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An atlas of the pelagic distribution and abundance of seabirds
in the southern Indian Ocean, 1981 to 1990

Eric J. Woehler, Carolyn L. Hodges and David J. Watts

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**AN ATLAS OF THE PELAGIC DISTRIBUTION AND ABUNDANCE OF
SEABIRDS IN THE SOUTHERN INDIAN OCEAN, 1981 TO 1990**

by

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ABSTRACT

The pelagic distributions and relative abundances of 57 taxa of seabirds (50 species and seven species groups), comprising 38 905 records of 323 870 individuals are mapped on a monthly basis. The data were collected from research cruises and resupply vessels in the southern Indian Ocean, between 60°E and 160°E, and between 40°S and the Antarctic Continent. The records, collected in the 10 years 1981 to 1990, were made in all months except August, with the majority made in October to March.

1. INTRODUCTION

Records of the pelagic distributions of seabirds in the Indian Ocean, reported by Falla (1937), Watson *et al.* (1971) and Johnstone and Kerry (1976), have provided the framework for more recent studies, examining the relationships between seabirds and their prey species (Abrams 1985a) and seasonal foraging ranges (Stahl *et al.* 1985). These studies have also augmented the known pelagic distributions, which for many species have been inferred from few, widely scattered records (Watson 1975).

An international project, utilising standard techniques for recording seabirds-at-sea data, was a component of the Biological Investigation of Marine Antarctic Systems and Stocks (BIOMASS) program, initiated in 1980. Analyses of data sets collected during BIOMASS have been undertaken (BIOMASS 1983, 1985; Abrams 1983, 1985b). Prior to the BIOMASS program, the collection of seabird data had been made using a variety of techniques and methodologies.

The present data report presages a detailed study, examining various aspects of the data that were collected on ANARE research cruises and resupply voyages between 1981 and 1990.

2. METHODS

The seabird data were collected according to the methods prescribed by the BIOMASS Working Party on Bird Ecology (BIOMASS 1982), in the Indian Ocean between 60°E and 160°E and between 40°S and the Antarctic Continent. Records were made in all months except August in the years 1981 to 1990. The majority of records were made in the months of October to March, inclusive. A marine science cruise to Heard Island was conducted during May to July 1990. Voyages in September to November are generally 'ice-edge' cruises; those in December to March reach the Antarctic mainland. Meteorological and oceanographic data were collected concurrently with the seabird data. The data were scrutinised, and doubtful identifications and obvious errors were omitted; all other data collected have been mapped.

The data were mapped on a monthly basis for 50 species and seven species groups (e.g. 'prions'), independent of the year of collection. The areas of the circles used in the maps are proportional to the average number of birds seen per observation at a location. The smallest circle on a map represents one bird per record. Records from observation points within 30 nautical miles (approximately 55 km), of each other were combined, and a new average calculated. This method provided a more accurate estimation of the relative abundance of a species over the area sampled, since an alternative approach of 'binning' the records into unit squares, based on degrees of latitude and longitude, has the fundamental problem of generating unequal areas per bin over the large latitudinal range of the data set (Johnstone and Kerry 1976).

3. RESULTS

The numbers of records for each month are listed in Table 1. A total of 40 354 records of birds was collected in all months, except August. A further 975 records of 'no birds seen' contributed to the 41 329 records over the 10 years 1981 to 1990. Of these 41 329 records, 38 905 have been mapped here. Some unidentified species groups (e.g. unidentified petrels), were not mapped; similarly, coastal species such as gannets, *Sula* sp., were not mapped. A total of 323 870 birds of 50 species and seven species groups (Table 2), has been mapped.

Conventions

Except for the cruise track maps (see below), all maps in this Note are identified with a decimal number, e.g. 9.1. The number before the decimal is the species code, as in Table 2, and the number after the decimal is the month of the sightings. Thus, Map 9.1 presents the January records of wandering albatrosses - species 9. The numbering for all maps uses this system, even if there are no records for that species in a given month, so that all '.3' maps will always show March data, '.6' are maps of June data, and so on.

Cruise tracks/monthly records

The sites at which records were made for each month are shown in Maps A to L; there is no Map G. By comparing these cruise maps with the corresponding species maps (see below), the absence of a record for a particular species/month/locality combination can be attributed to either a lack of sampling at that locality, or an absence of records of the species for that month/locality.

Null records

The sites at which records were made of no birds present are mapped, per month, in Maps 0.1 to 0.12. The numbers of null records per month are given in Table 1.

Table 1. Summary of records made per month, with and without seabirds.

Month	Records of Seabirds	Null Records	Total Monthly Records
January	6024	149	6173
February	4205	178	4383
March	4190	88	4278
April	602	1	603
May	1786	6	1794
June	1849	3	1852
July	184	1	185
August	0	0	0
September	1344	91	1435
October	3368	155	3523
November	6160	78	6238
December	10 642	225	10 867
Totals	40 354	975	41 329

Table 2. Records of 57 taxa of seabirds from the southern Indian Ocean, 1981-90.

Number	Common Name	Scientific Name	Records	Individuals
1	Emperor penguin	<i>Aptenodytes forsteri</i>	338	1015
2	King penguin	<i>Aptenodytes patagonicus</i>	5	17
3	Adélie penguin	<i>Pygoscelis adeliae</i>	1296	10 238
4	Chinstrap penguin	<i>Pygoscelis antarctica</i>	45	
5	Gentoo penguin	<i>Pygoscelis papua</i>	46	
6	Rockhopper penguin	<i>Eudyptes chrysocome</i>	1	10
7	Macaroni/royal penguin	<i>Eudyptes chrysophorus/schlegeli</i>	5	11
8	Penguin sp.		78	237
9	Wandering albatross	<i>Diomedea exulans</i>	1509	2166
10	Northern royal albatross	<i>Diomedea epomophora sandfordi</i>	1	2
11	Southern royal albatross	<i>Diomedea epomophora epomophora</i>	28	34
12	Royal albatross sp.	<i>Diomedea epomophora</i>	3	3
13	Black-browed albatross	<i>Diomedea melanophrys</i>	1129	1622
14	Buller's albatross	<i>Diomedea bulleri</i>	7	8
15	Grey-headed albatross	<i>Diomedea chrysostoma</i>	523	631
16	Yellow-nosed albatross	<i>Diomedea chlororhynchos</i>	32	33
17	White-capped albatross	<i>Diomedea cauta</i>	228	504
18	Sooty albatross	<i>Phoebetria fusca</i>	32	40
19	Light-mantled sooty albatross	<i>Phoebetria palpebrata</i>	1740	3284
20	Salvin's albatross	<i>Diomedea cauta salvini</i>	5	5
21	Southern giant petrel	<i>Macronectes giganteus</i>	741	999
22	Northern giant petrel	<i>Macronectes halli</i>	402	628
23	Southern fulmar	<i>Fulmarus glacialisoides</i>	1865	6704
24	Antarctic petrel	<i>Thalassarche antarctica</i>	3106	75 494
25	Cape petrel	<i>Daption capense</i>	3822	20 949
26	Snow petrel	<i>Pagodroma nivea</i>	2427	8448
27	Prion sp.	<i>Pachyptila sp.</i>	5166	42 401
28	Blue petrel	<i>Halobaena caerulea</i>	1718	9372
29	Great-winged petrel	<i>Pterodroma macroptera</i>	53	81
30	White-headed petrel	<i>Pterodroma lessoni</i>	1116	1633
31	Kerguelen petrel	<i>Pterodroma brevirostris</i>	367	466
32	Soft-plumaged petrel	<i>Pterodroma mollis</i>	258	494
33	Mottled petrel	<i>Pterodroma inexpectata</i>	151	232
34	Gould's petrel	<i>Pterodroma leucoptera</i>	16	22
35	White-chinned petrel	<i>Procellaria aequinoctialis</i>	4430	24 718
36	Grey petrel	<i>Procellaria cinerea</i>	412	587
37	(Westland) black petrel	<i>Procellaria westlandica</i>	3	3
38	Greater shearwater	<i>Puffinus gravis</i>	6	13
39	Short-tailed & sooty shearwaters	<i>Puffinus tenuirostris & griseus</i>	812	39 577
40	Fluttering shearwater	<i>Puffinus gavia</i>	4	20
41	Little shearwater	<i>Puffinus assimilis</i>	12	16
42	Shearwater sp.	<i>Puffinus sp.</i>	1538	60 644
43	Wilson's storm petrel	<i>Oceanites oceanicus</i>	2032	6718
44	Grey-backed storm petrel	<i>Garrodia nereis</i>	13	14
45	White-faced storm petrel	<i>Pelagodroma marina</i>	1	1
46	Black-bellied storm petrel	<i>Fregetta tropica</i>	517	1133
47	White-bellied storm petrel	<i>Fregata grallaria</i>	200	333
48	Diving petrel sp.	<i>Pelecanoides sp.</i>	323	1372
49	Blue-eyed shag	<i>Phalacrocorax atriceps</i>	26	309
50	South polar skua	<i>Catharacta maccormicki</i>	228	340
51	Subantarctic skua	<i>Catharacta lönbergi</i>	19	23
52	Great skua	<i>Catharacta skua</i>	70	82
53	Pomarine skua	<i>Stercorarius pomarinus</i>	4	6
54	Jaeger sp.	<i>Stercorarius sp.</i>	1	1
55	Kelp gull	<i>Larus dominicanus</i>	10	11
56	Antarctic tern	<i>Sterna vittata</i>	28	90
57	Arctic tern	<i>Sterna paradisaea</i>	40	65
Totals			38 905	323 870

Species records

Penguins

***Aptenodytes, Pygoscelis and Eudyptes* sp.**

Maps 1.1 to 7.12 show where records of the seven species of identified penguins have been made; maps 8.2 to 8.12 show the locations for records of unidentified penguins.

Albatrosses

***Diomedea and Phoebetria* sp.**

Maps 9.1 to 11.12 and maps 13.1 to 20.12 show where the records of 12 species and identifiable subspecies of albatrosses have been made. Map 12.12 shows the locations of royal albatrosses that were not identified to subspecies.

Fulmarine petrels

***Macronectes, Fulmarus, Thalassoica, Daption and Pagodroma* sp.**

Maps 21.1 to 26.12 show where records of the six species of fulmarine petrels have been made.

Prions and blue petrels

***Pachyptila and Halobaena* sp.**

All records of prions have been incorporated for the purposes of mapping. While specific identifications have been made, the difficulties of identifying prions at sea meant that all records of prions were mapped together.

Gadfly petrels

***Pterodroma* sp.**

Maps 29.1 to 34.12 show where records of six species of *Pterodroma* petrels have been made.

Petrels

***Procellaria* sp.**

Maps 35.1 to 37.2 show where records of three species of *Procellaria* petrels have been made.

Shearwaters

***Puffinus* sp.**

Maps 38.2 to 41.12 show where the records of three species of shearwaters have been made. As with prions, records for a further two species (short-tailed and sooty shearwaters) have been incorporated for mapping due to the problems in field identification. Records of unidentified shearwaters are presented in Maps 42.1 to 42.12.

Storm petrels

***Oceanites, Garrodia, Pelagodroma and Fregetta* sp.**

Records of five species of storm petrels of four genera are presented in Maps 43.1 to 47.12.

Diving petrels

***Pelecanoides* sp.**

Records of two species: common and South Georgian diving petrels, are shown in Maps 48.1 to 48.12. The records have been combined for mapping, since it is not possible to identify individuals of these species in the field.

Shags

***Phalacrocorax* sp.**

Records of blue-eyed shags, *Phalacrocorax* sp., are shown in Maps 49.6 to 49.12. At least three subspecies or species are included: one at each of the breeding localities of Iles Kerguelen, Heard and Macquarie Islands.

