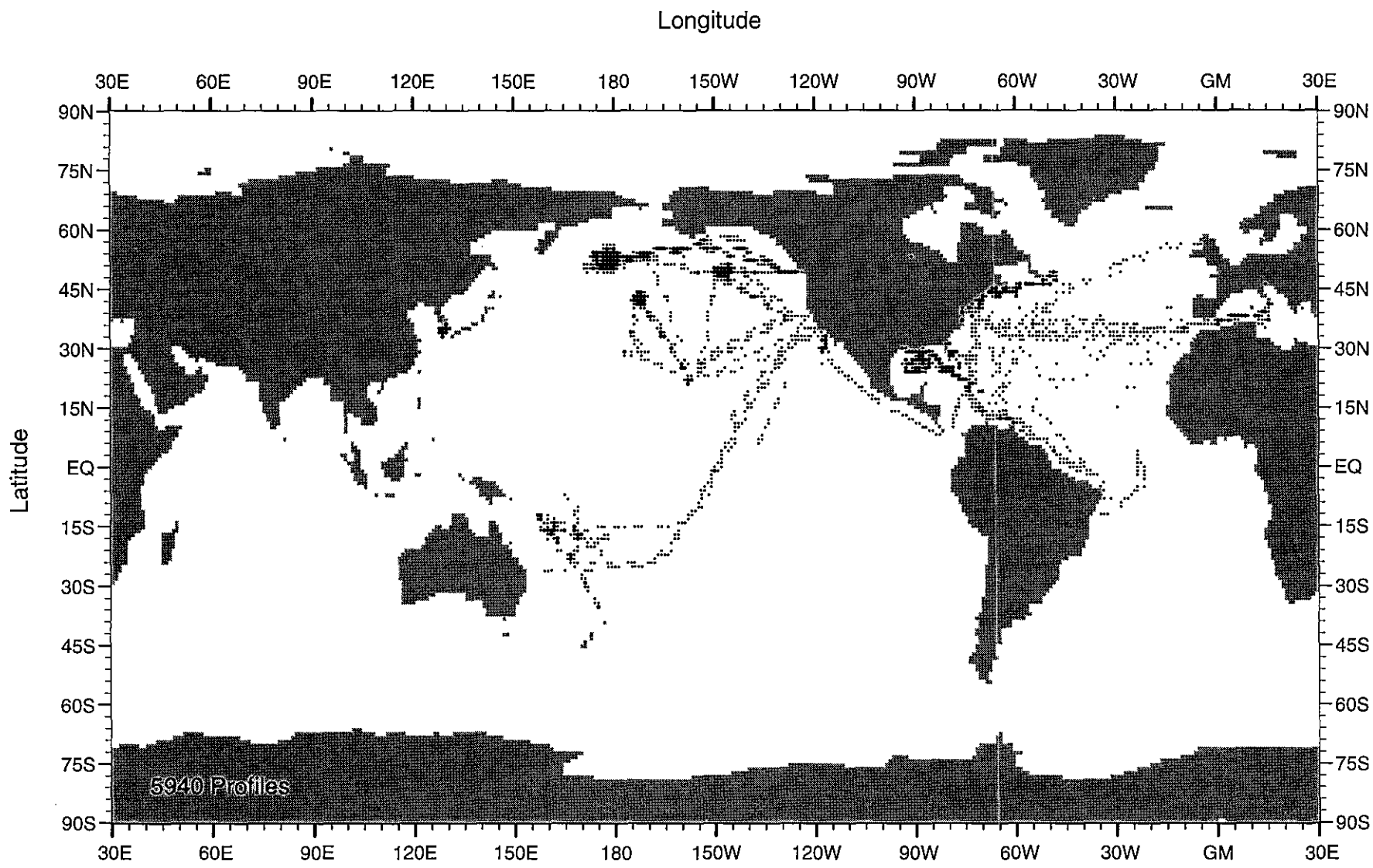

Fig. B11 WOD98 MBT profile distribution for July-September for 1943

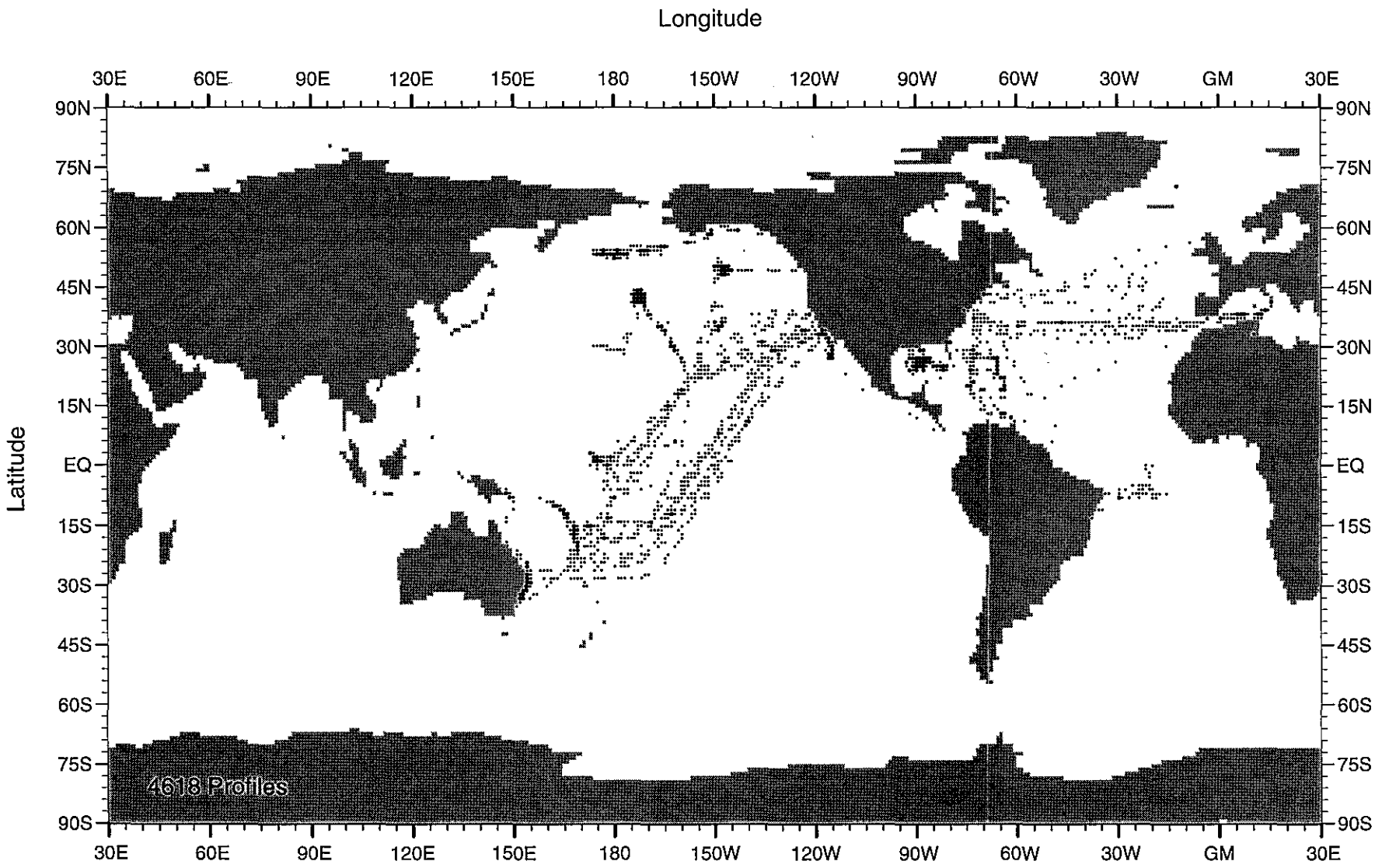

Fig. B12 WOD98 MBT profile distribution for October-December for 1943

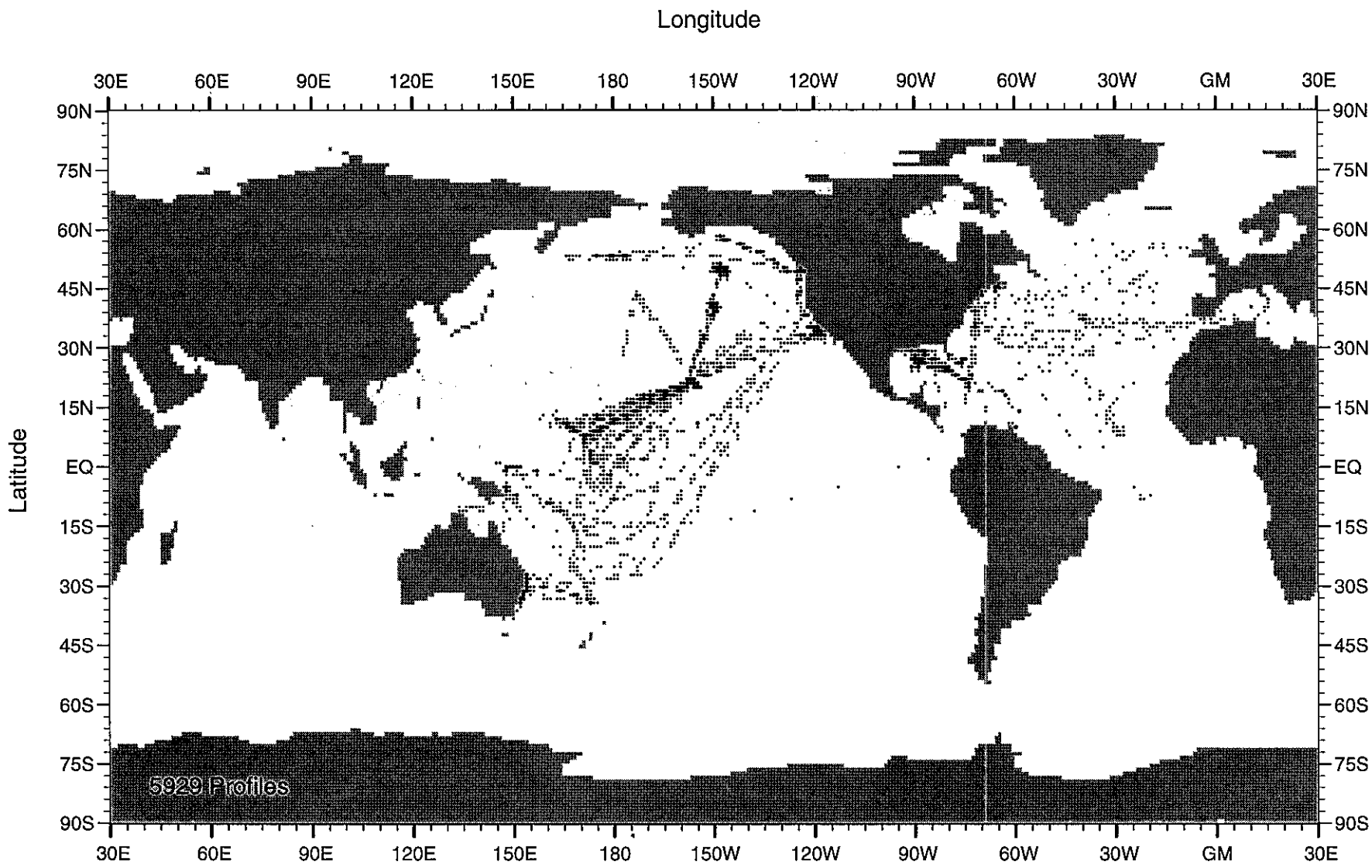

Fig. B13 WOD98 MBT profile distribution for January-March for 1944

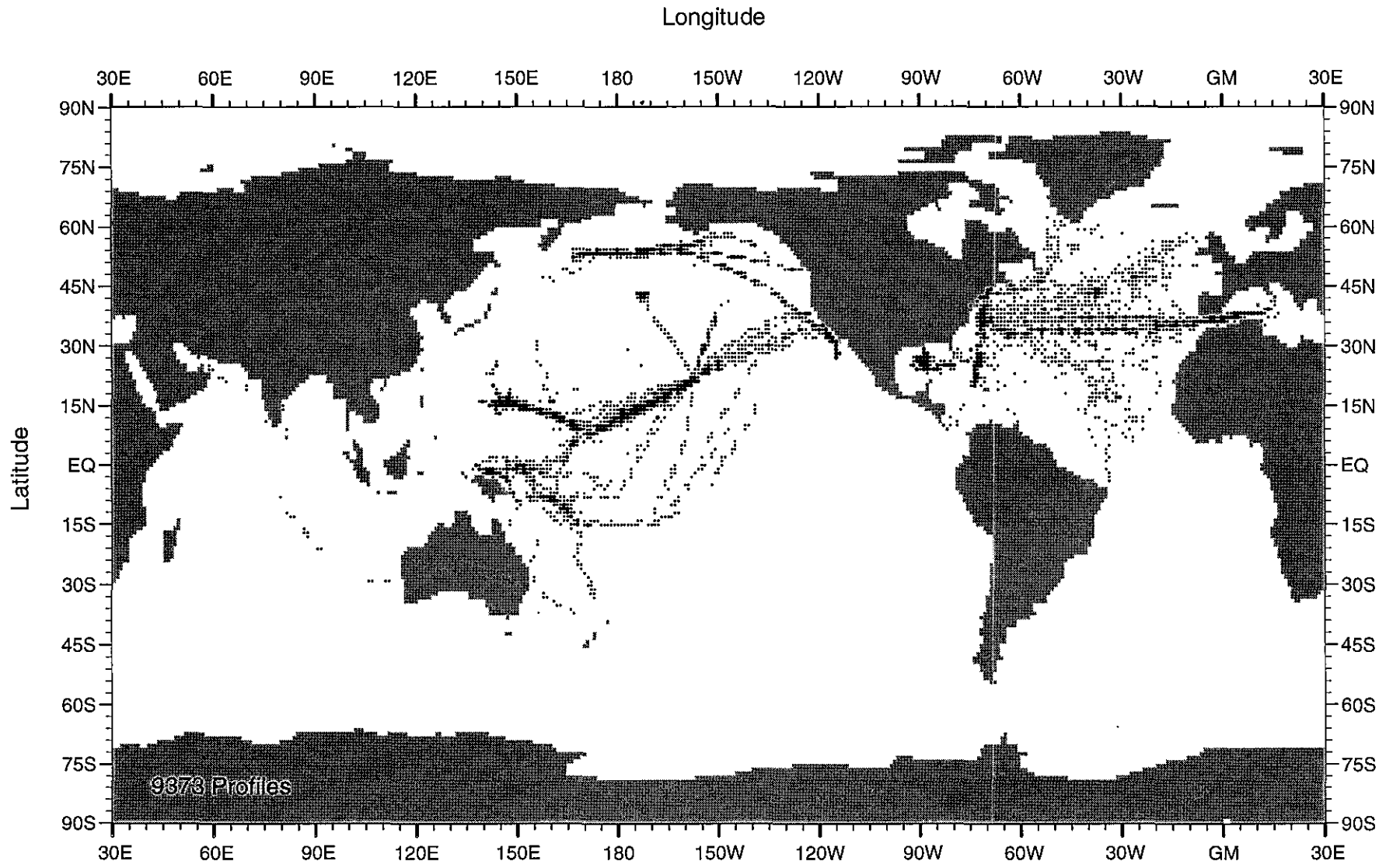

Fig. B14 WOD98 MBT profile distribution for April-June for 1944

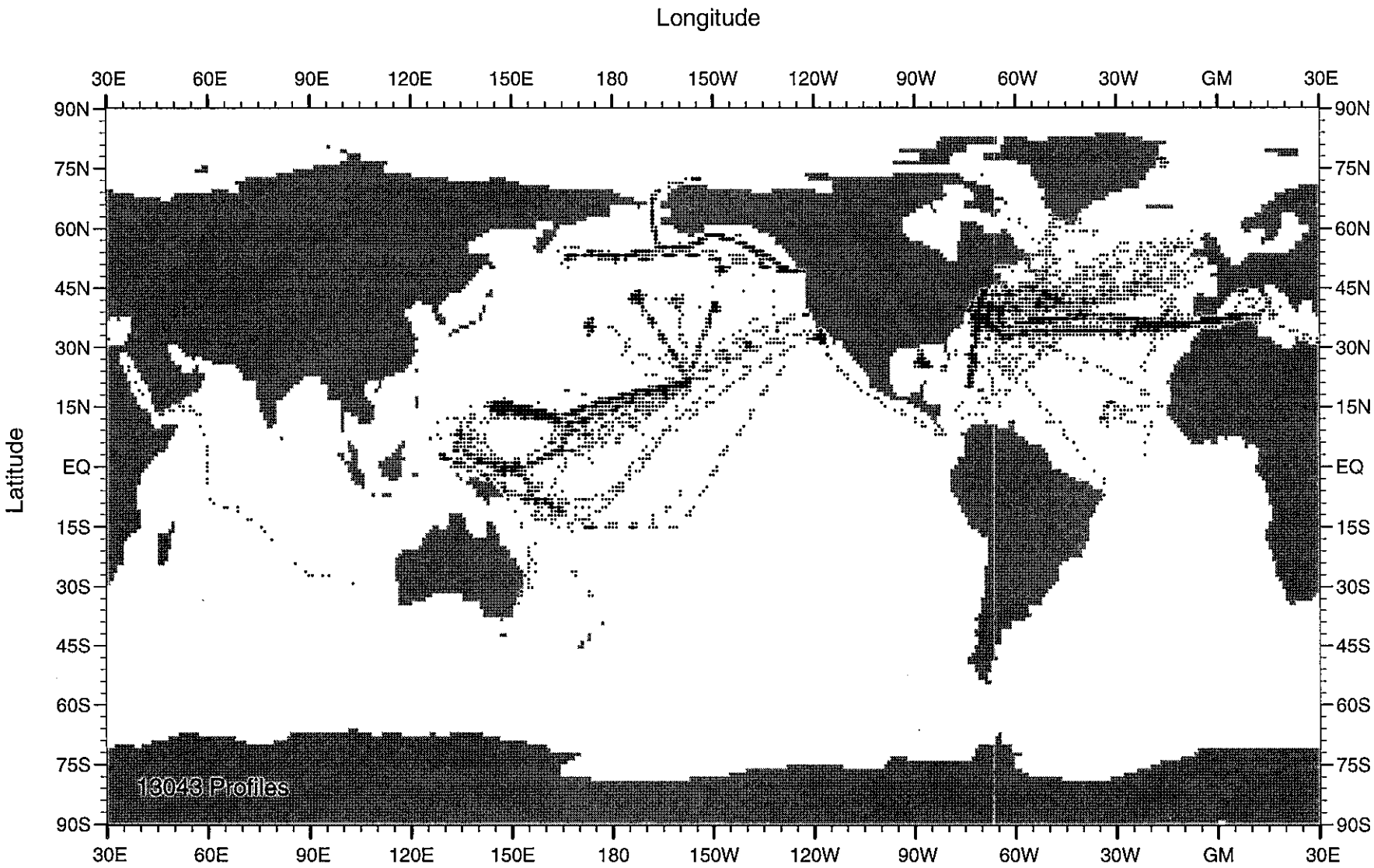

Fig. B15 WOD98 MBT profile distribution for July-September for 1944

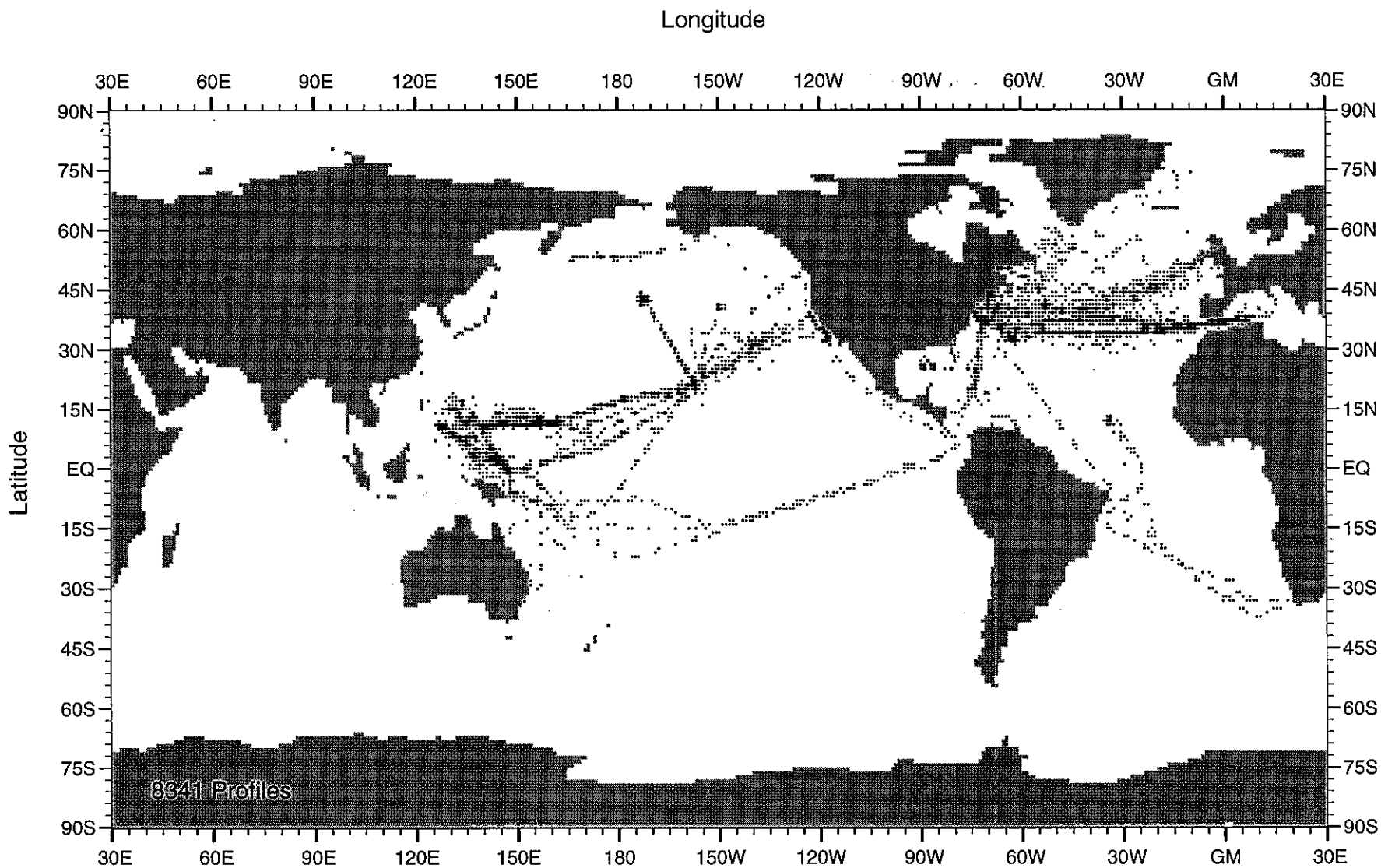

Fig. B16 WOD98 MBT profile distribution for October-December for 1944

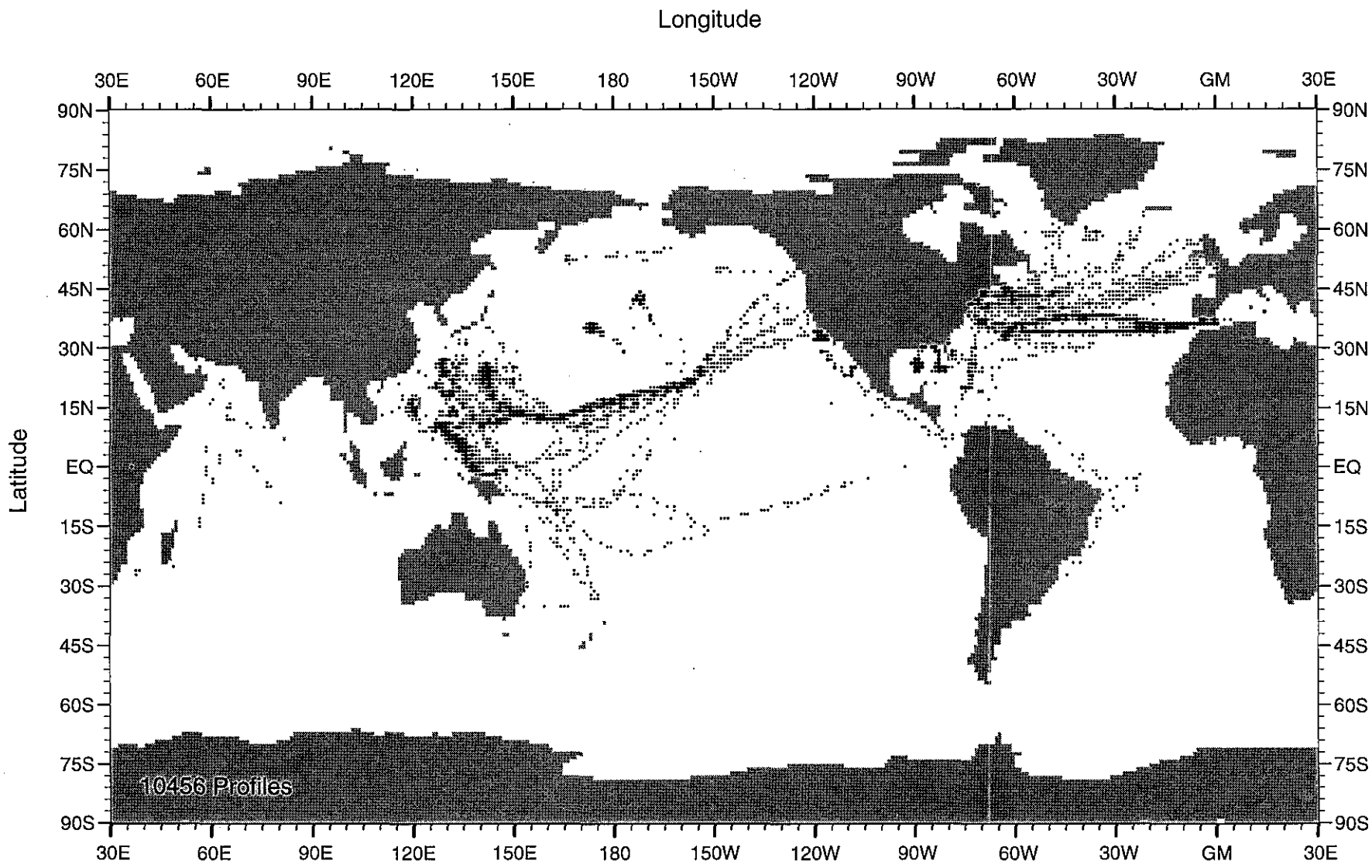

Fig. B17 WOD98 MBT profile distribution for January-March for 1945

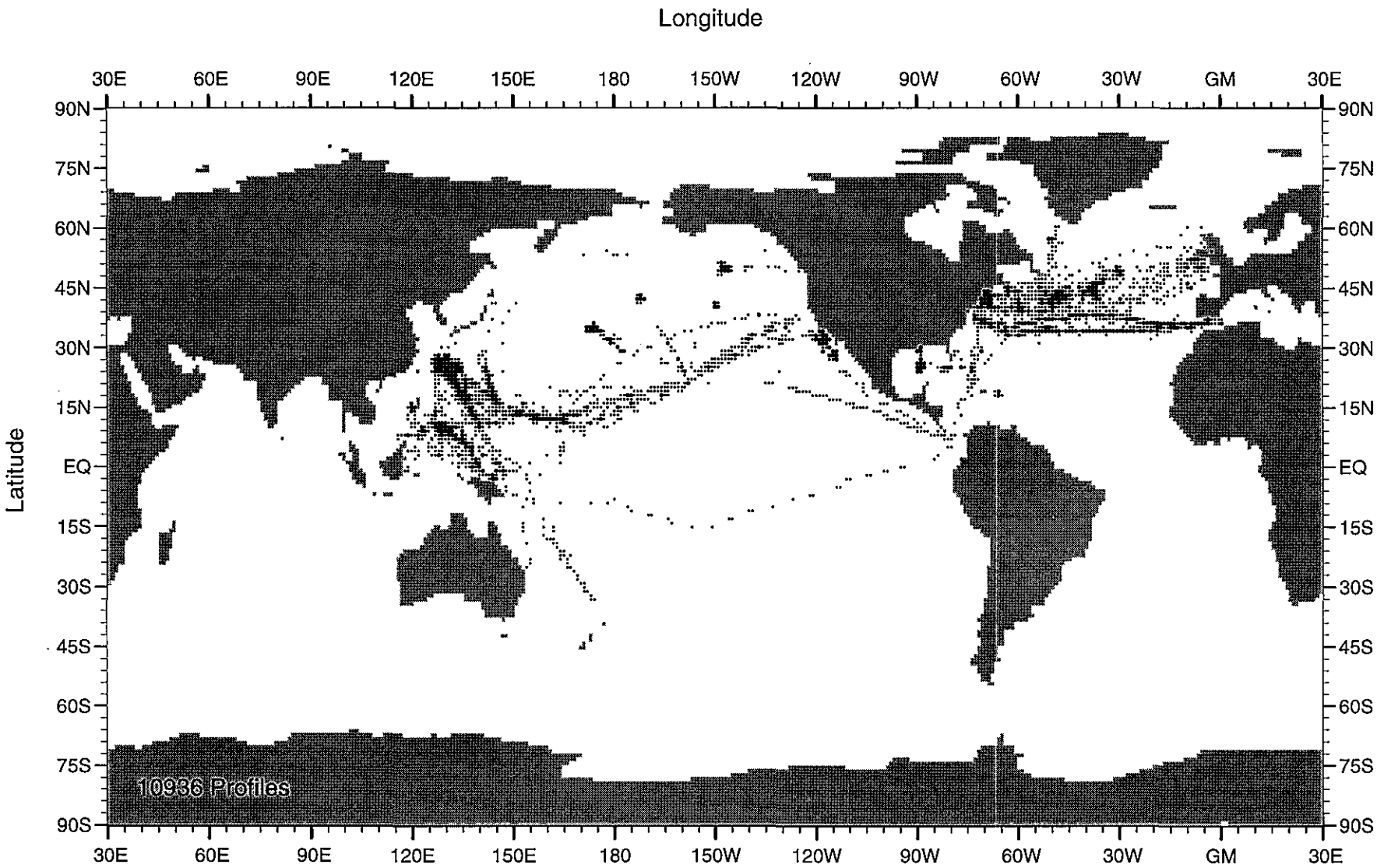

Fig. B18 WOD98 MBT profile distribution for April-June for 1945

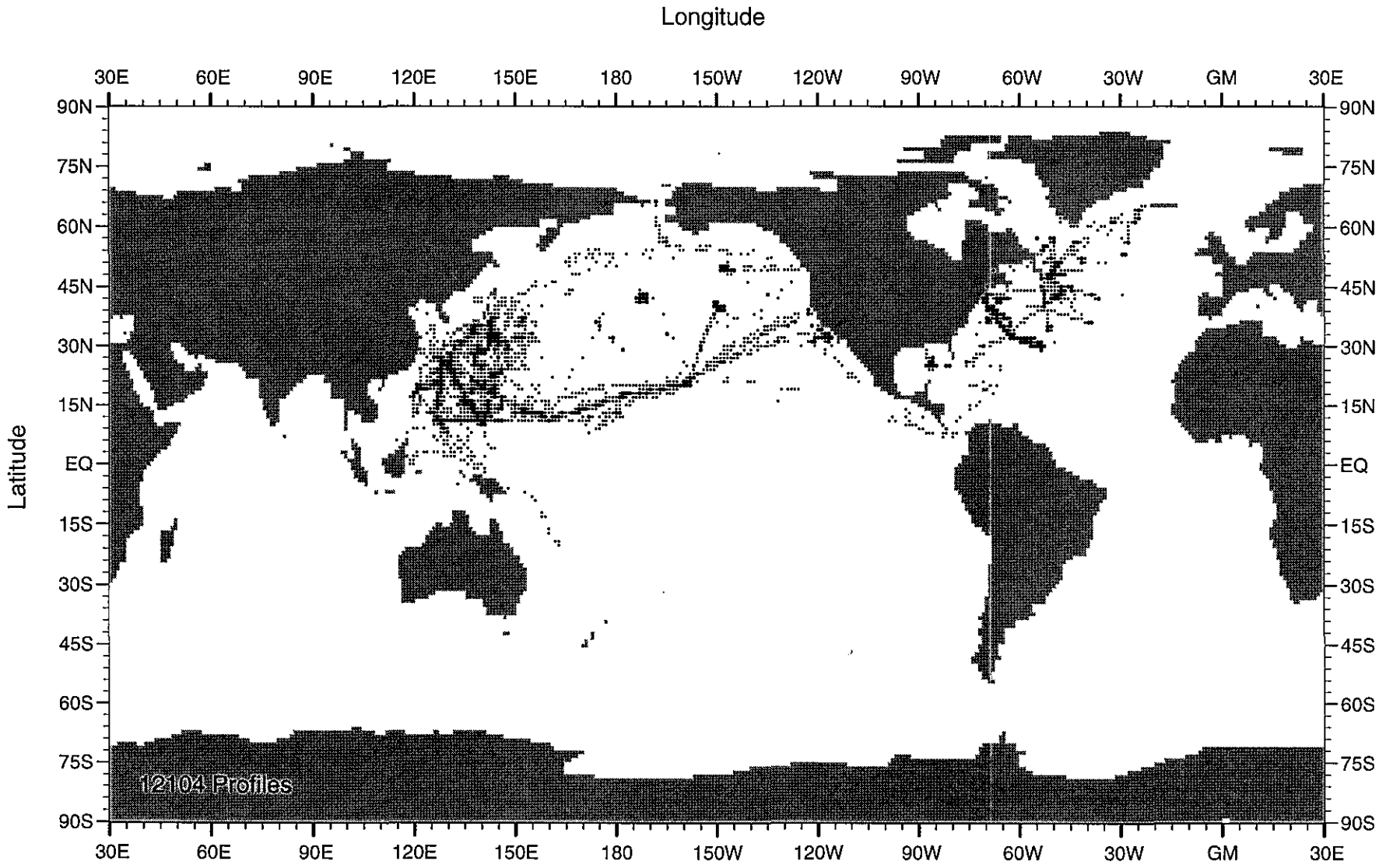

Fig. B19 WOD98 MBT profile distribution for July-September for 1945

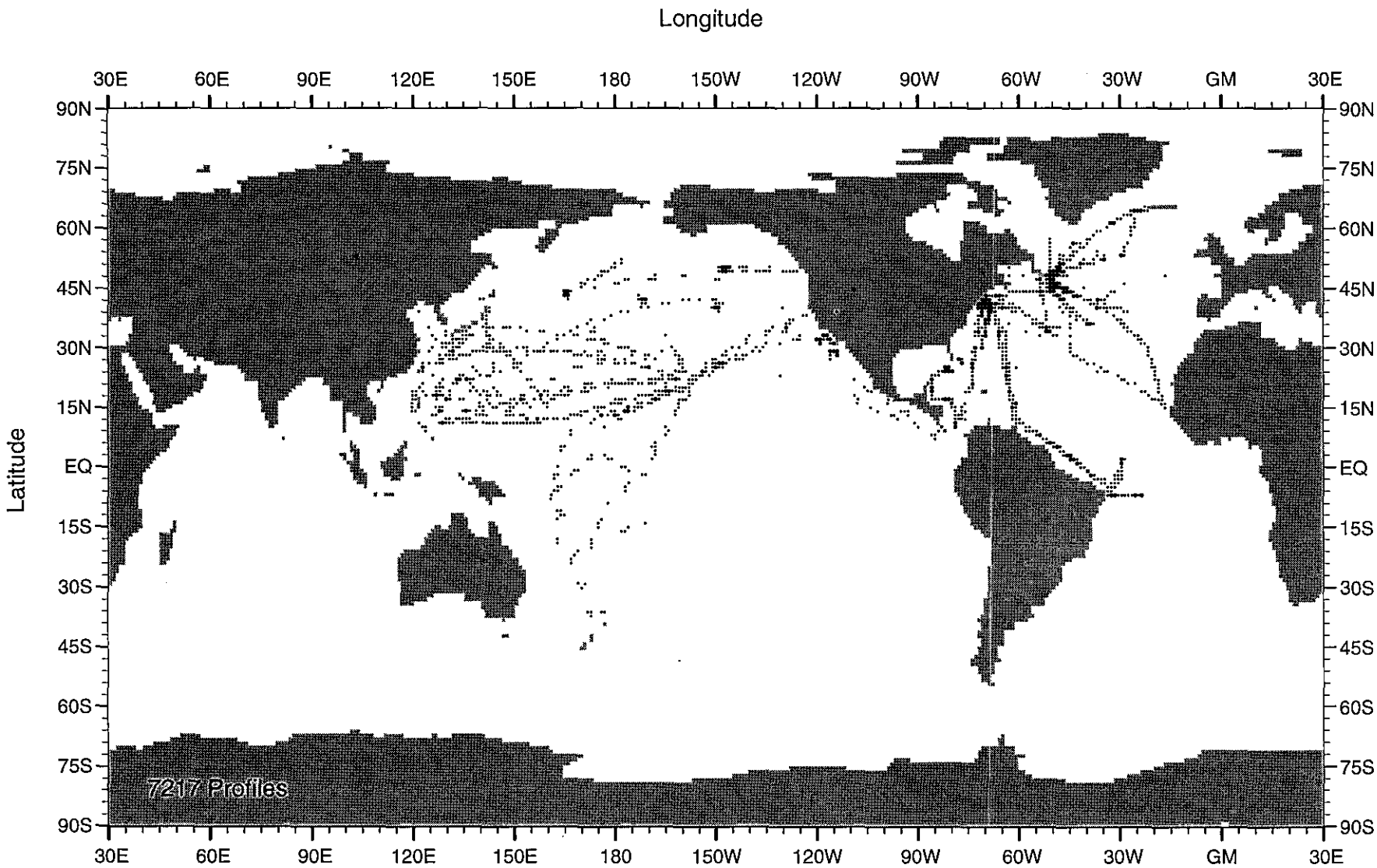

Fig. B20 WOD98 MBT profile distribution for October-December for 1945

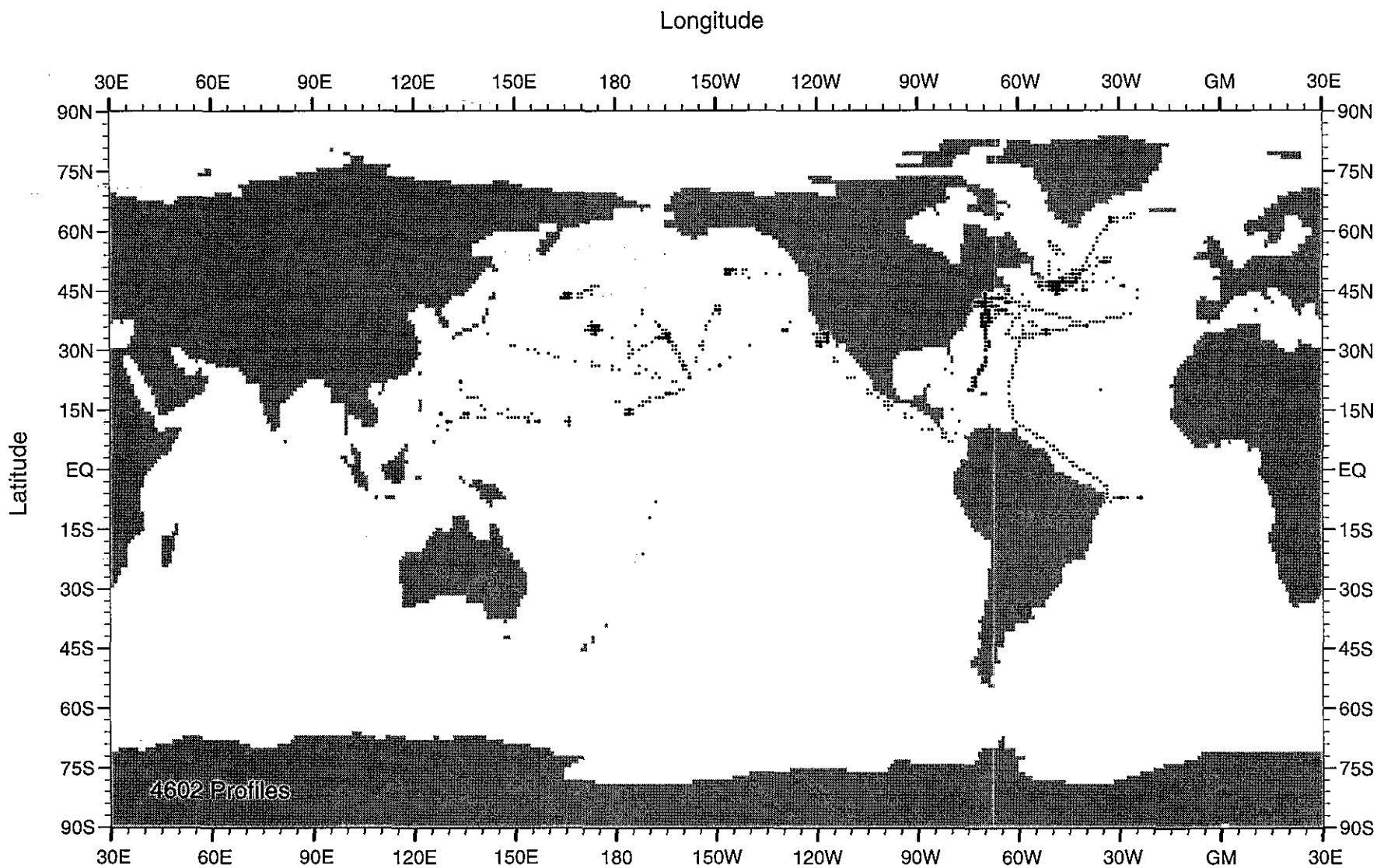

Fig. B21 WOD98 MBT profile distribution for January-March for 1946

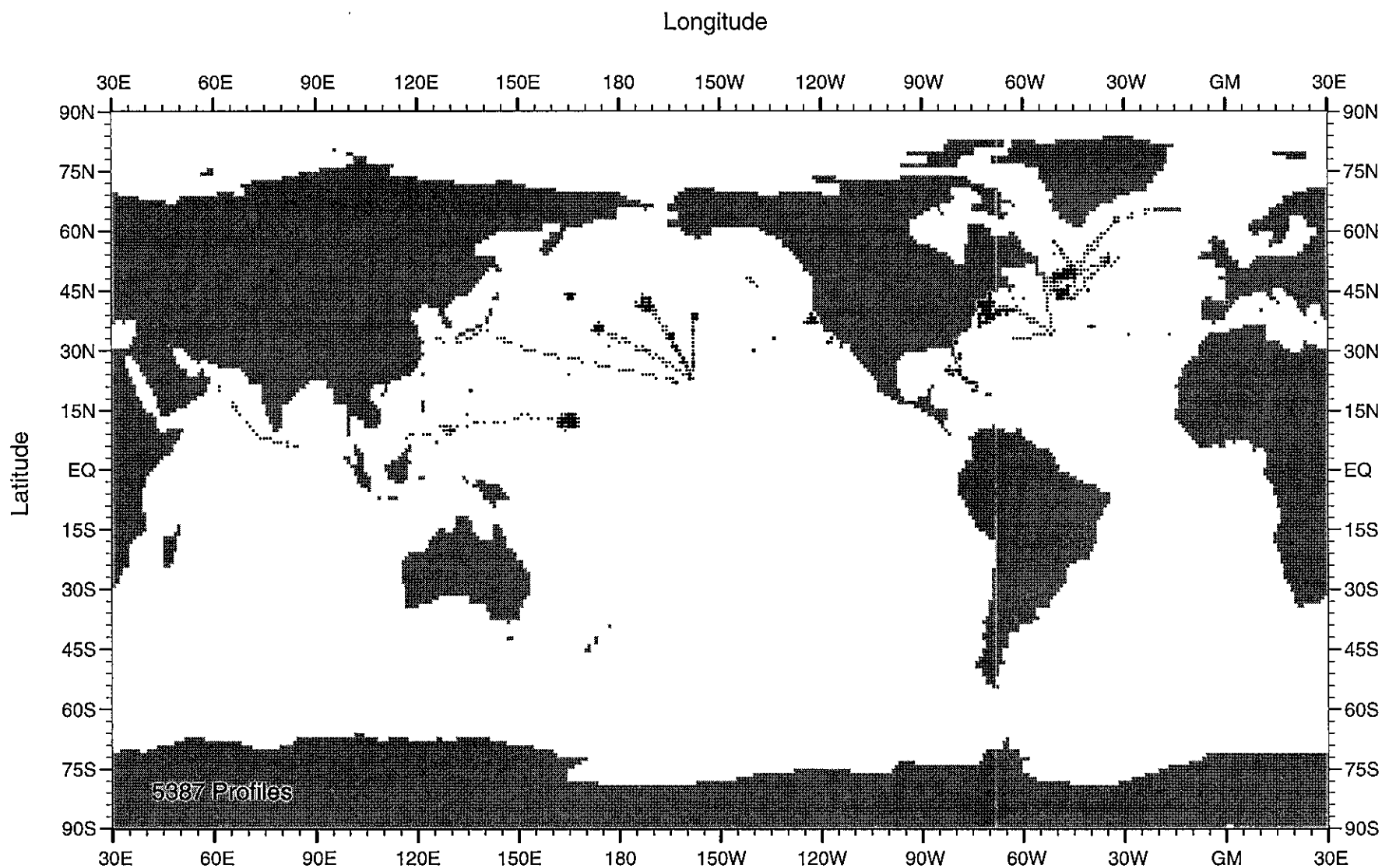

Fig. B22 WOD98 MBT profile distribution for April-June for 1946

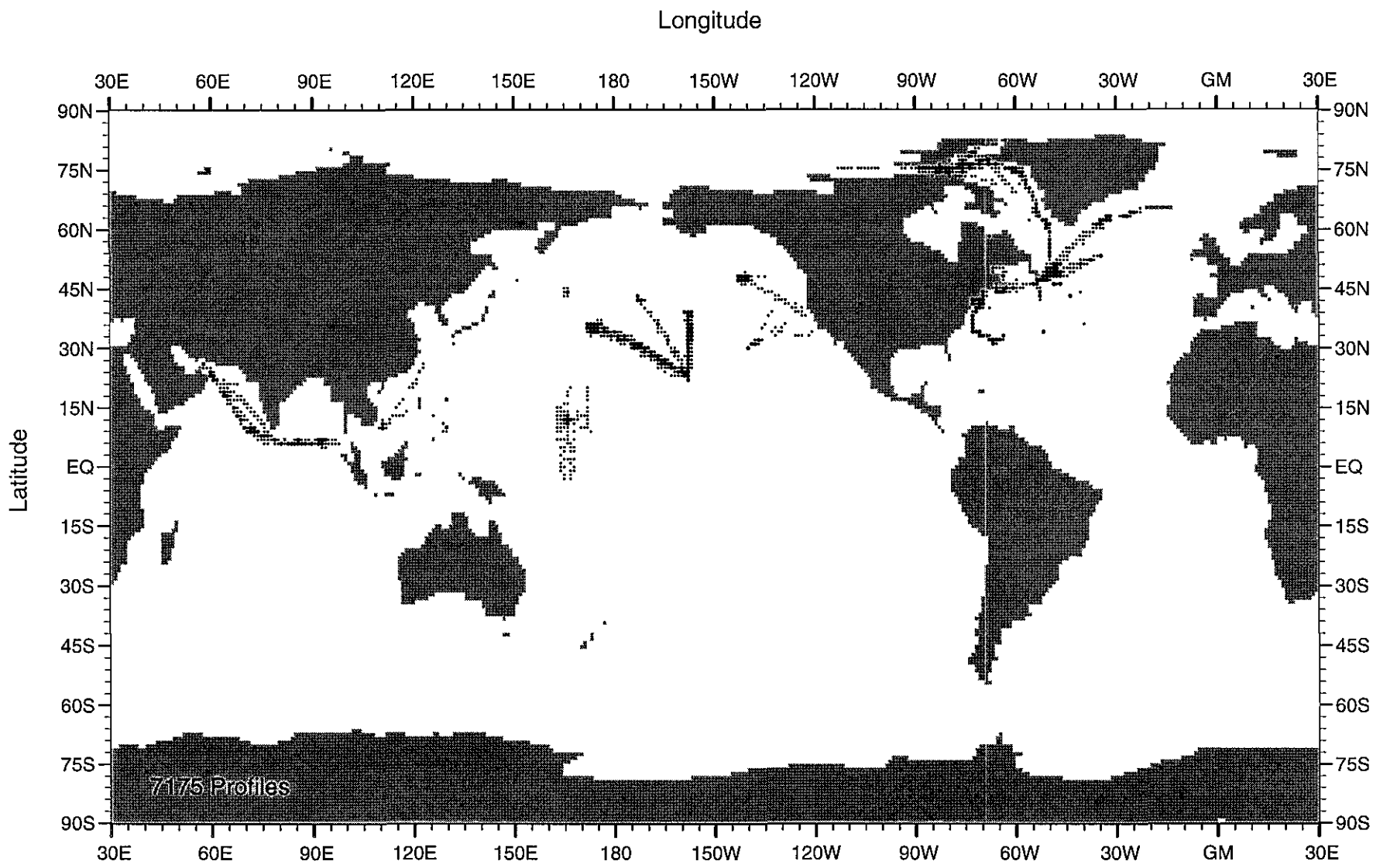

Fig. B23 WOD98 MBT profile distribution for July-September for 1946

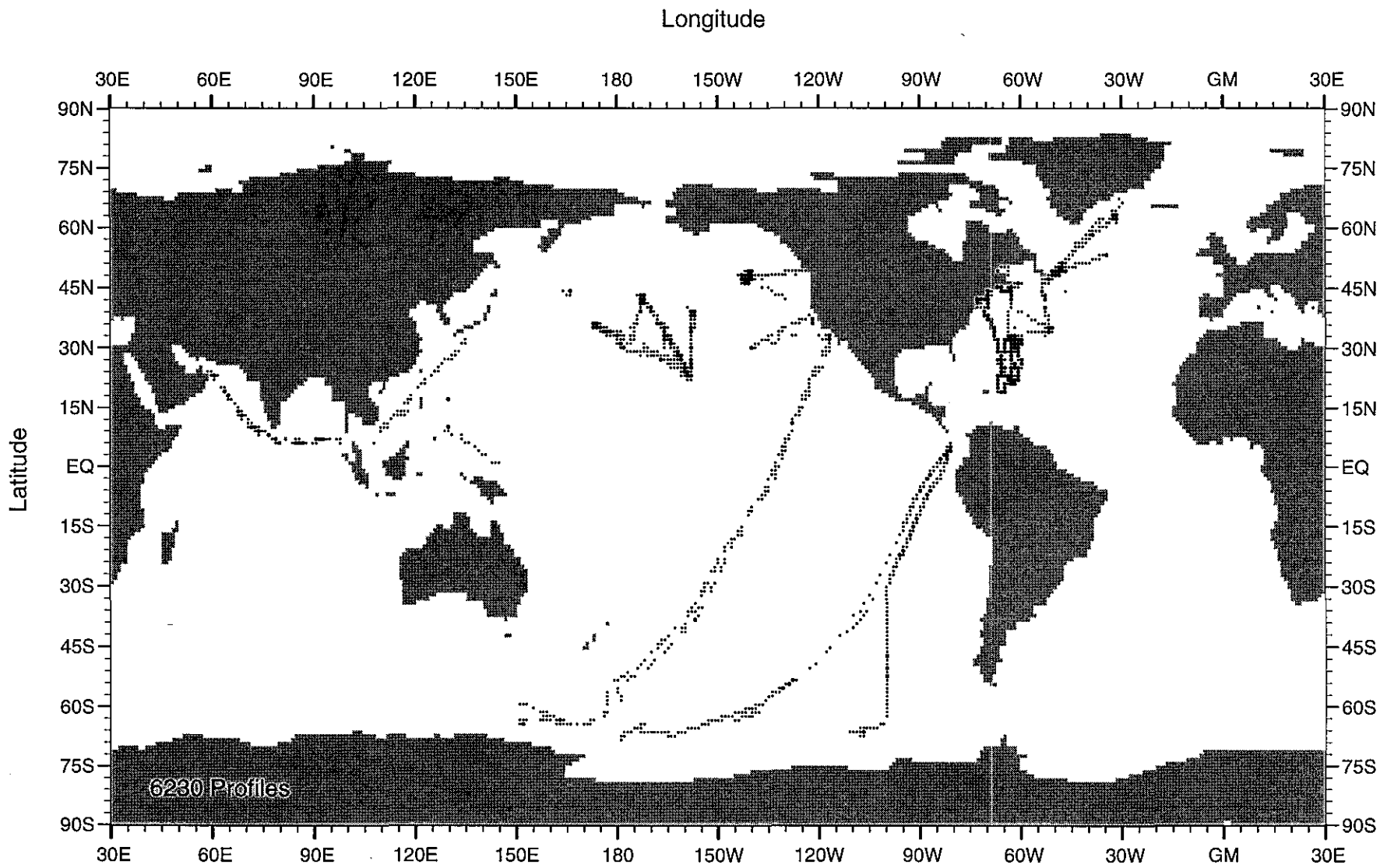

Fig. B24 WOD98 MBT profile distribution for October-December for 1946

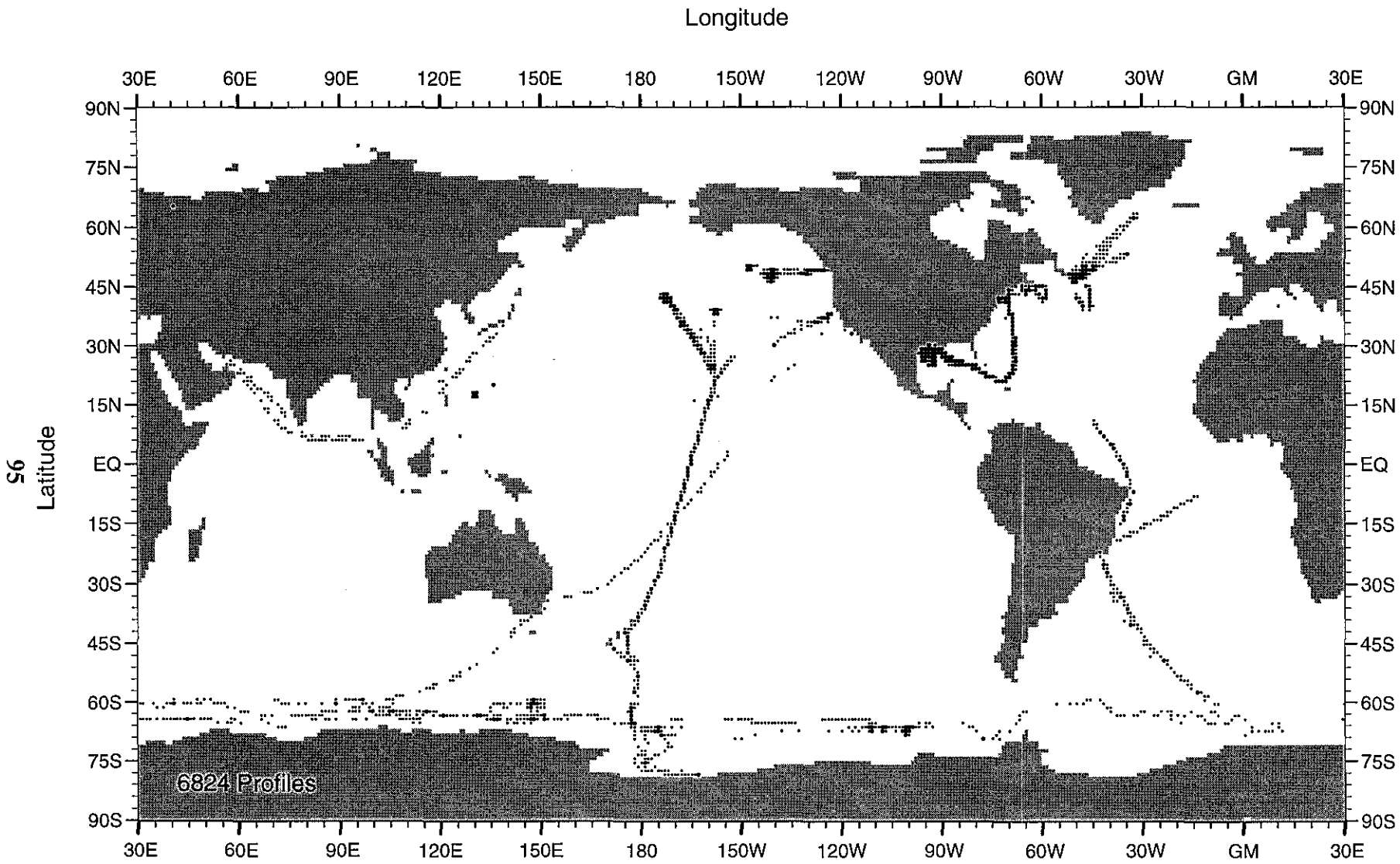

Fig. B25 WOD98 MBT profile distribution for January-March for 1947

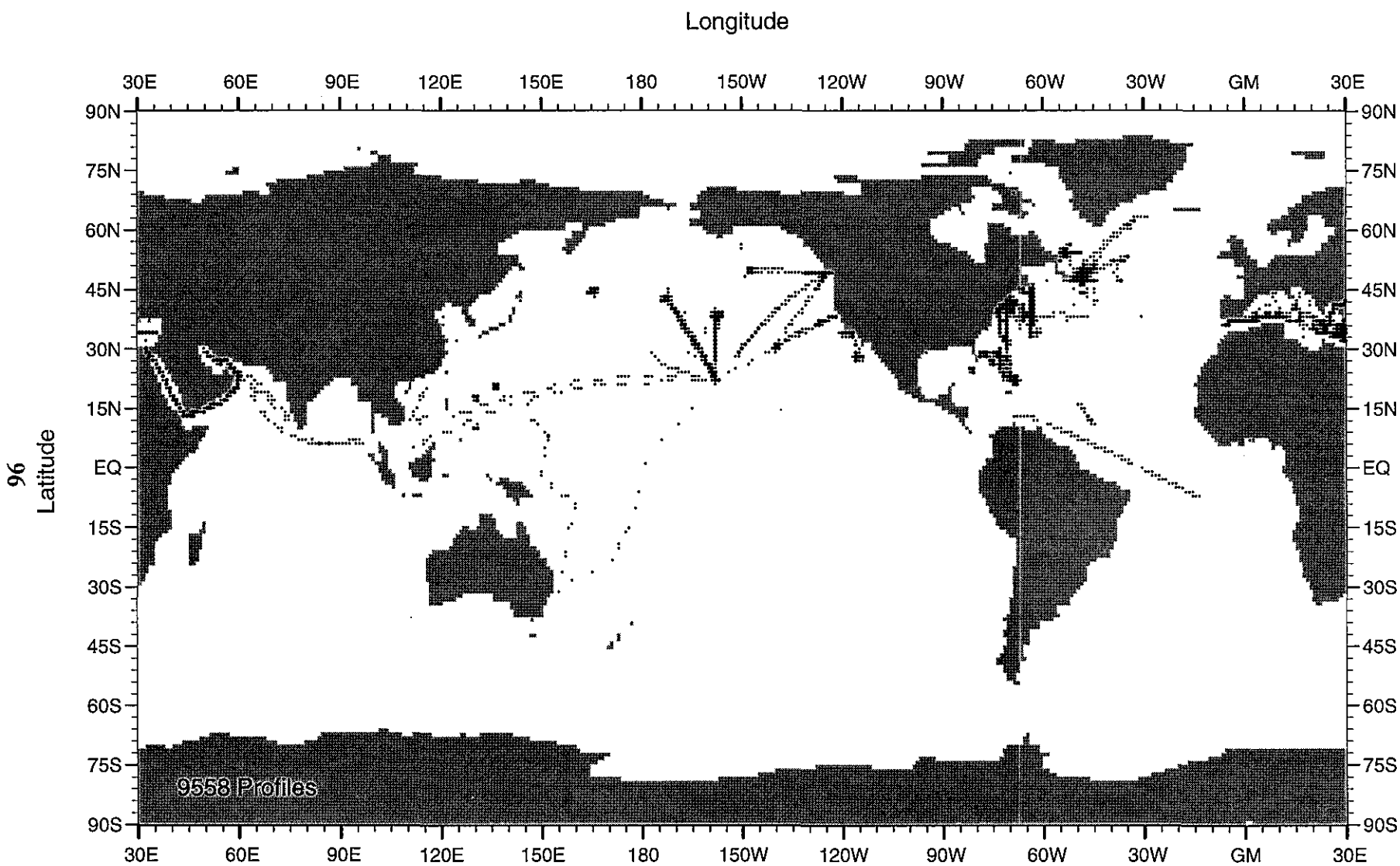

Fig. B26 WOD98 MBT profile distribution for April-June for 1947

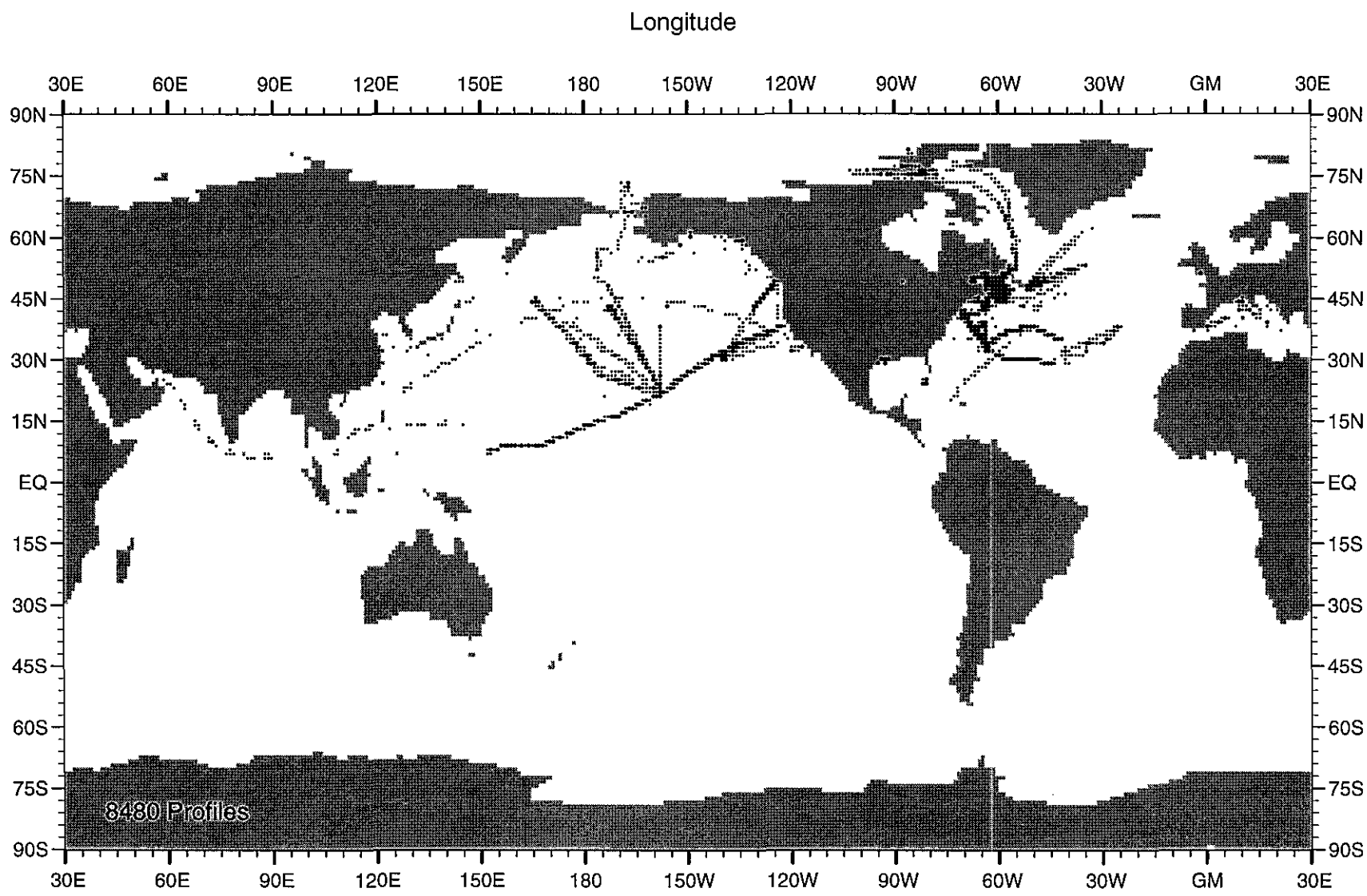

Fig. B27 WOD98 MBT profile distribution for July-September for 1947

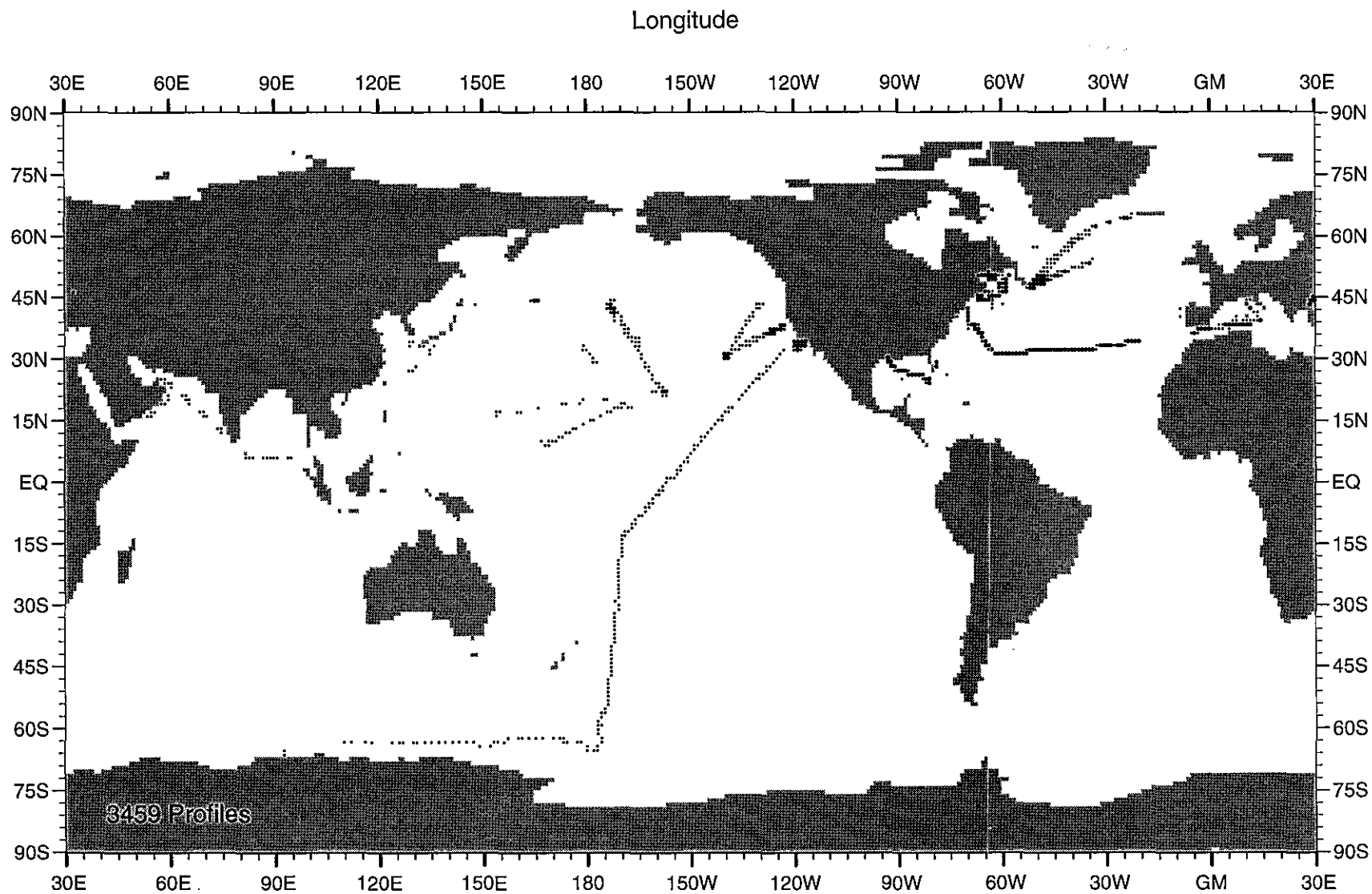

Fig. B28 WOD98 MBT profile distribution for October-December for 1947

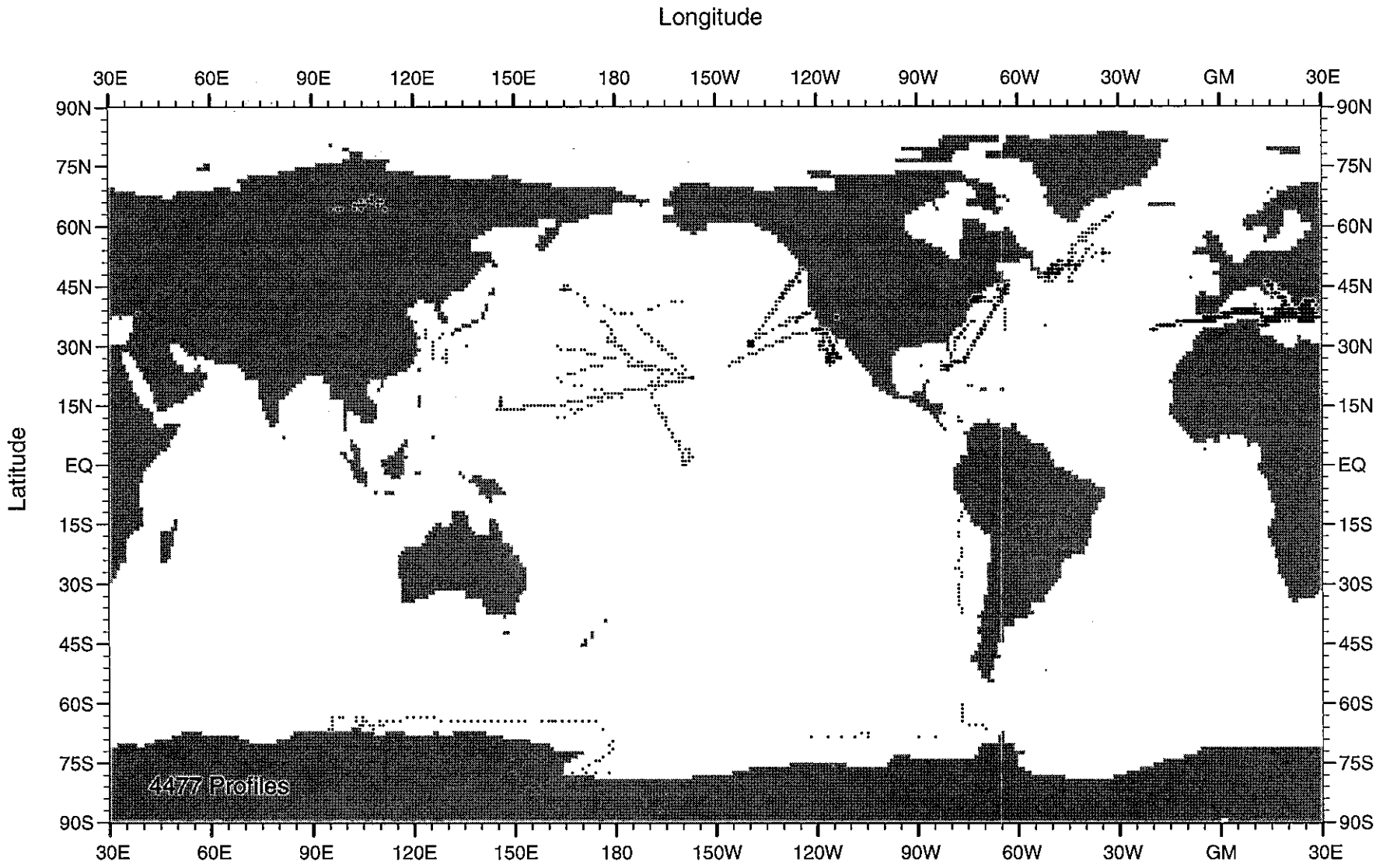

Fig. B29 WOD98 MBT profile distribution for January-March for 1948

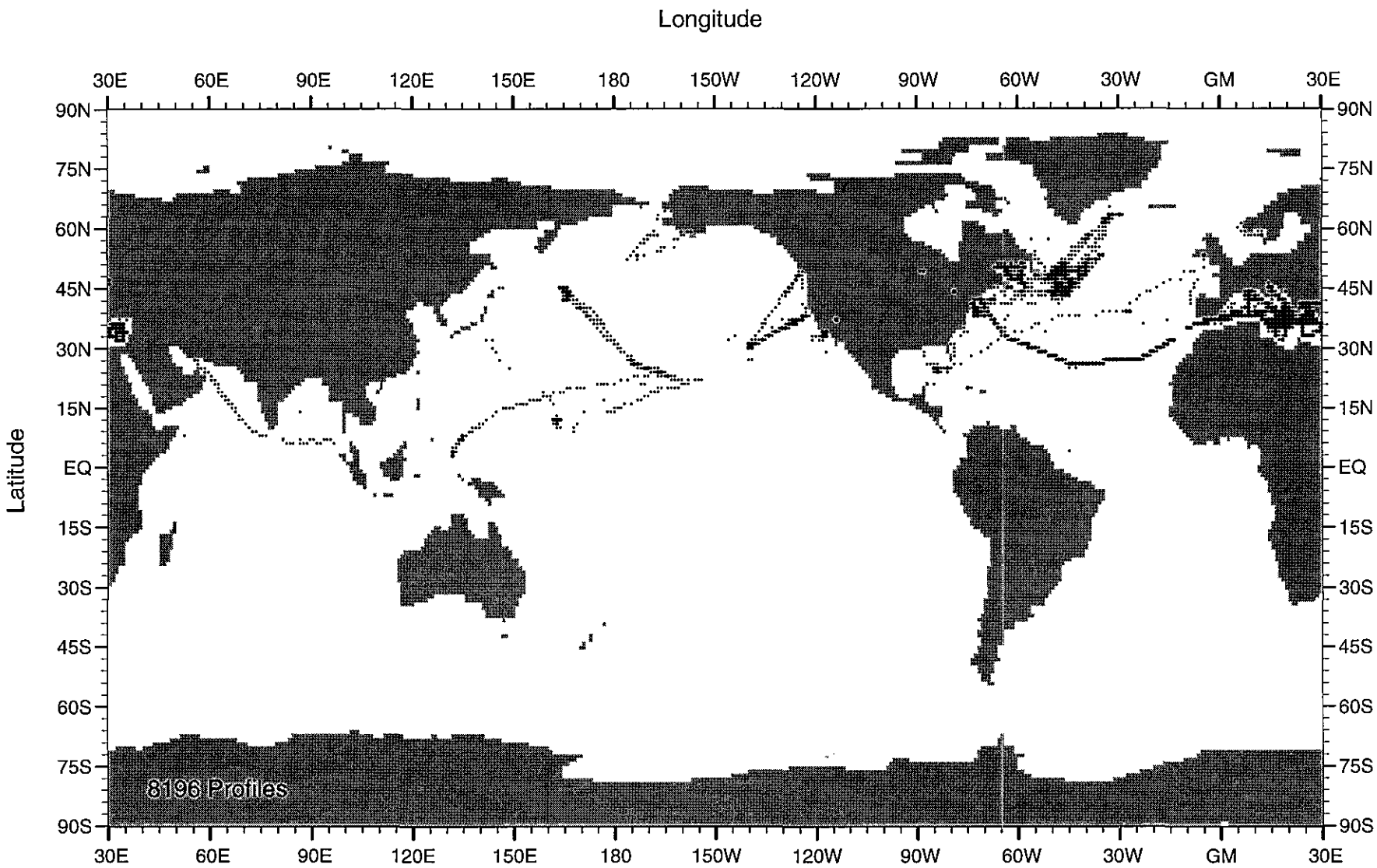

Fig. B30 WOD98 MBT profile distribution for April-June for 1948

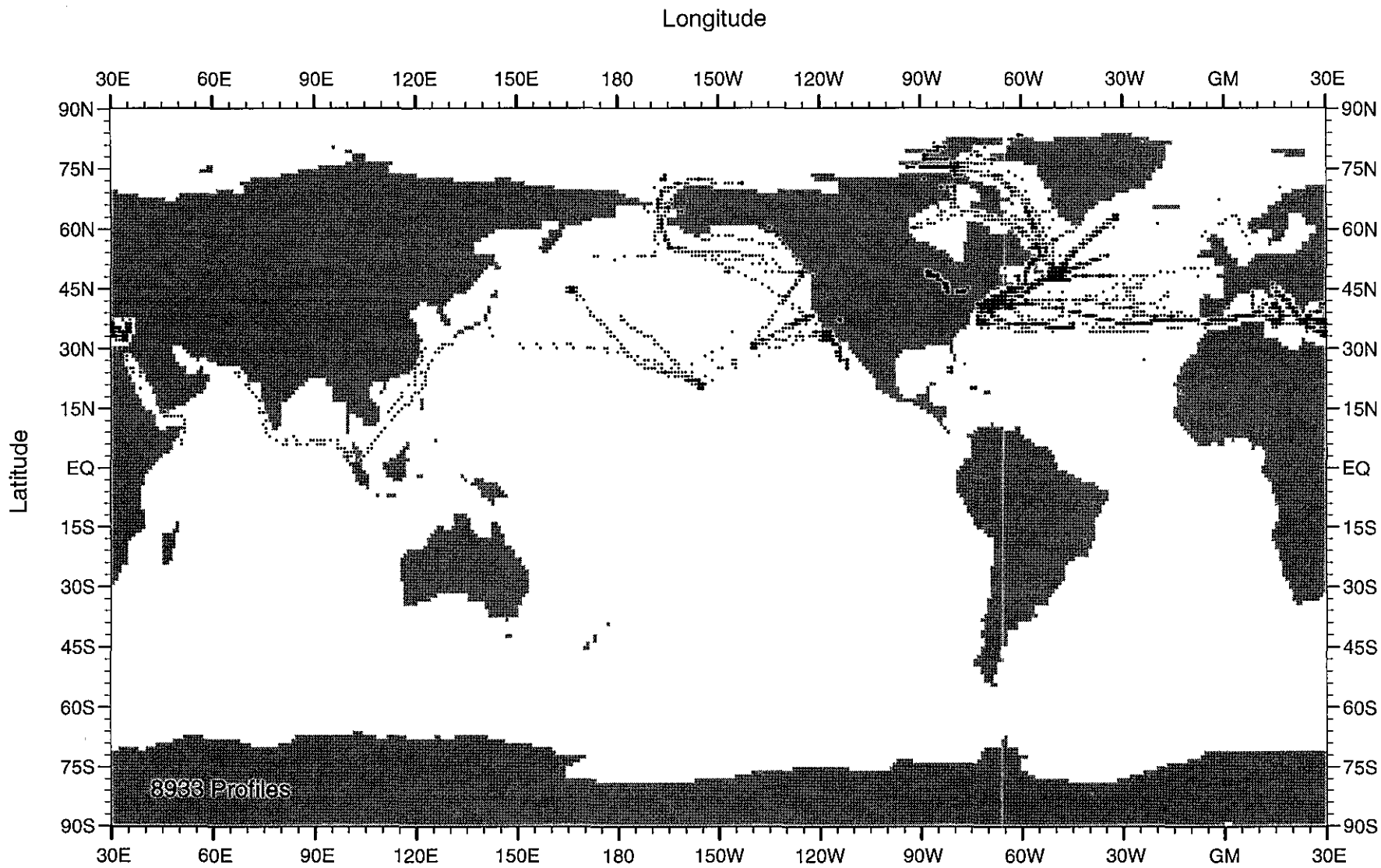

Fig. B31 WOD98 MBT profile distribution for July-September for 1948

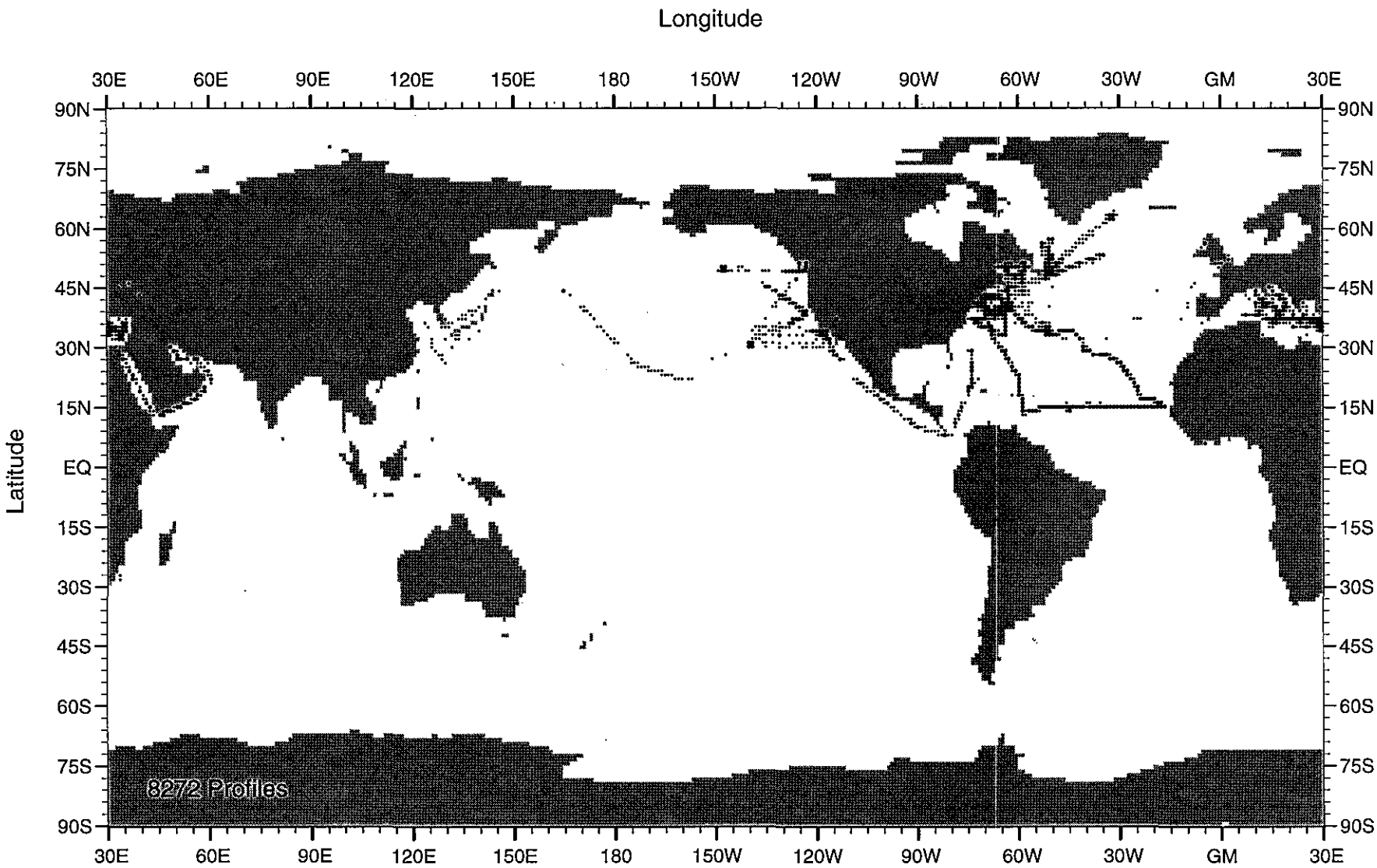

Fig. B32 WOD98 MBT profile distribution for October-December for 1948

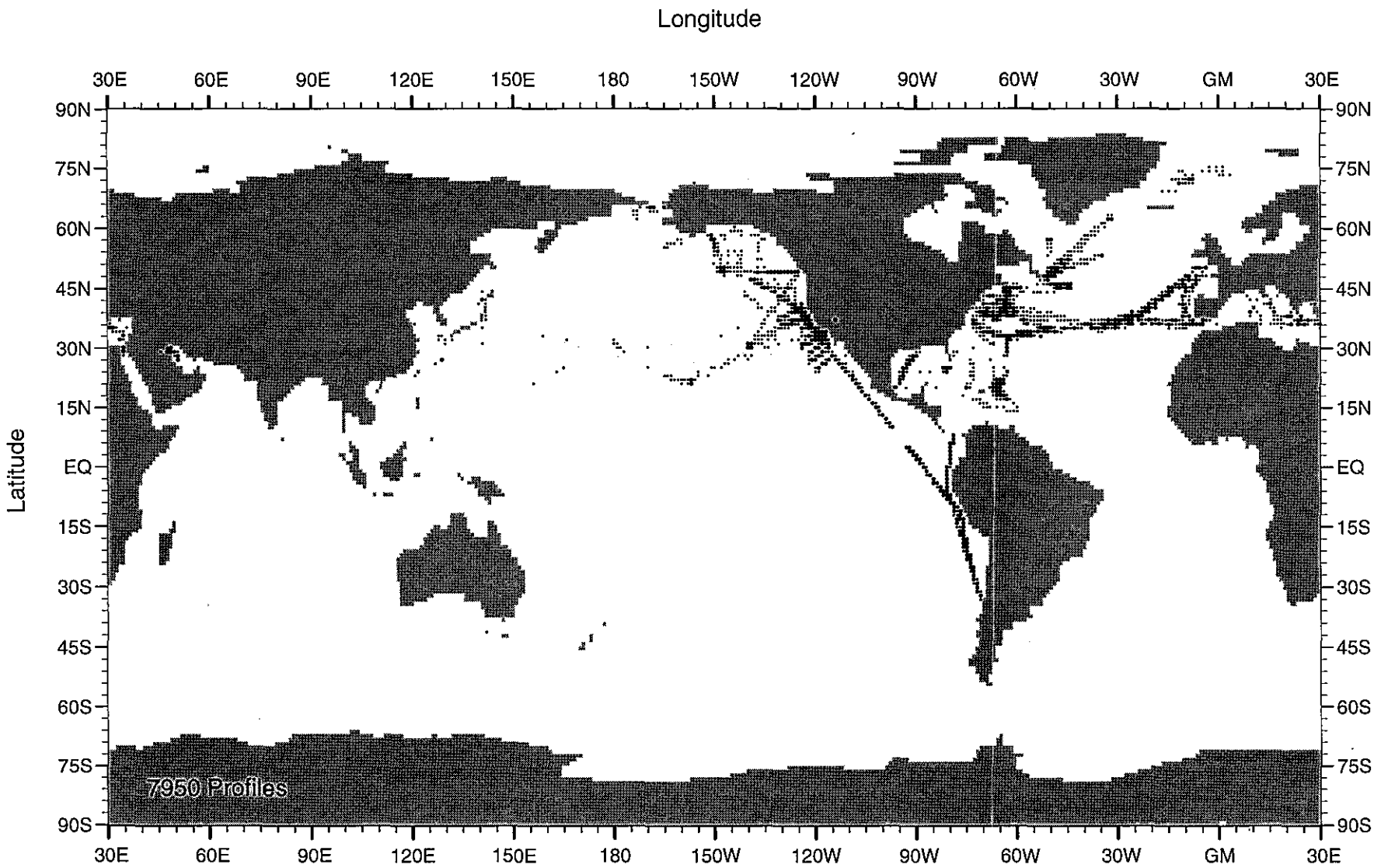

Fig. B33 WOD98 MBT profile distribution for January-March for 1949

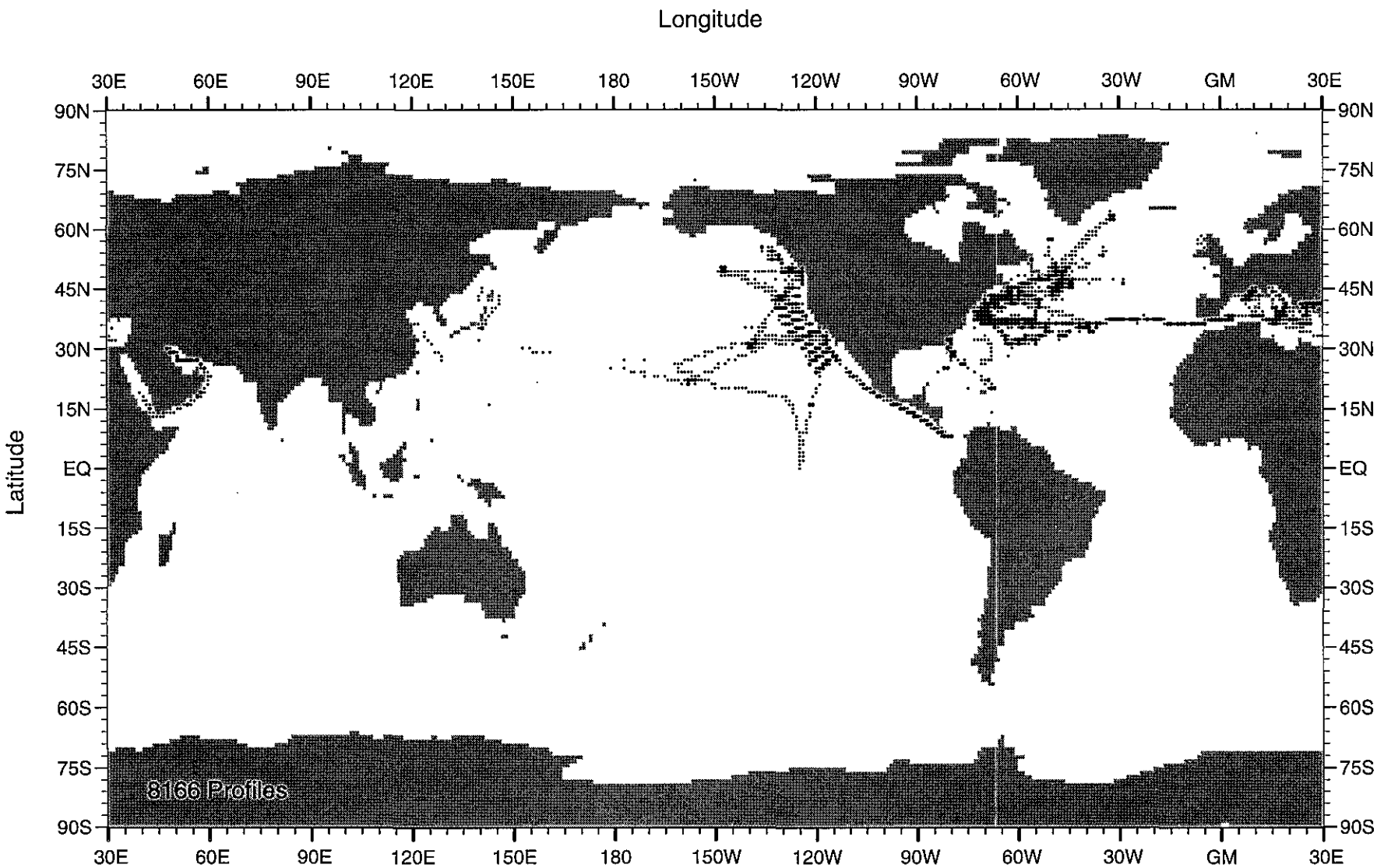

Fig. B34 WOD98 MBT profile distribution for April-June for 1949

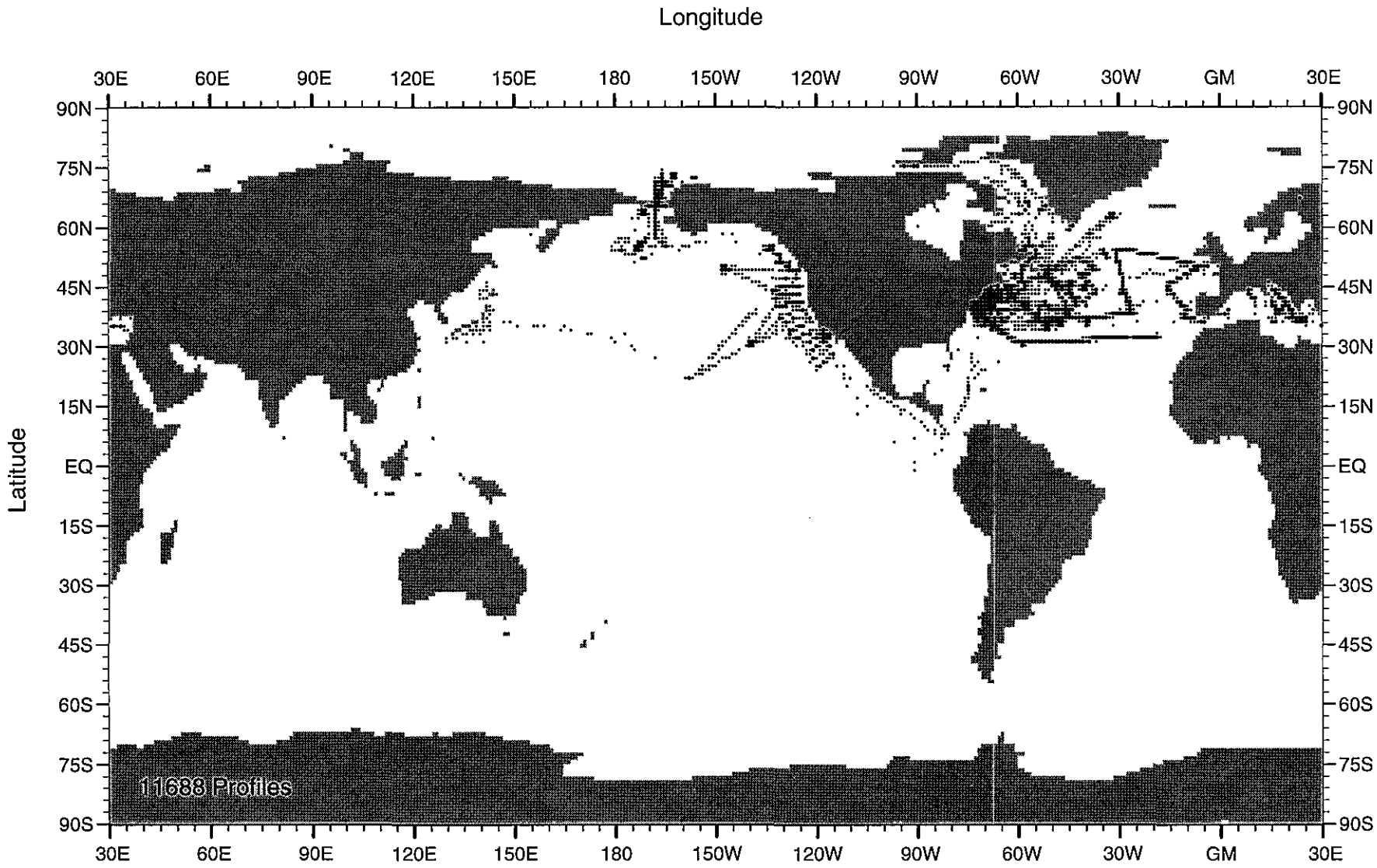

Fig. B35 WOD98 MBT profile distribution for July-September for 1949

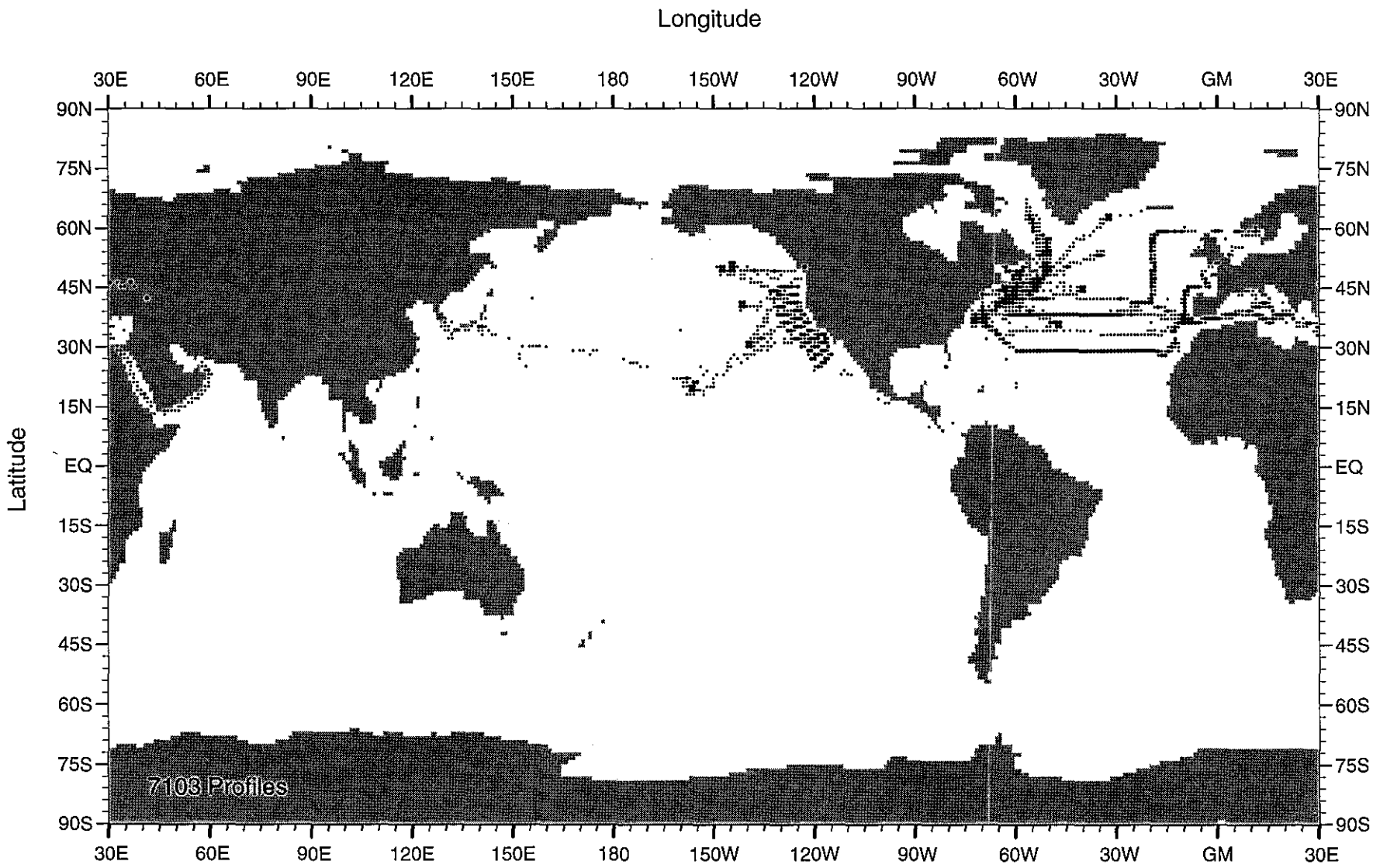

Fig. B36 WOD98 MBT profile distribution for October-December for 1949