Skuas

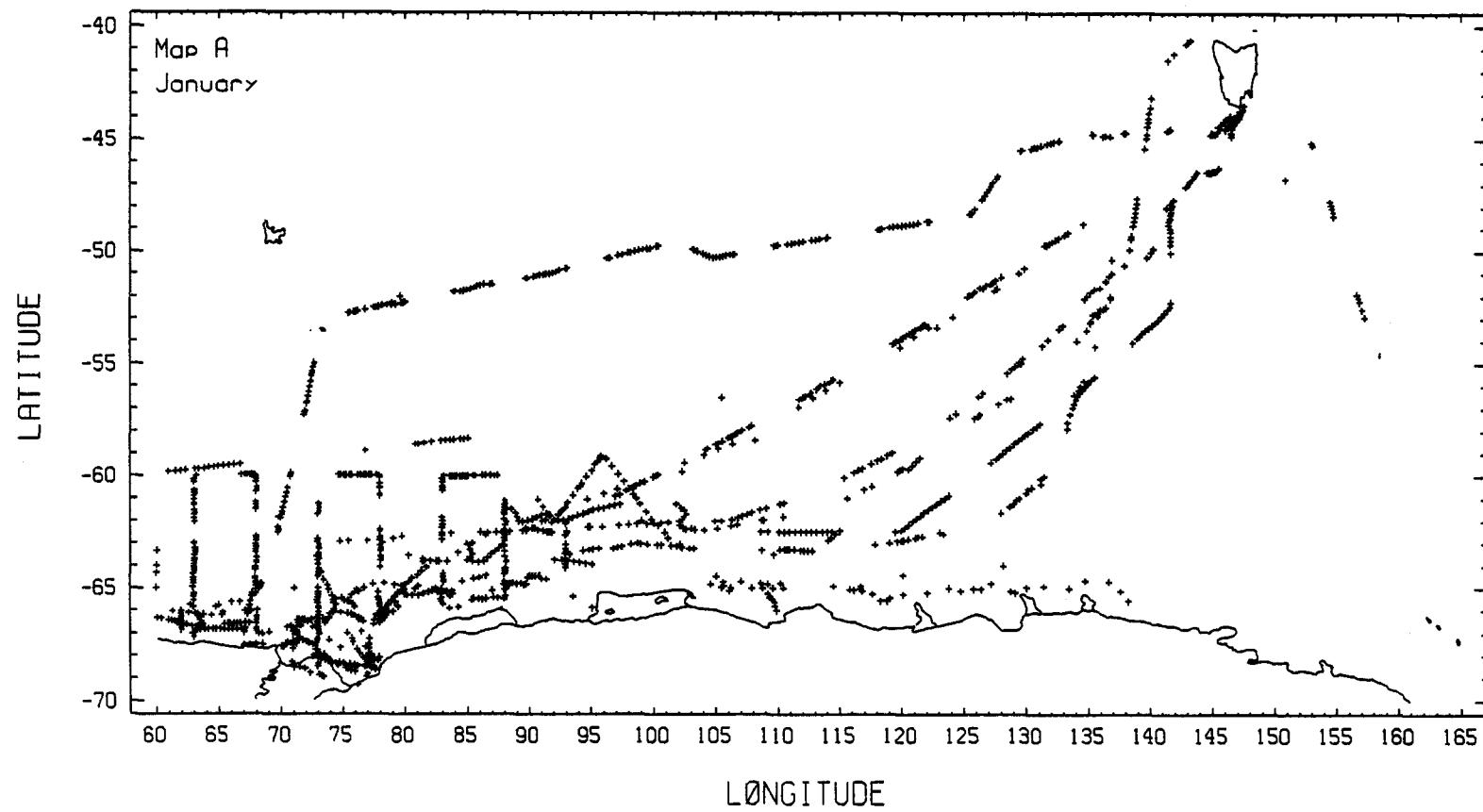
***Catharacta* and *Stercorarius* sp.**

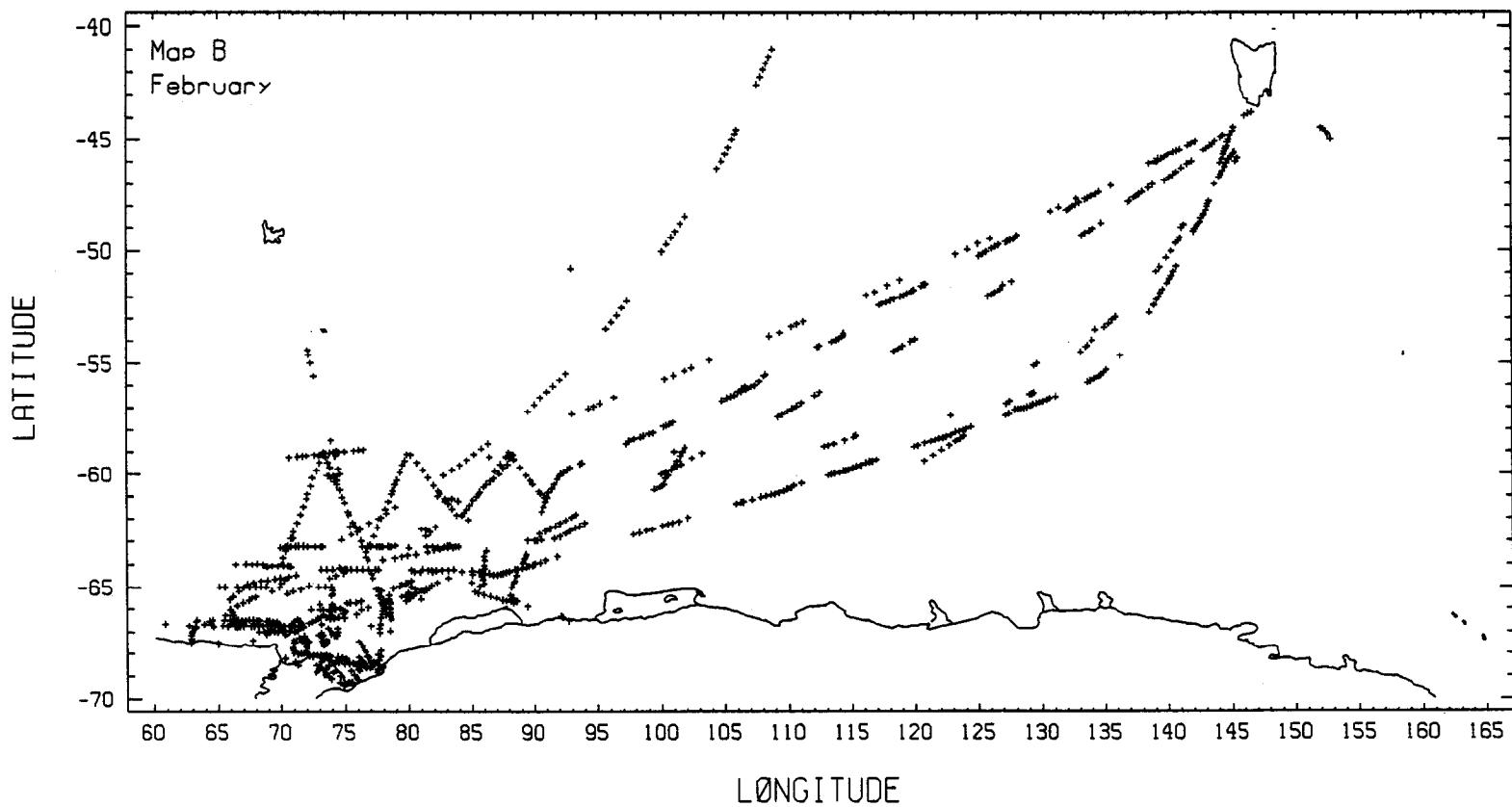
Records of skuas, *Catharacta* sp. and jaegers, *Stercorarius* sp., are presented in Maps 50.1 to 53.12. An unidentified *Stercorarius* sp. record is presented in Map 54.11. It is likely that some records of subantarctic skuas were recorded as great skuas.

Gulls and terns

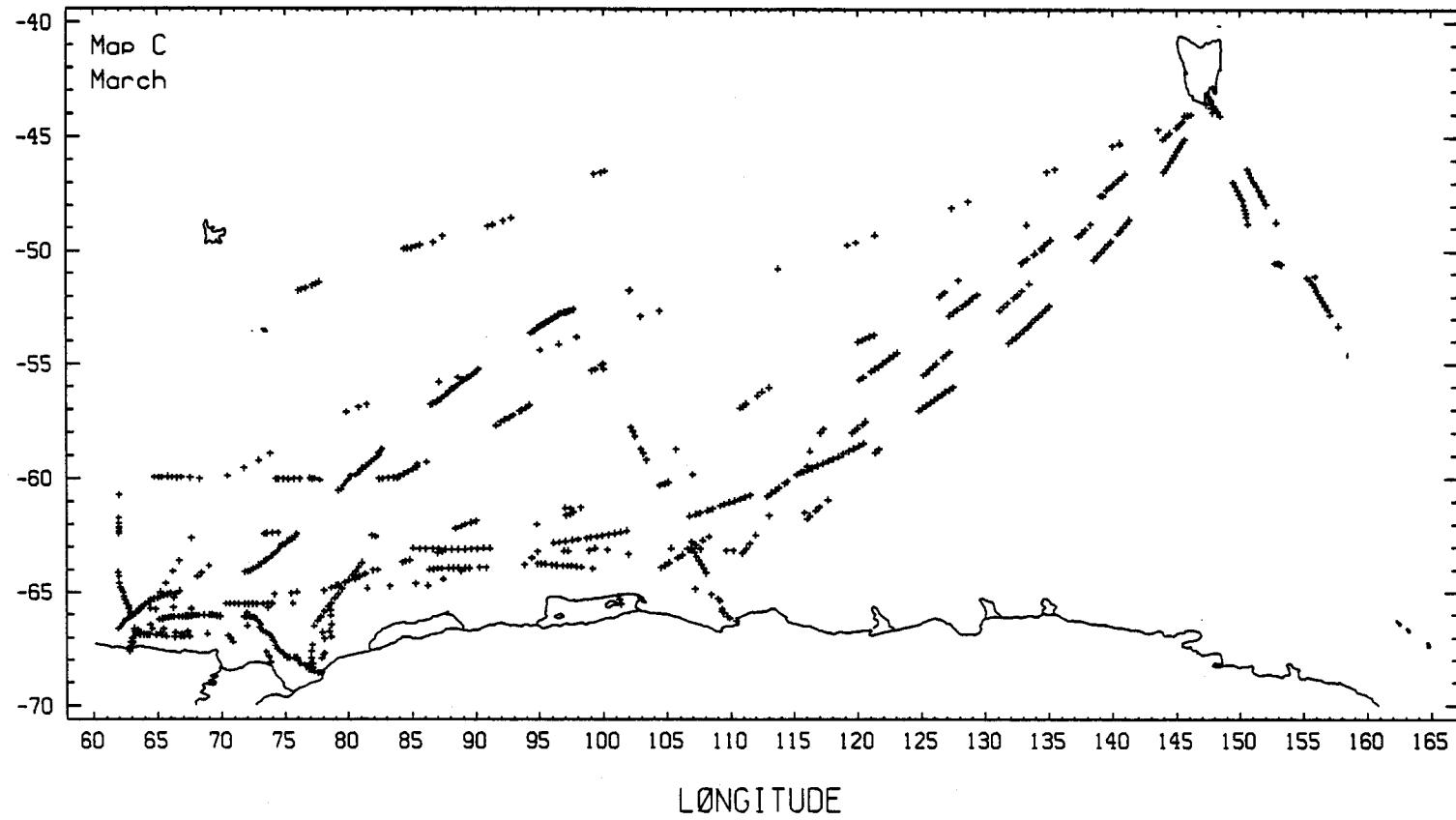
***Larus* and *Sterna* sp.**

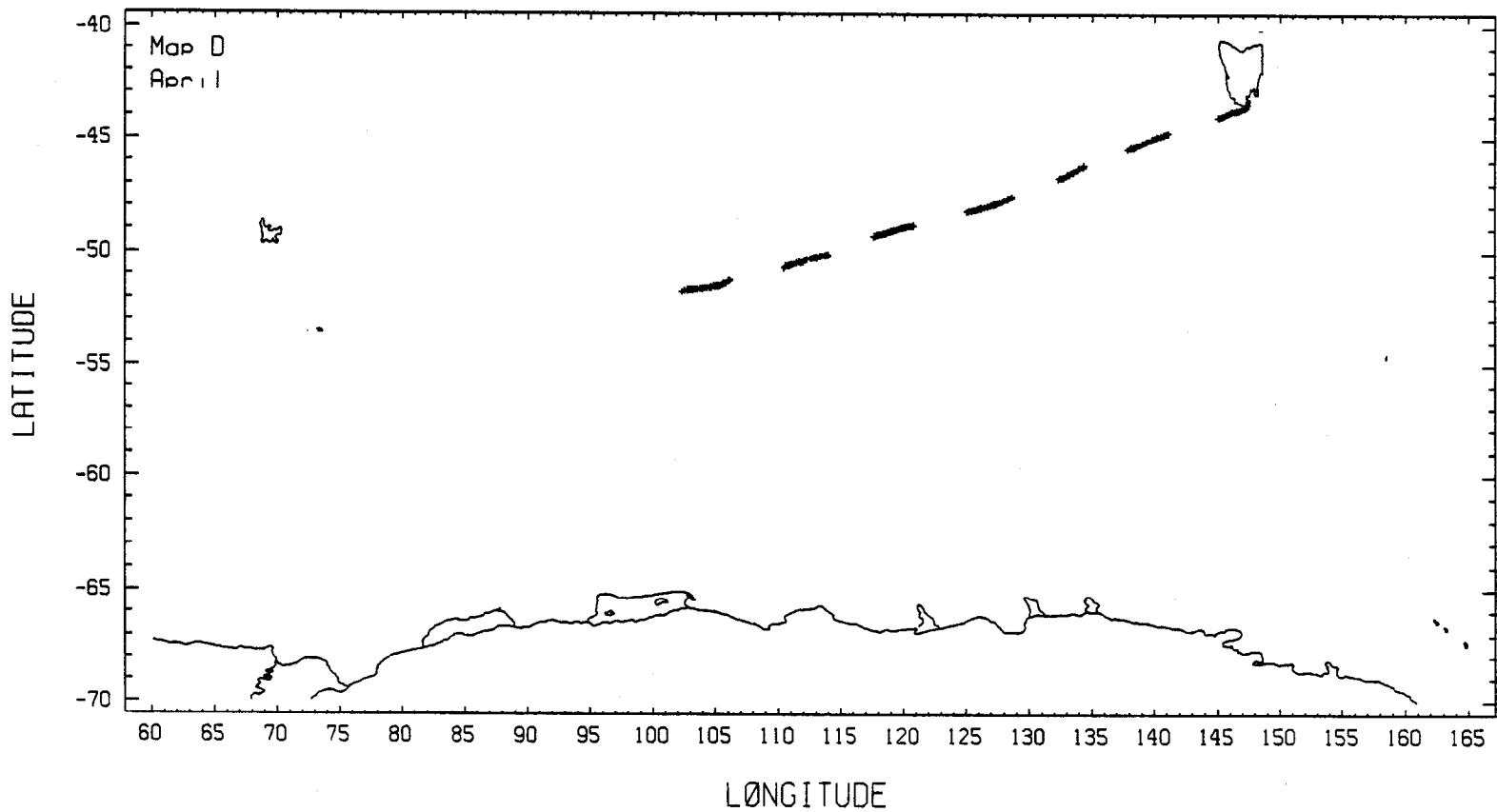
Records of kelp gulls, Antarctic and Arctic terns are presented in Maps 55.1 to 57.12.



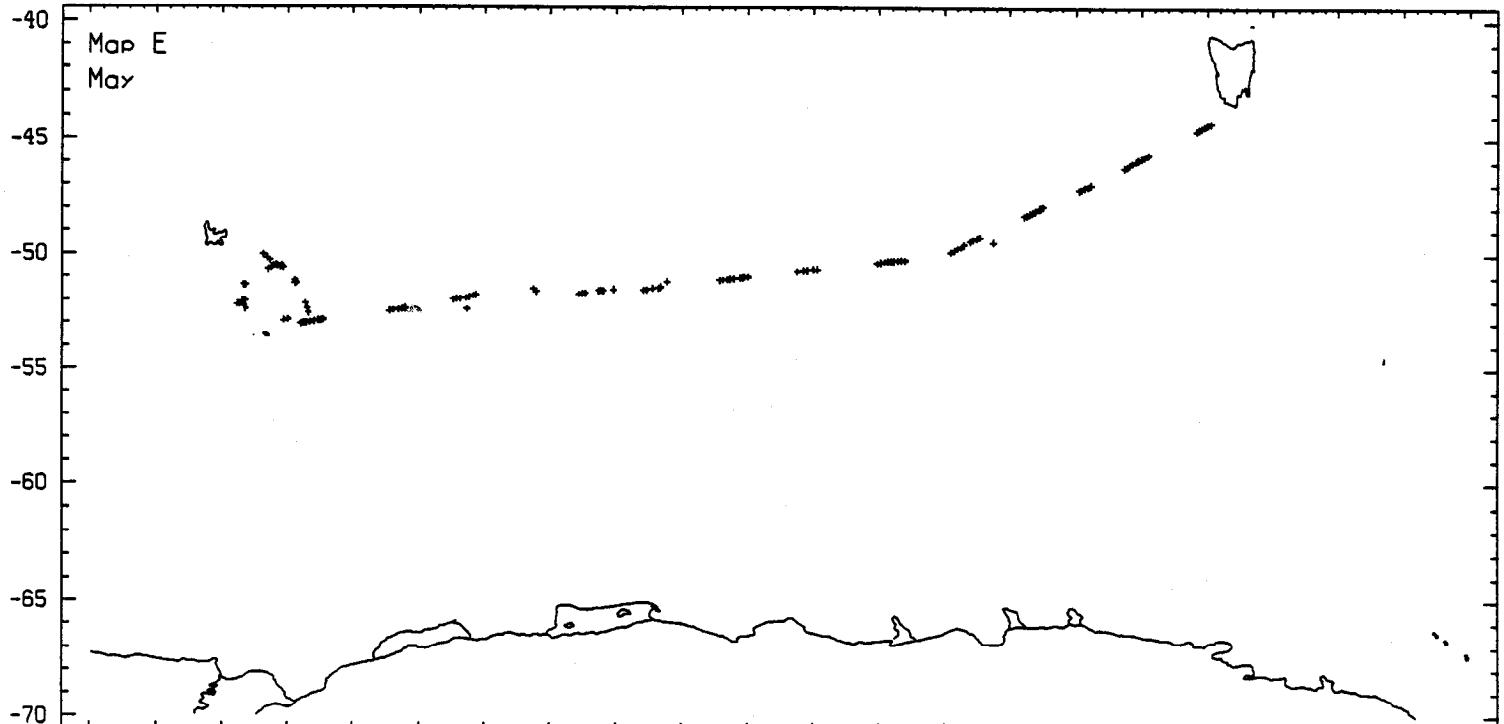


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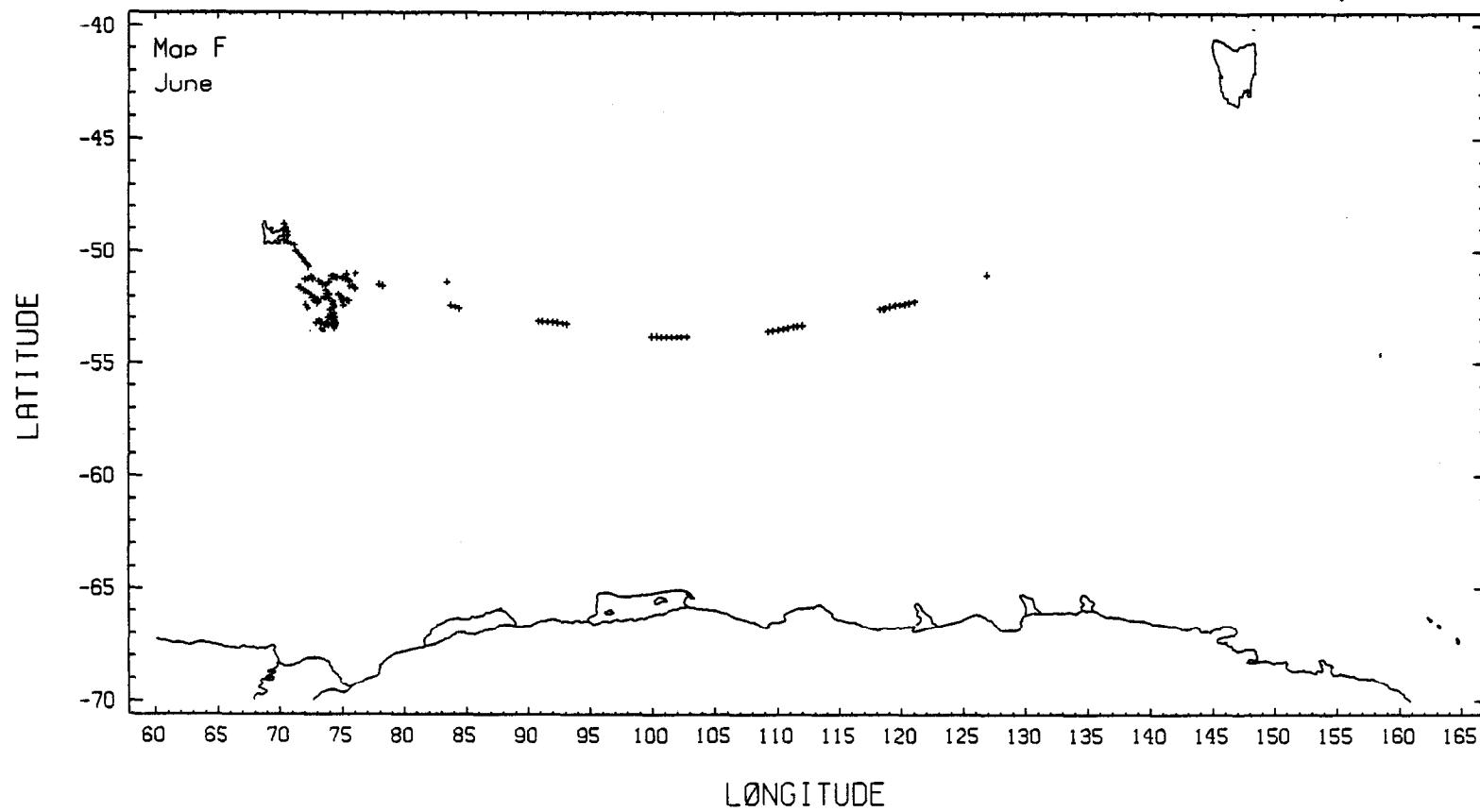




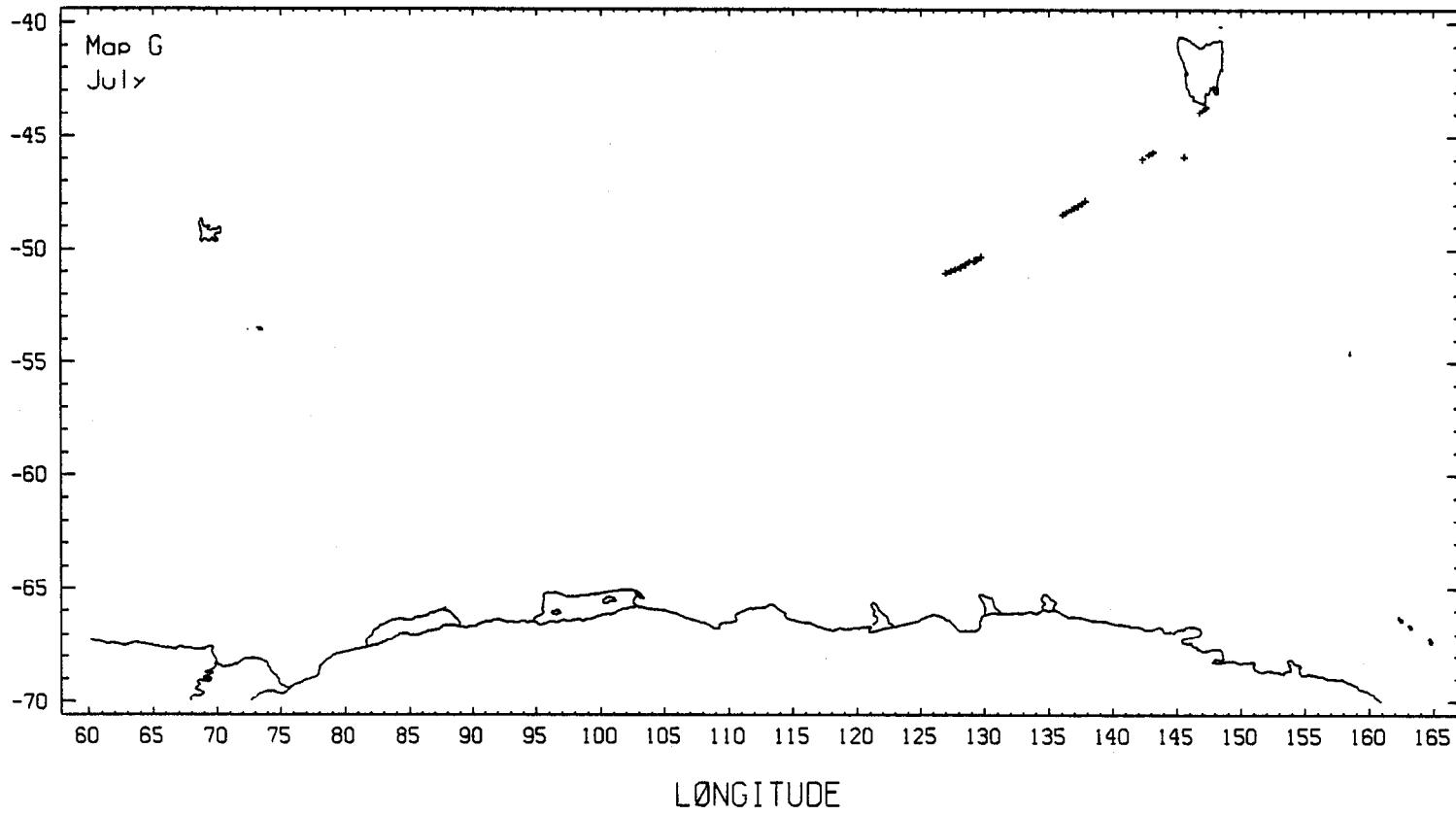
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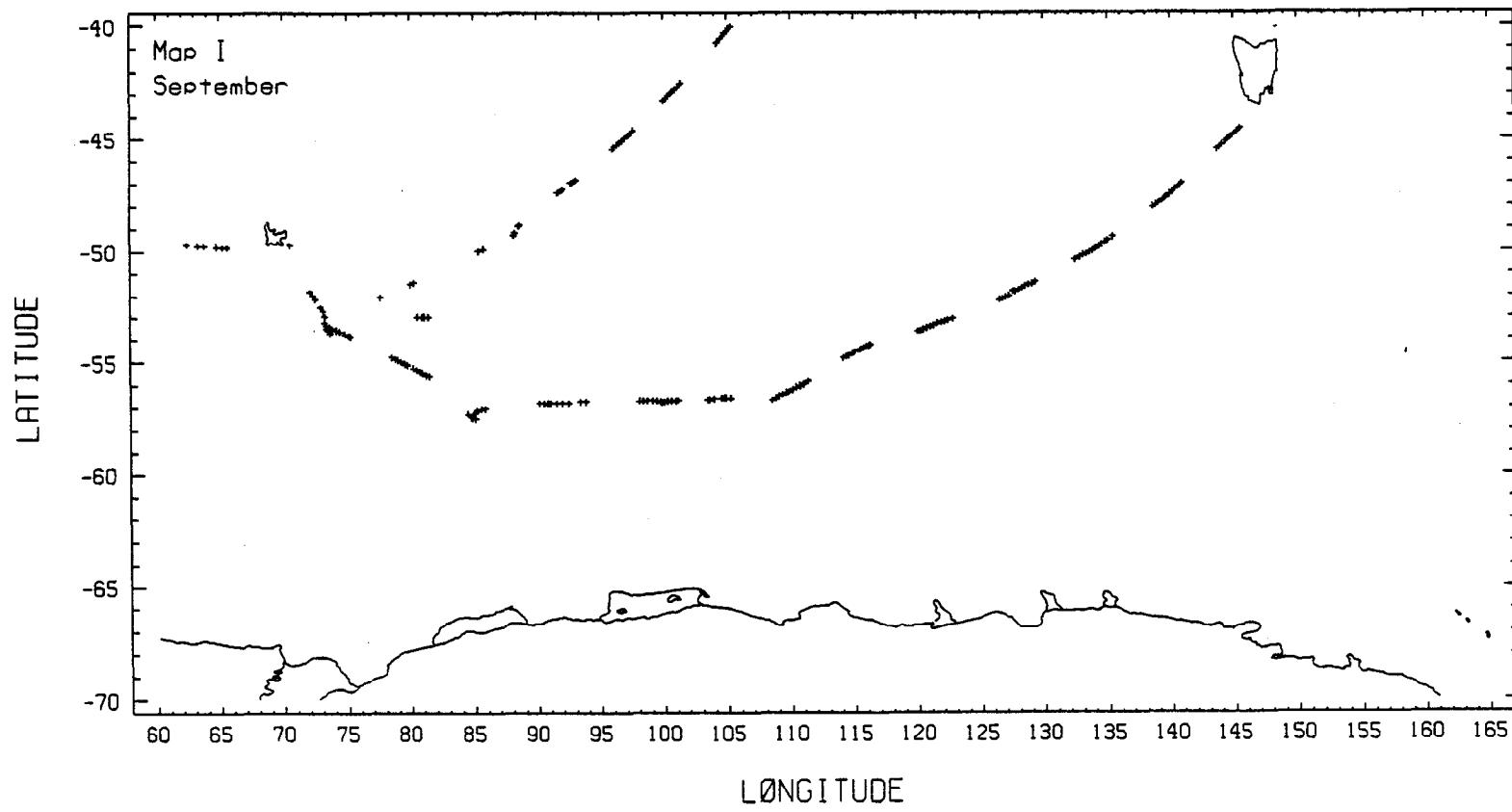


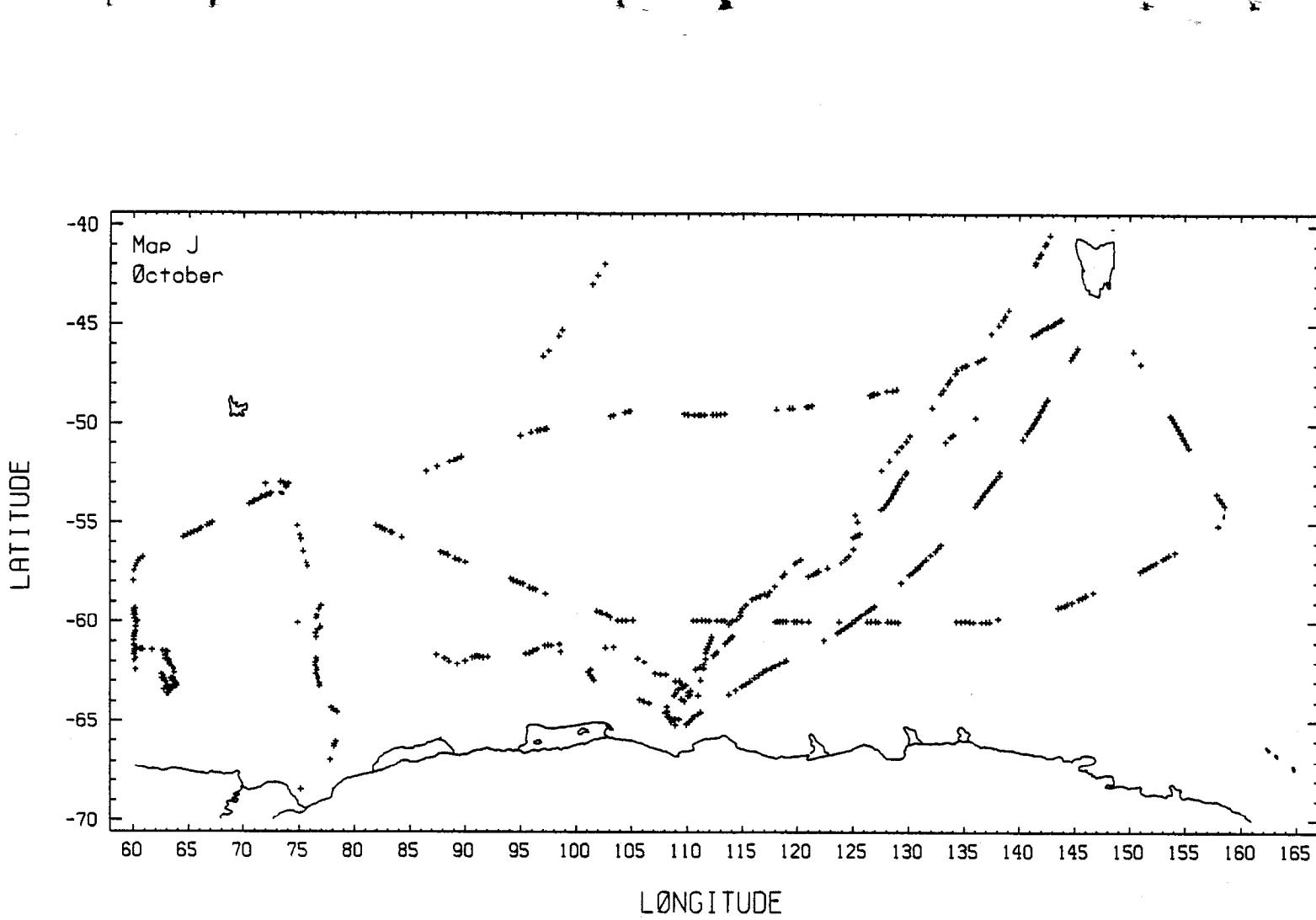
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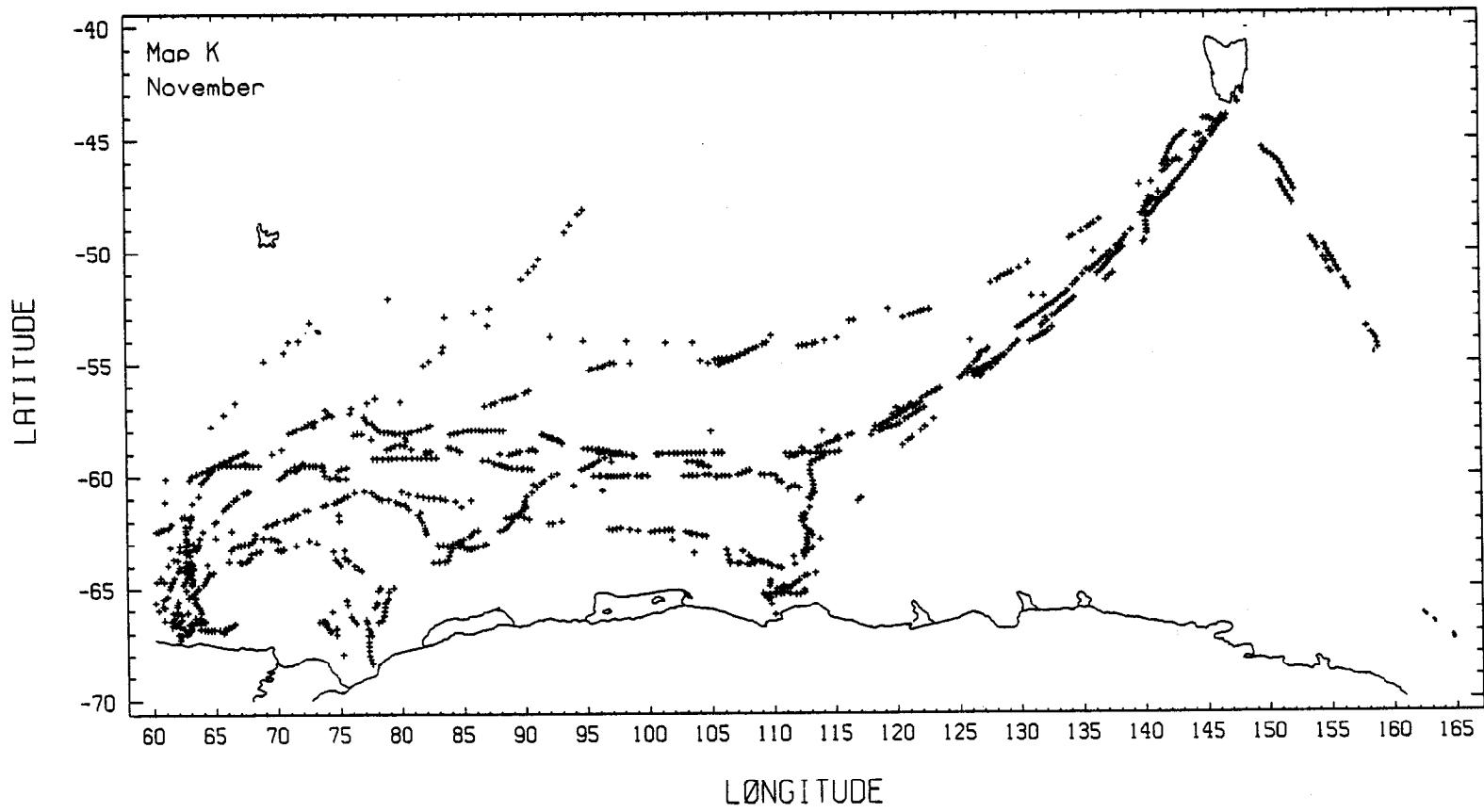