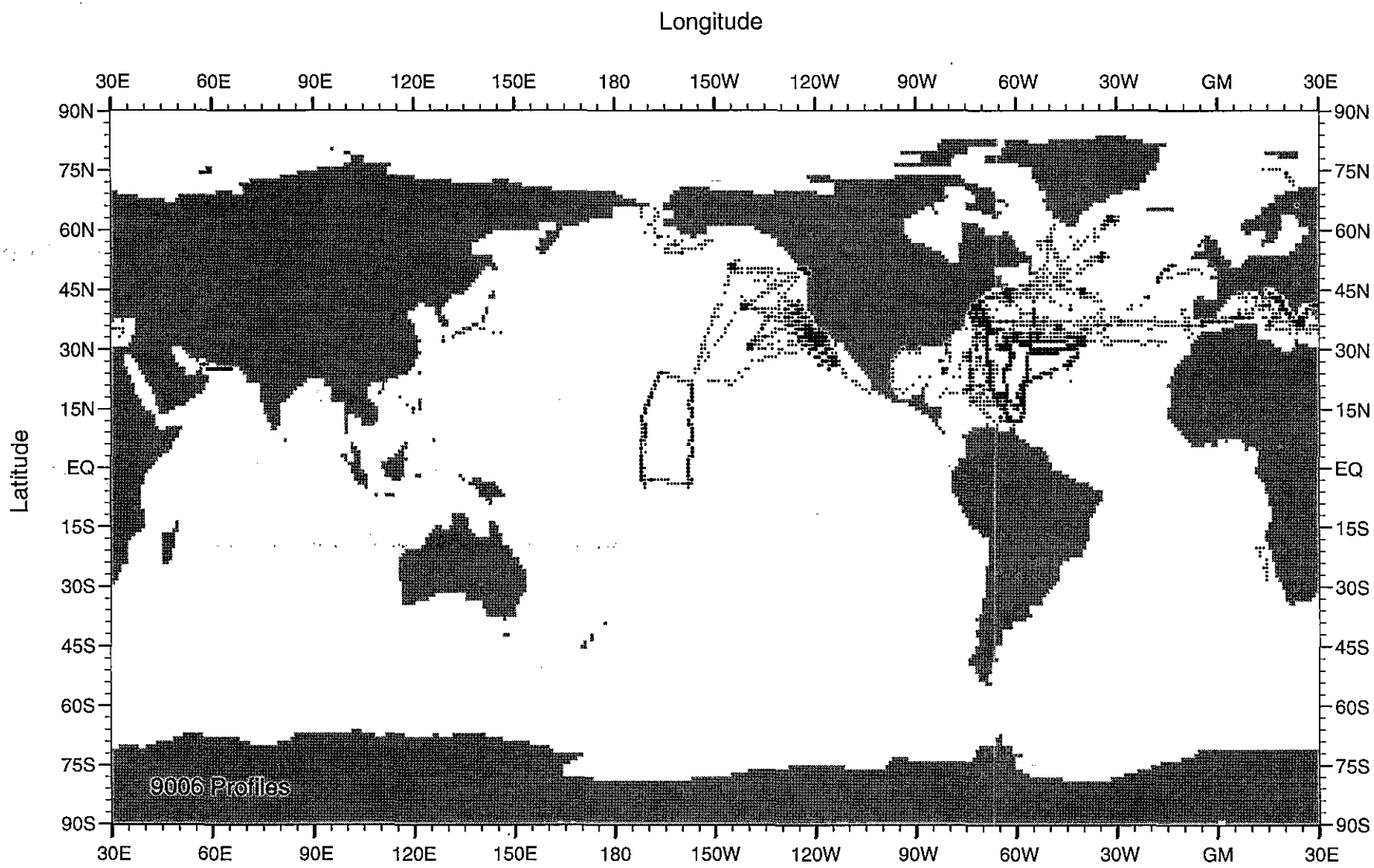

Fig. B37 WOD98 MBT profile distribution for January-March for 1950

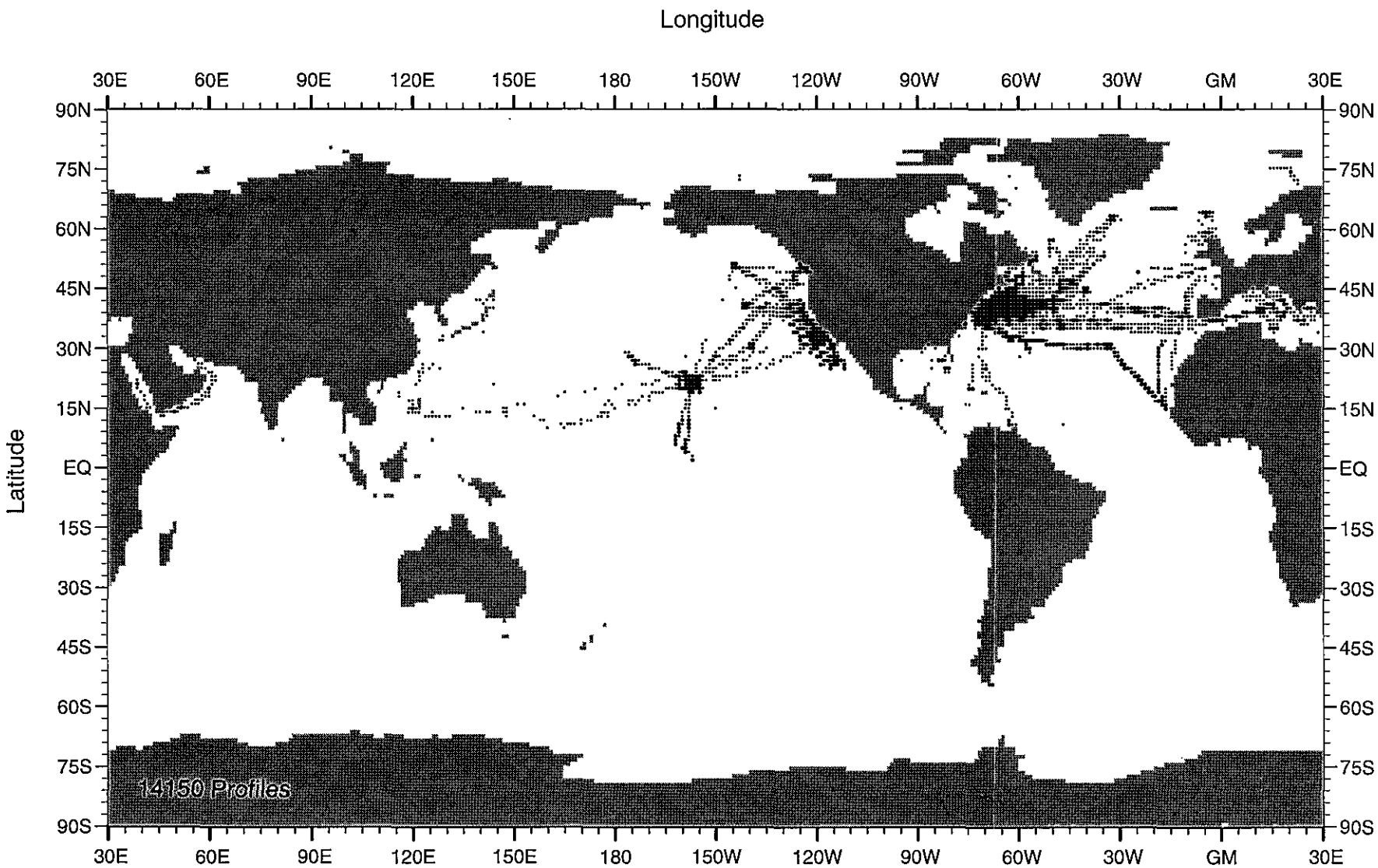

Fig. B38 WOD98 MBT profile distribution for April-June for 1950

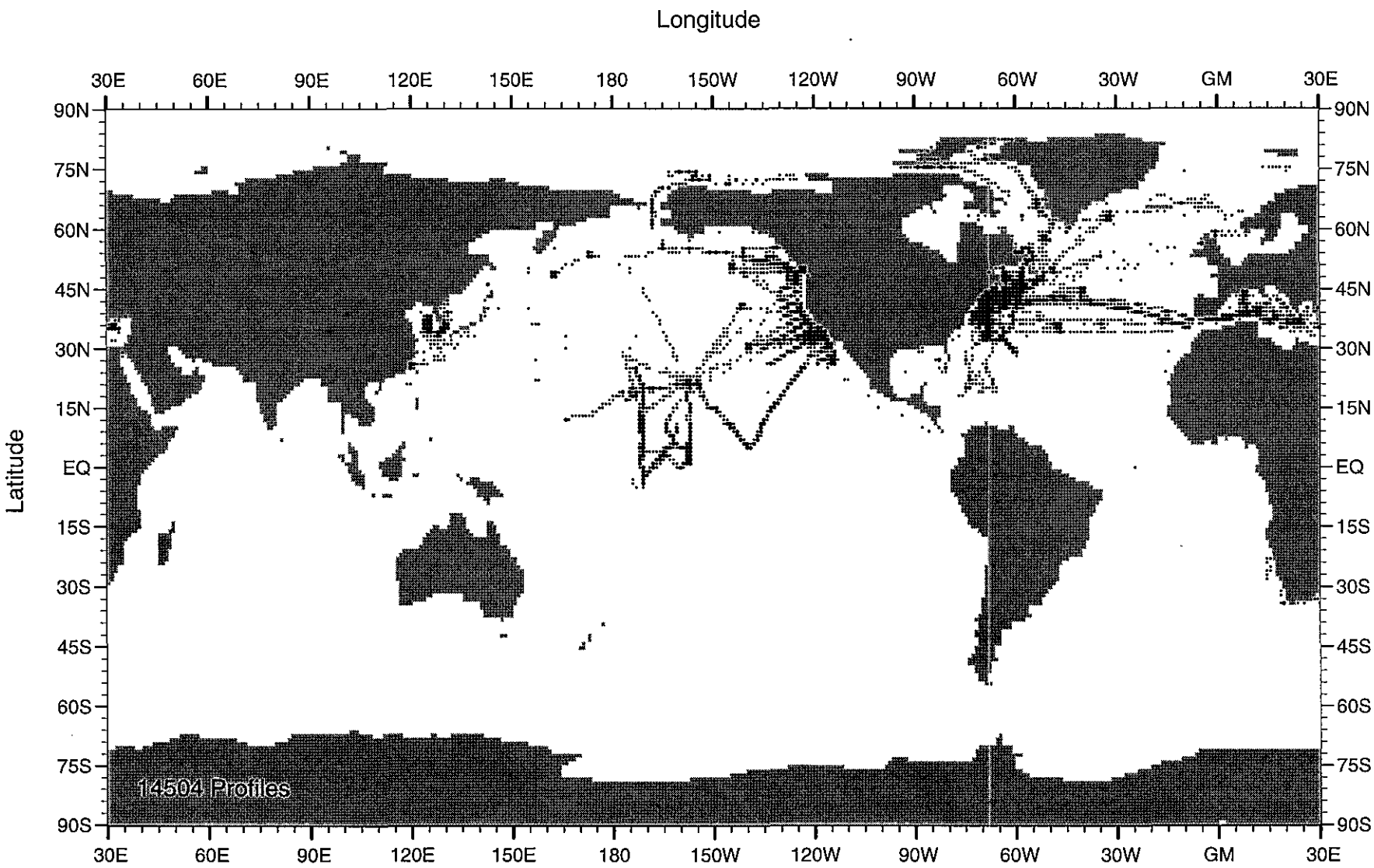

Fig. B39 WOD98 MBT profile distribution for July-September for 1950

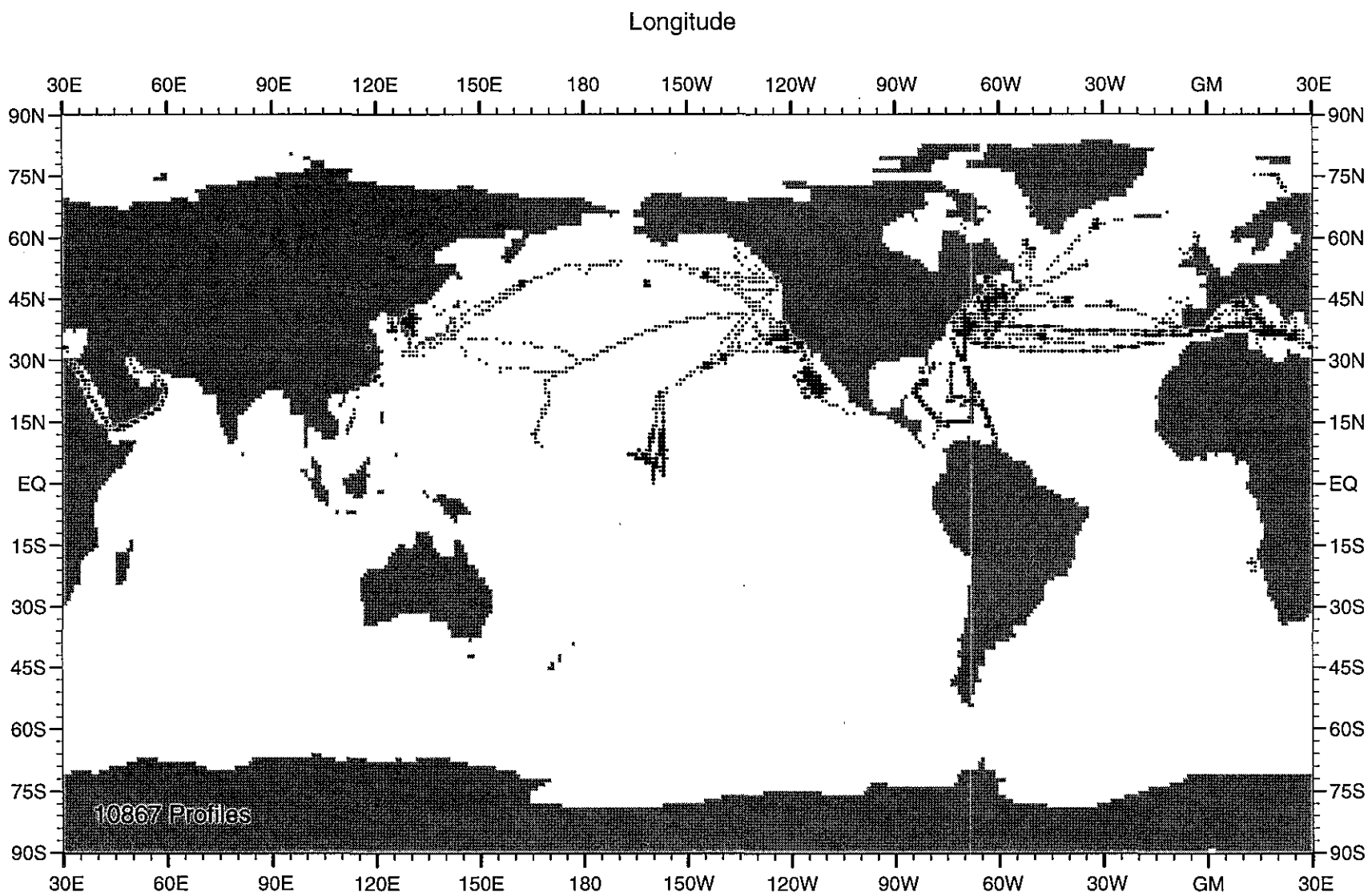

Fig. B40 WOD98 MBT profile distribution for October-December for 1950

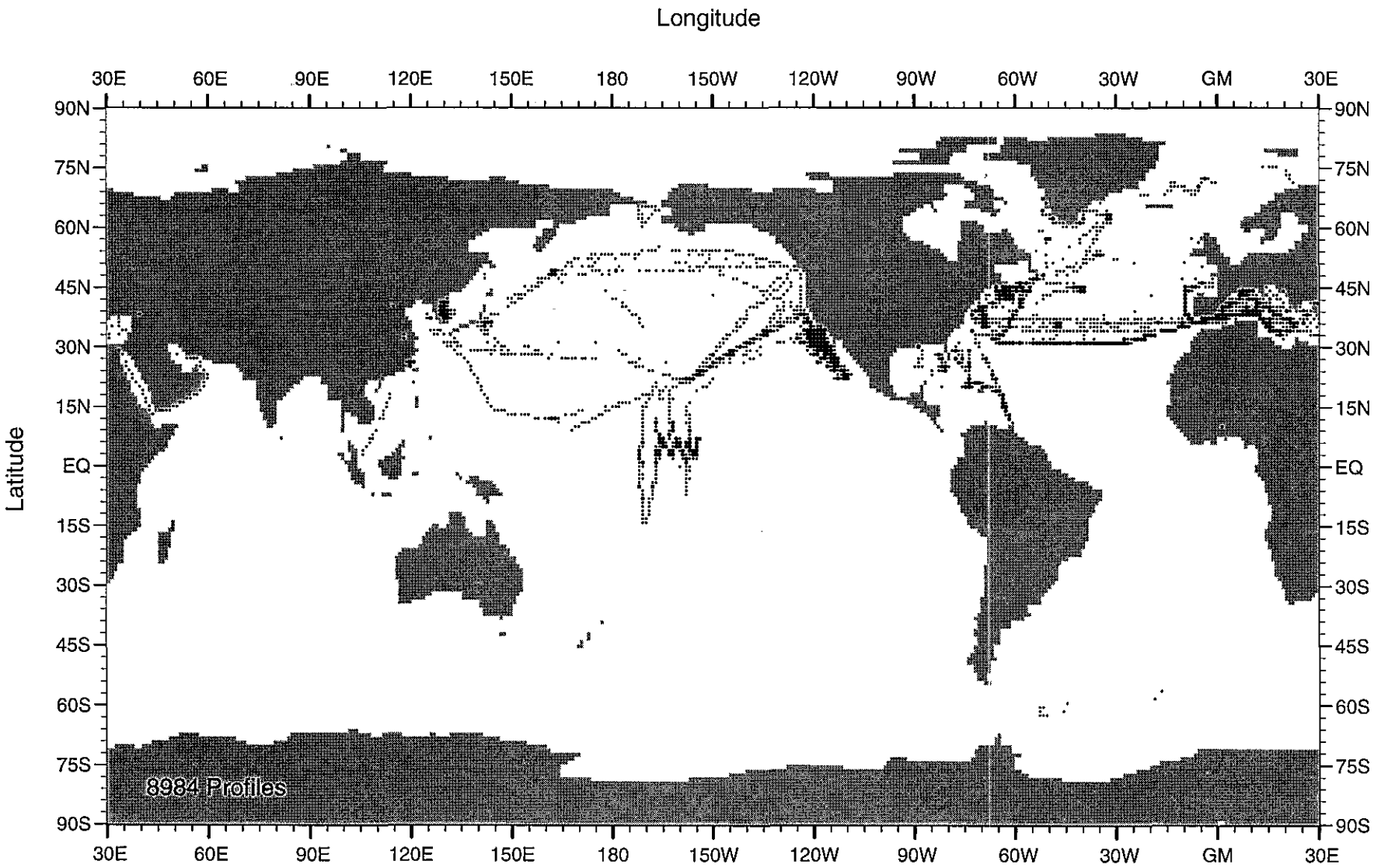

Fig. B41 WOD98 MBT profile distribution for January-March for 1951

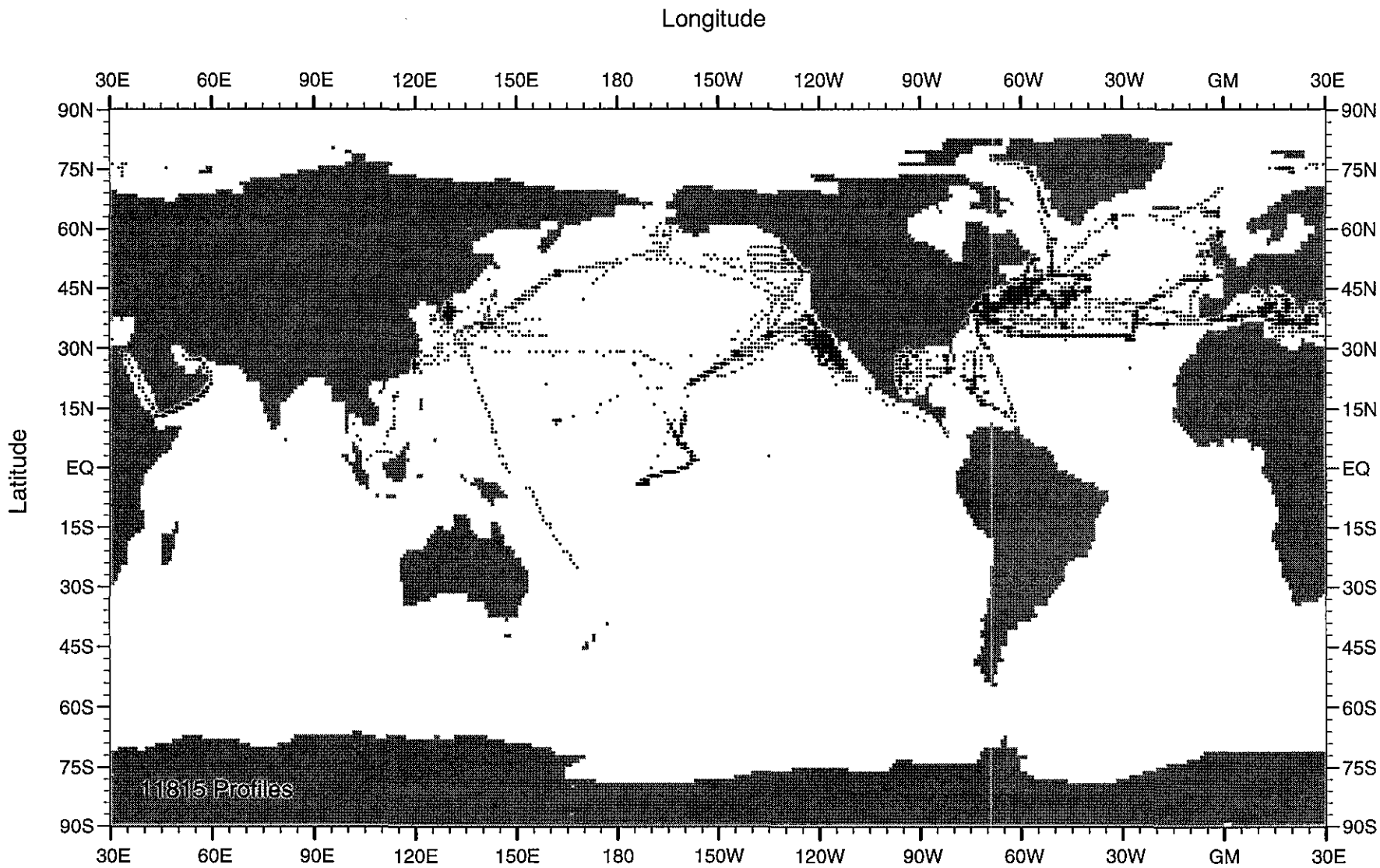

Fig. B42 WOD98 MBT profile distribution for April-June for 1951

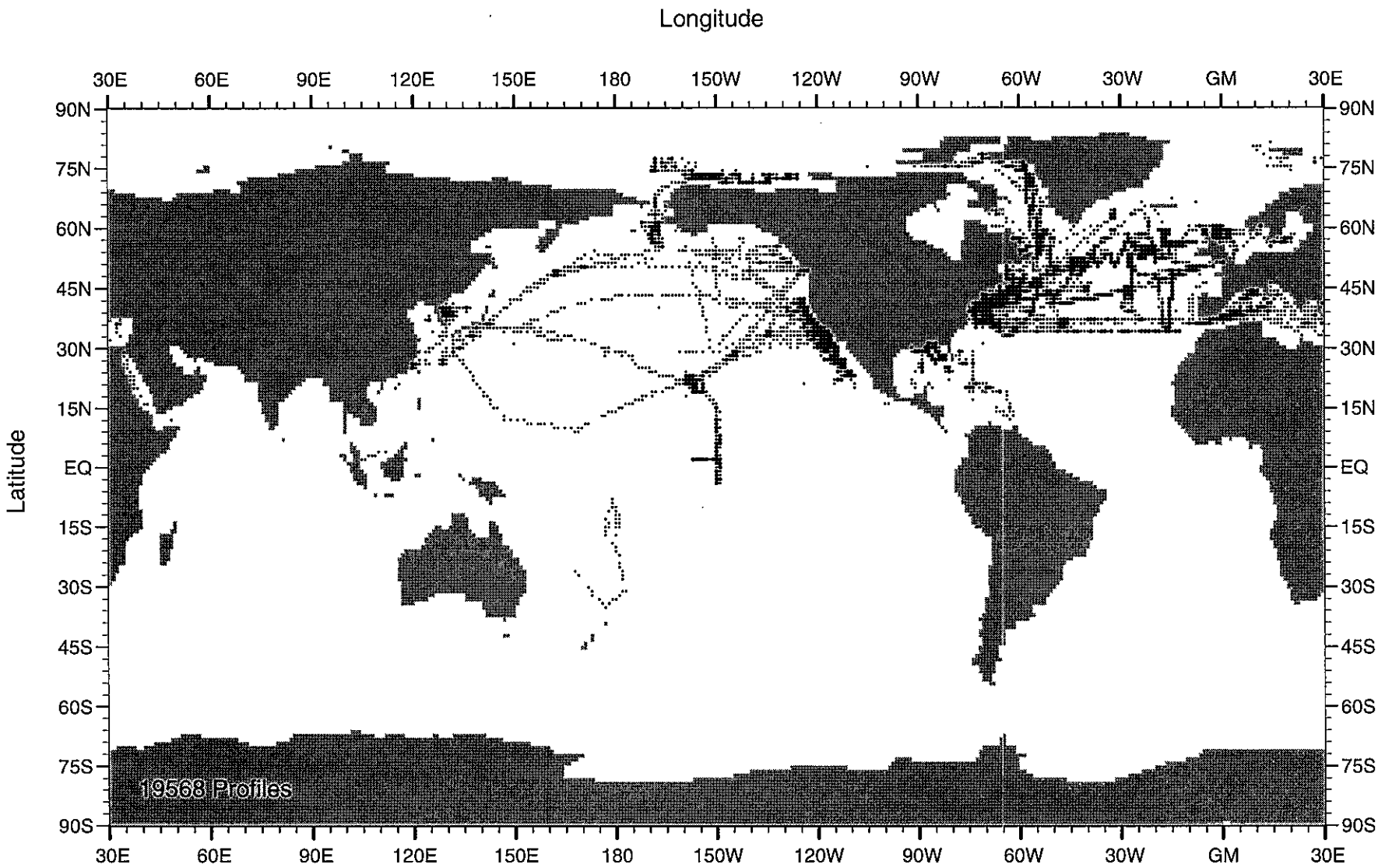

Fig. B43 WOD98 MBT profile distribution for July-September for 1951

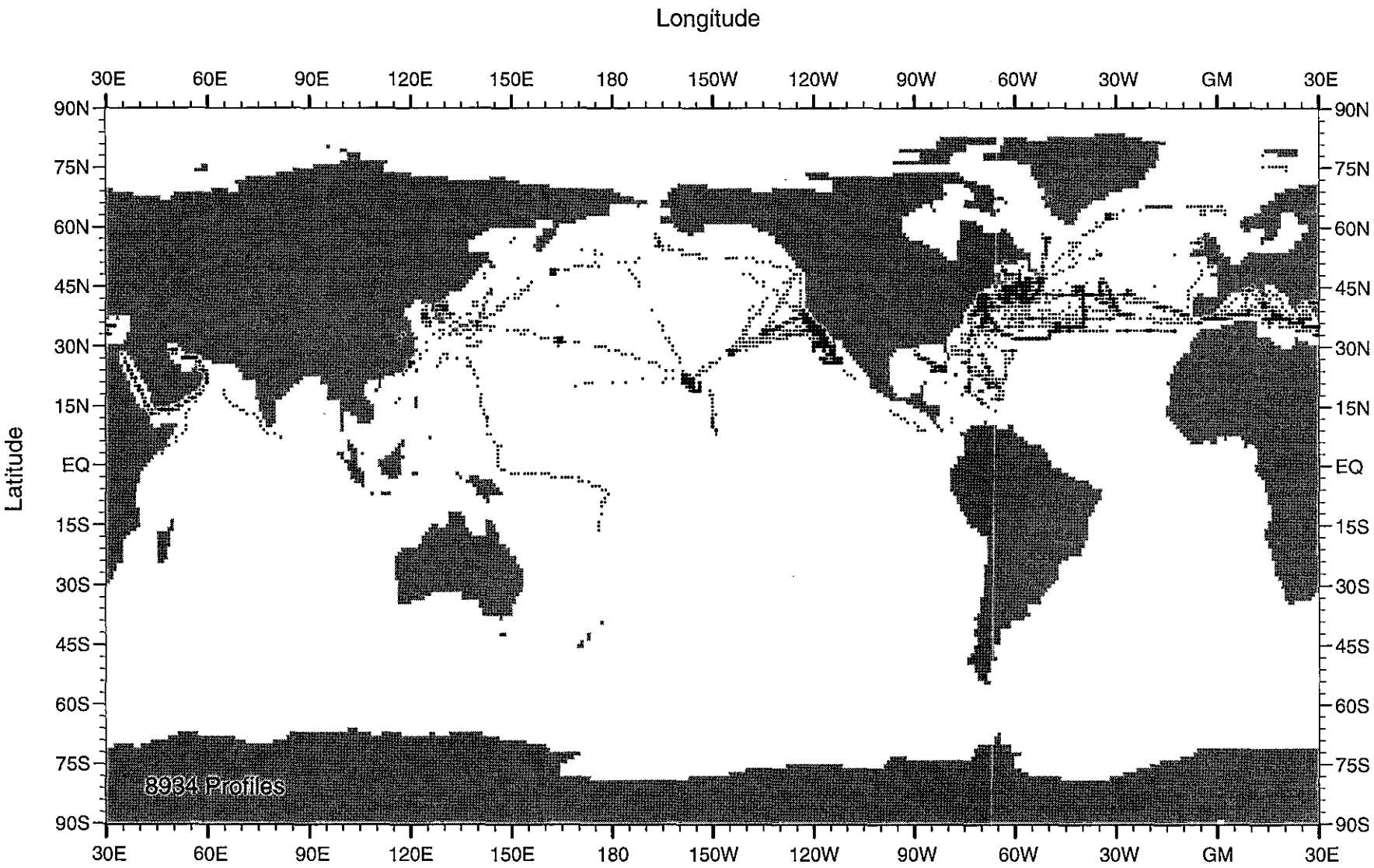

Fig. B44 WOD98 MBT profile distribution for October-December for 1951

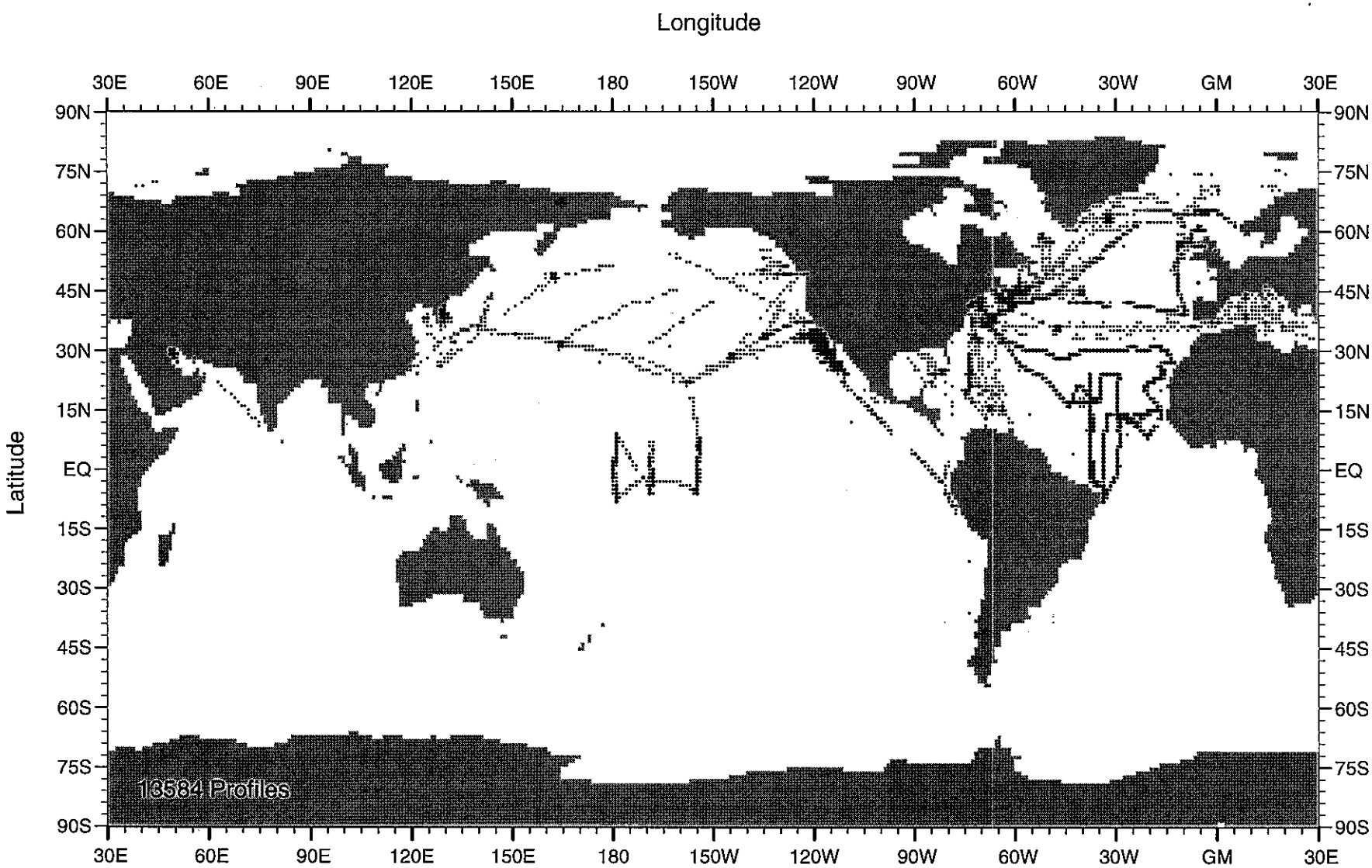

Fig. B45 WOD98 MBT profile distribution for January-March for 1952

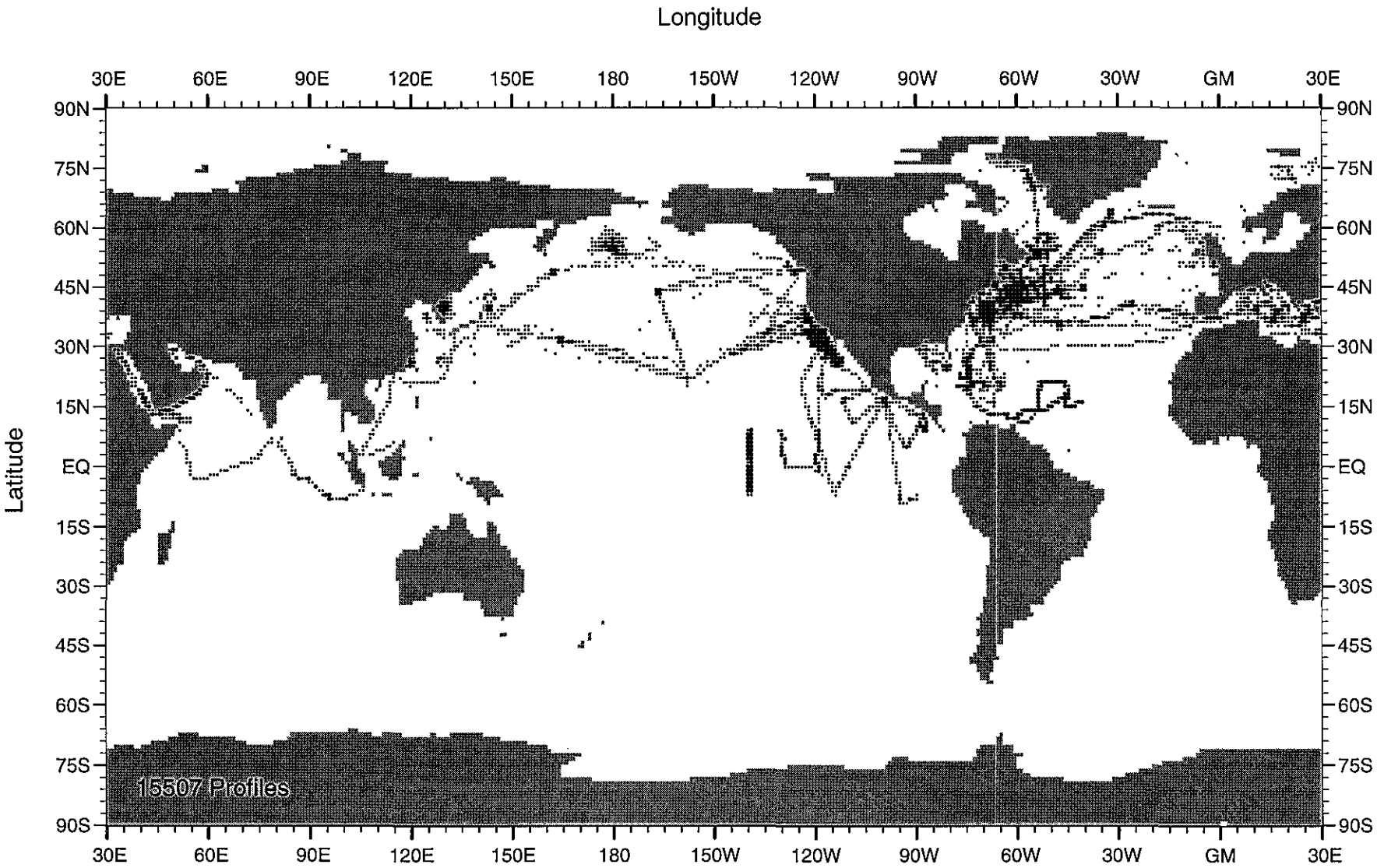

Fig. B46 WOD98 MBT profile distribution for April-June for 1952

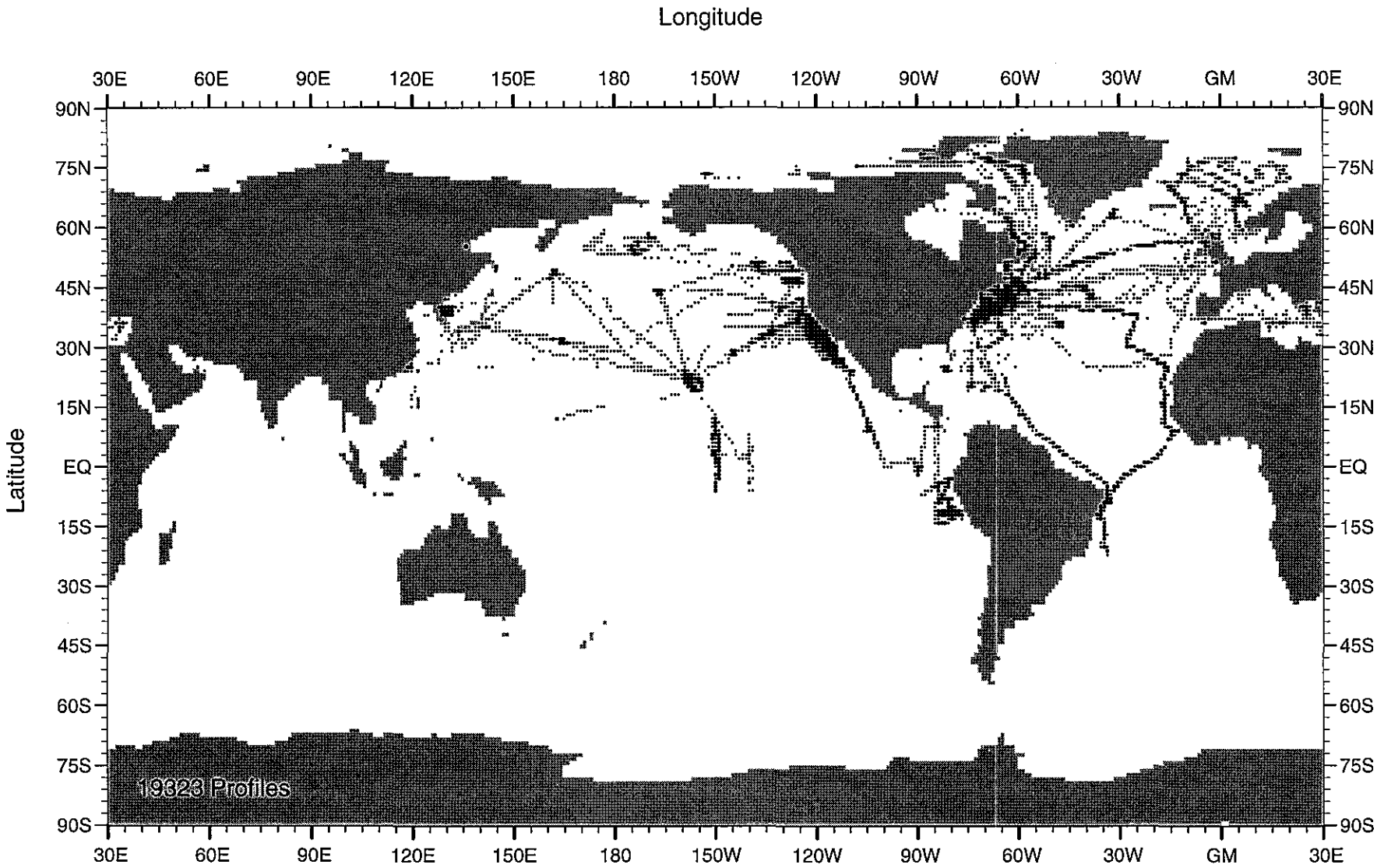

Fig. B47 WOD98 MBT profile distribution for July-September for 1952

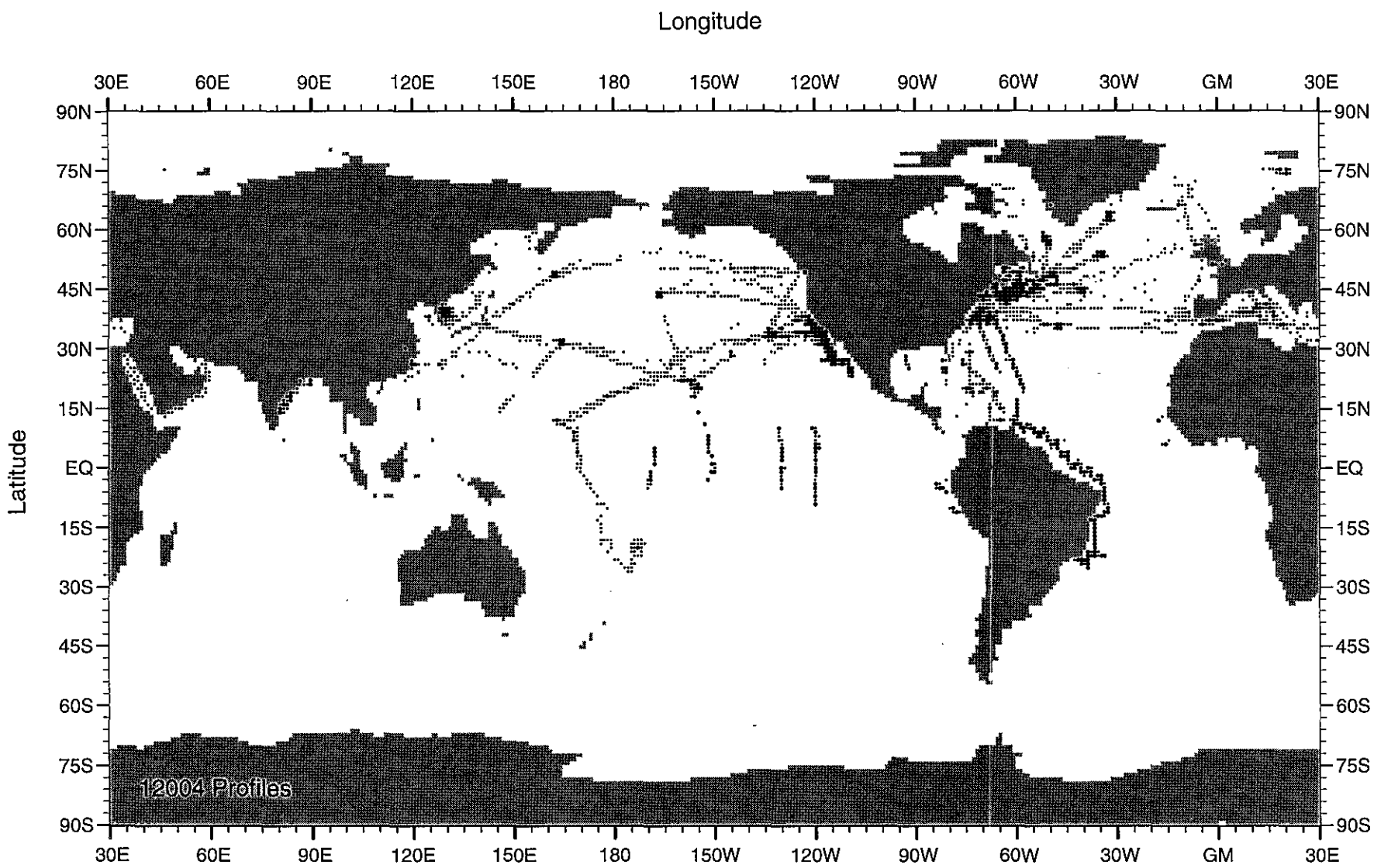

Fig. B48 WOD98 MBT profile distribution for October-December for 1952

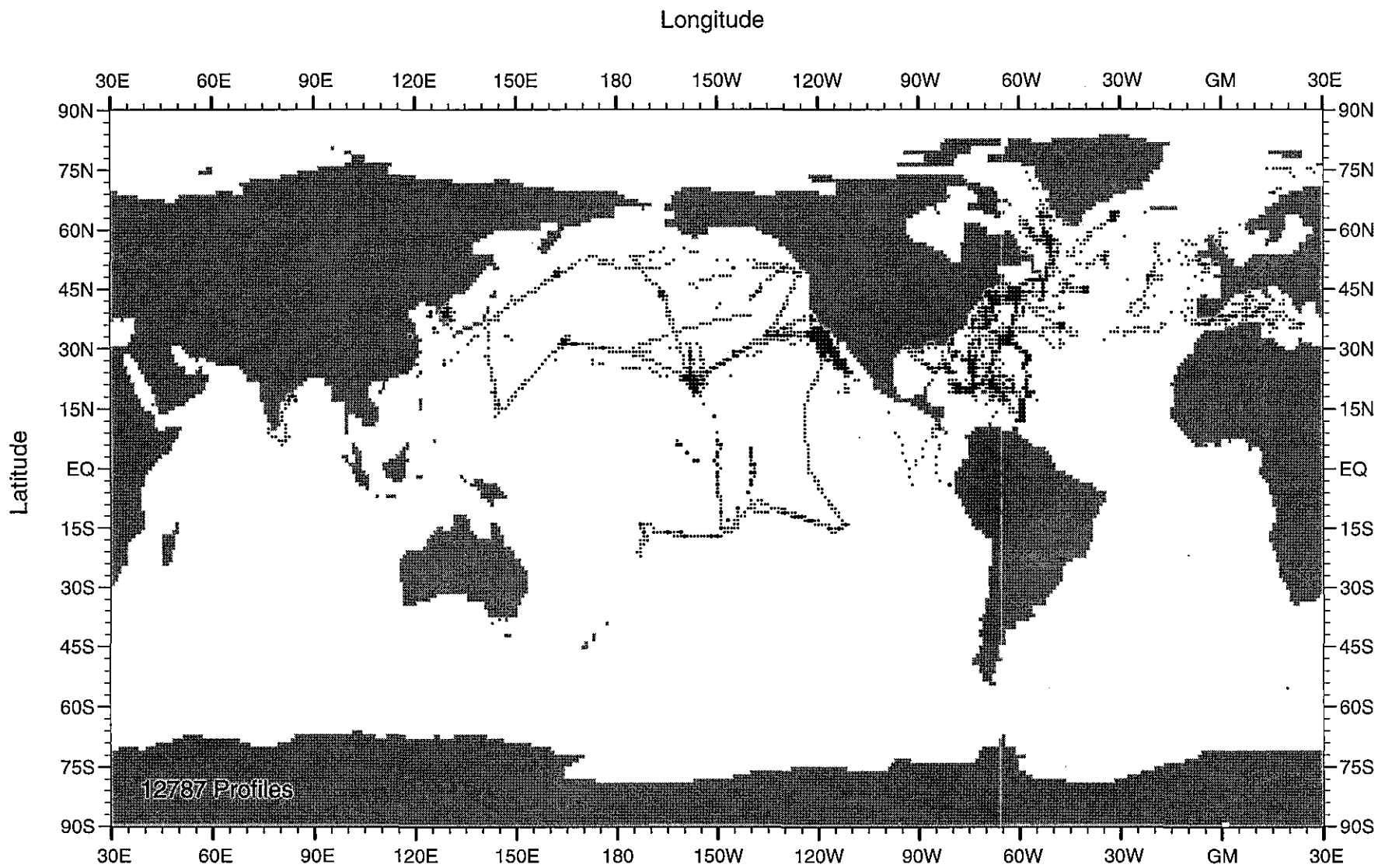

Fig. B49 WOD98 MBT profile distribution for January-March for 1953

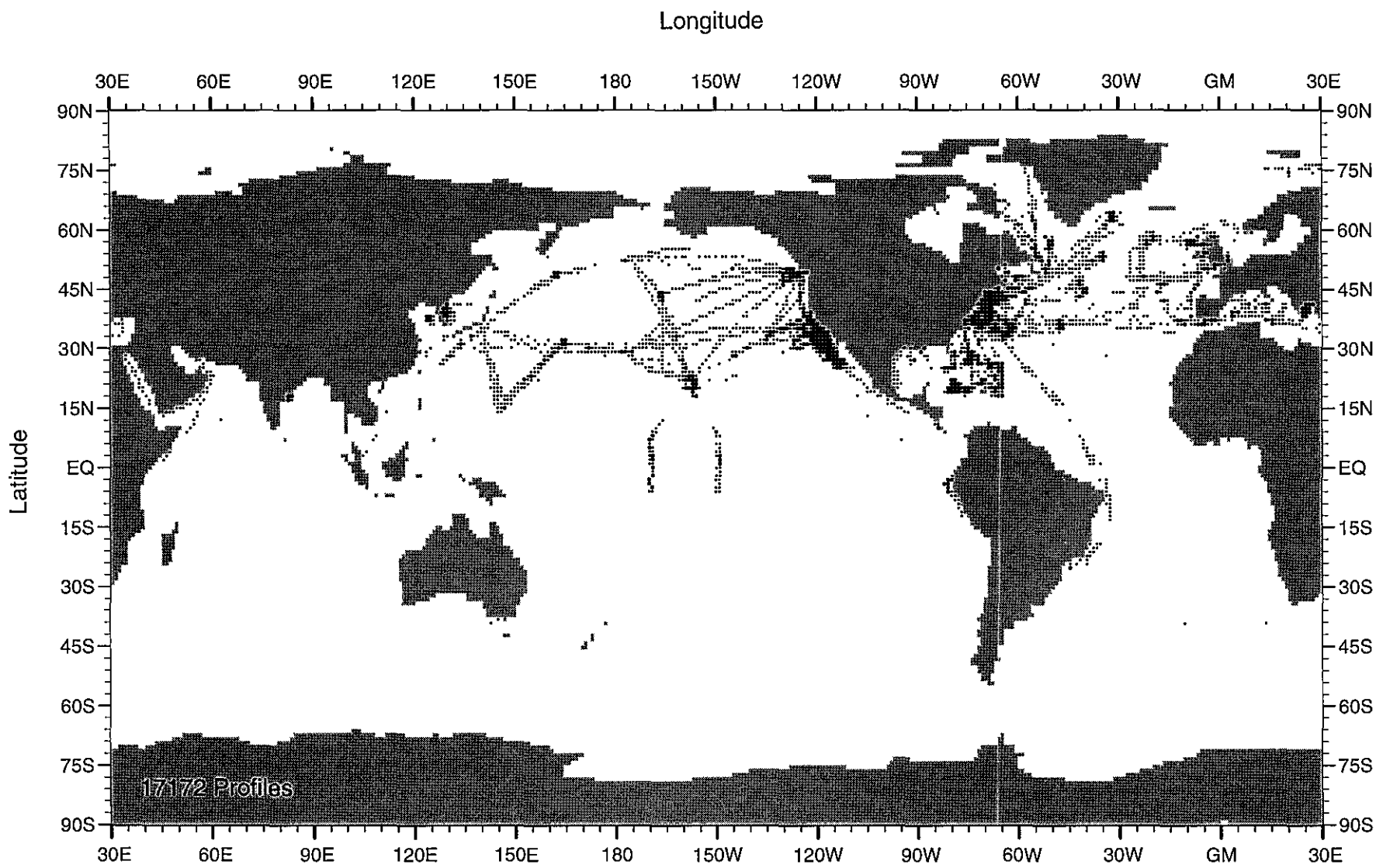

Fig. B50 WOD98 MBT profile distribution for April-June for 1953

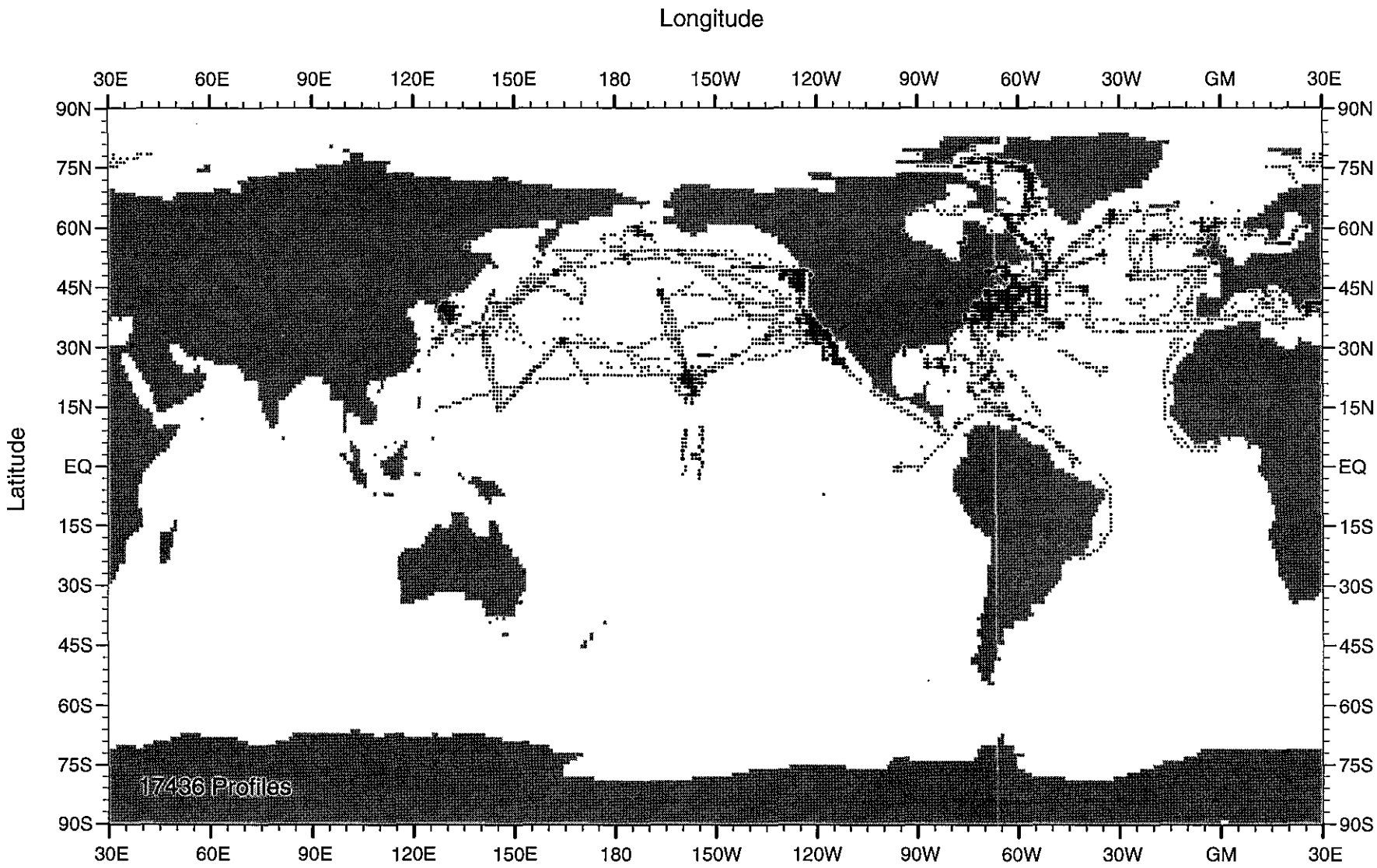

Fig. B51 WOD98 MBT profile distribution for July-September for 1953

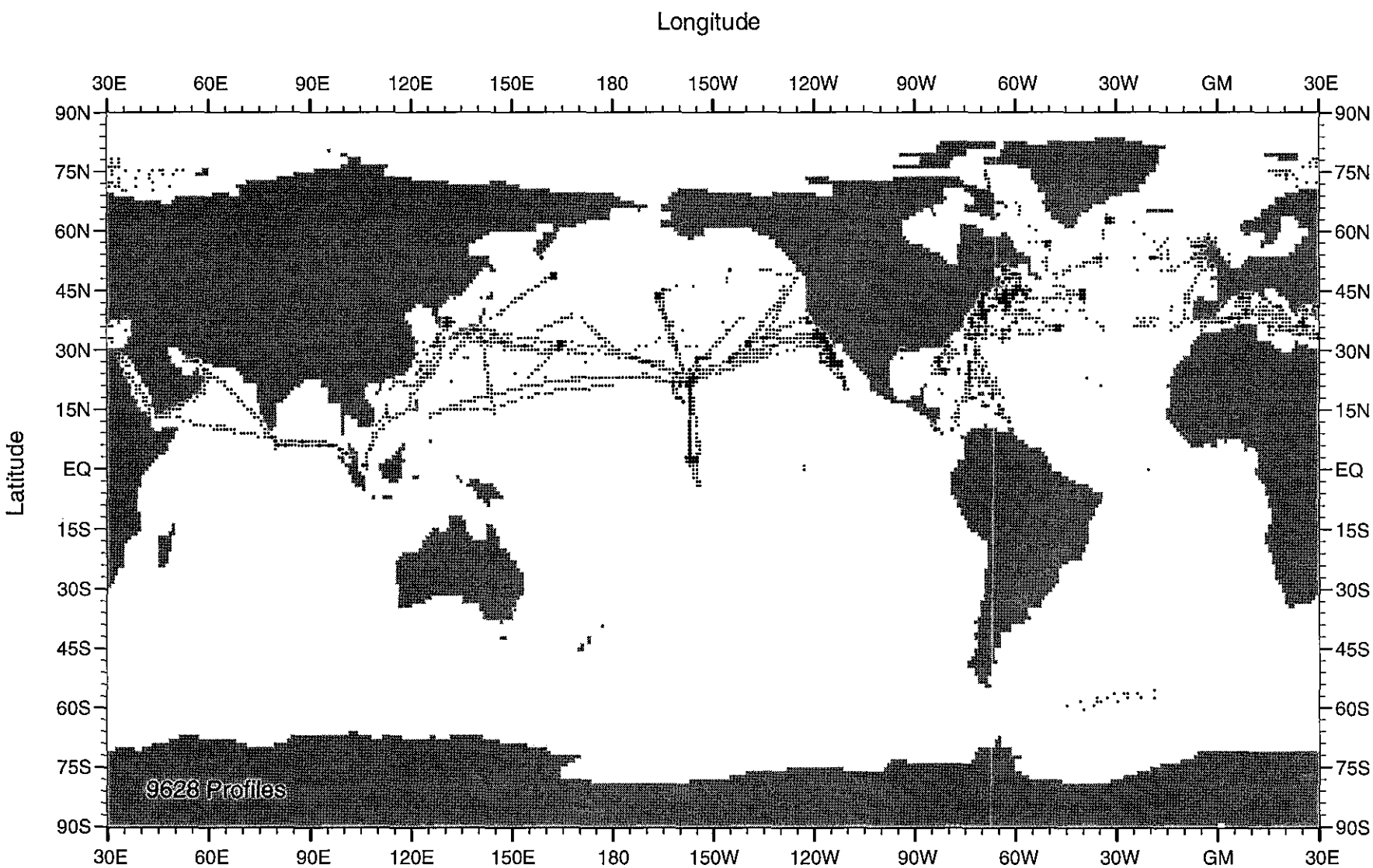

Fig. B52 WOD98 MBT profile distribution for October-December for 1953

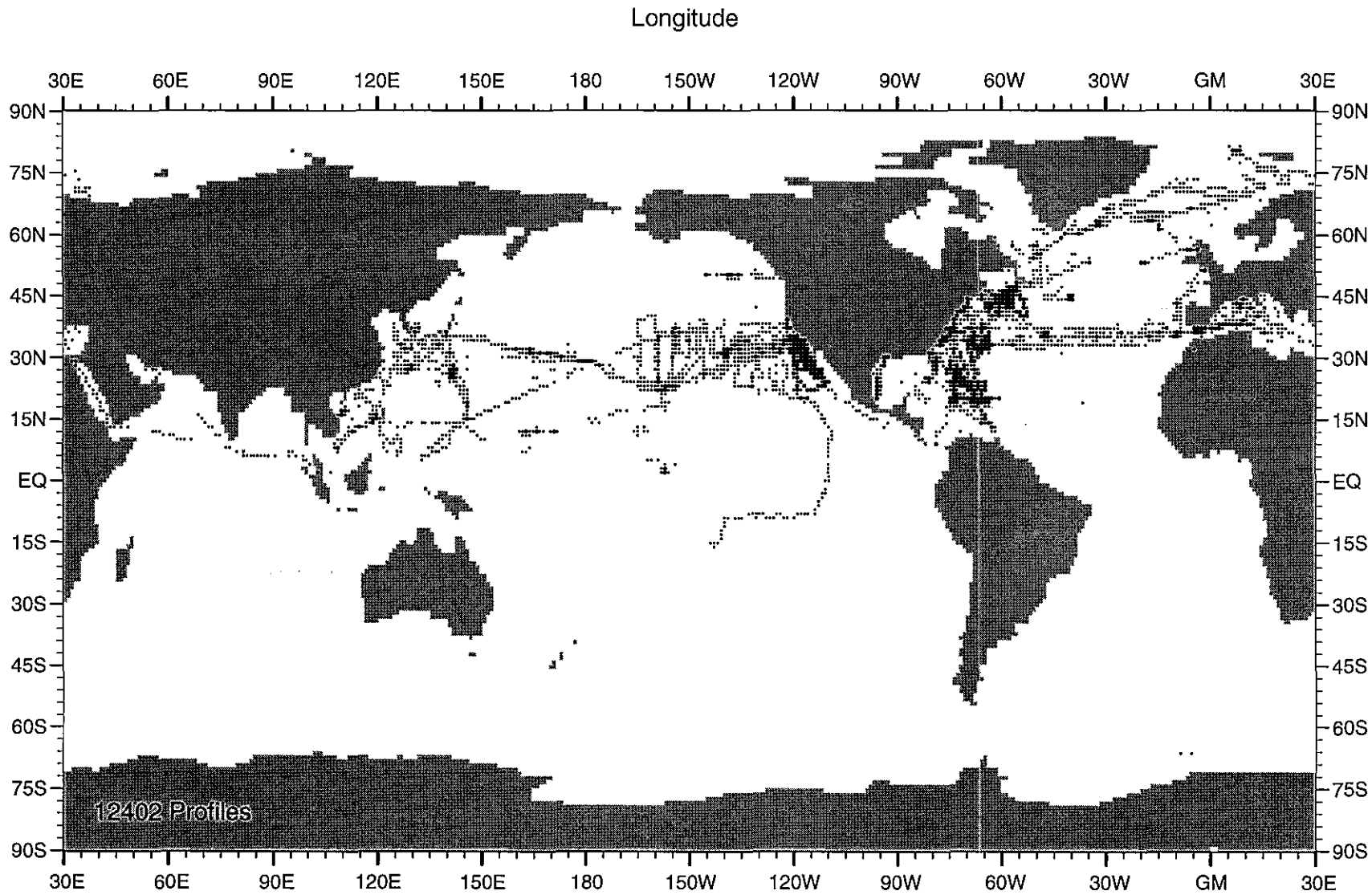

Fig. B53 WOD98 MBT profile distribution for January-March for 1954

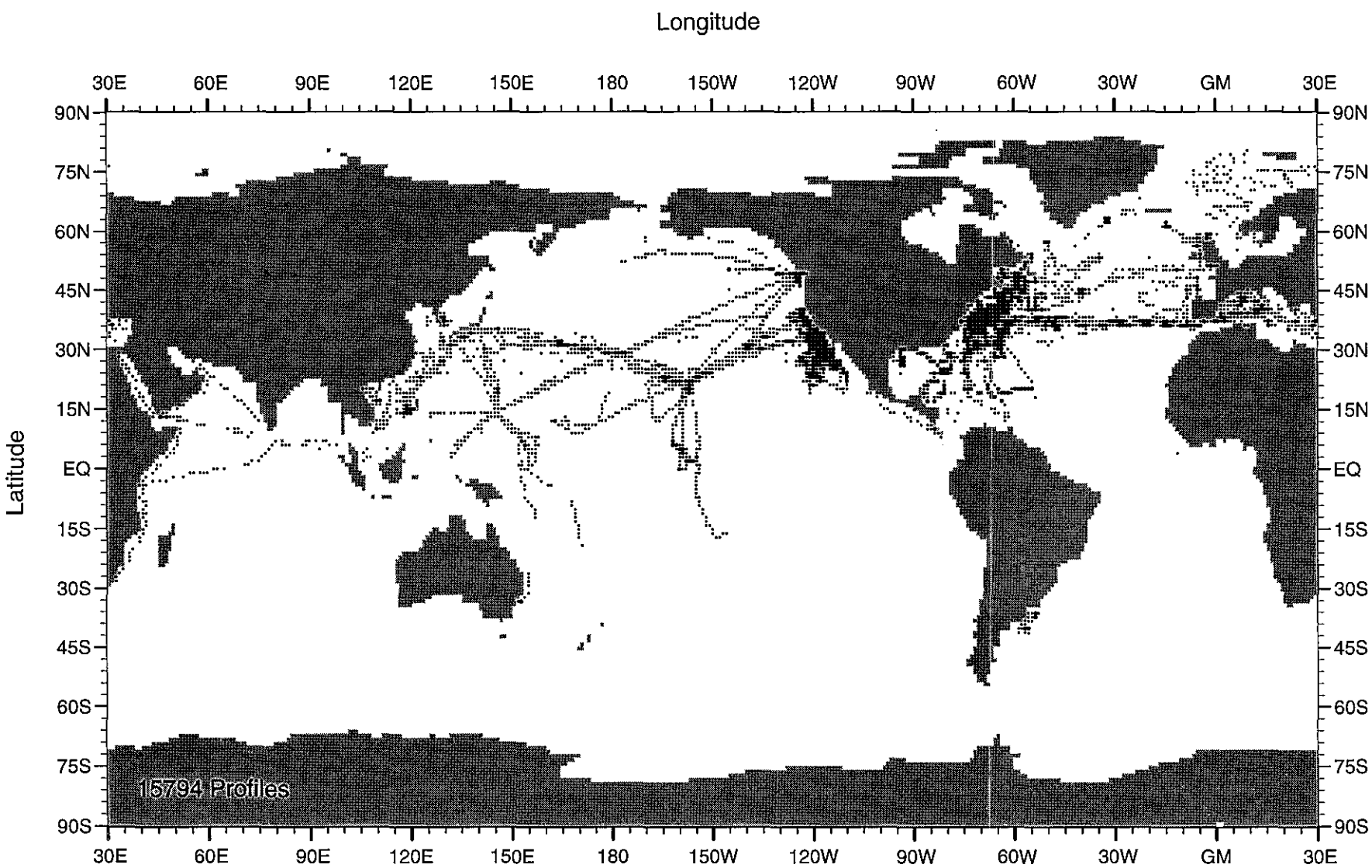

Fig. B54 WOD98 MBT profile distribution for April-June for 1954

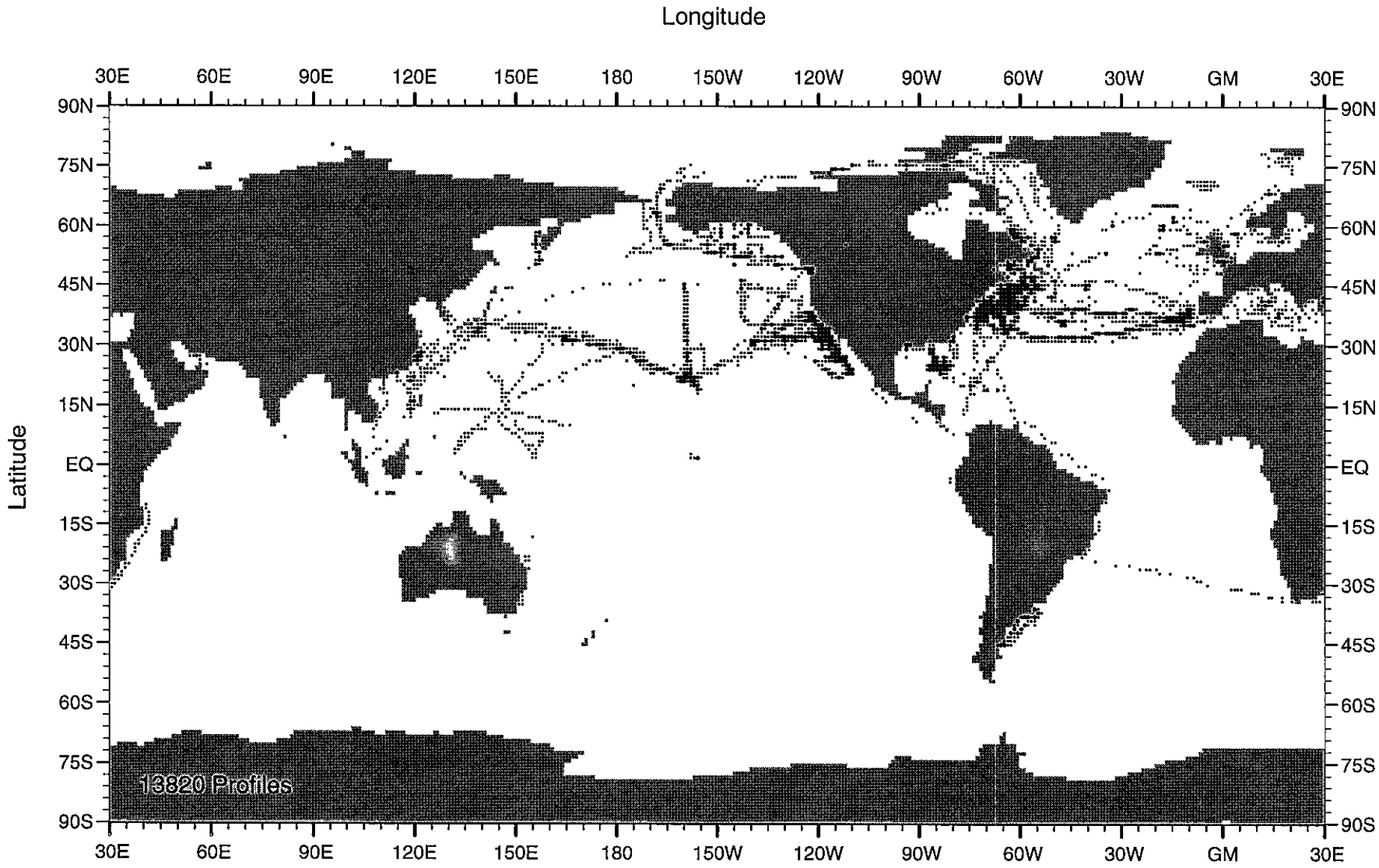

Fig. B55 WOD98 MBT profile distribution for July-September for 1954

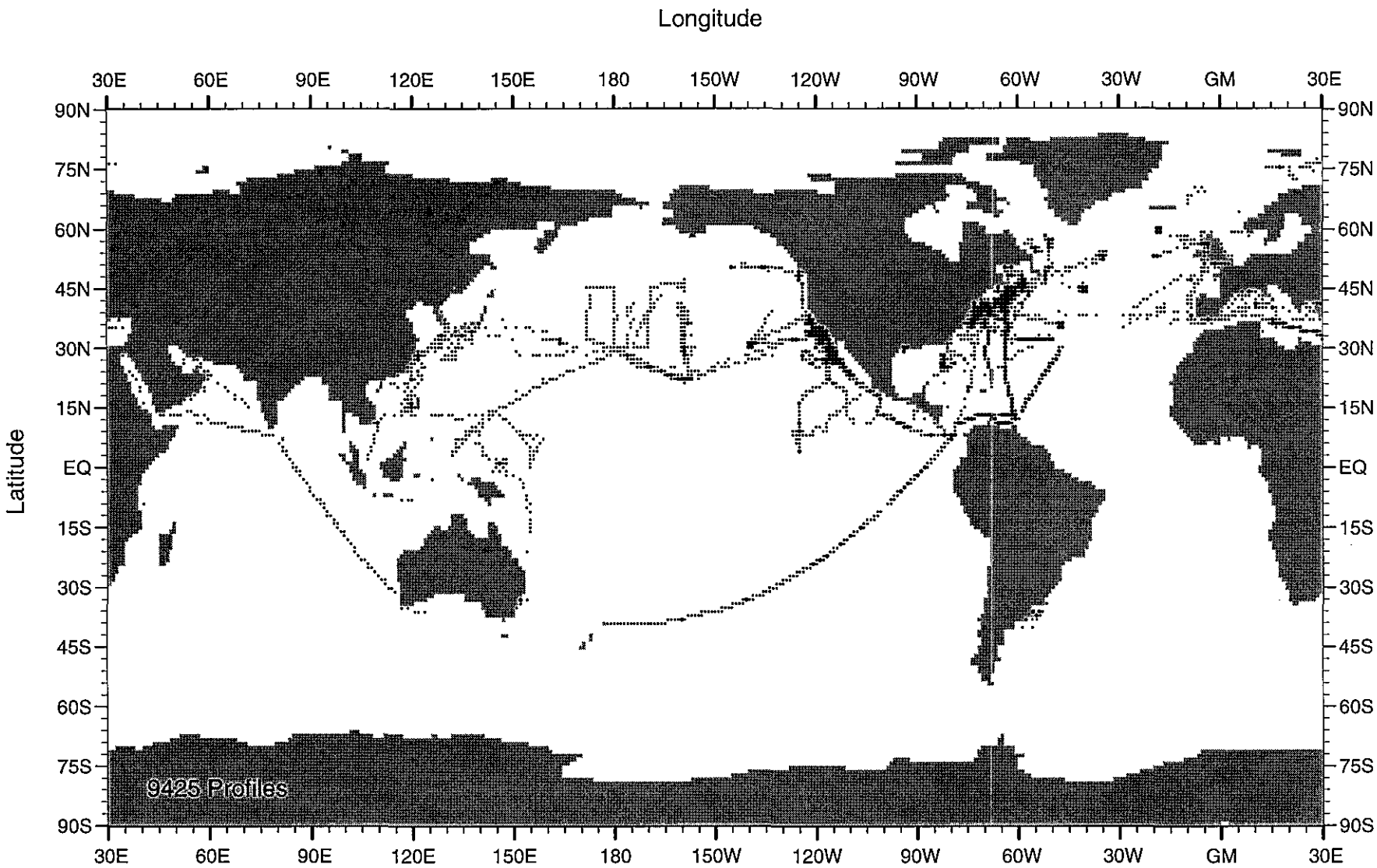

Fig. B56 WOD98 MBT profile distribution for October-December for 1954

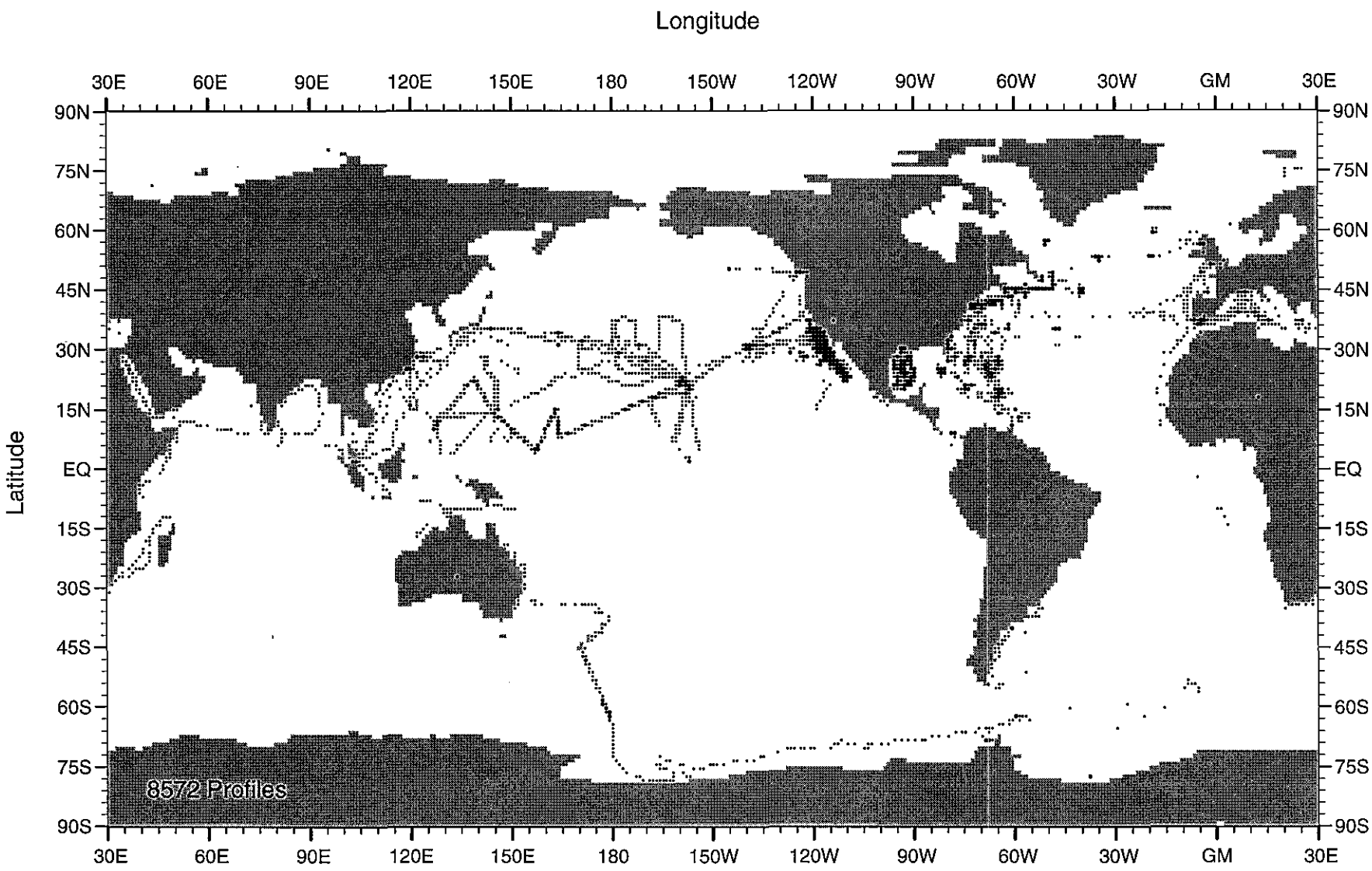

Fig. B57 WOD98 MBT profile distribution for January-March for 1955

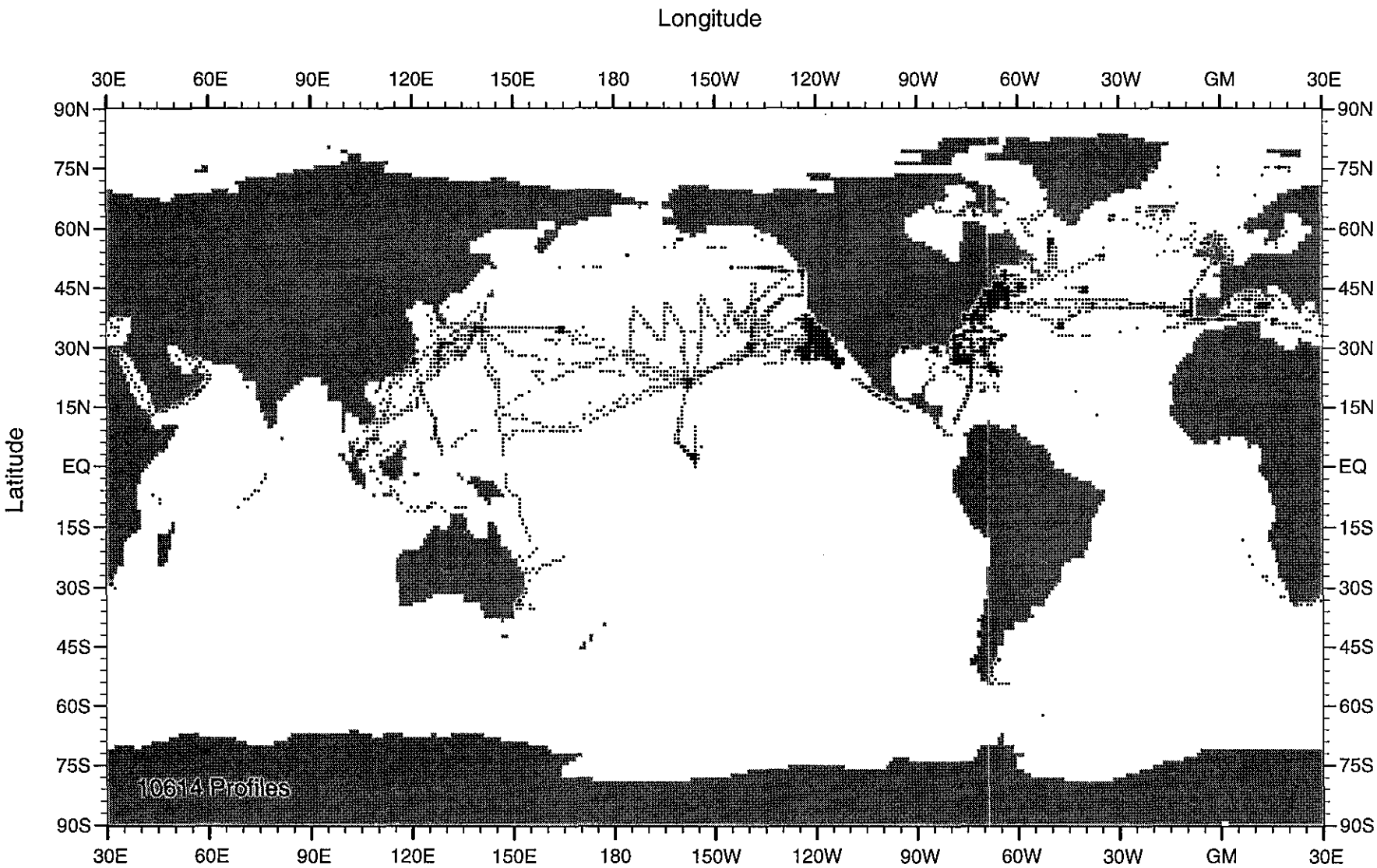

Fig. B58 WOD98 MBT profile distribution for April-June for 1955

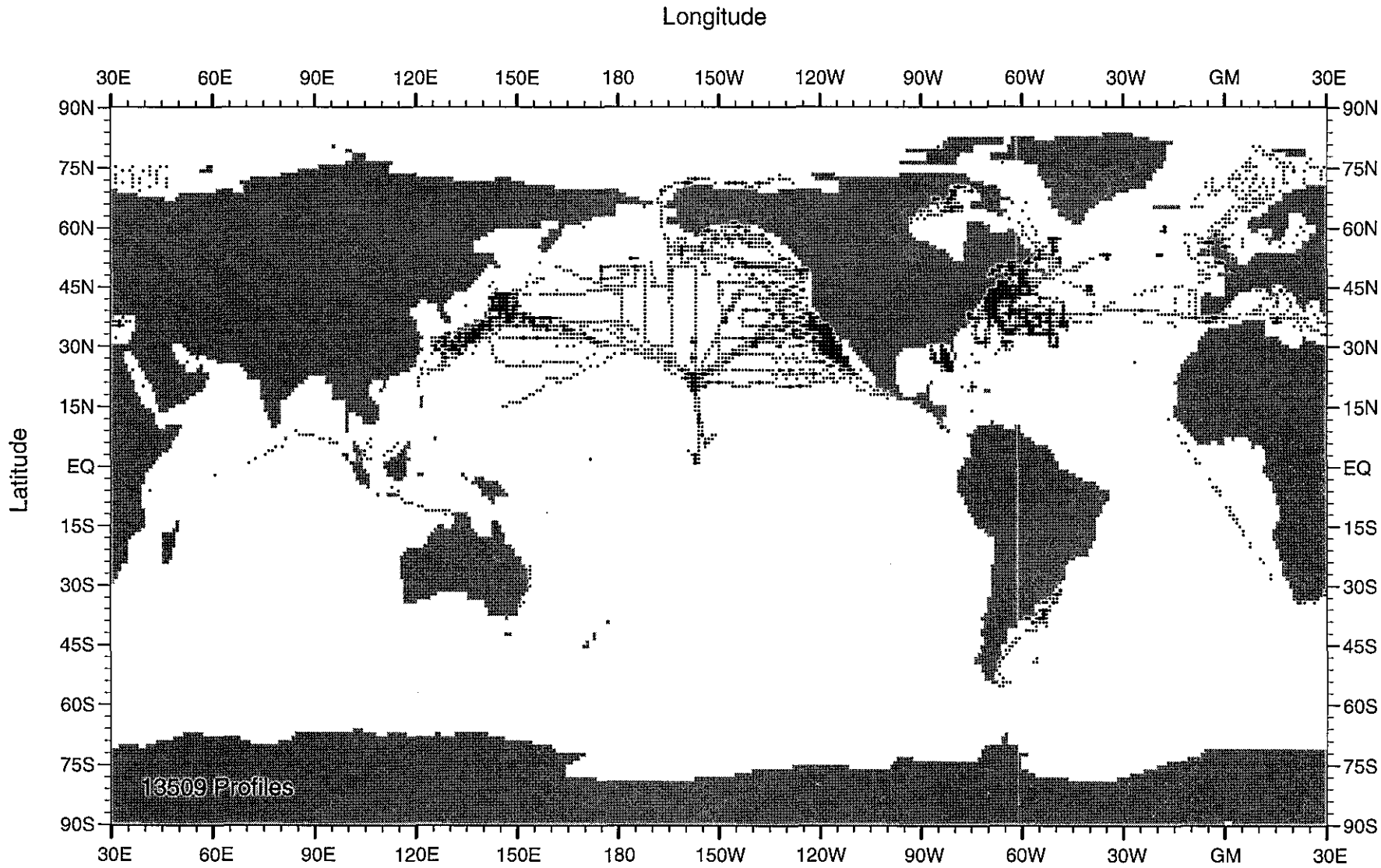

Fig. B59 WOD98 MBT profile distribution for July-September for 1955

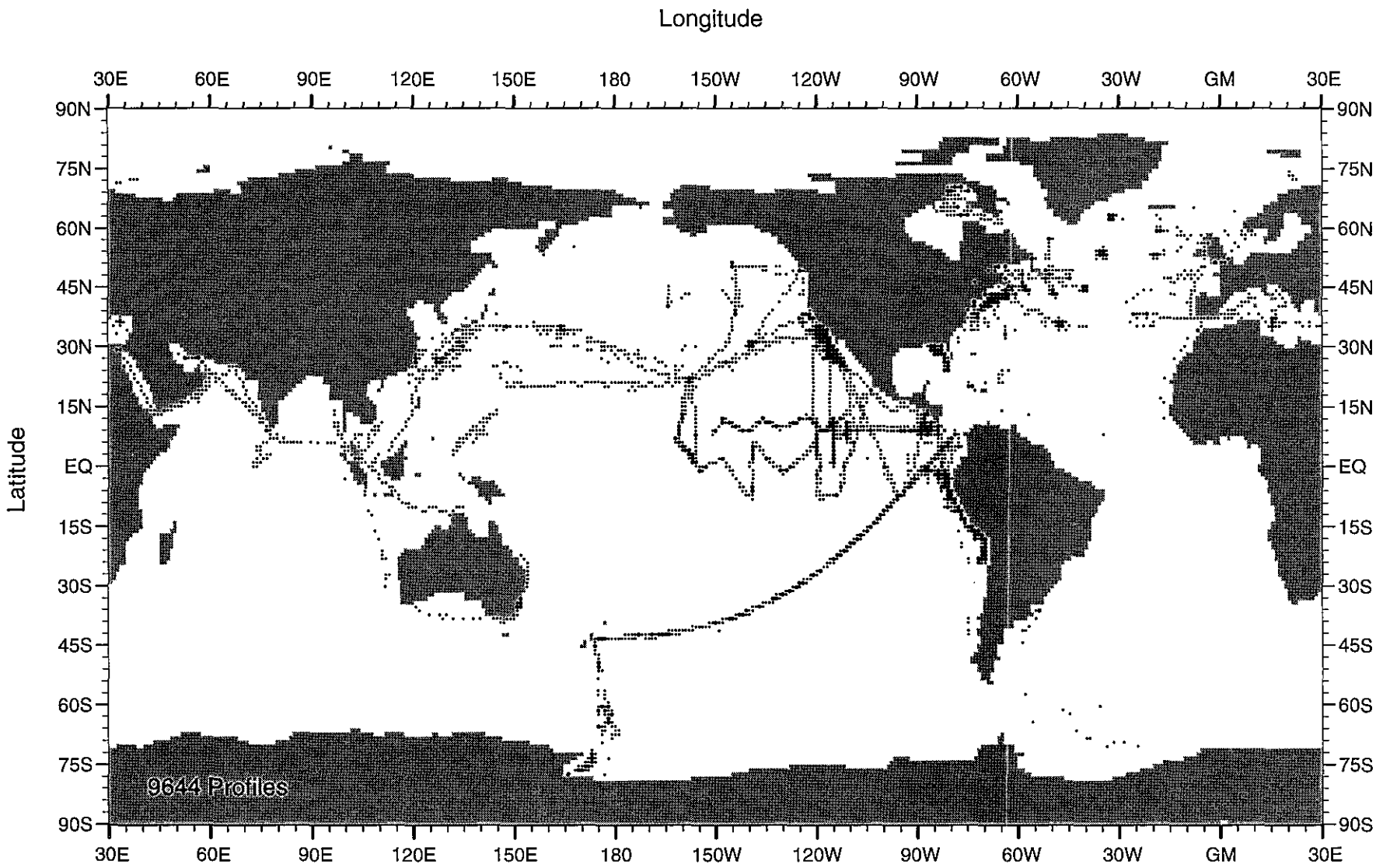

Fig. B60 WOD98 MBT profile distribution for October-December for 1955

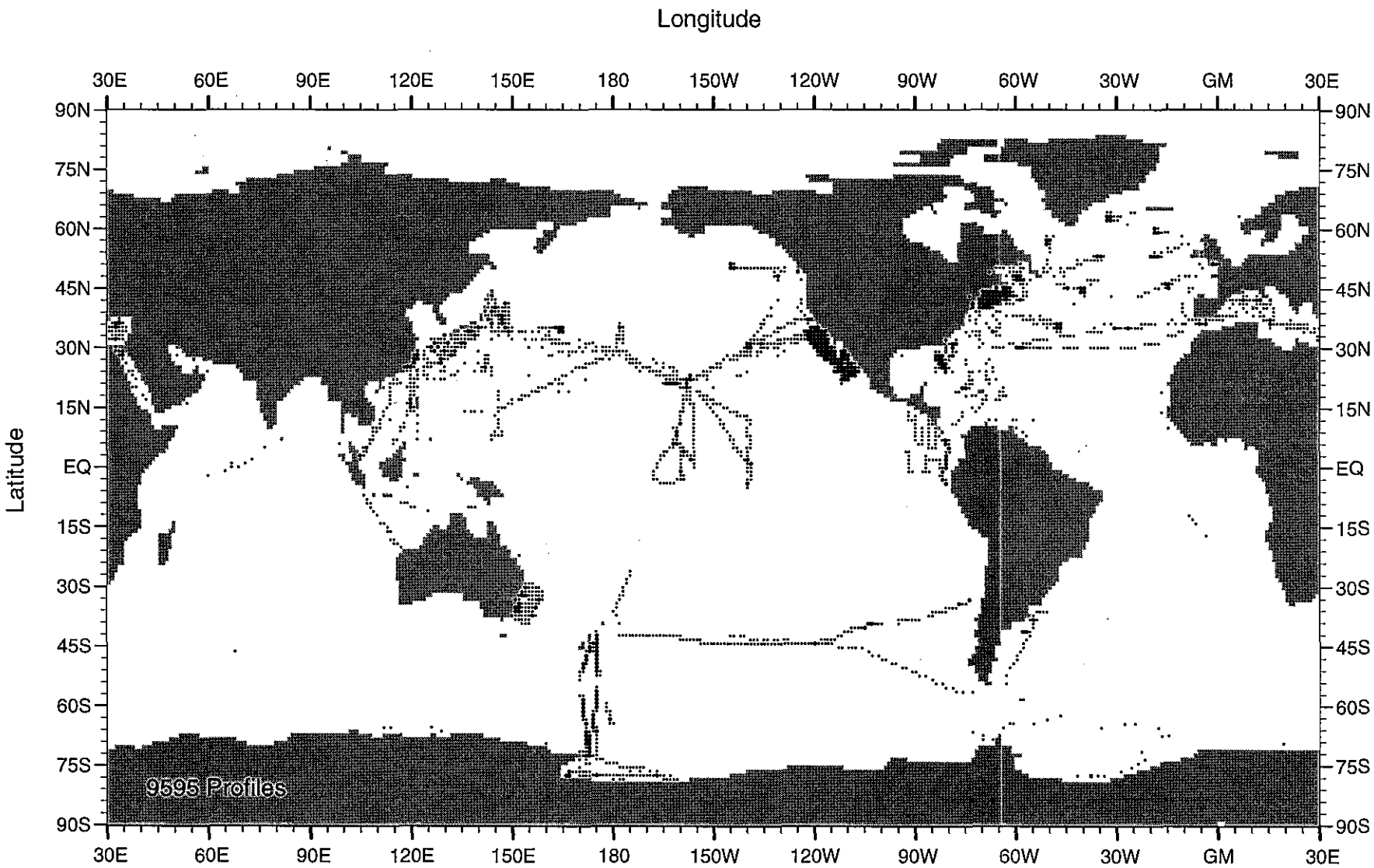

Fig. B61 WOD98 MBT profile distribution for January-March for 1956

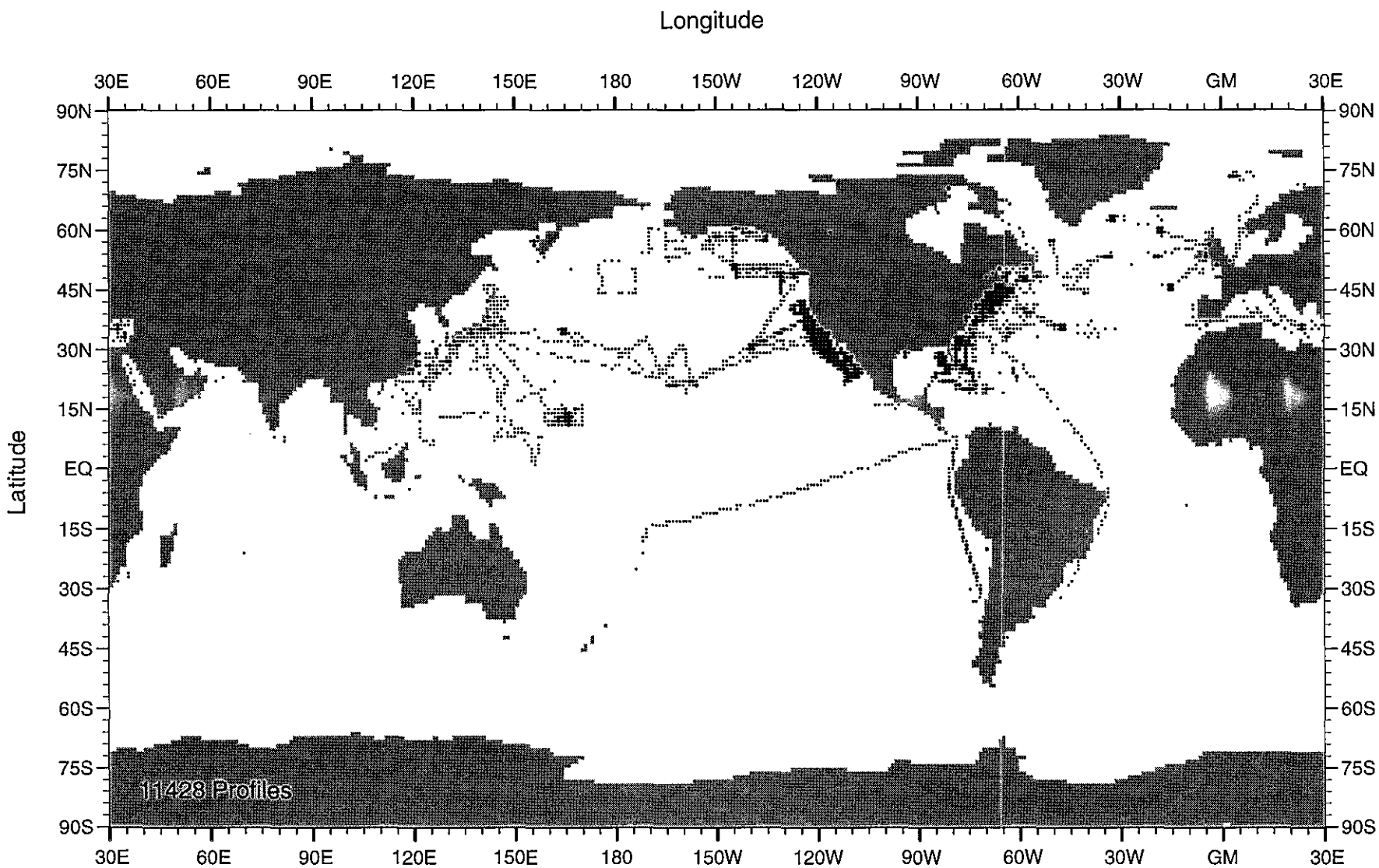

Fig. B62 WOD98 MBT profile distribution for April-June for 1956

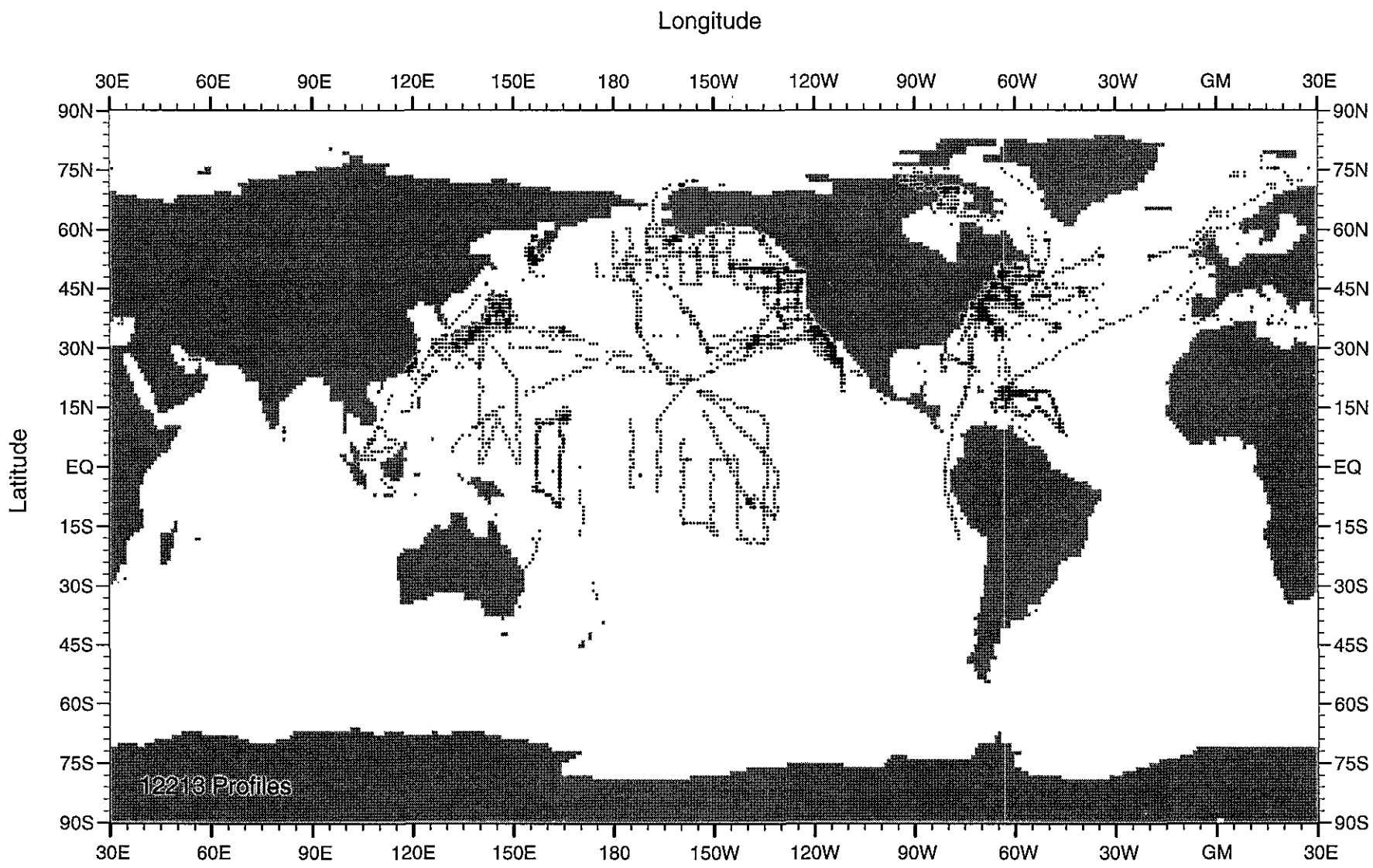

Fig. B63 WOD98 MBT profile distribution for July-September for 1956

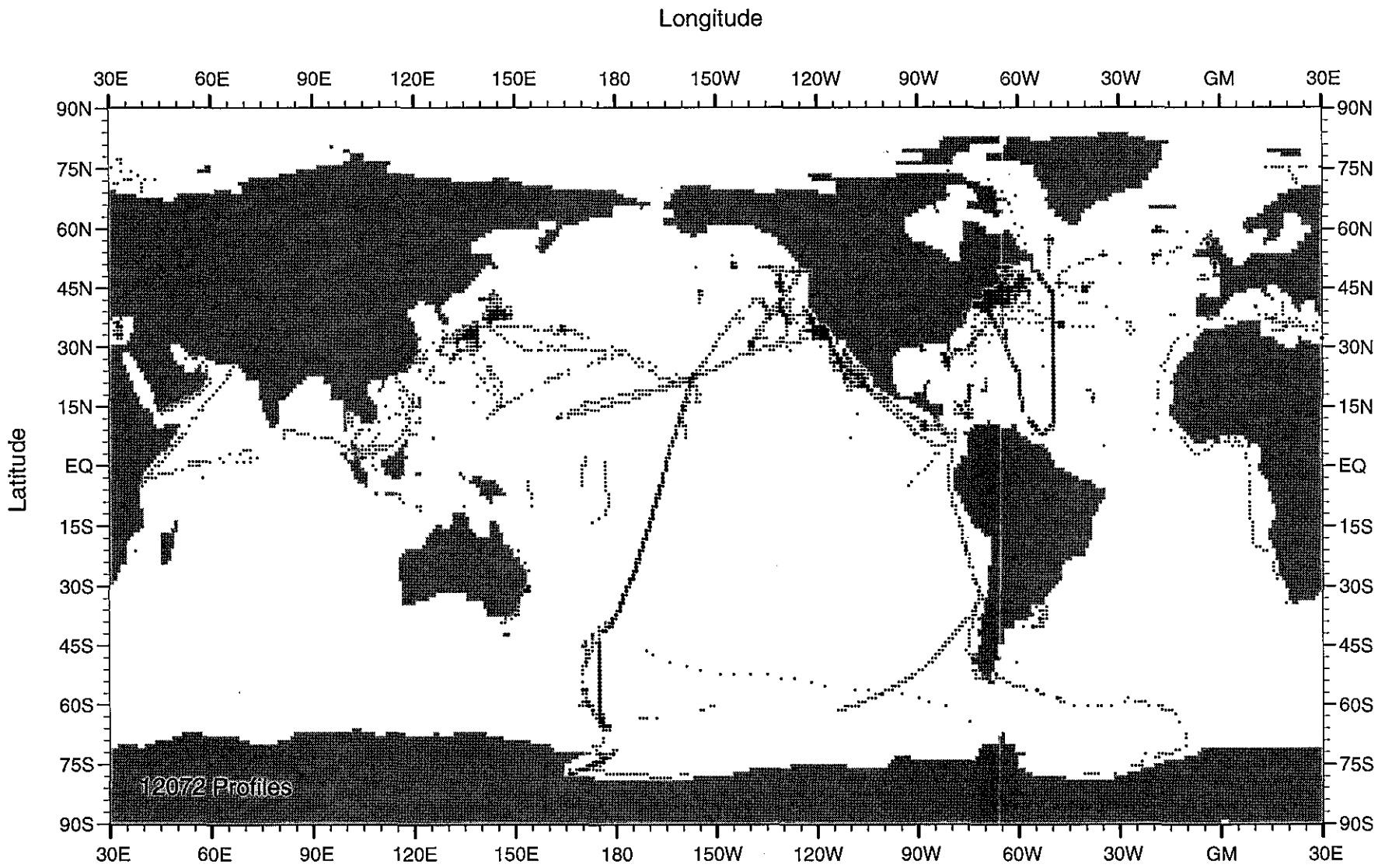

Fig. B64 WOD98 MBT profile distribution for October-December for 1956

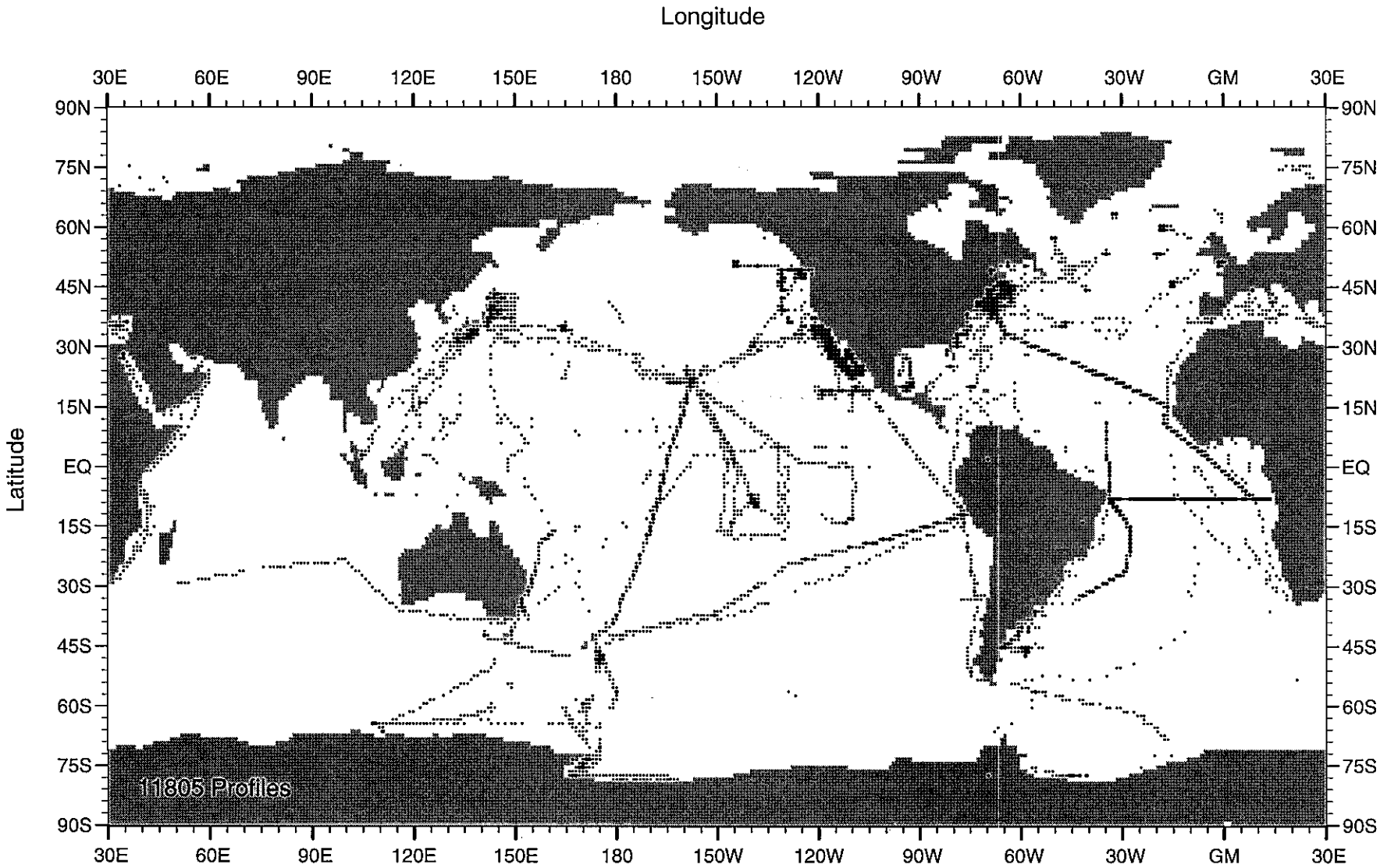

Fig. B65 WOD98 MBT profile distribution for January-March for 1957

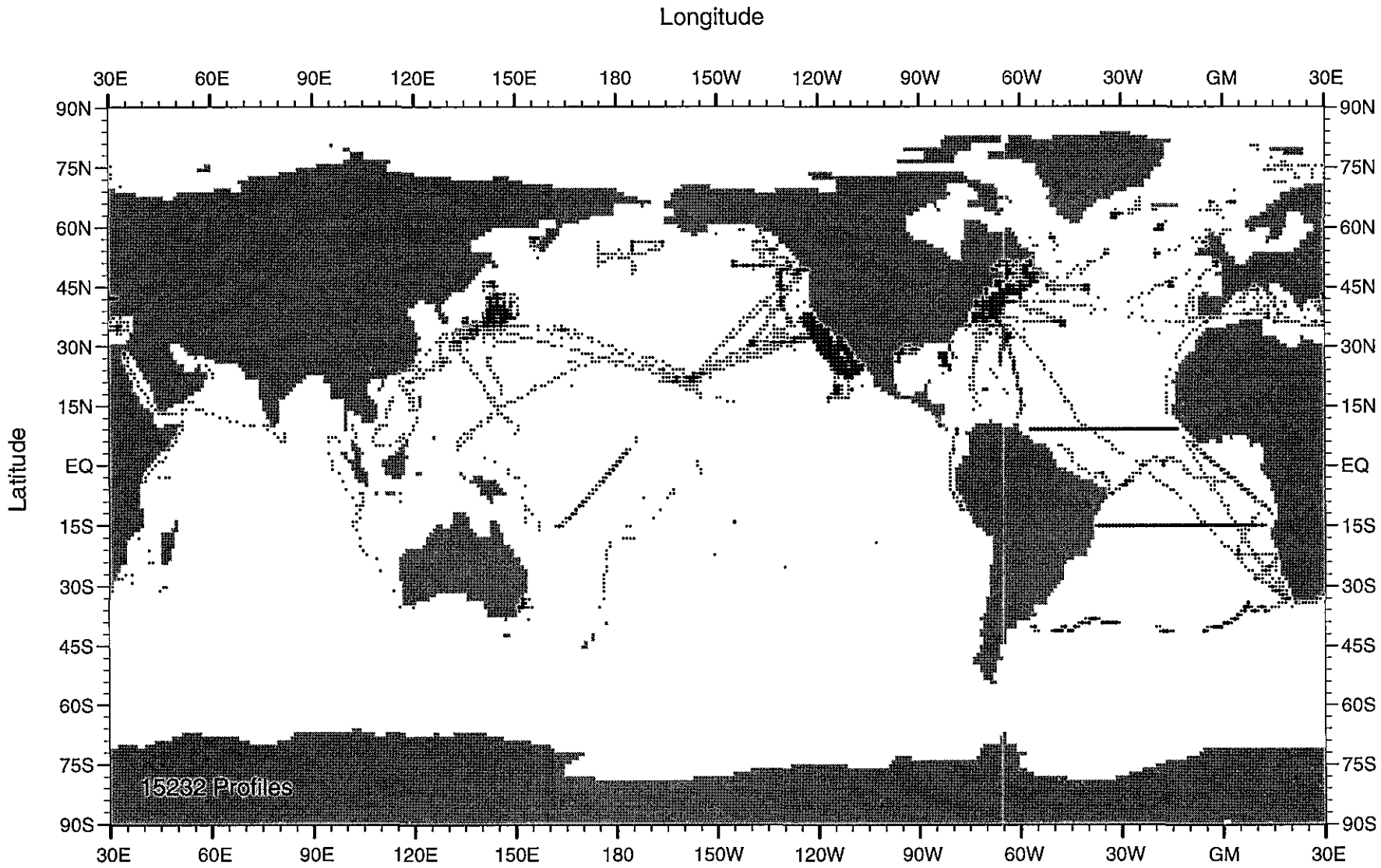

Fig. B66 WOD98 MBT profile distribution for April-June for 1957

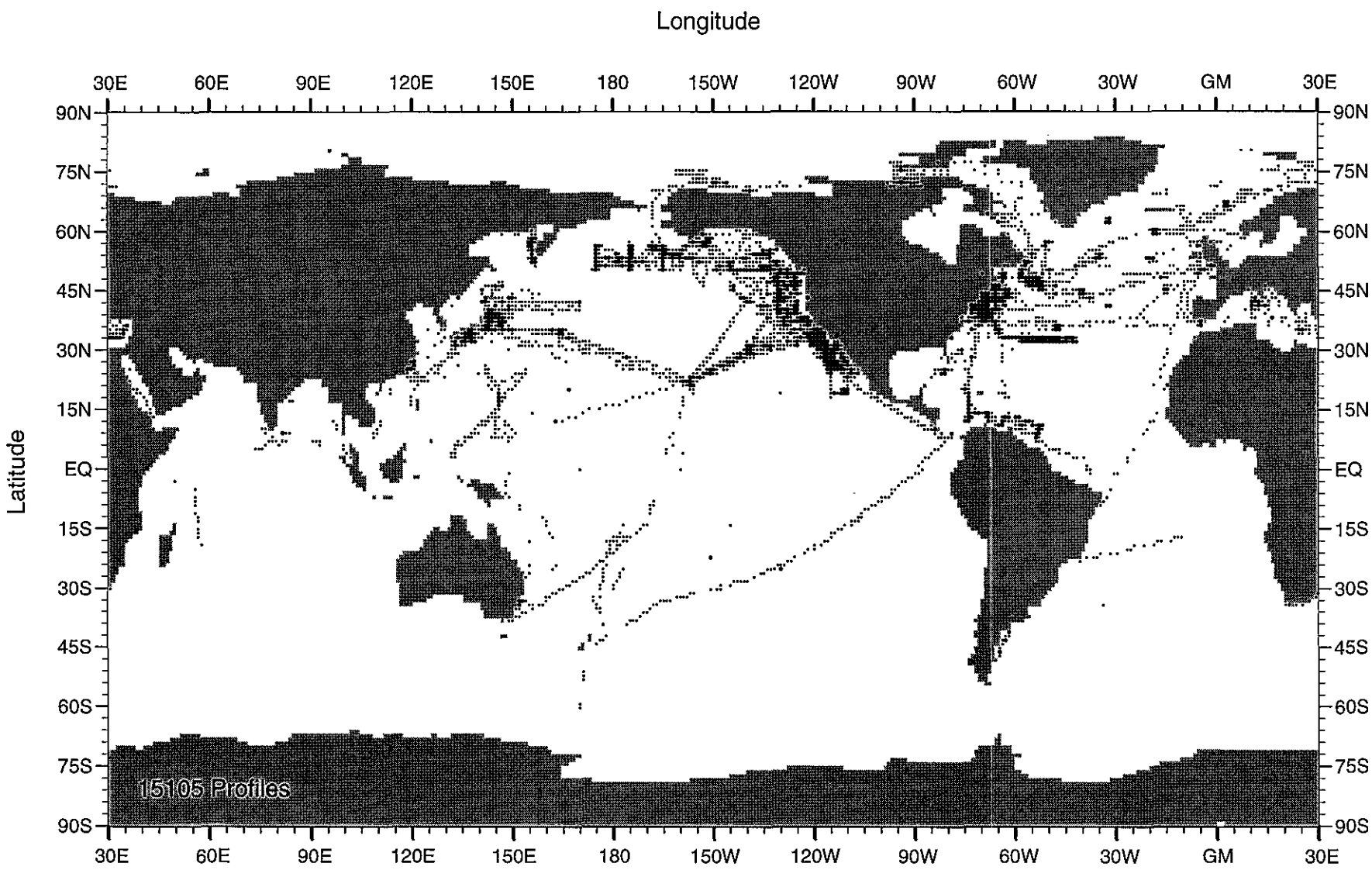

Fig. B67 WOD98 MBT profile distribution for July-September for 1957

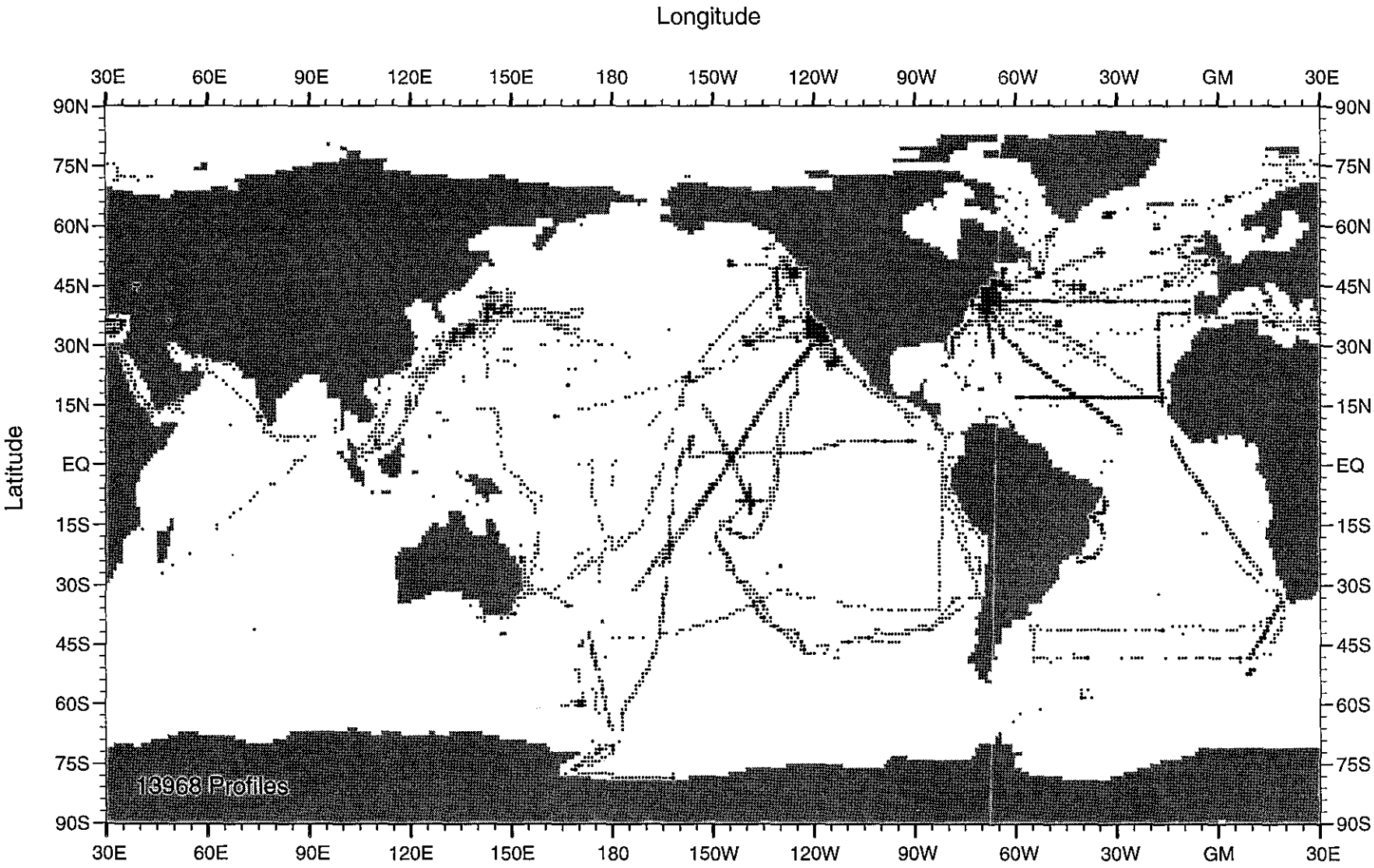

Fig. B68 WOD98 MBT profile distribution for October-December for 1957

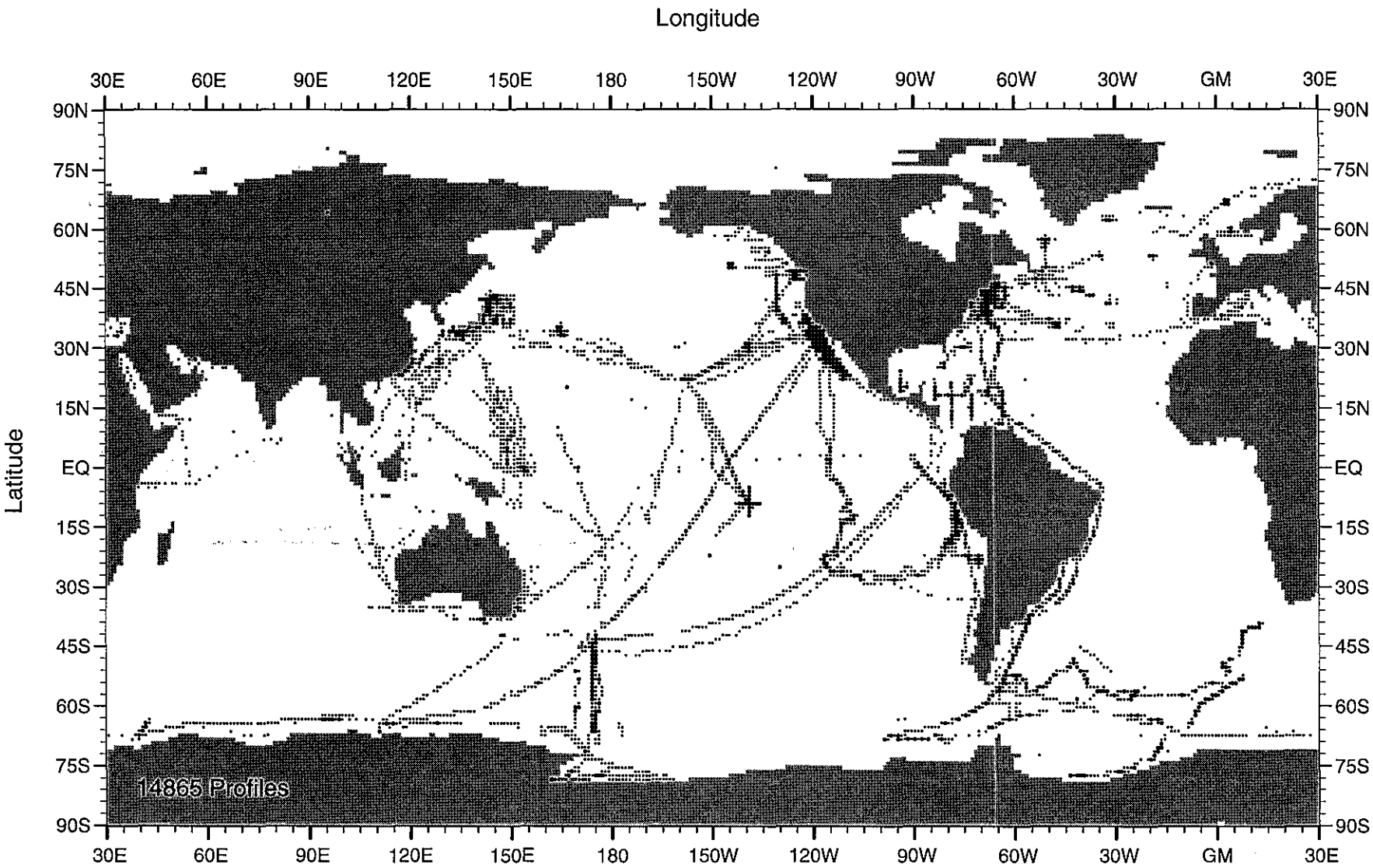

Fig. B69 WOD98 MBT profile distribution for January-March for 1958

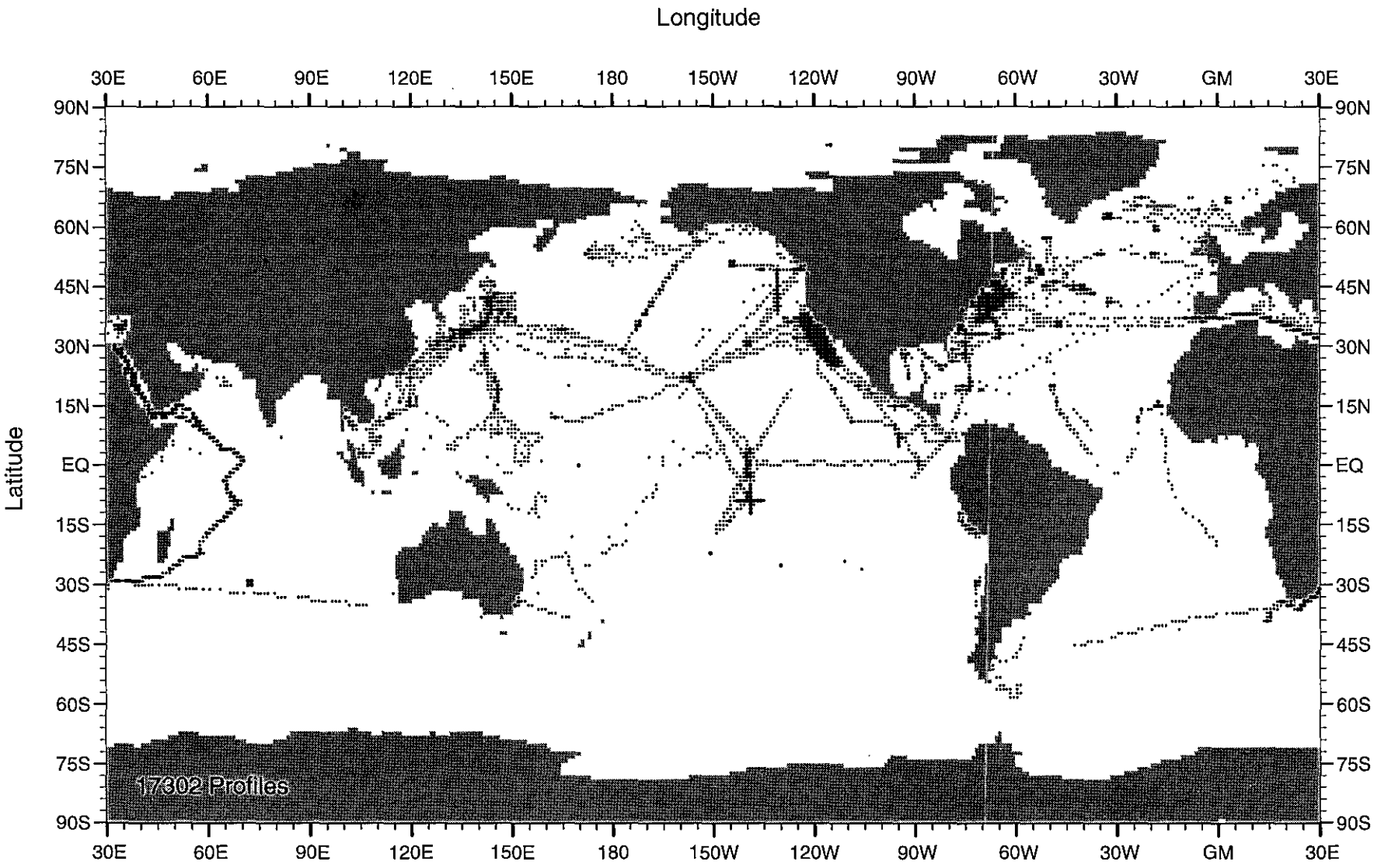

Fig. B70 WOD98 MBT profile distribution for April-June for 1958

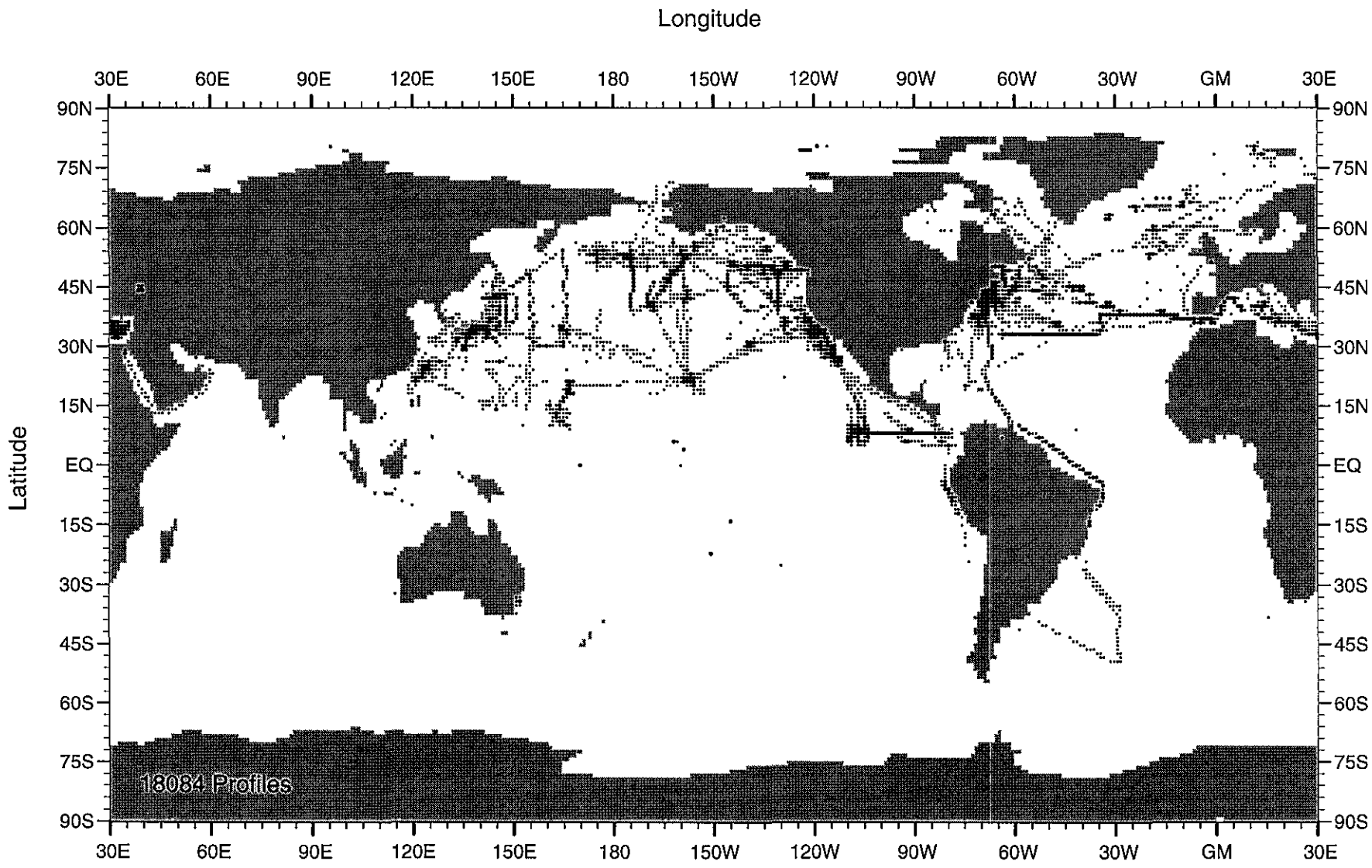

Fig. B71 WOD98 MBT profile distribution for July-September for 1958

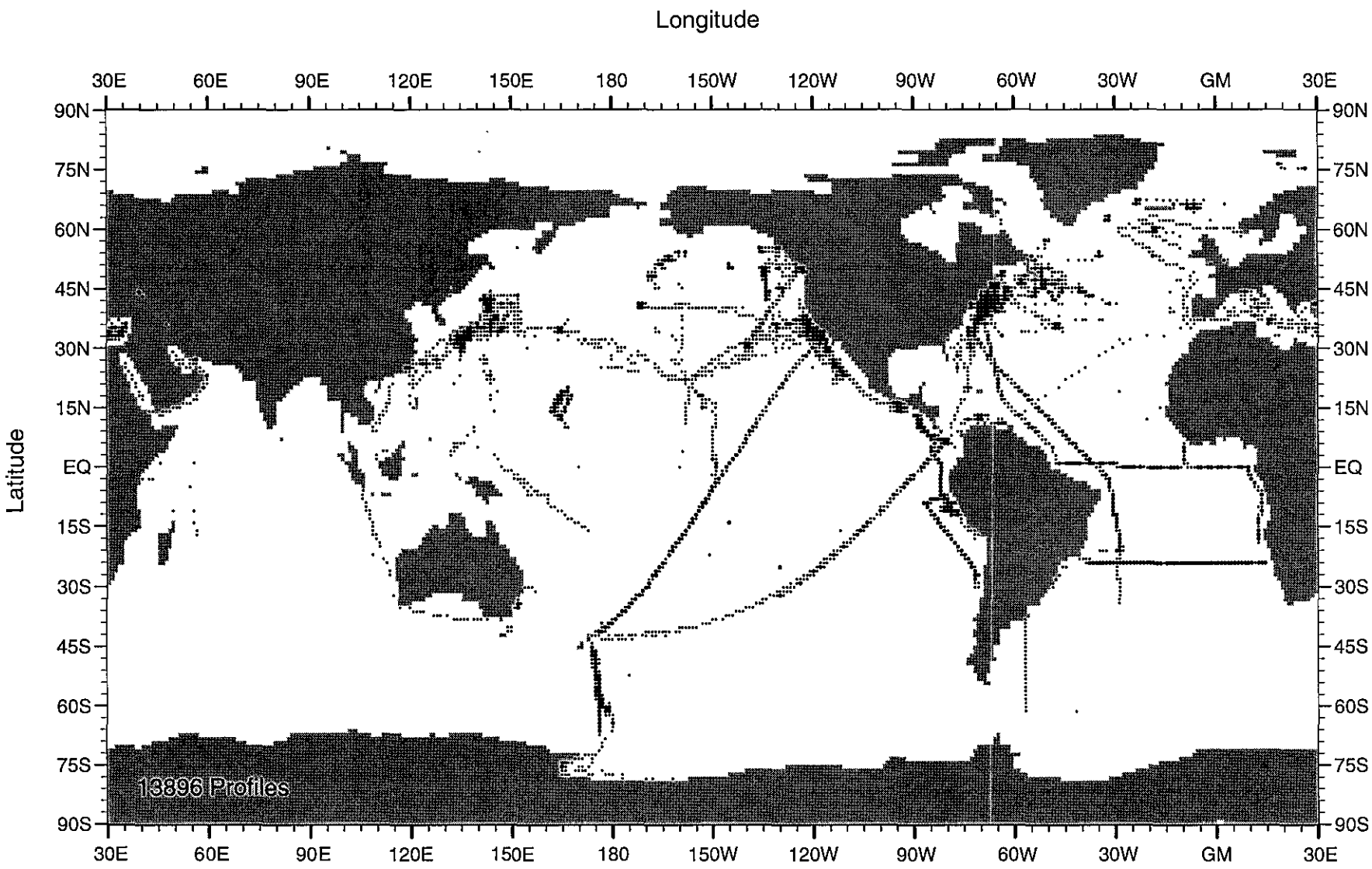

Fig. B72 WOD98 MBT profile distribution for October-December for 1958

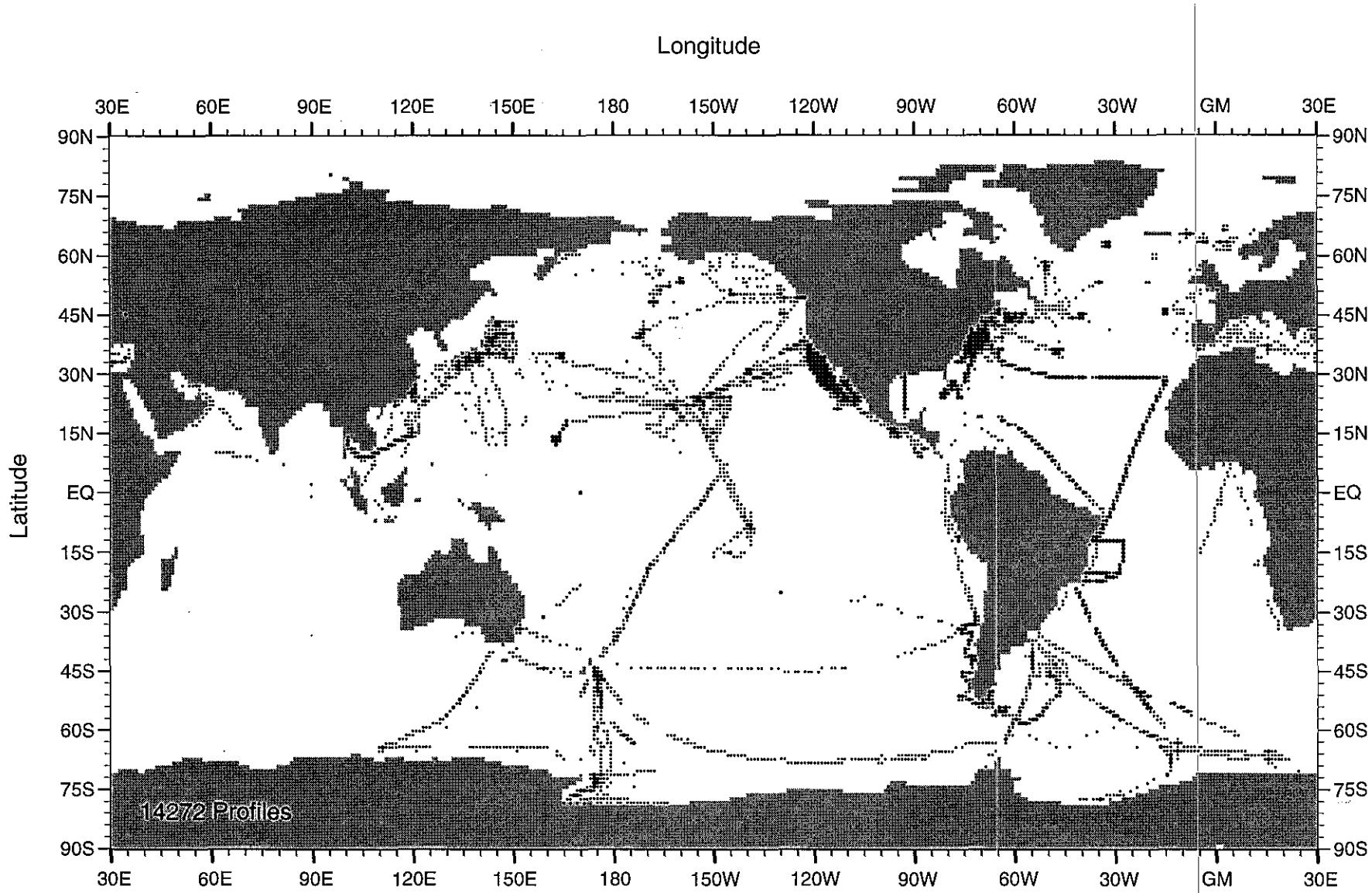

Fig. B73 WOD98 MBT profile distribution for January-March for 1959

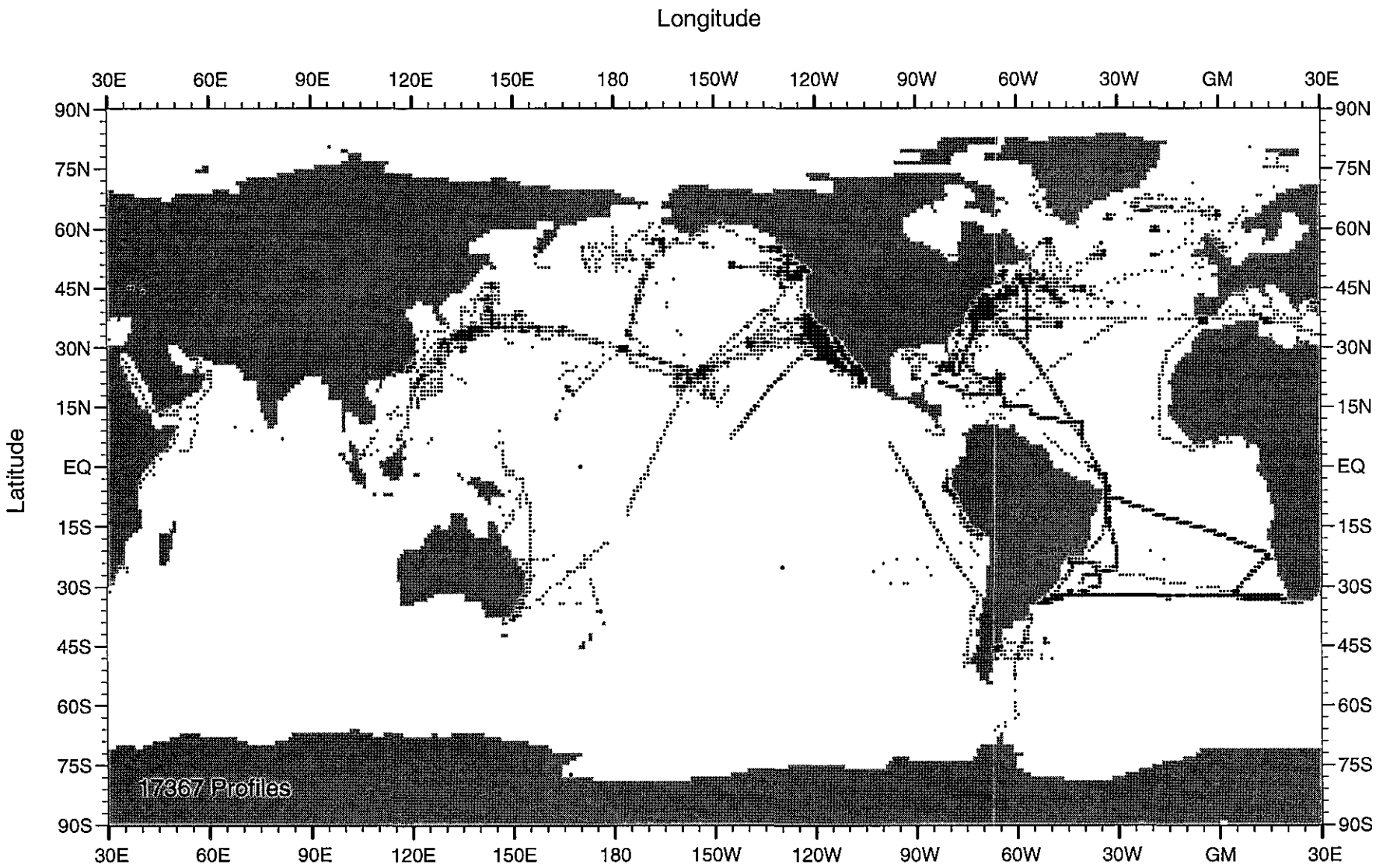

Fig. B74 WOD98 MBT profile distribution for April-June for 1959

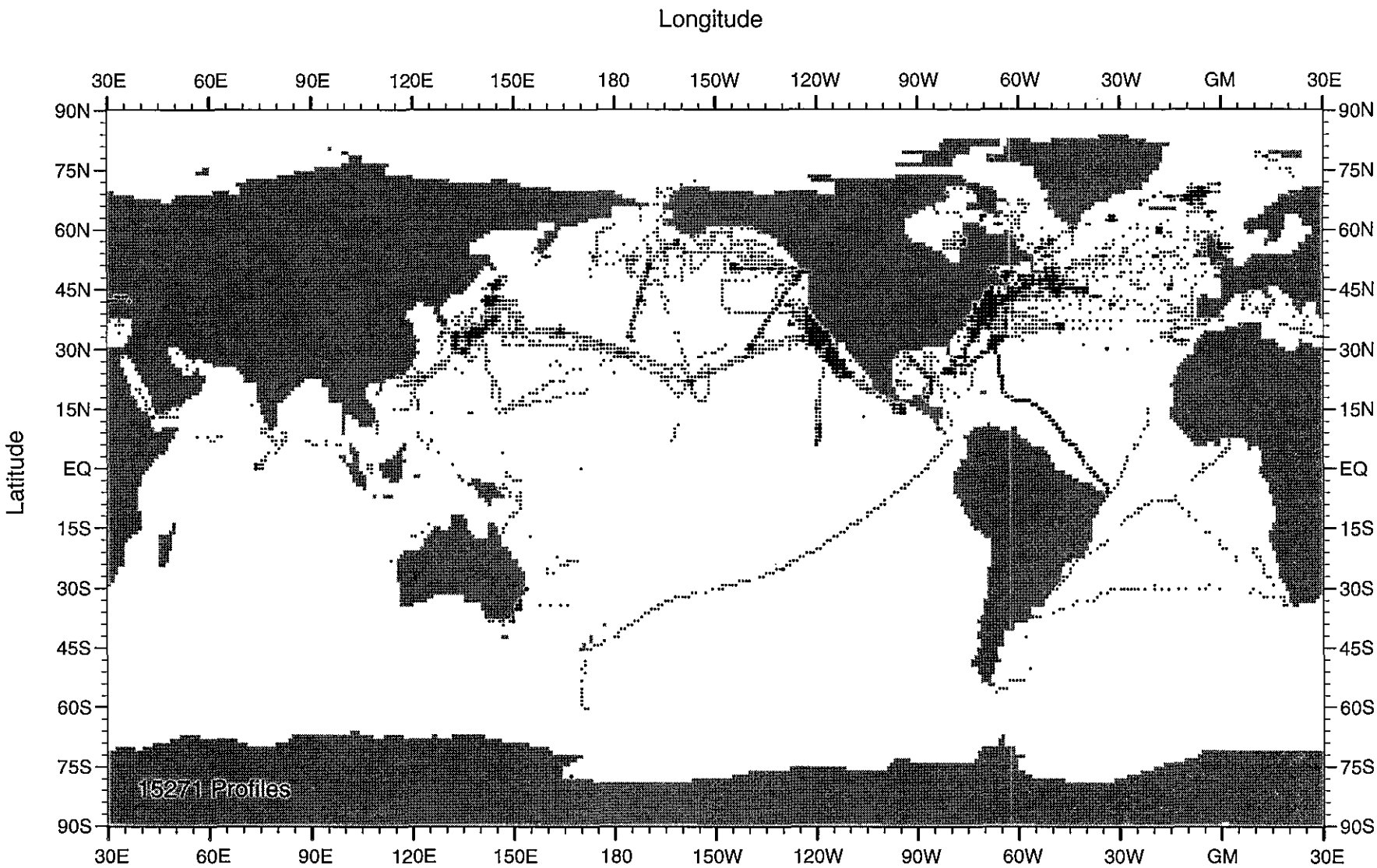

Fig. B75 WOD98 MBT profile distribution for July-September for 1959

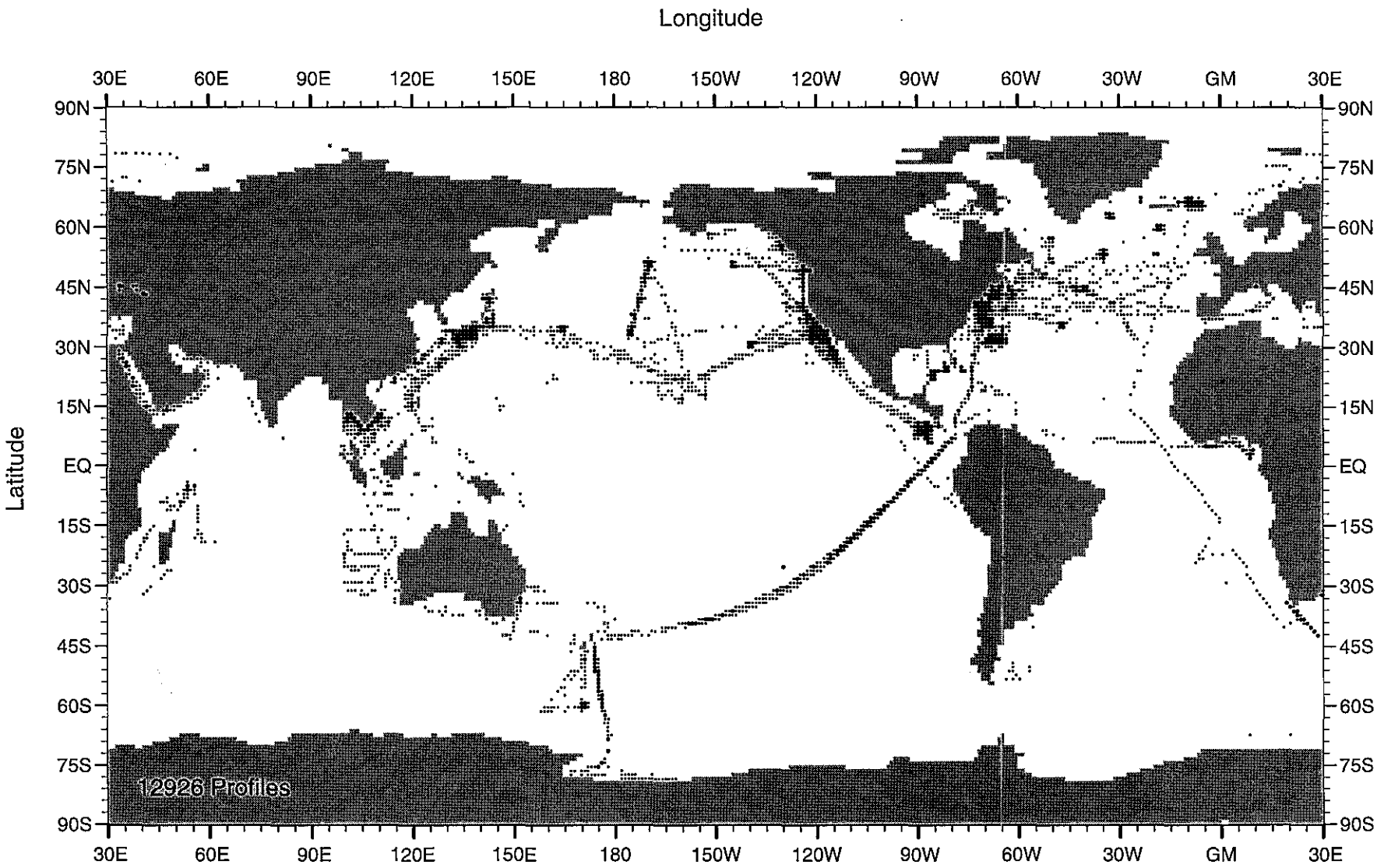

Fig. B76 WOD98 MBT profile distribution for October-December for 1959

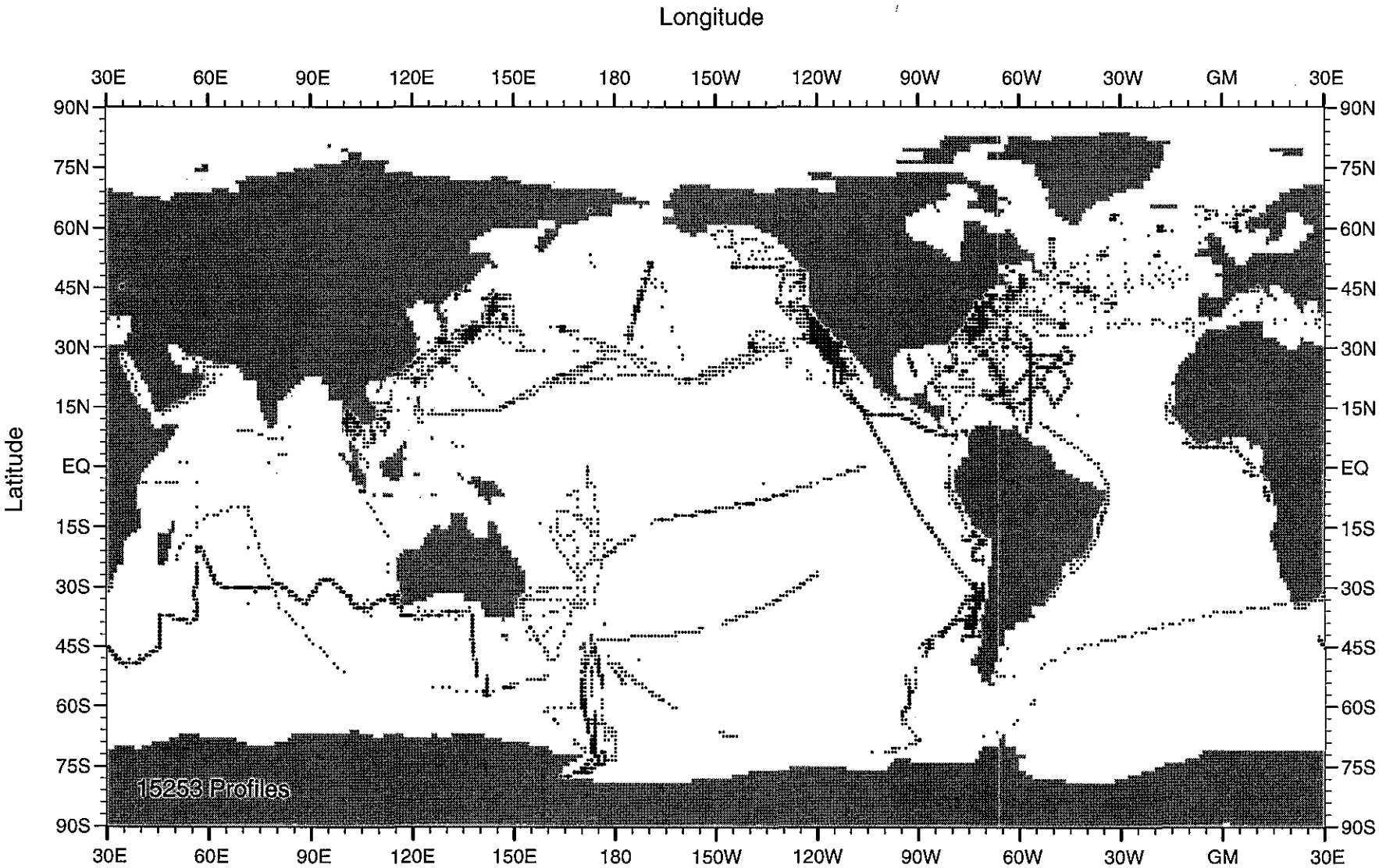

Fig. B77 WOD98 MBT profile distribution for January-March for 1960

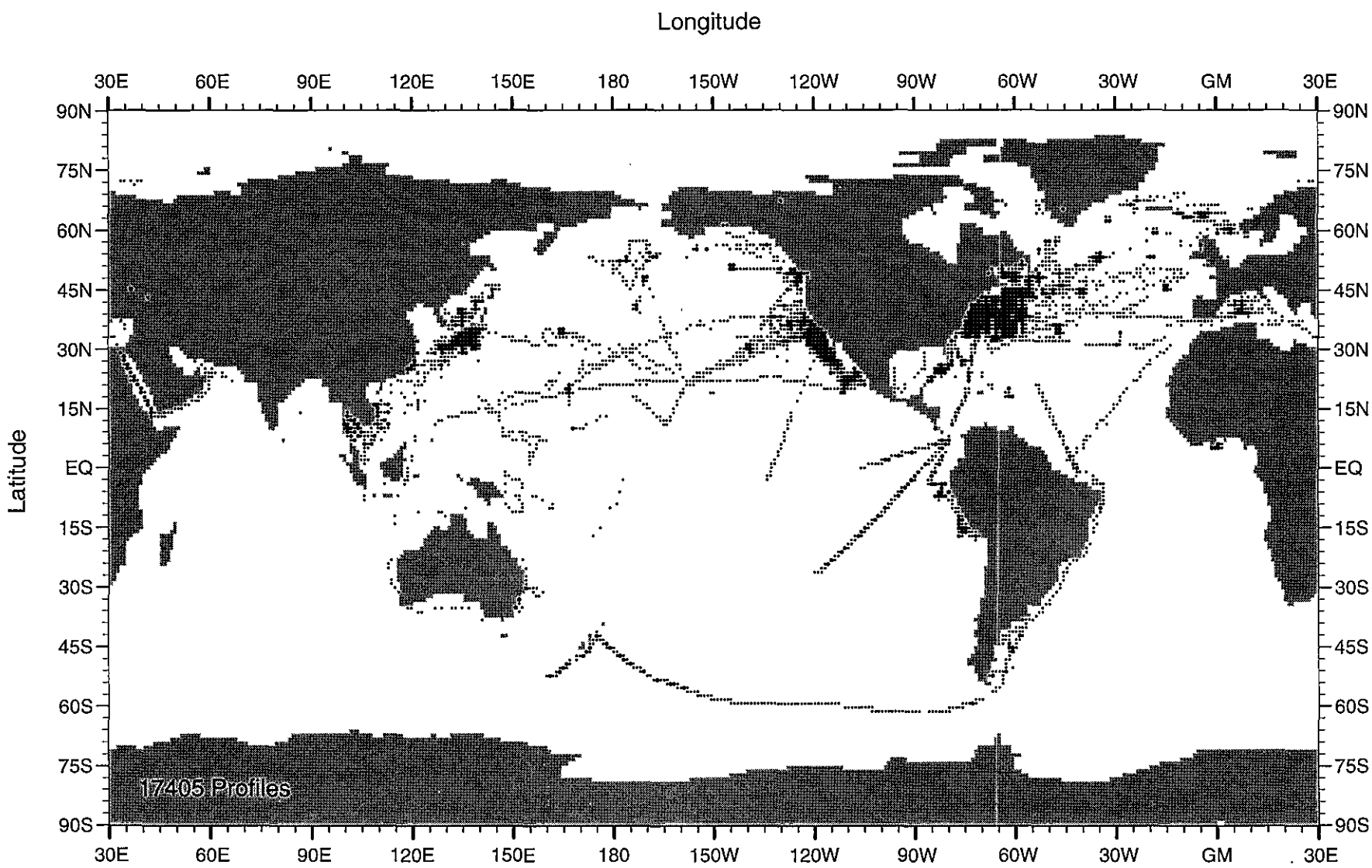

Fig. B78 WOD98 MBT profile distribution for April-June for 1960

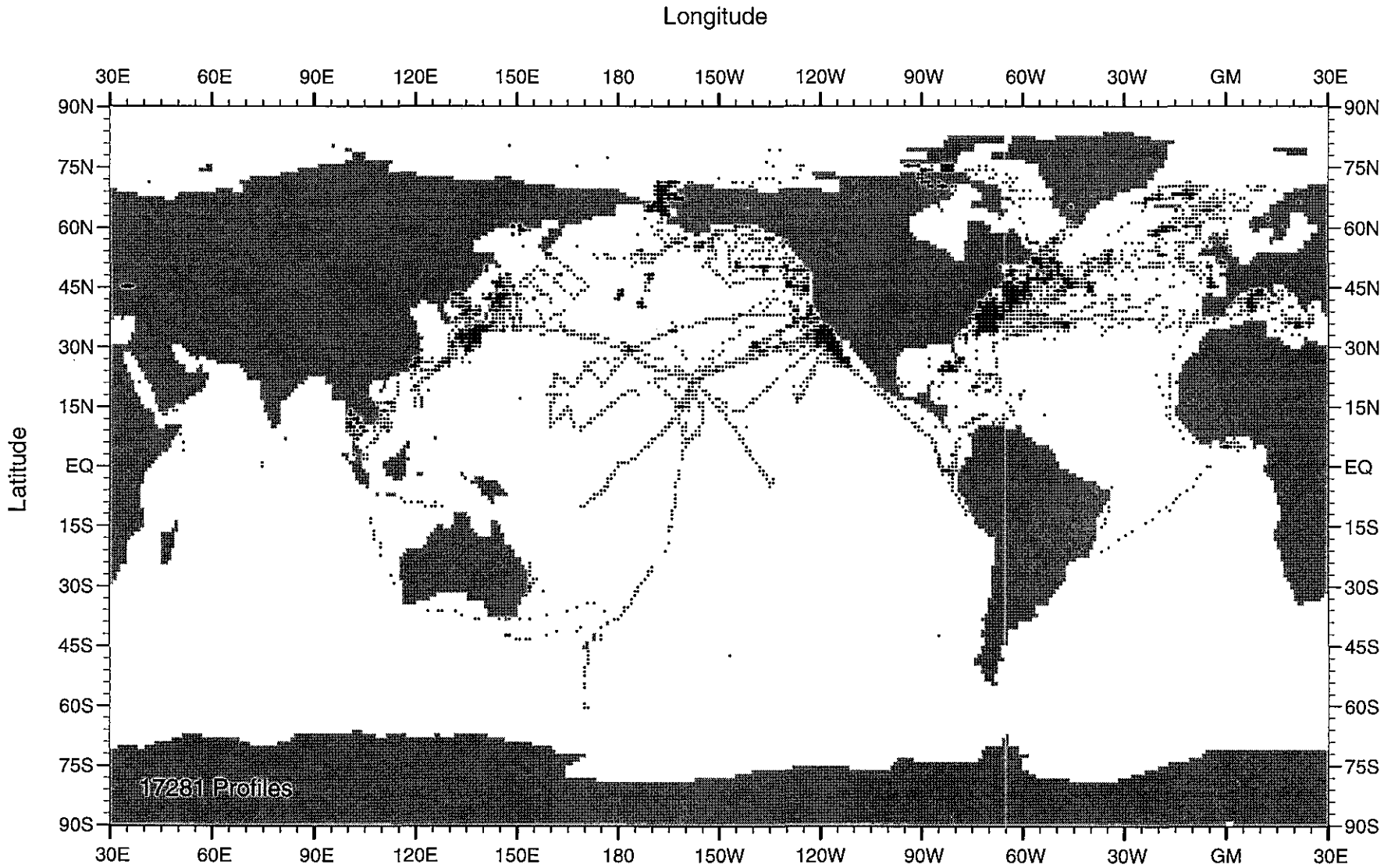

Fig. B79 WOD98 MBT profile distribution for July-September for 1960

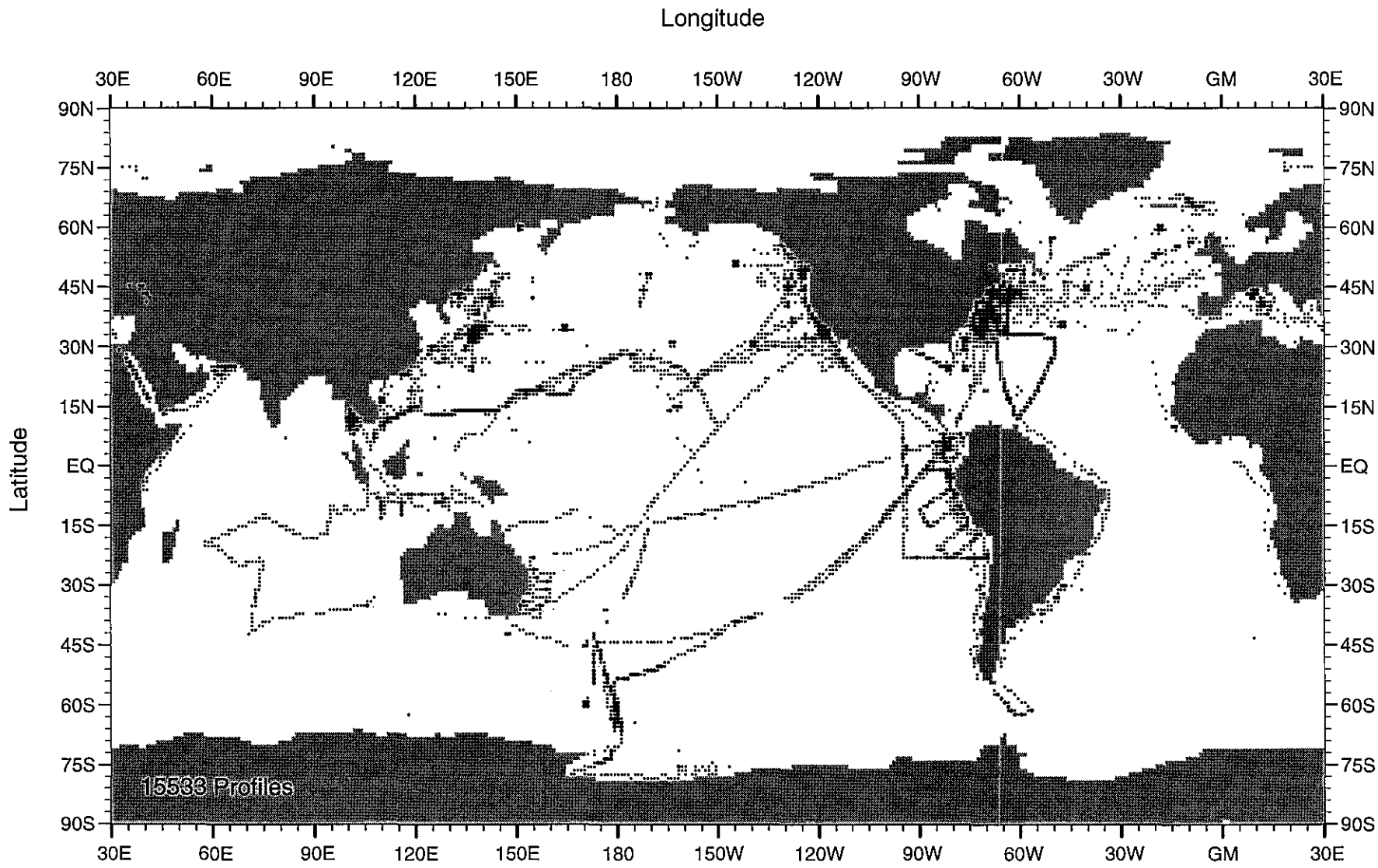

Fig. B80 WOD98 MBT profile distribution for October-December for 1960

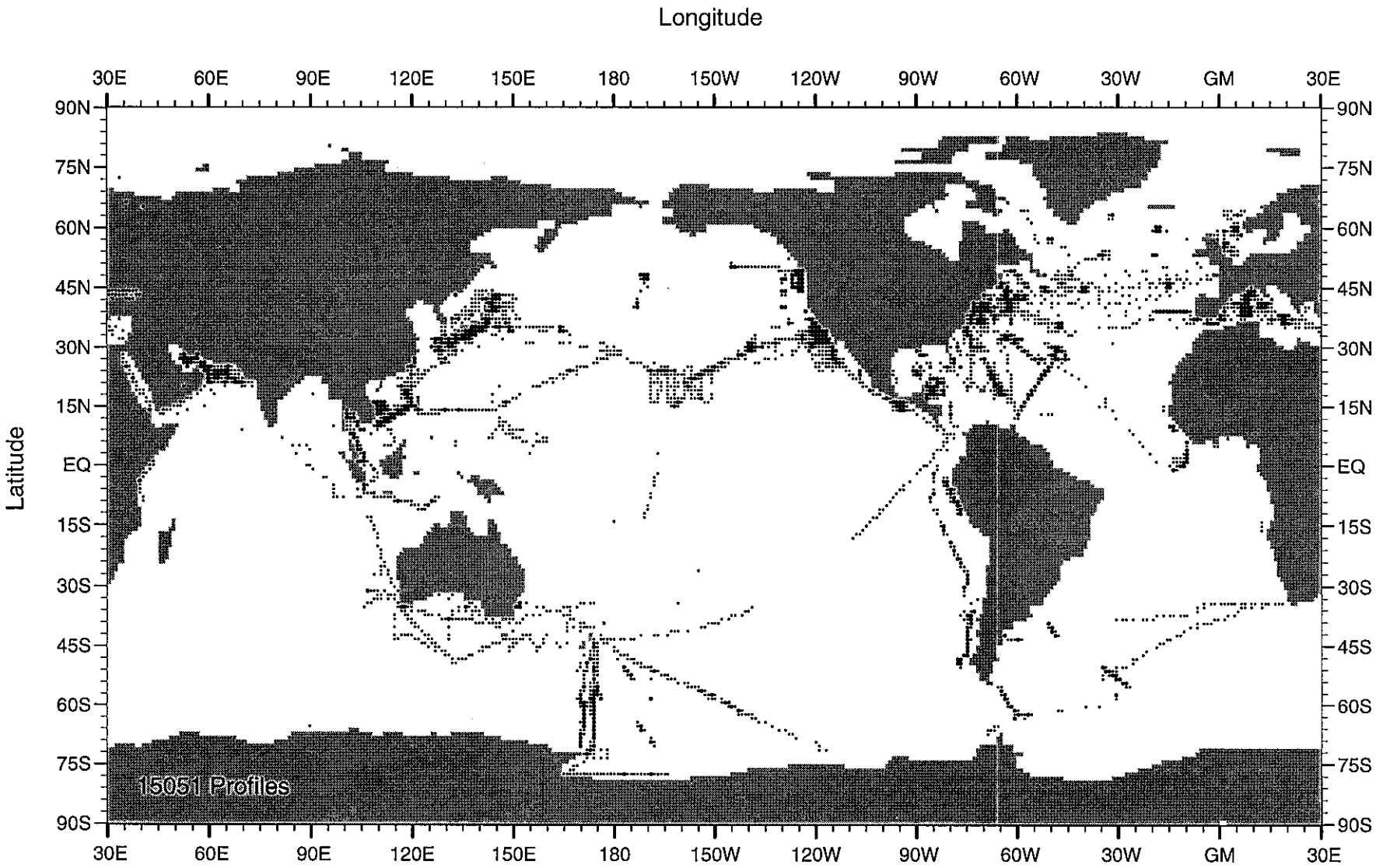

Fig. B81 WOD98 MBT profile distribution for January-March for 1961

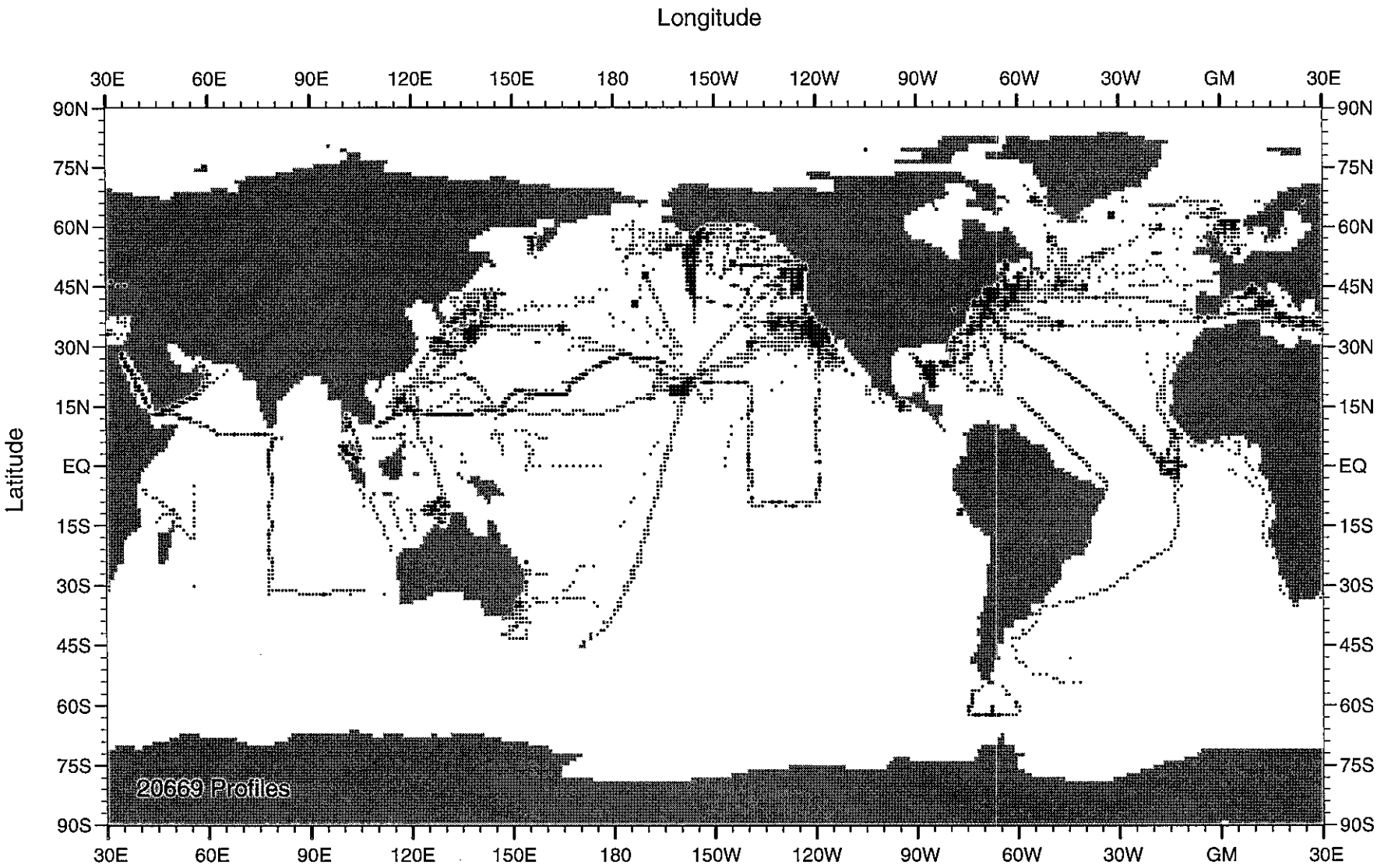

Fig. B82 WOD98 MBT profile distribution for April-June for 1961

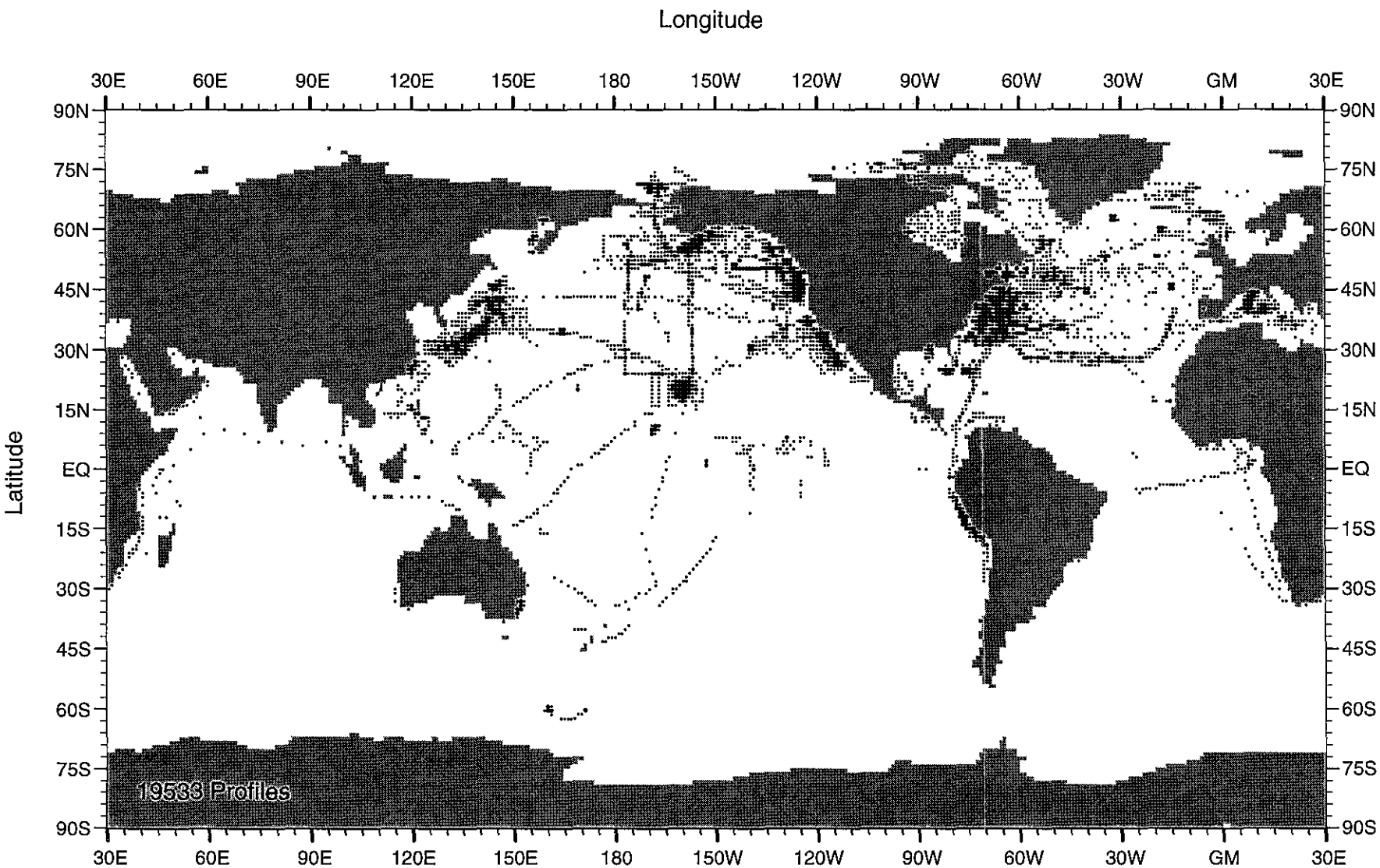

Fig. B83 WOD98 MBT profile distribution for July-September for 1961

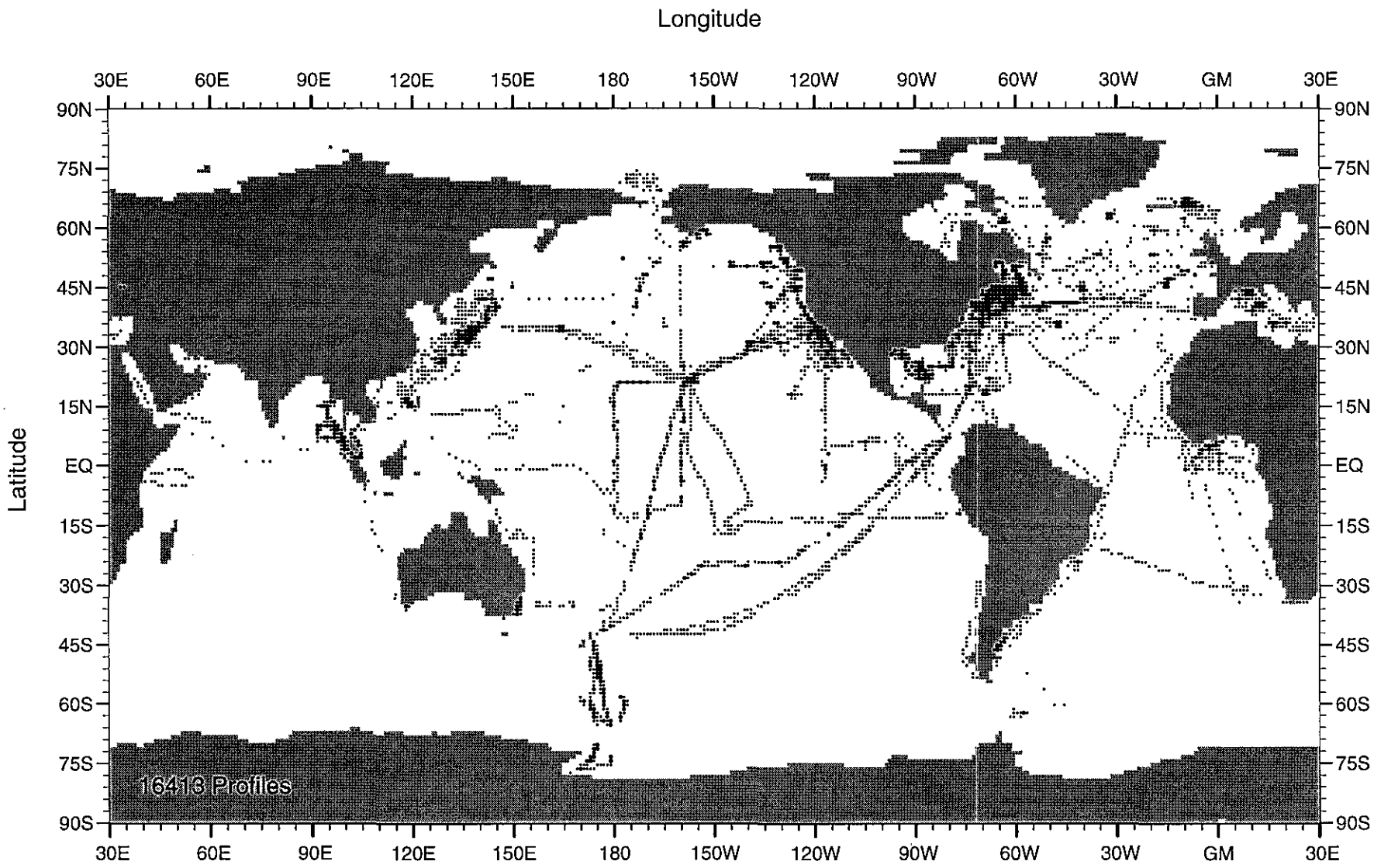

Fig. B84 WOD98 MBT profile distribution for October-December for 1961

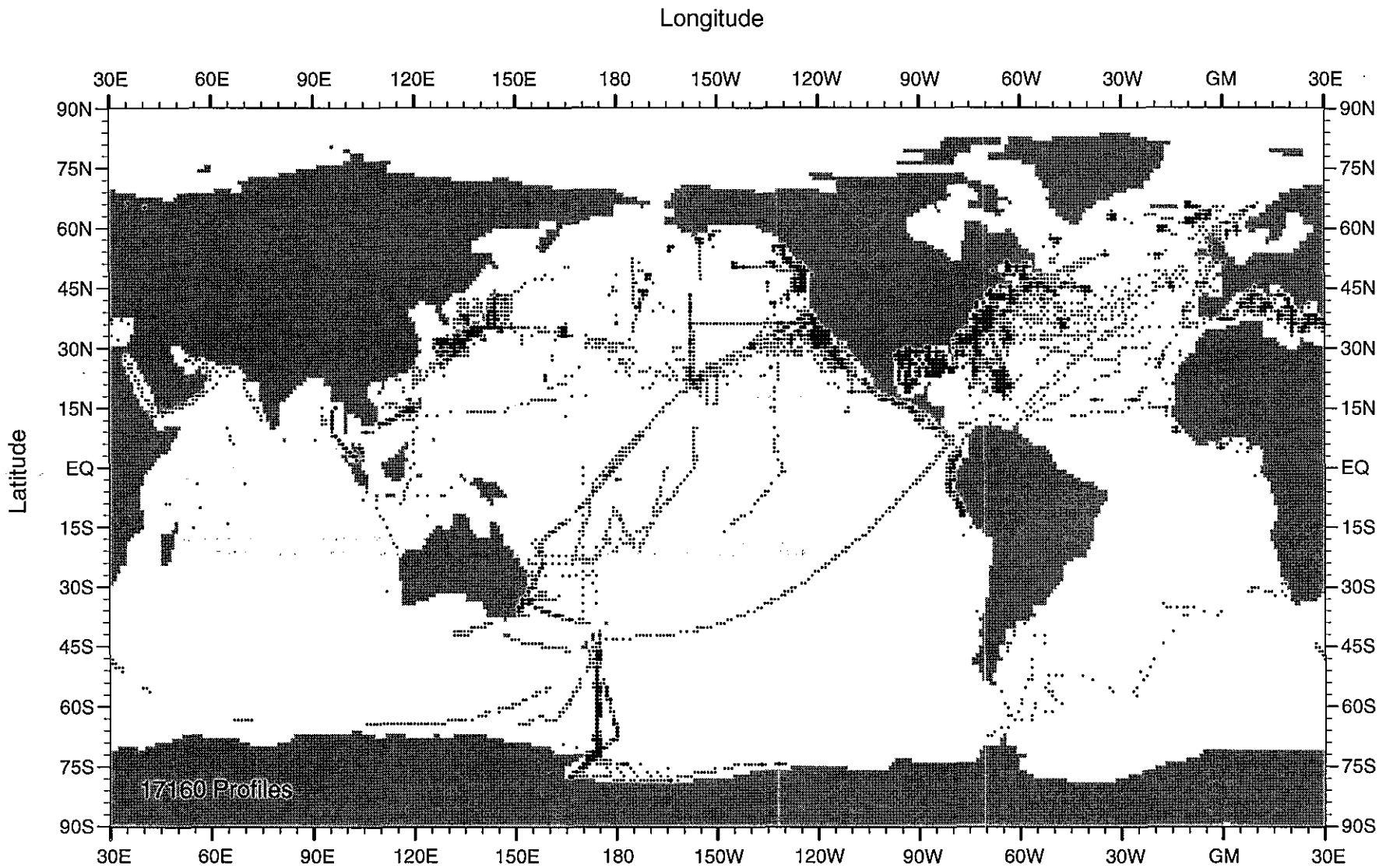

Fig. B85 WOD98 MBT profile distribution for January-March for 1962

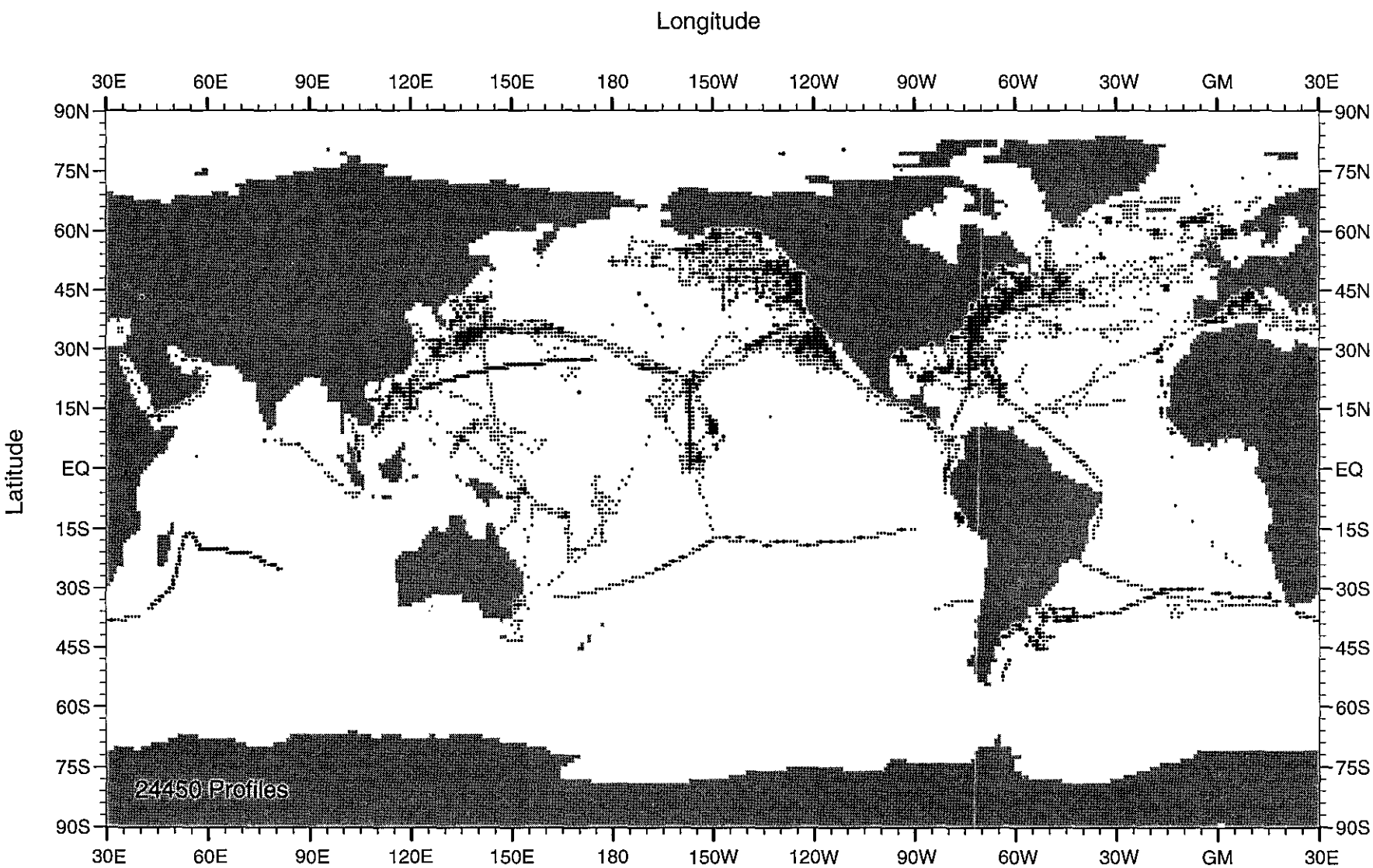

Fig. B86 WOD98 MBT profile distribution for April-June for 1962

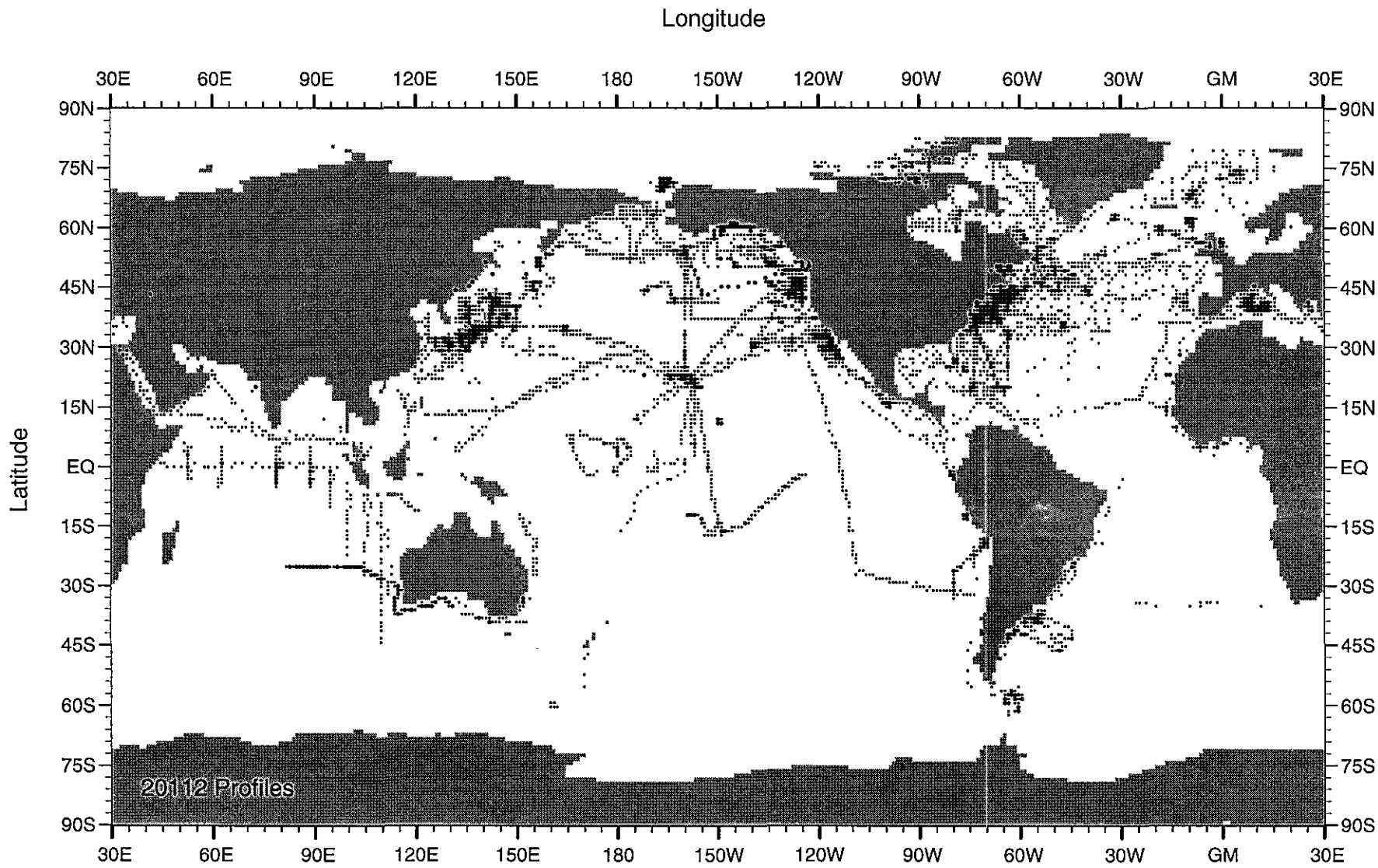

Fig. B87 WOD98 MBT profile distribution for July-September for 1962

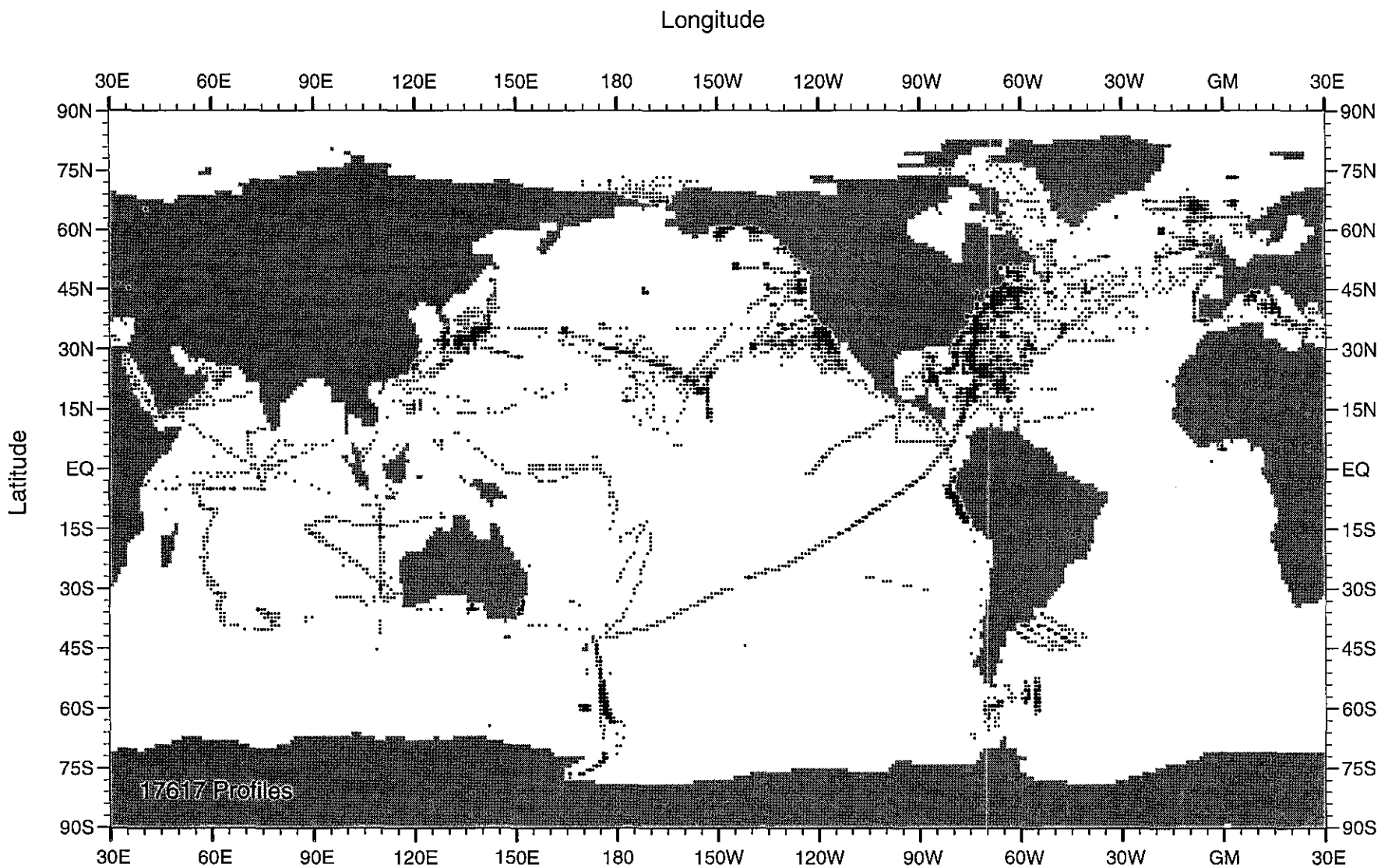