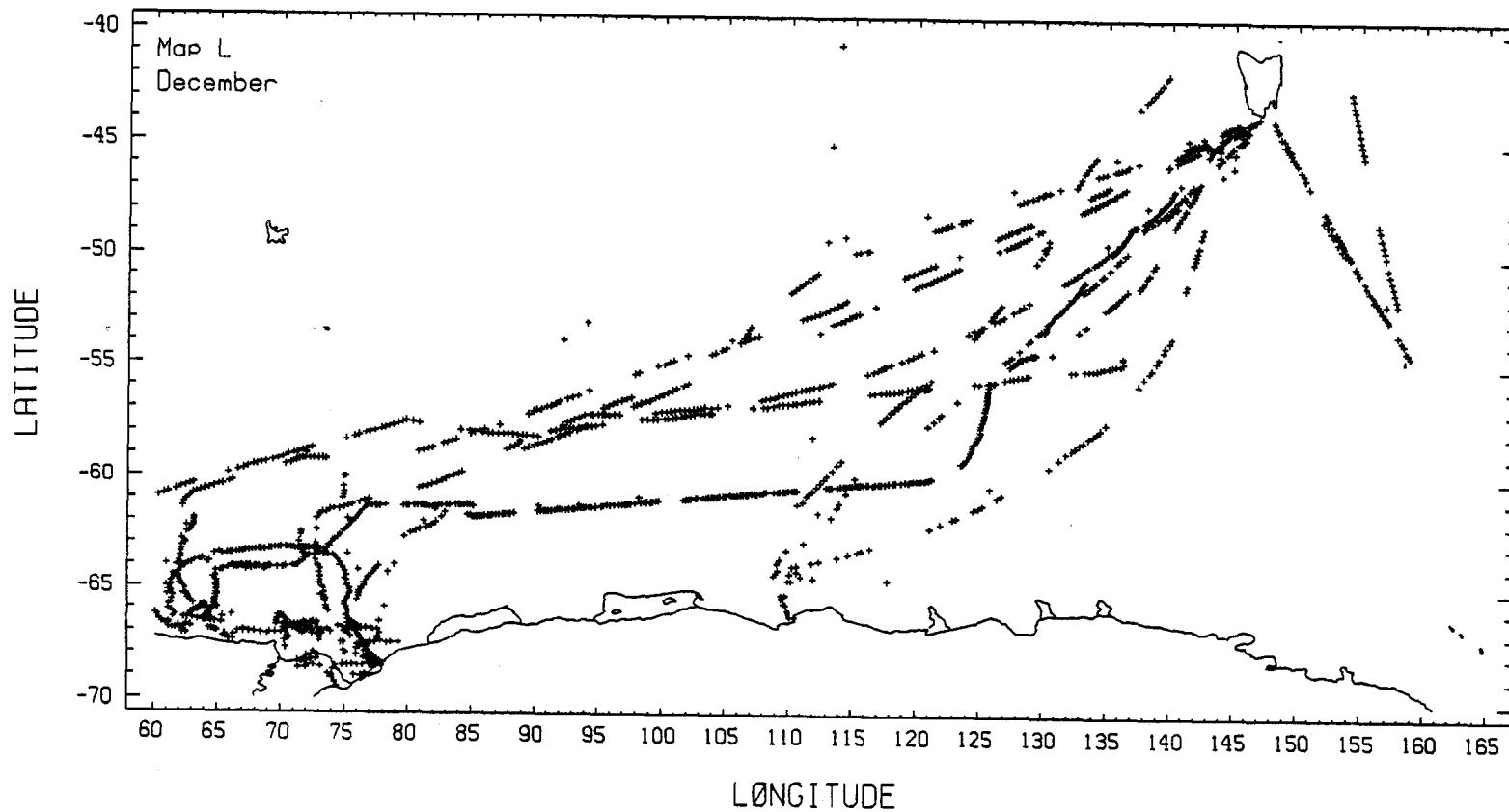
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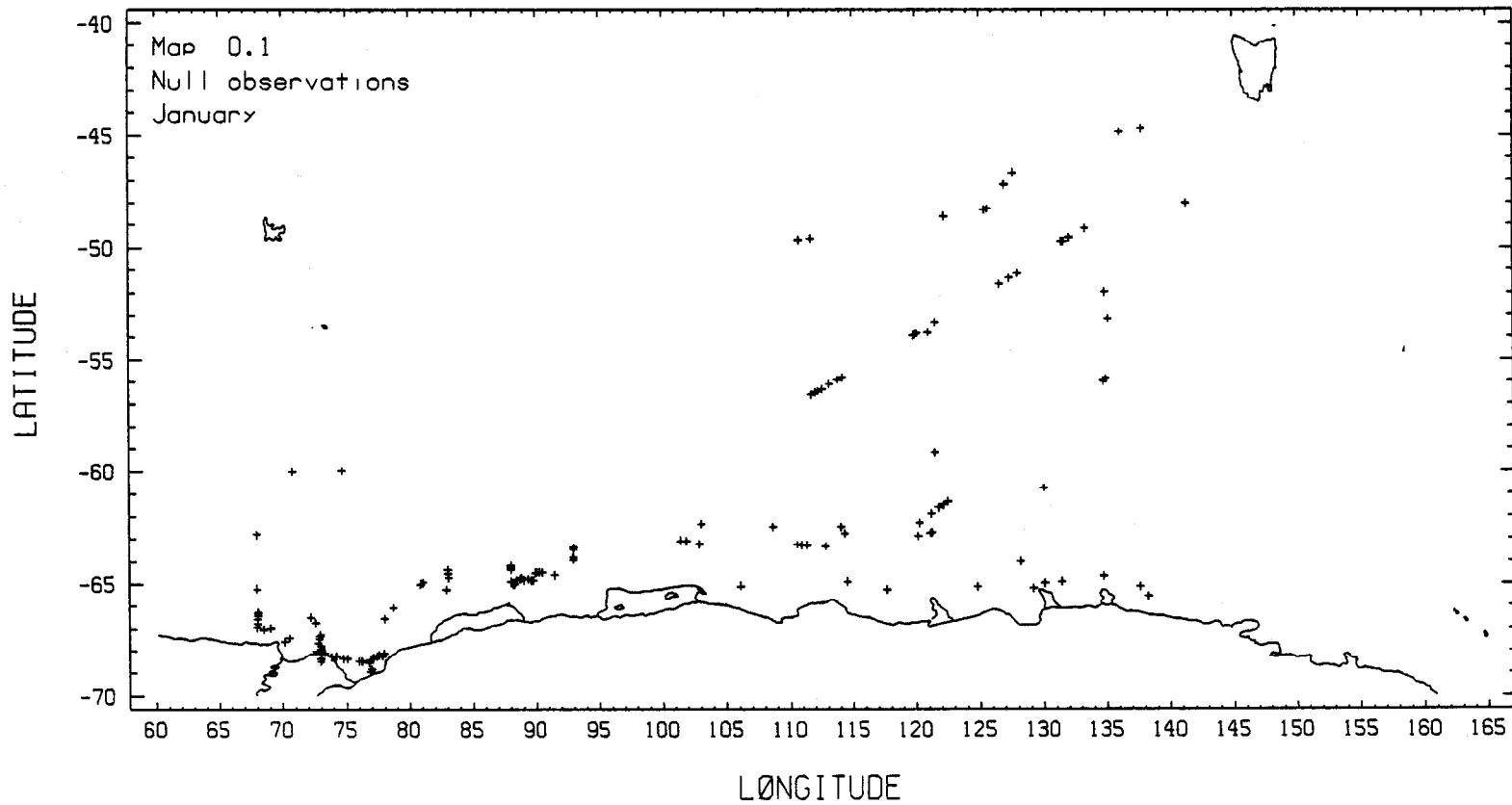