Fig. B88 WOD98 MBT profile distribution for October-December for 1962

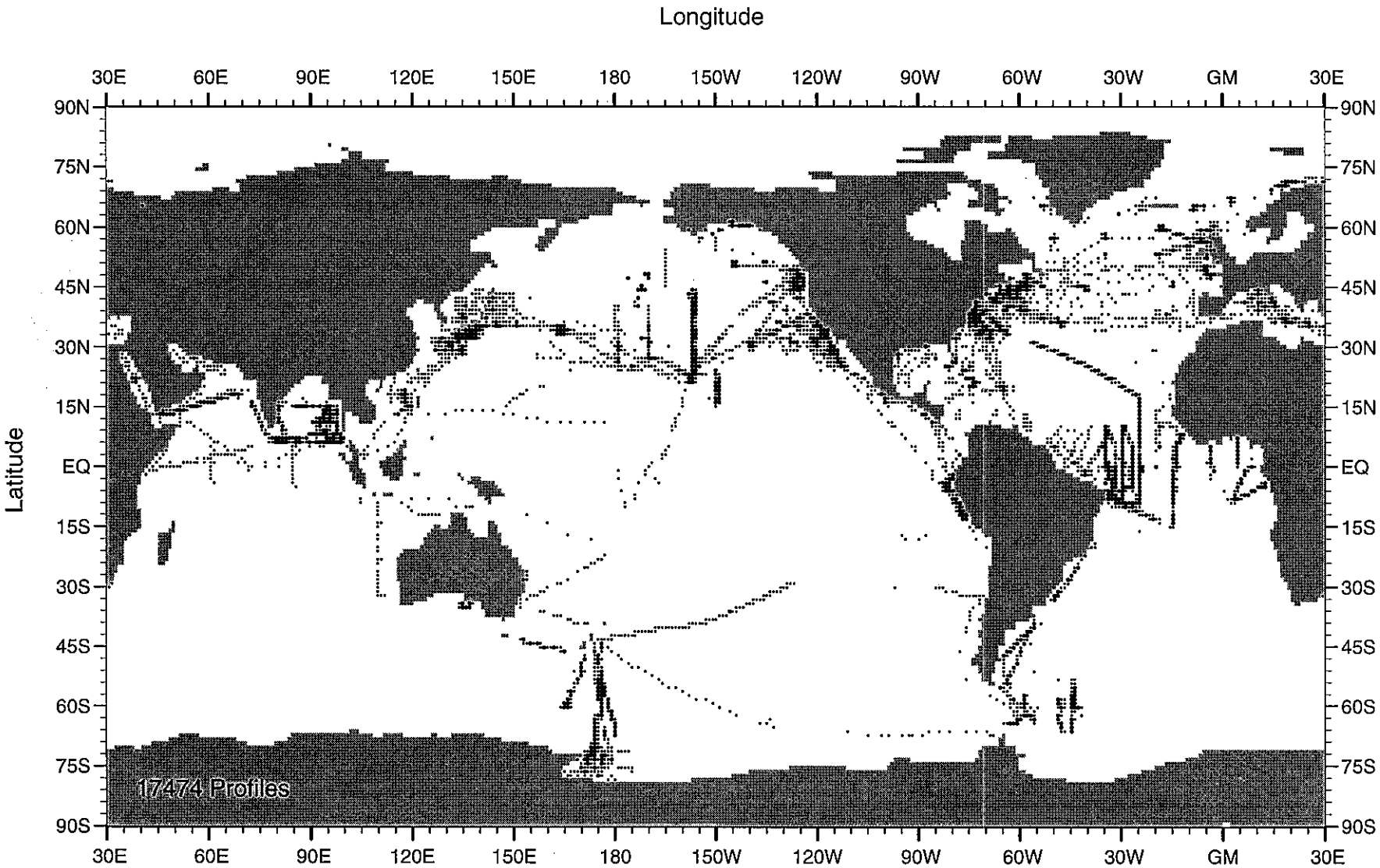

Fig. B89 WOD98 MBT profile distribution for January-March for 1963

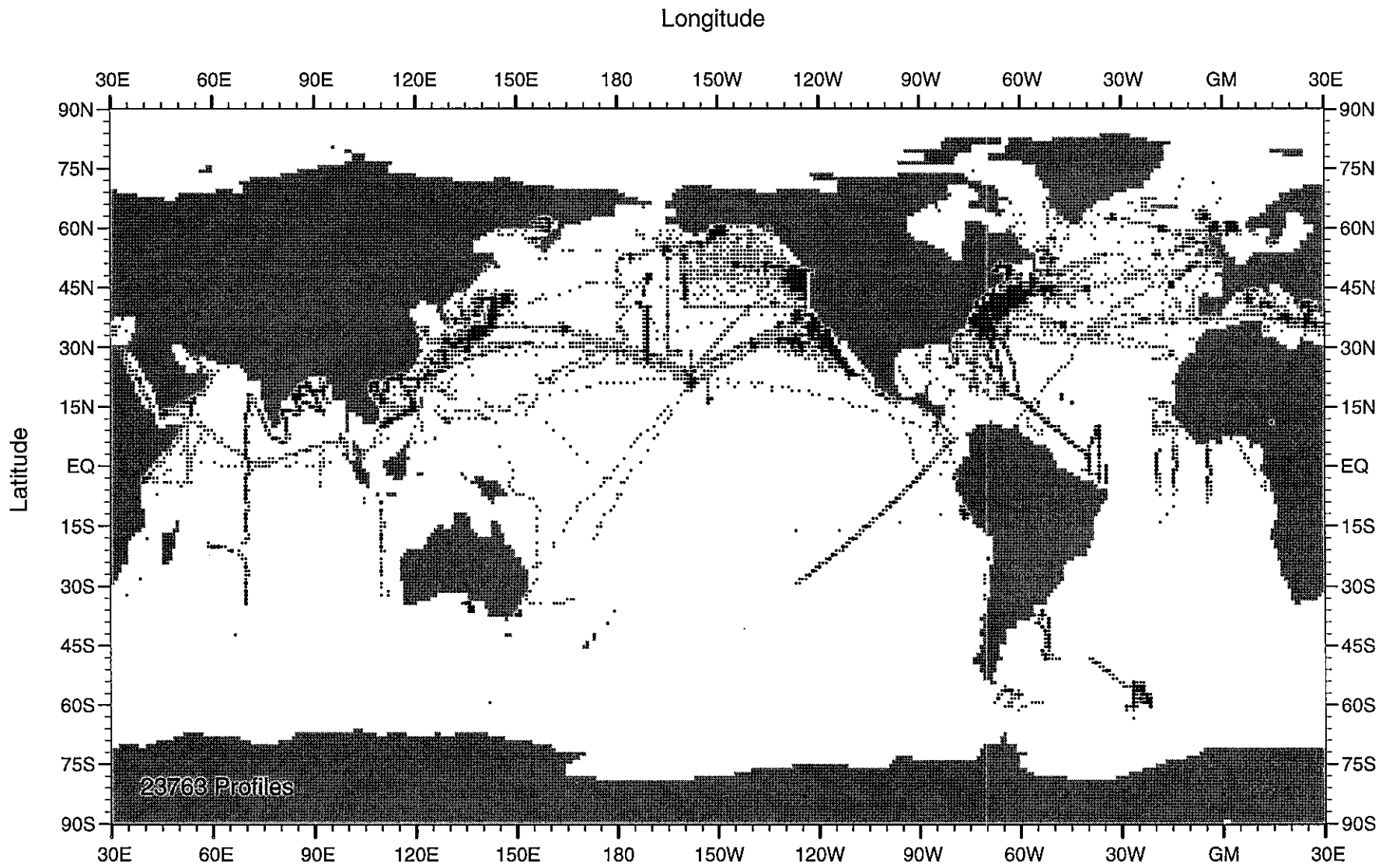

Fig. B90 WOD98 MBT profile distribution for April-June for 1963

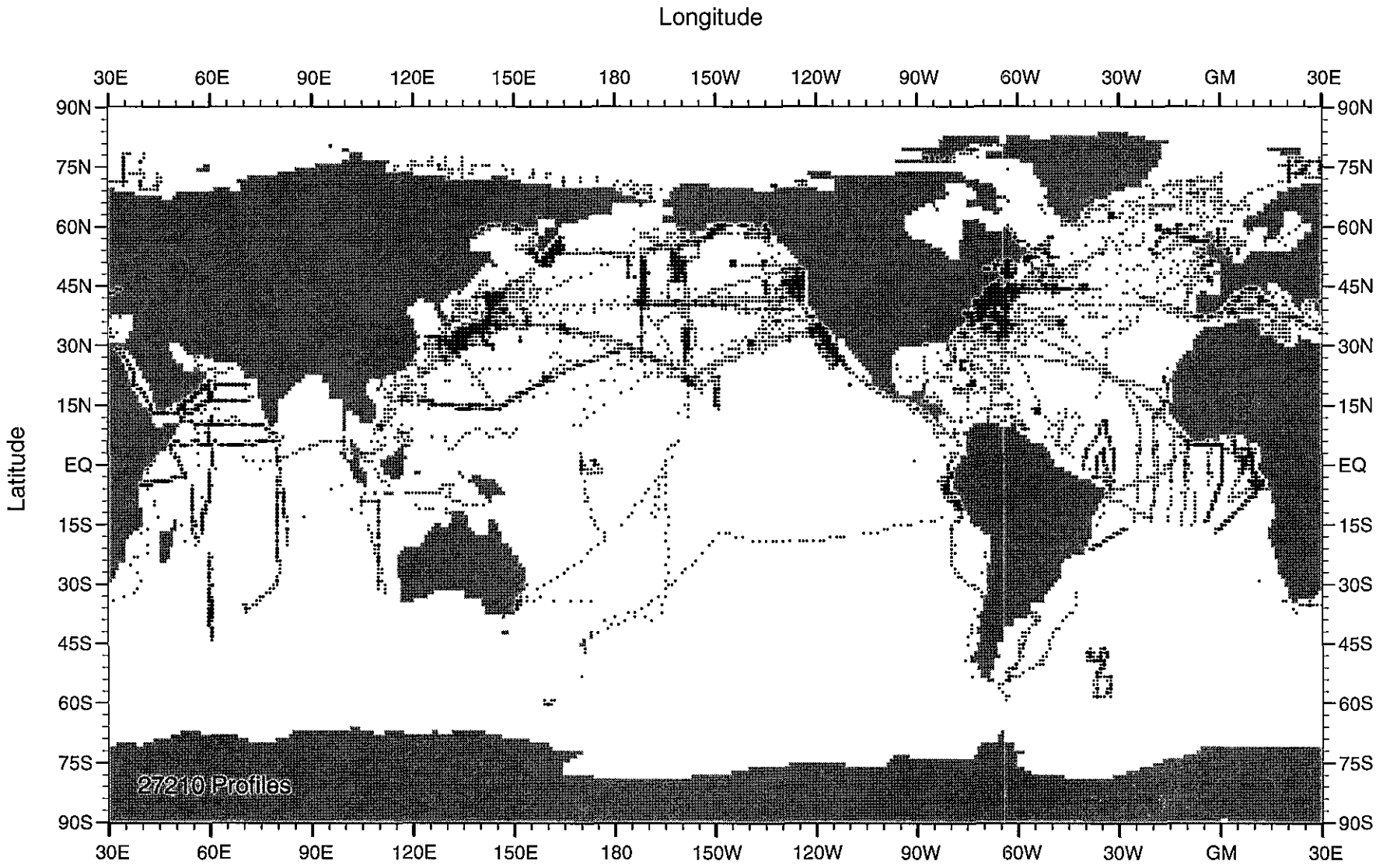

Fig. B91 WOD98 MBT profile distribution for July-September for 1963

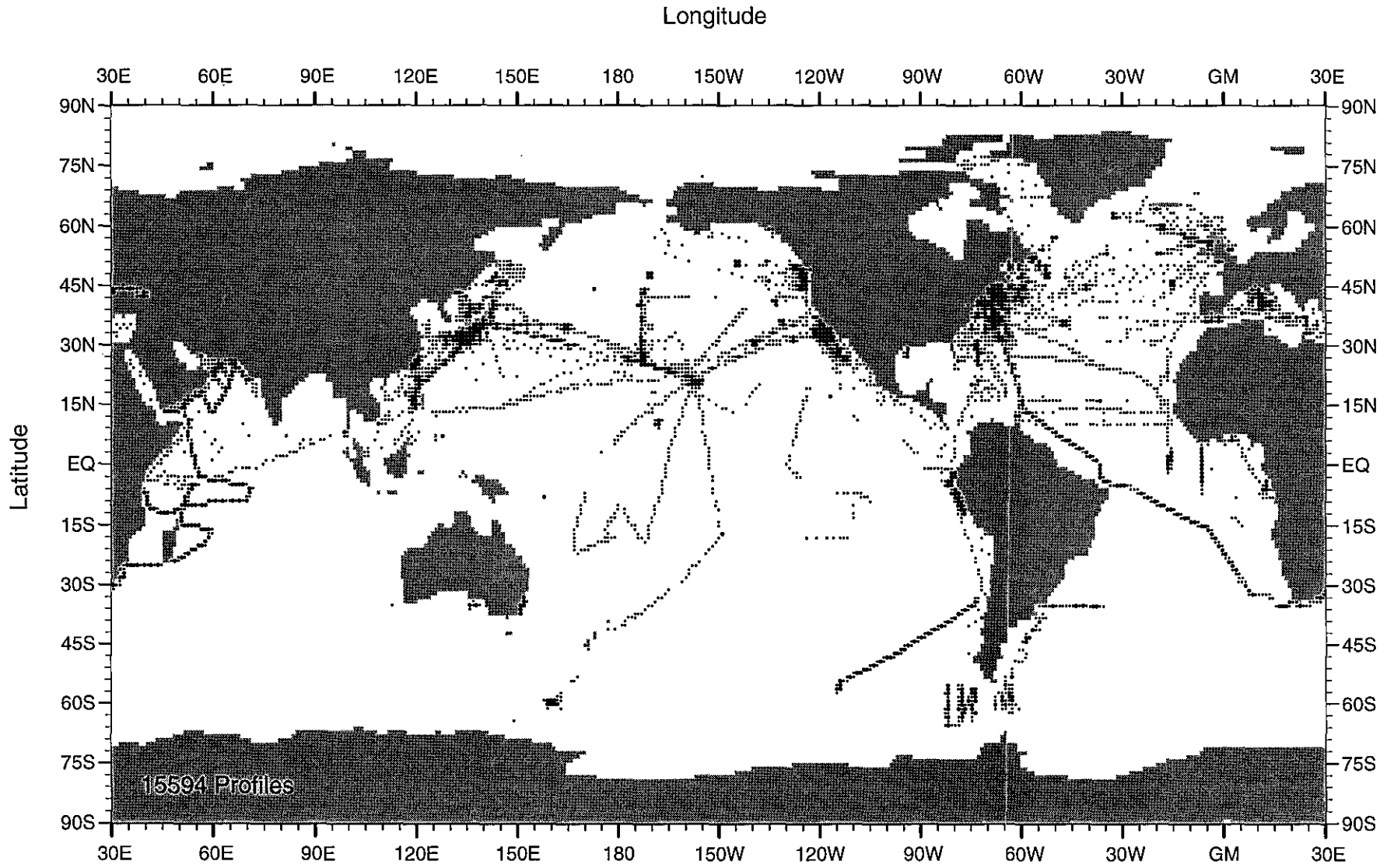

Fig. B92 WOD98 MBT profile distribution for October-December for 1963

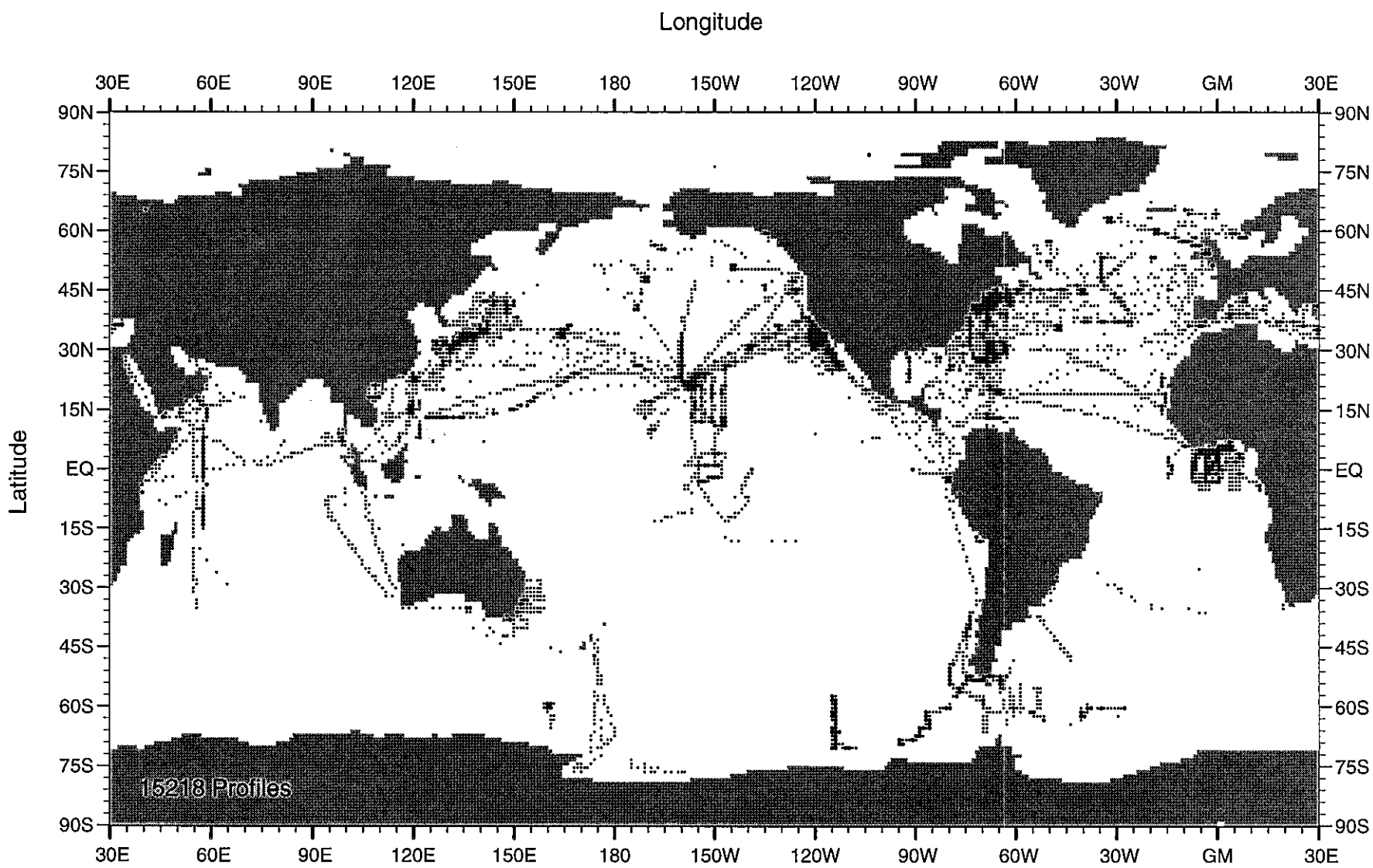

Fig. B93 WOD98 MBT profile distribution for January-March for 1964

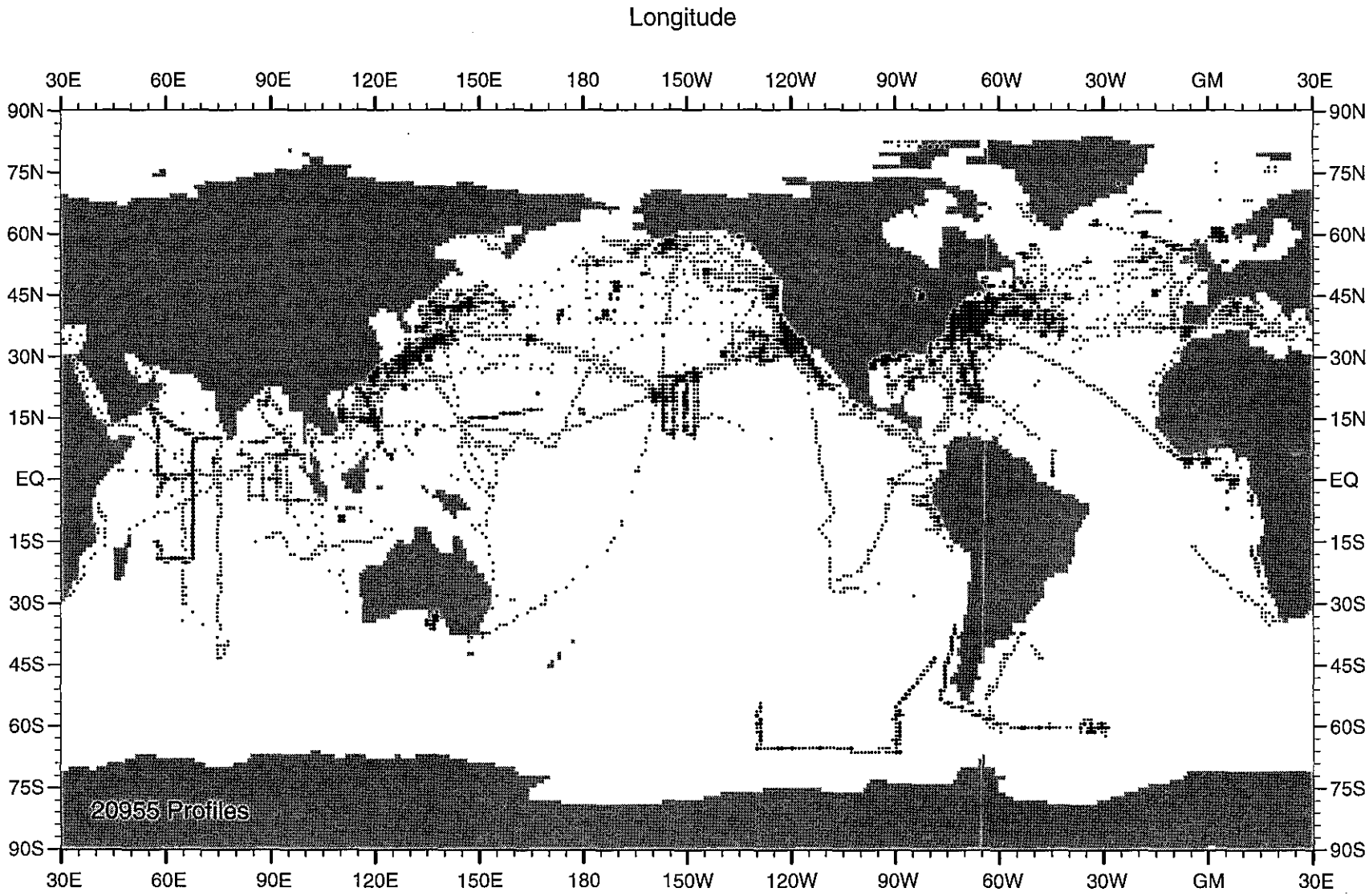

Fig. B94 WOD98 MBT profile distribution for April-June for 1964

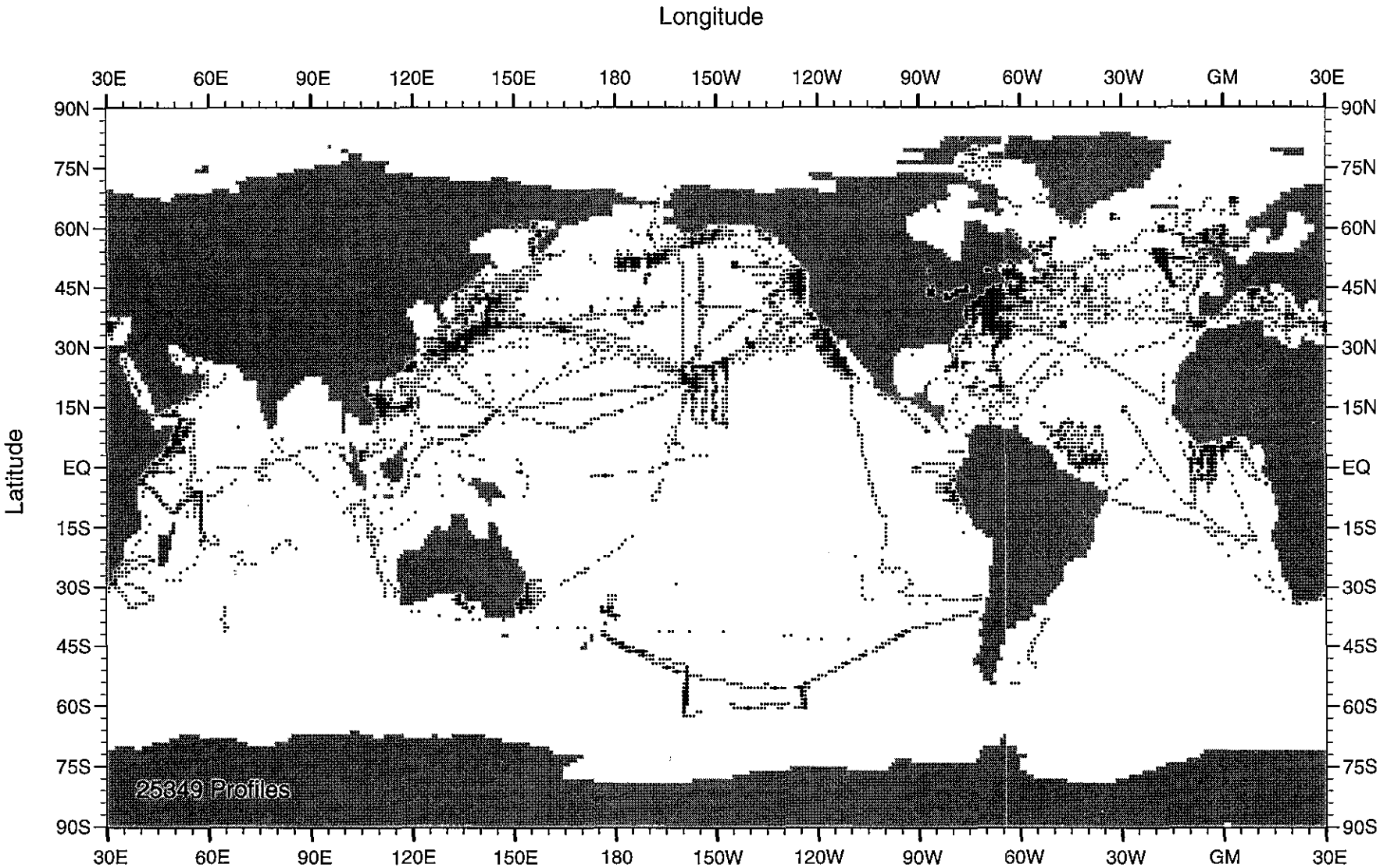

Fig. B95 WOD98 MBT profile distribution for July-September for 1964

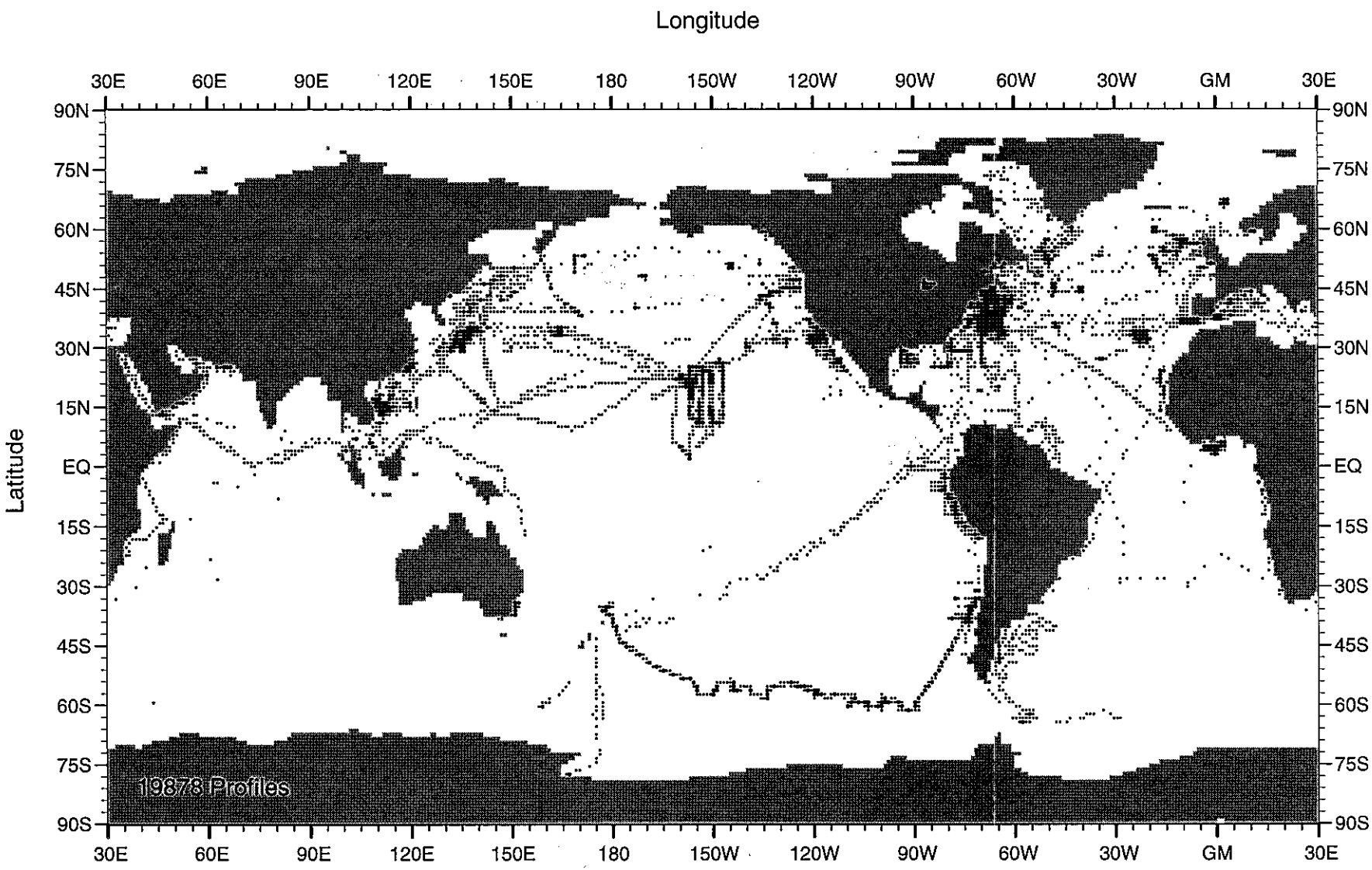

Fig. B96 WOD98 MBT profile distribution for October-December for 1964

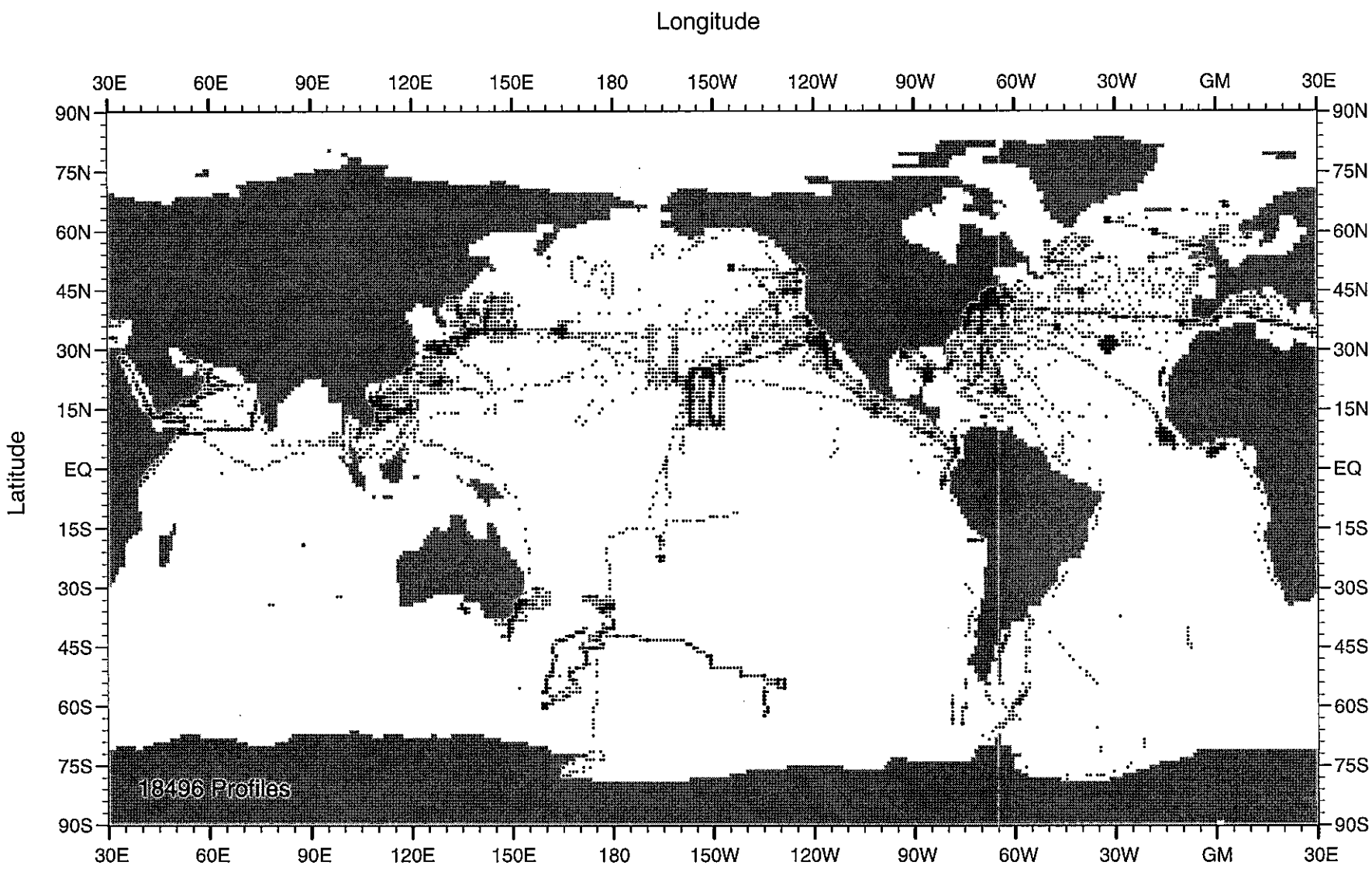

Fig. B97 WOD98 MBT profile distribution for January-March for 1965

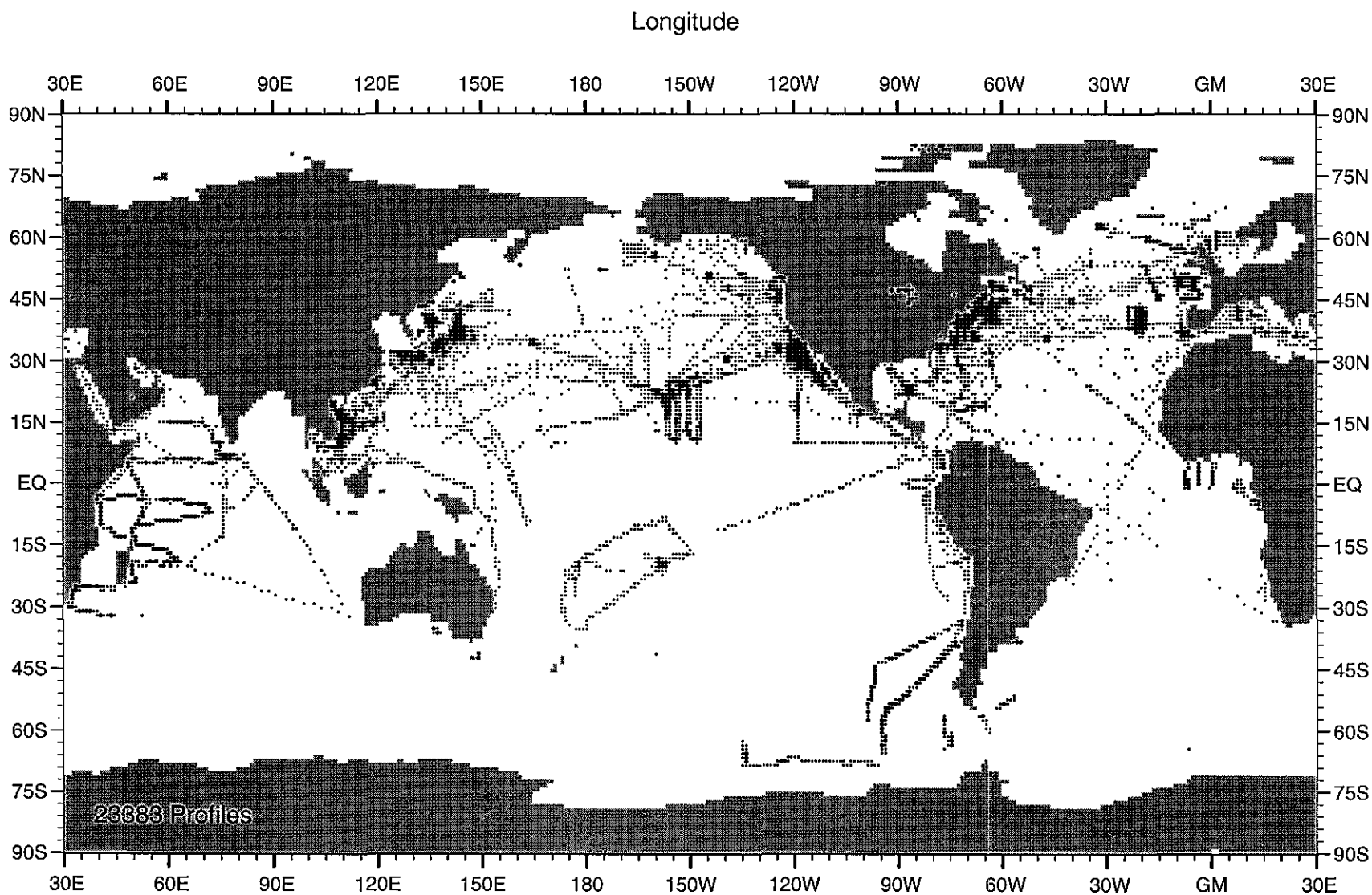

Fig. B98 WOD98 MBT profile distribution for April-June for 1965

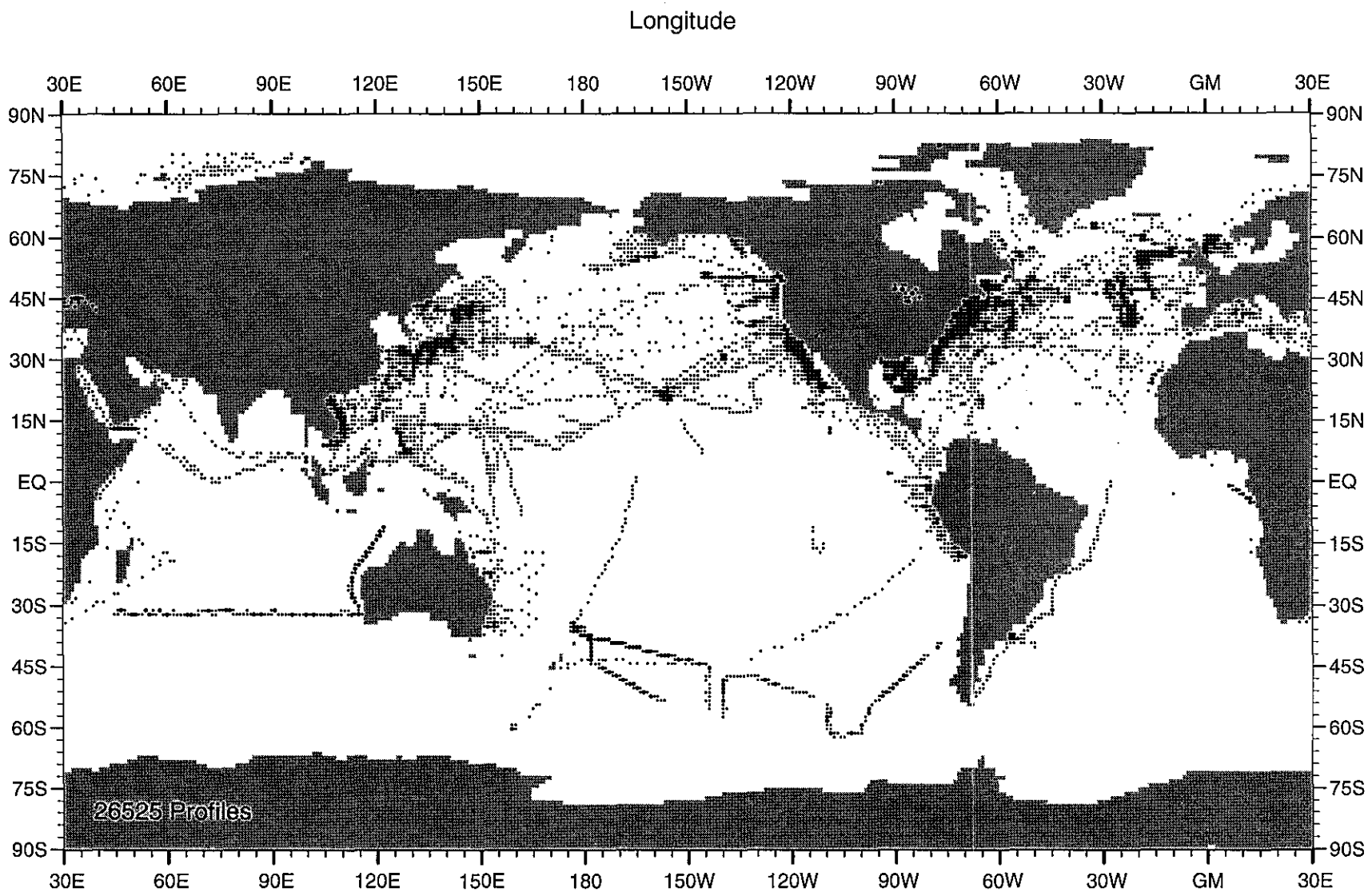

Fig. B99 WOD98 MBT profile distribution for July-September for 1965

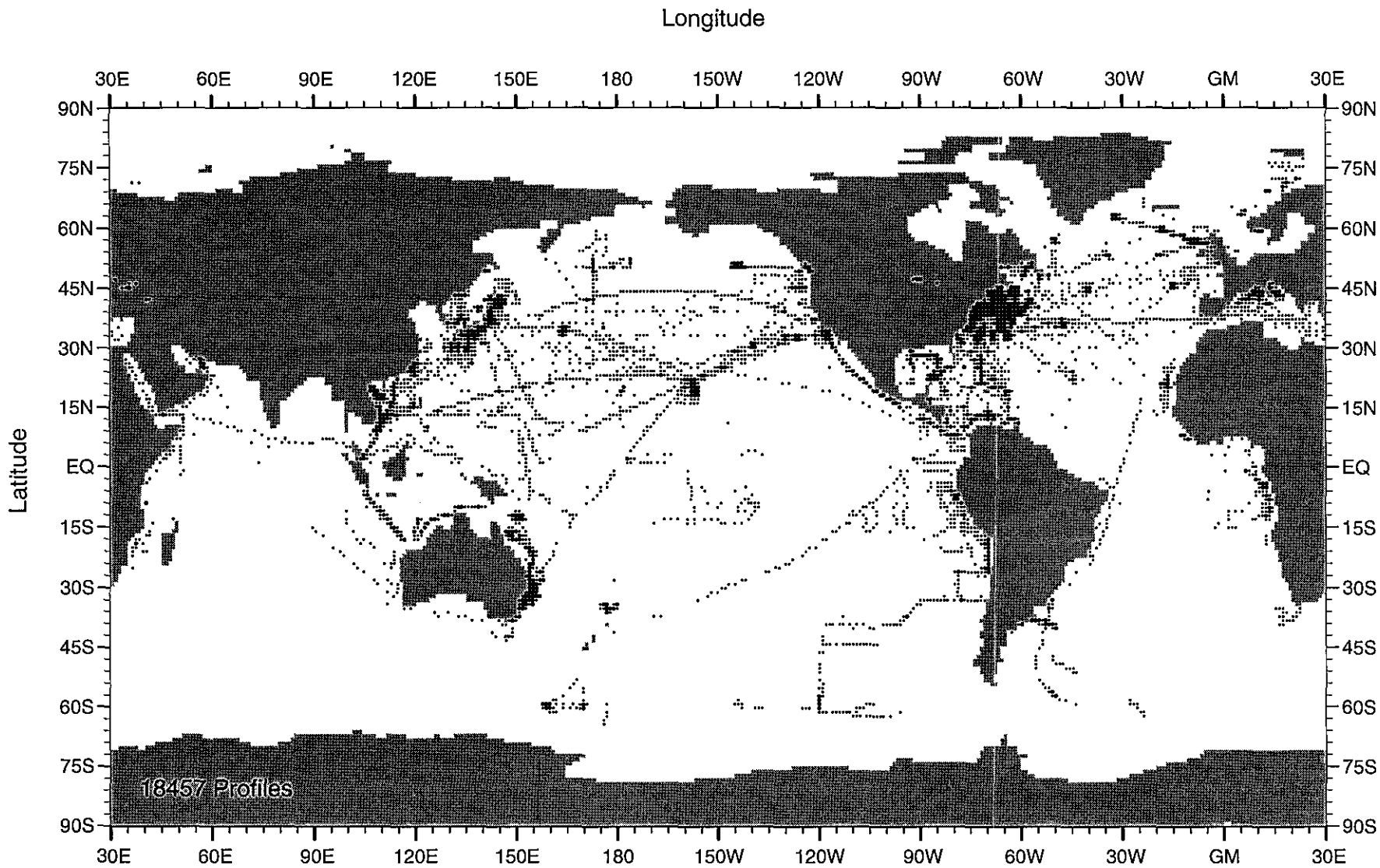

Fig. B100 WOD98 MBT profile distribution for October-December for 1965

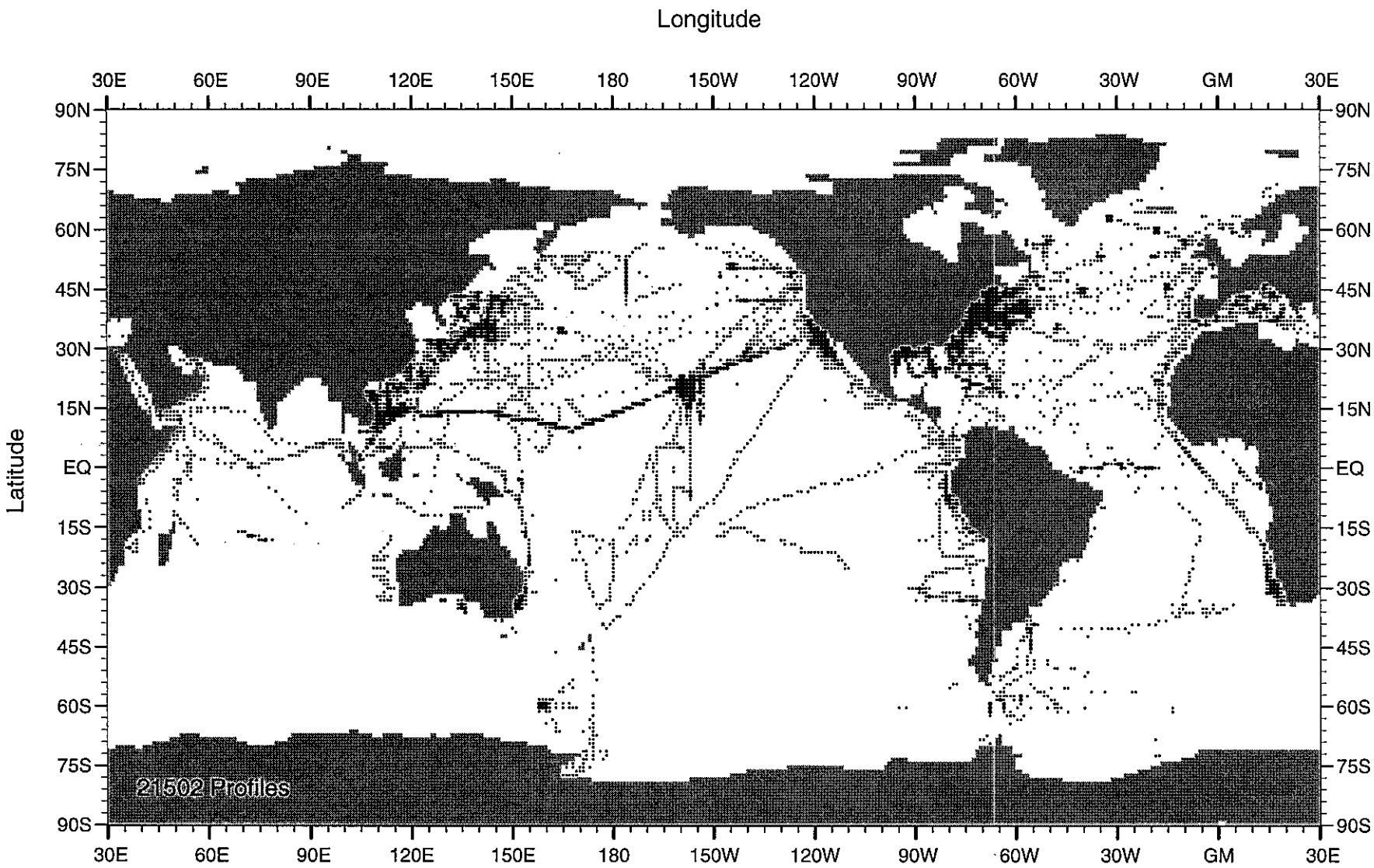

Fig. B101 WOD98 MBT profile distribution for January-March for 1966

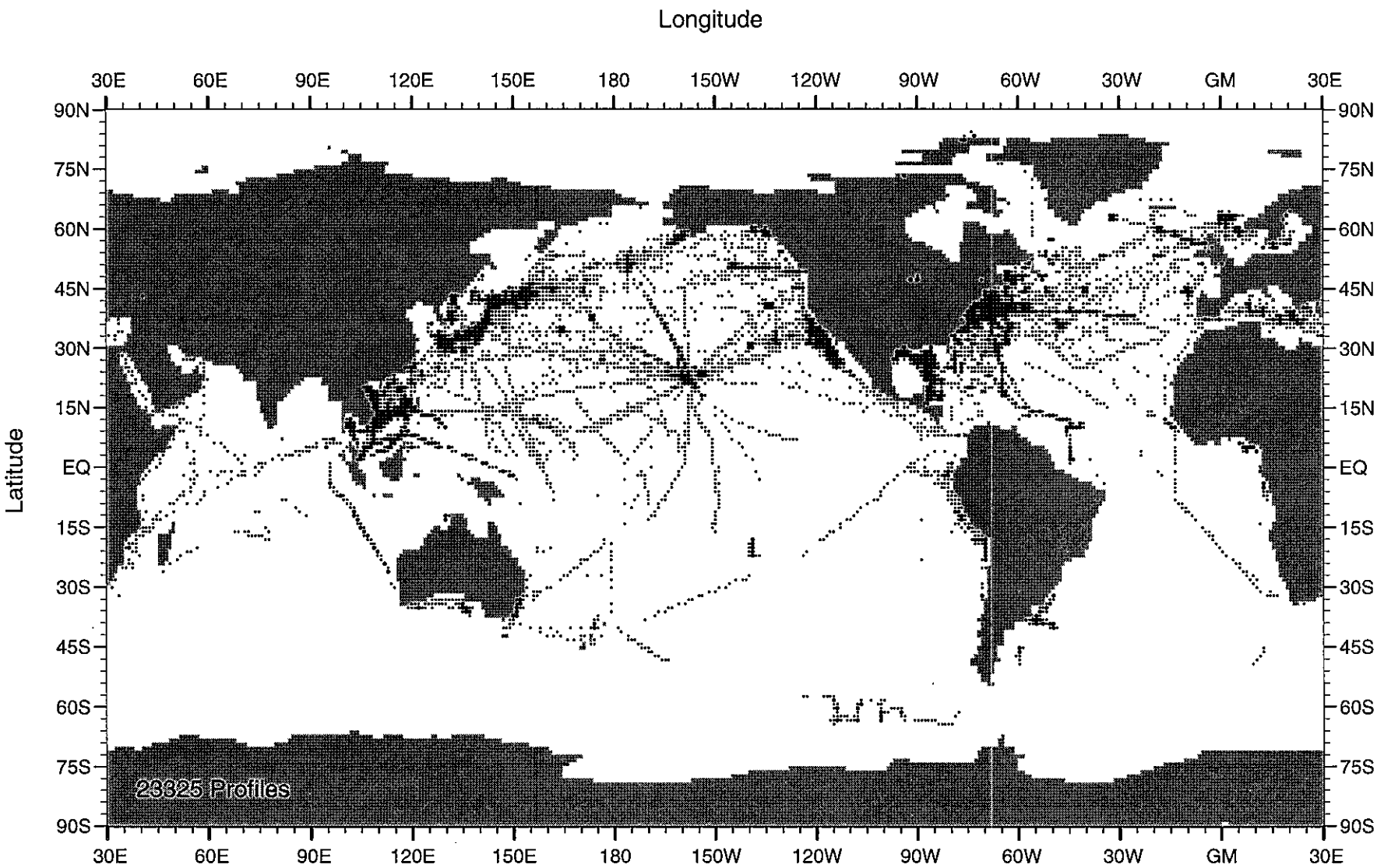

Fig. B102 WOD98 MBT profile distribution for April-June for 1966

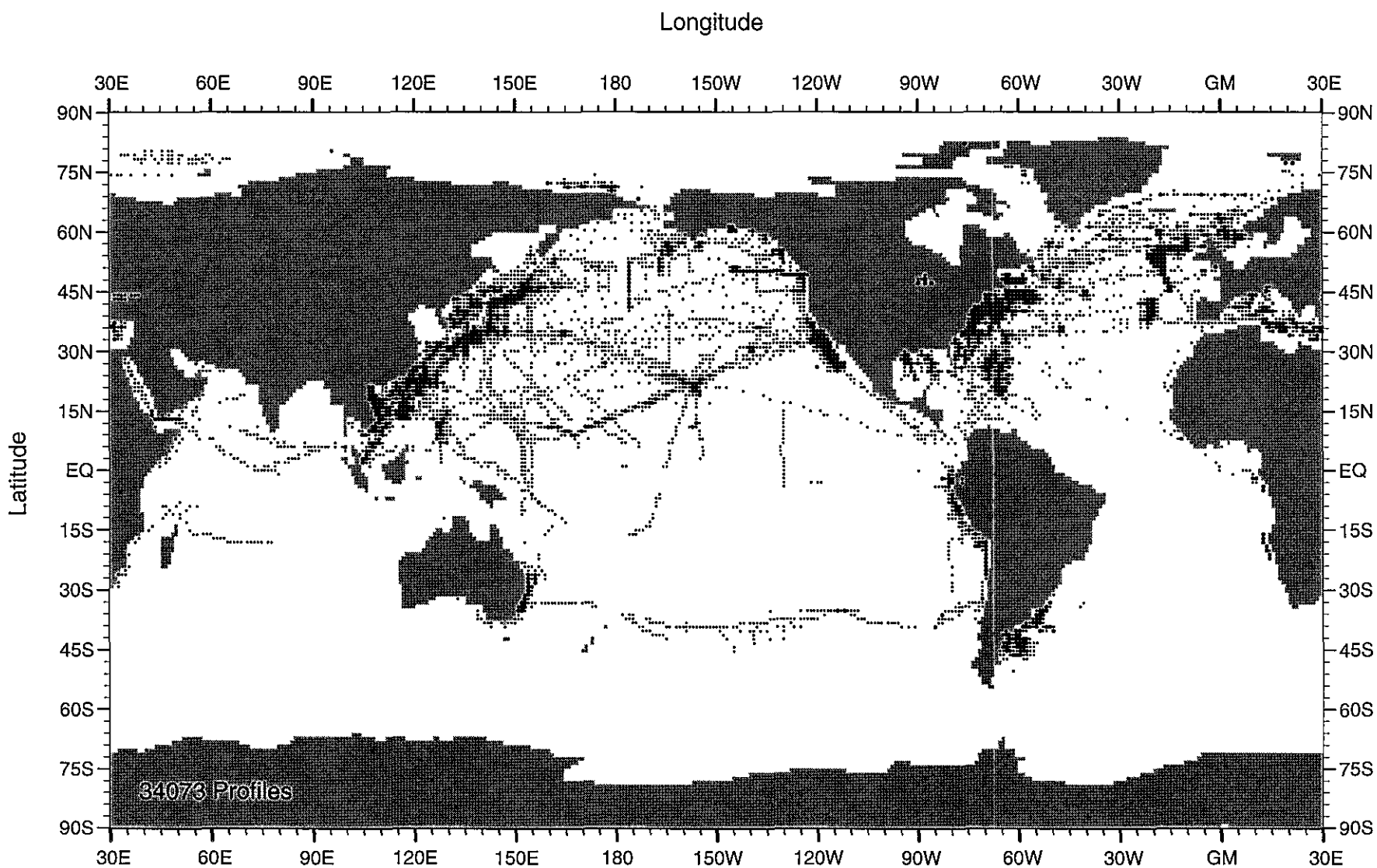

Fig. B103 WOD98 MBT profile distribution for July-September for 1966

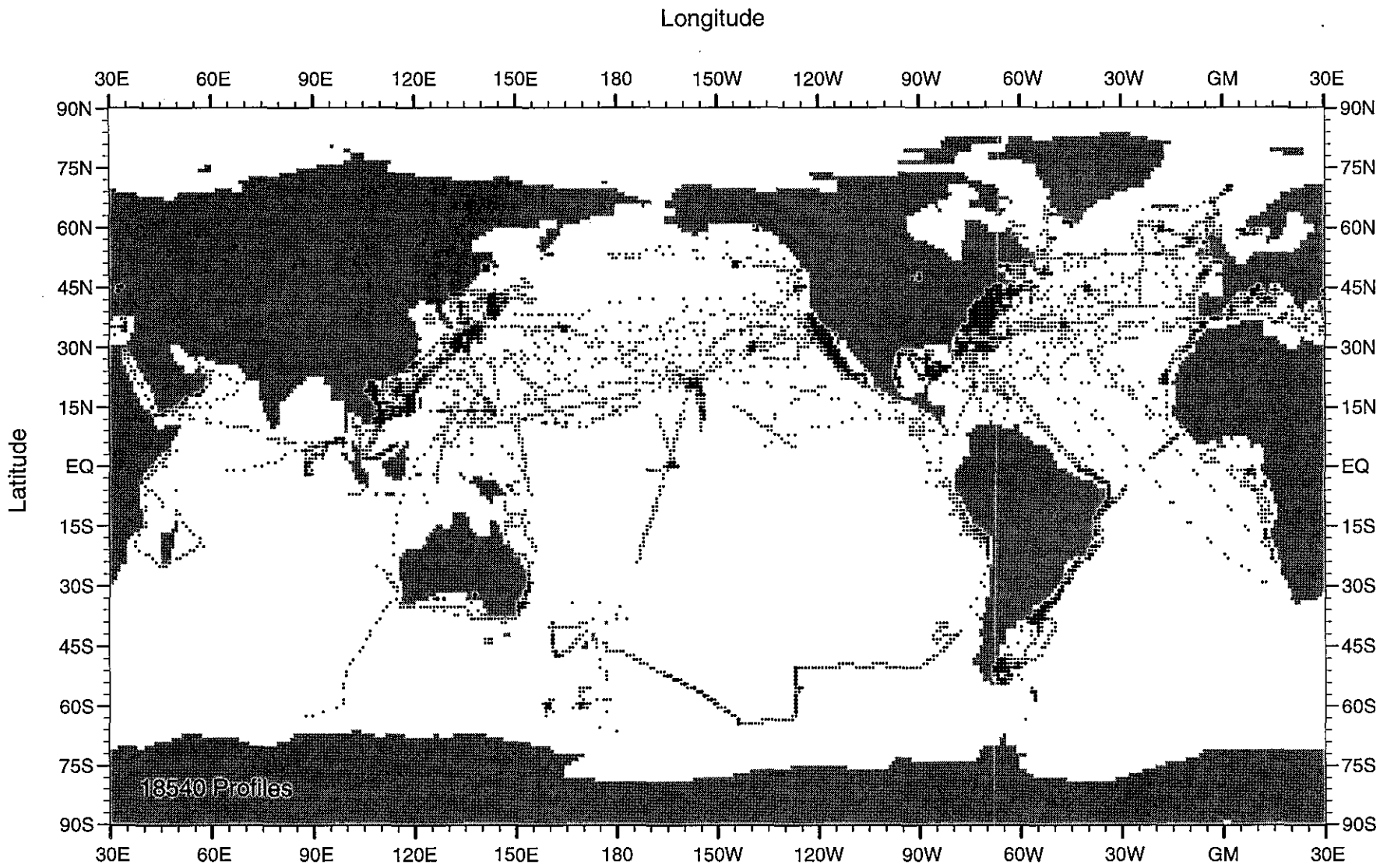

Fig. B104 WOD98 MBT profile distribution for October-December for 1966

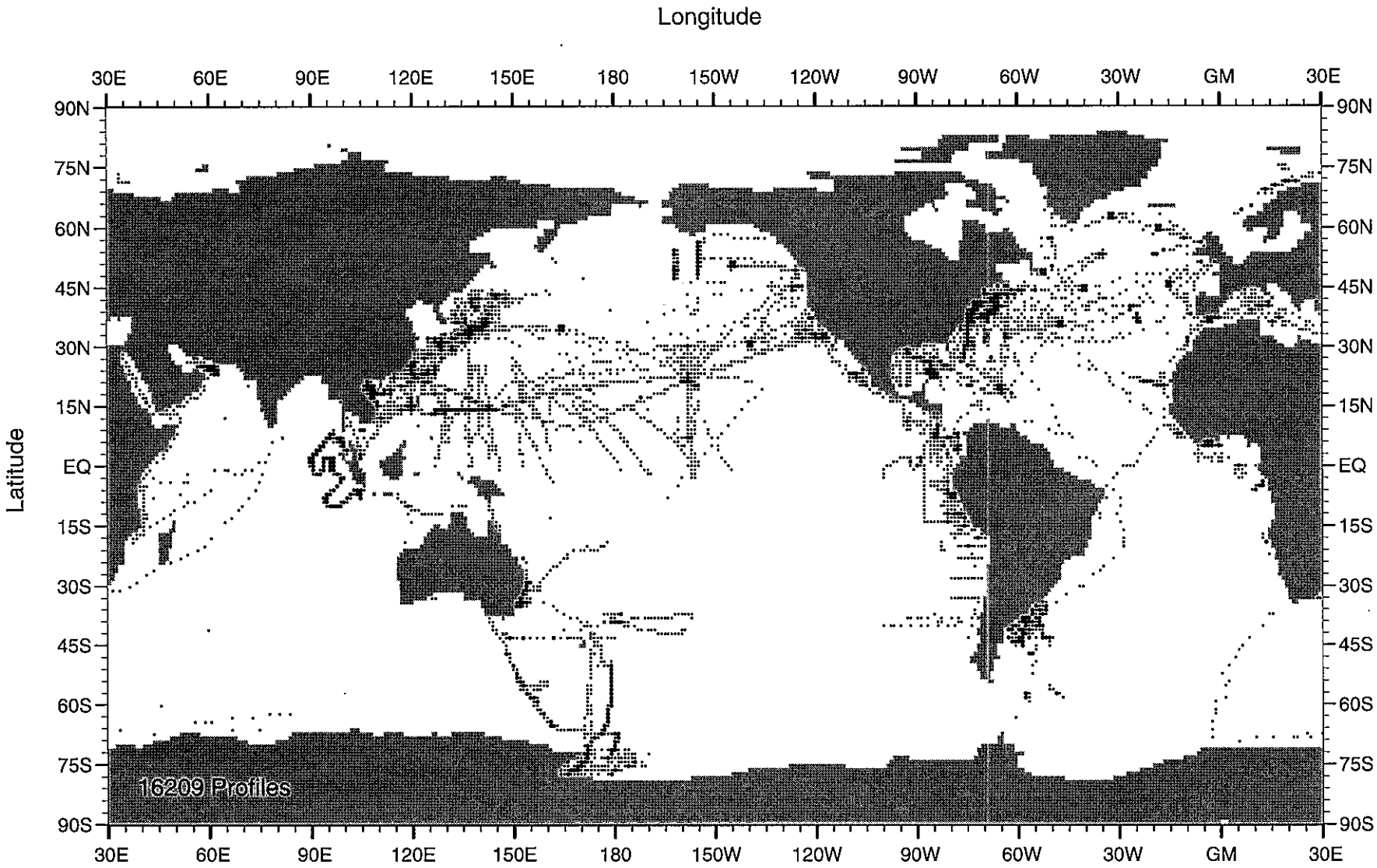

Fig. B105 WOD98 MBT profile distribution for January-March for 1967

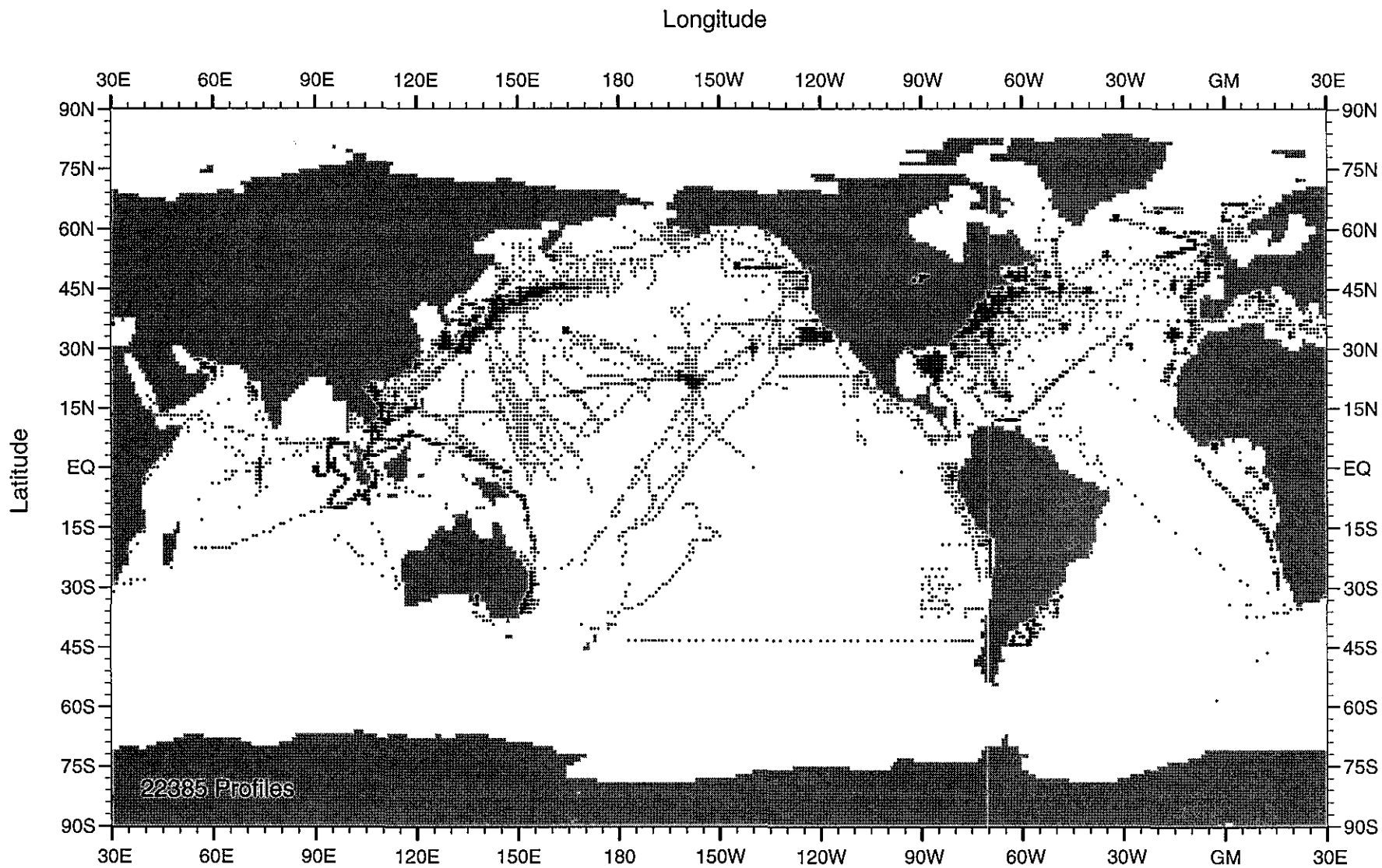

Fig. B106 WOD98 MBT profile distribution for April-June for 1967

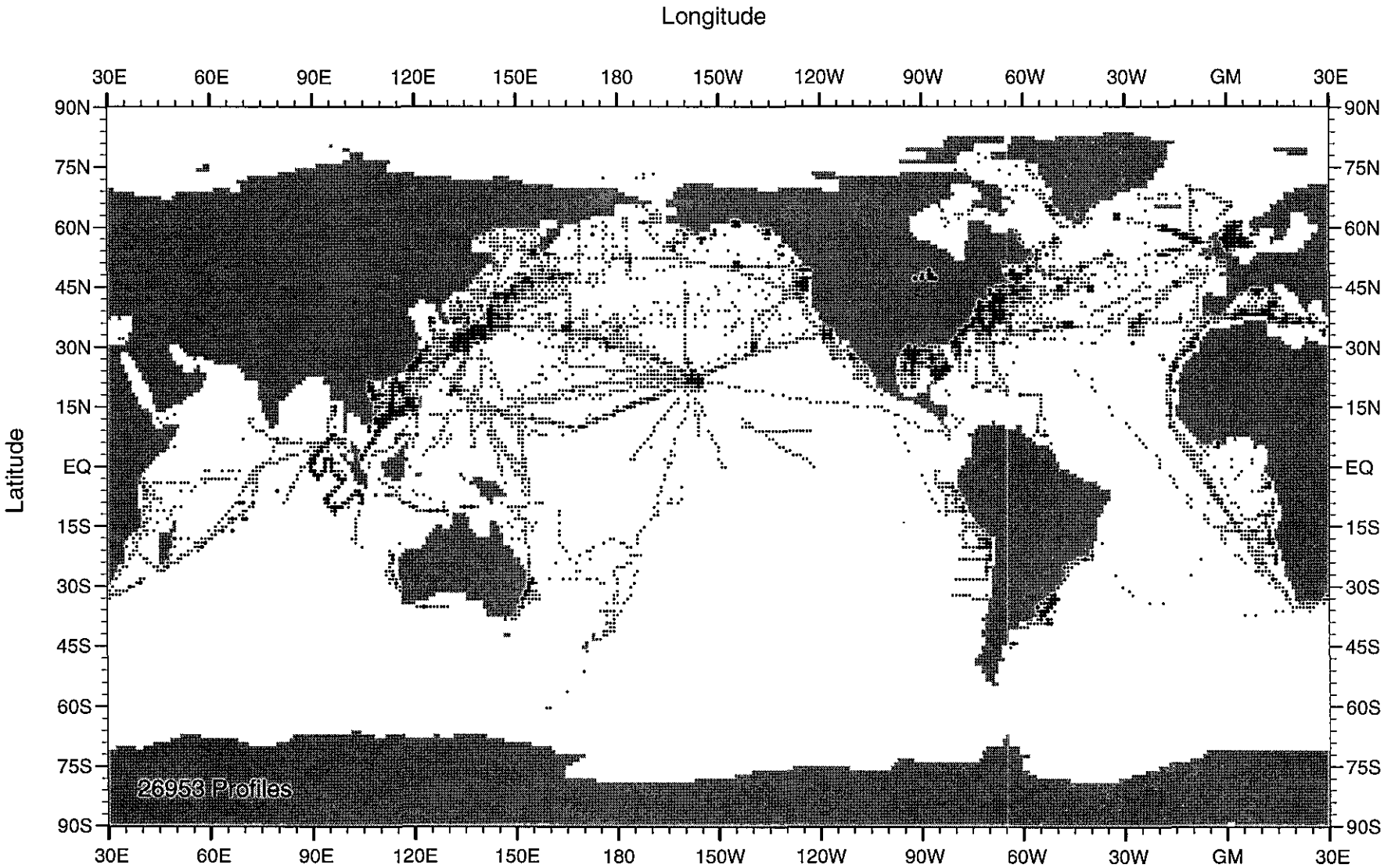

Fig. B107 WOD98 MBT profile distribution for July-September for 1967

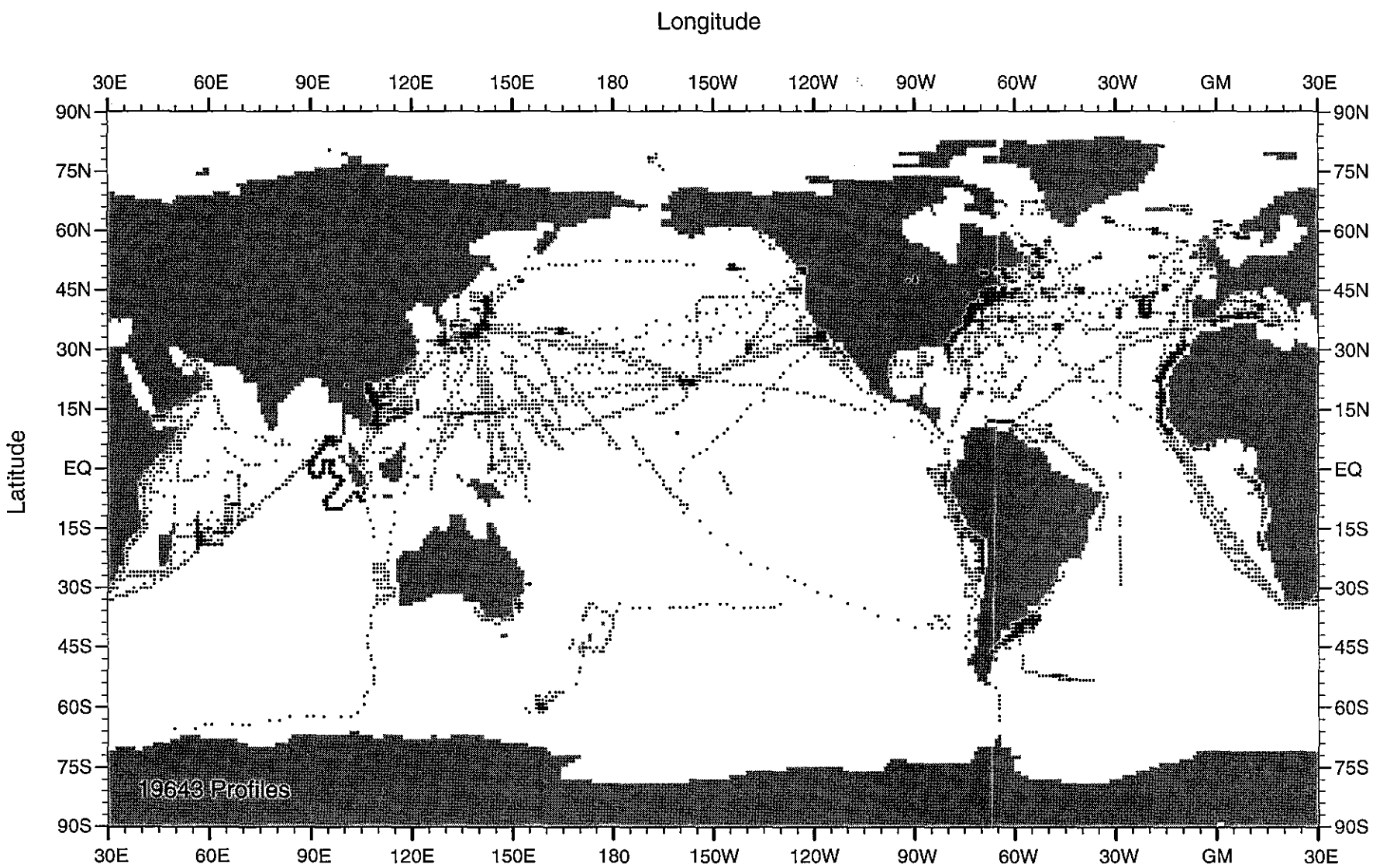

Fig. B108 WOD98 MBT profile distribution for October-December for 1967

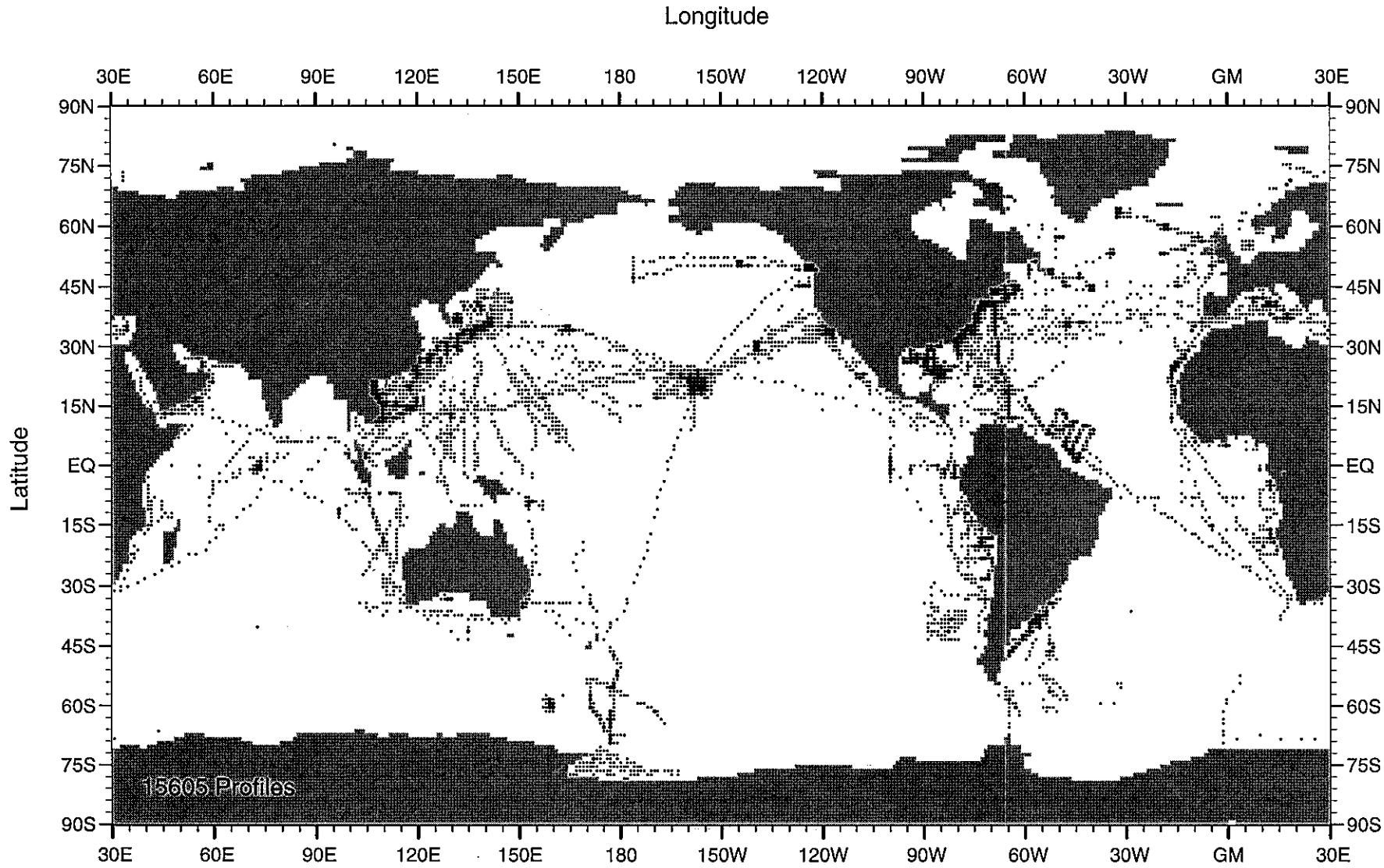

Fig. B109 WOD98 MBT profile distribution for January-March for 1968

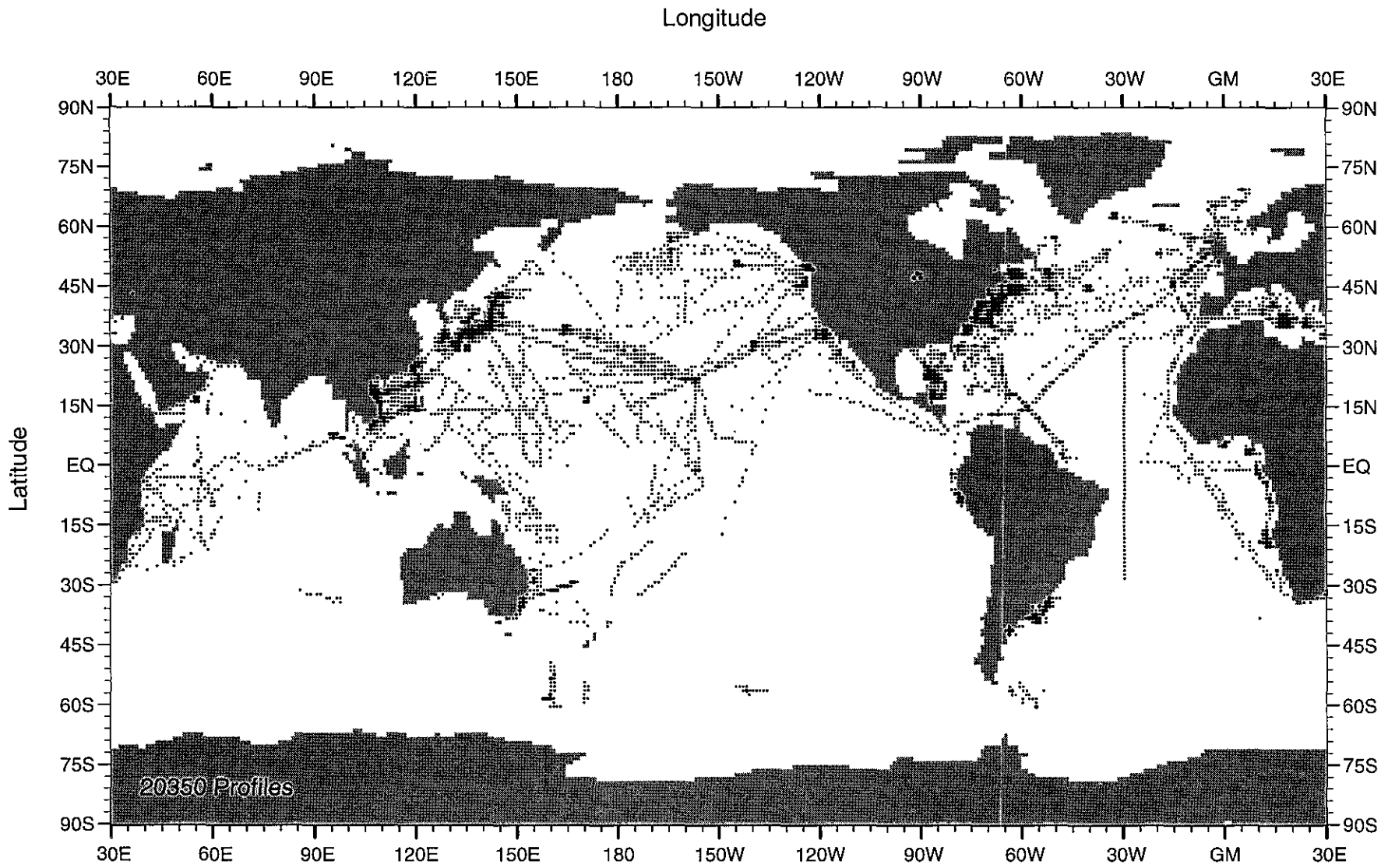

Fig. B110 WOD98 MBT profile distribution for April-June for 1968

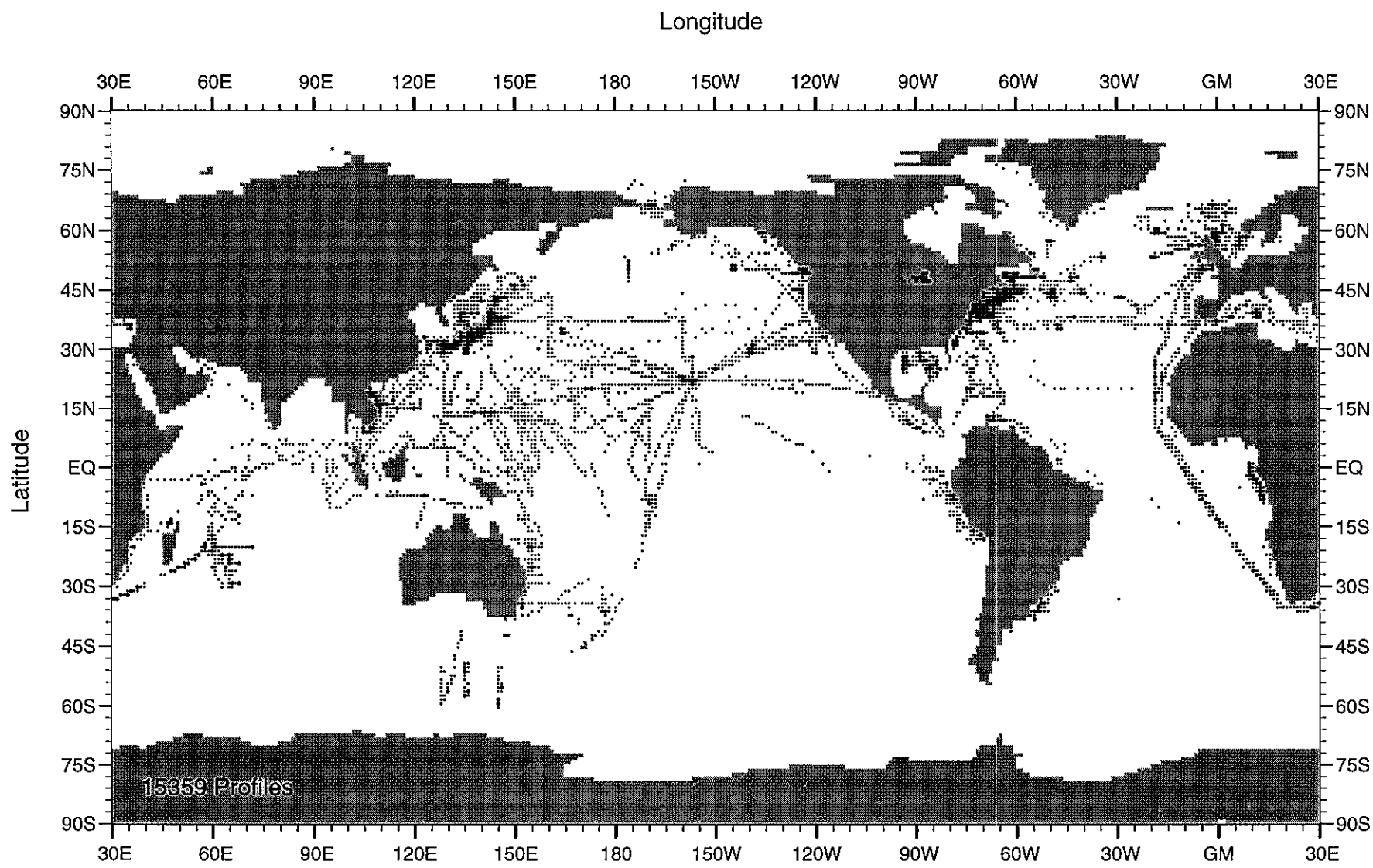

Fig. B111 WOD98 MBT profile distribution for July-September for 1968

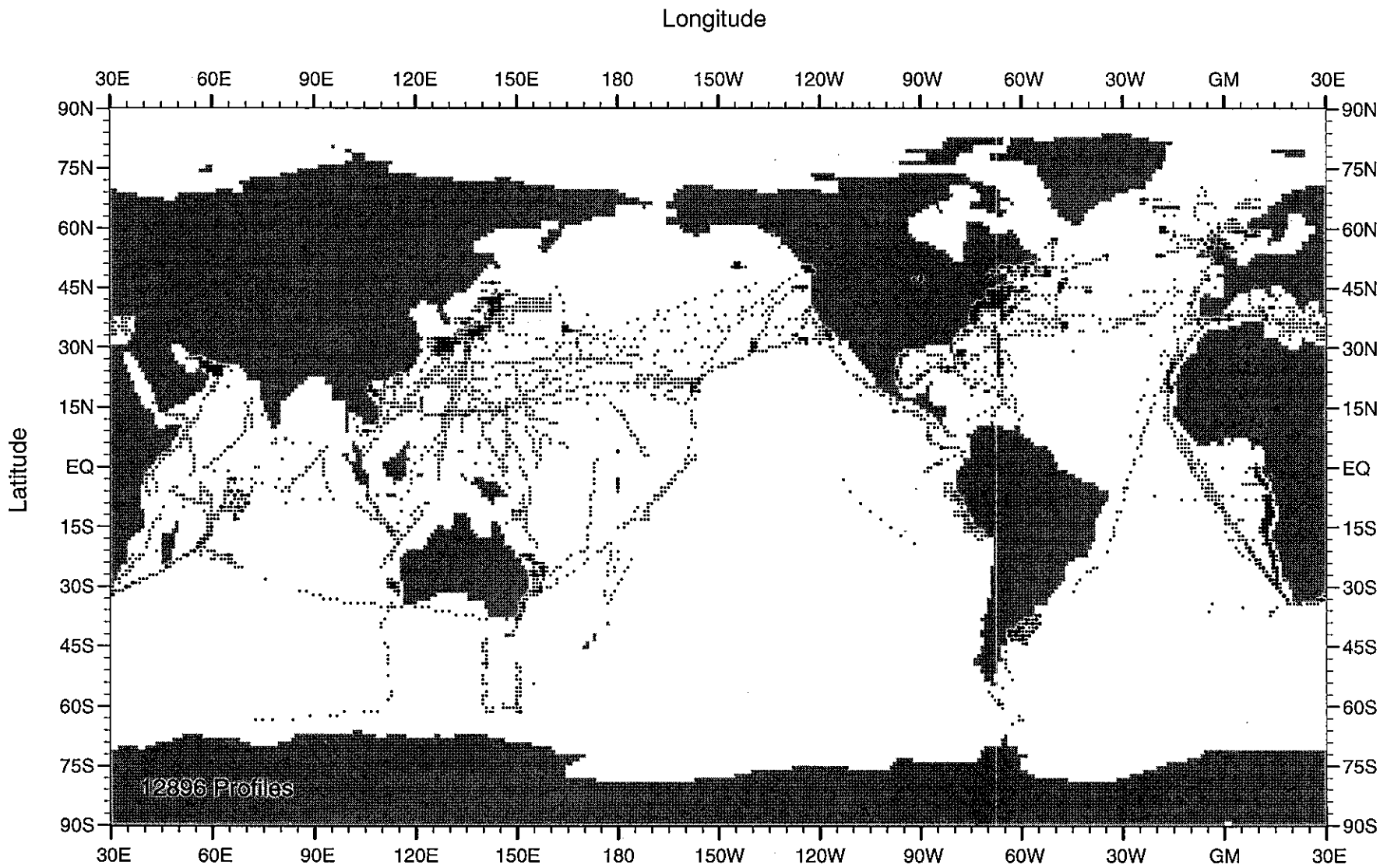

Fig. B112 WOD98 MBT profile distribution for October-December for 1968

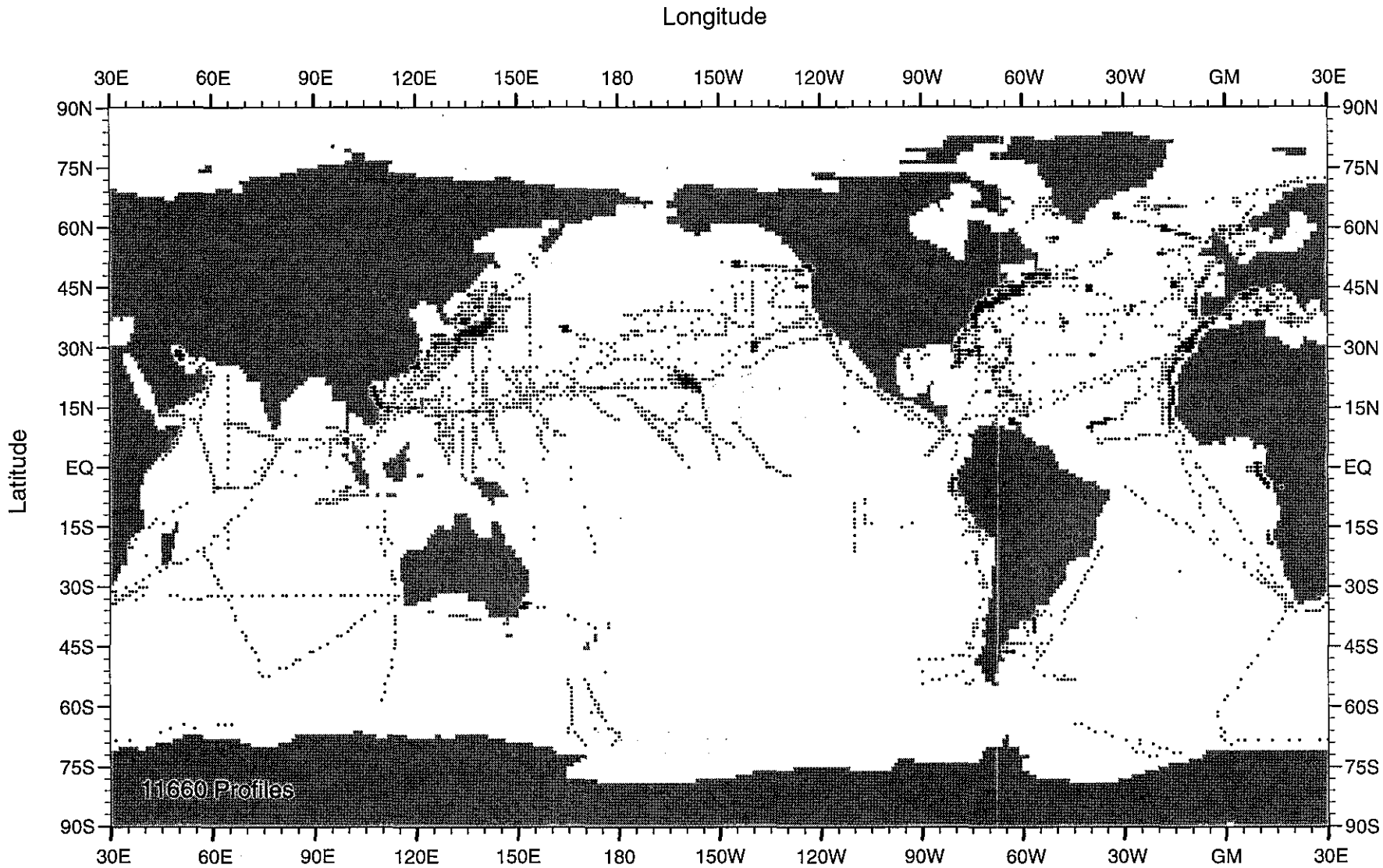

Fig. B113 WOD98 MBT profile distribution for January-March for 1969

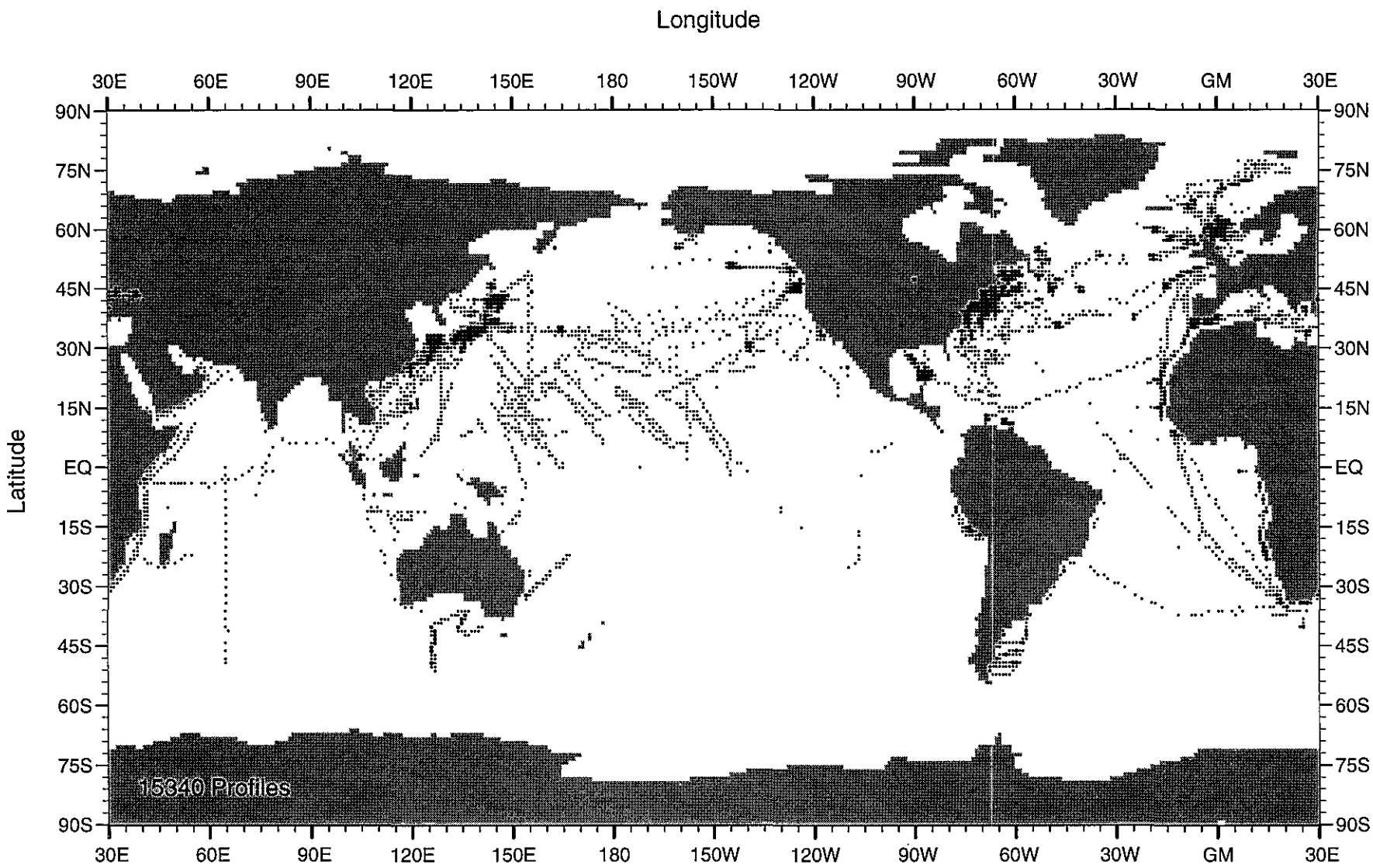