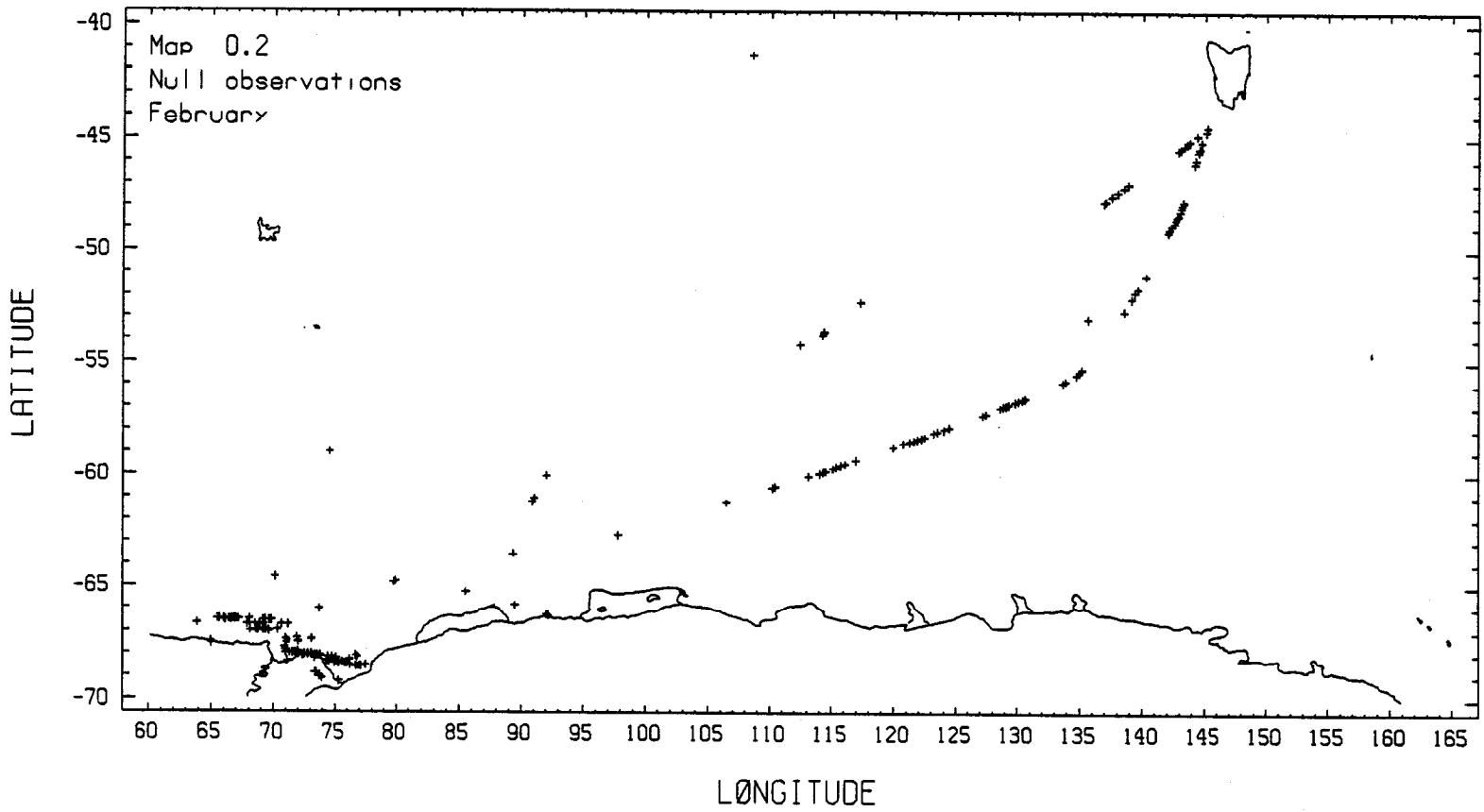


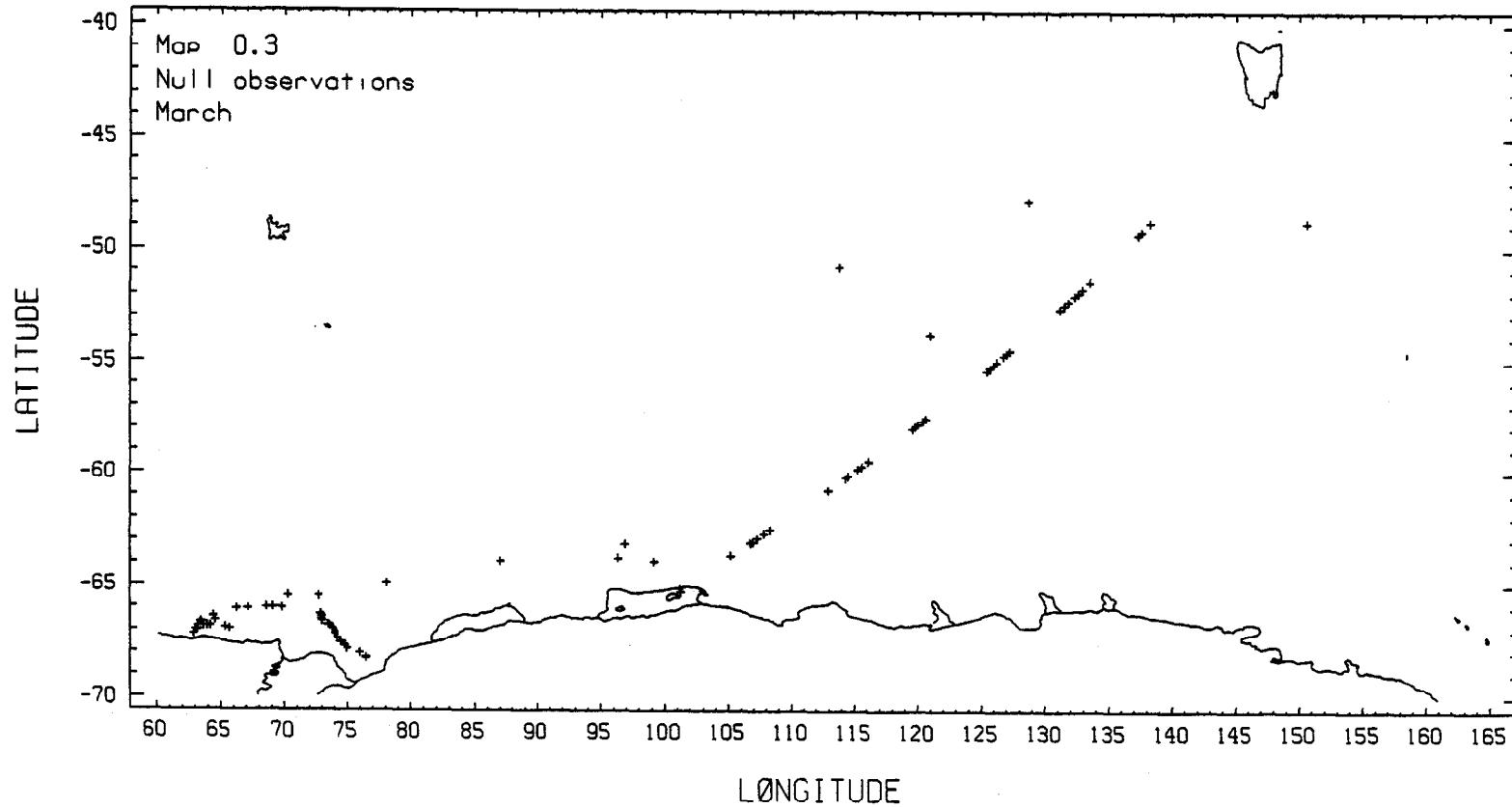


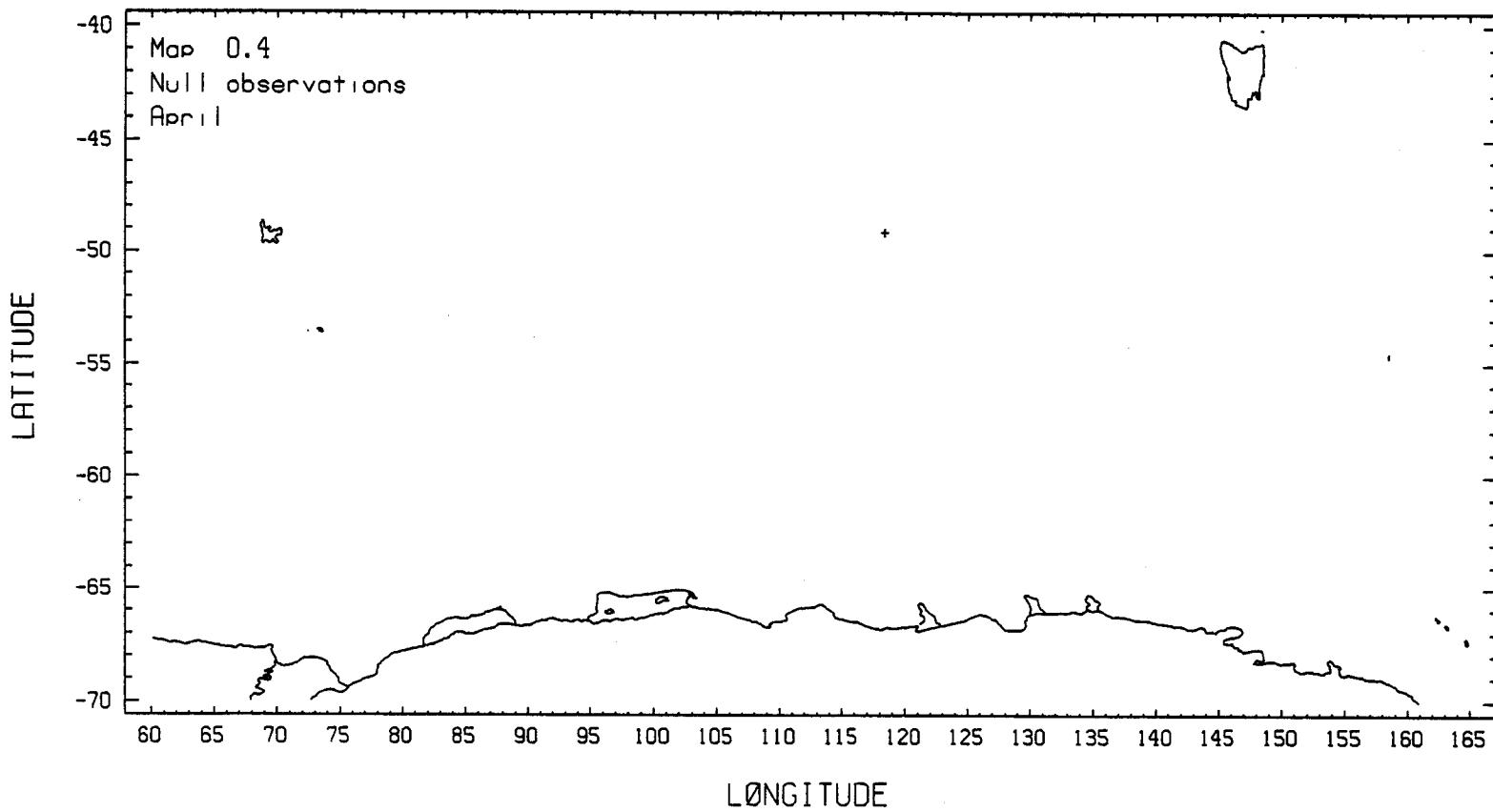


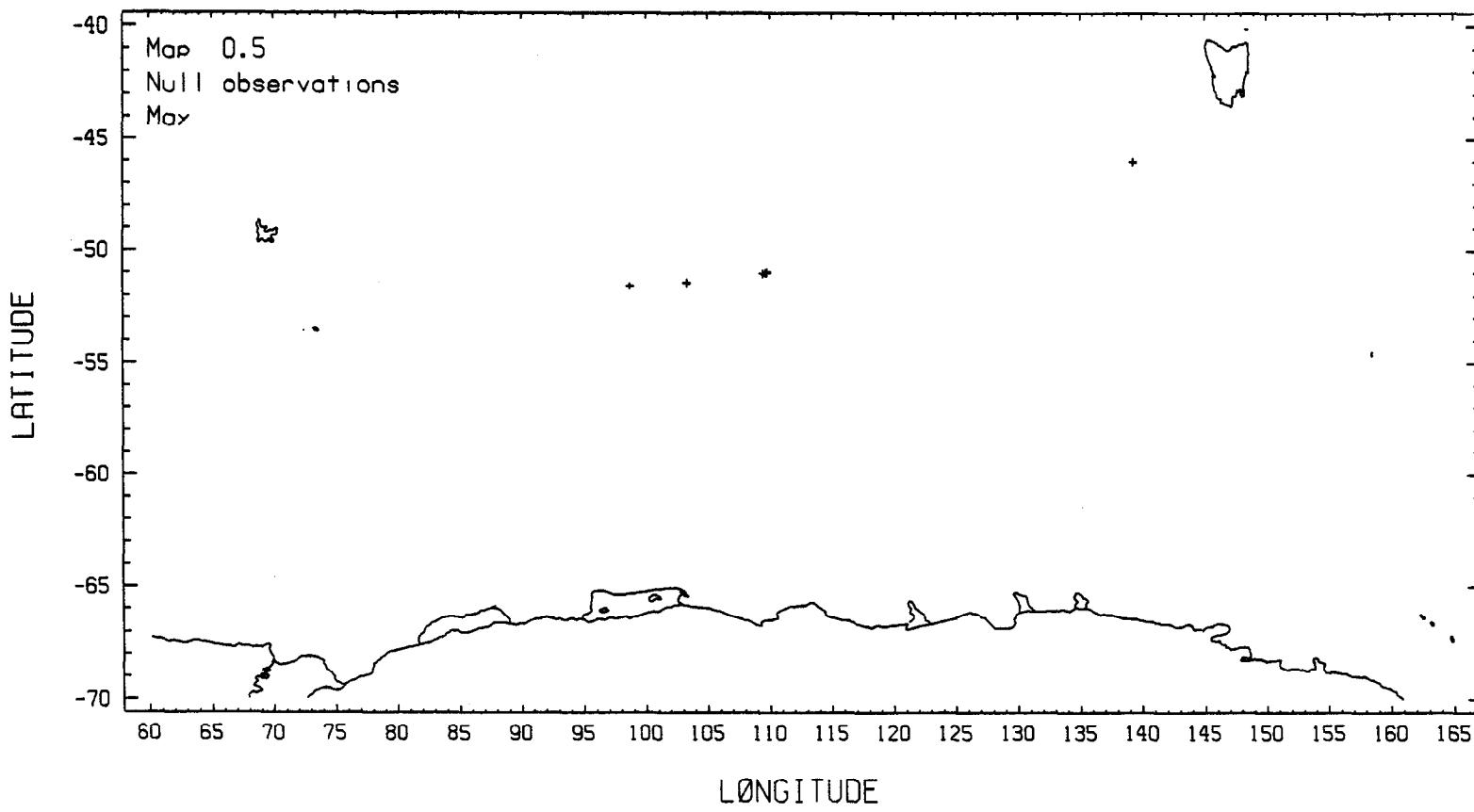


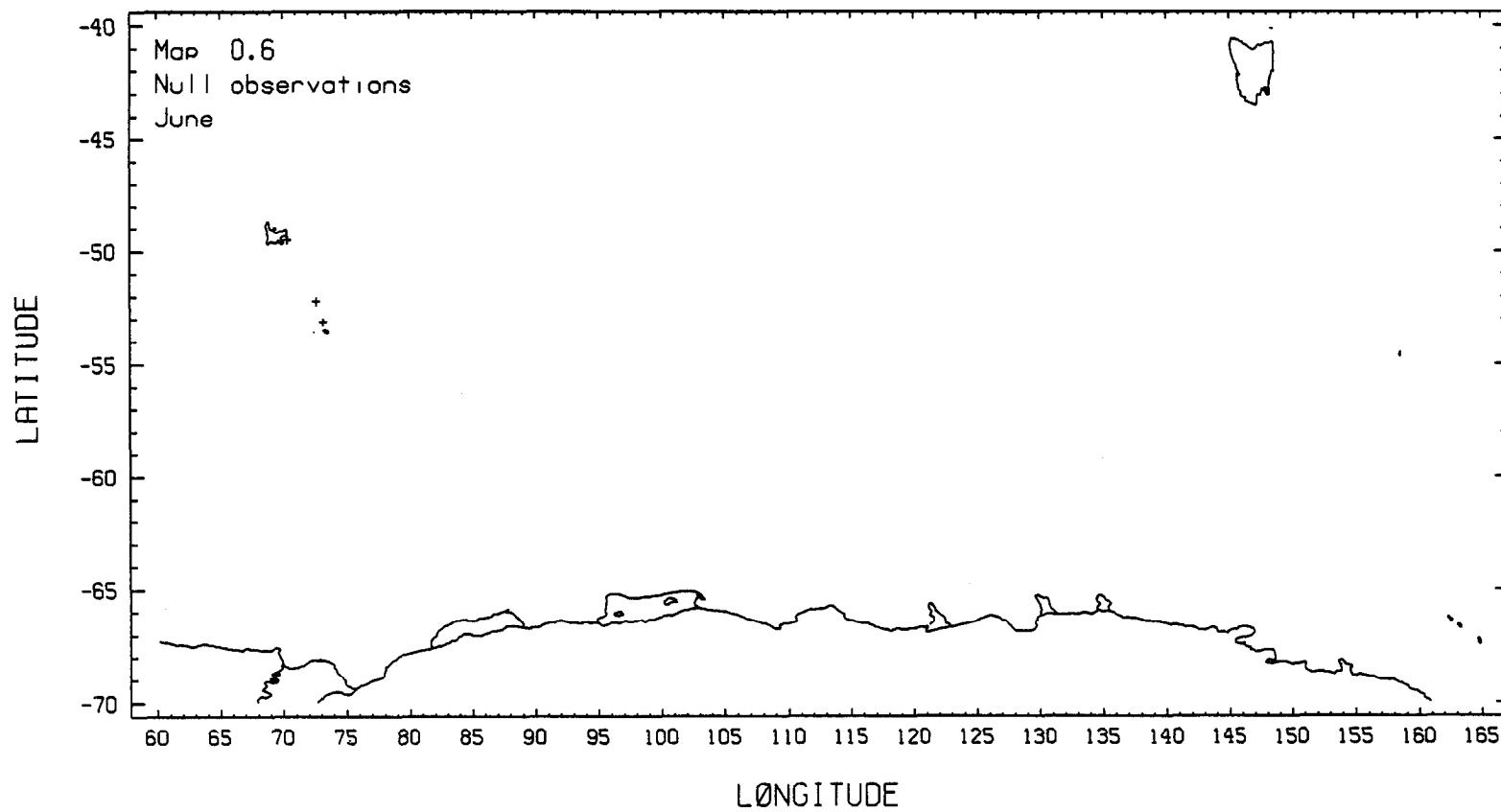