Fig. B114 WOD98 MBT profile distribution for April-June for 1969

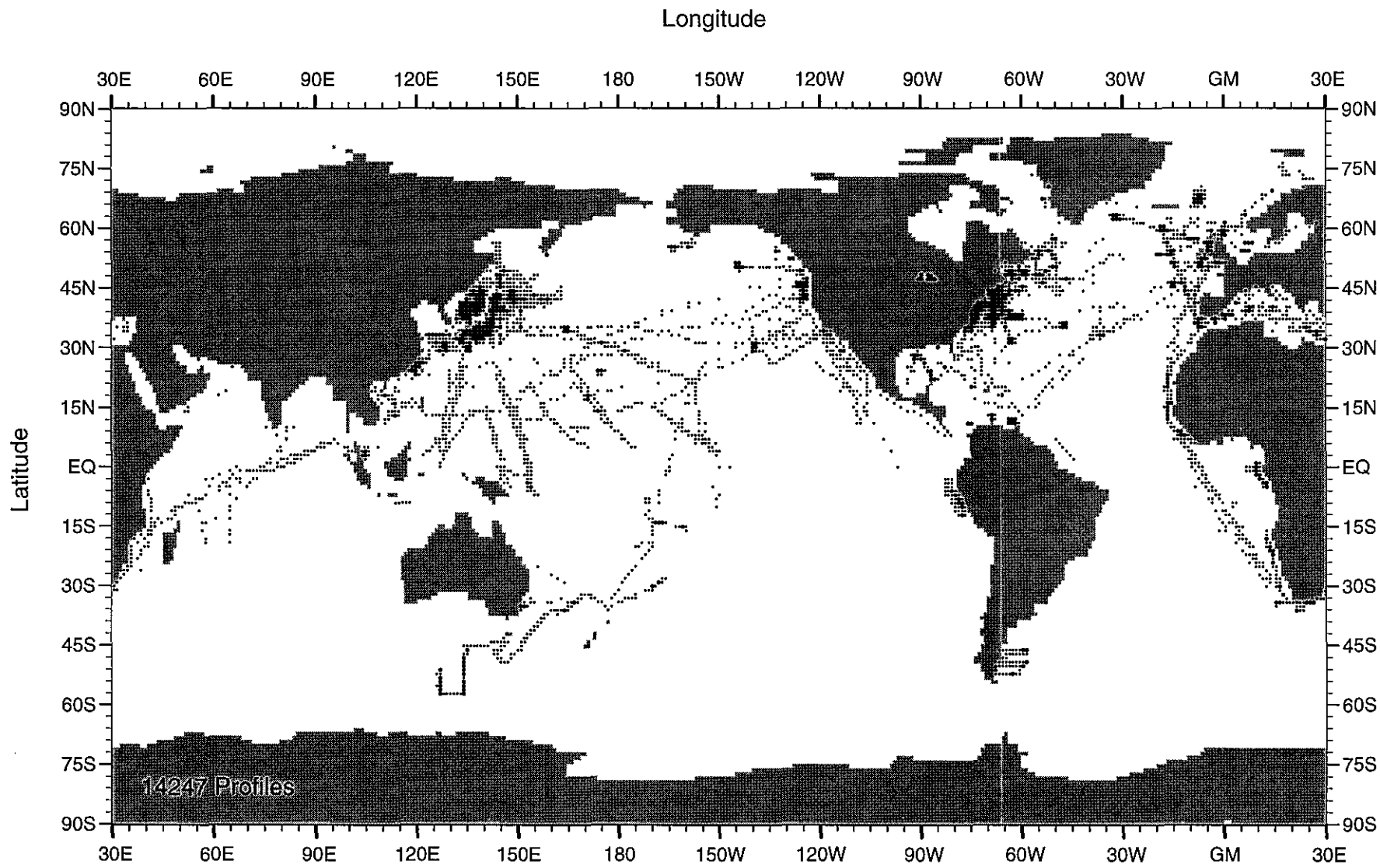

Fig. B115 WOD98 MBT profile distribution for July-September for 1969

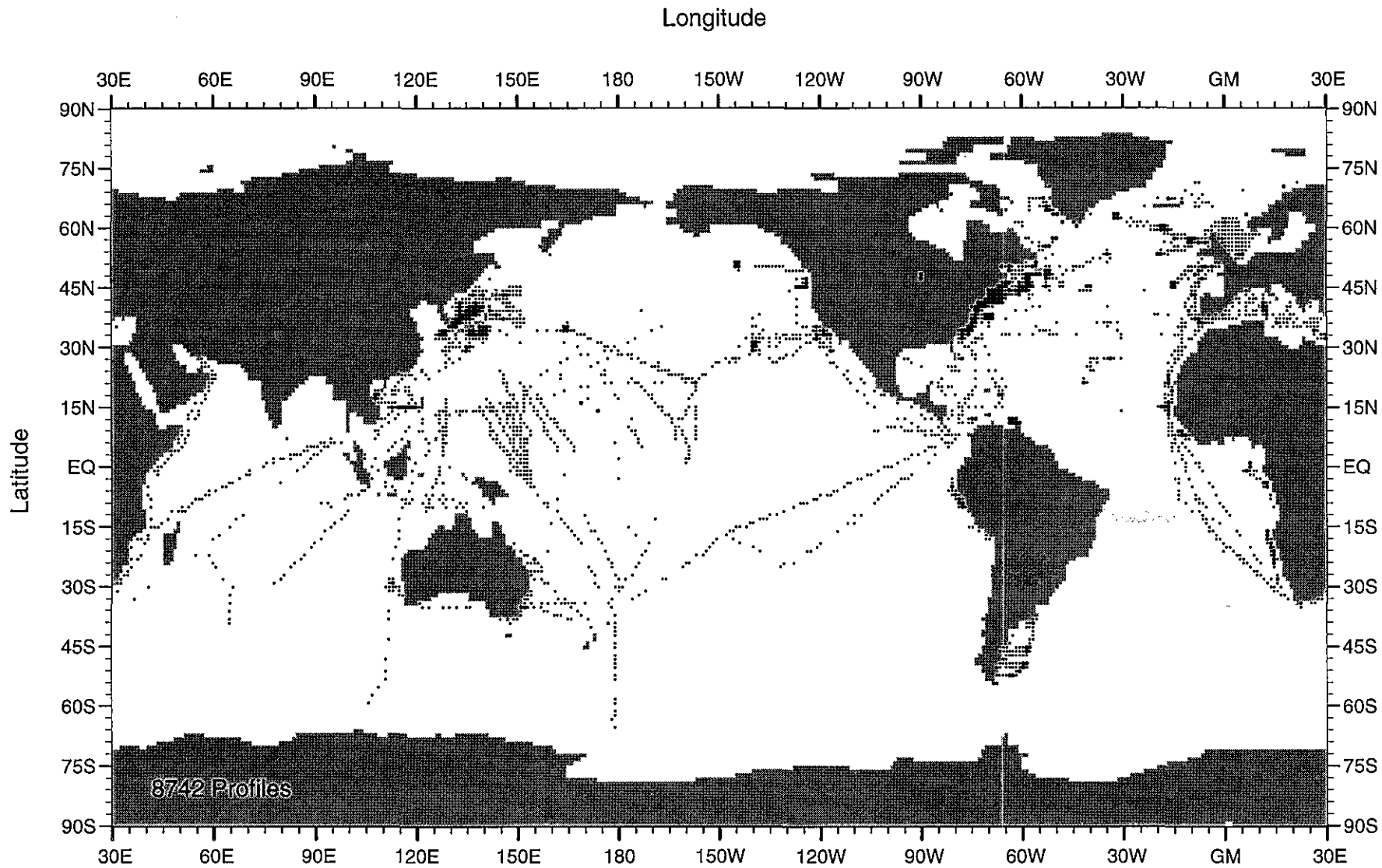

Fig. B116 WOD98 MBT profile distribution for October-December for 1969

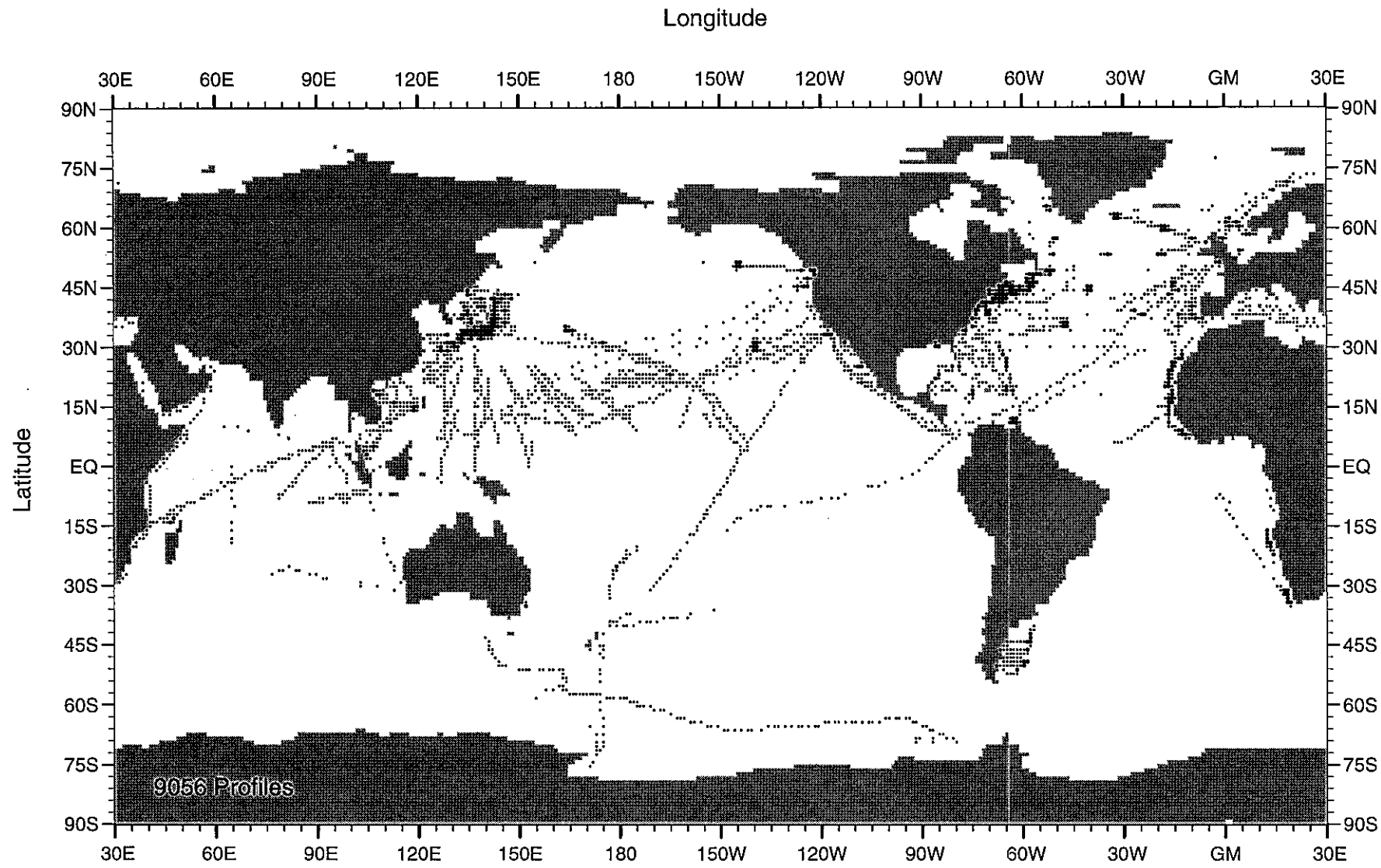

Fig. B117 WOD98 MBT profile distribution for January-March for 1970

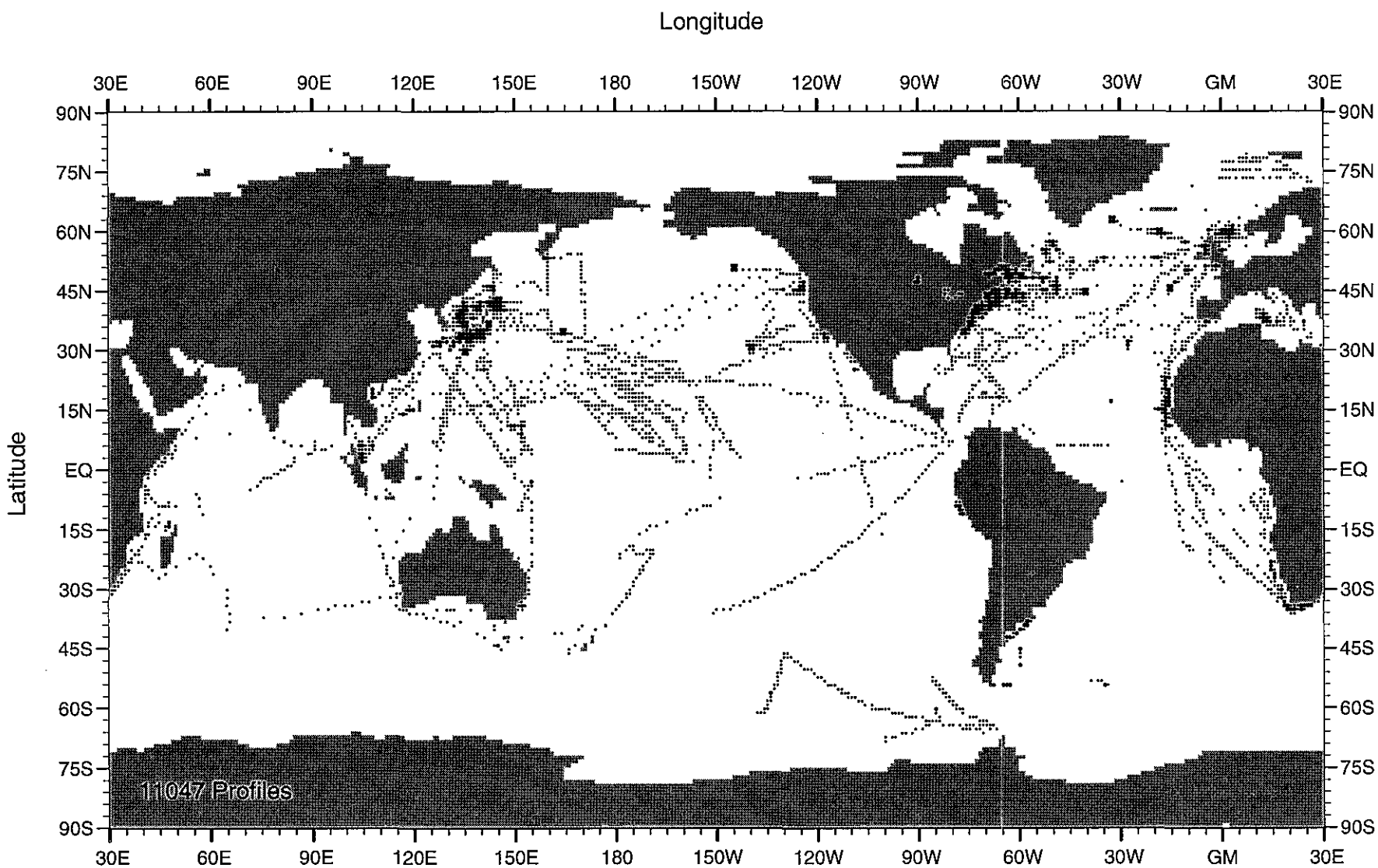

Fig. B118 WOD98 MBT profile distribution for April-June for 1970

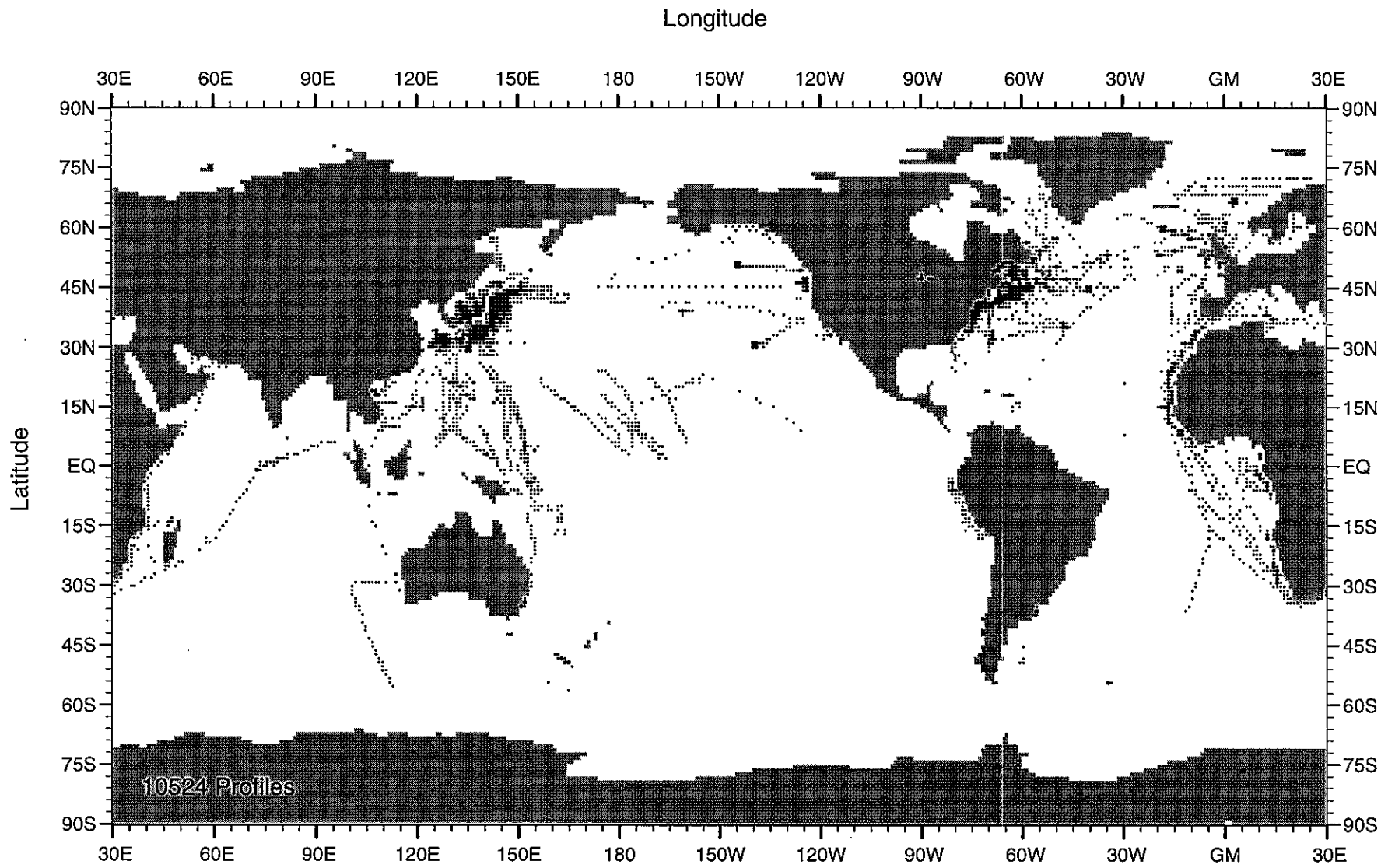

Fig. B119 WOD98 MBT profile distribution for July-September for 1970

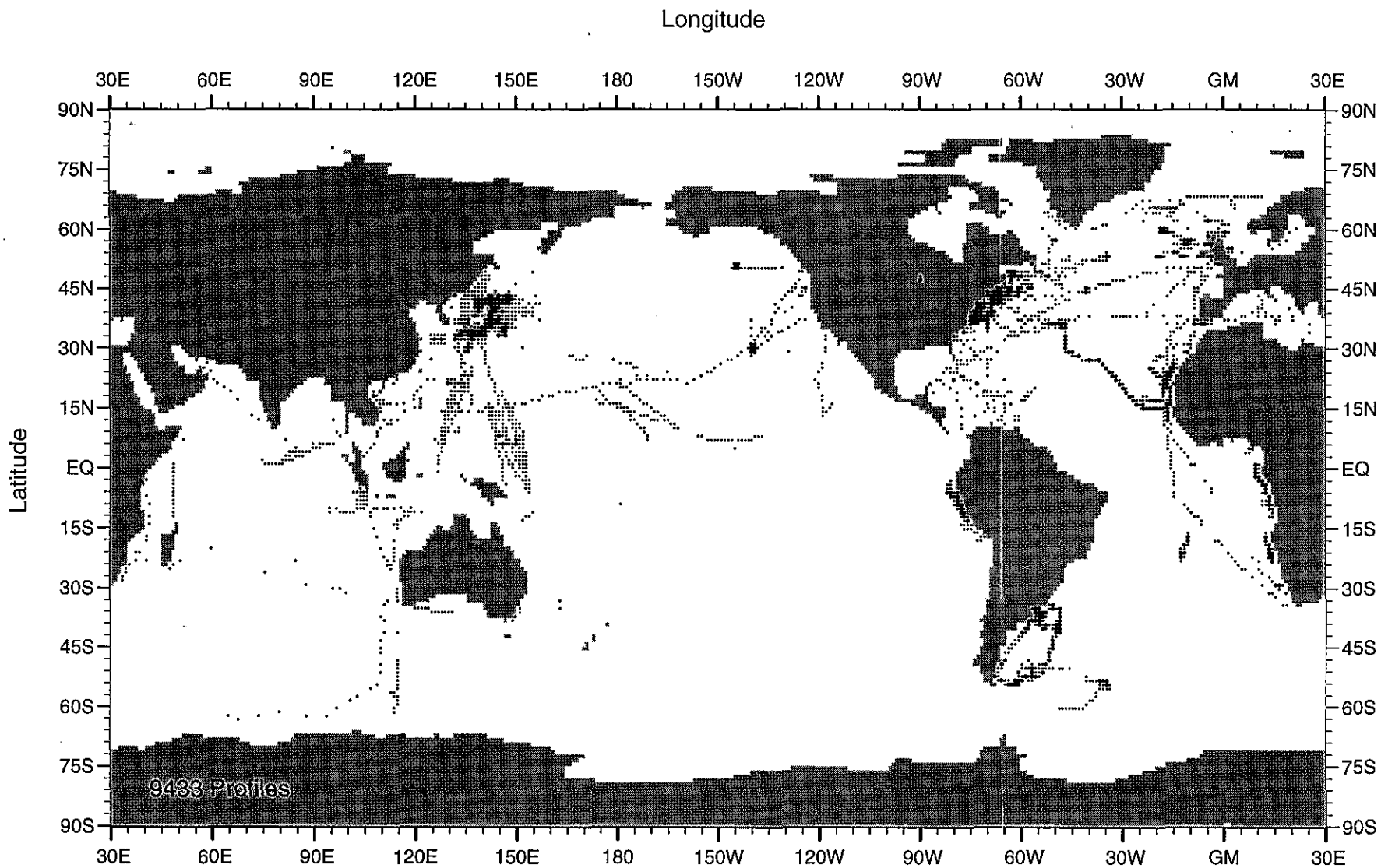

Fig. B120 WOD98 MBT profile distribution for October-December for 1970

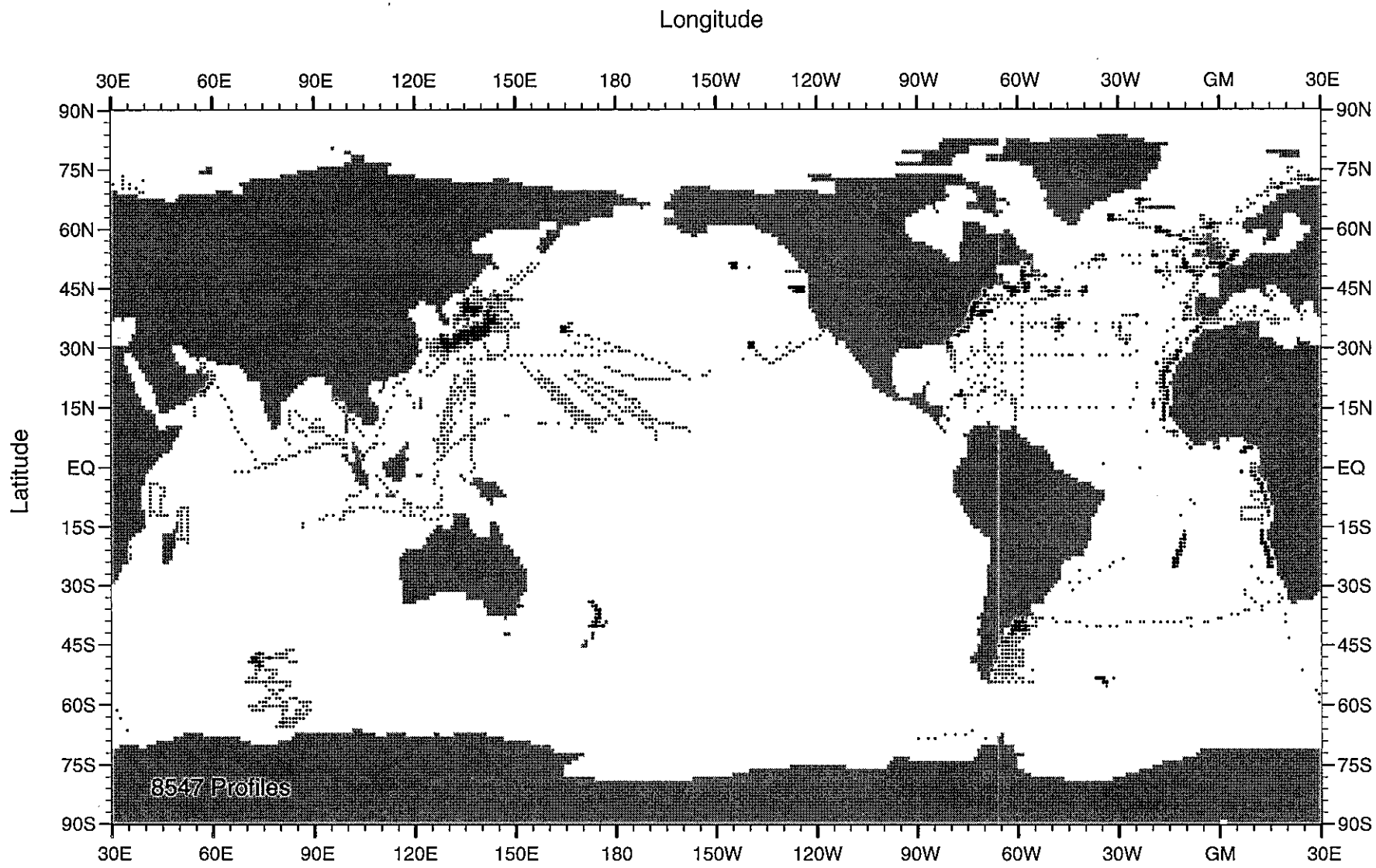

Fig. B121 WOD98 MBT profile distribution for January-March for 1971

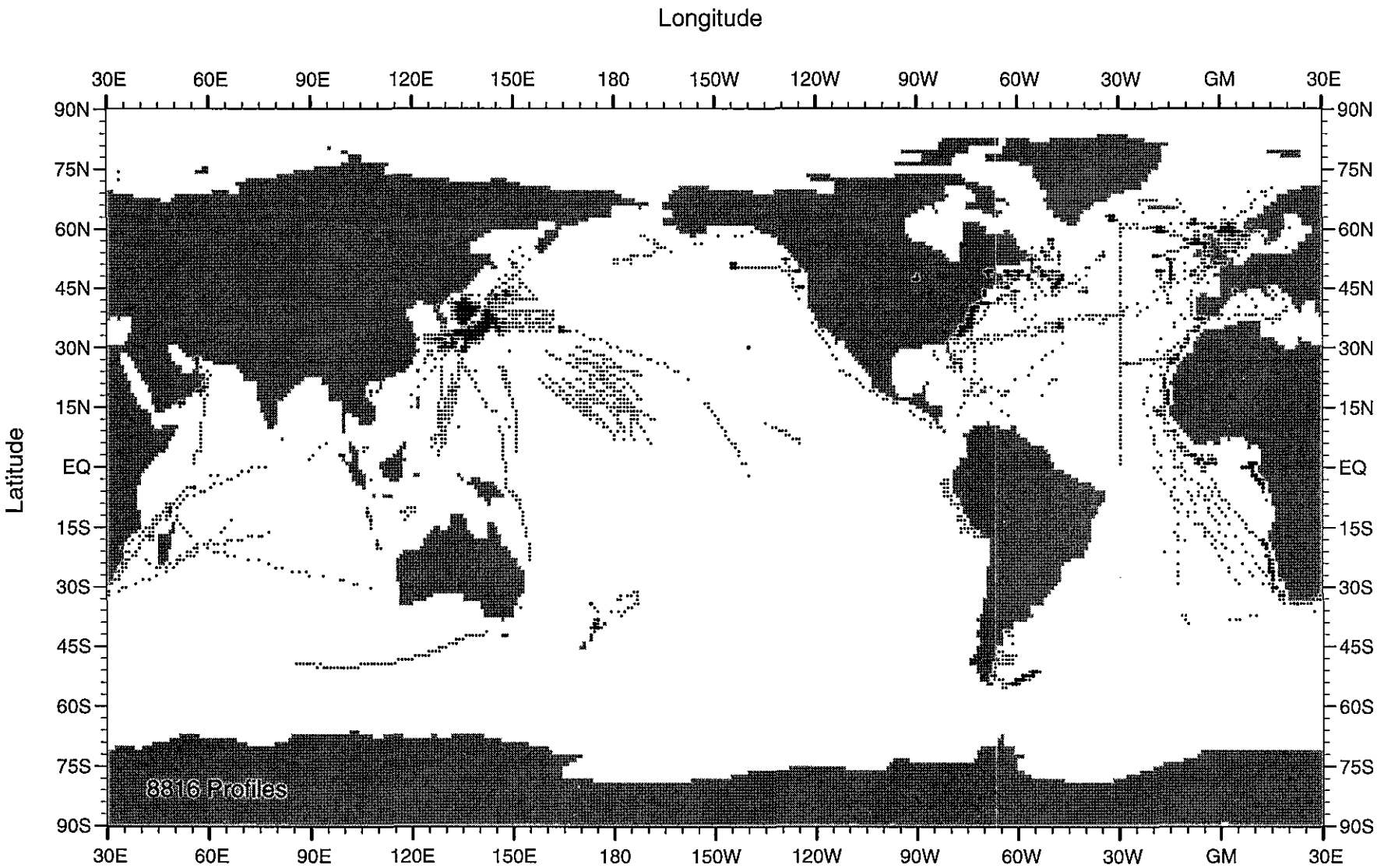

Fig. B122 WOD98 MBT profile distribution for April-June for 1971

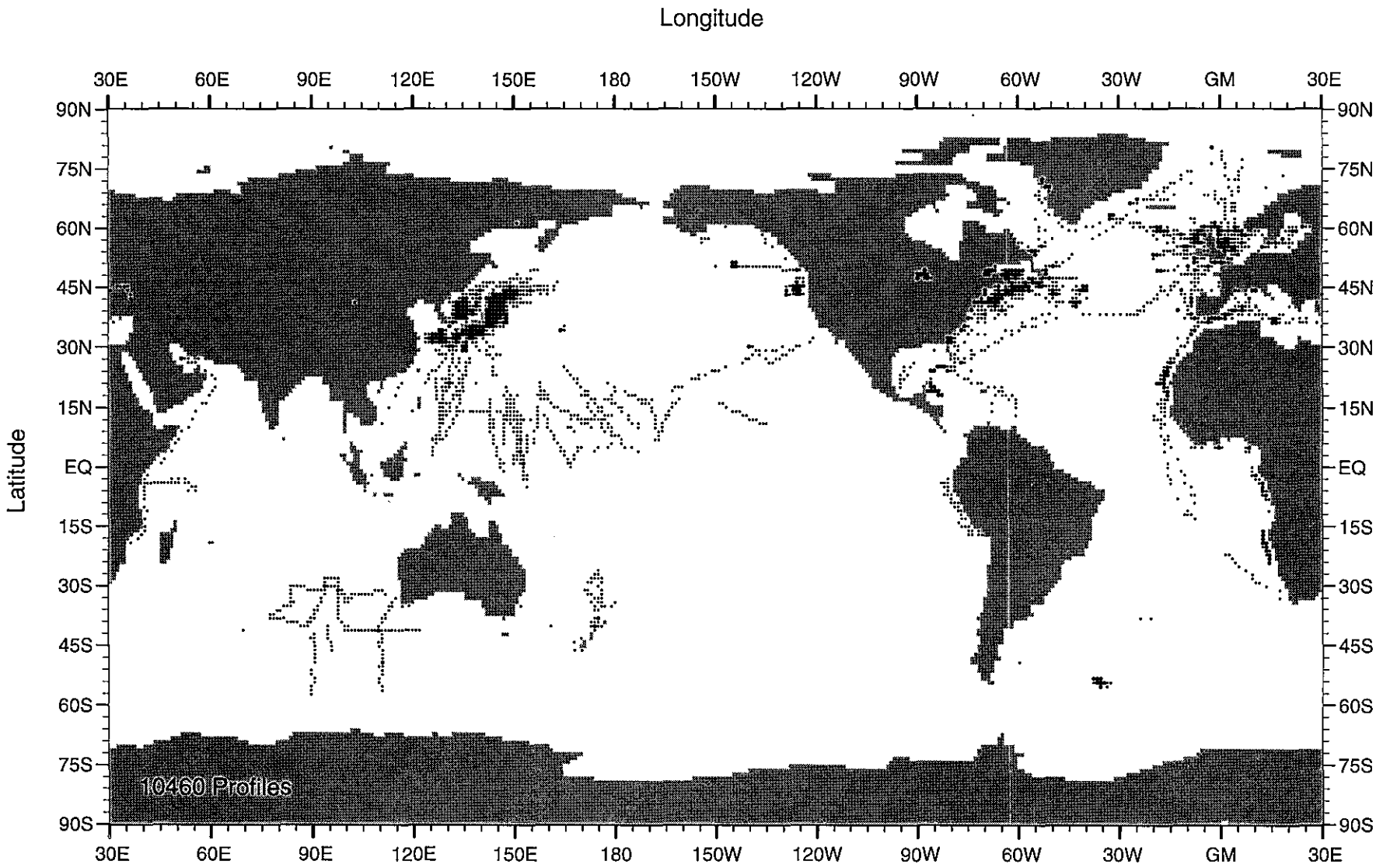

Fig. B123 WOD98 MBT profile distribution for July-September for 1971

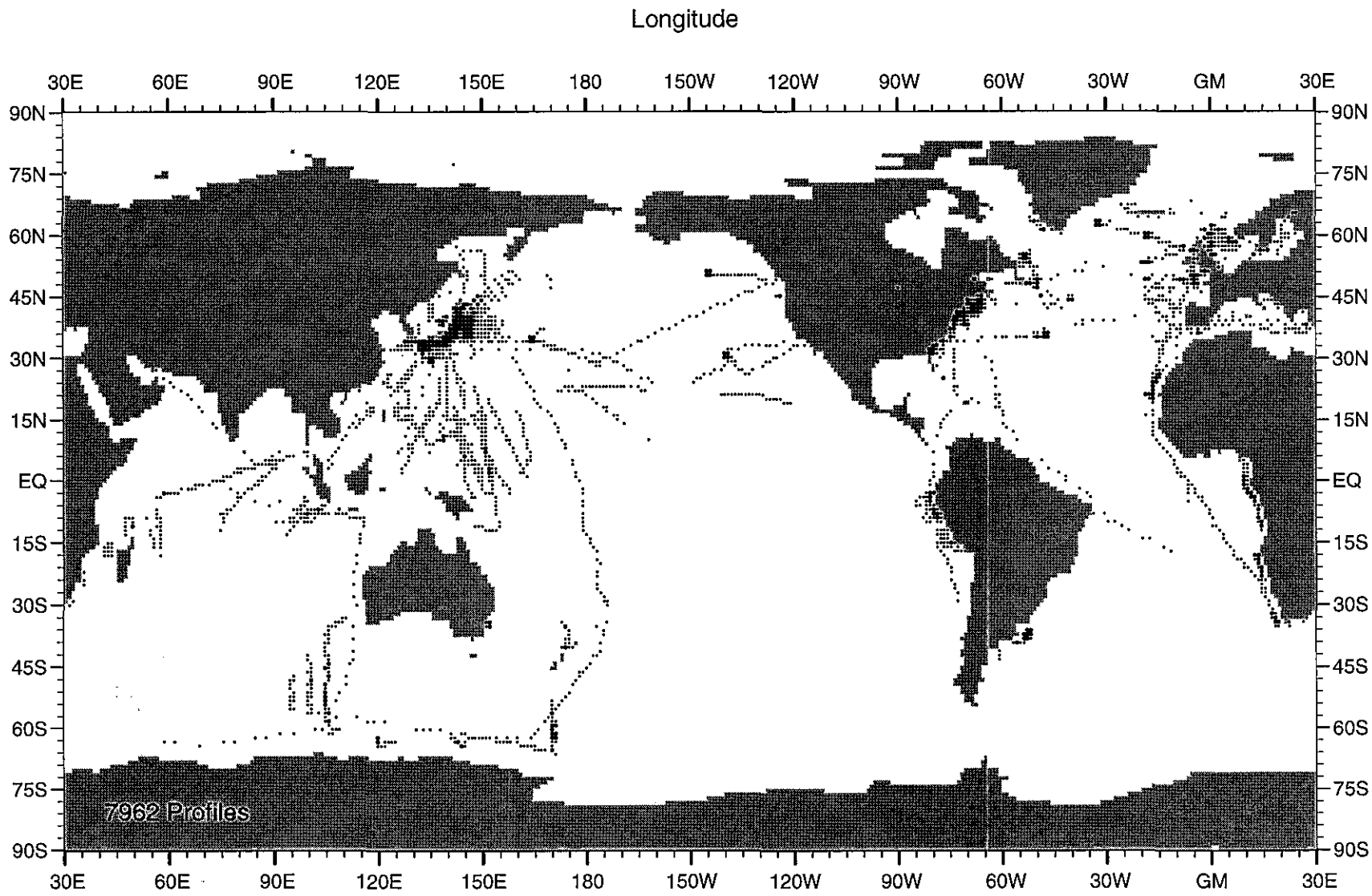

Fig. B124 WOD98 MBT profile distribution for October-December for 1971

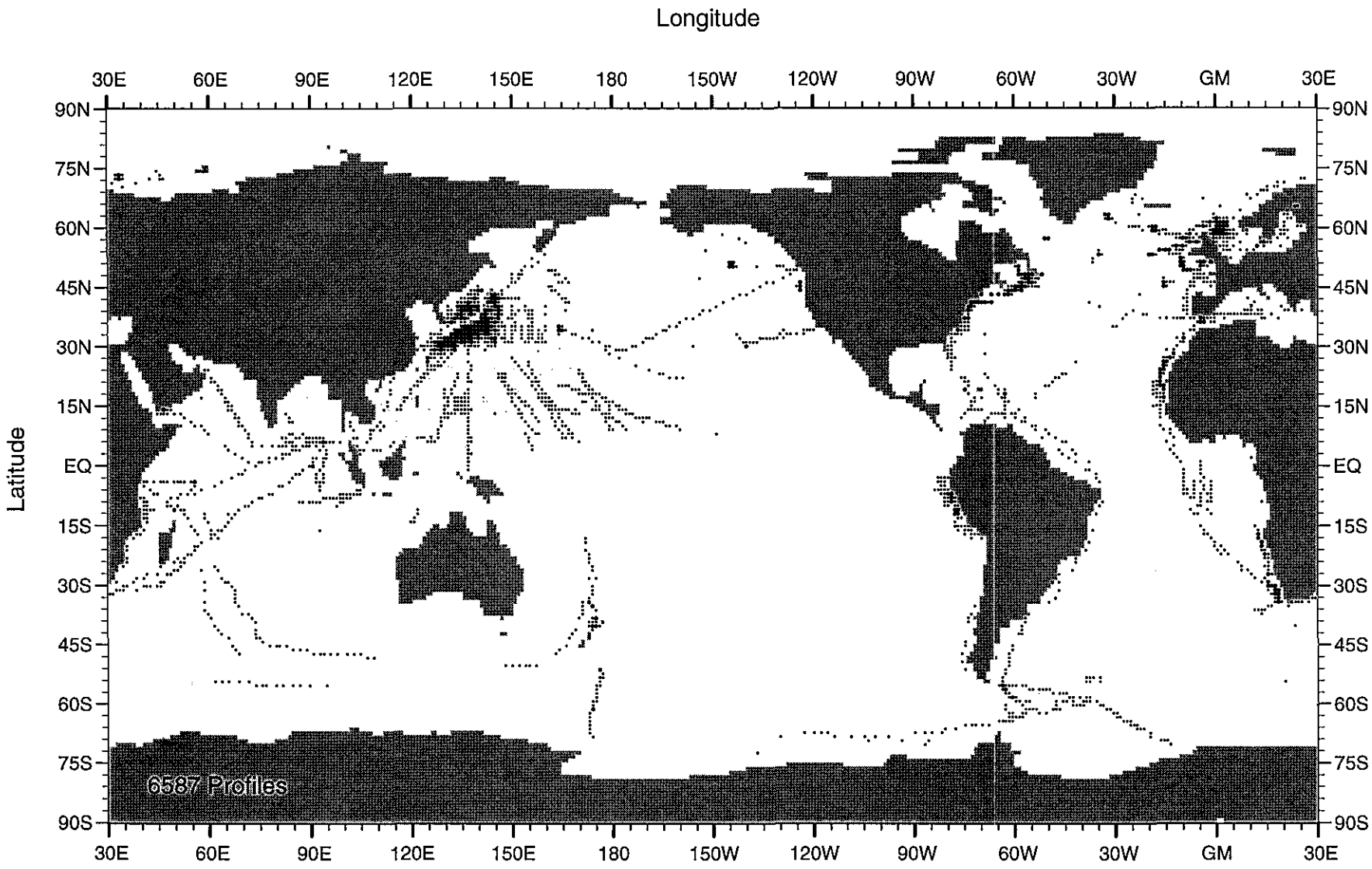

Fig. B125 WOD98 MBT profile distribution for January-March for 1972

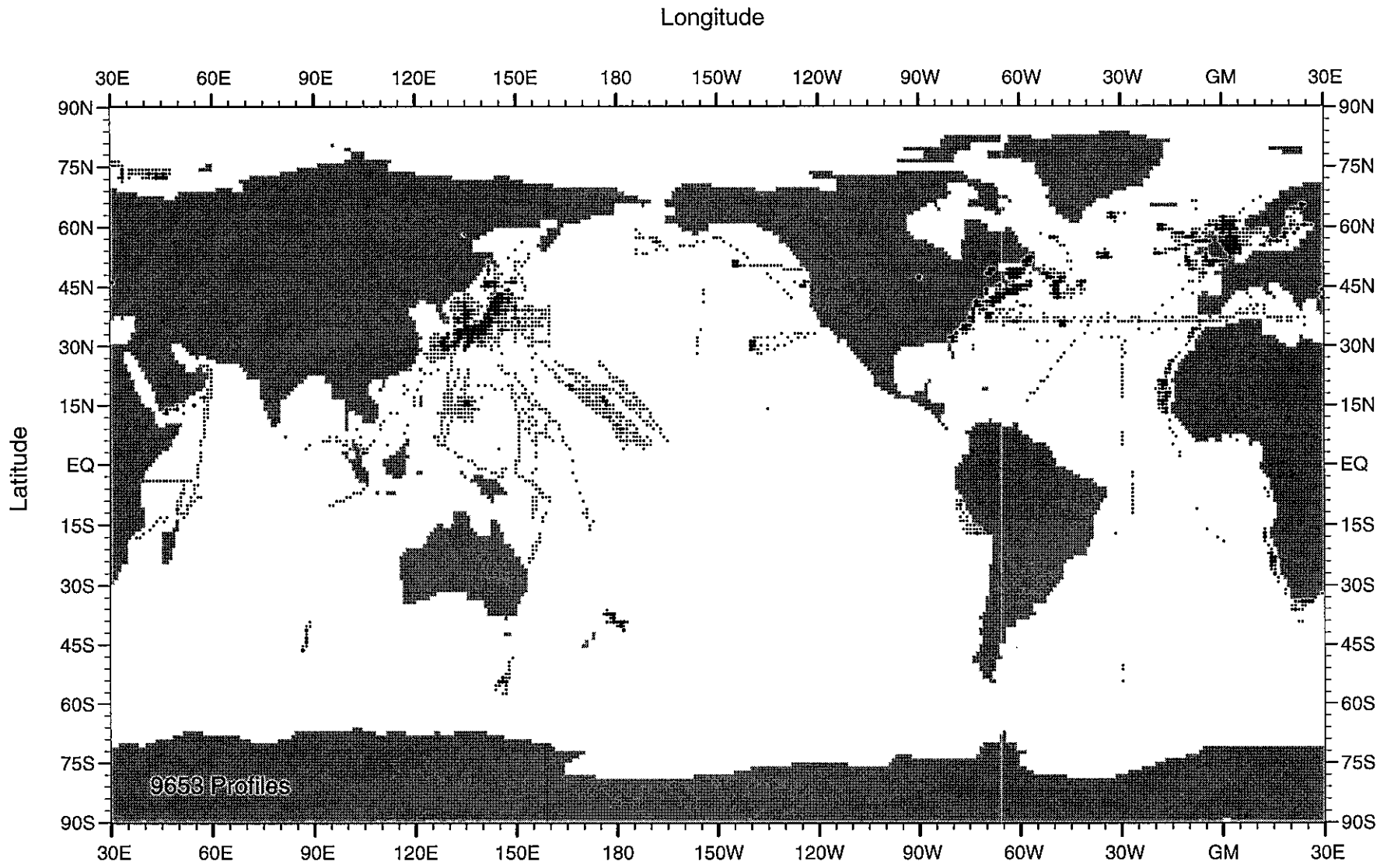

Fig. B126 WOD98 MBT profile distribution for April-June for 1972

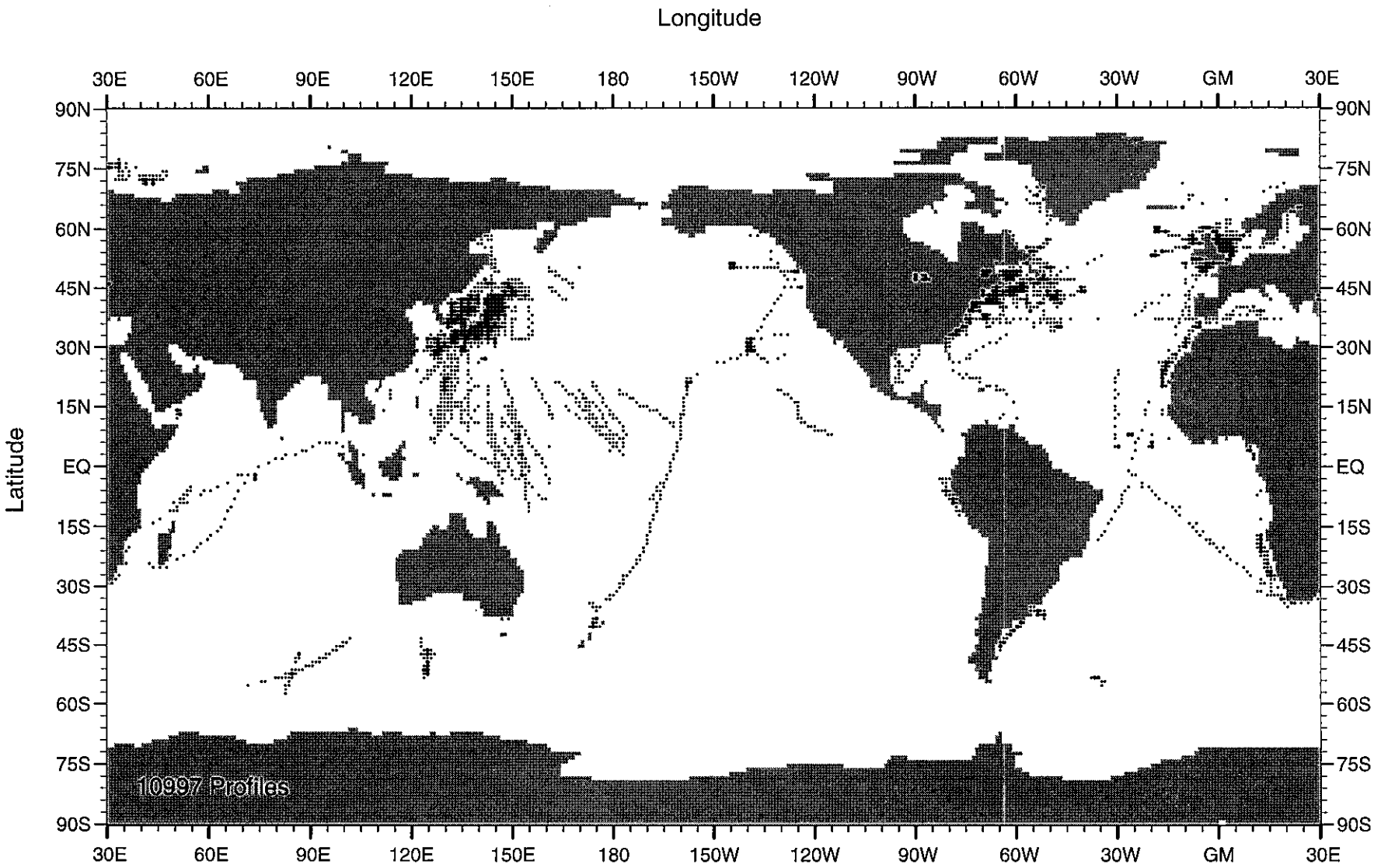

Fig. B127 WOD98 MBT profile distribution for July-September for 1972

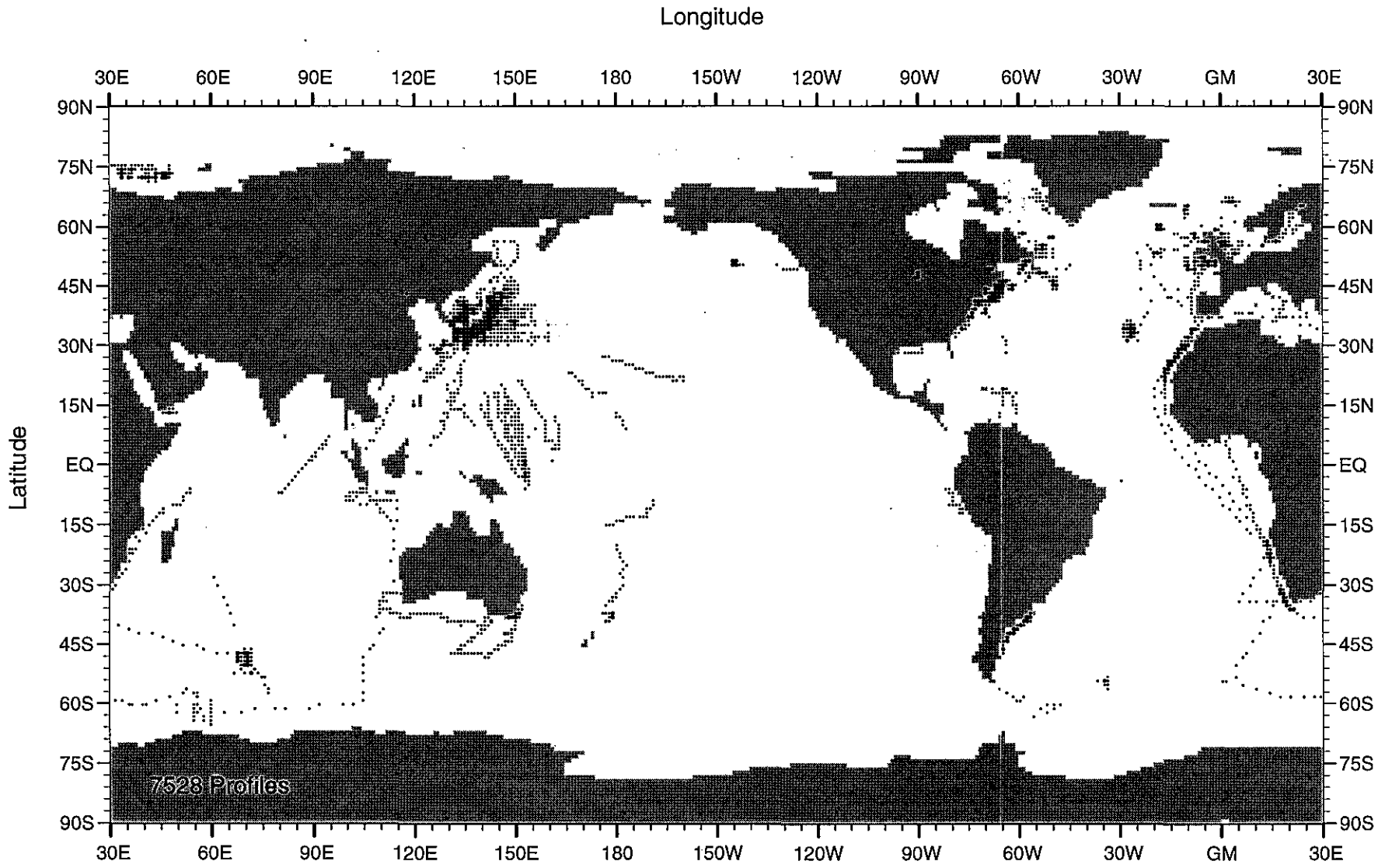

Fig. B128 WOD98 MBT profile distribution for October-December for 1972

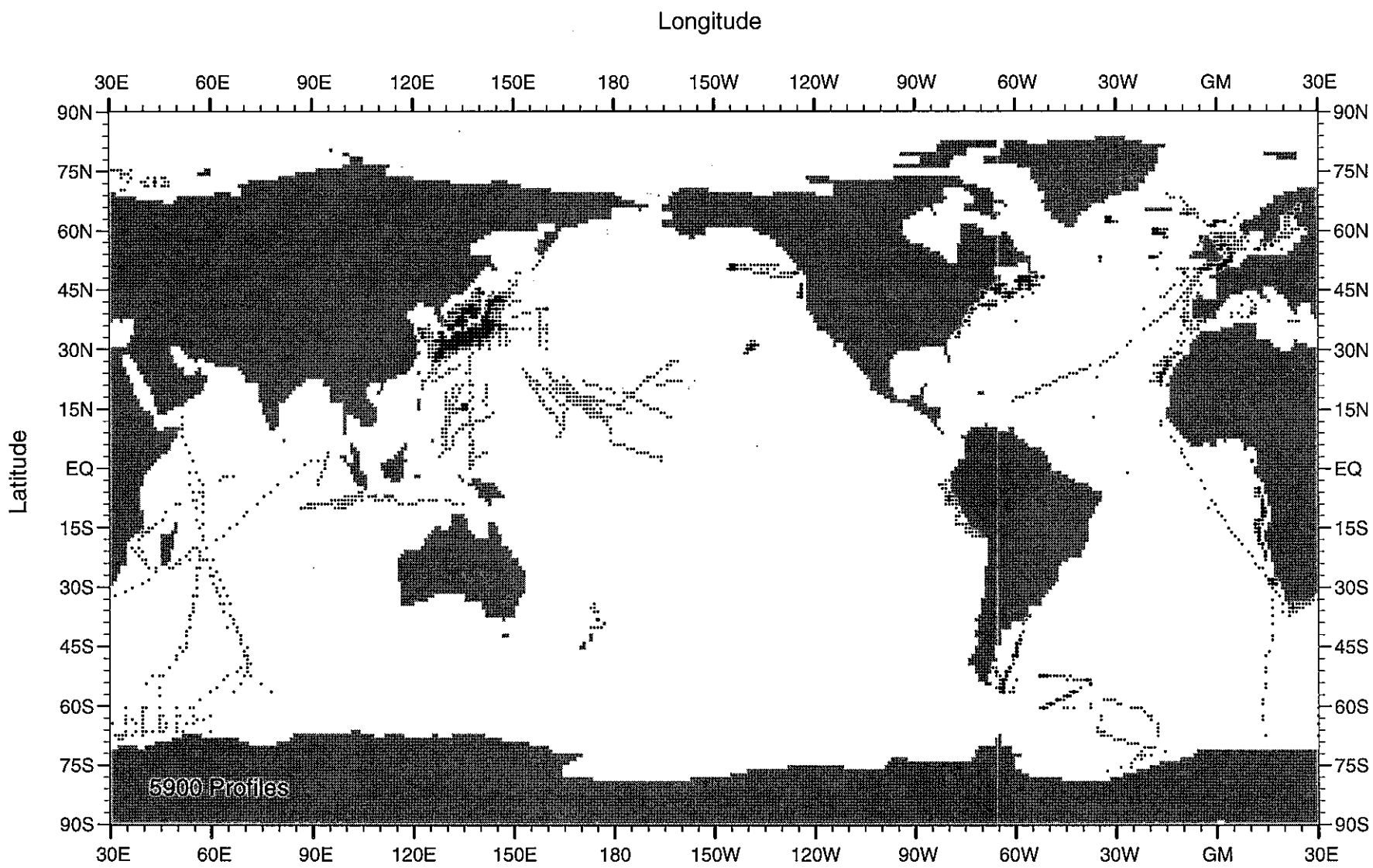

Fig. B129 WOD98 MBT profile distribution for January-March for 1973

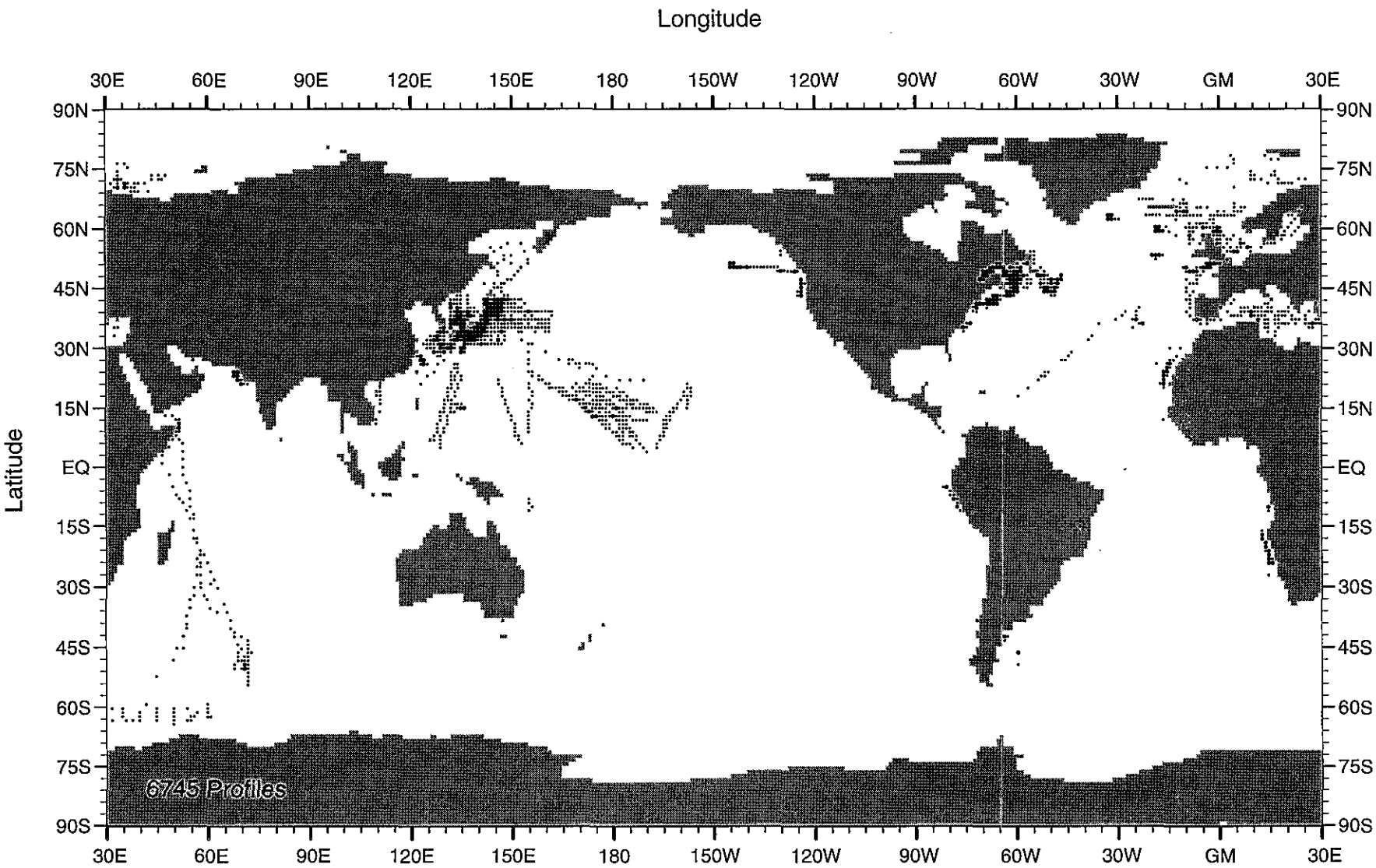

Fig. B130 WOD98 MBT profile distribution for April-June for 1973

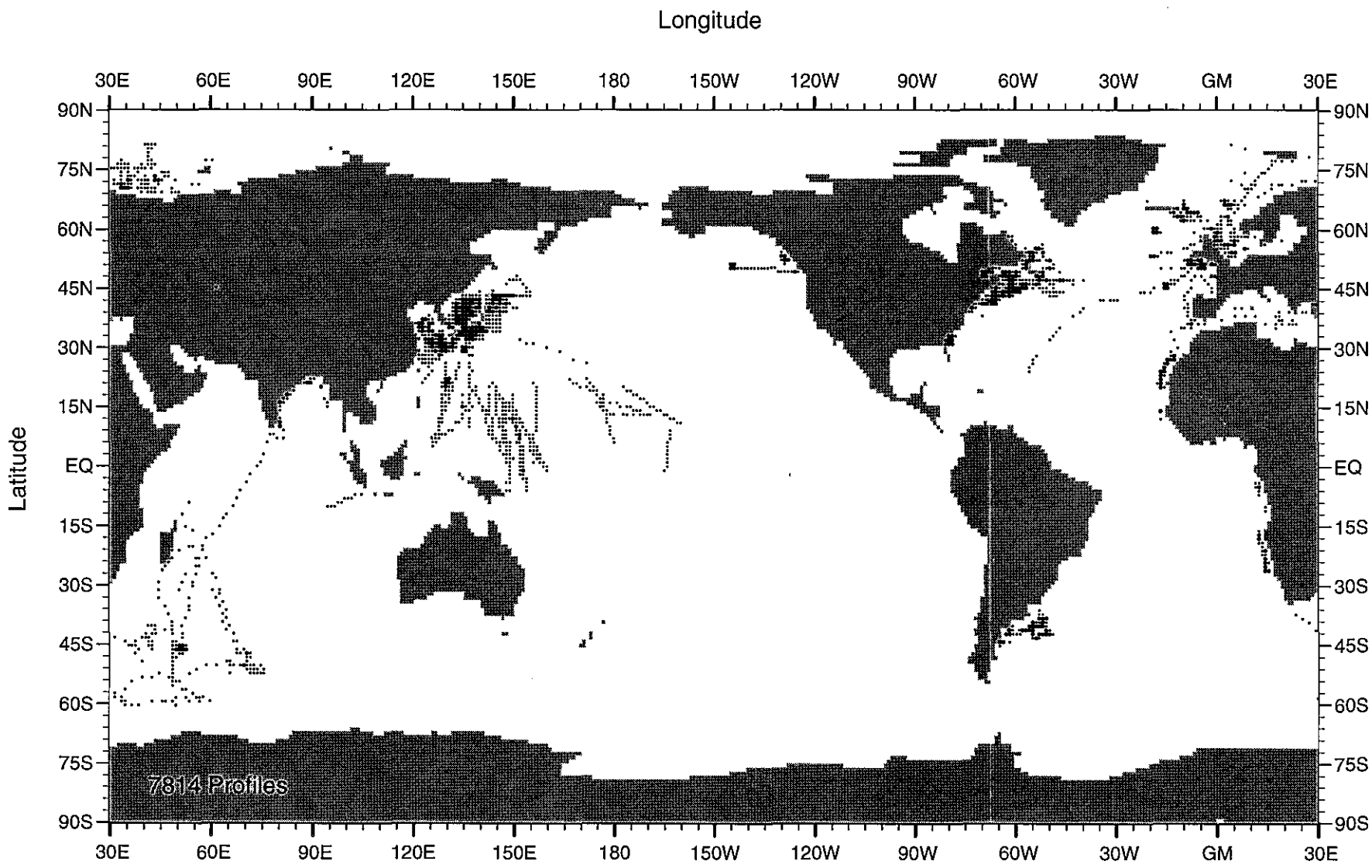

Fig. B131 WOD98 MBT profile distribution for July-September for 1973

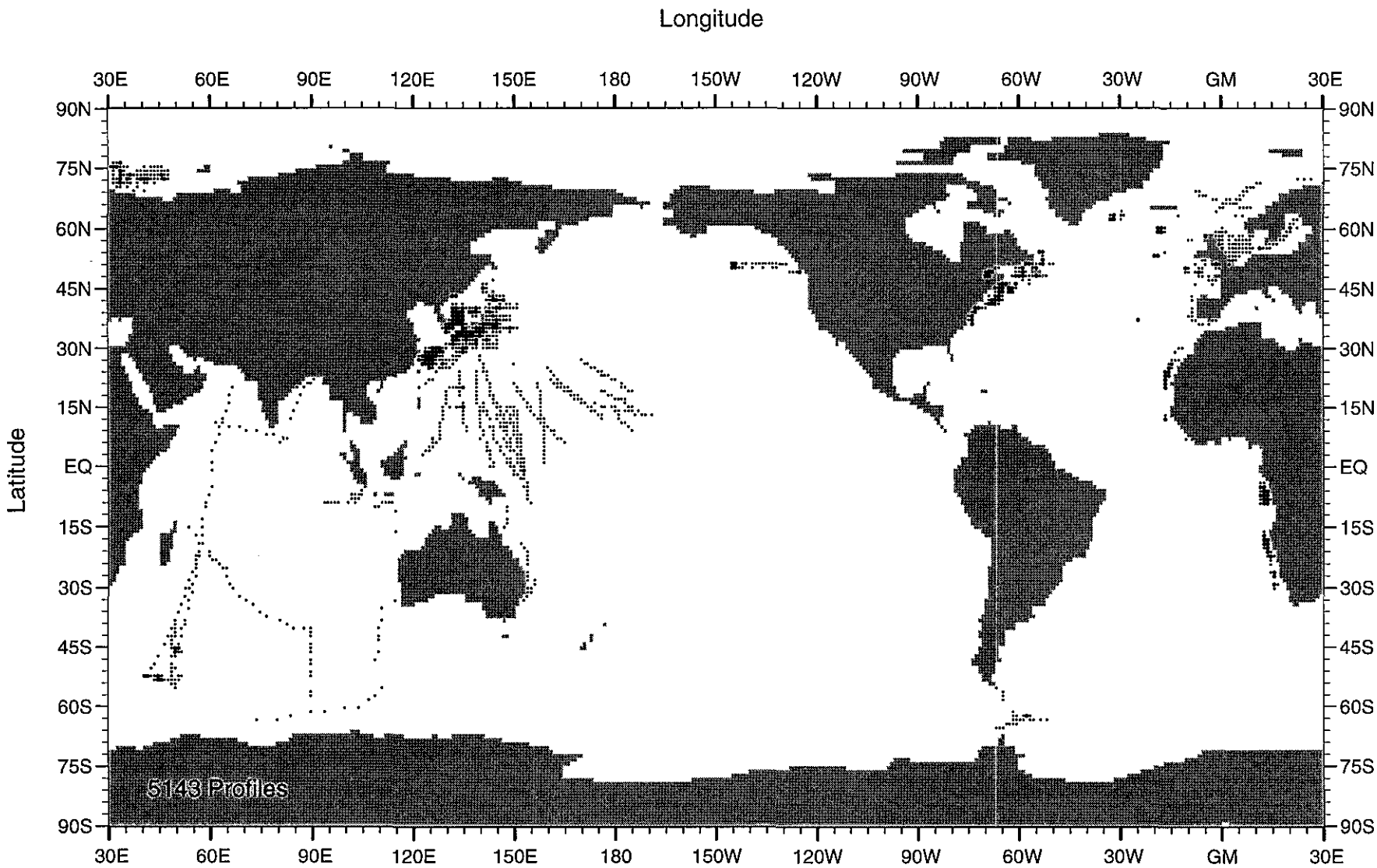

Fig. B132 WOD98 MBT profile distribution for October-December for 1973

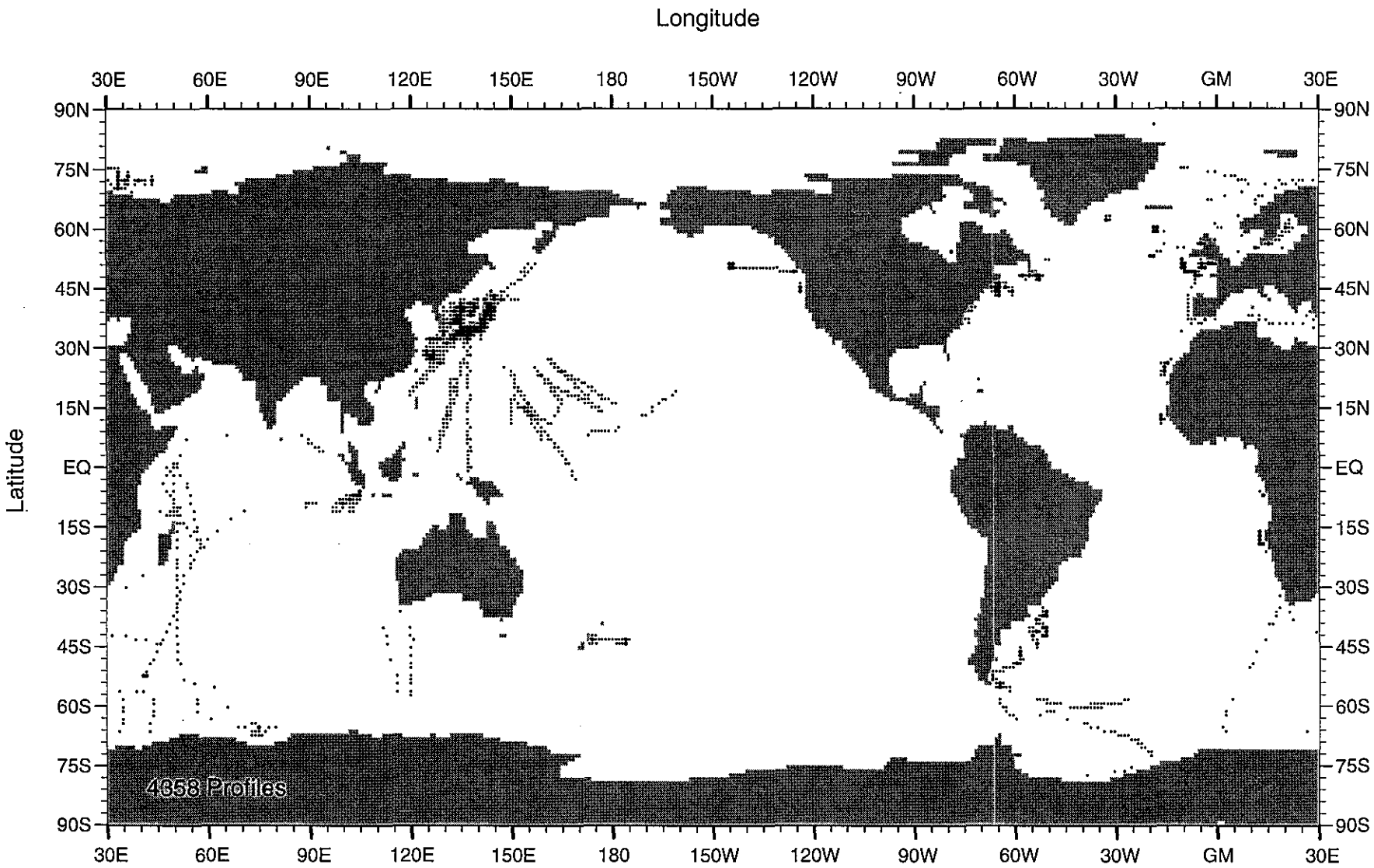

Fig. B133 WOD98 MBT profile distribution for January-March for 1974

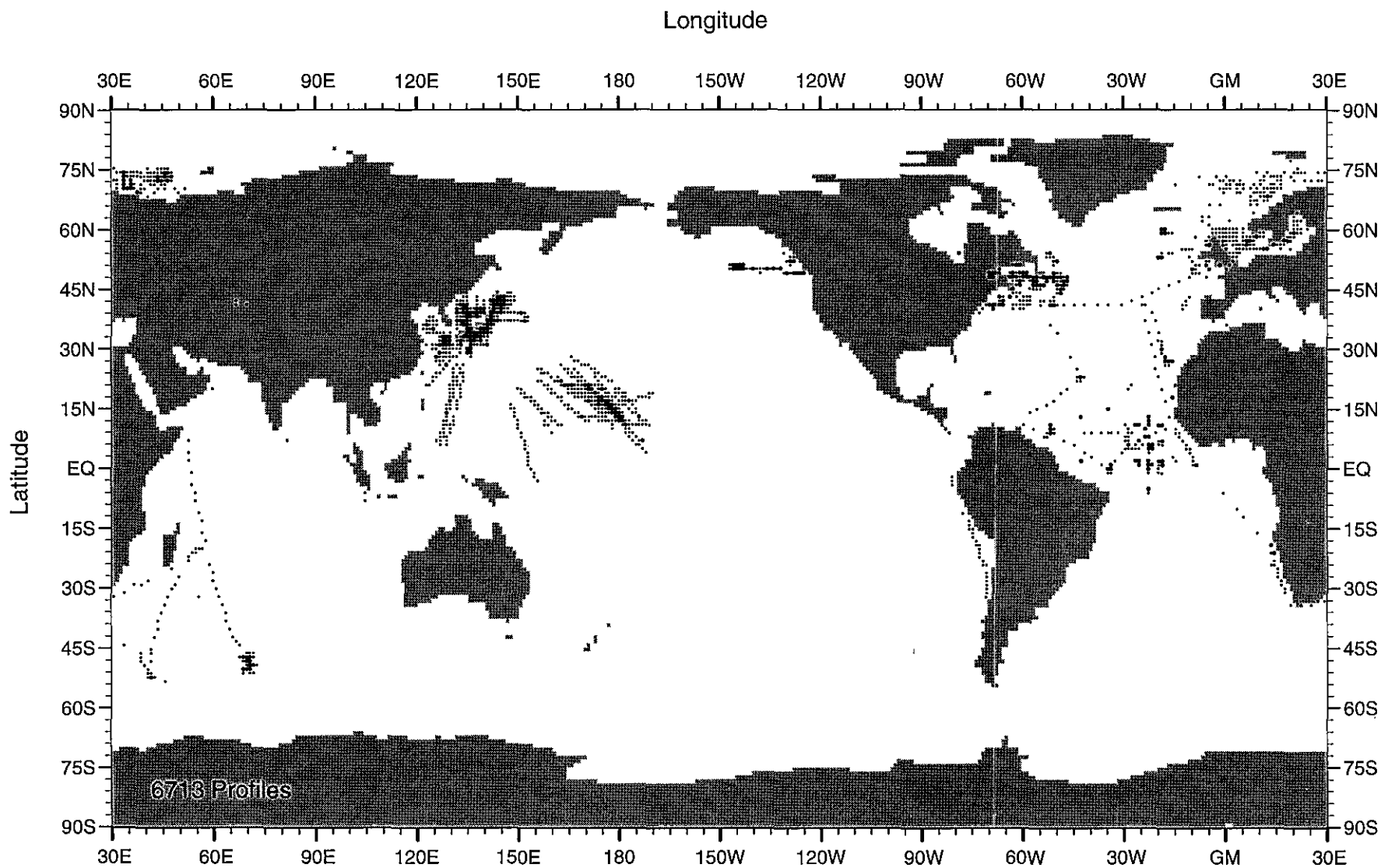

Fig. B134 WOD98 MBT profile distribution for April-June for 1974

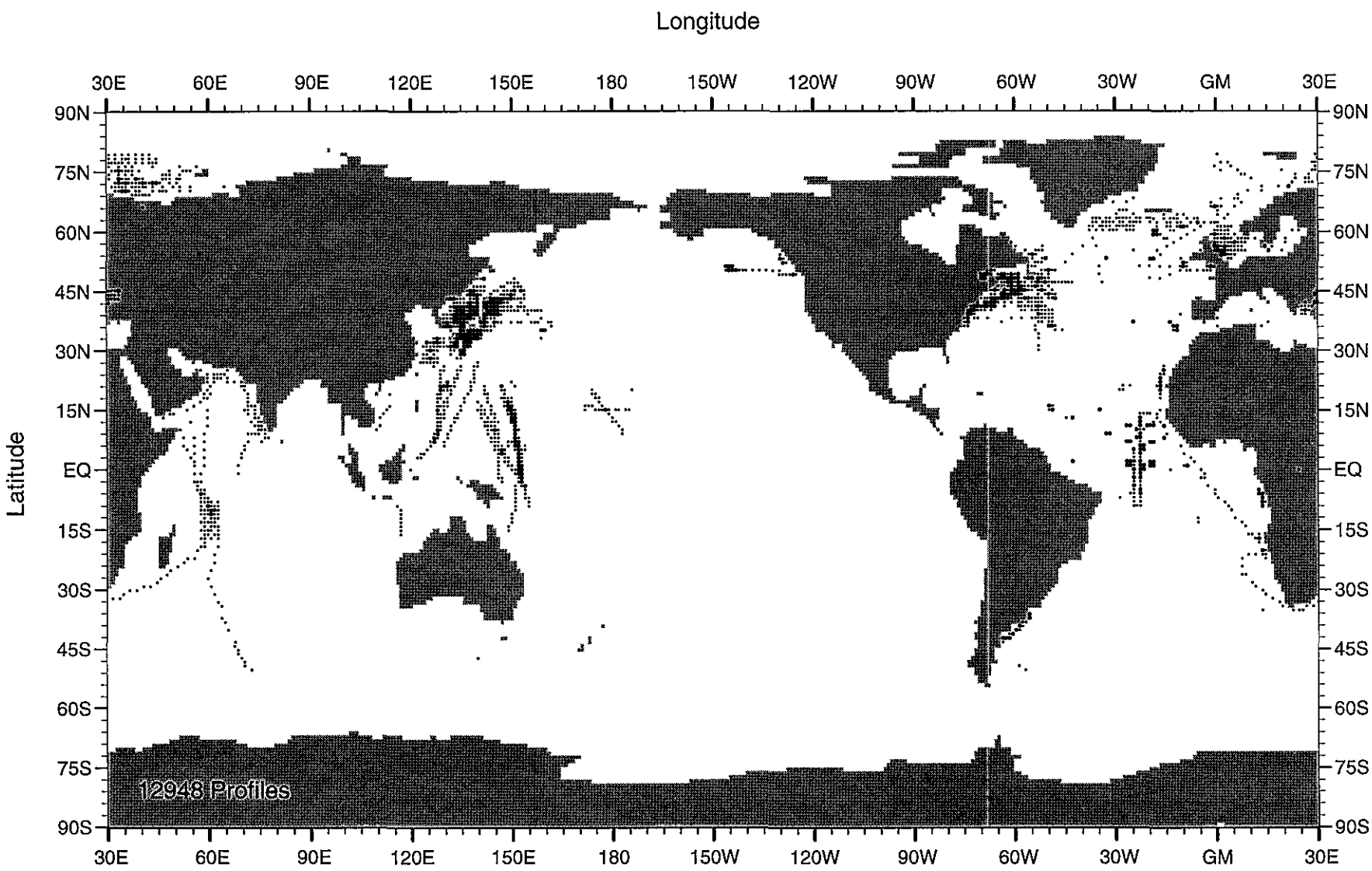

Fig. B135 WOD98 MBT profile distribution for July-September for 1974

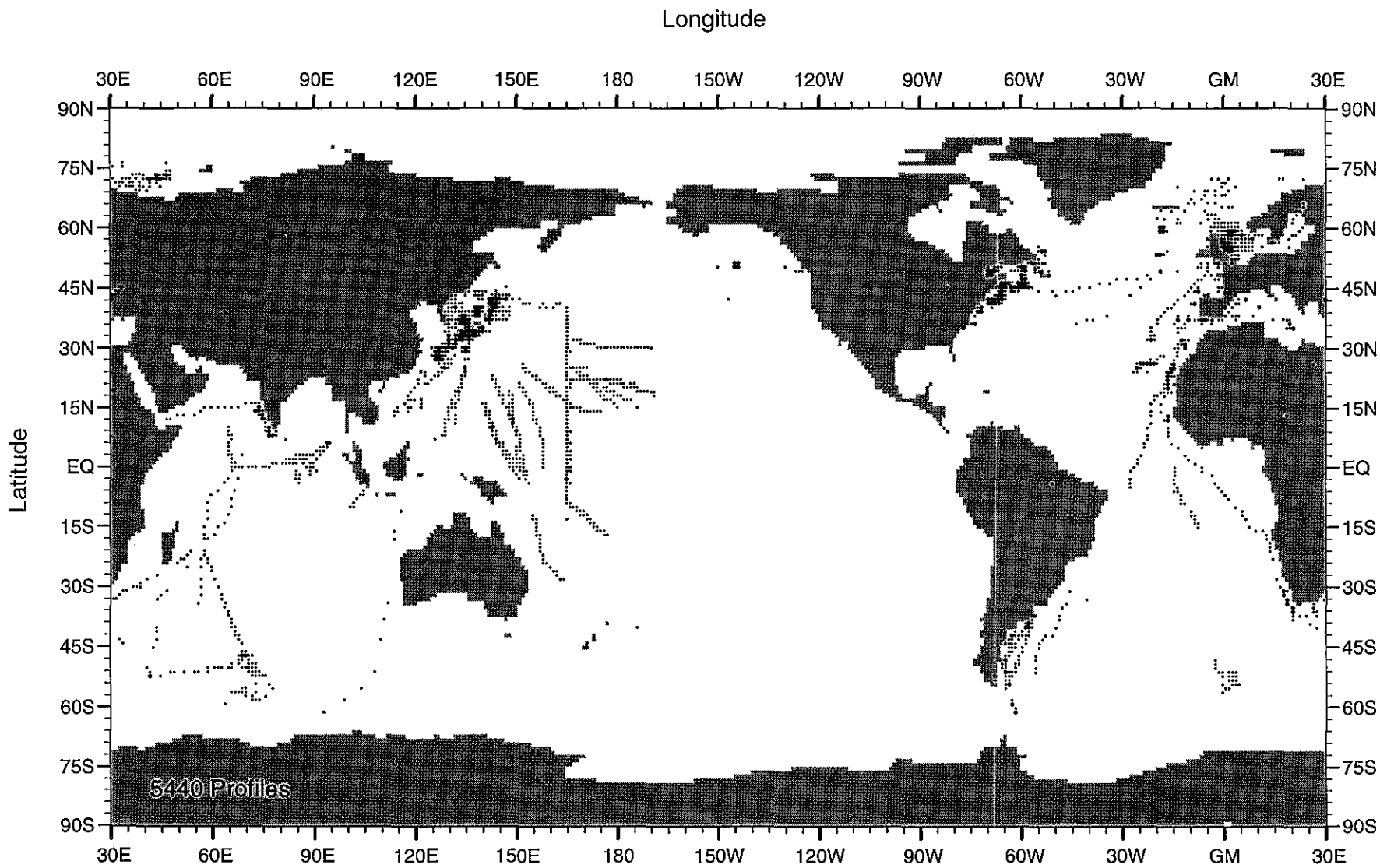

Fig. B136 WOD98 MBT profile distribution for October-December for 1974

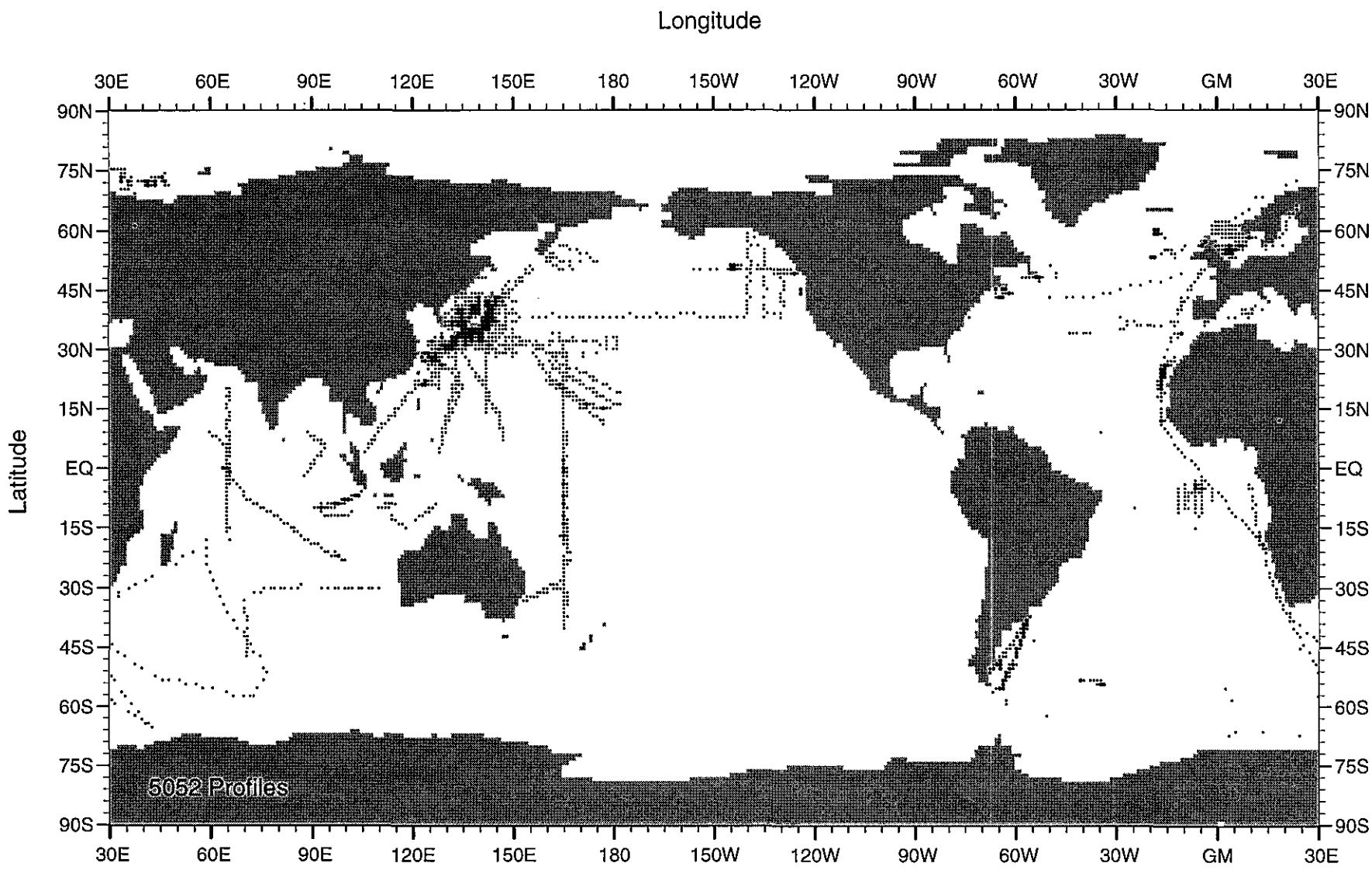

Fig. B137 WOD98 MBT profile distribution for January-March for 1975

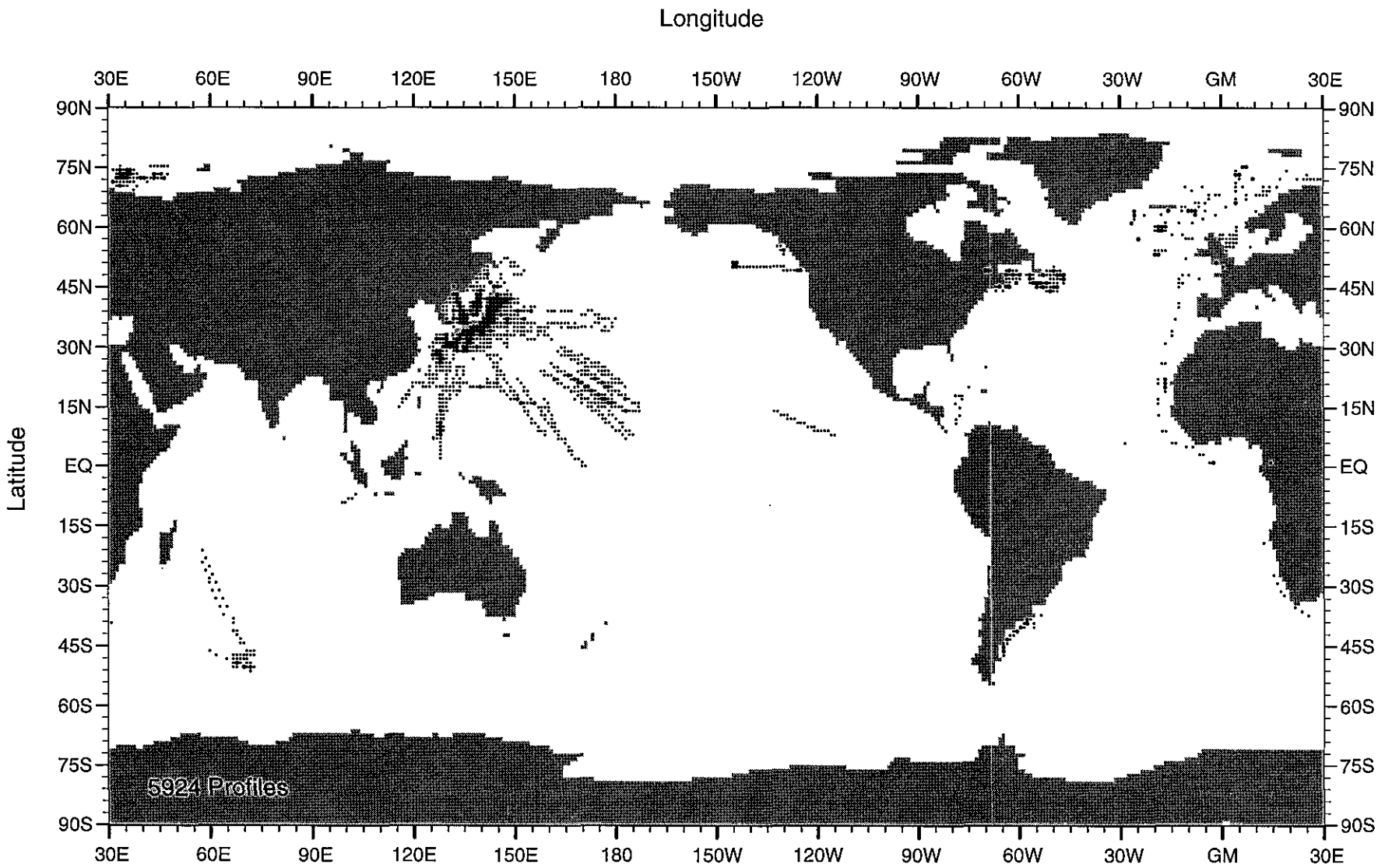

Fig. B138 WOD98 MBT profile distribution for April-June for 1975

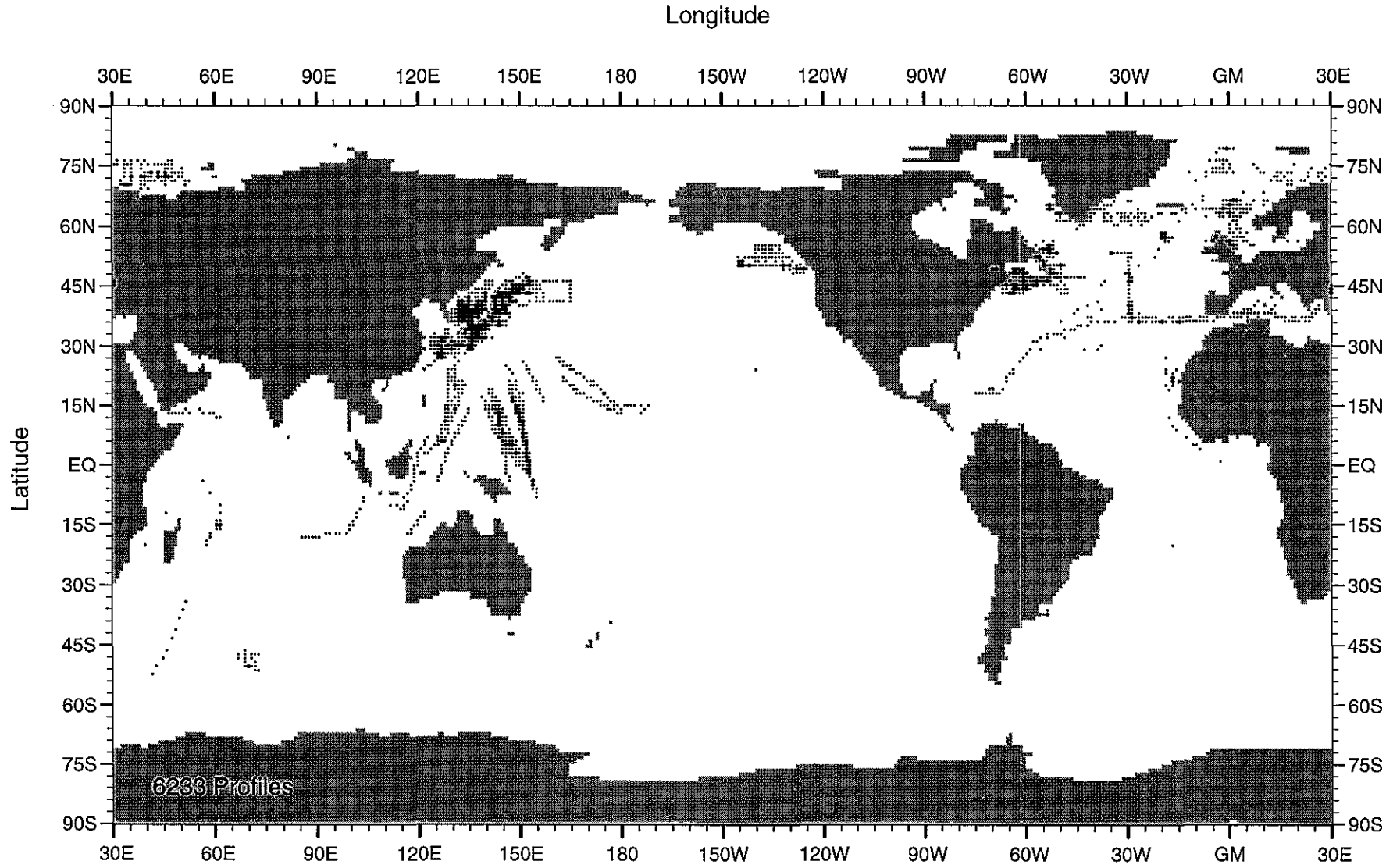

Fig. B139 WOD98 MBT profile distribution for July-September for 1975