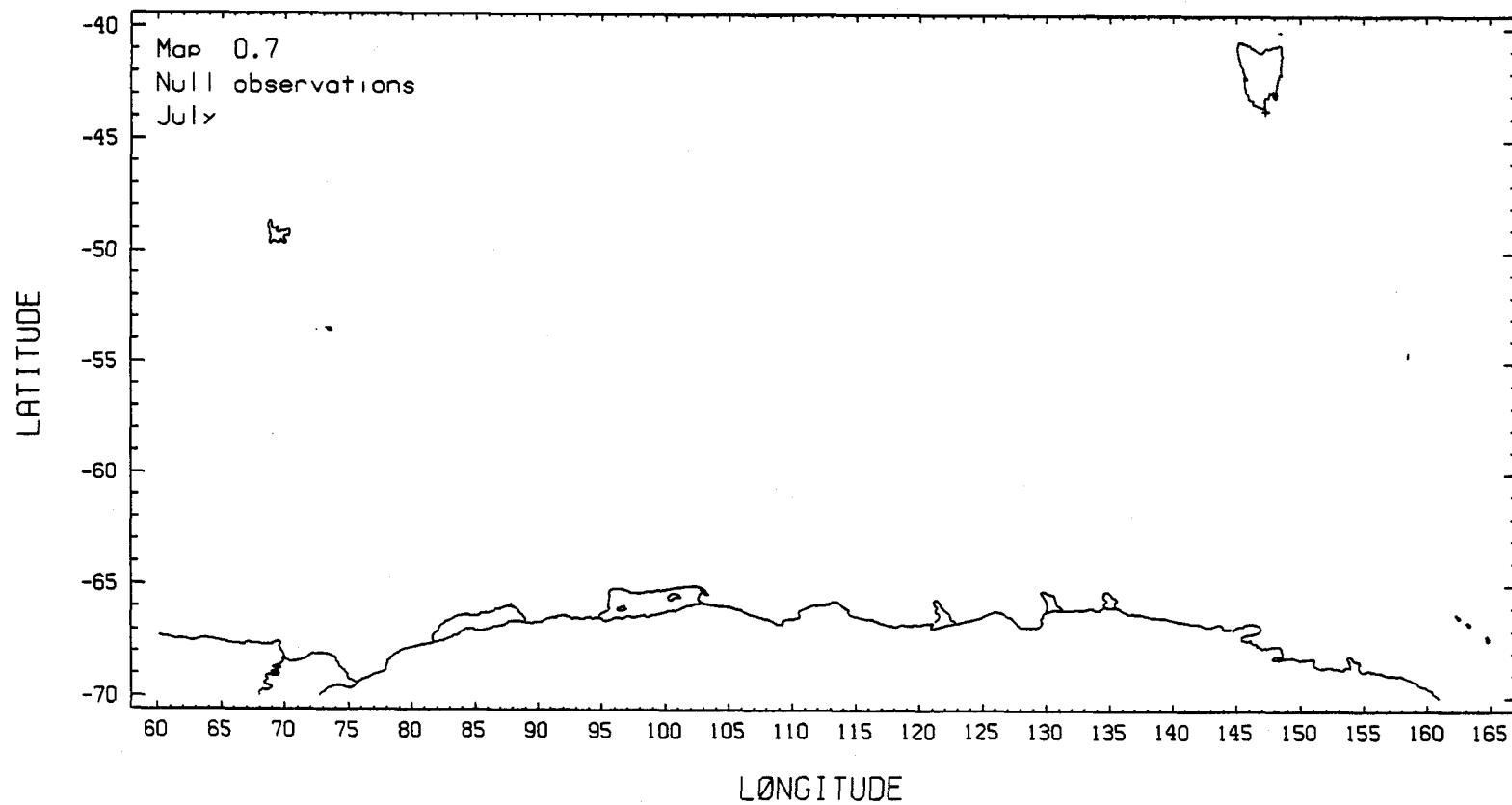


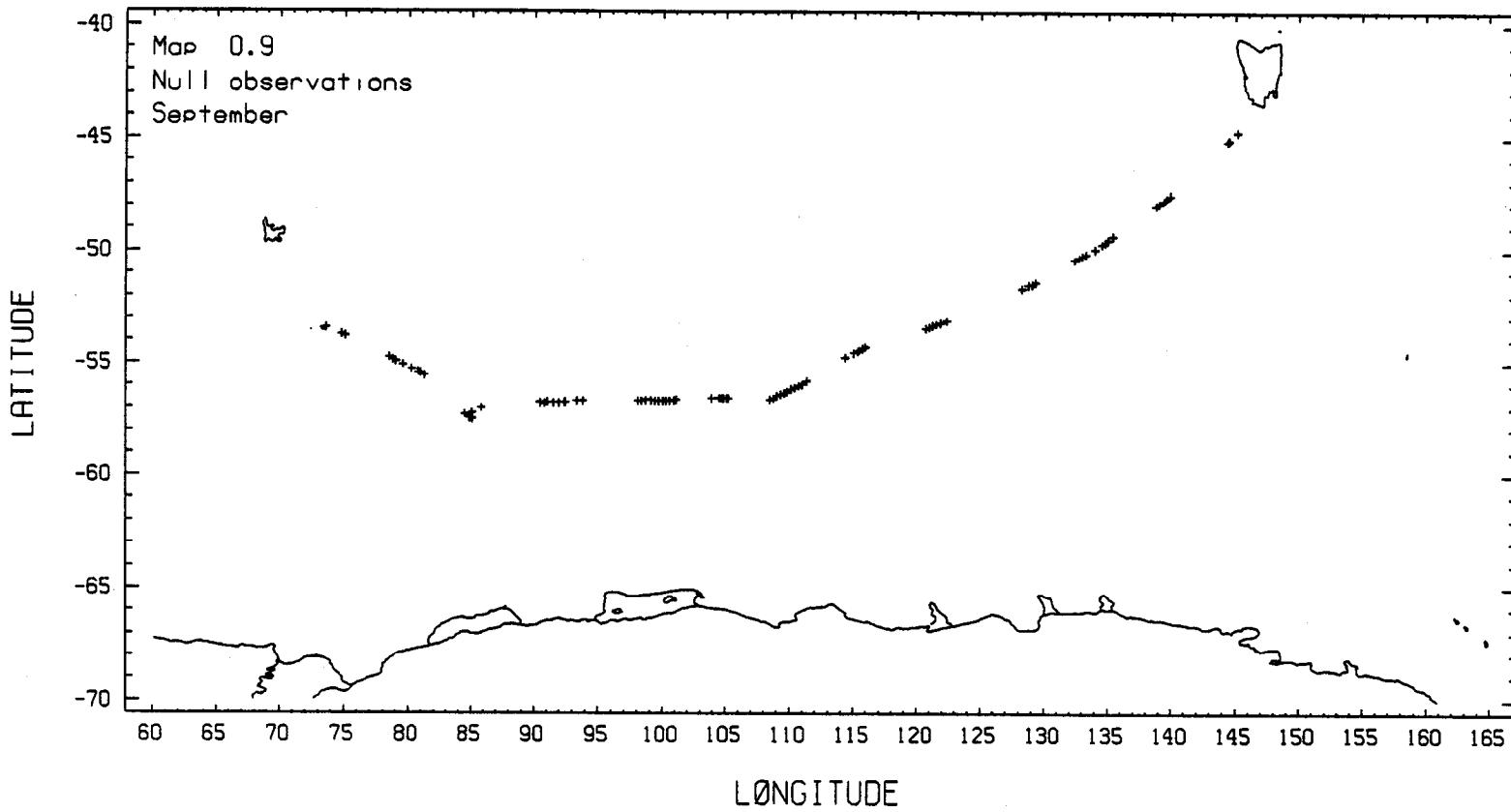


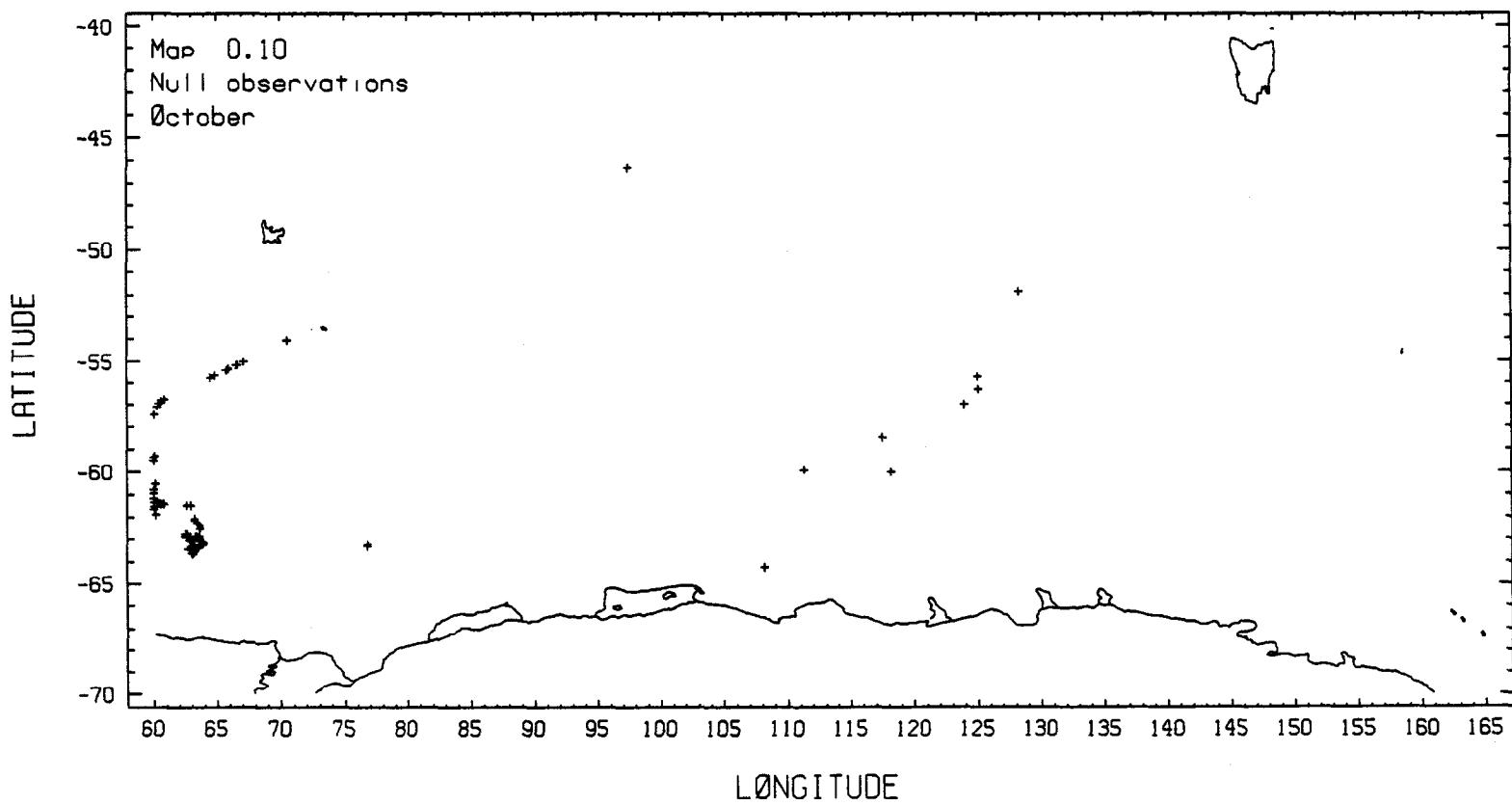


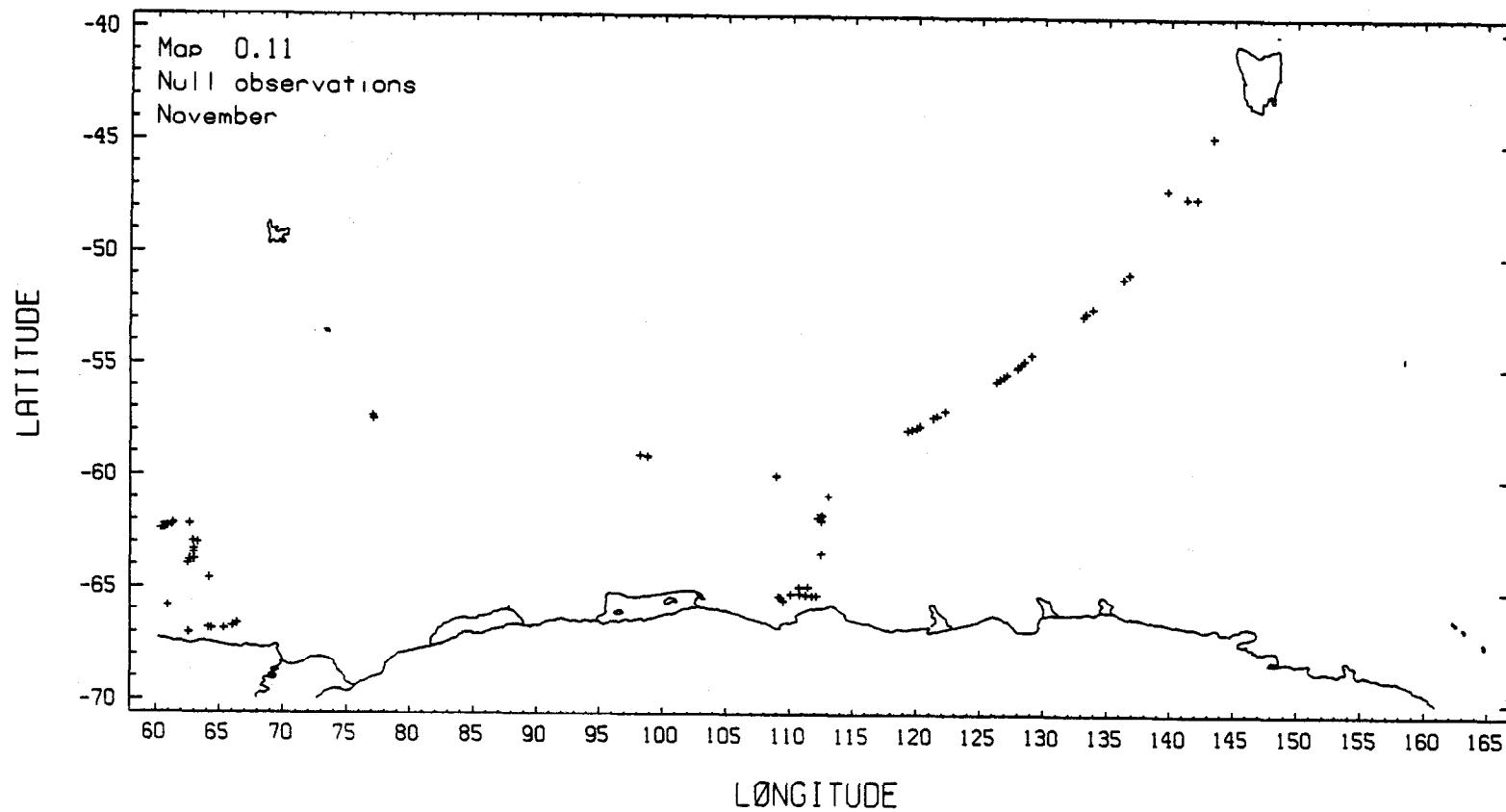


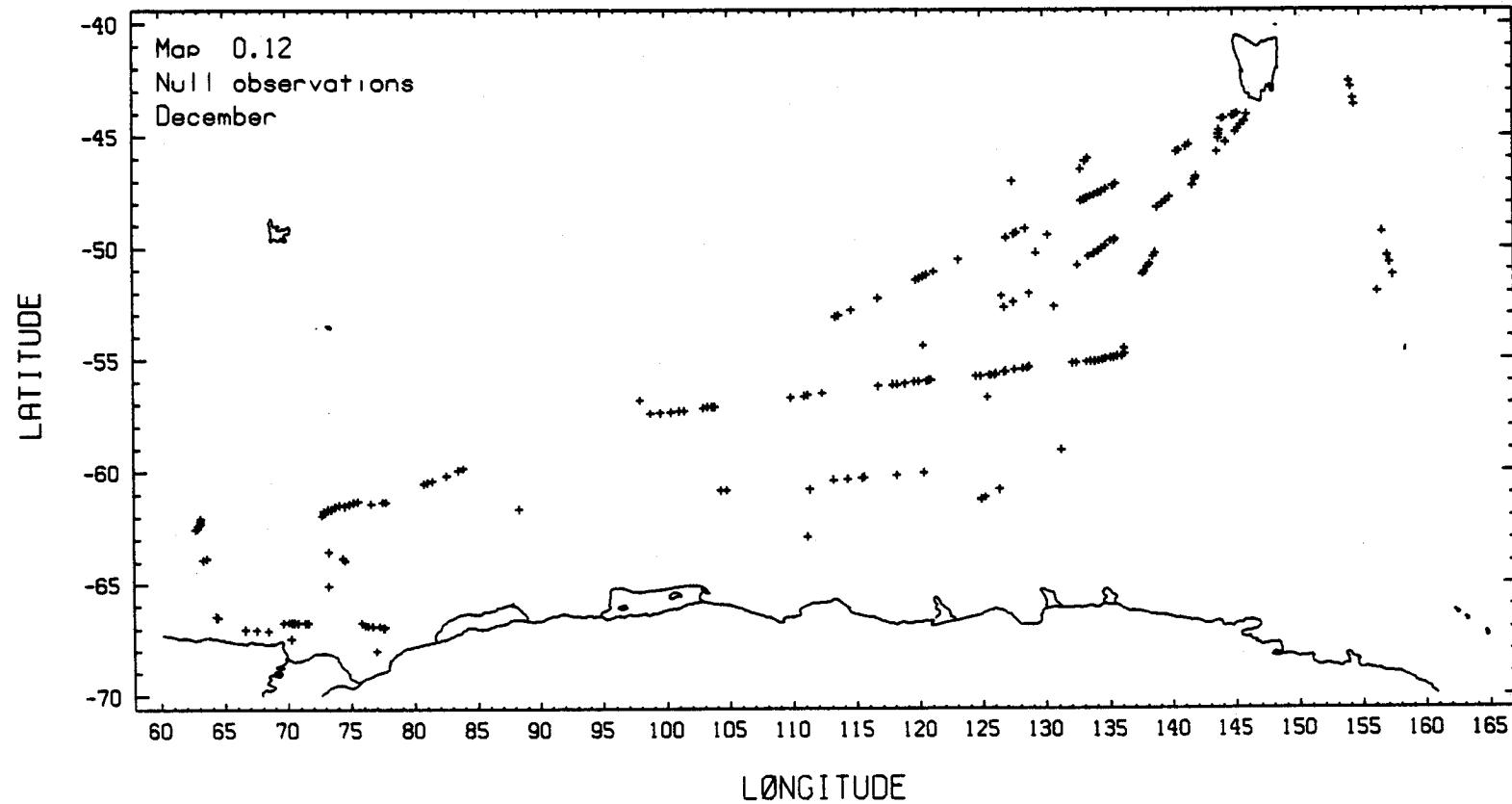


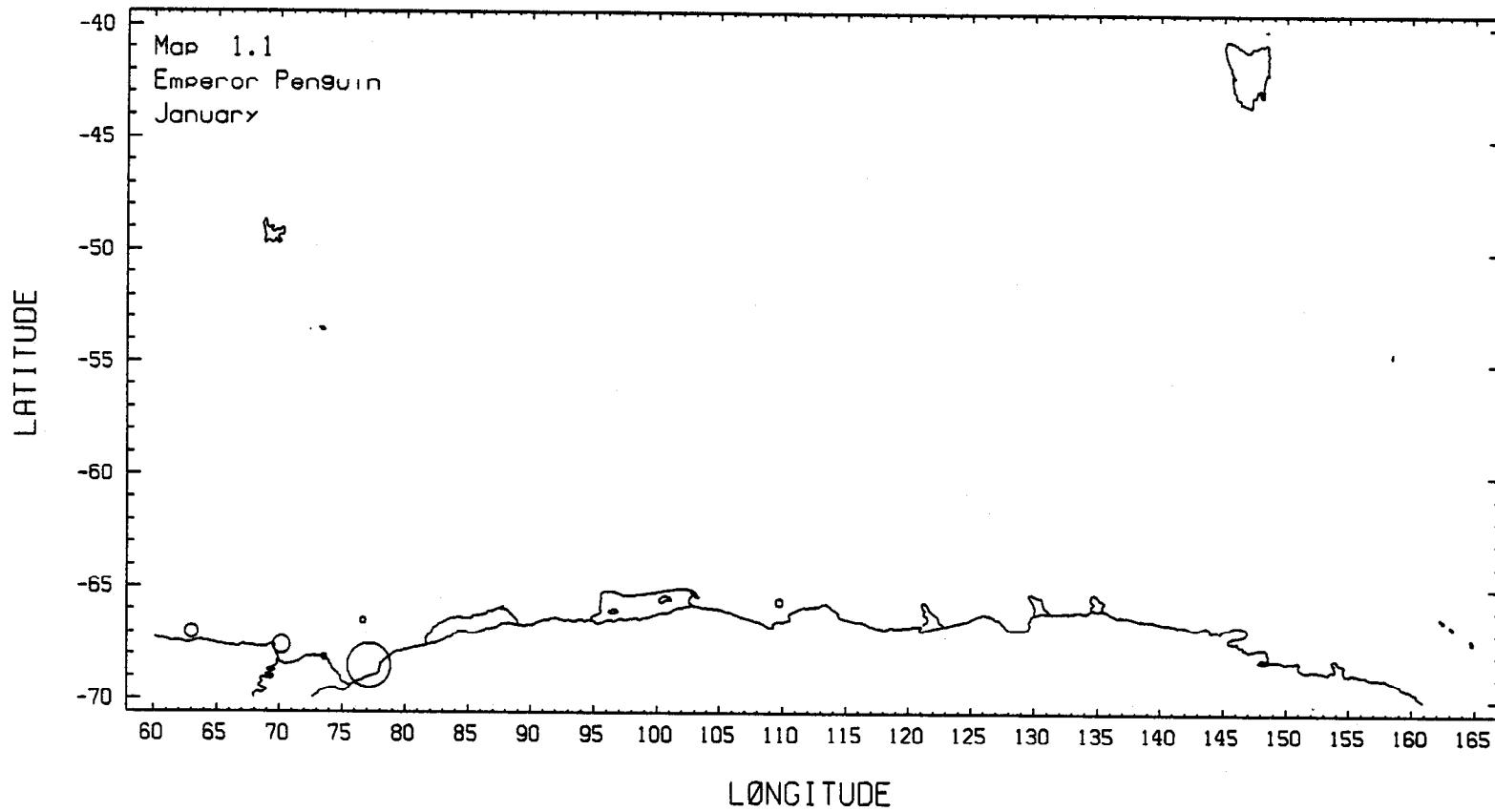