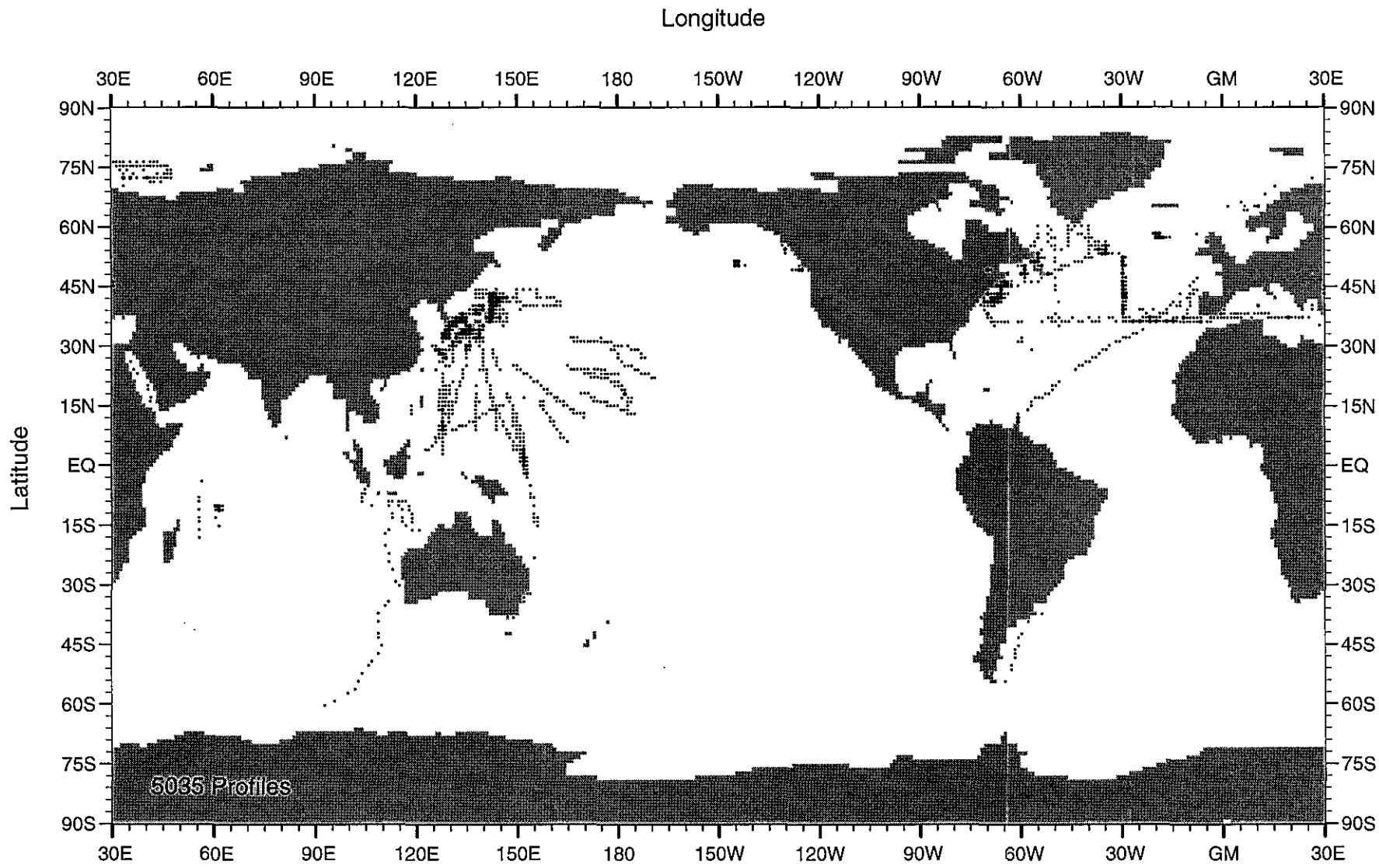

Fig. B140 WOD98 MBT profile distribution for October-December for 1975

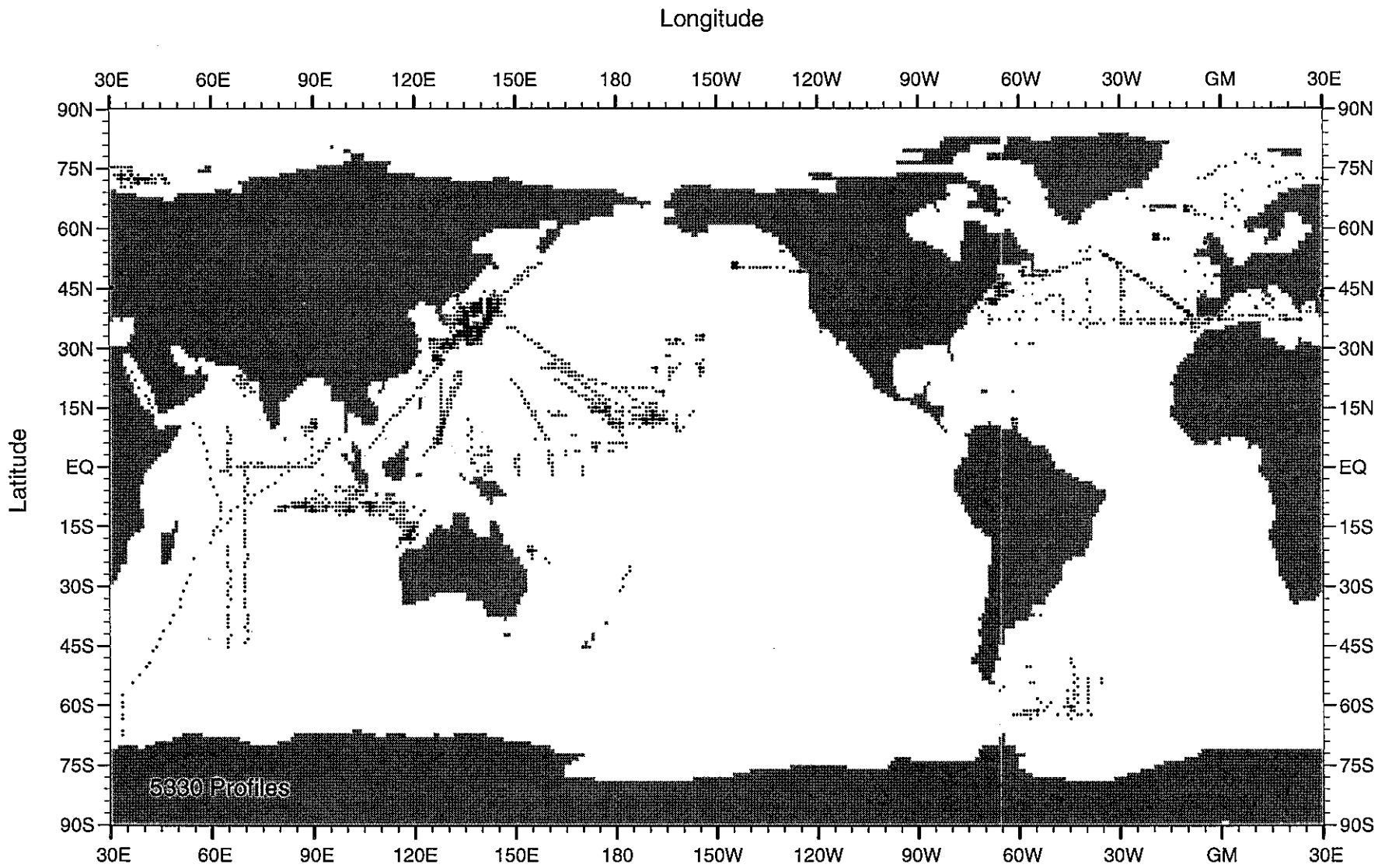

Fig. B141 WOD98 MBT profile distribution for January-March for 1976

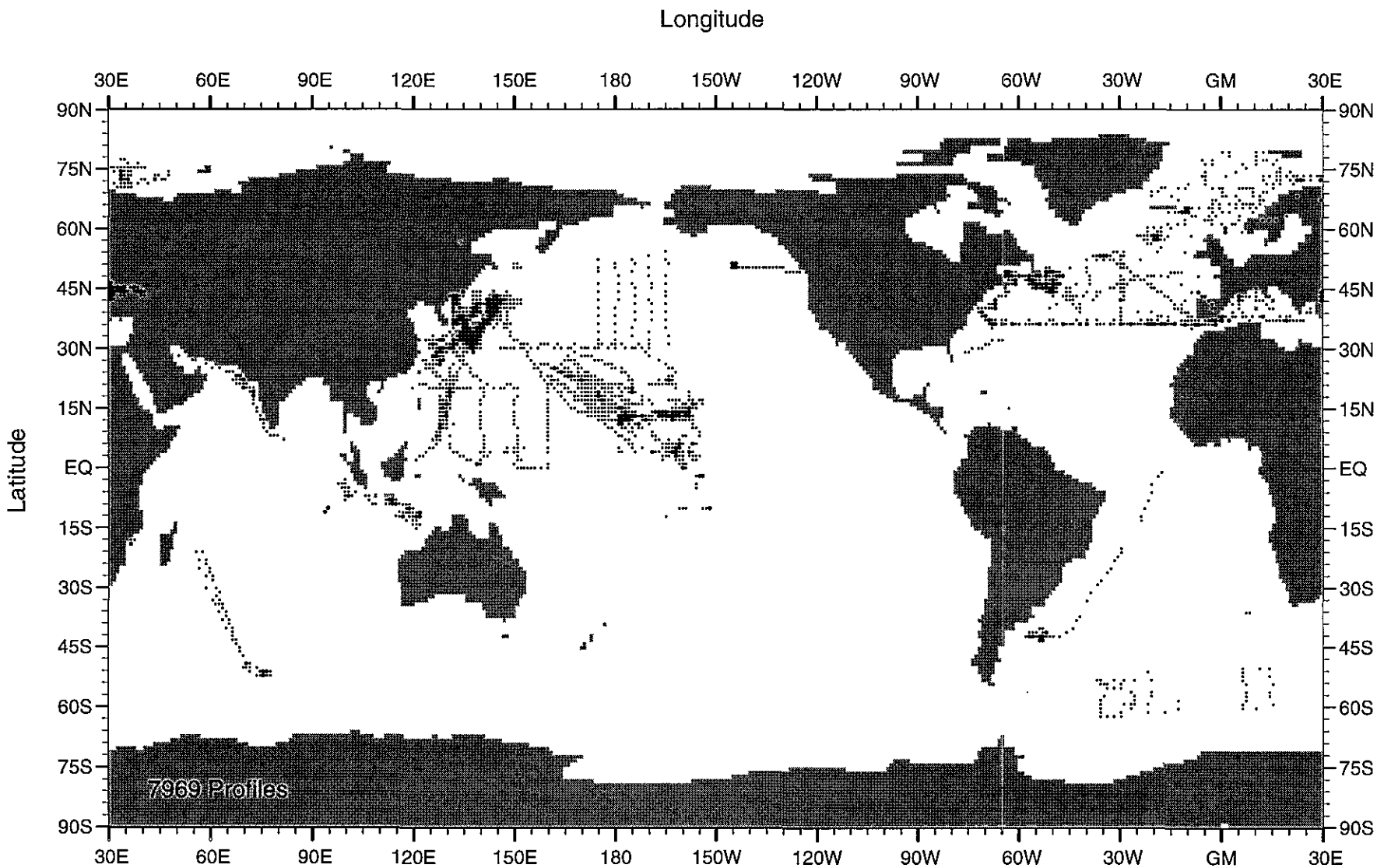

Fig. B142 WOD98 MBT profile distribution for April-June for 1976

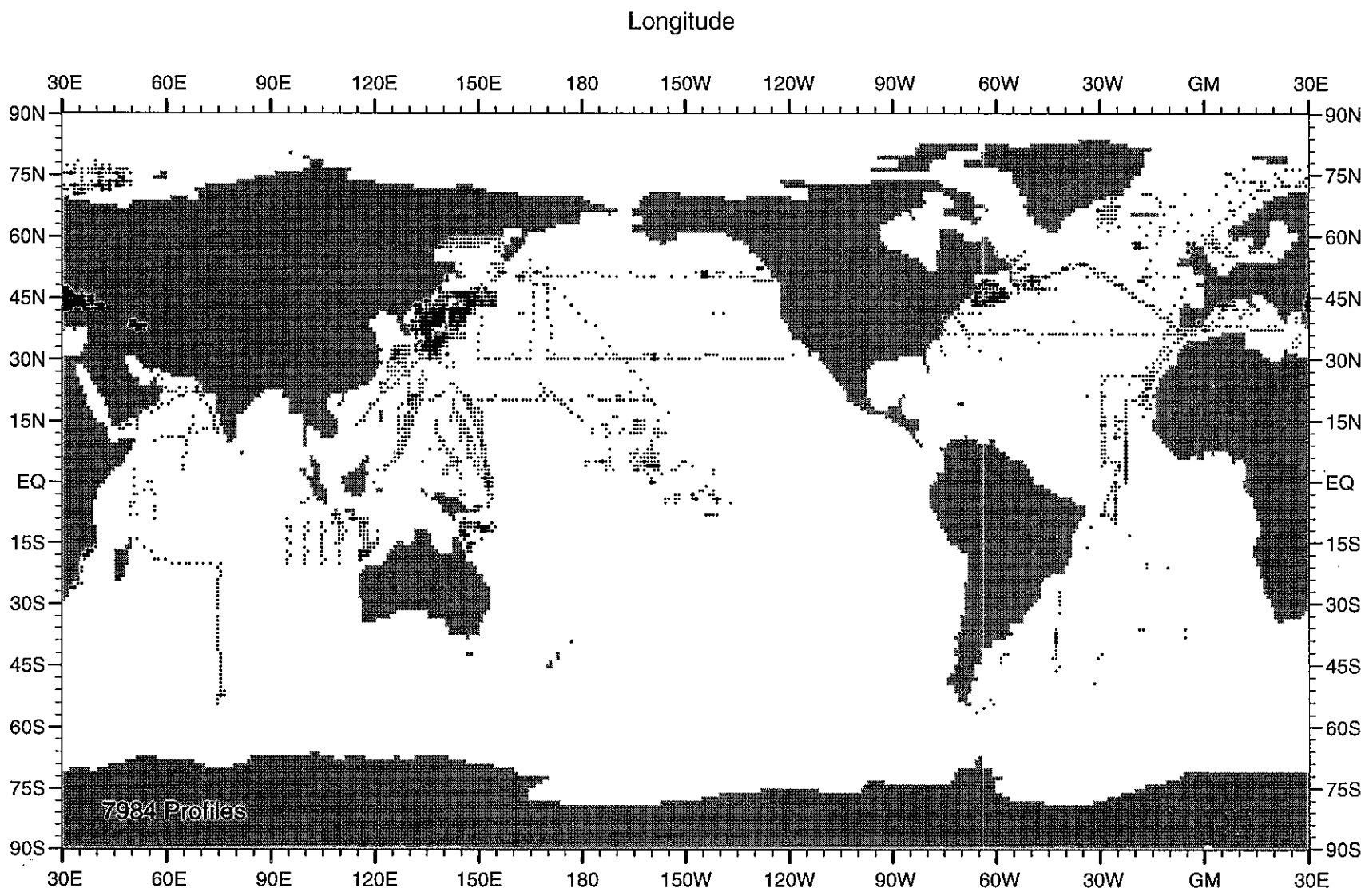

Fig. B143 WOD98 MBT profile distribution for July-September for 1976

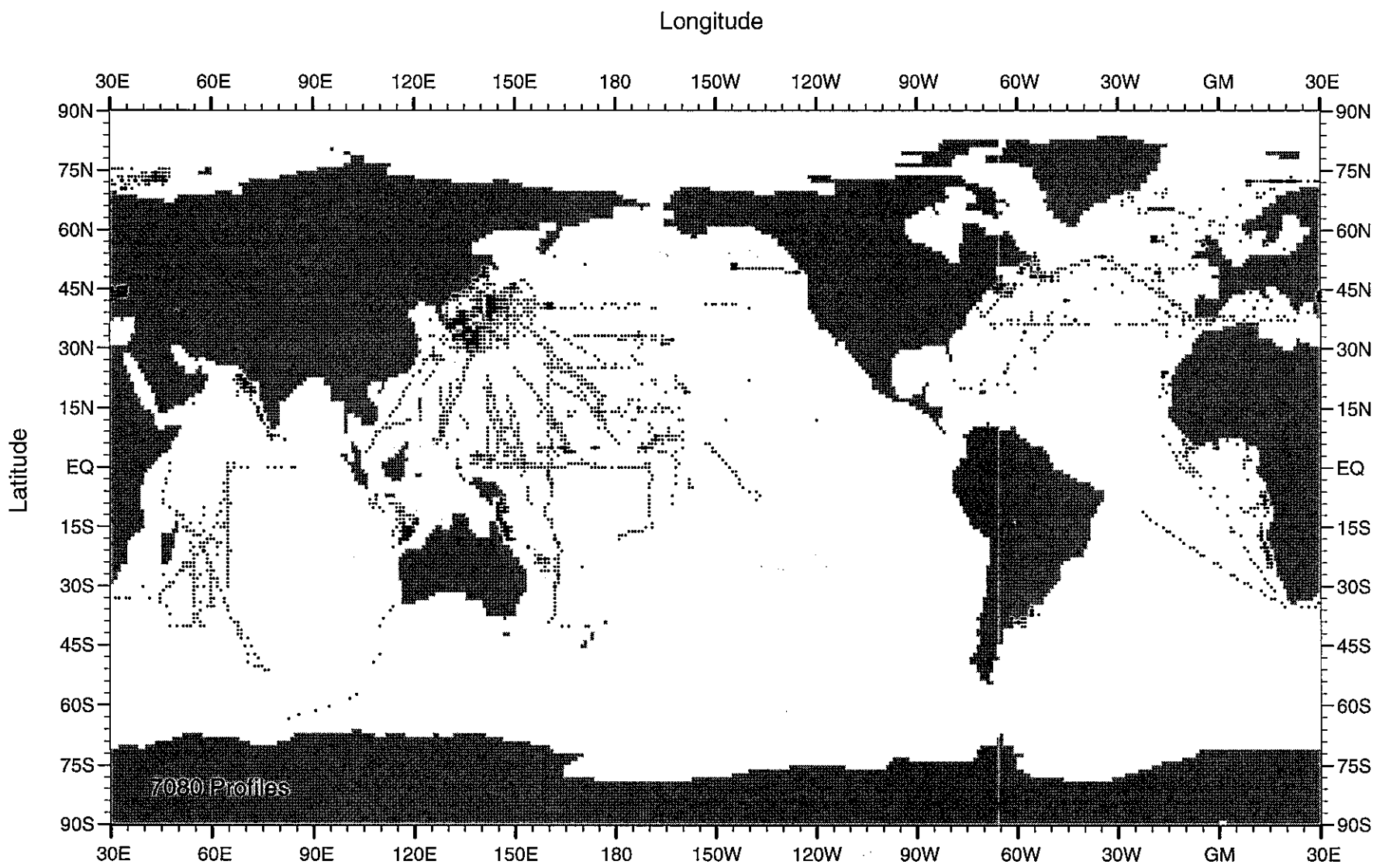

Fig. B144 WOD98 MBT profile distribution for October-December for 1976

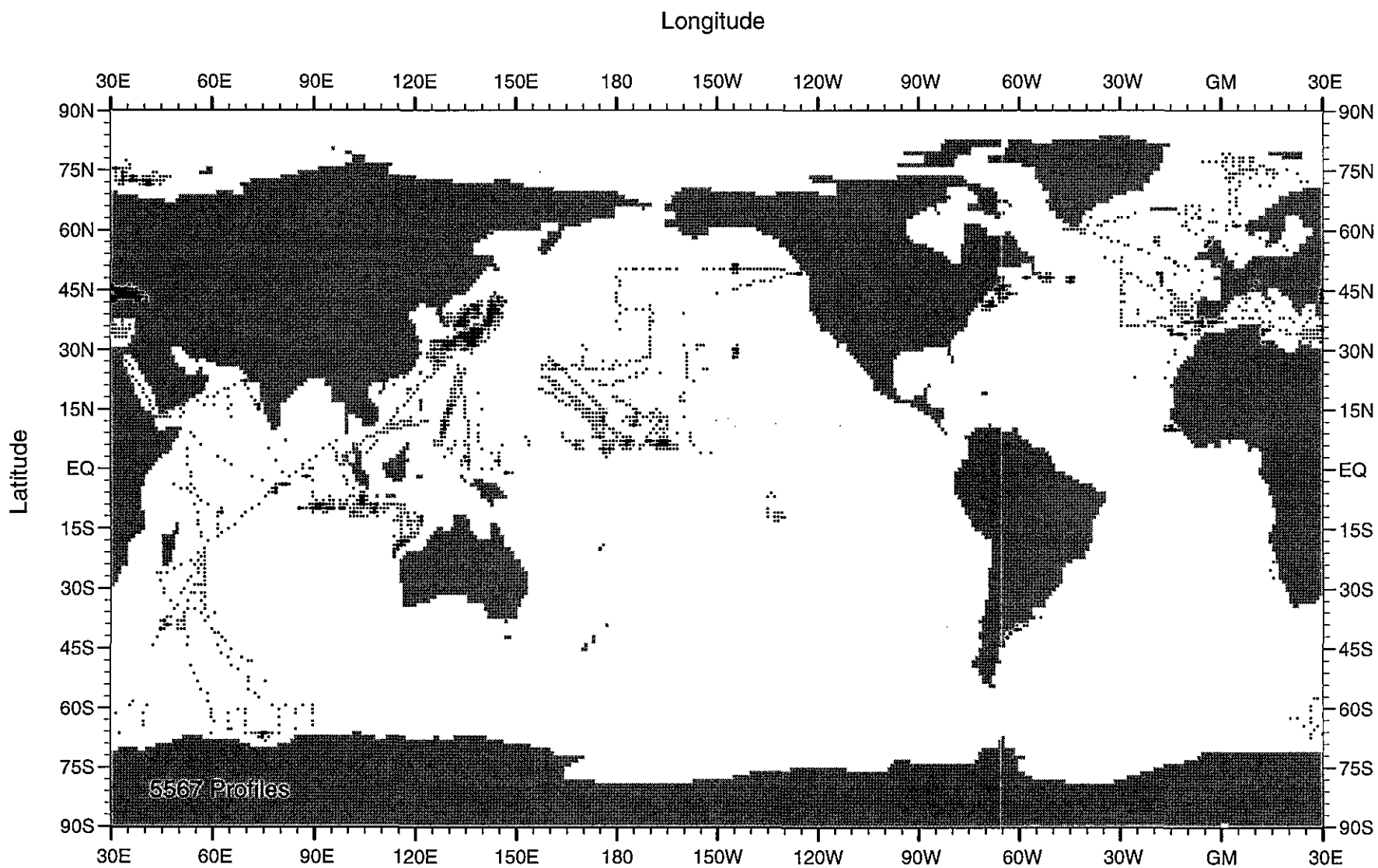

Fig. B145 WOD98 MBT profile distribution for January-March for 1977

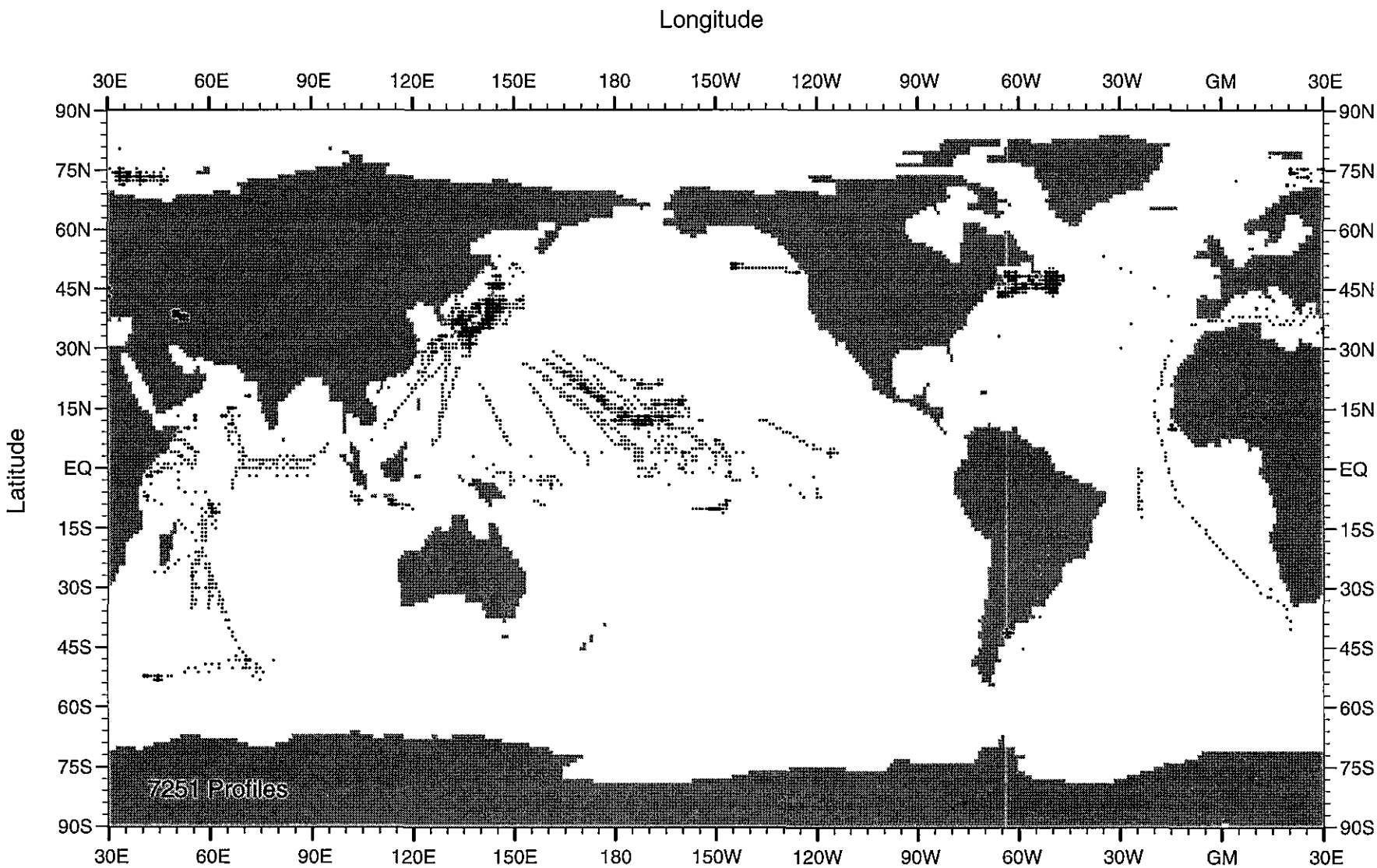

Fig. B146 WOD98 MBT profile distribution for April-June for 1977

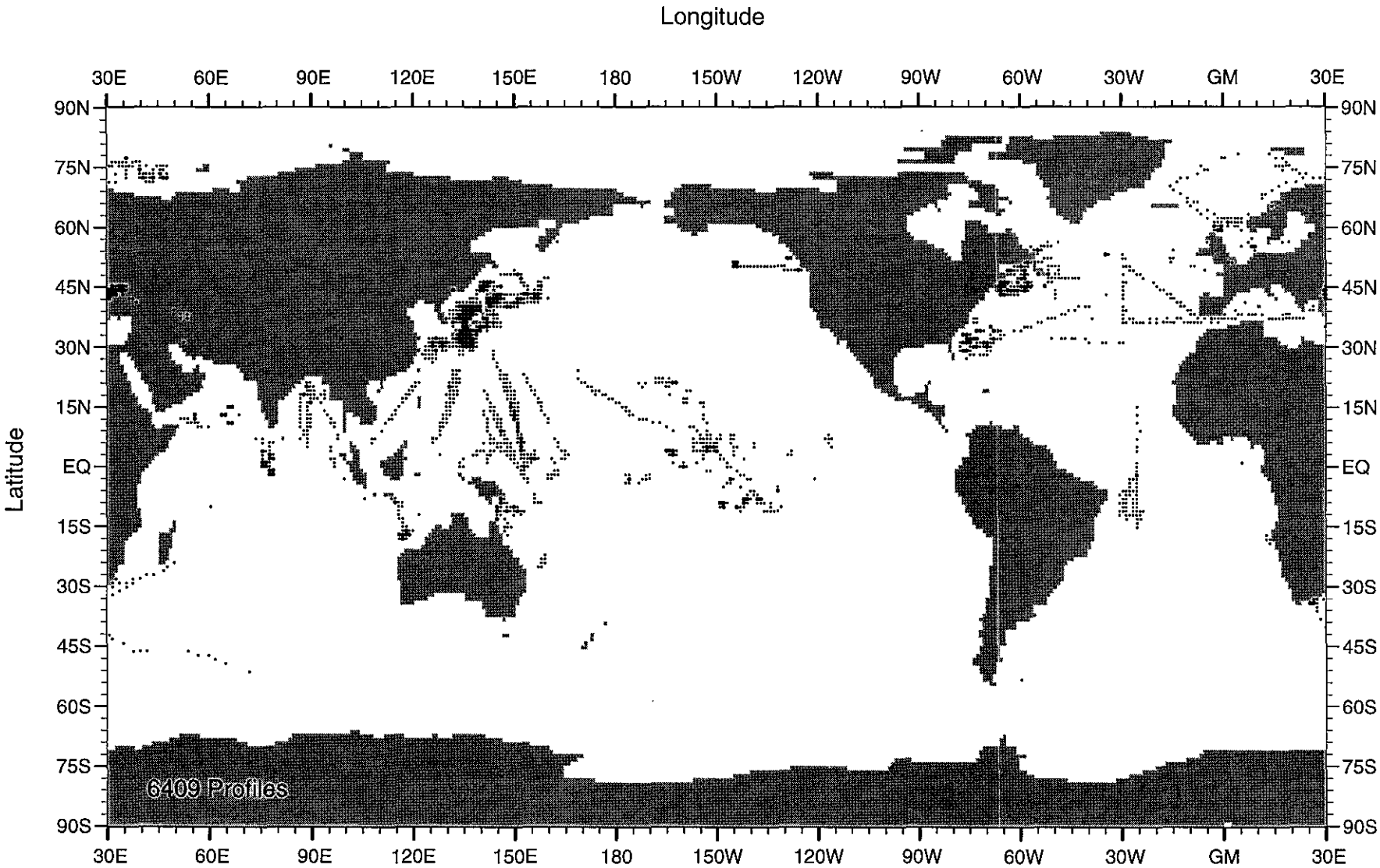

Fig. B147 WOD98 MBT profile distribution for July-September for 1977

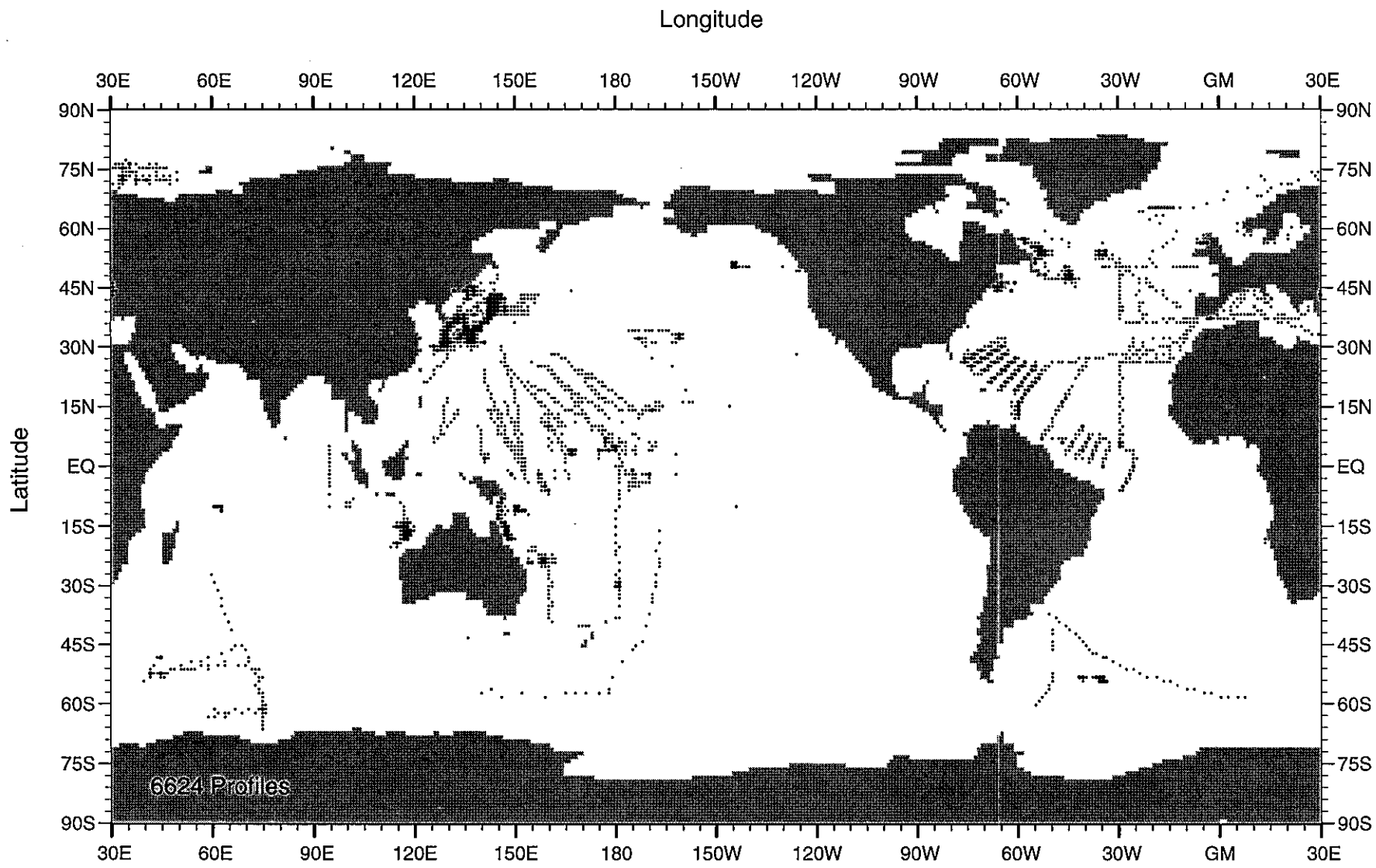

Fig. B148 WOD98 MBT profile distribution for October-December for 1977

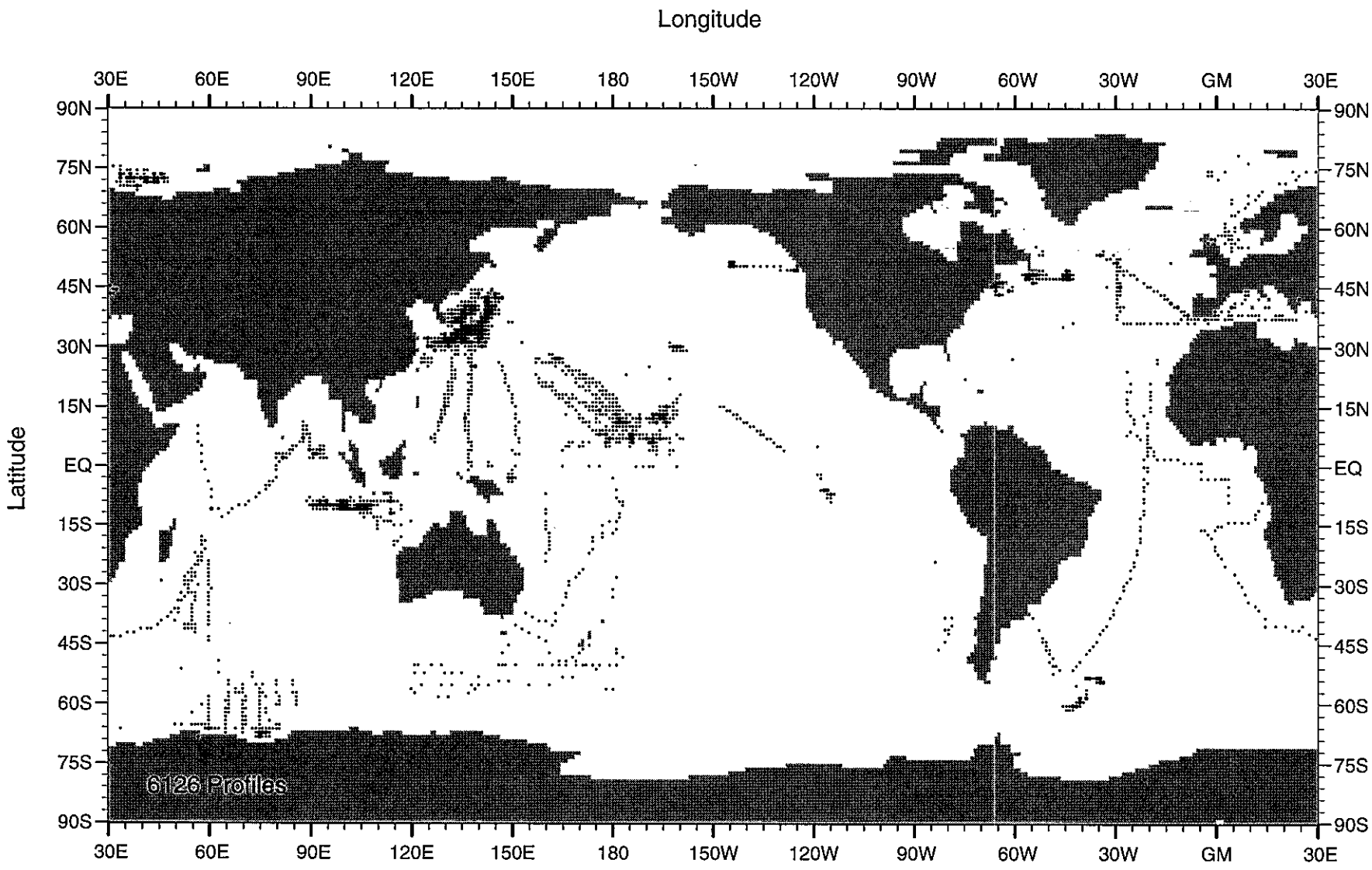

Fig. B149 WOD98 MBT profile distribution for January-March for 1978

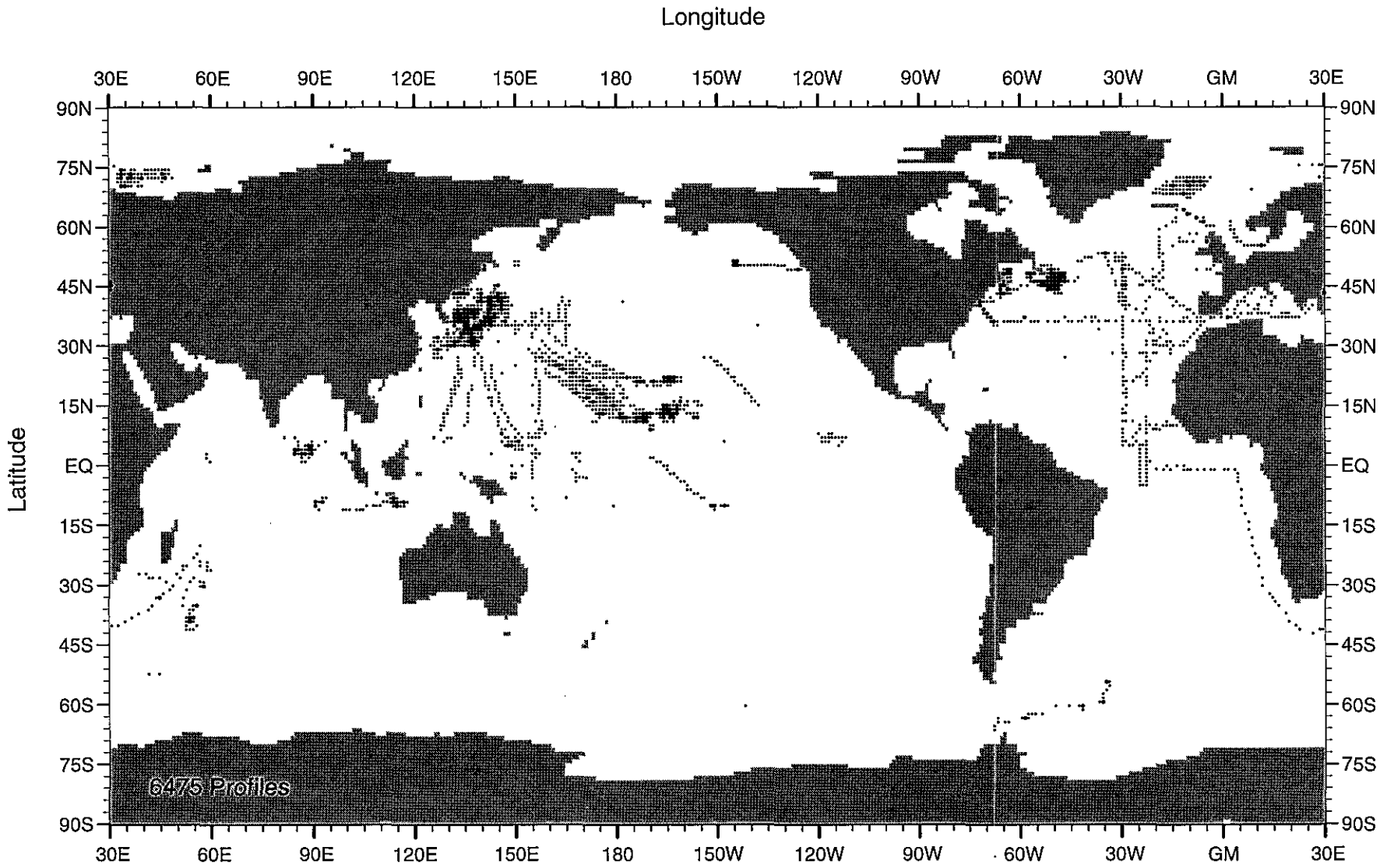

Fig. B150 WOD98 MBT profile distribution for April-June for 1978

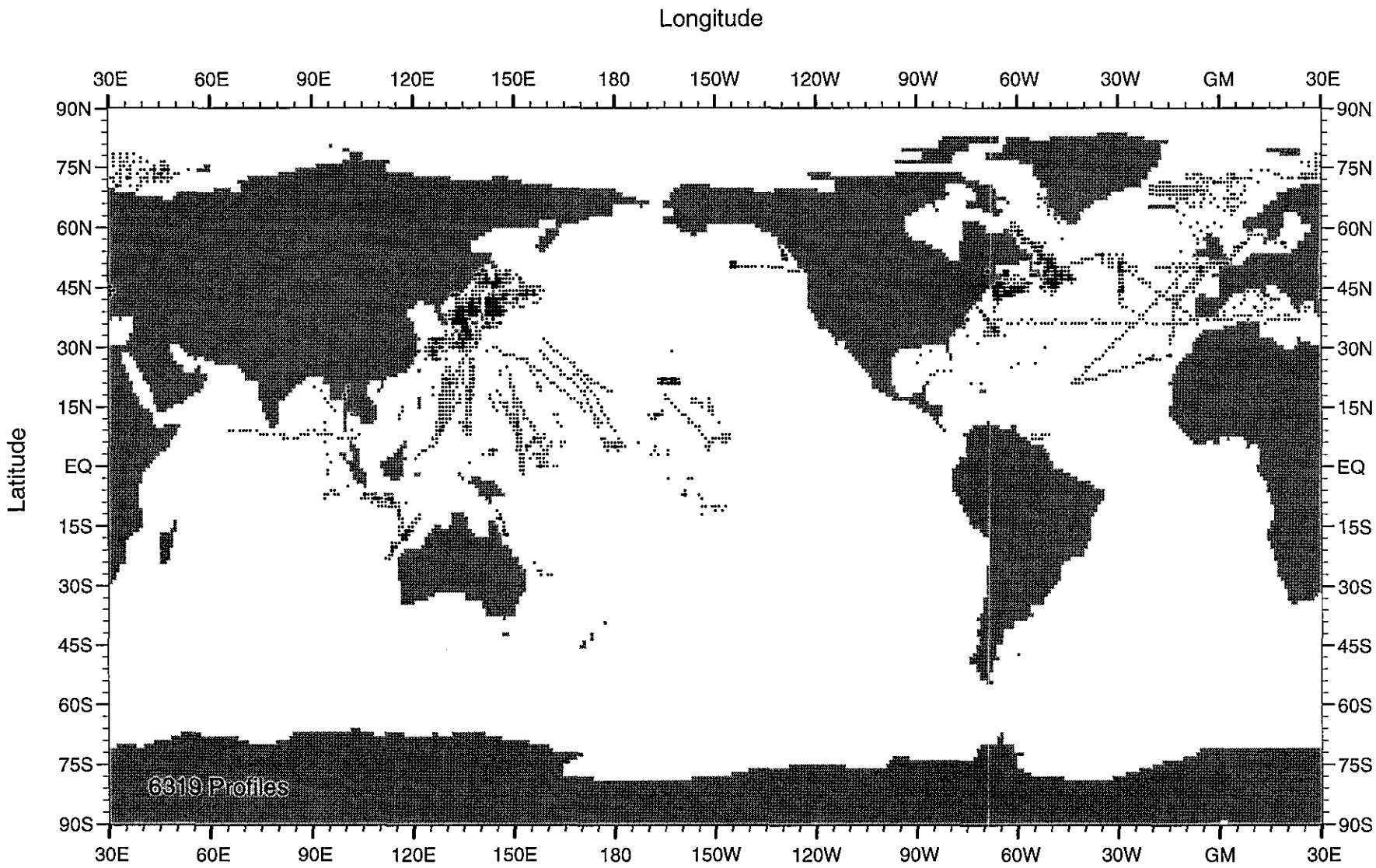

Fig. B151 WOD98 MBT profile distribution for July-September for 1978

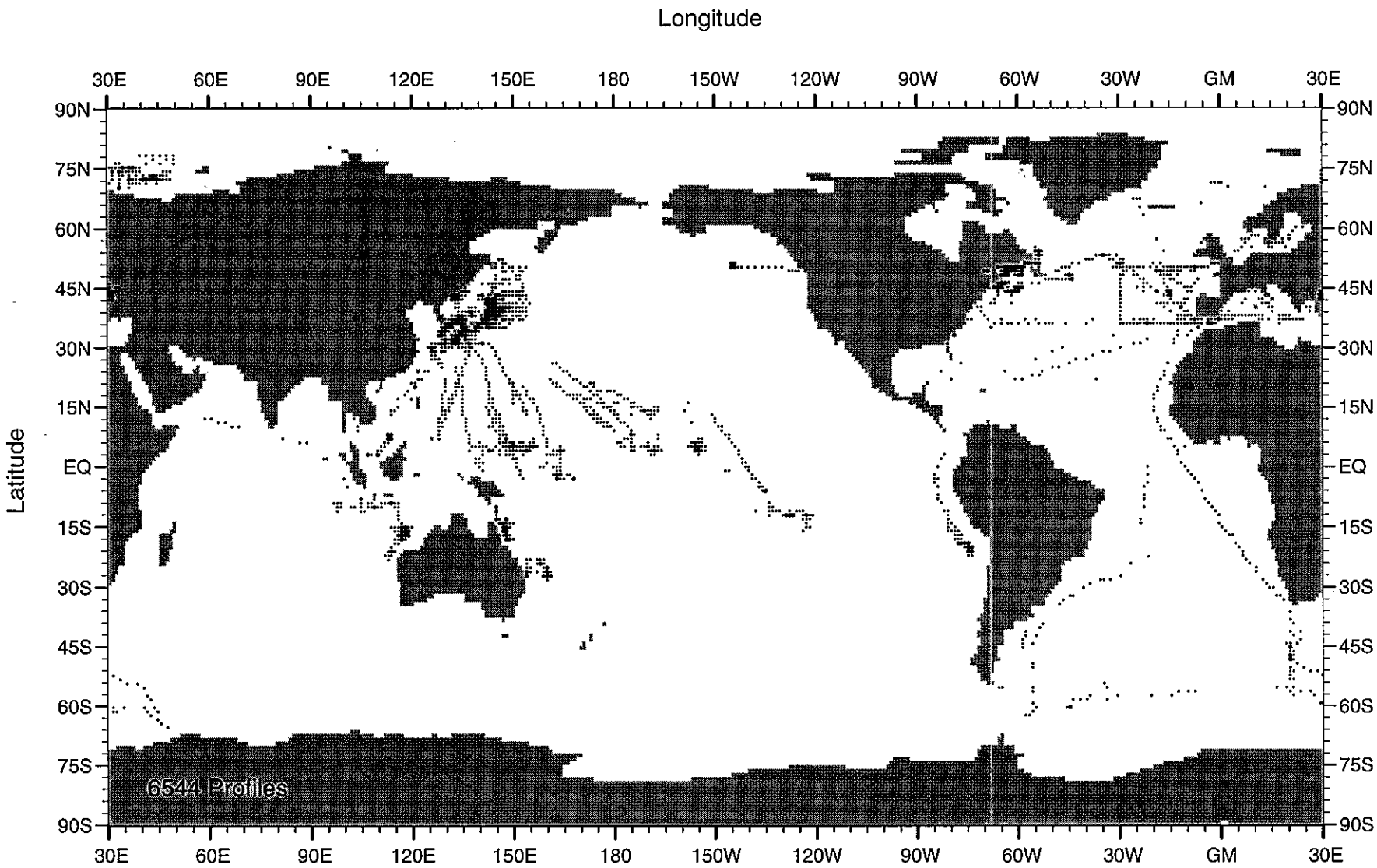

Fig. B152 WOD98 MBT profile distribution for October-December for 1978

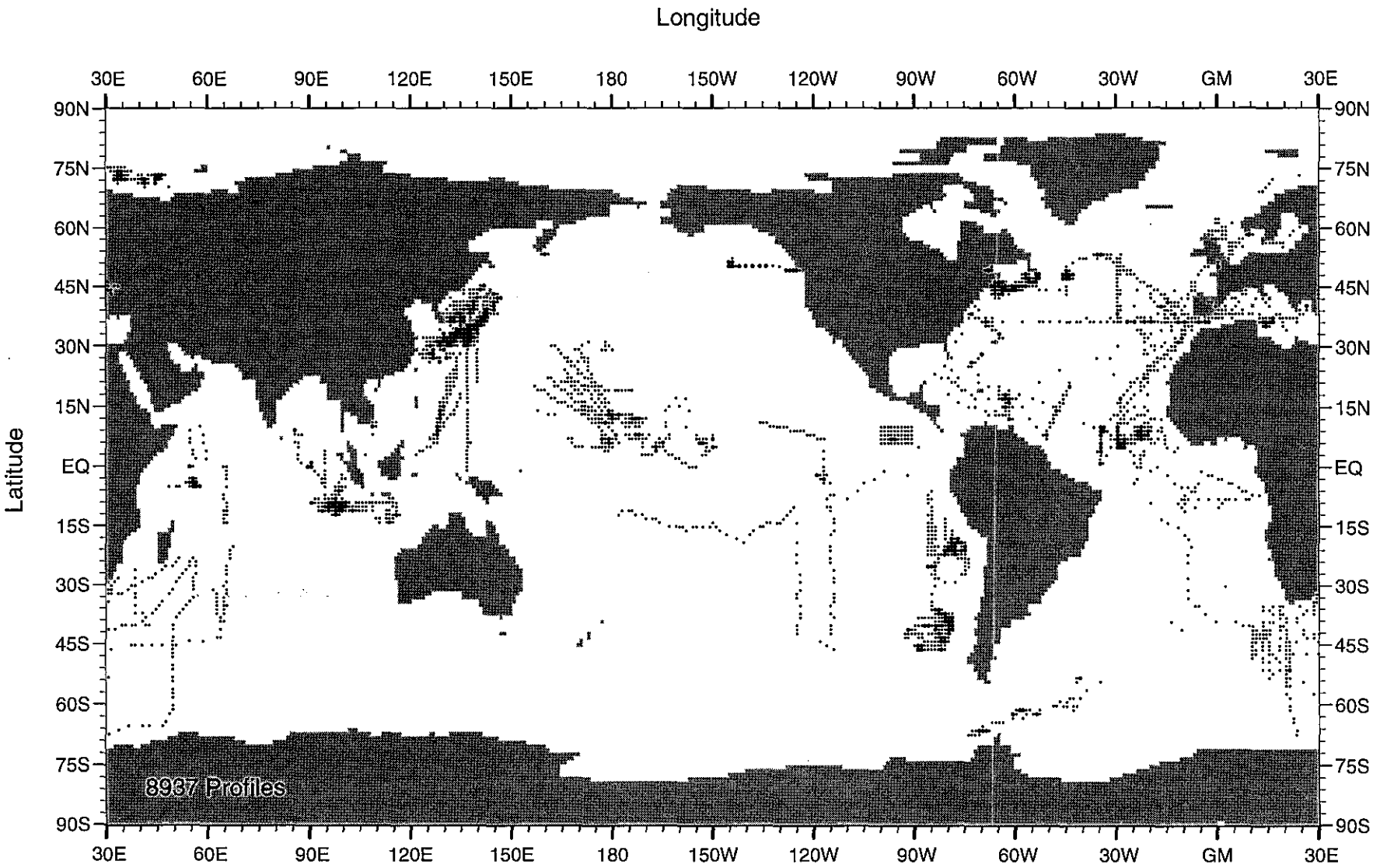

Fig. B153 WOD98 MBT profile distribution for January-March for 1979

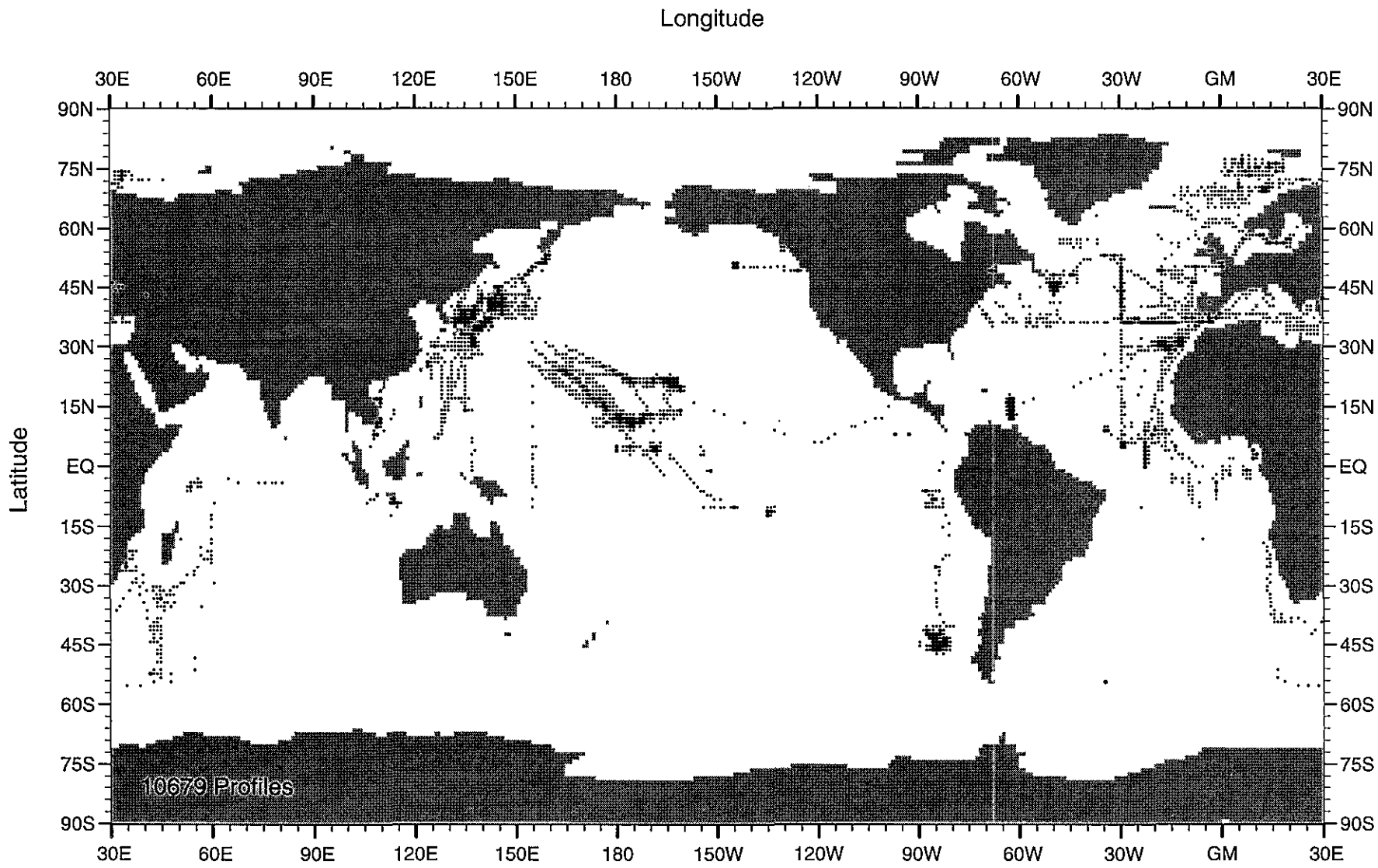

Fig. B154 WOD98 MBT profile distribution for April-June for 1979

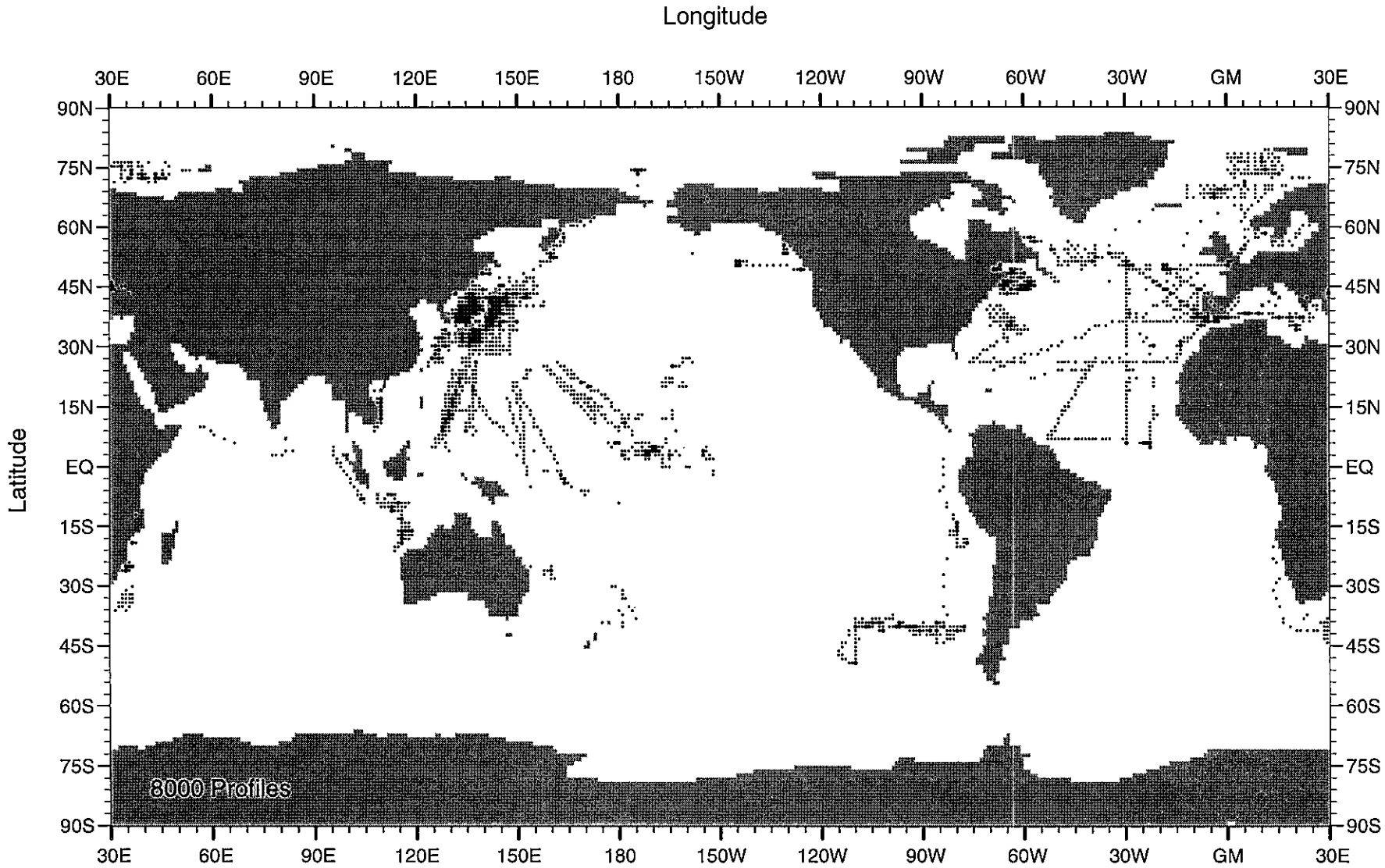

Fig. B155 WOD98 MBT profile distribution for July-September for 1979

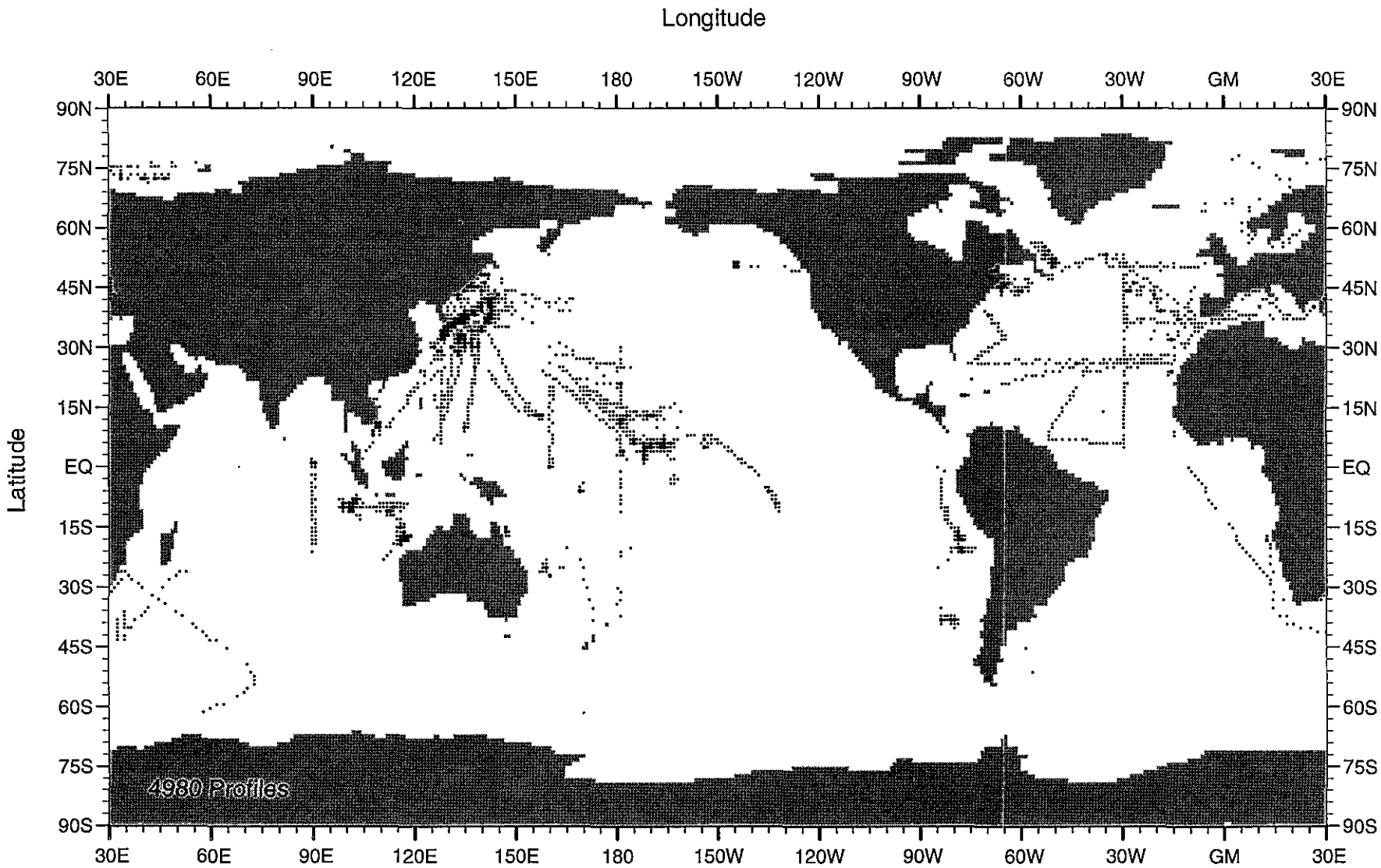

Fig. B156 WOD98 MBT profile distribution for October-December for 1979

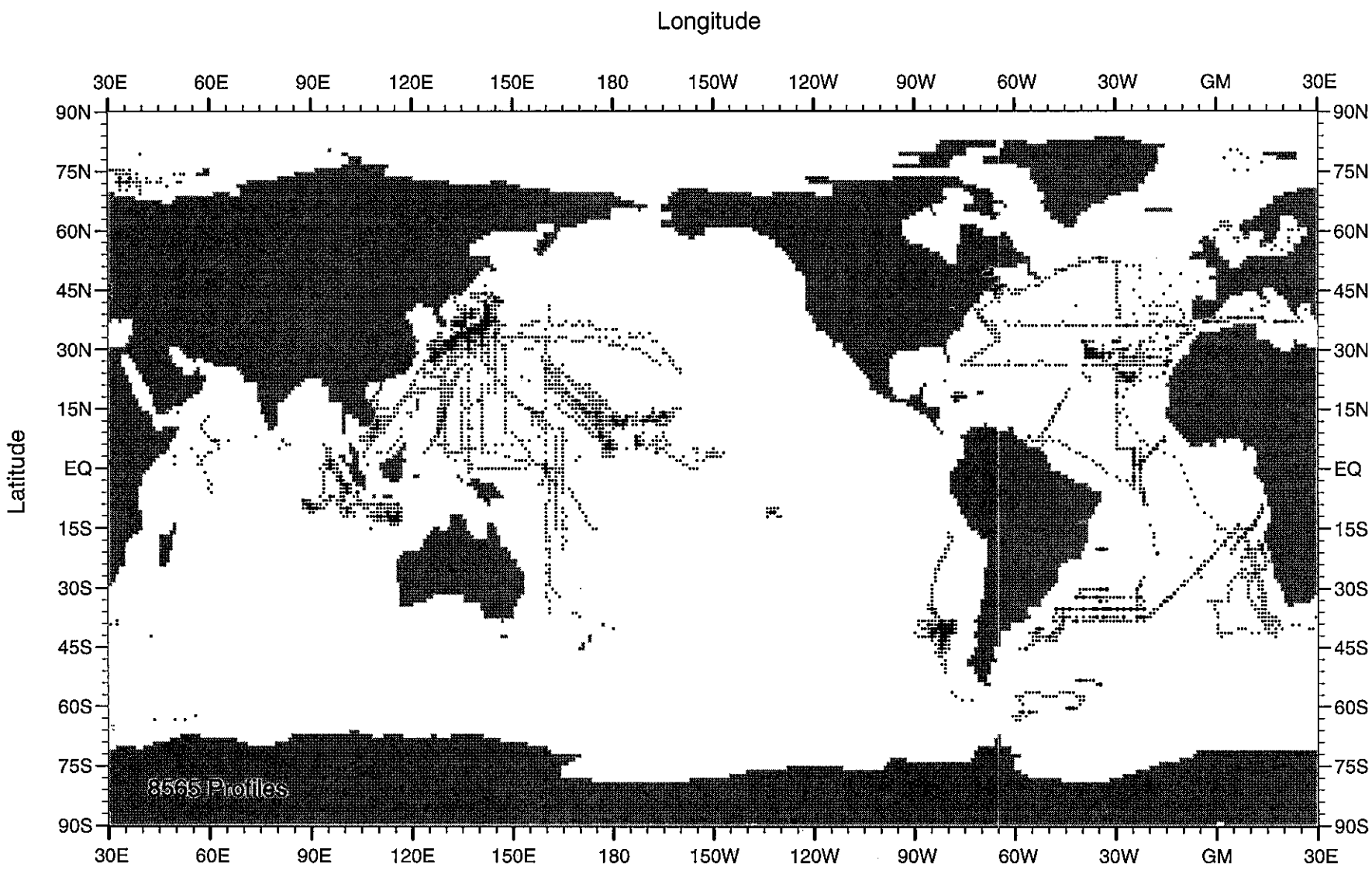

Fig. B157 WOD98 MBT profile distribution for January-March for 1980

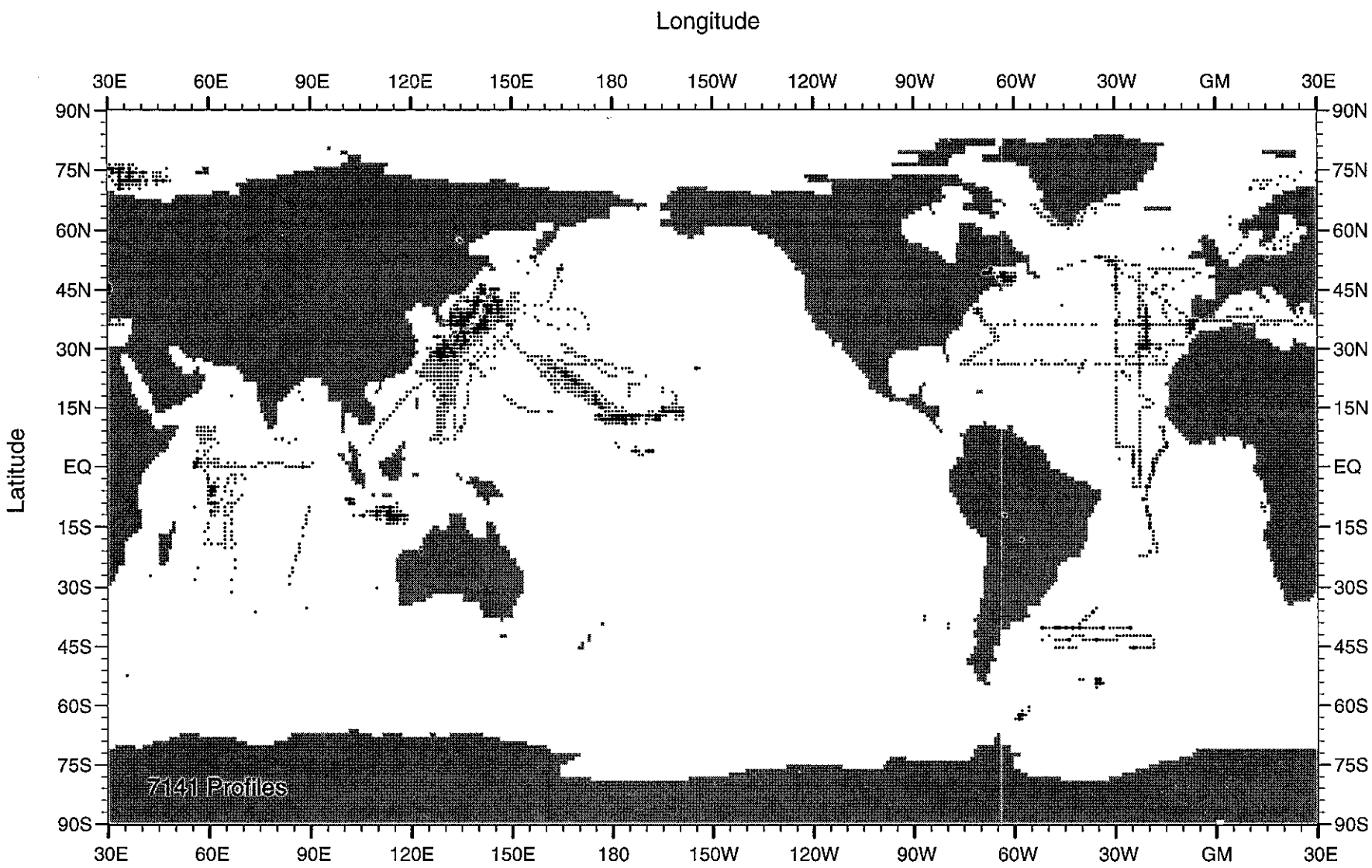

Fig. B158 WOD98 MBT profile distribution for April-June for 1980

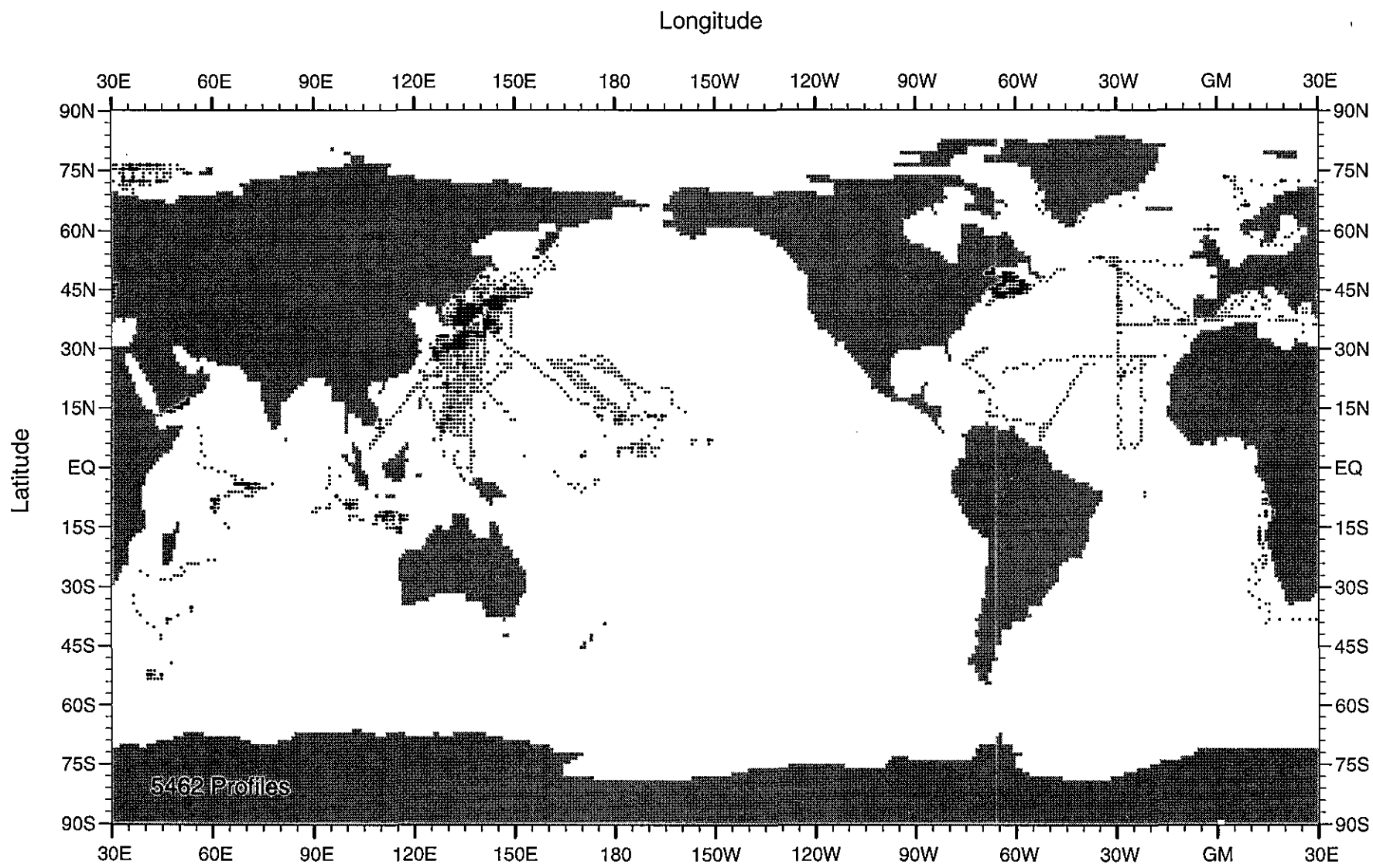

Fig. B159 WOD98 MBT profile distribution for July-September for 1980

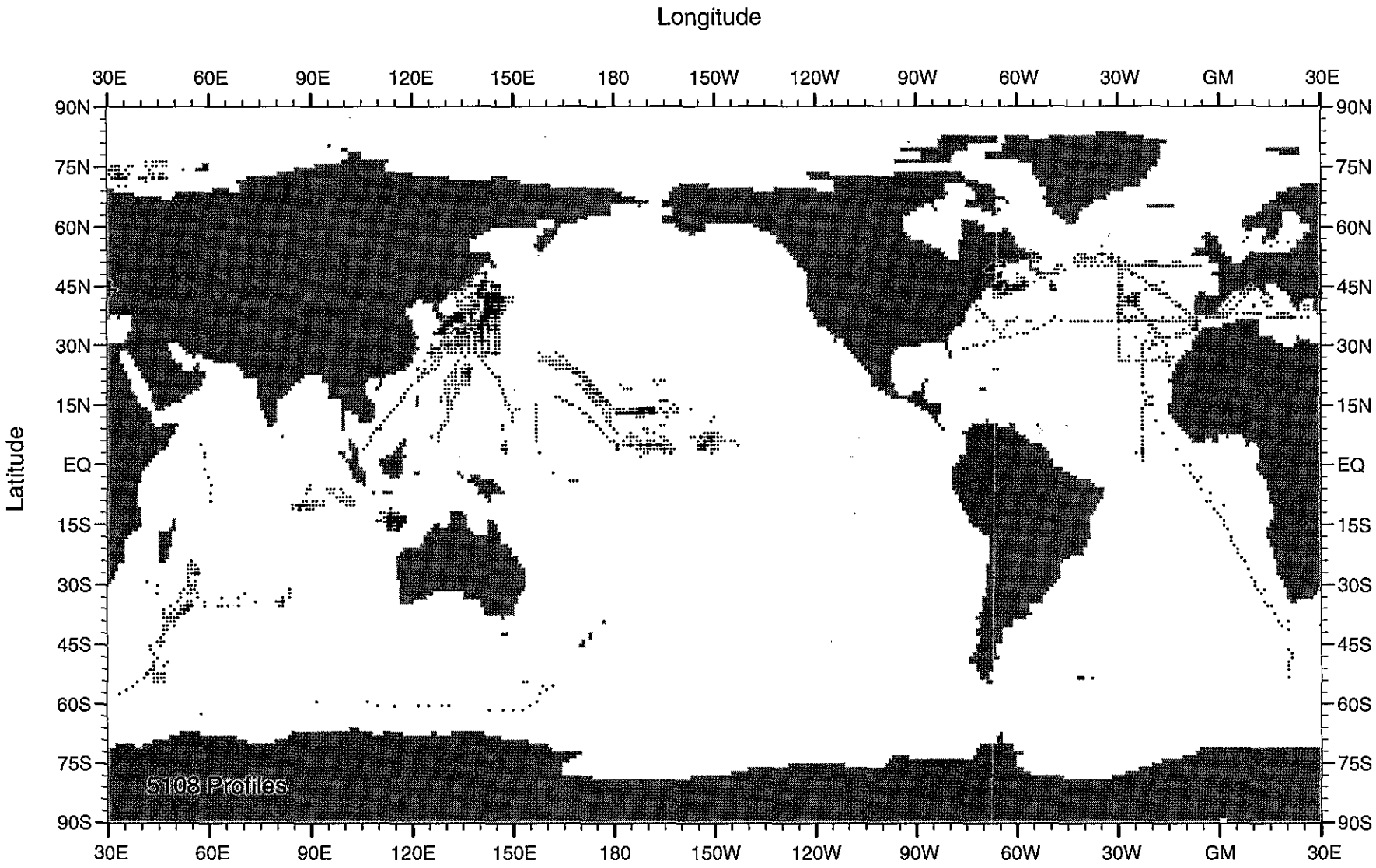

Fig. B160 WOD98 MBT profile distribution for October-December for 1980

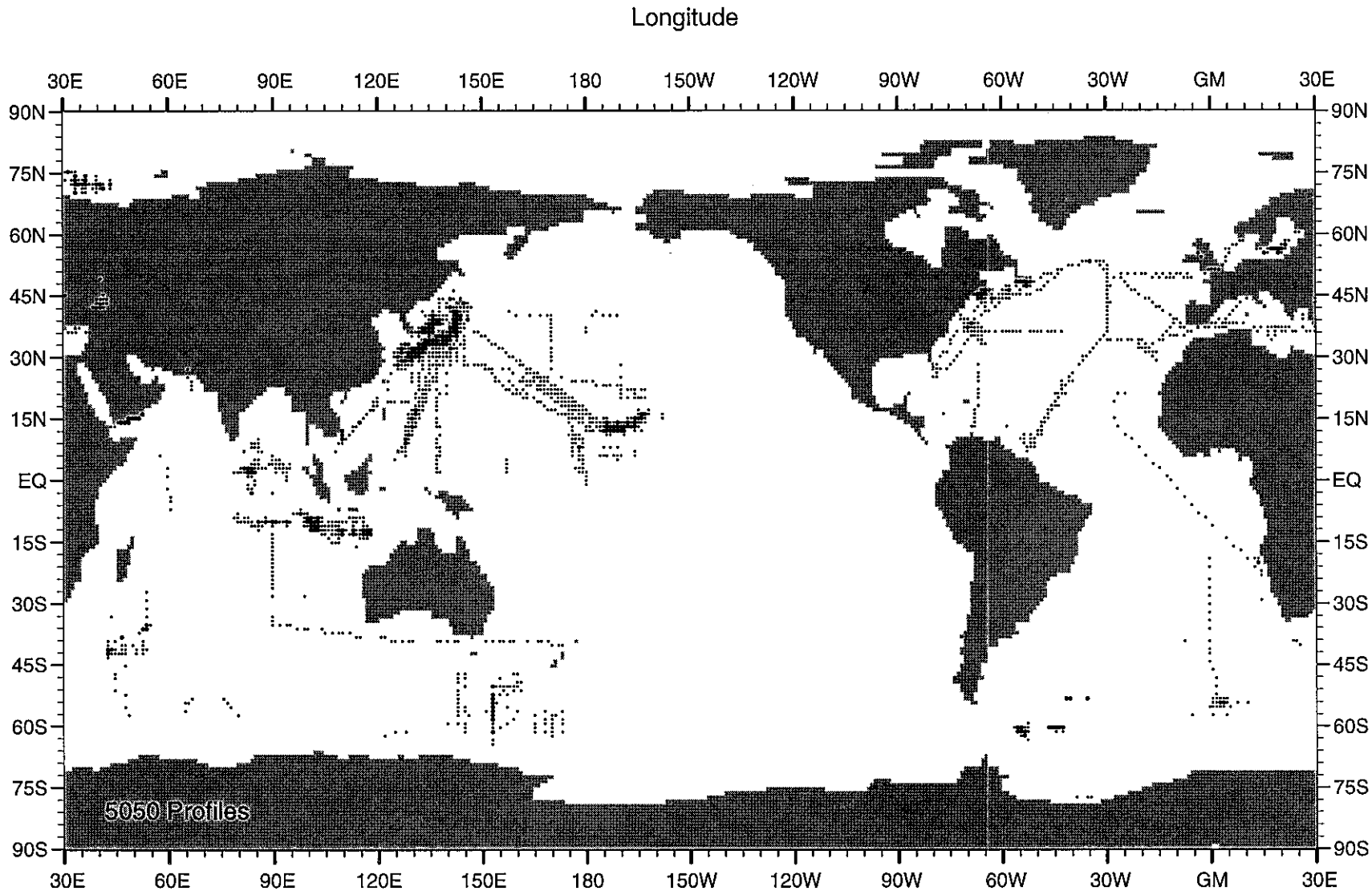

Fig. B161 WOD98 MBT profile distribution for January-March for 1981

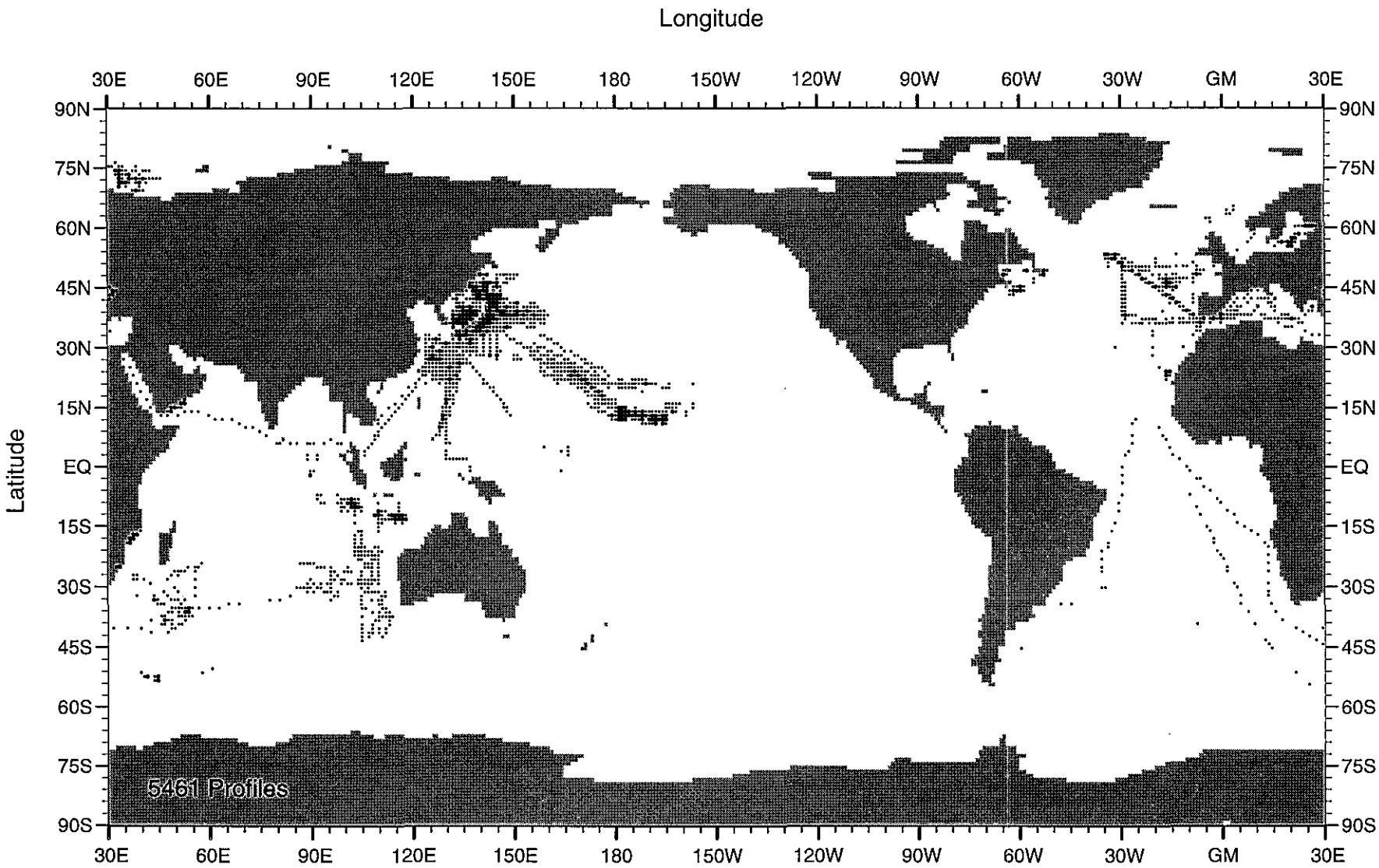

Fig. B162 WOD98 MBT profile distribution for April-June for 1981

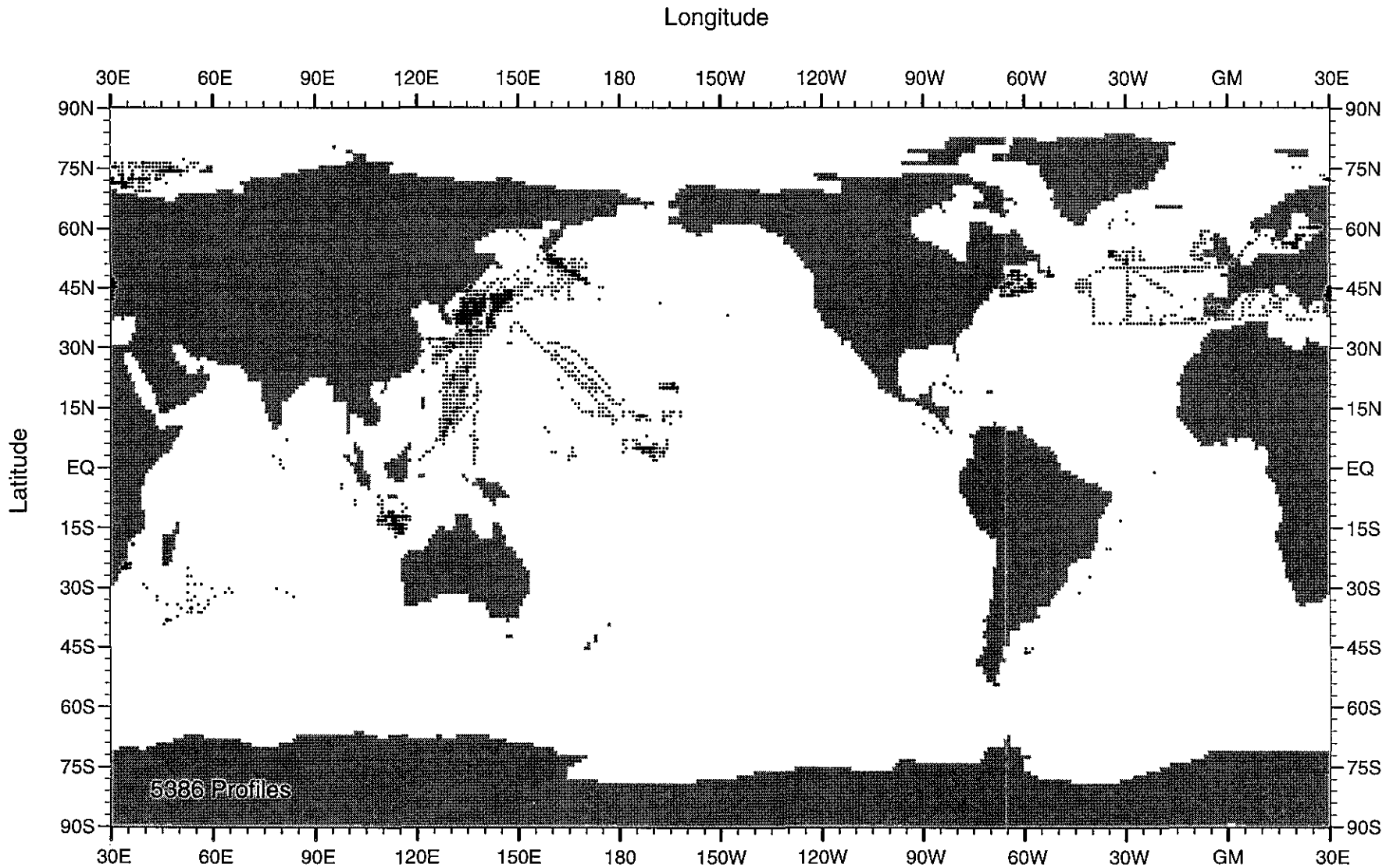

Fig. B163 WOD98 MBT profile distribution for July-September for 1981

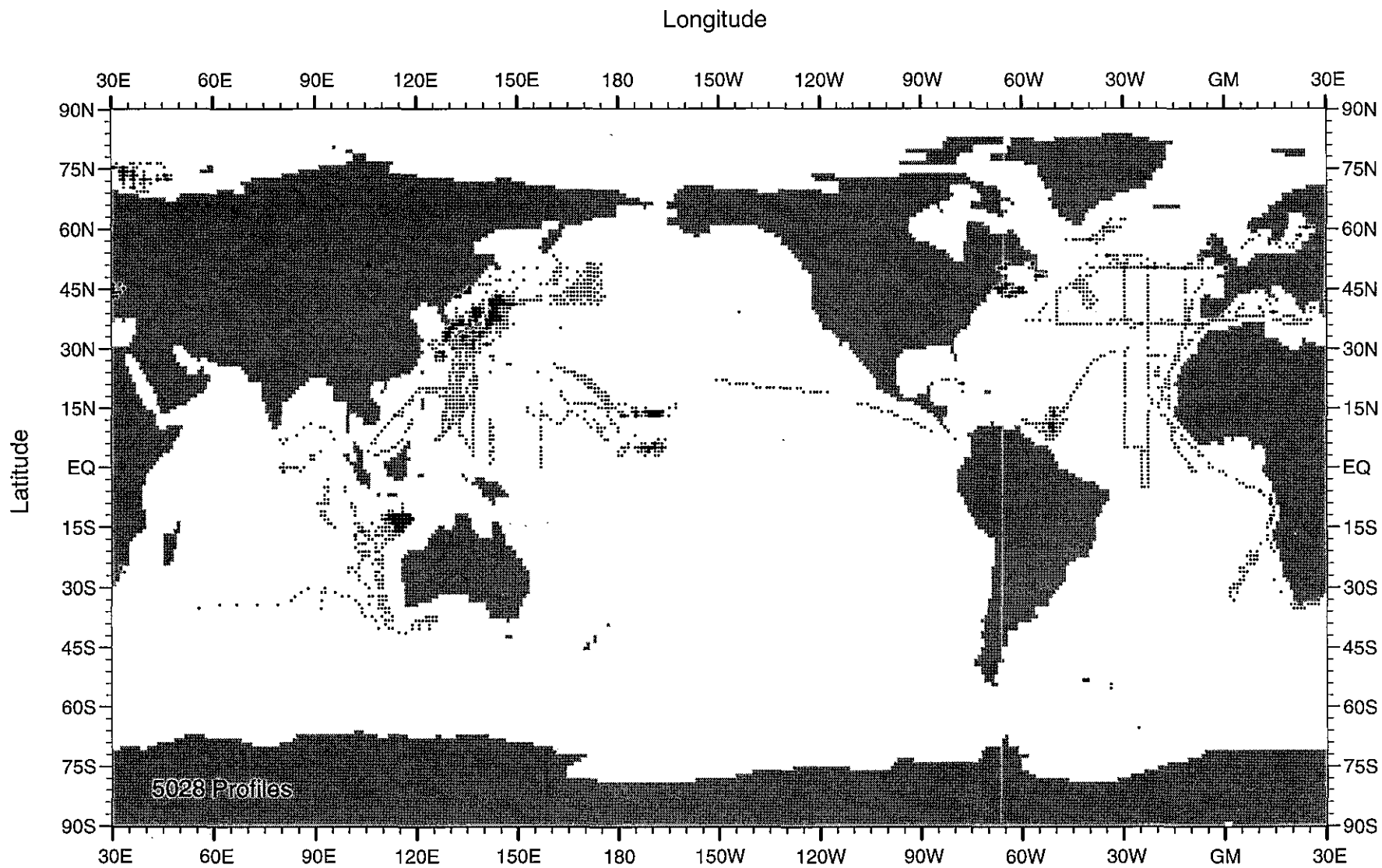

Fig. B164 WOD98 MBT profile distribution for October-December for 1981

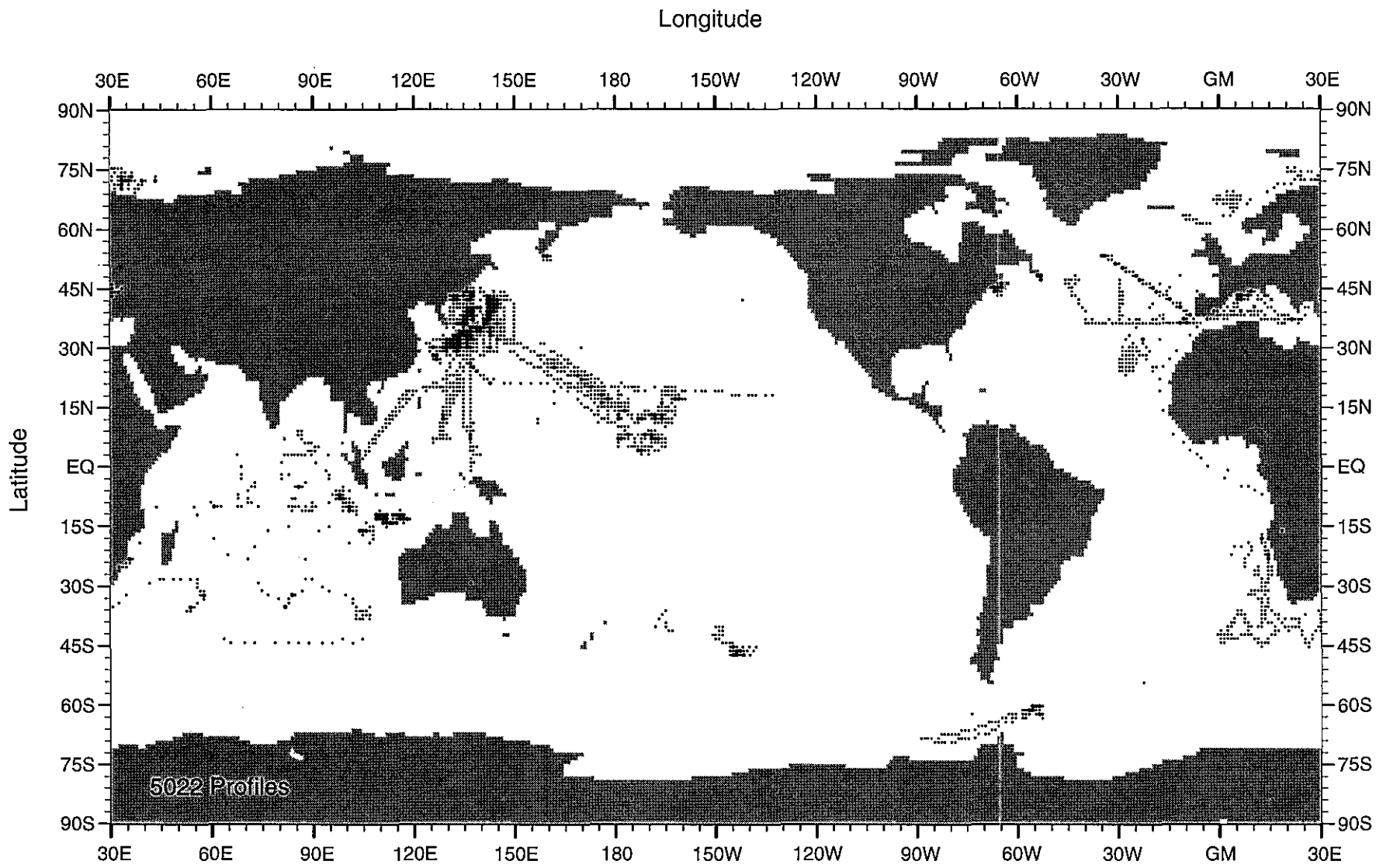