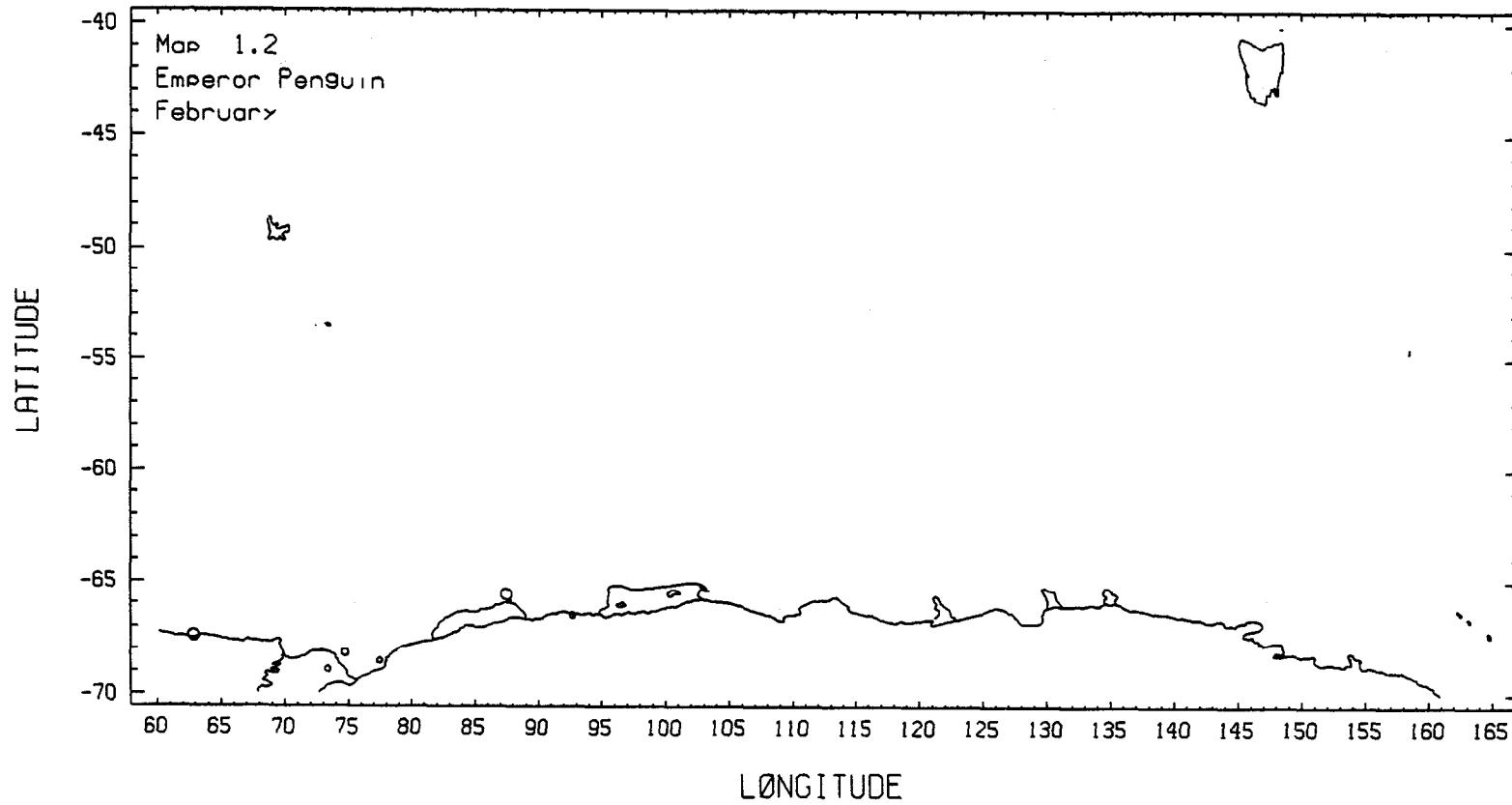




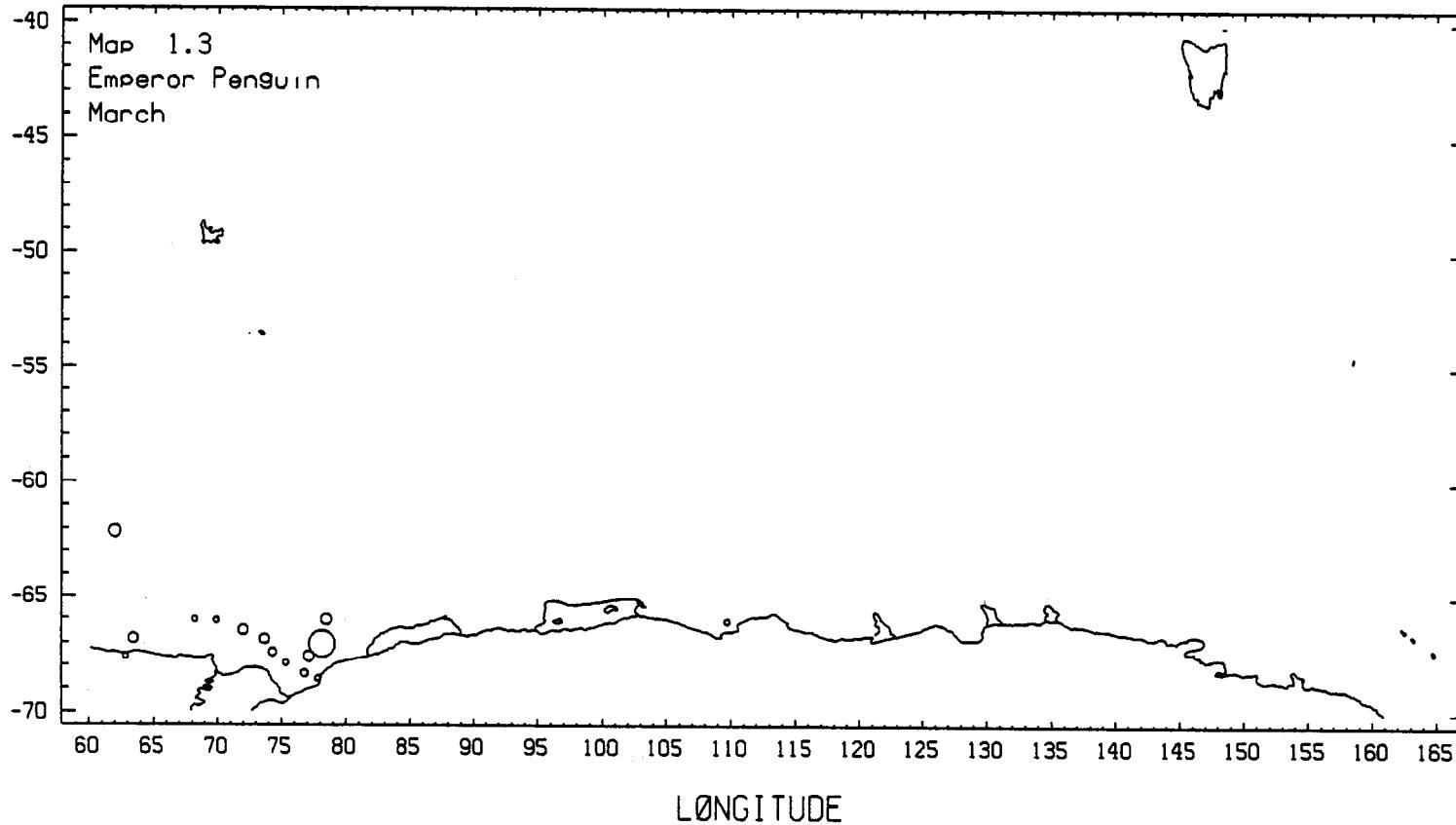


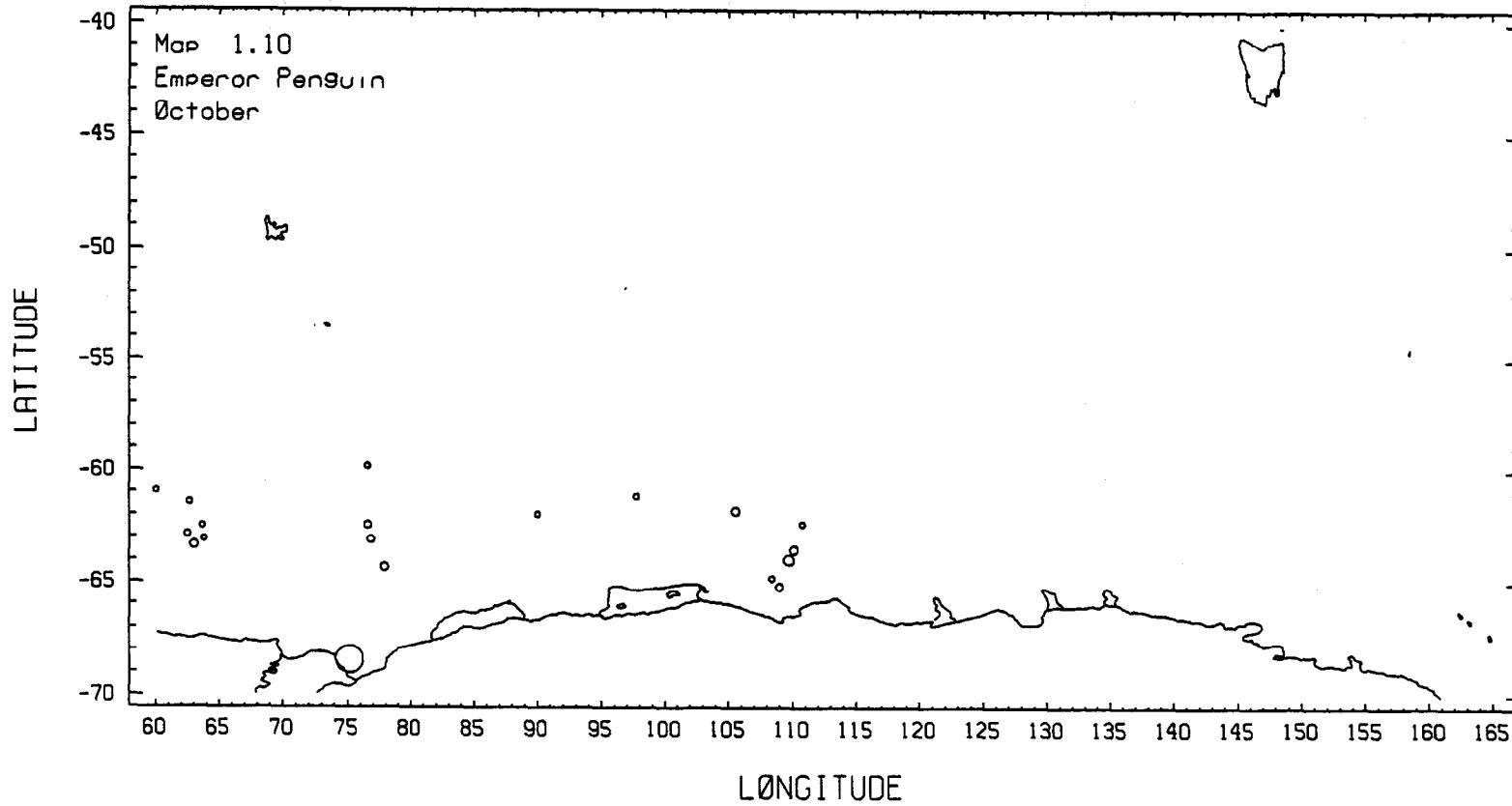




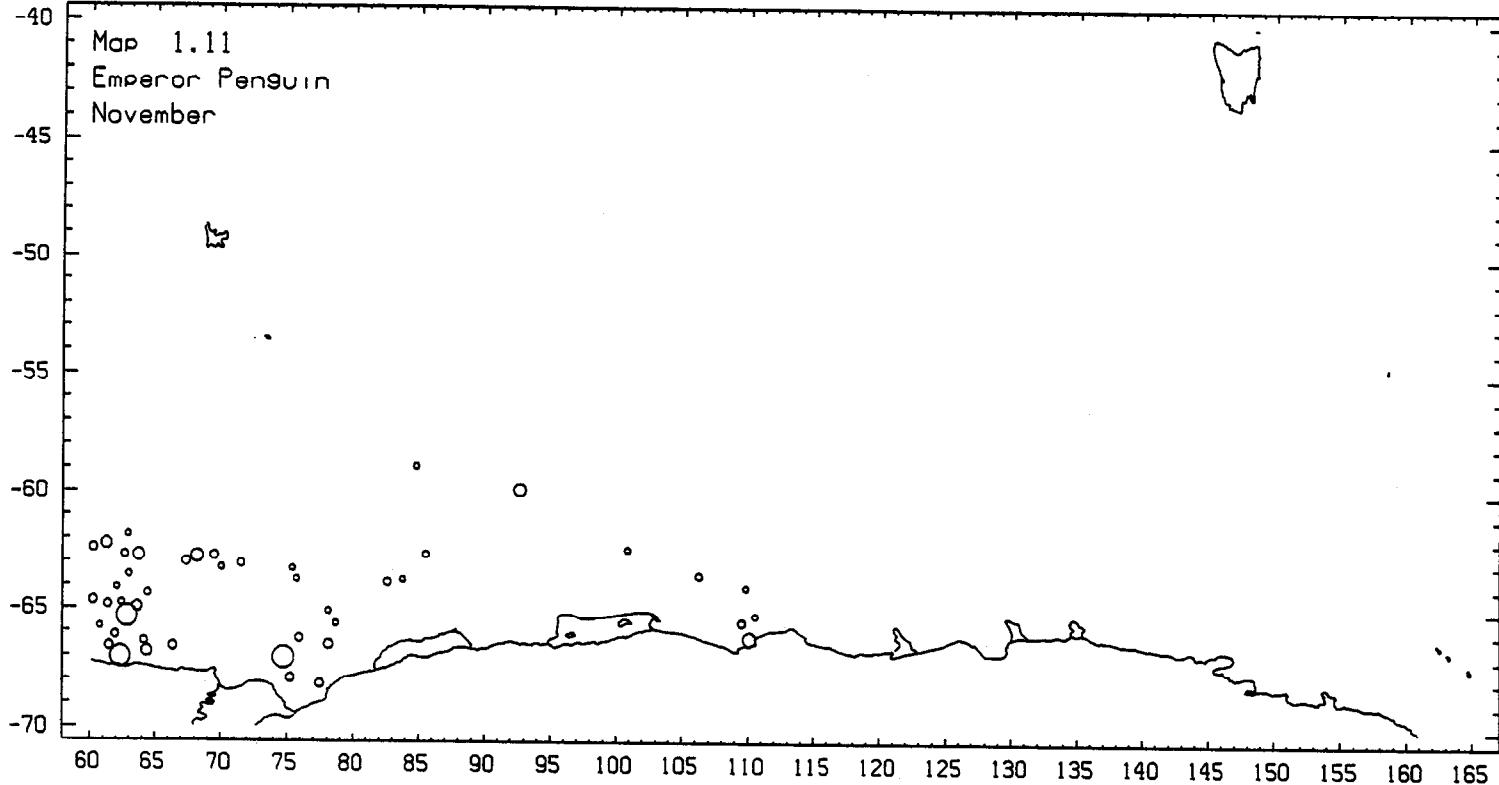


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