Fig. B165 WOD98 MBT profile distribution for January-March for 1982

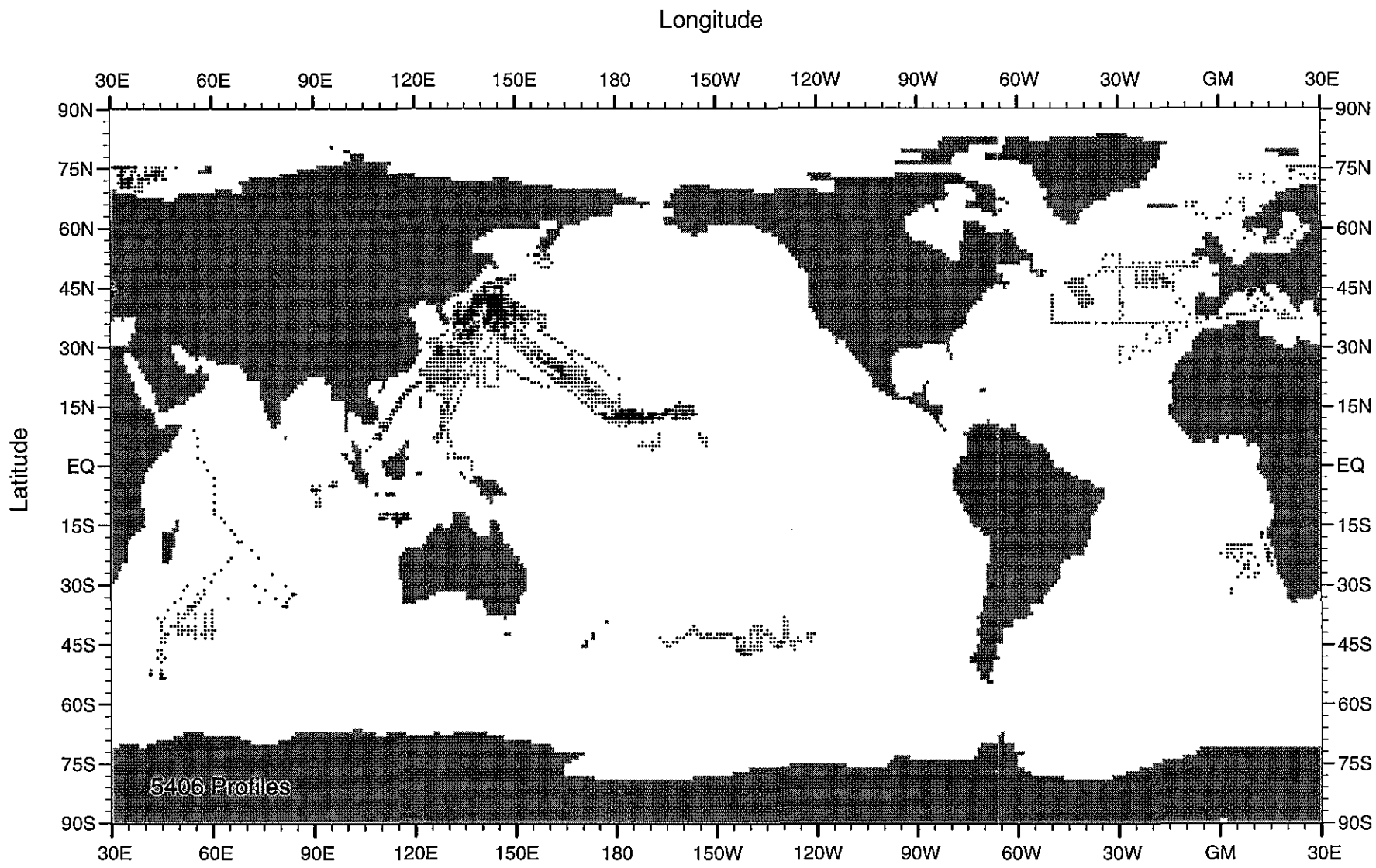

Fig. B166 WOD98 MBT profile distribution for April-June for 1982

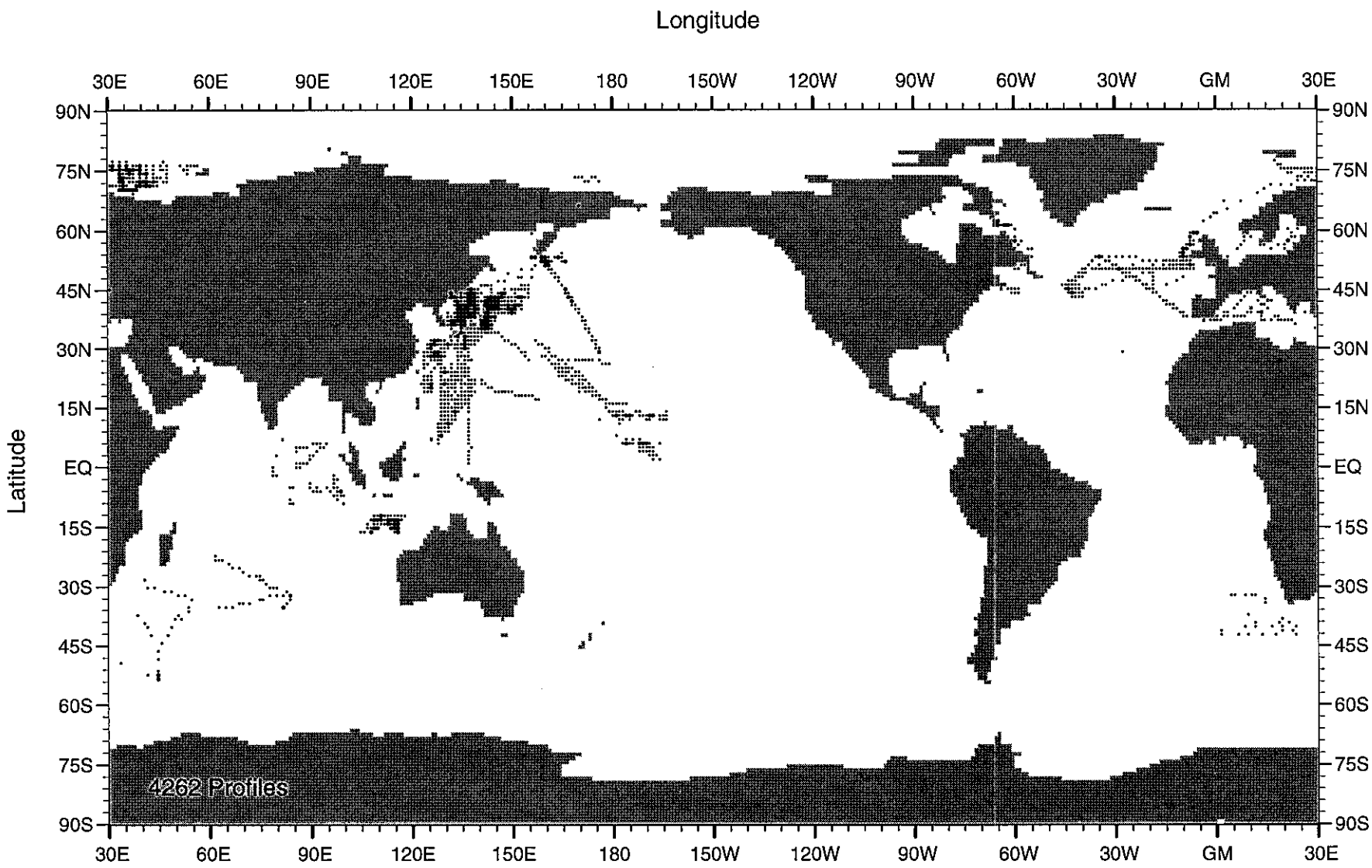

Fig. B167 WOD98 MBT profile distribution for July-September for 1982

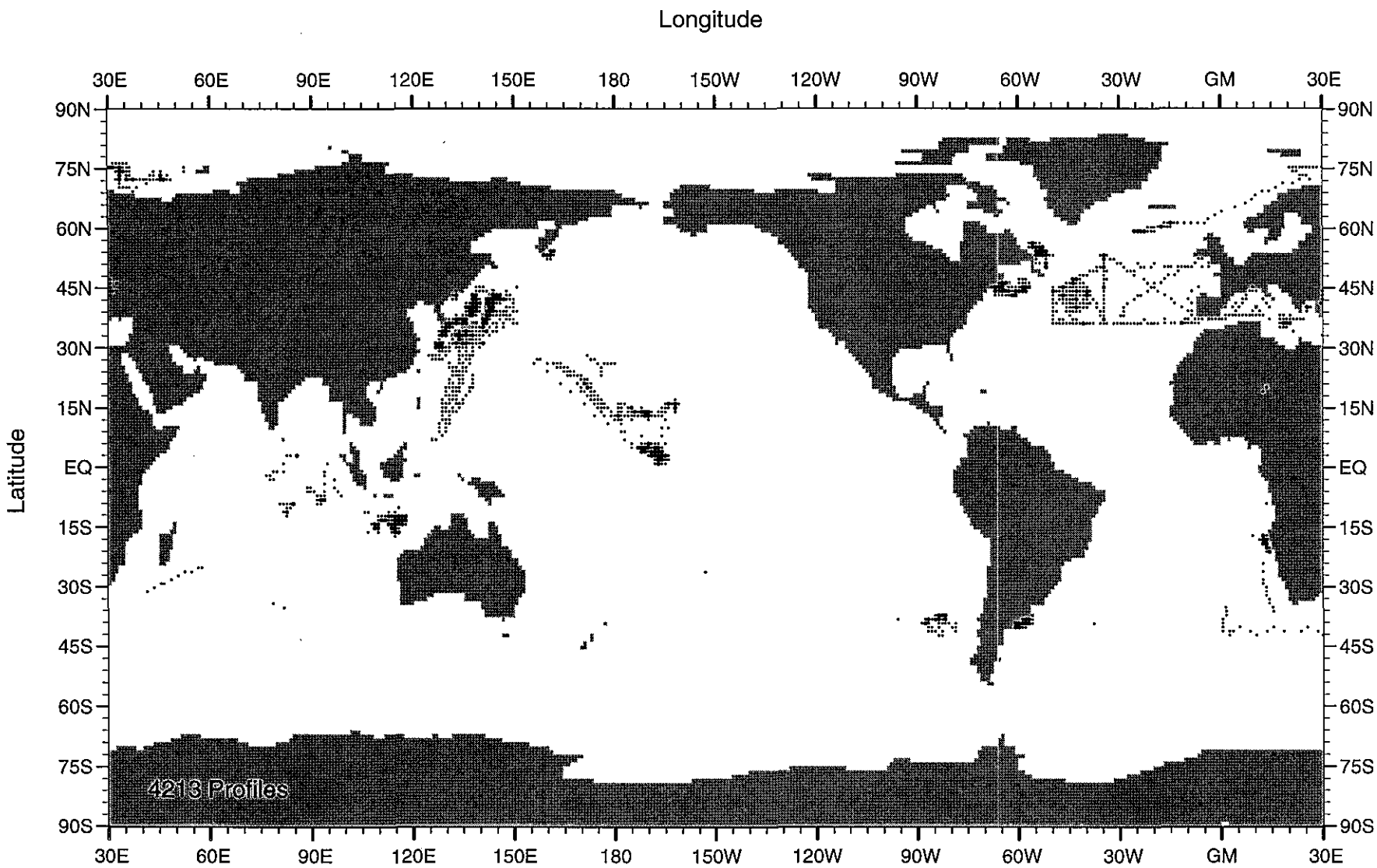

Fig. B168 WOD98 MBT profile distribution for October-December for 1982

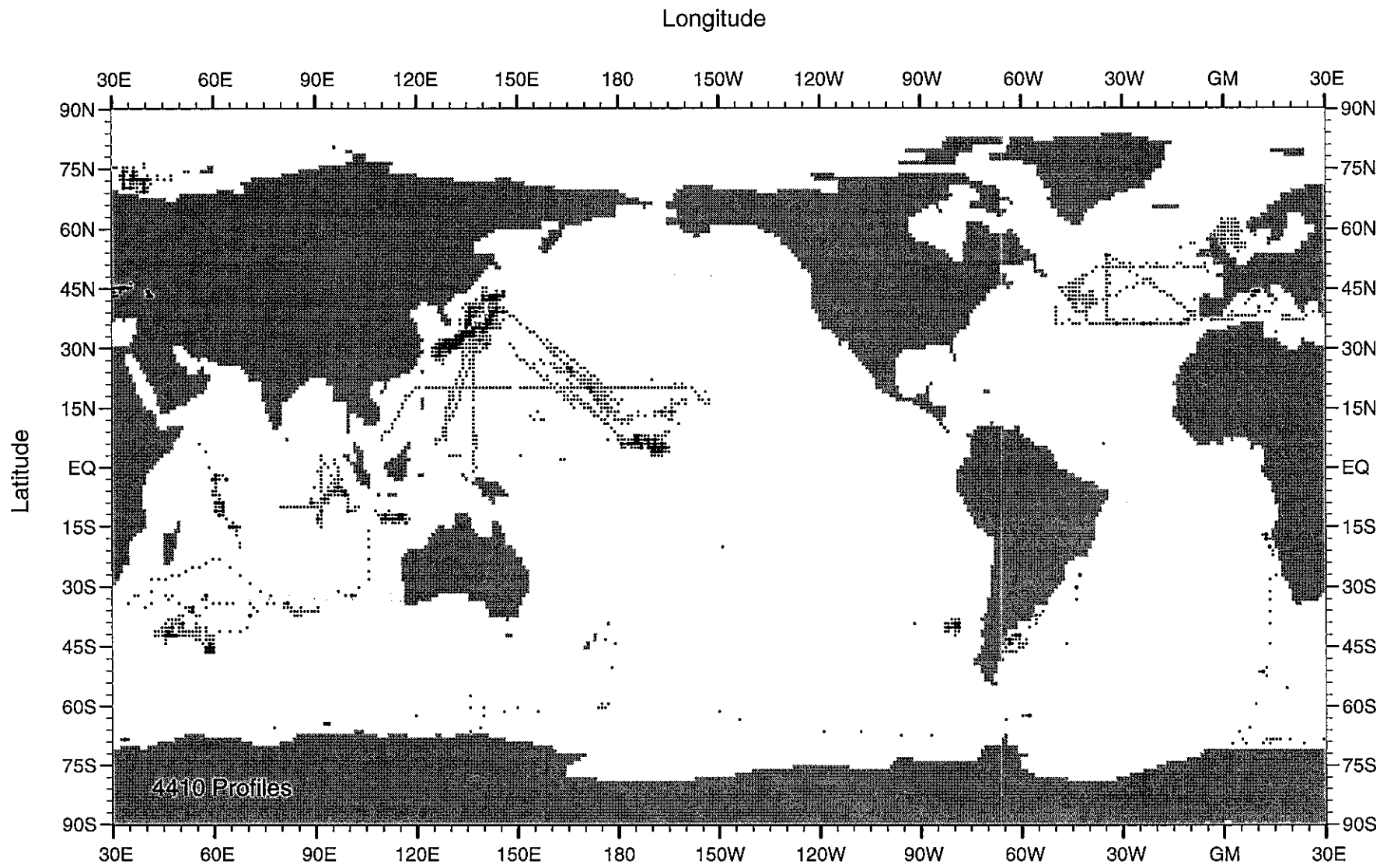

Fig. B169 WOD98 MBT profile distribution for January-March for 1983

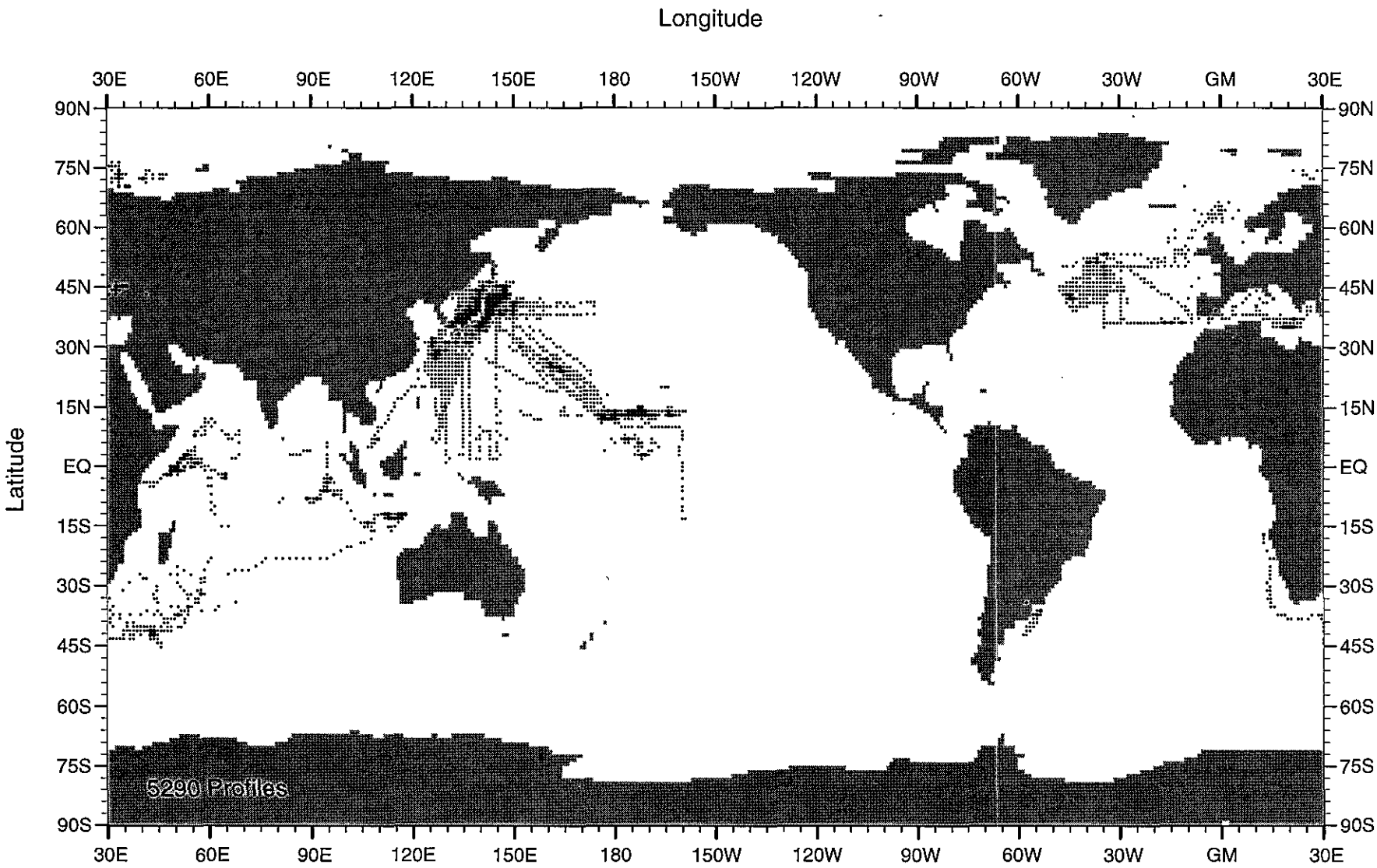

Fig. B170 WOD98 MBT profile distribution for April-June for 1983

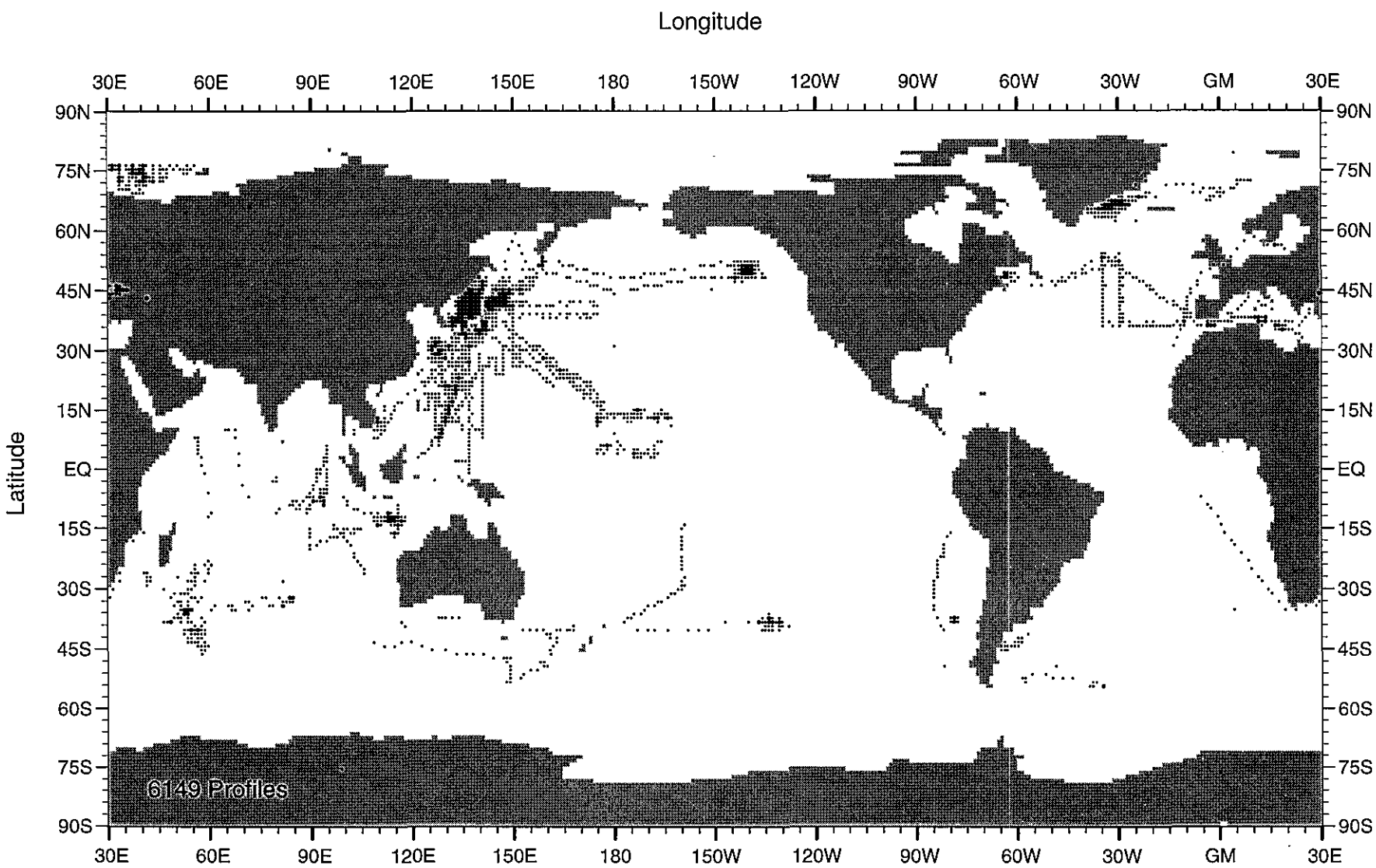

Fig. B171 WOD98 MBT profile distribution for July-September for 1983

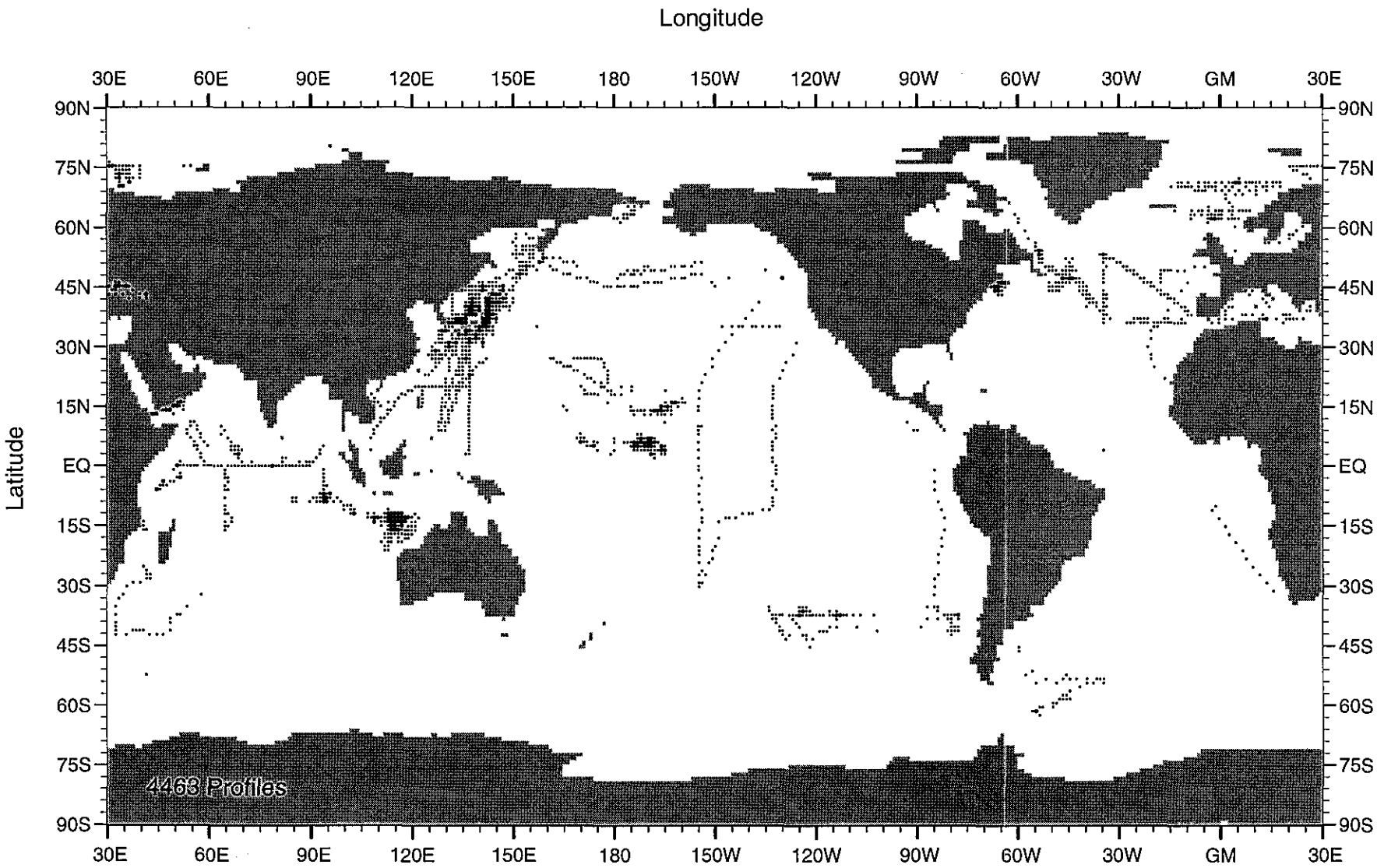

Fig. B172 WOD98 MBT profile distribution for October-December for 1983

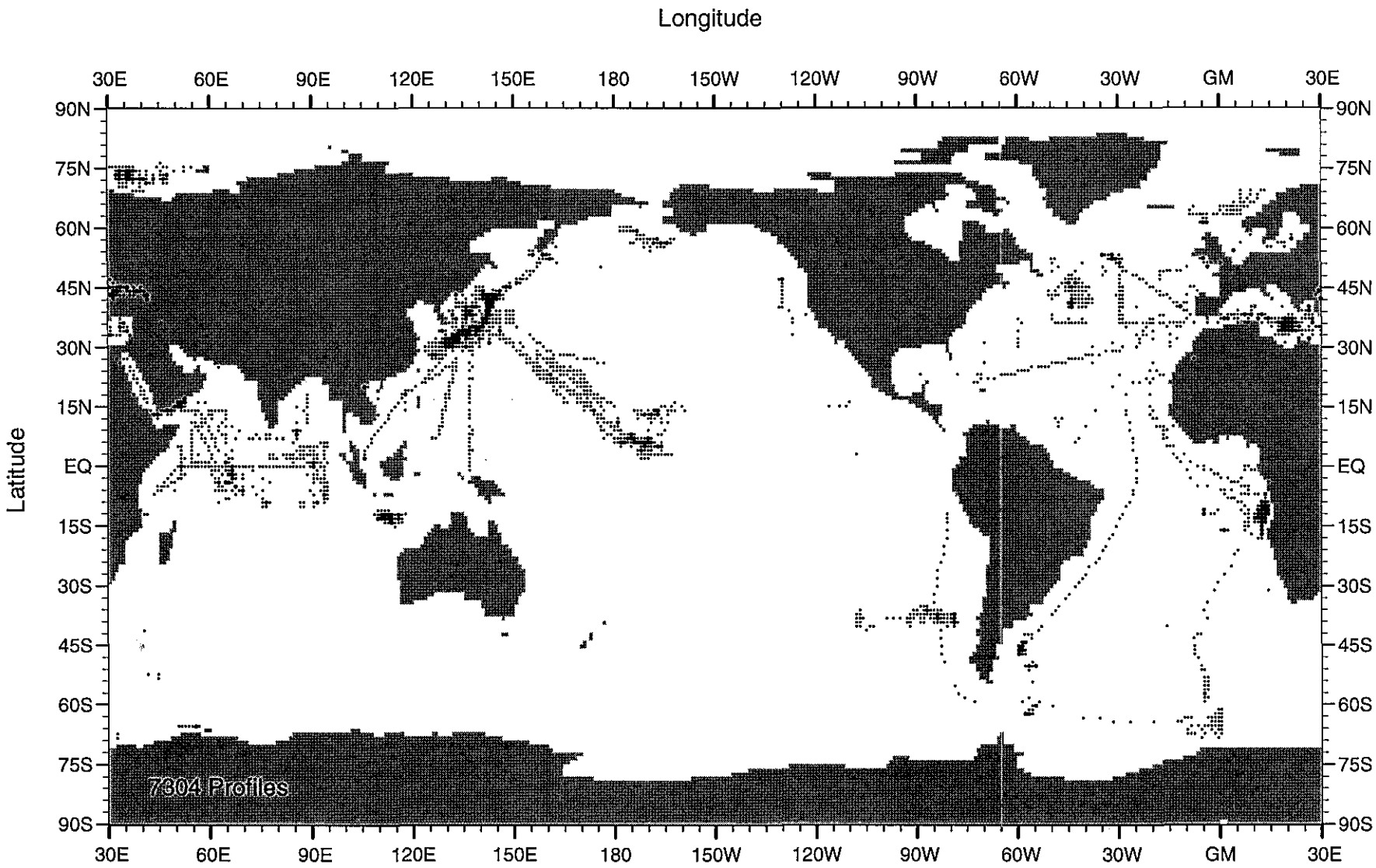

Fig. B173 WOD98 MBT profile distribution for January-March for 1984

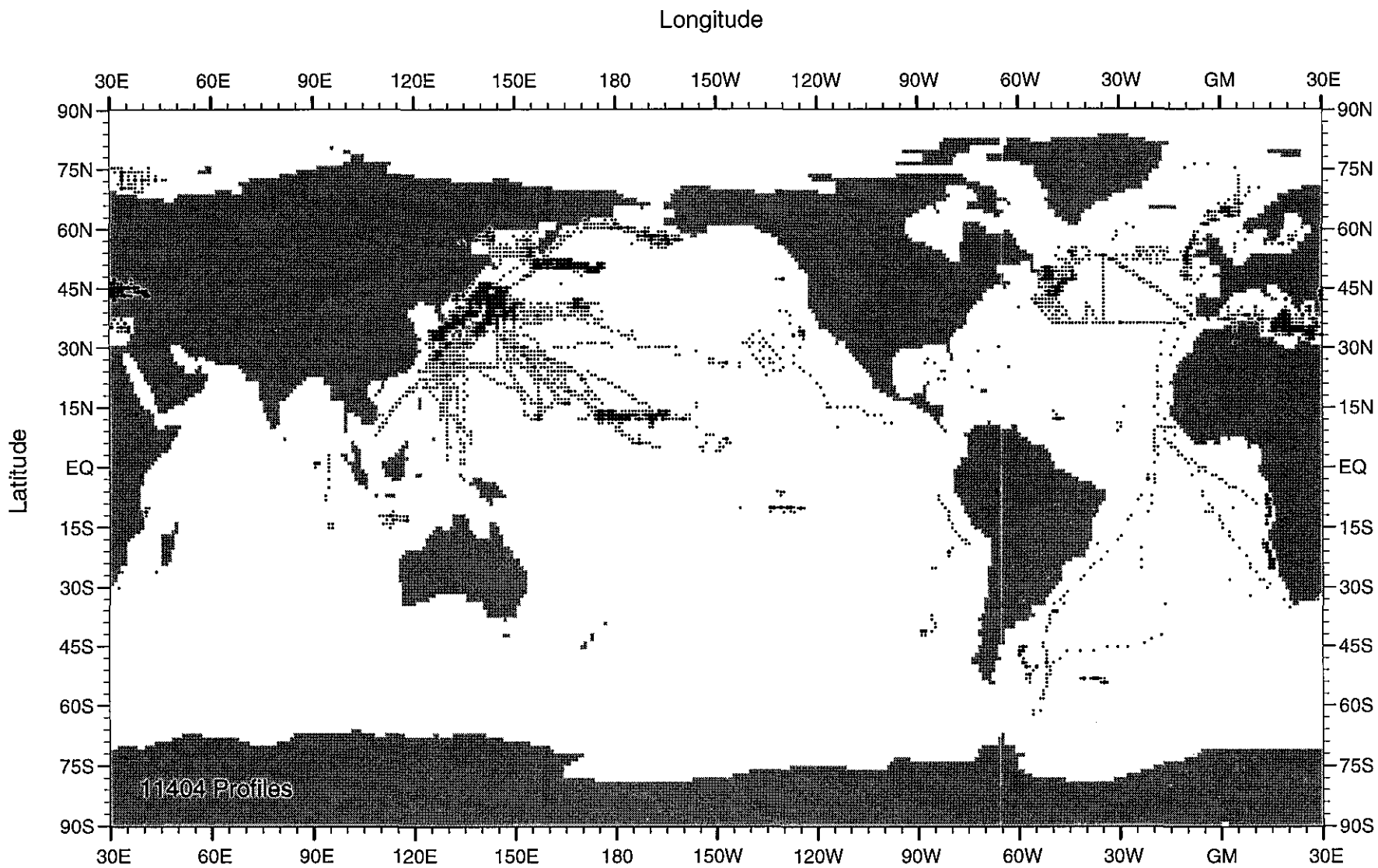

Fig. B174 WOD98 MBT profile distribution for April-June for 1984

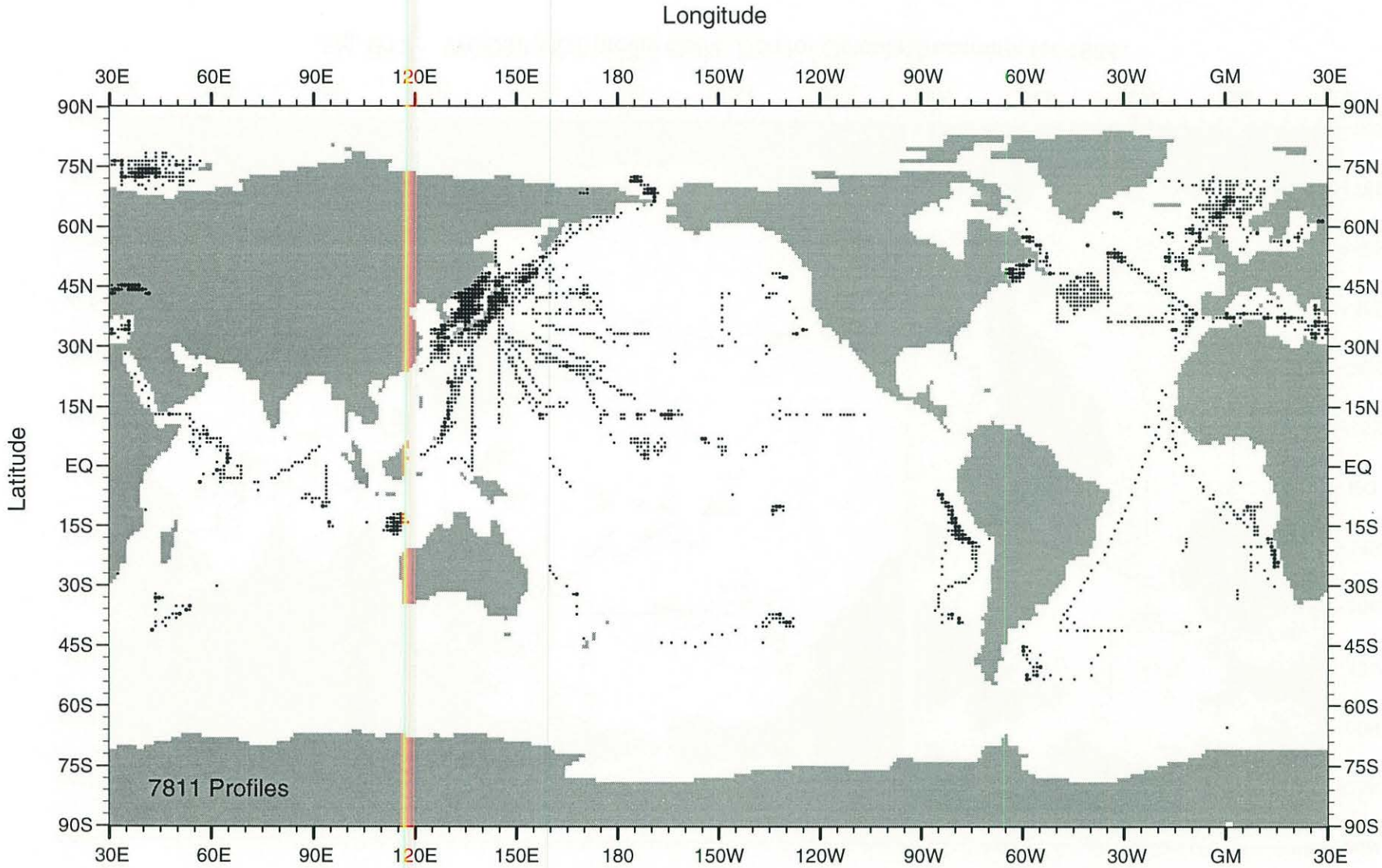

Fig. B175 WOD98 MBT profile distribution for July-September for 1984

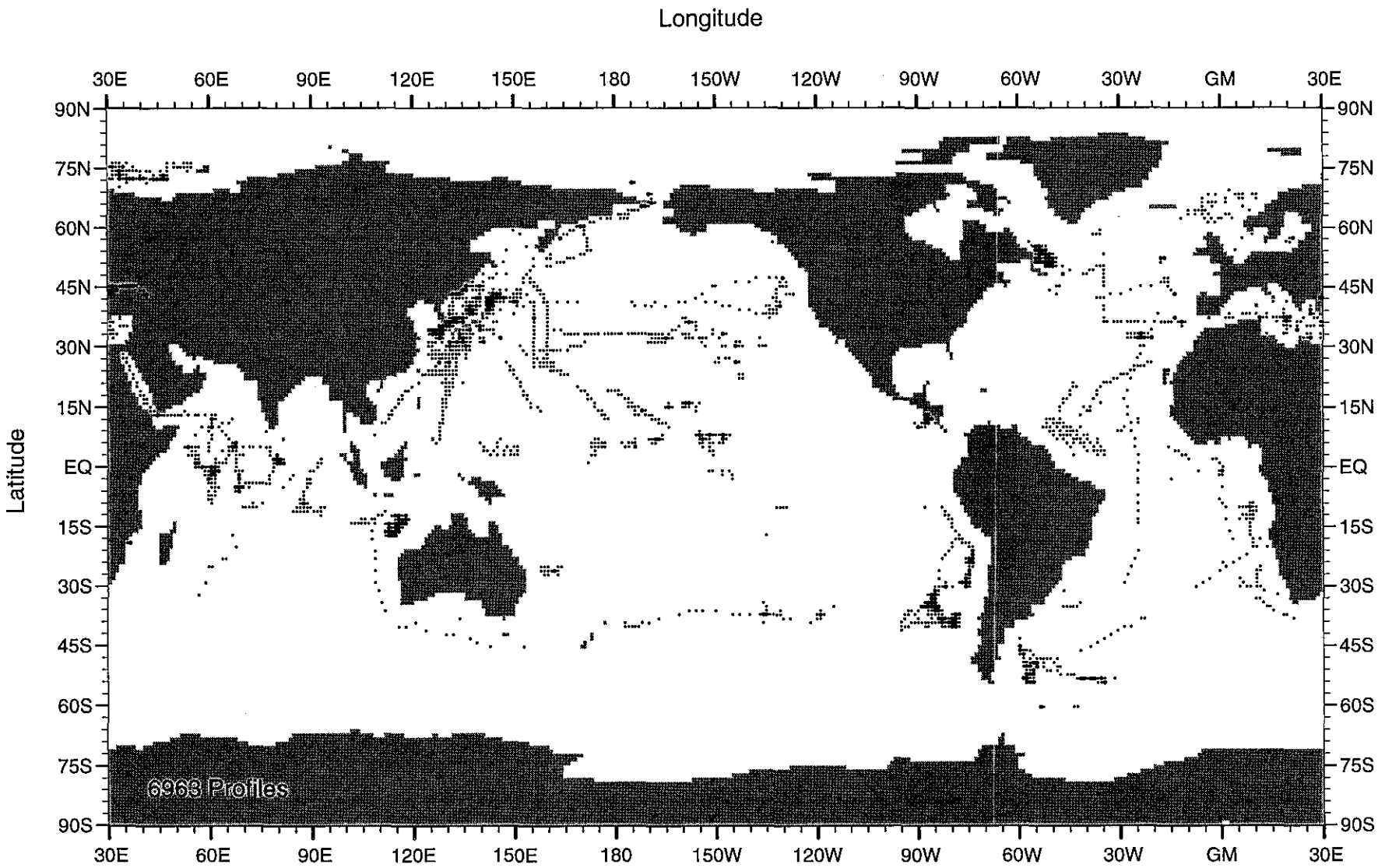

Fig. B176 WOD98 MBT profile distribution for October-December for 1984

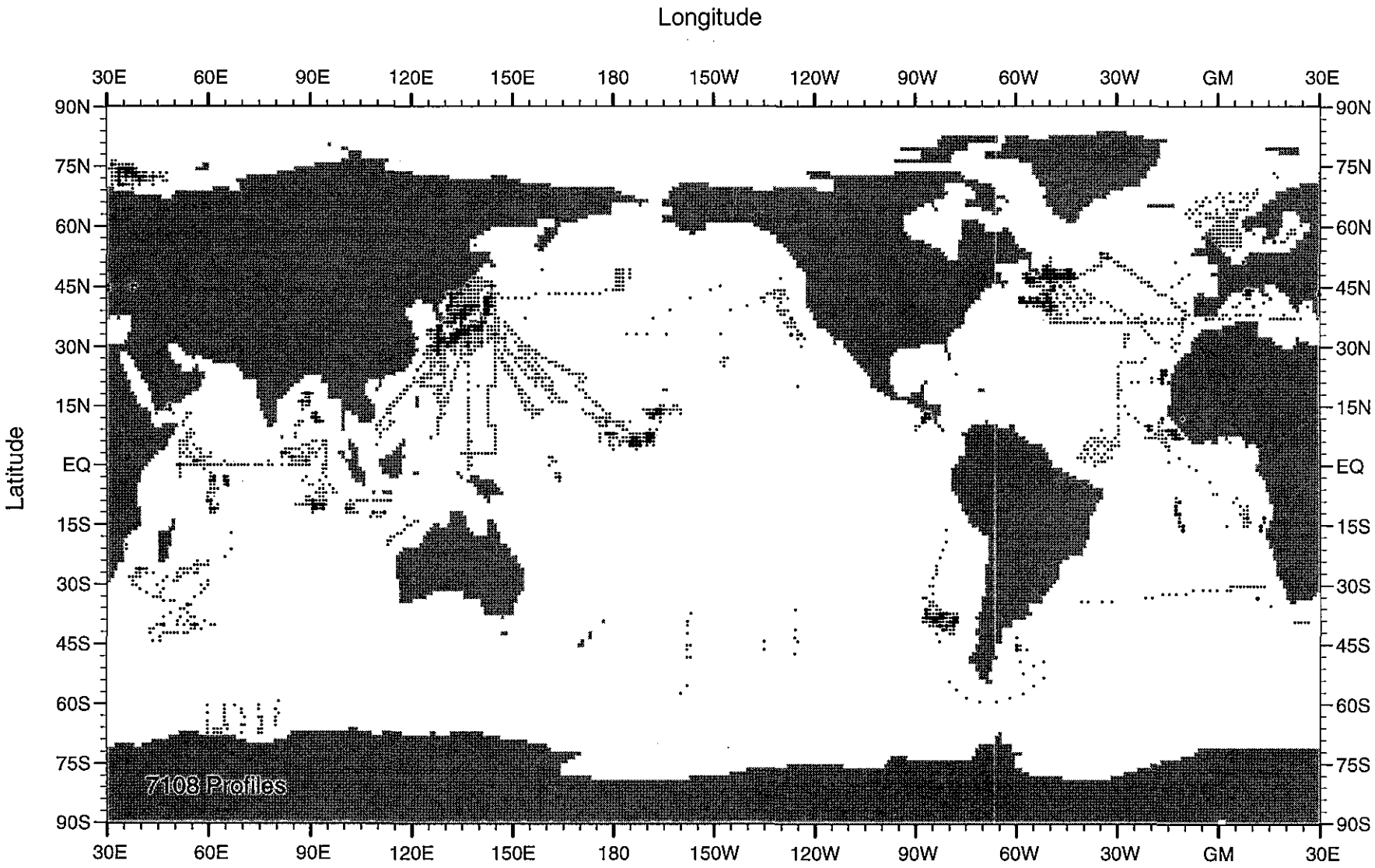

Fig. B177 WOD98 MBT profile distribution for January-March for 1985

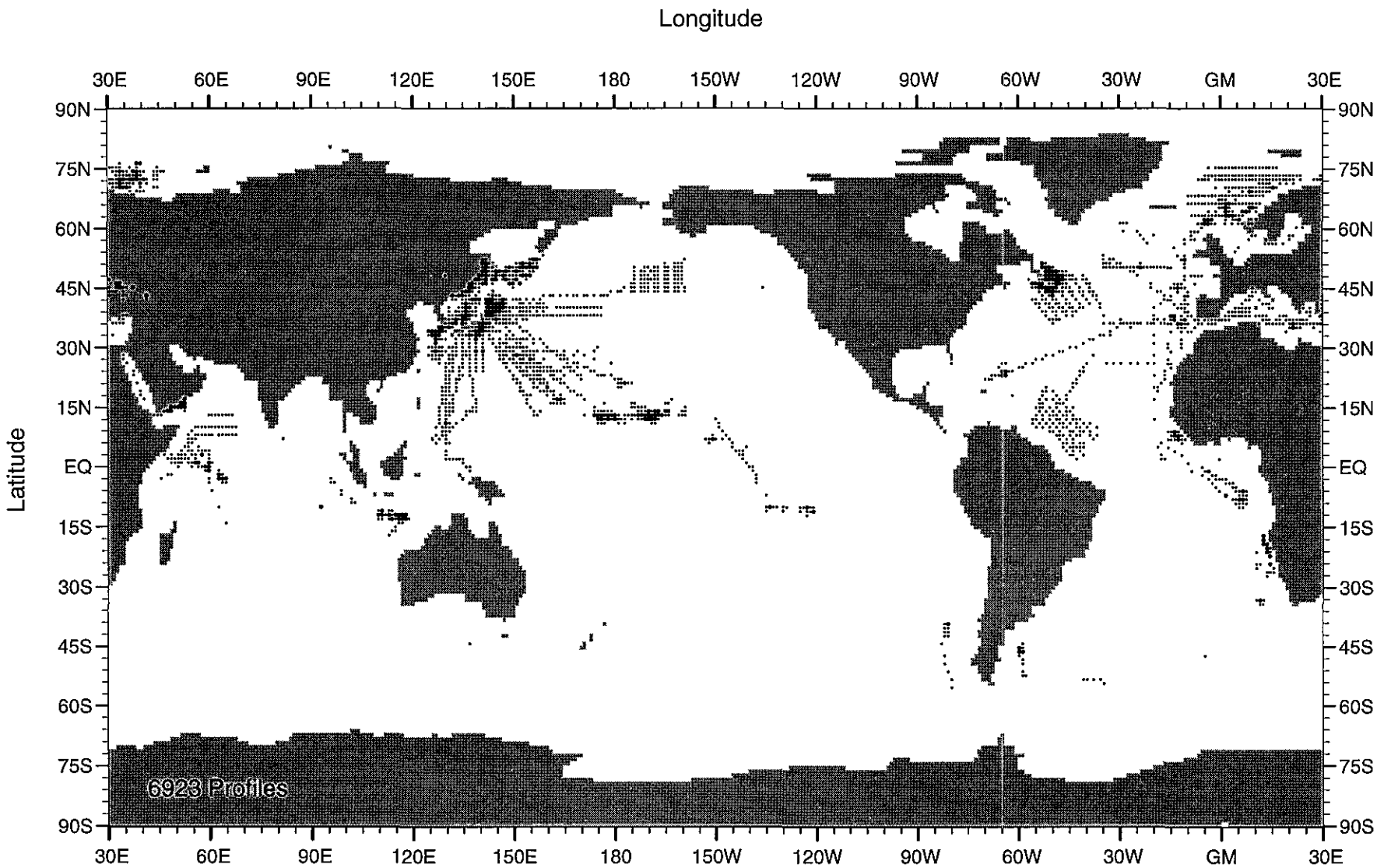

Fig. B178 WOD98 MBT profile distribution for April-June for 1985

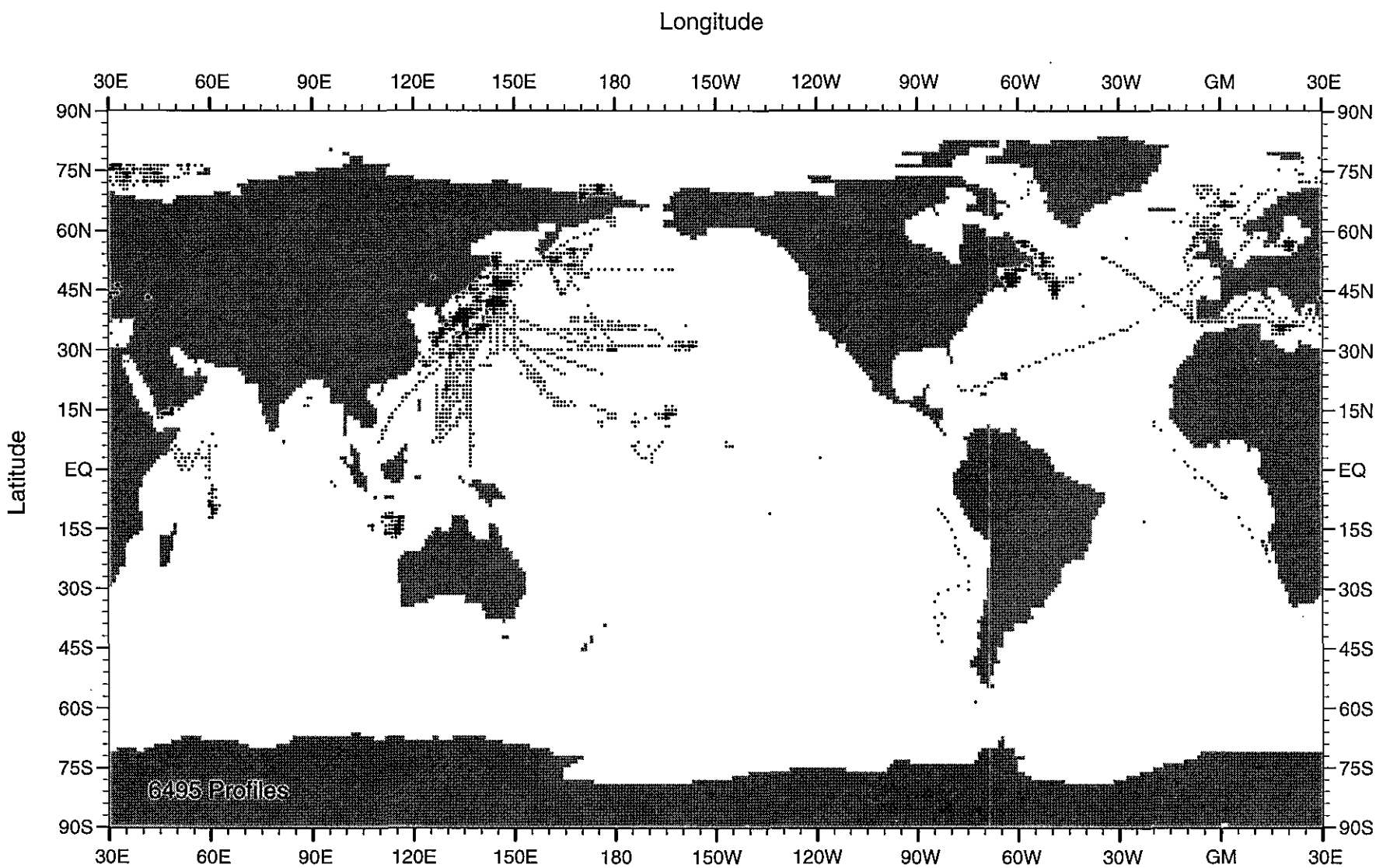

Fig. B179 WOD98 MBT profile distribution for July-September for 1985

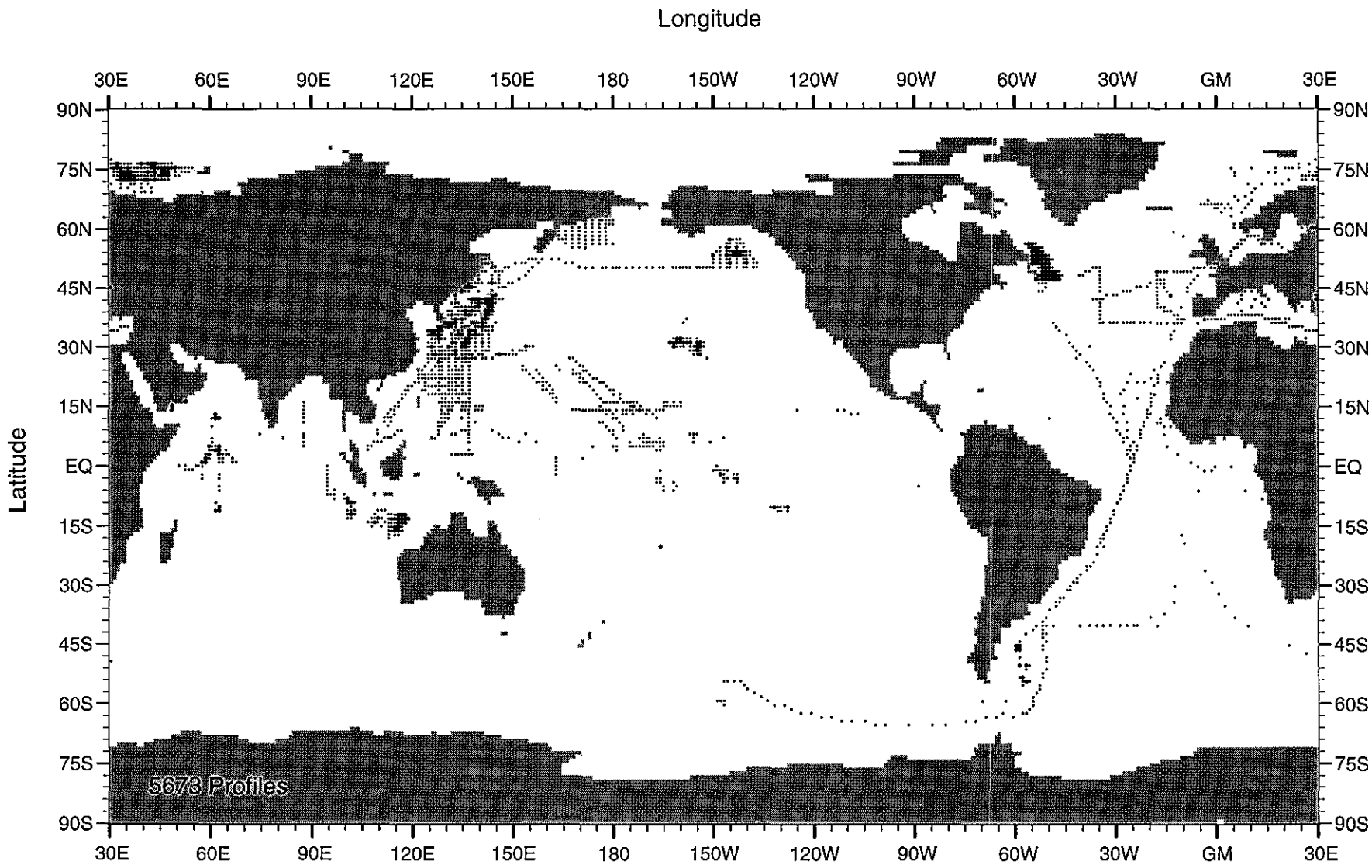

Fig. B180 WOD98 MBT profile distribution for October-December for 1985

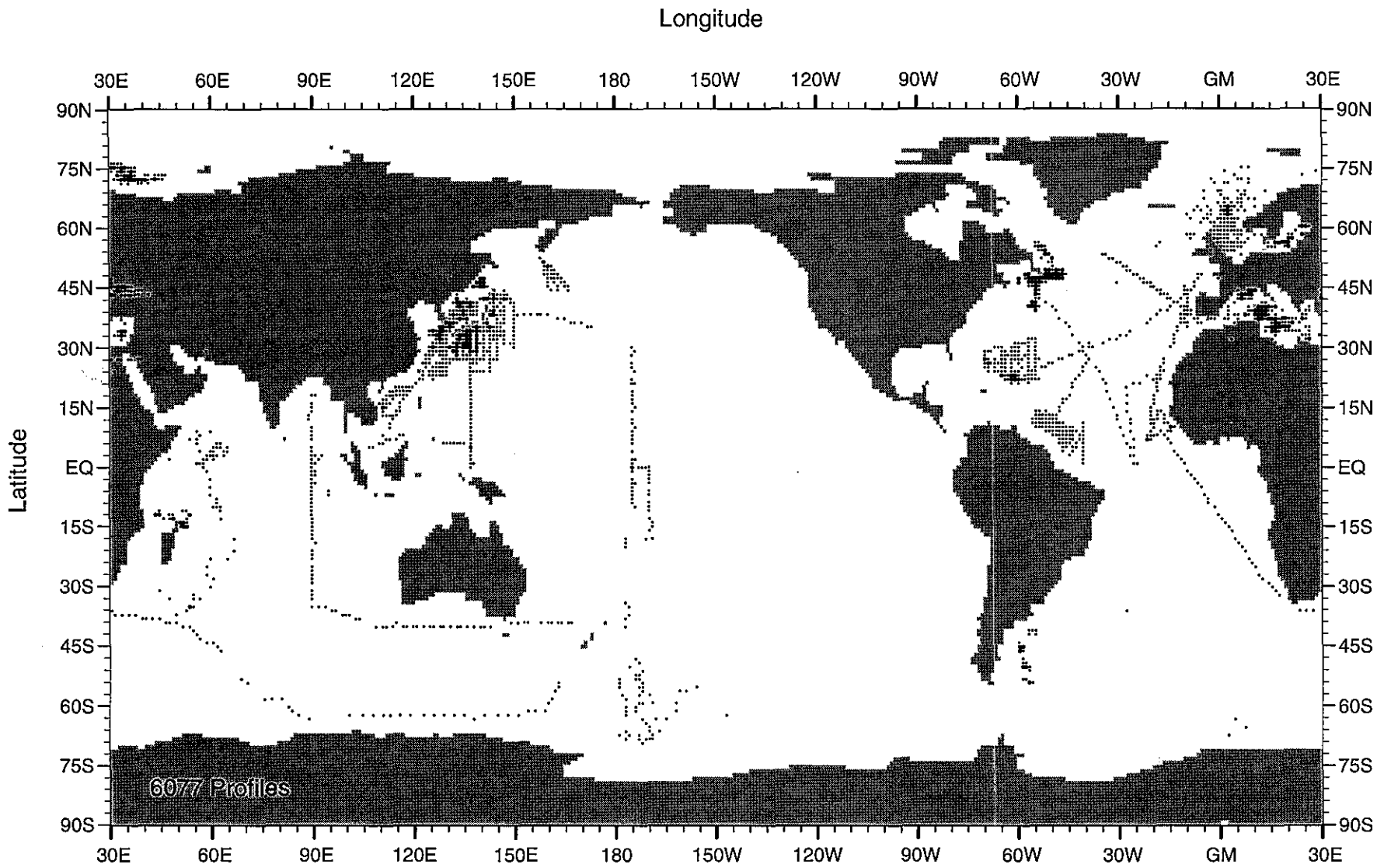

Fig. B181 WOD98 MBT profile distribution for January-March for 1986

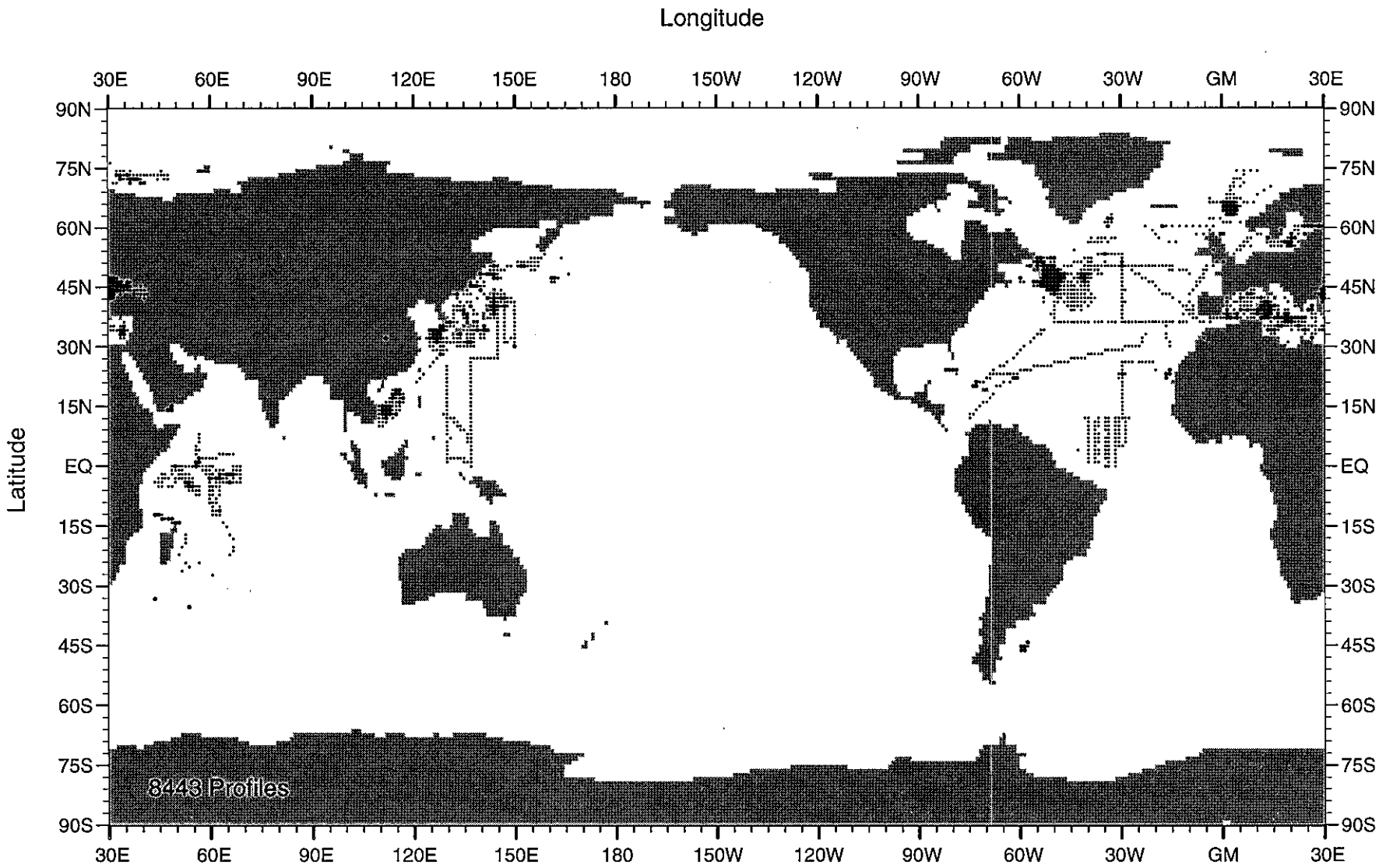

Fig. B182 WOD98 MBT profile distribution for April-June for 1986

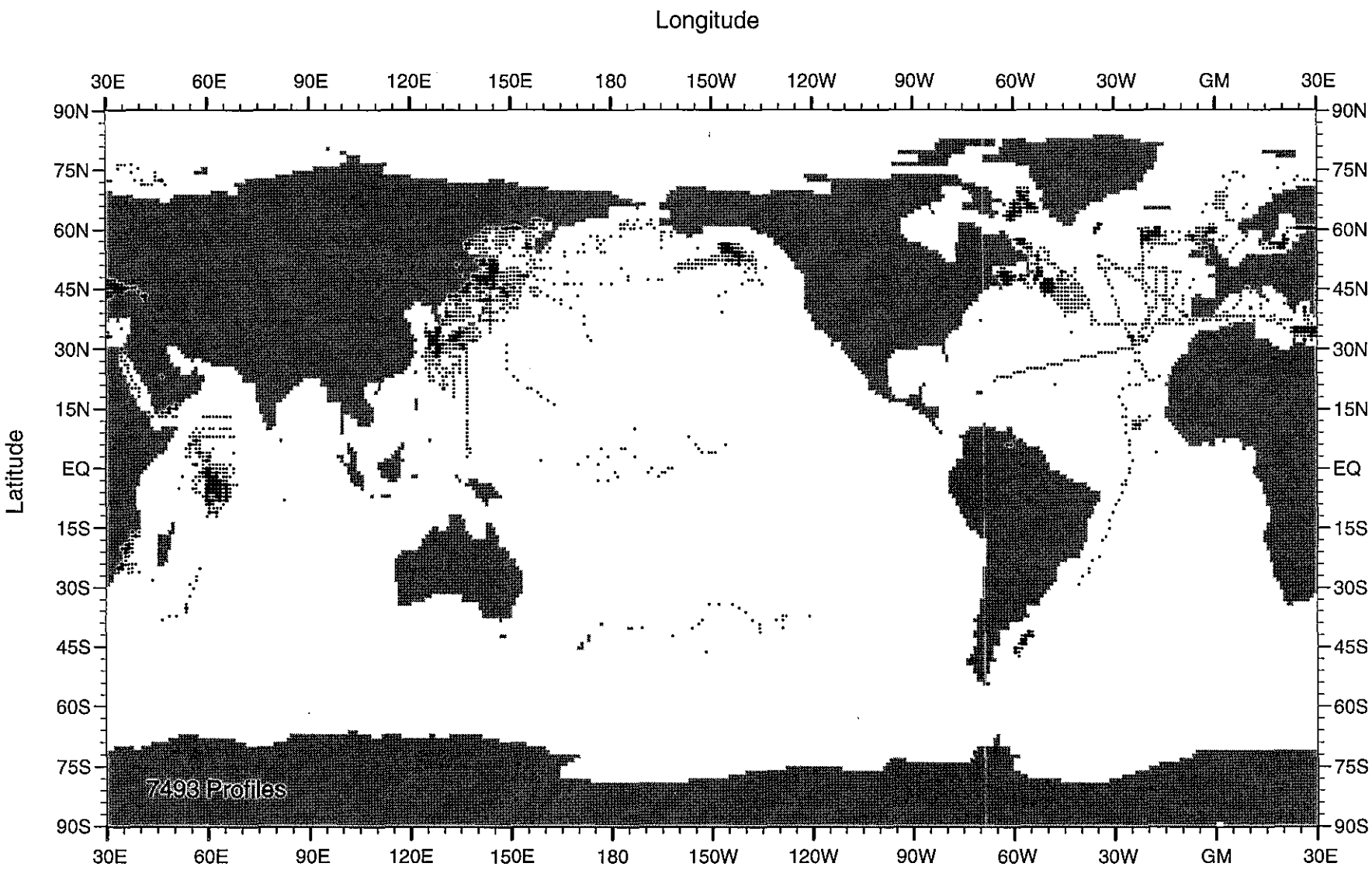

Fig. B183 WOD98 MBT profile distribution for July-September for 1986

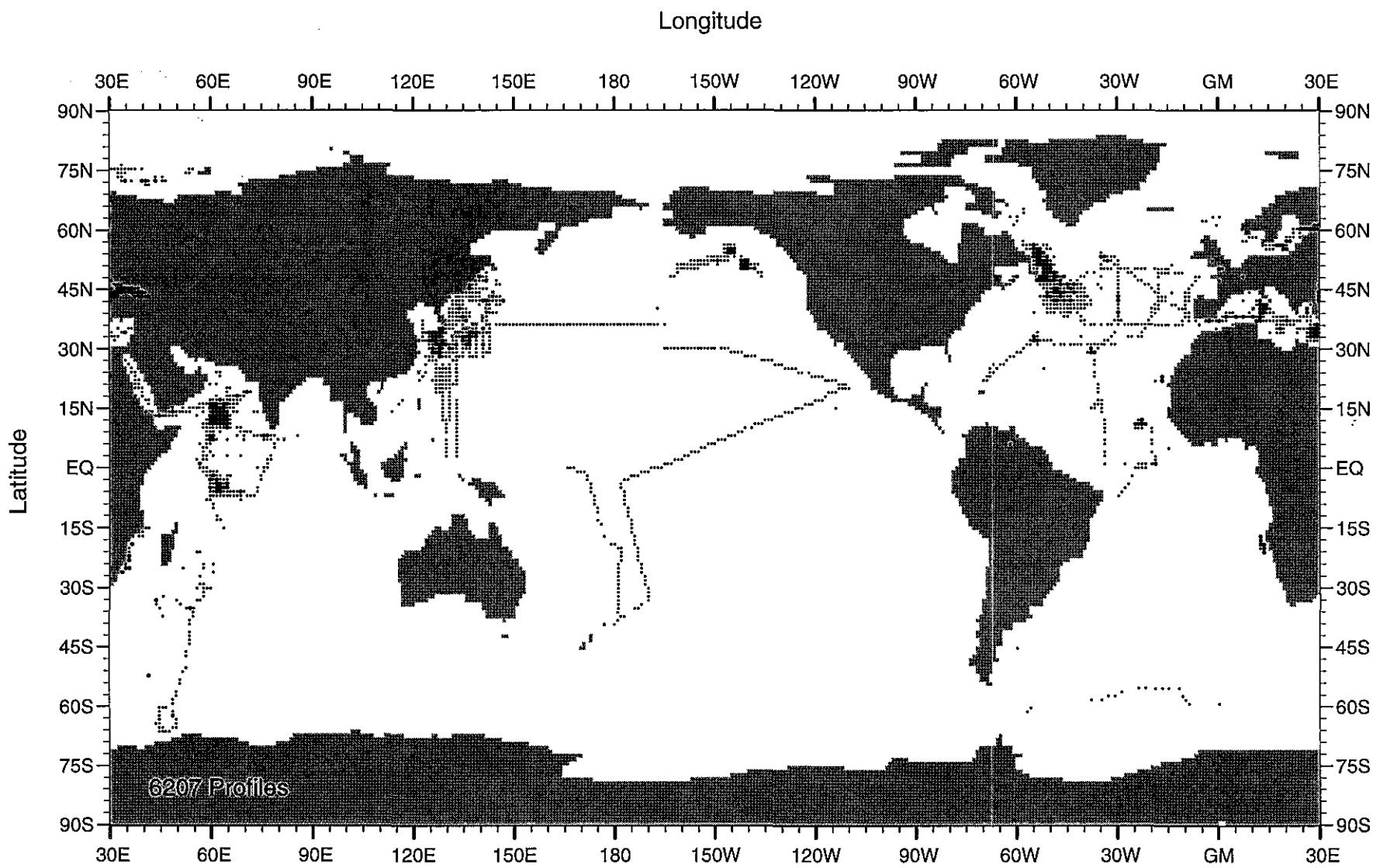

Fig. B184 WOD98 MBT profile distribution for October-December for 1986

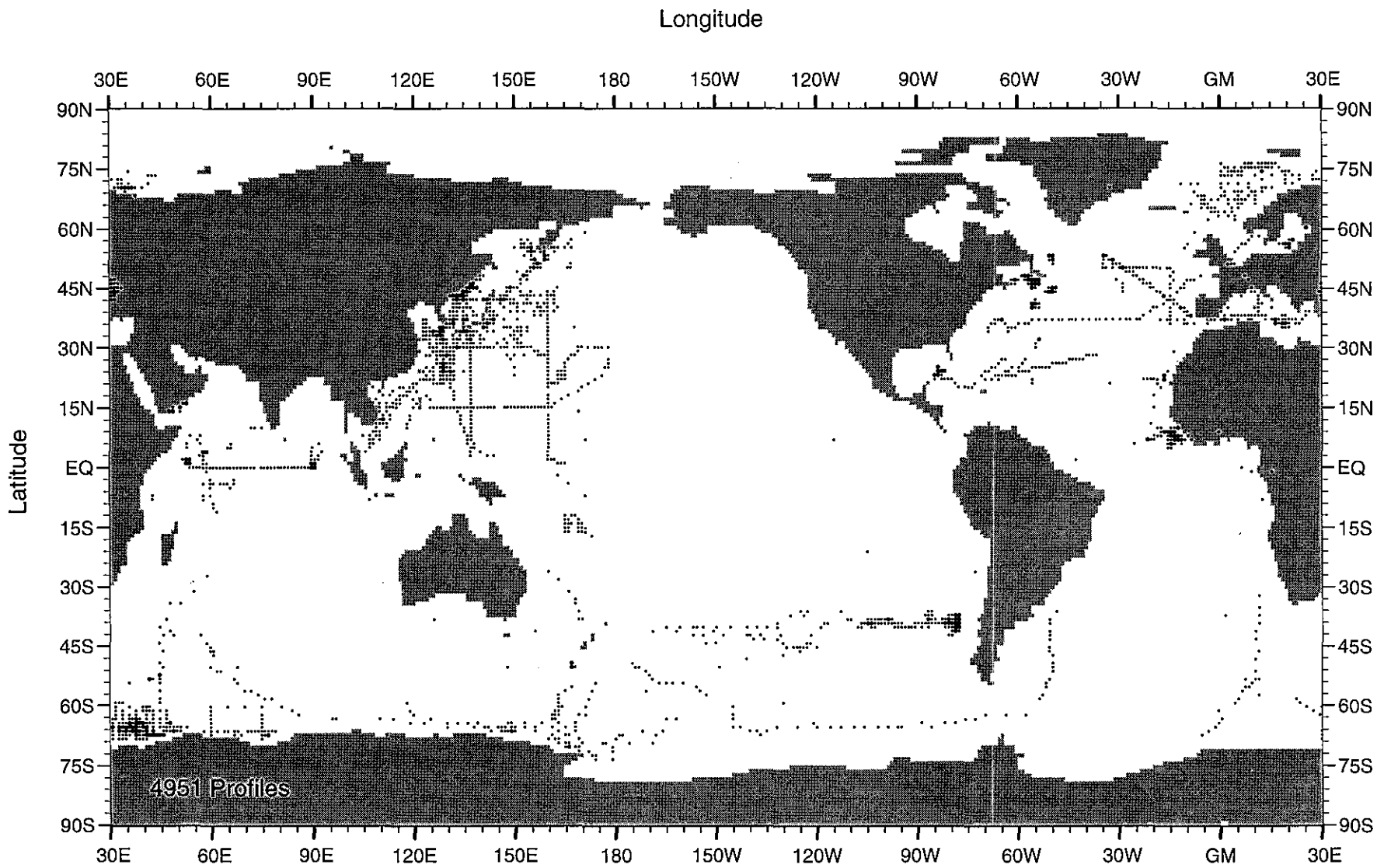

Fig. B185 WOD98 MBT profile distribution for January-March for 1987

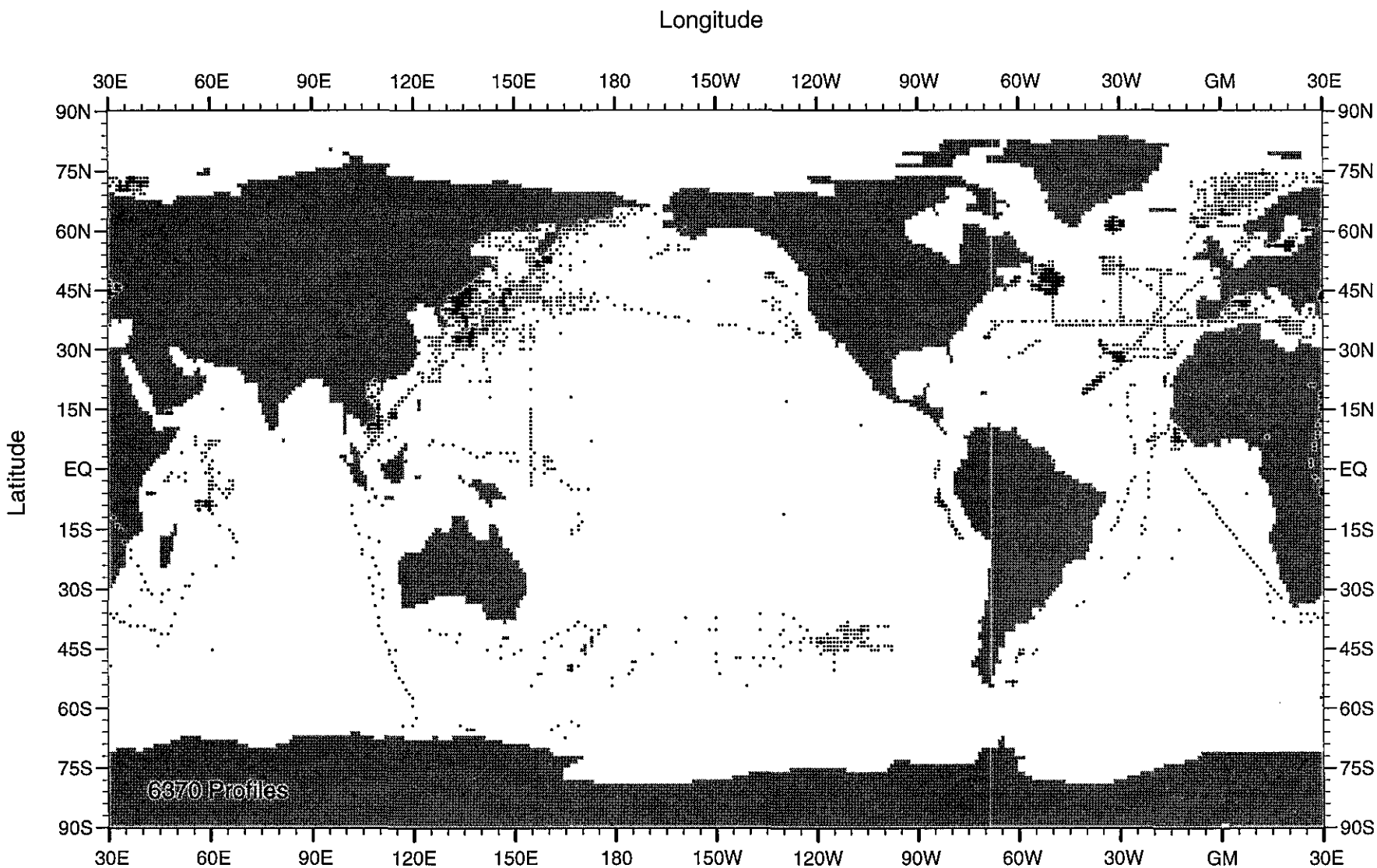

Fig. B186 WOD98 MBT profile distribution for April-June for 1987

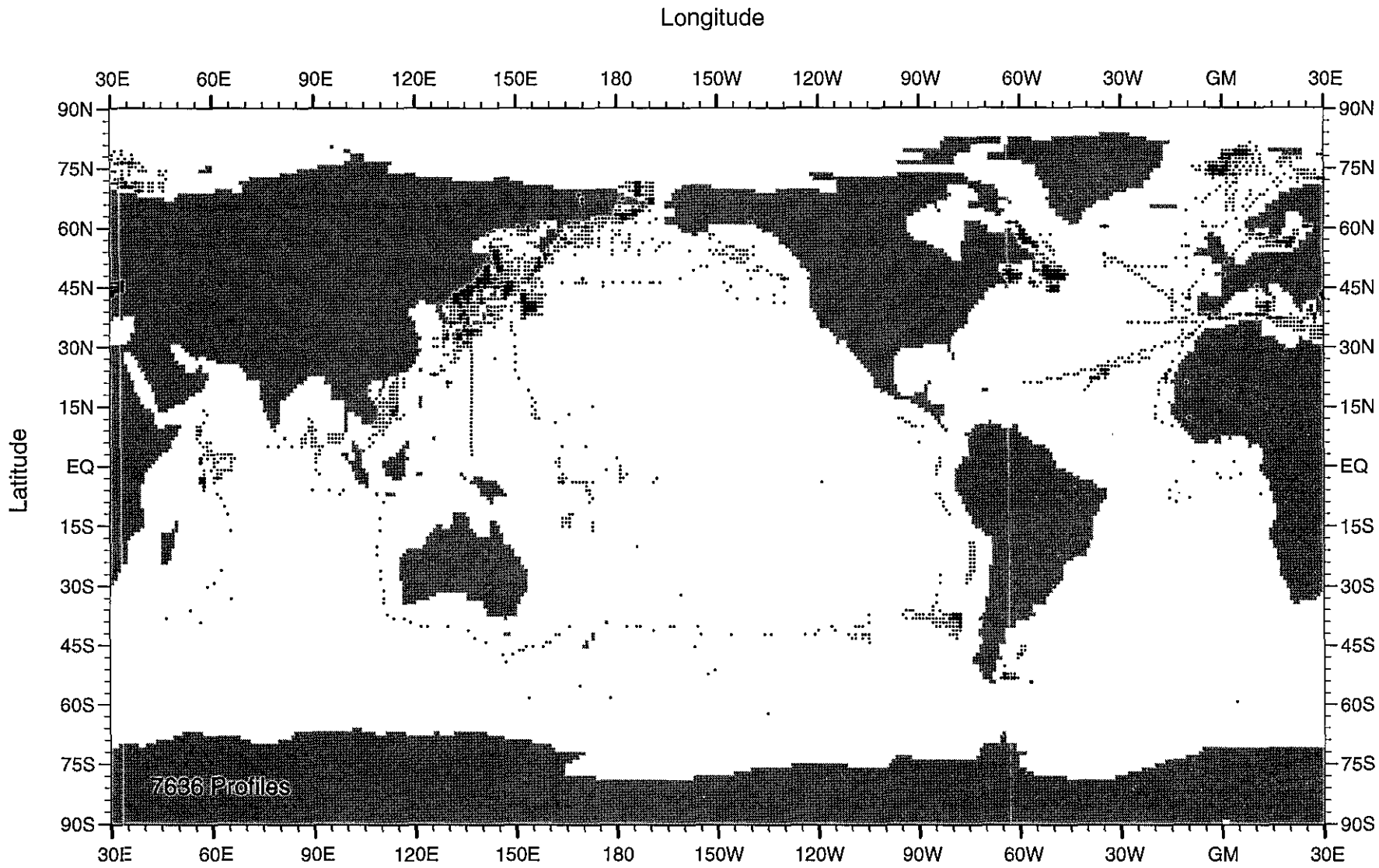

Fig. B187 WOD98 MBT profile distribution for July-September for 1987

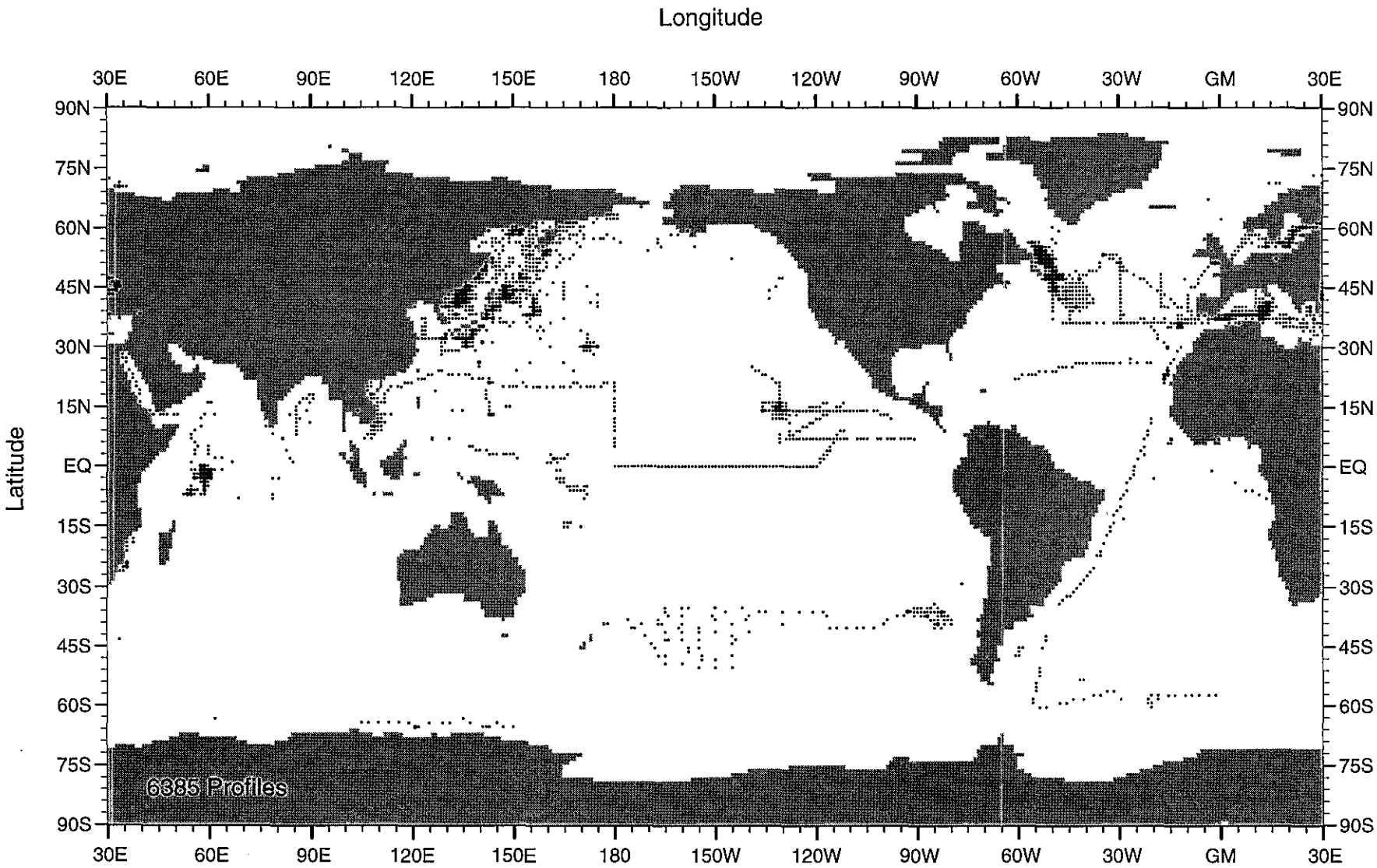

Fig. B188 WOD98 MBT profile distribution for October-December for 1987

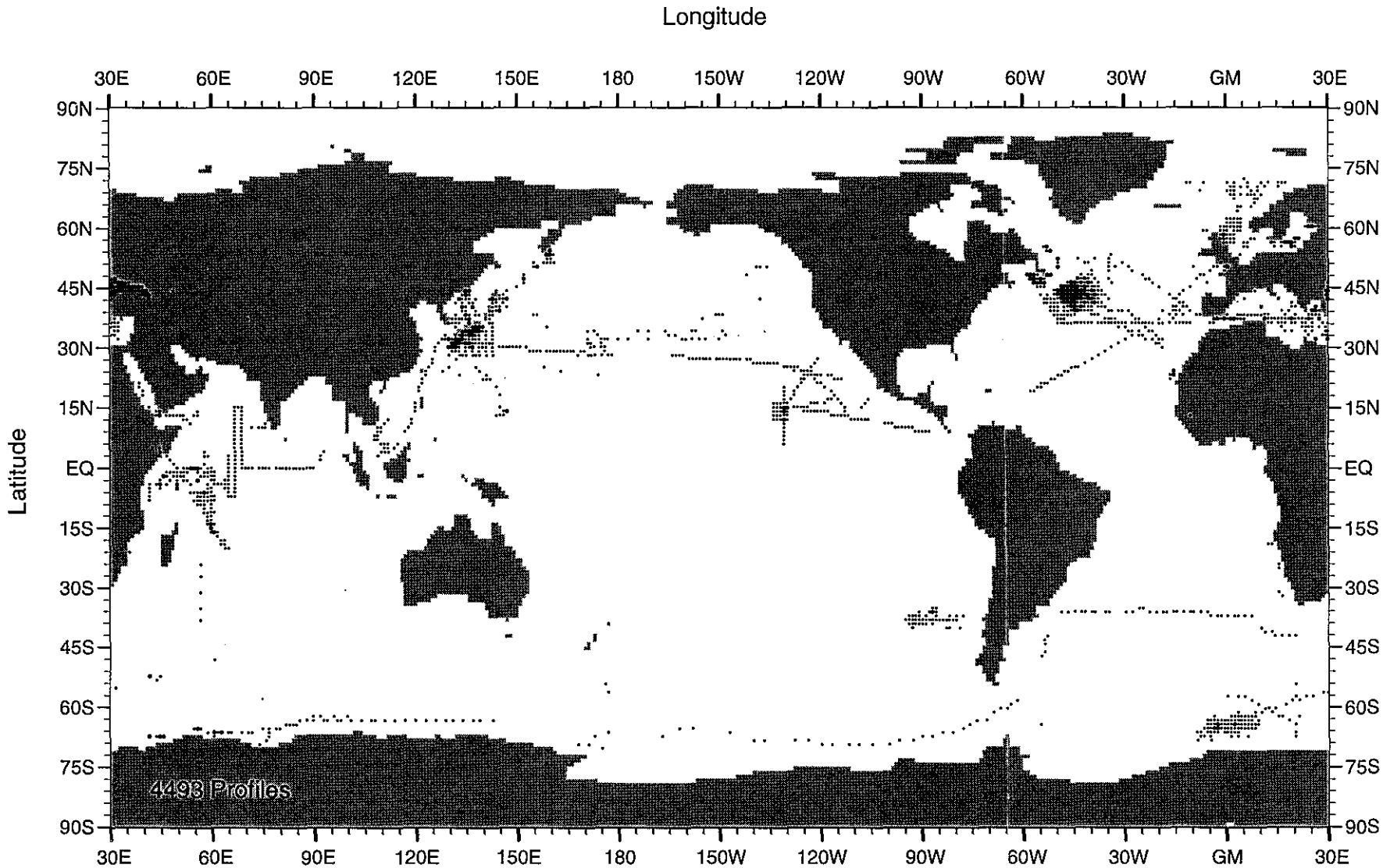

Fig. B189 WOD98 MBT profile distribution for January-March for 1988

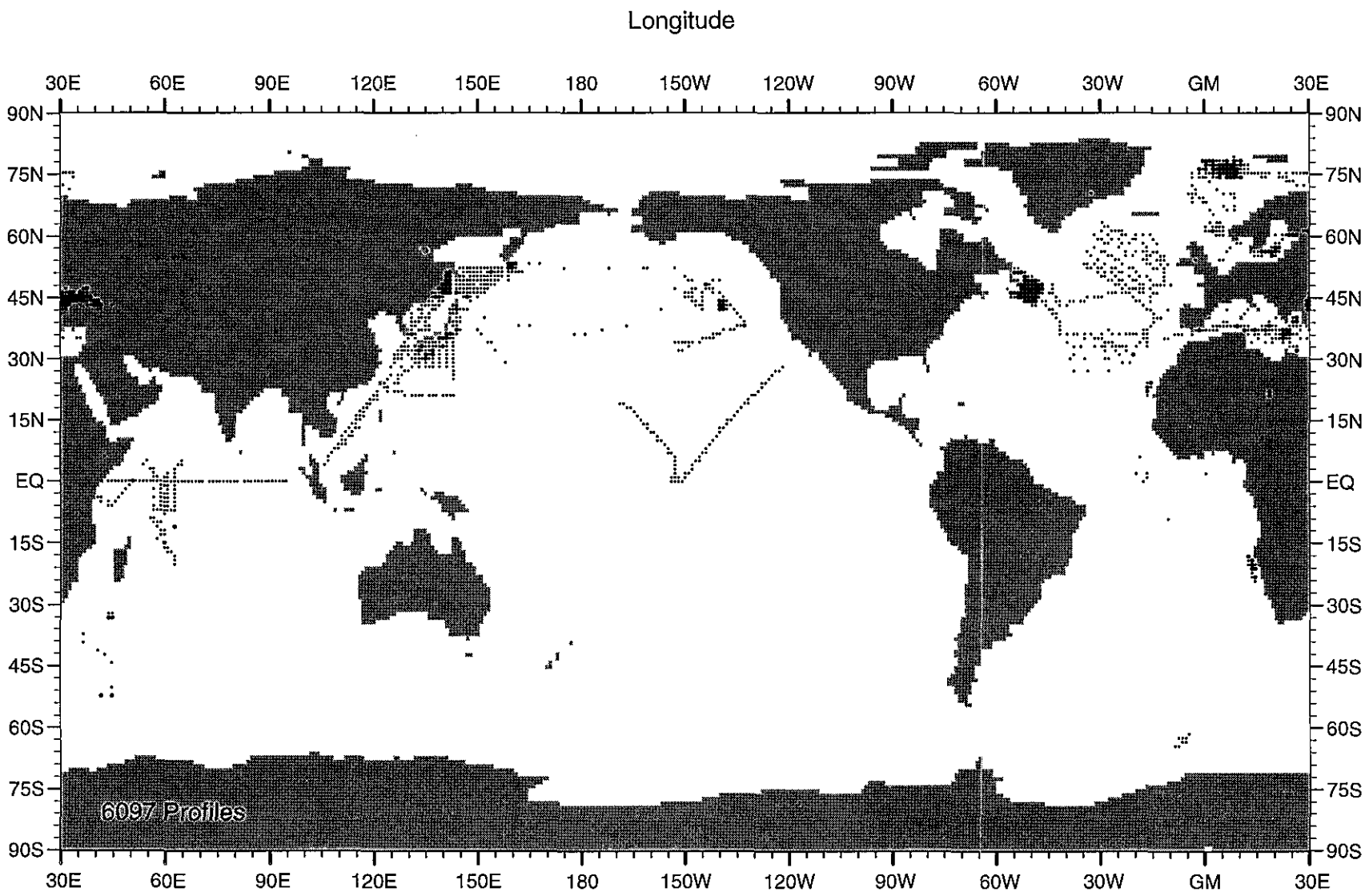

Fig. B190 WOD98 MBT profile distribution for April-June for 1988

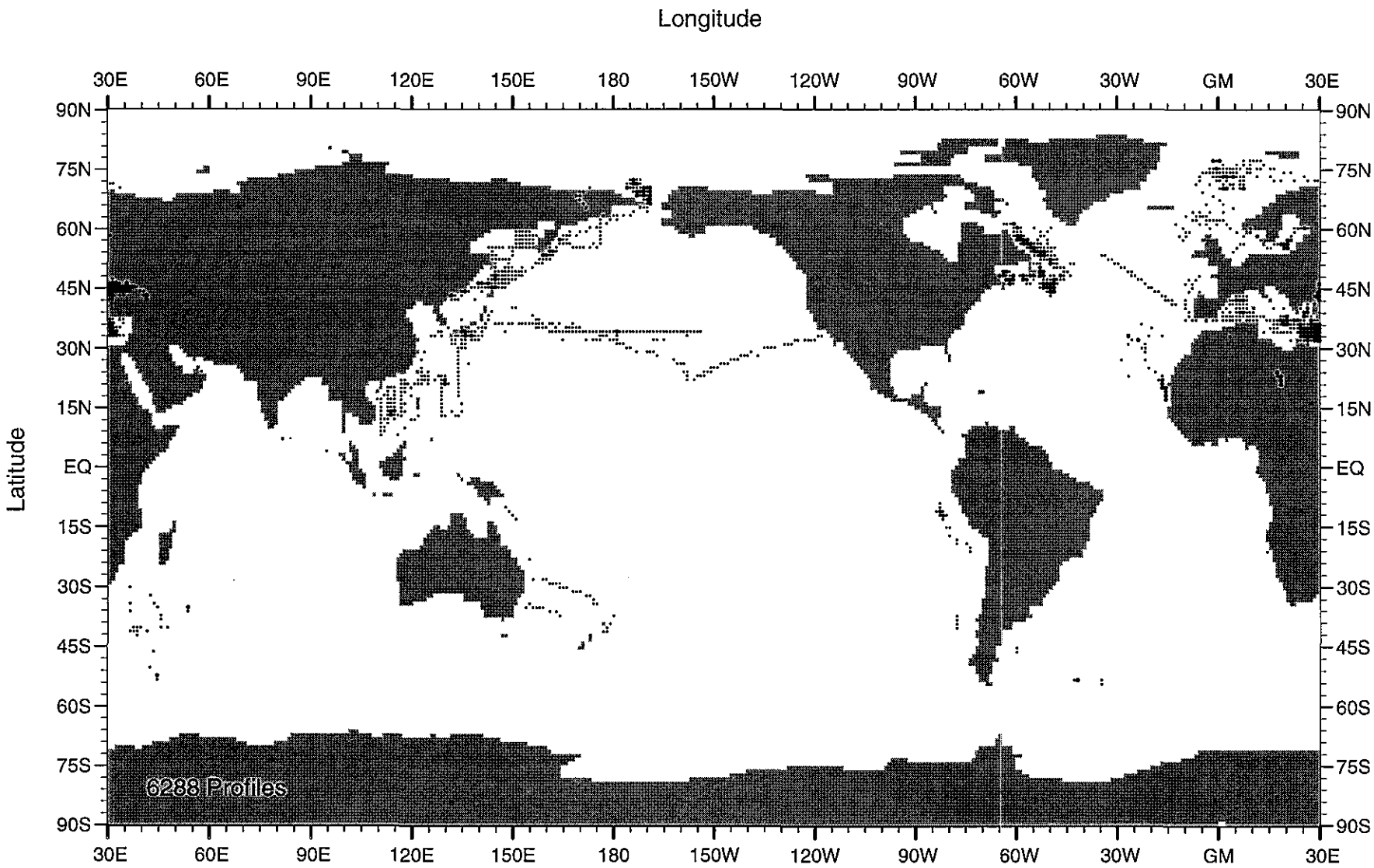

Fig. B191 WOD98 MBT profile distribution for July-September for 1988

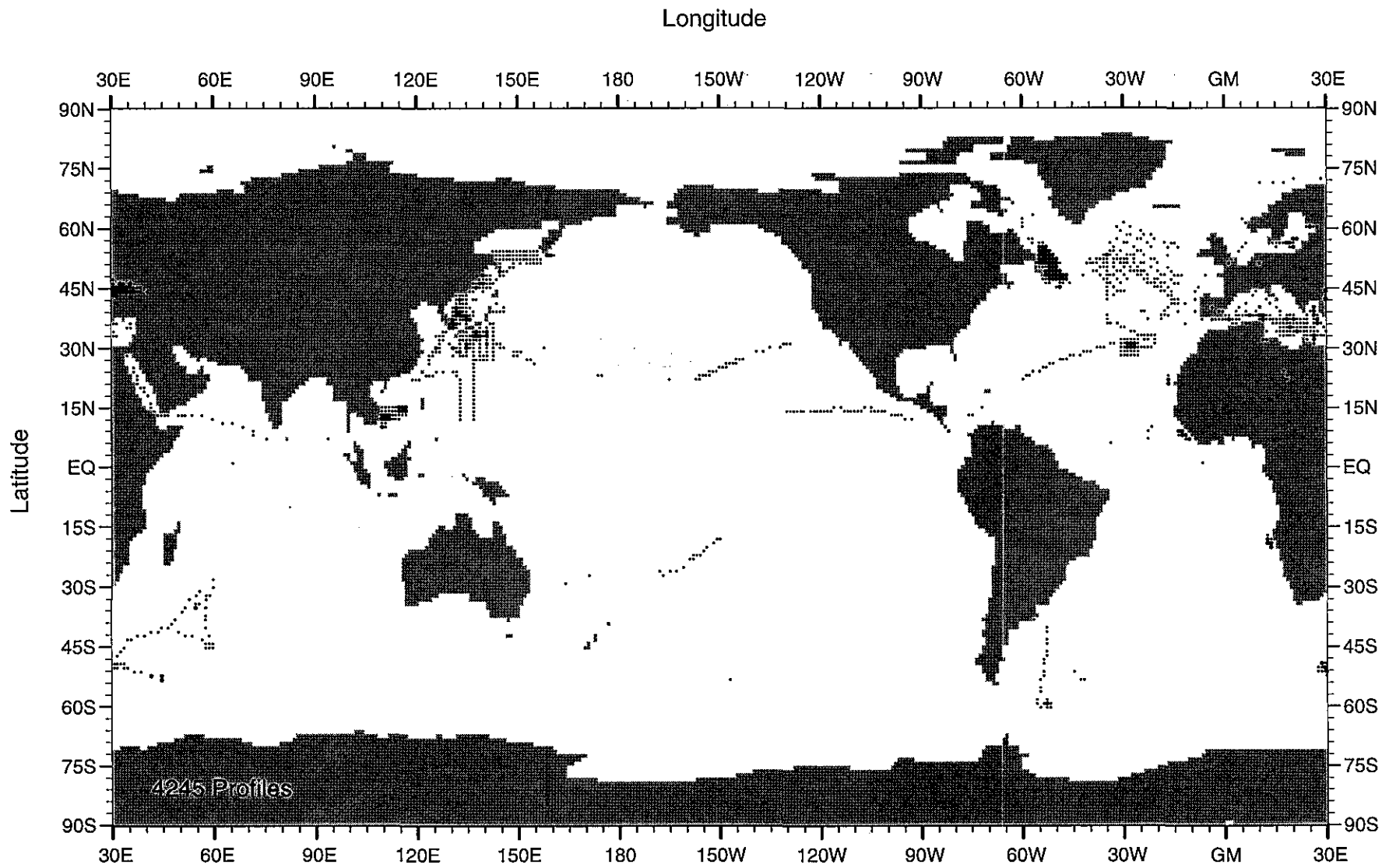

Fig. B192 WOD98 MBT profile distribution for October-December for 1988

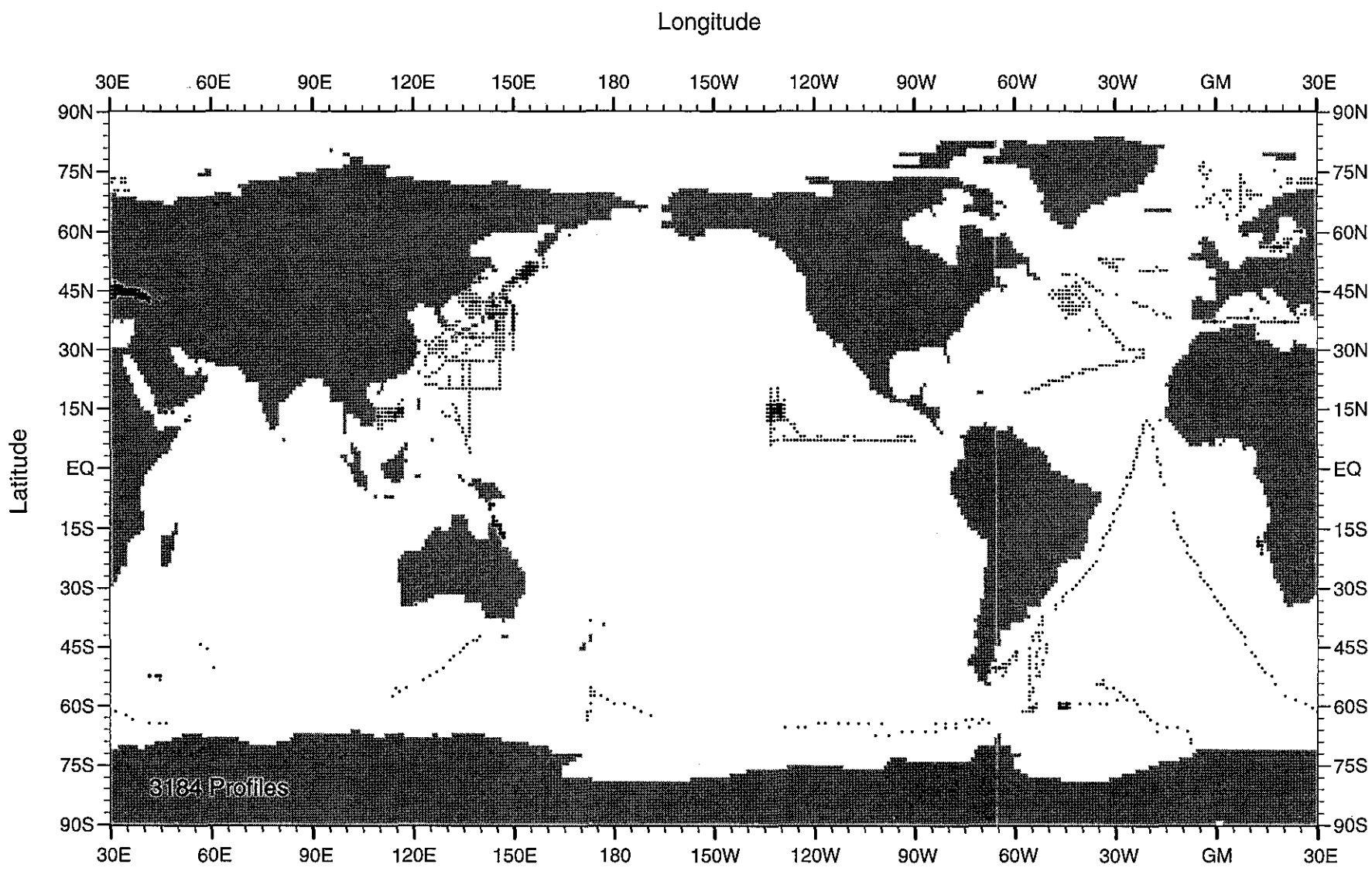

Fig. B193 WOD98 MBT profile distribution for January-March for 1989

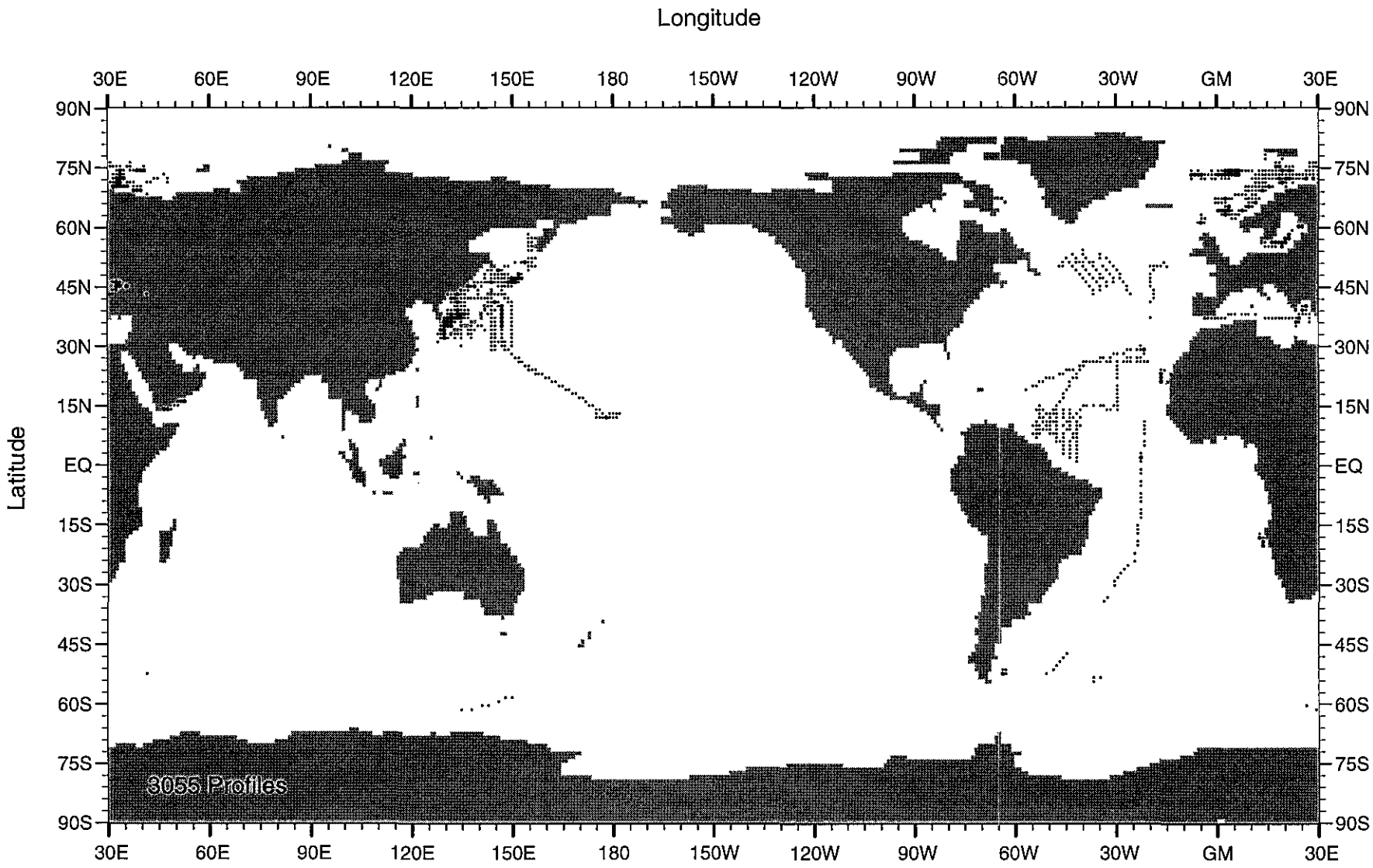

Fig. B194 WOD98 MBT profile distribution for April-June for 1989

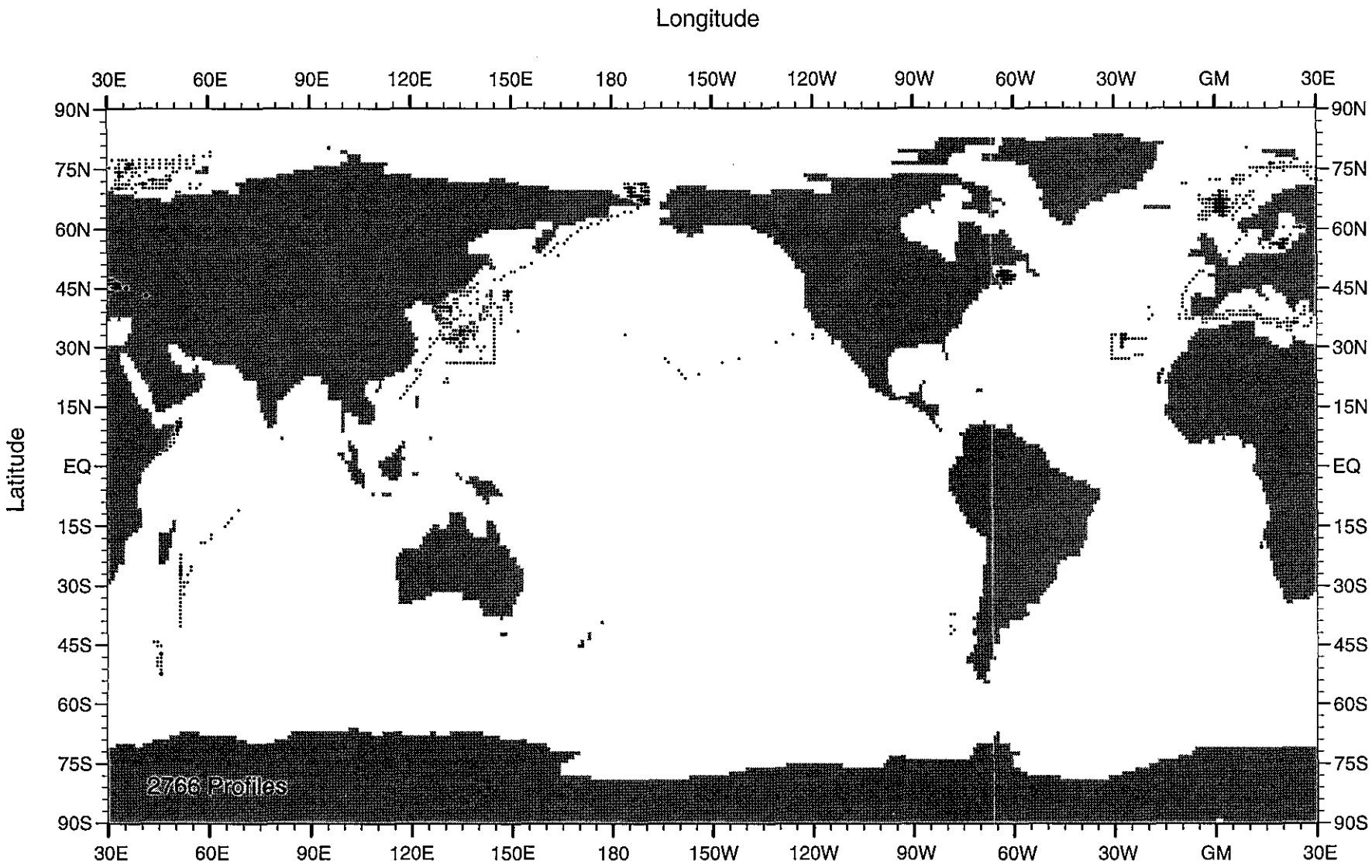

Fig. B195 WOD98 MBT profile distribution for July-September for 1989

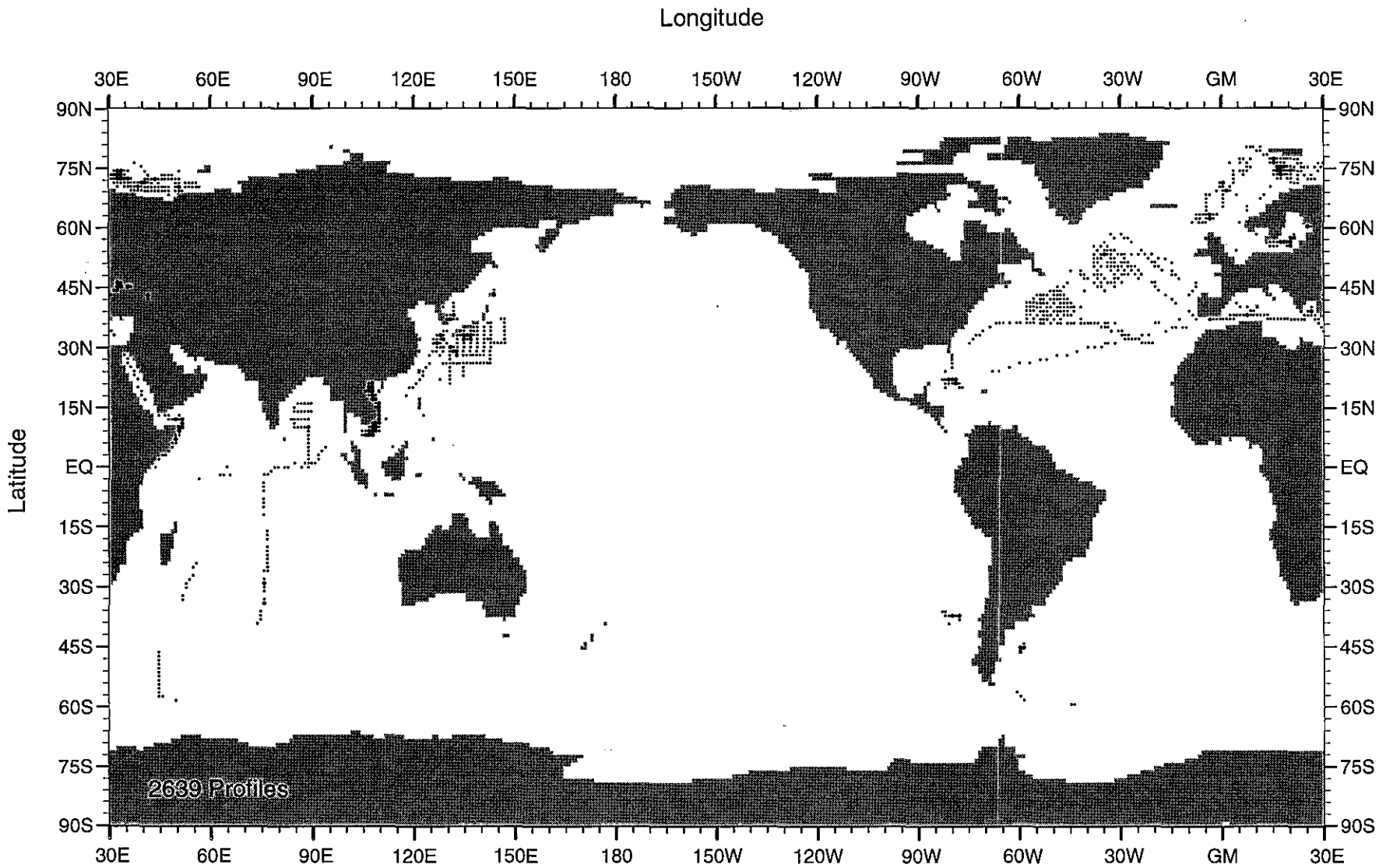

Fig. B196 WOD98 MBT profile distribution for October-December for 1989

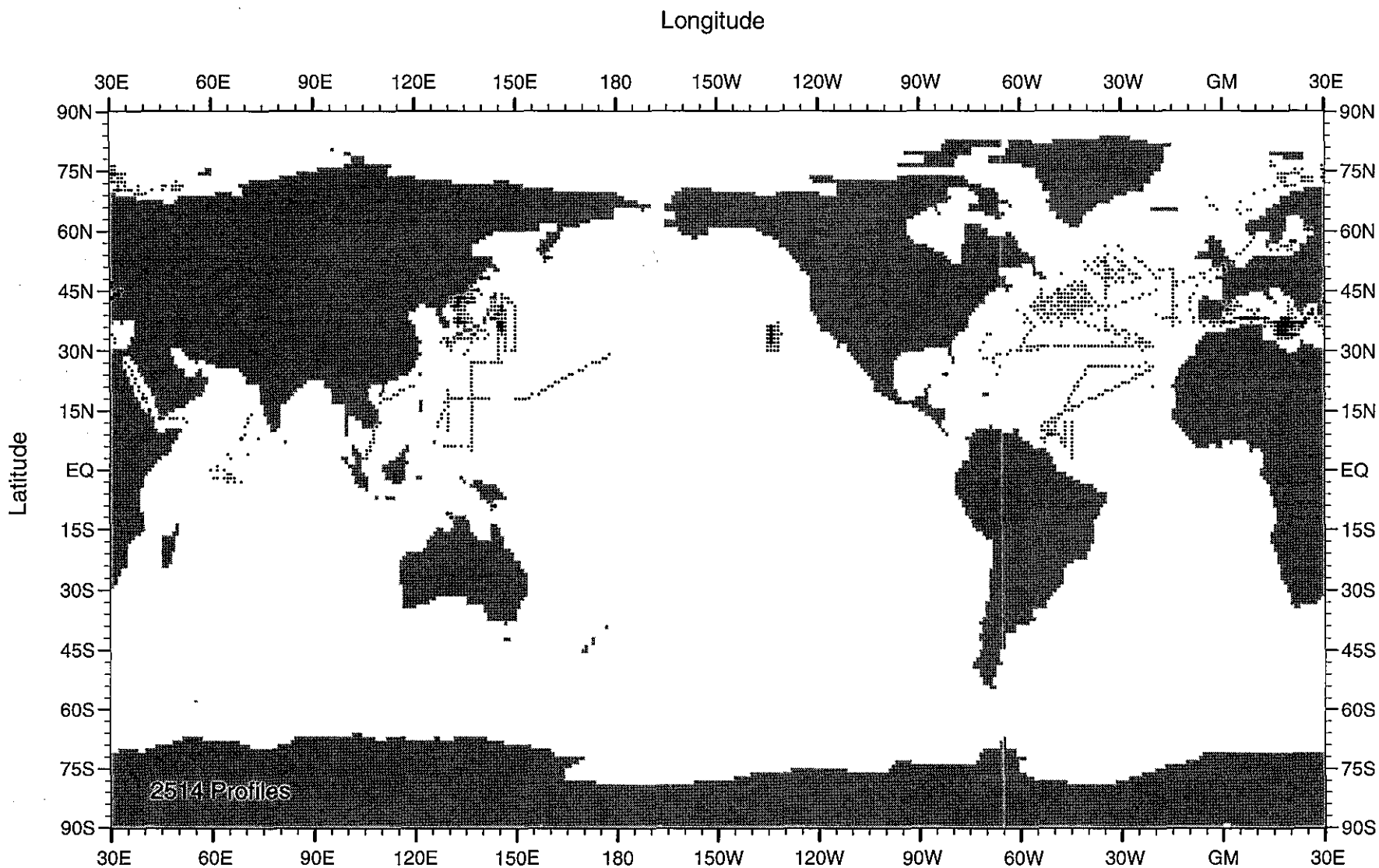

Fig. B197 WOD98 MBT profile distribution for January-March for 1990

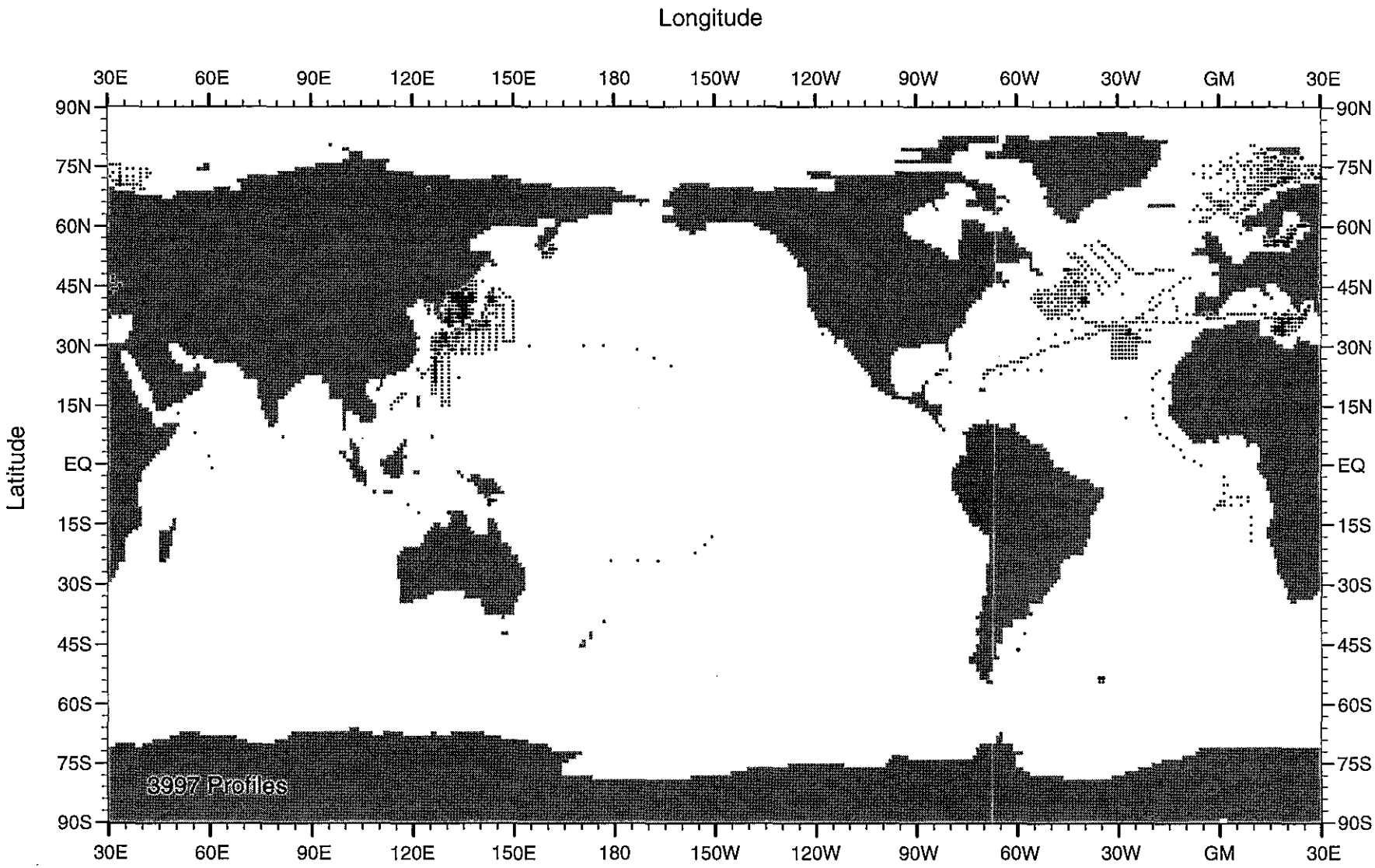

Fig. B198 WOD98 MBT profile distribution for April-June for 1990

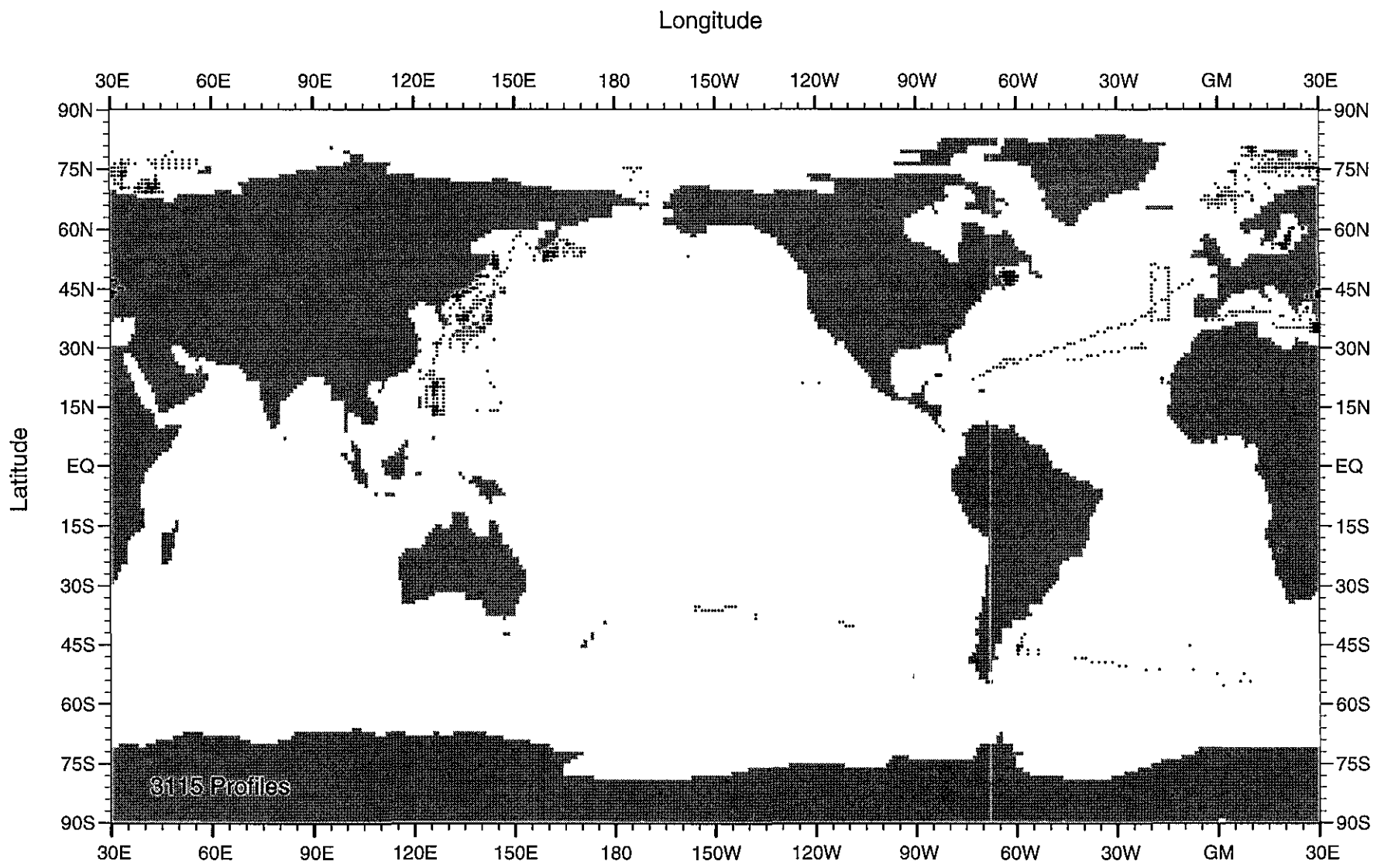

Fig. B199 WOD98 MBT profile distribution for July-September for 1990

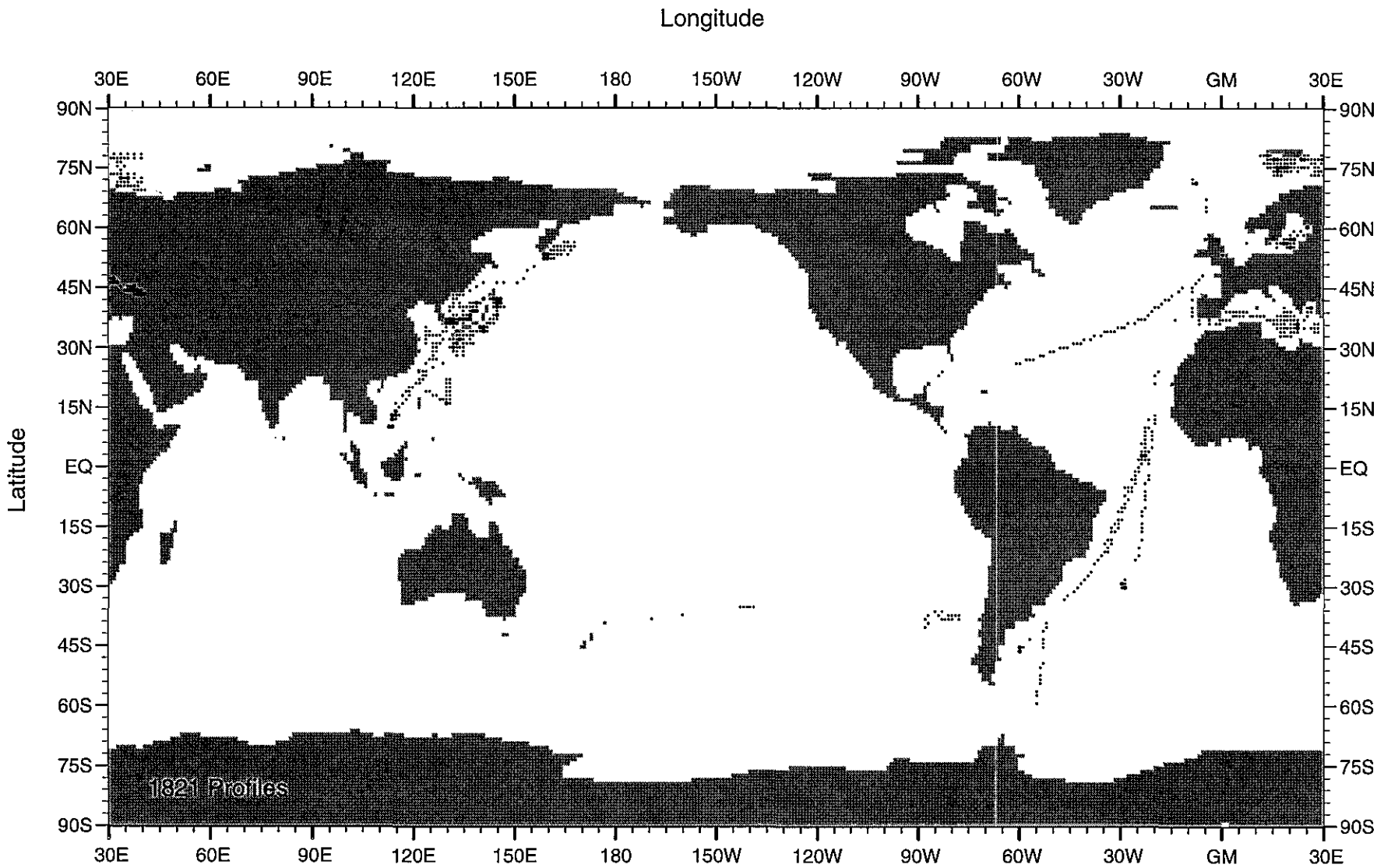

Fig. B200 WOD98 MBT profile distribution for October-December for 1990

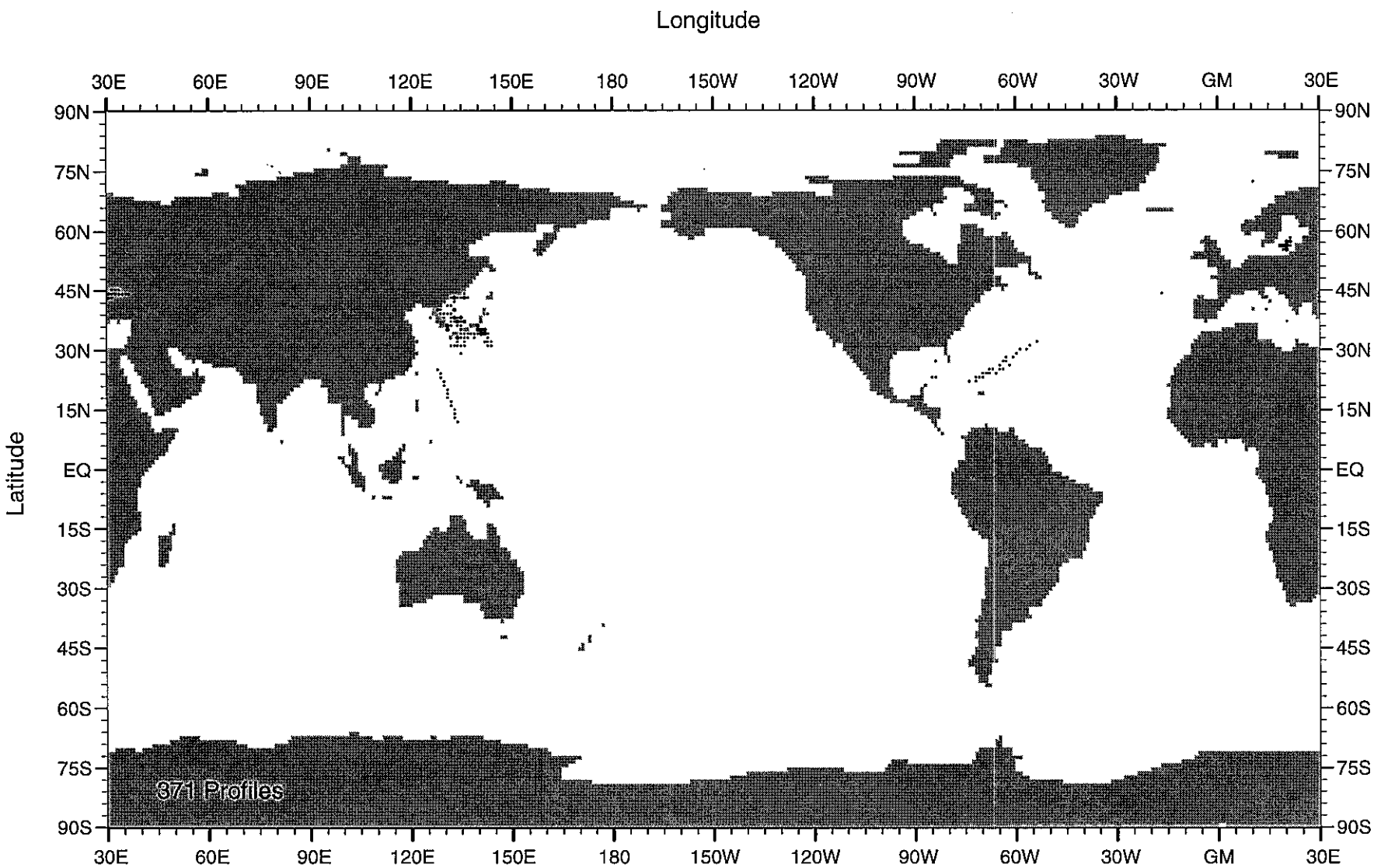

Fig. B201 WOD98 MBT profile distribution for January-March for 1991

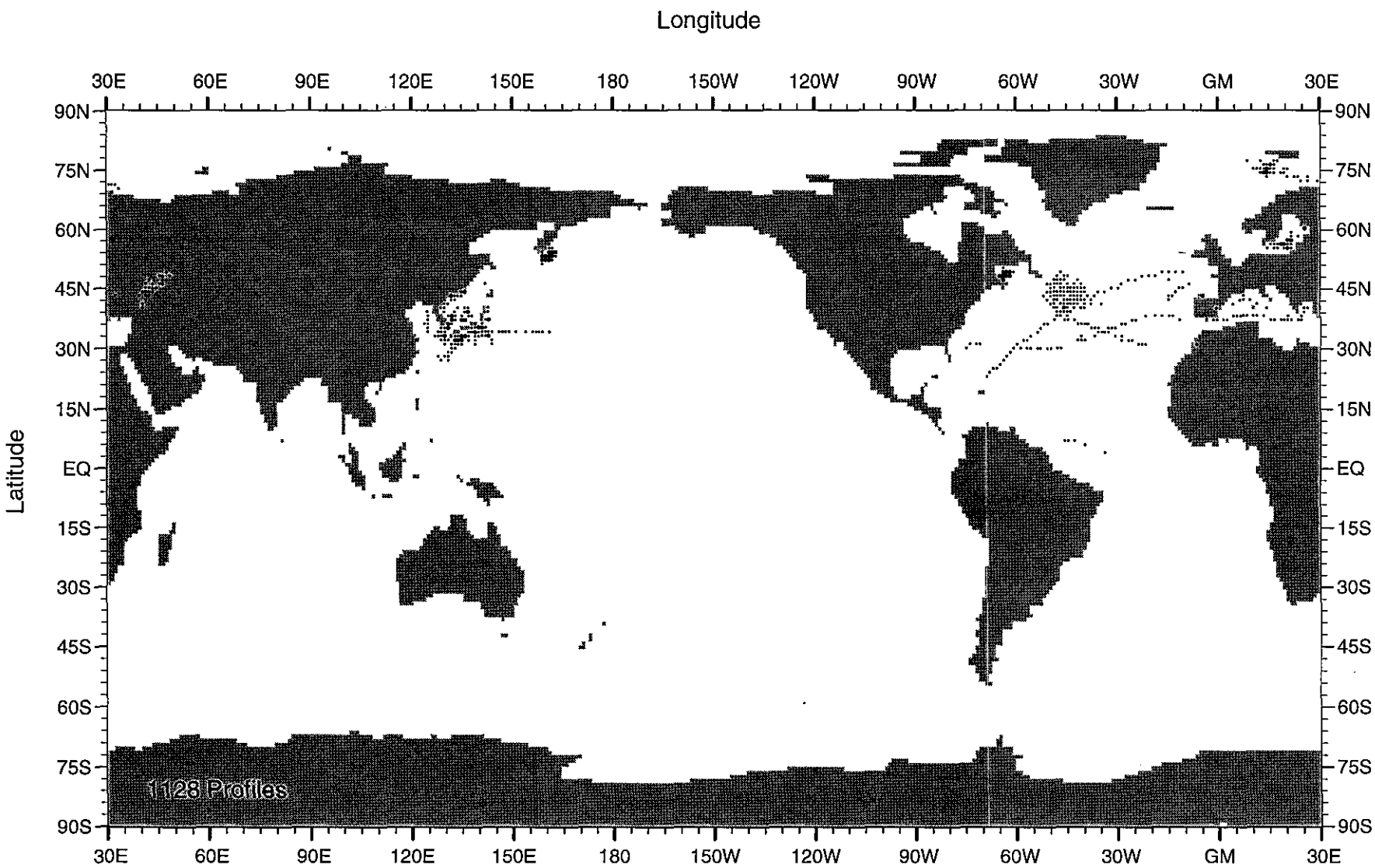

Fig. B202 WOD98 MBT profile distribution for April-June for 1991

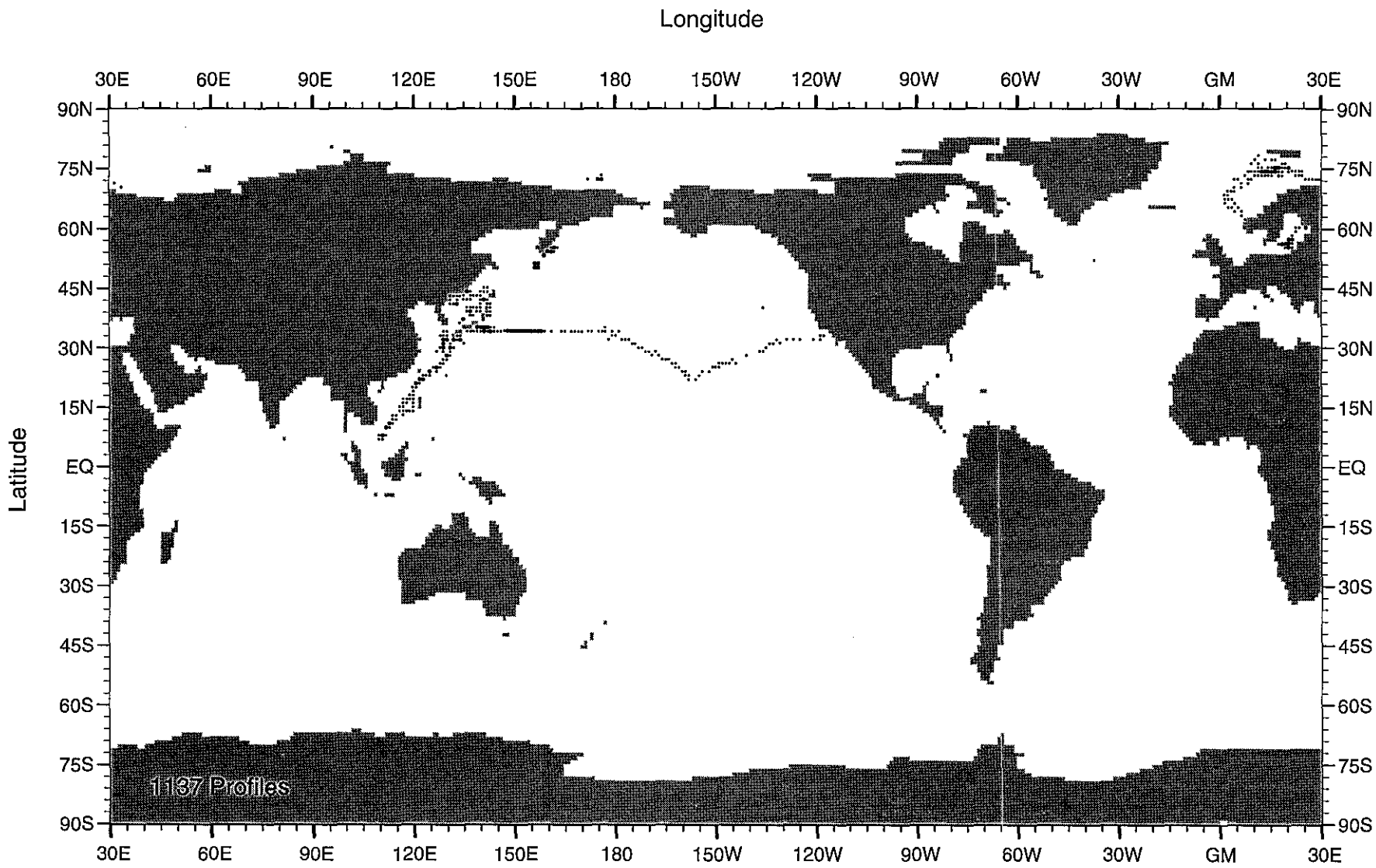

Fig. B203 WOD98 MBT profile distribution for July-September for 1991

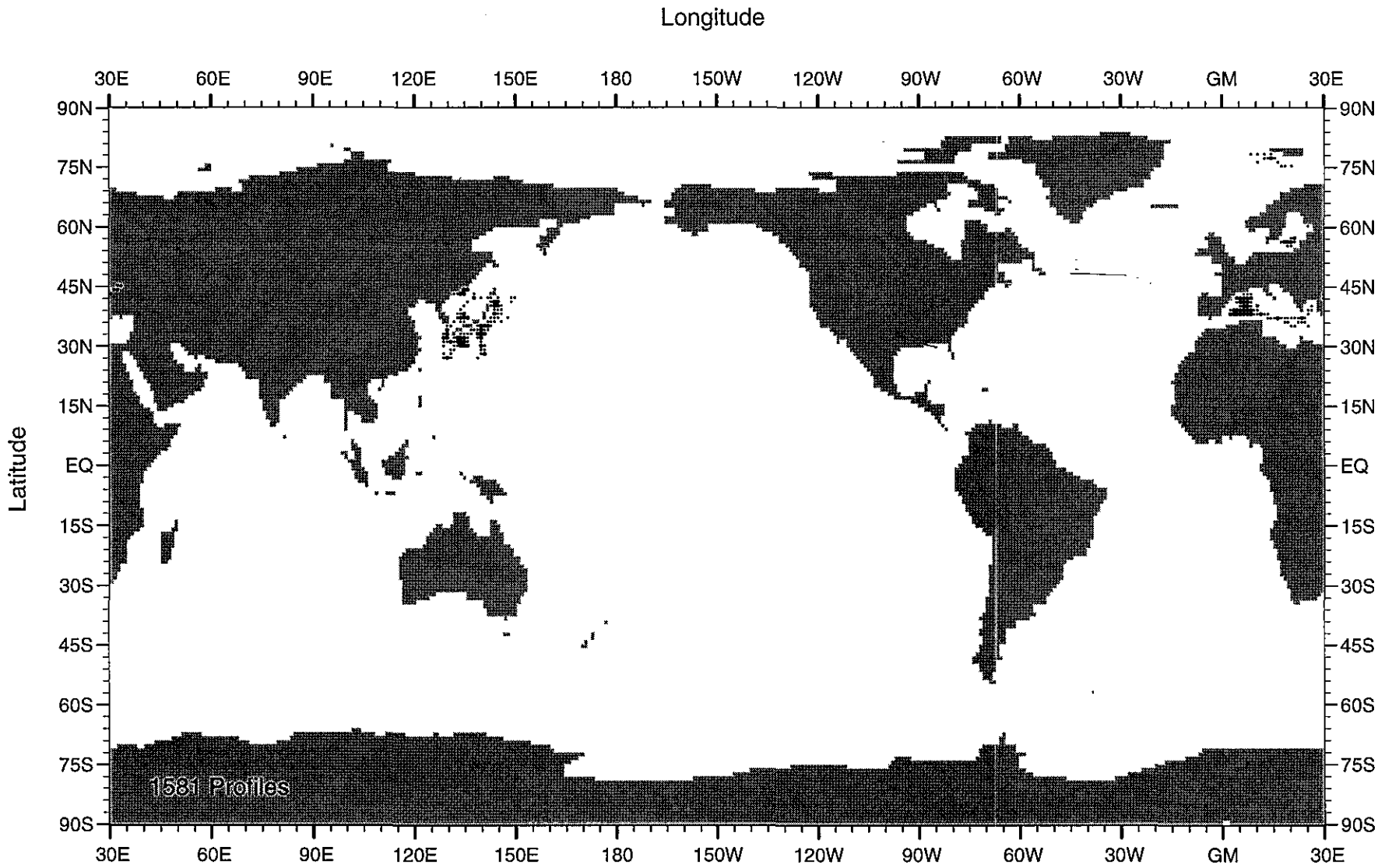

Fig. B204 WOD98 MBT profile distribution for October-December for 1991

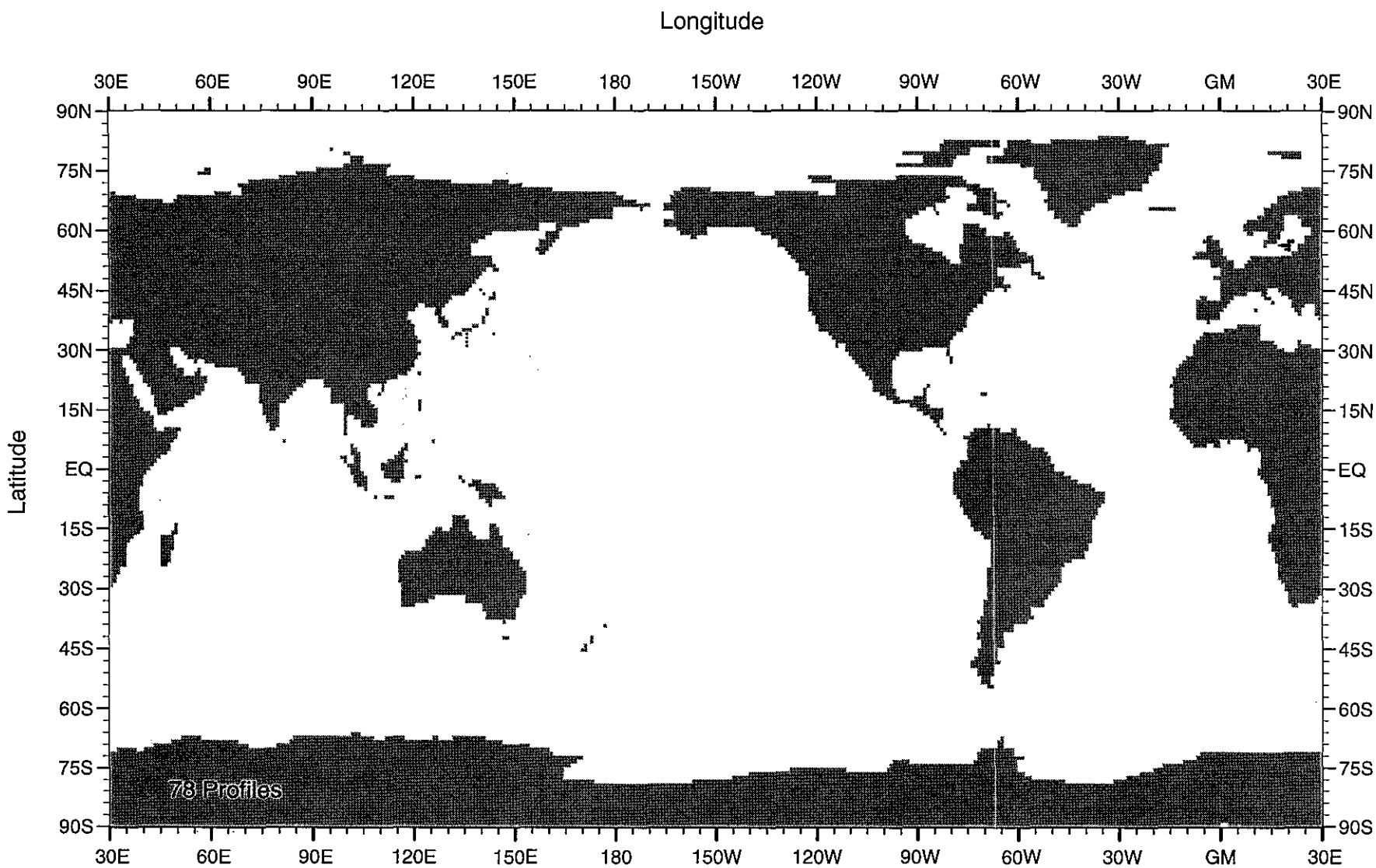

Fig. B205 WOD98 MBT profile distribution for January-March for 1992

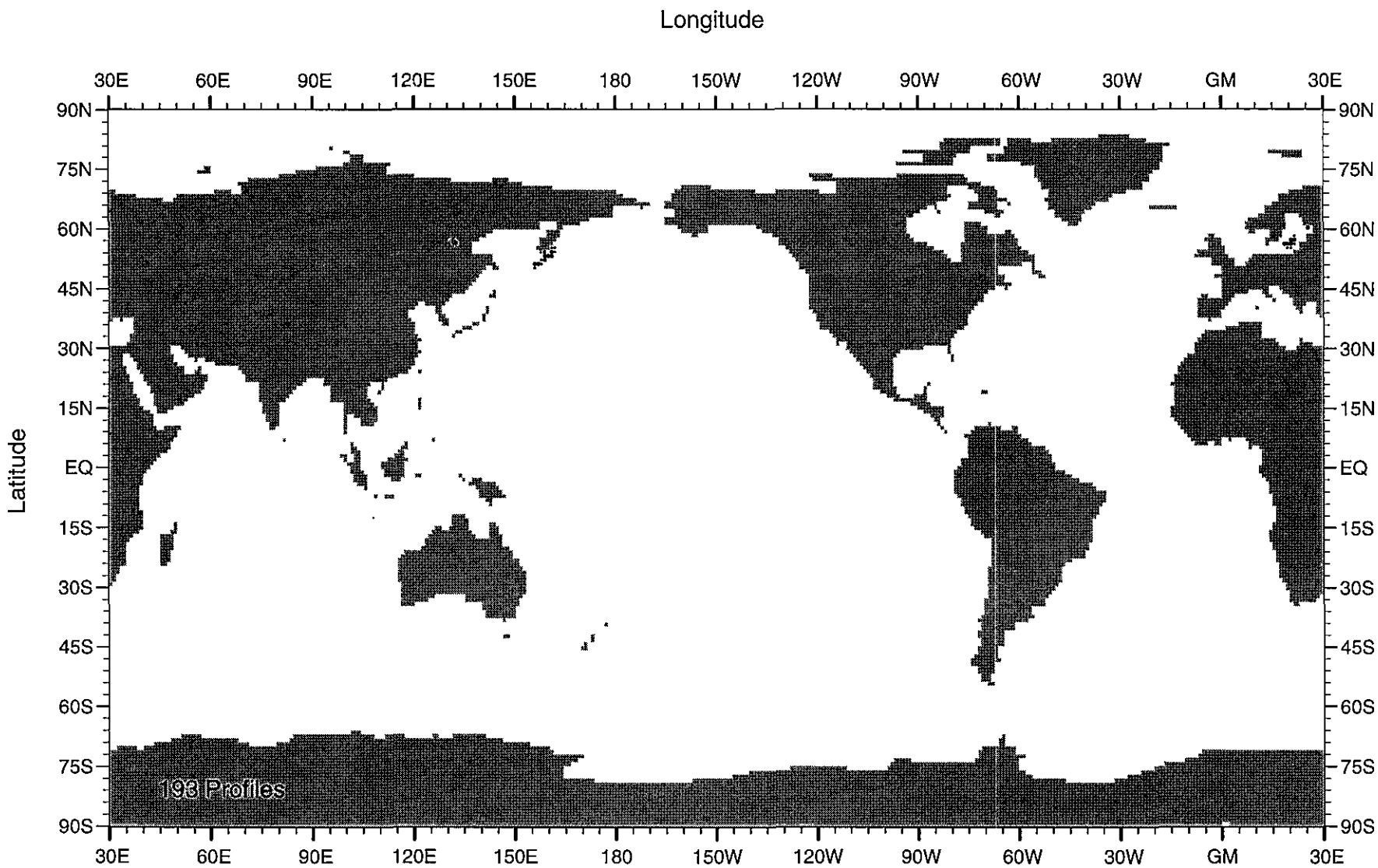

Fig. B206 WOD98 MBT profile distribution for April-June for 1992

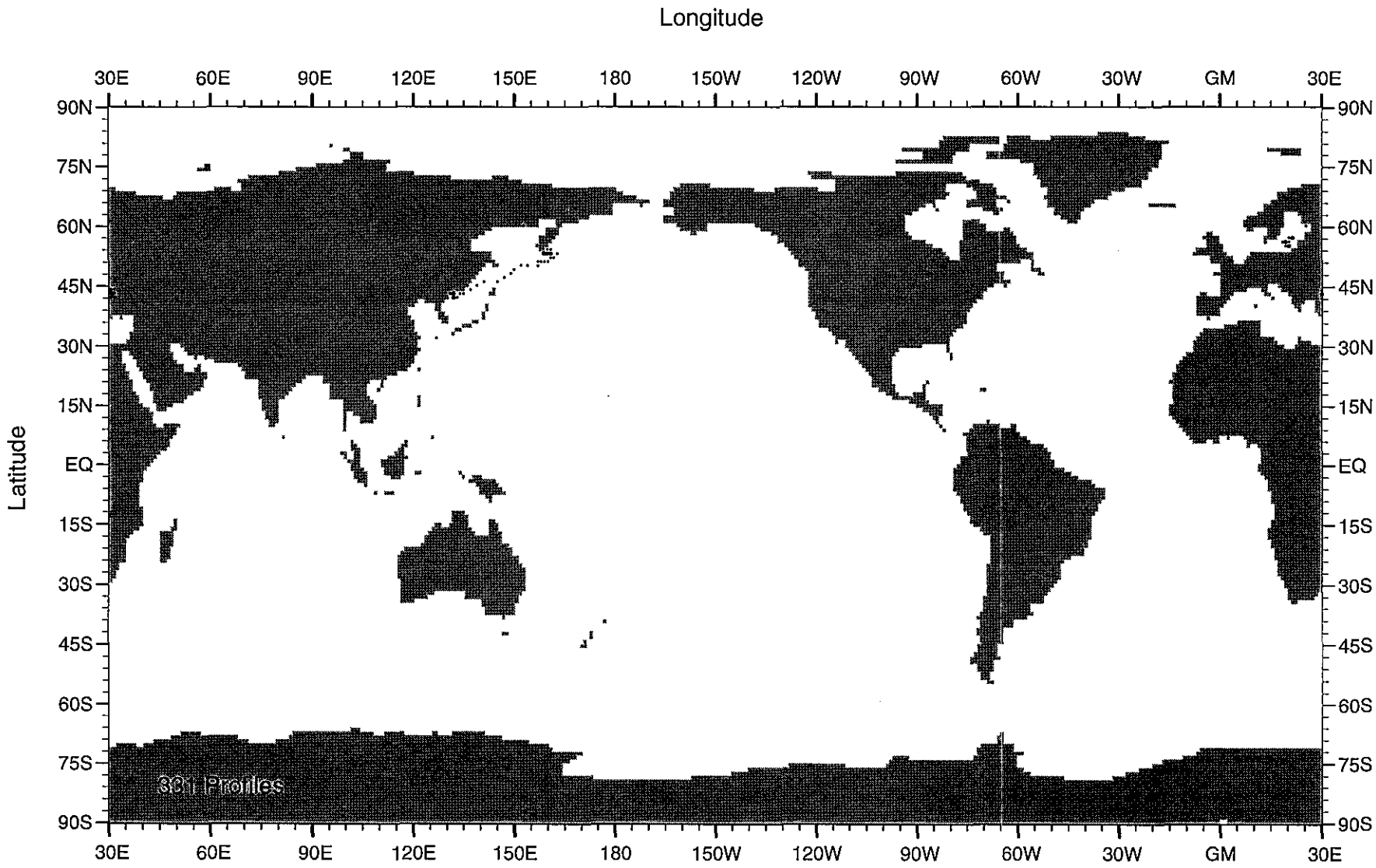

Fig. B207 WOD98 MBT profile distribution for July-September for 1992

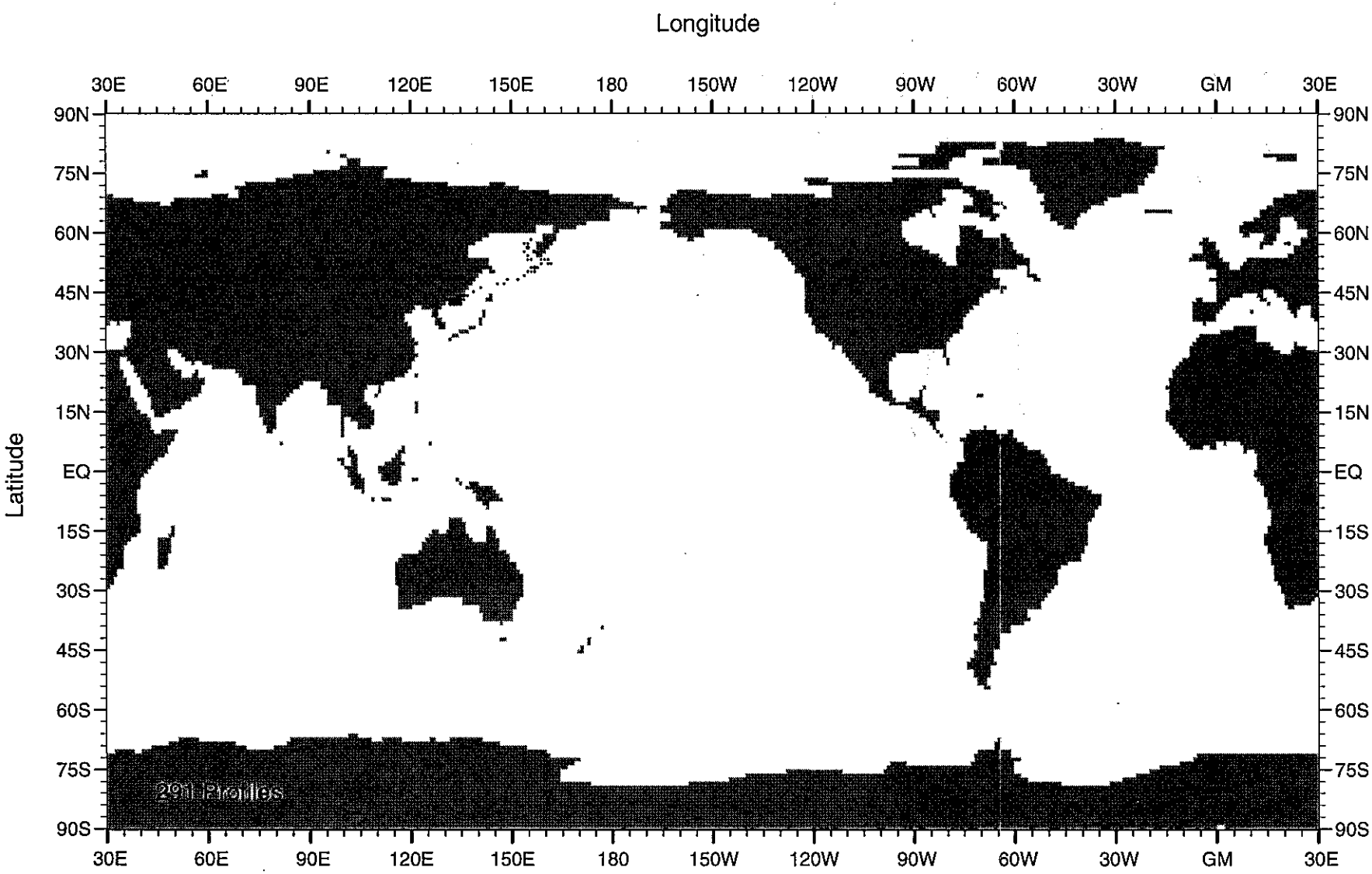

Fig. B208 WOD98 MBT profile distribution for October-December for 1992

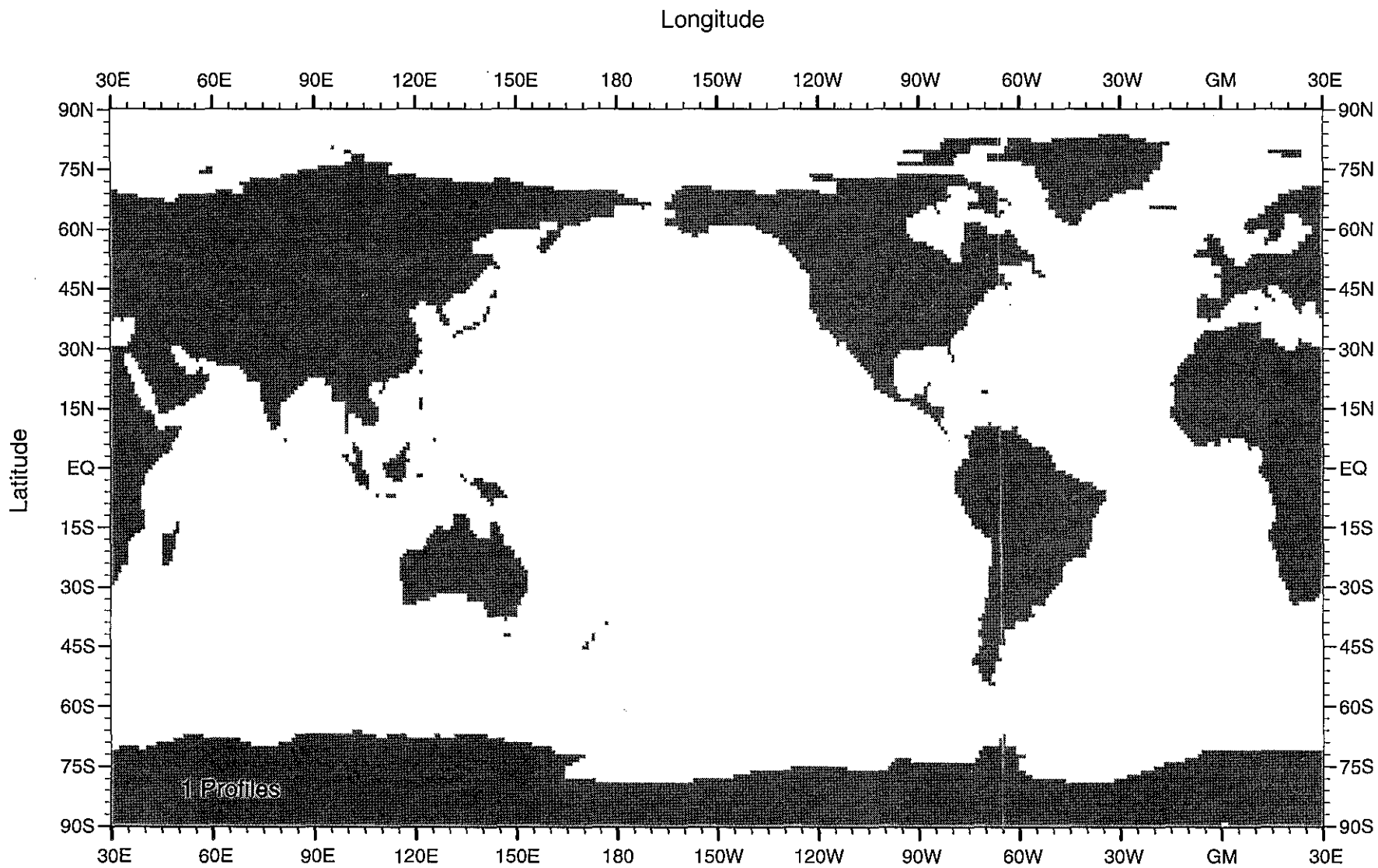

Fig. B209 WOD98 MBT profile distribution for January-March for 1993

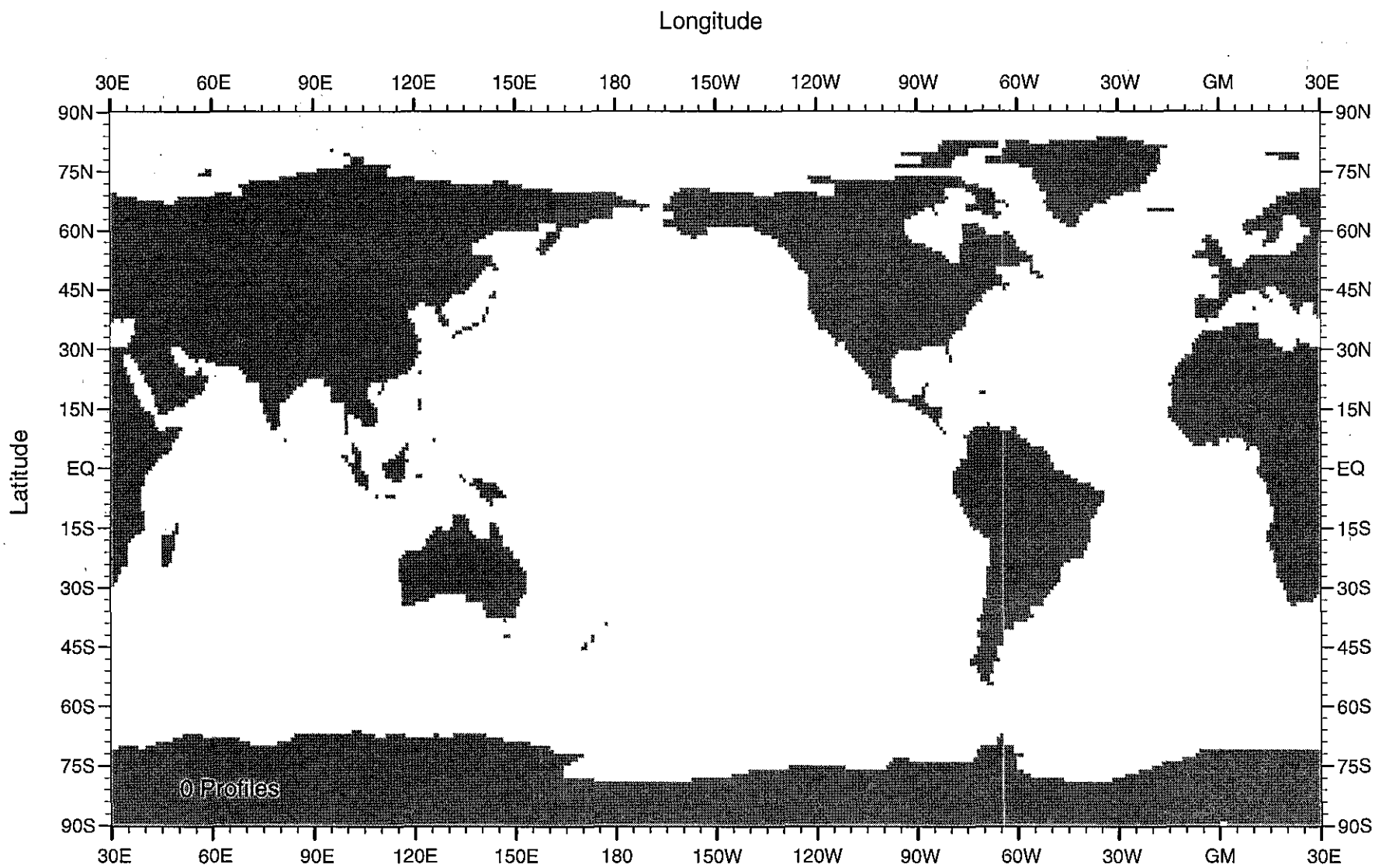

Fig. B210 WOD98 MBT profile distribution for April-June for 1993

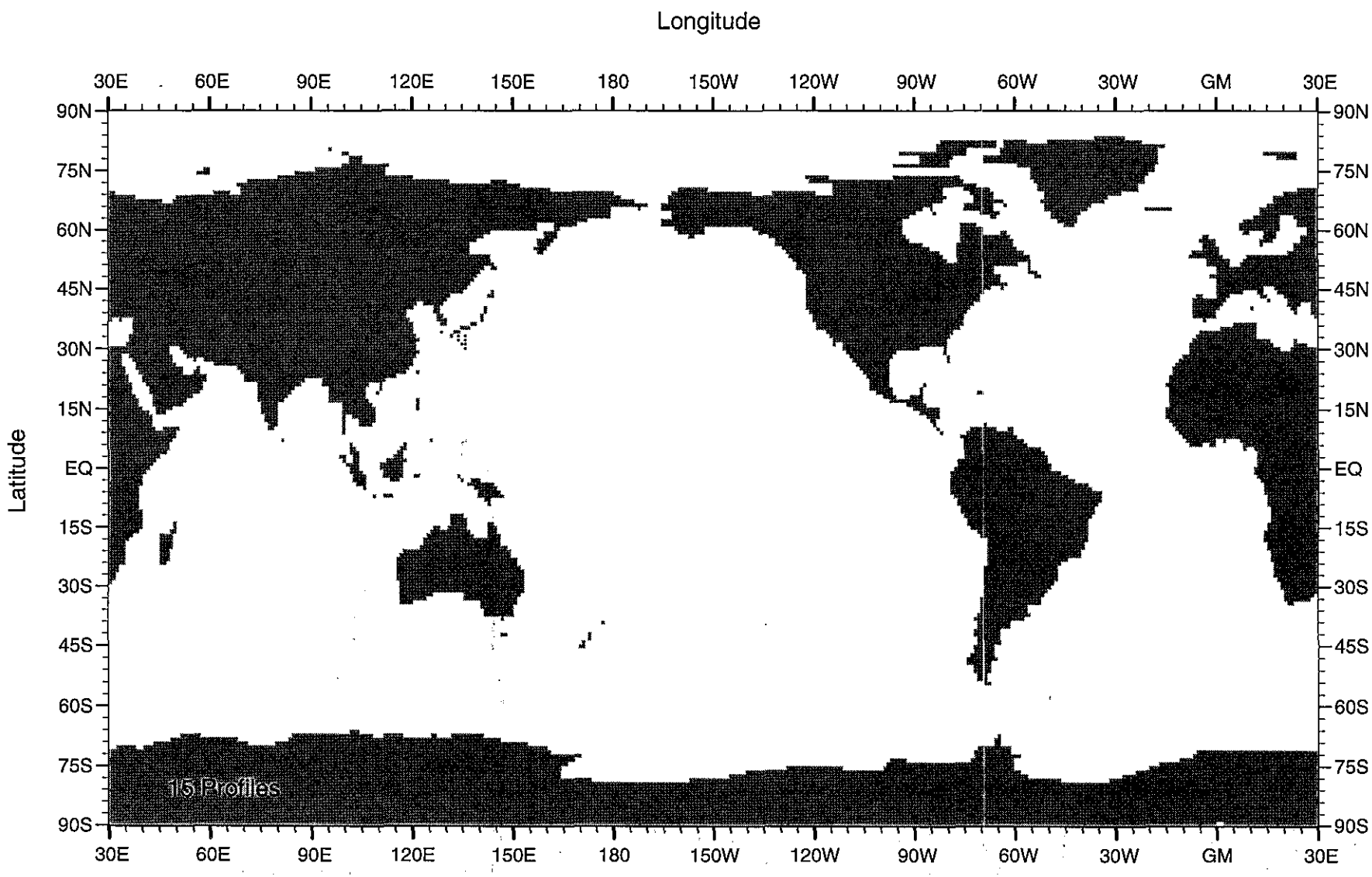

Fig. B211 WOD98 MBT profile distribution for July-September for 1993

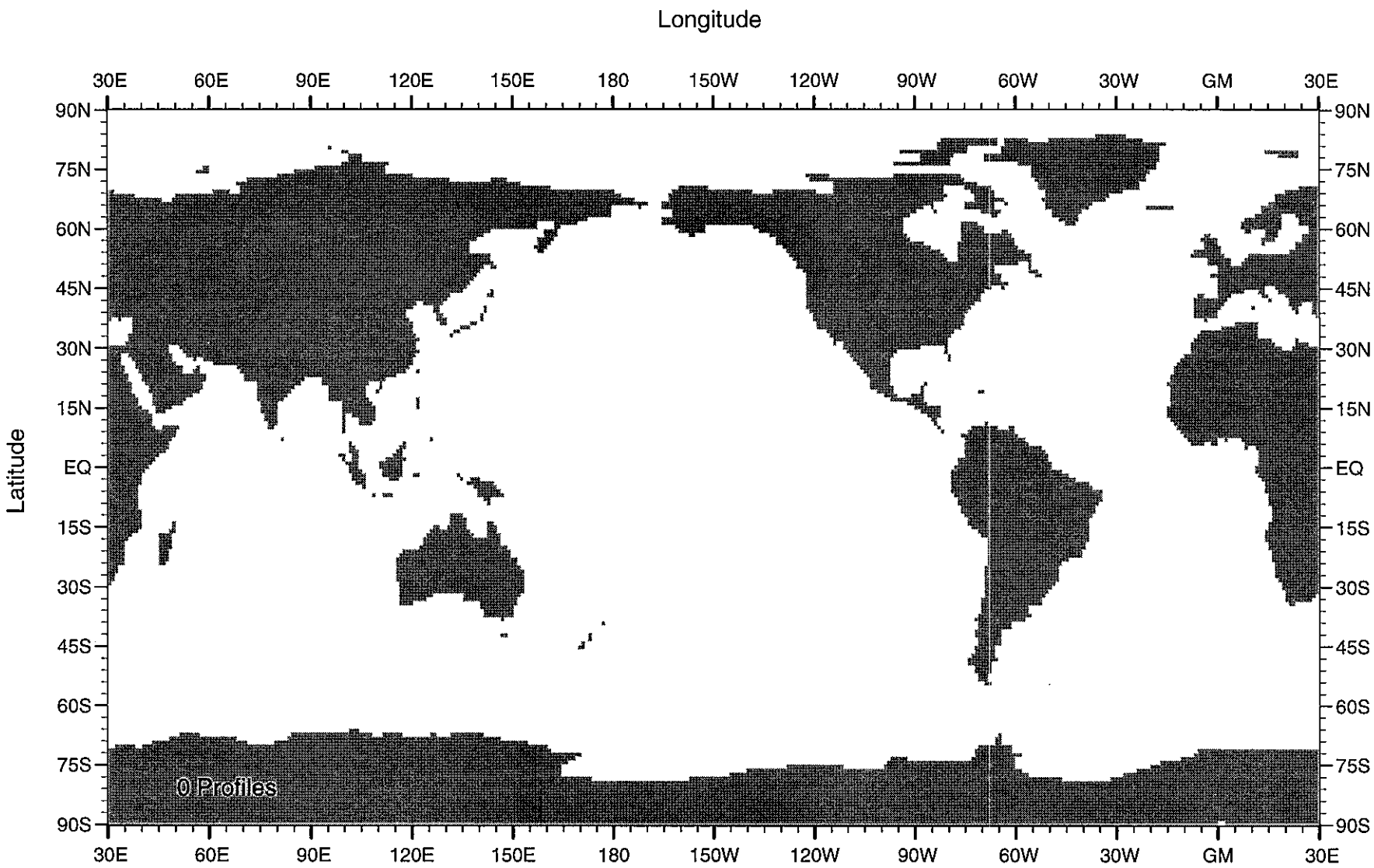

Fig. B212 WOD98 MBT profile distribution for October-December for 1993

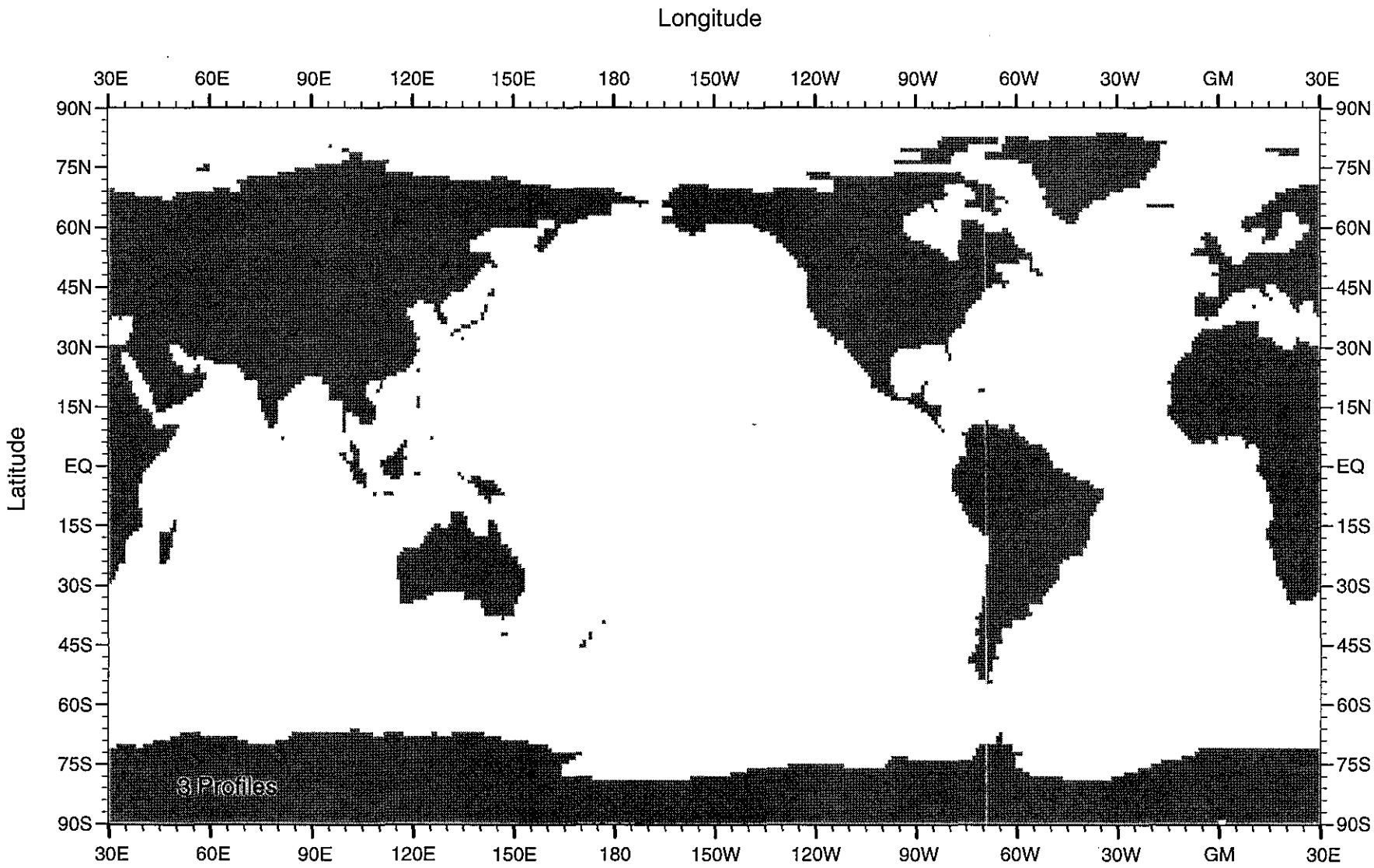

Fig. B213 WOD98 MBT profile distribution for January-March for 1994

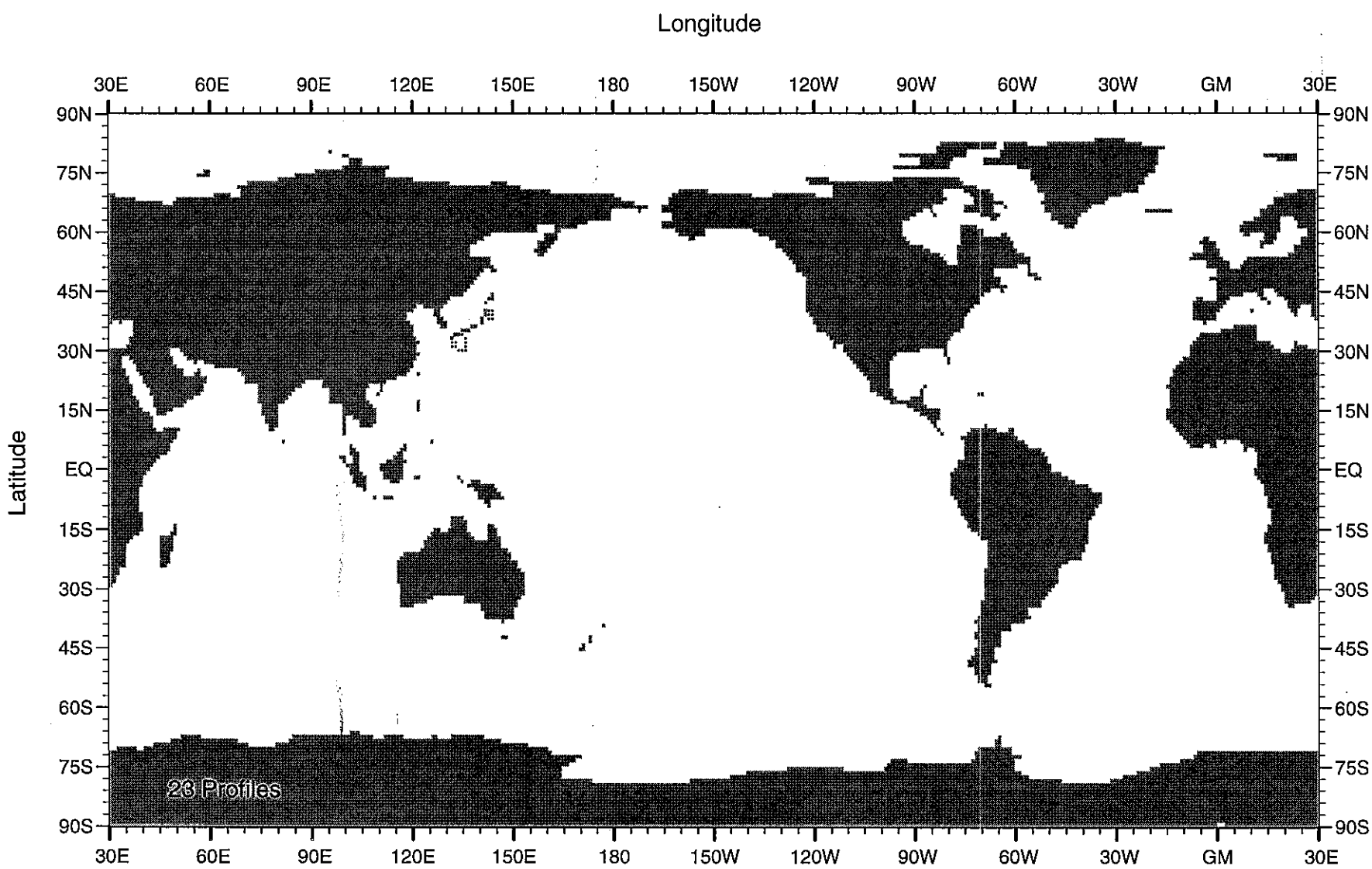

Fig. B214 WOD98 MBT profile distribution for April-June for 1994

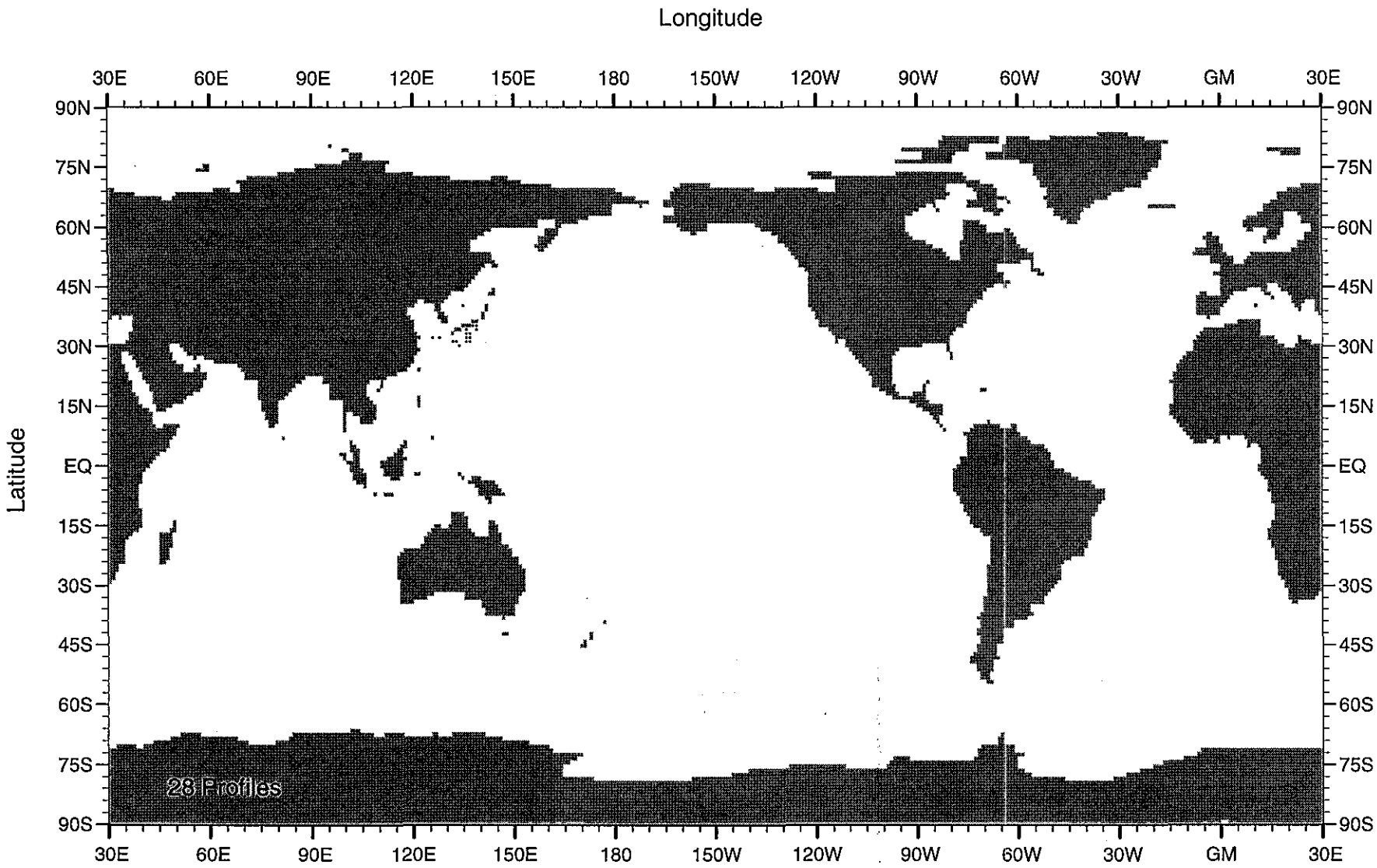

Fig. B215 WOD98 MBT profile distribution for July-September for 1994

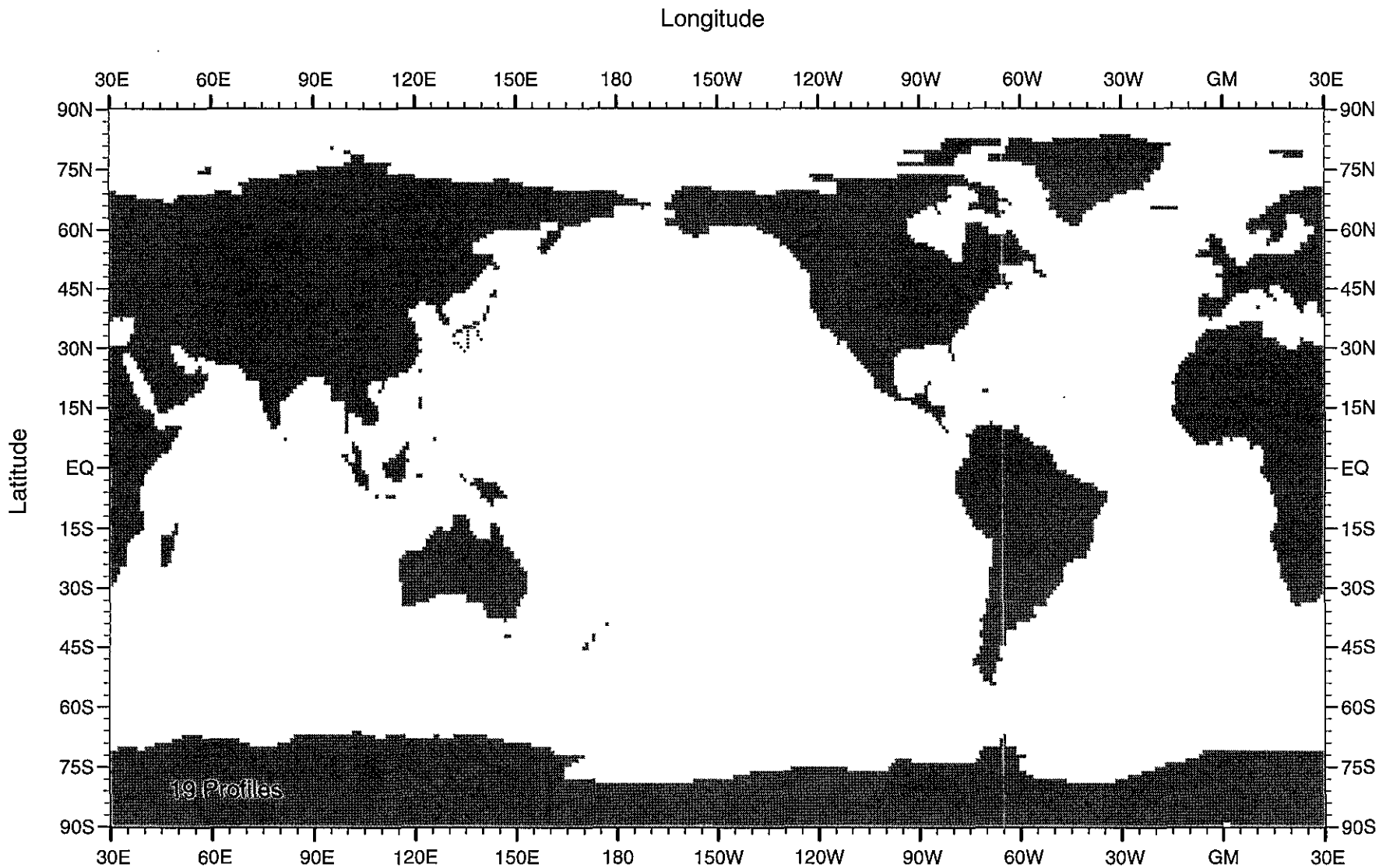

Fig. B216 WOD98 MBT profile distribution for October-December for 1994