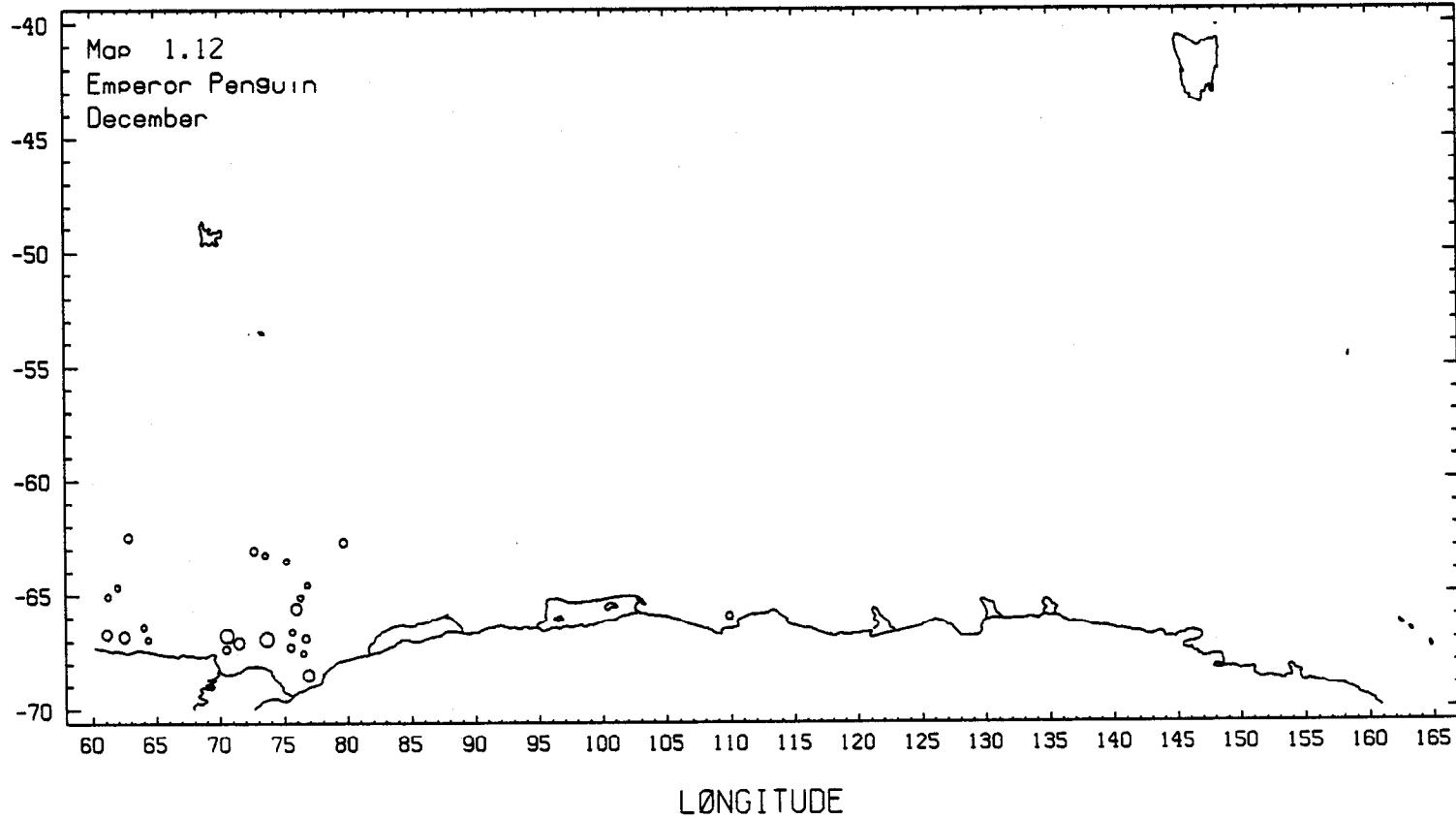


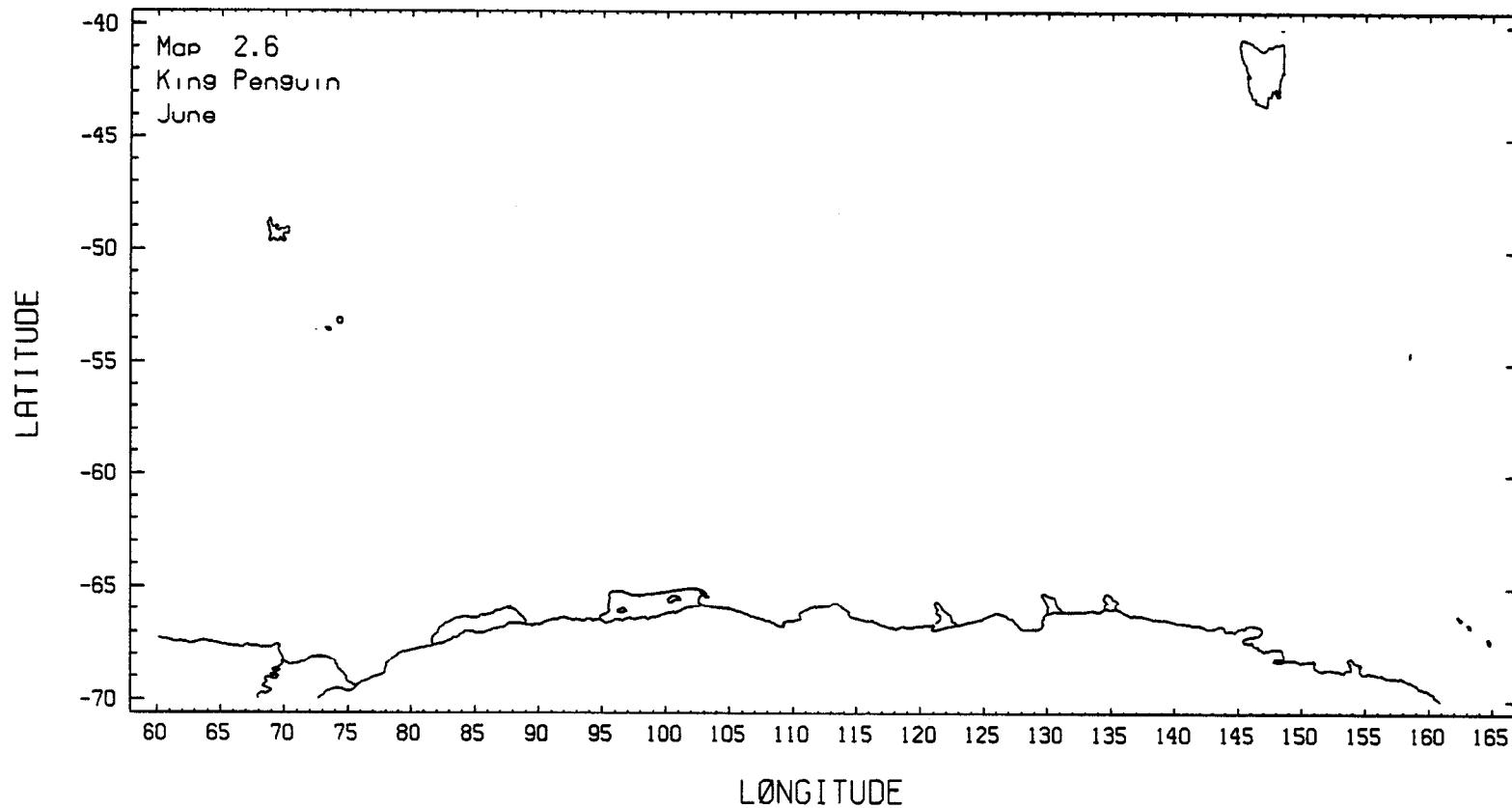


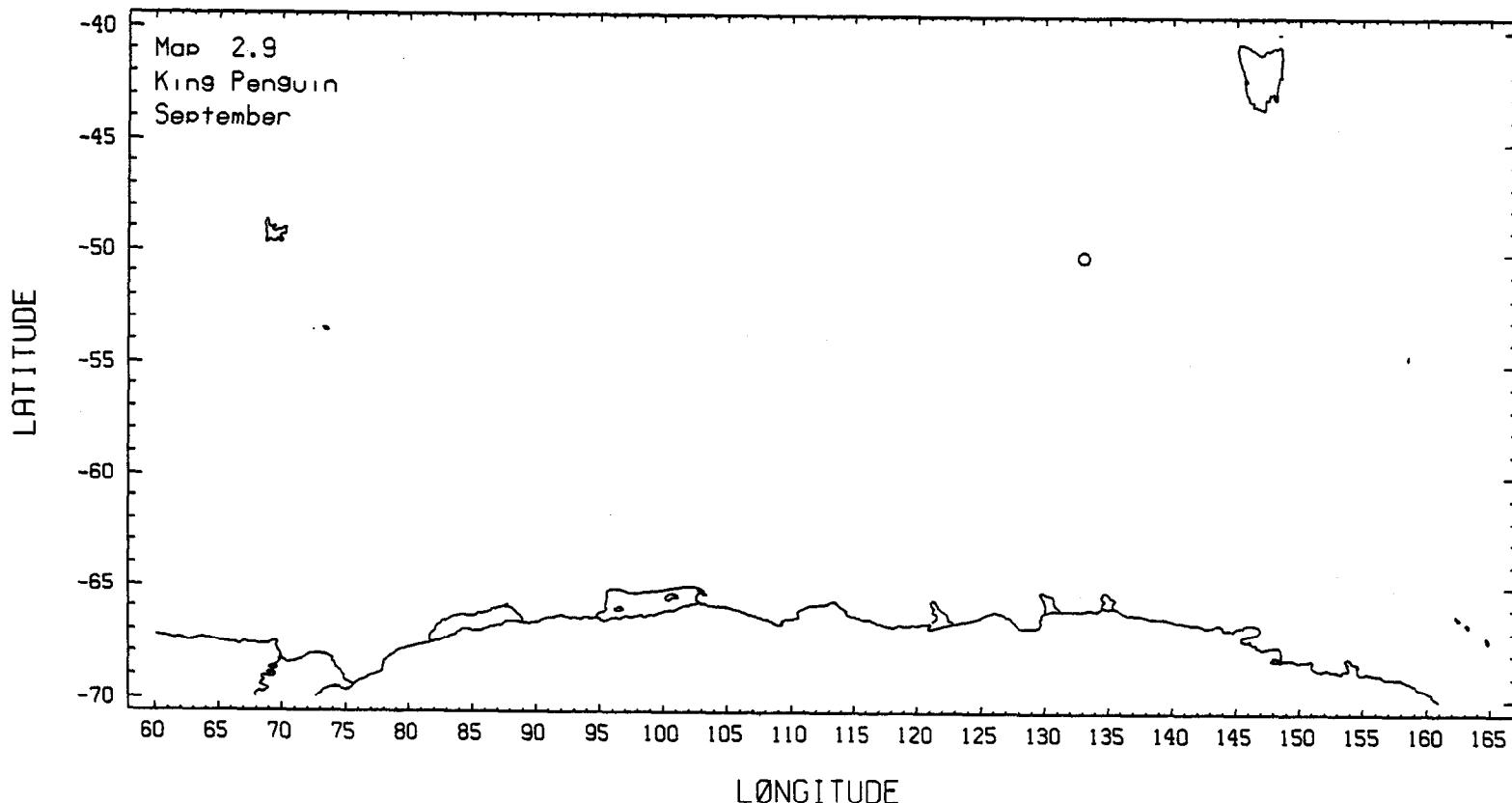
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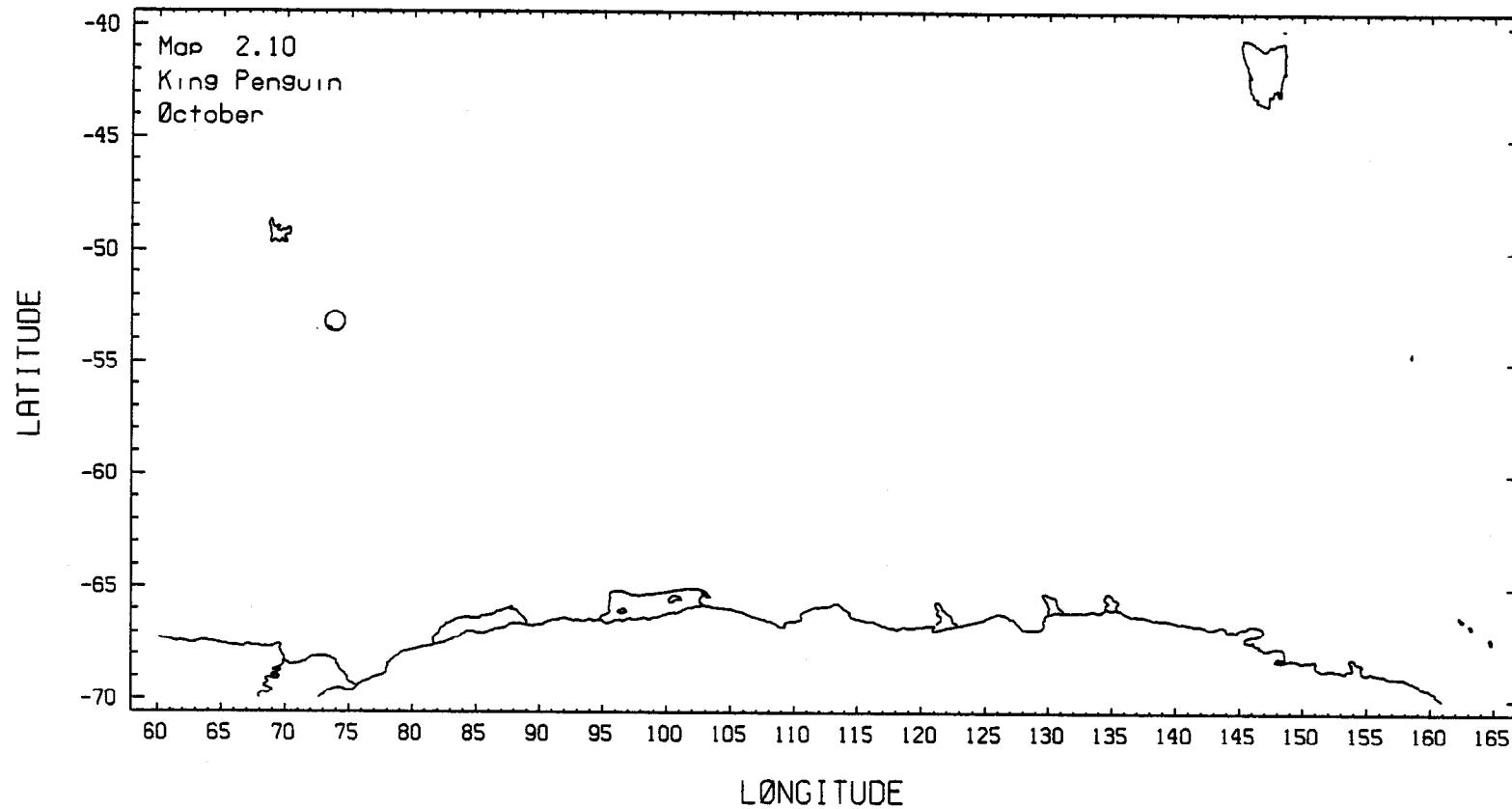


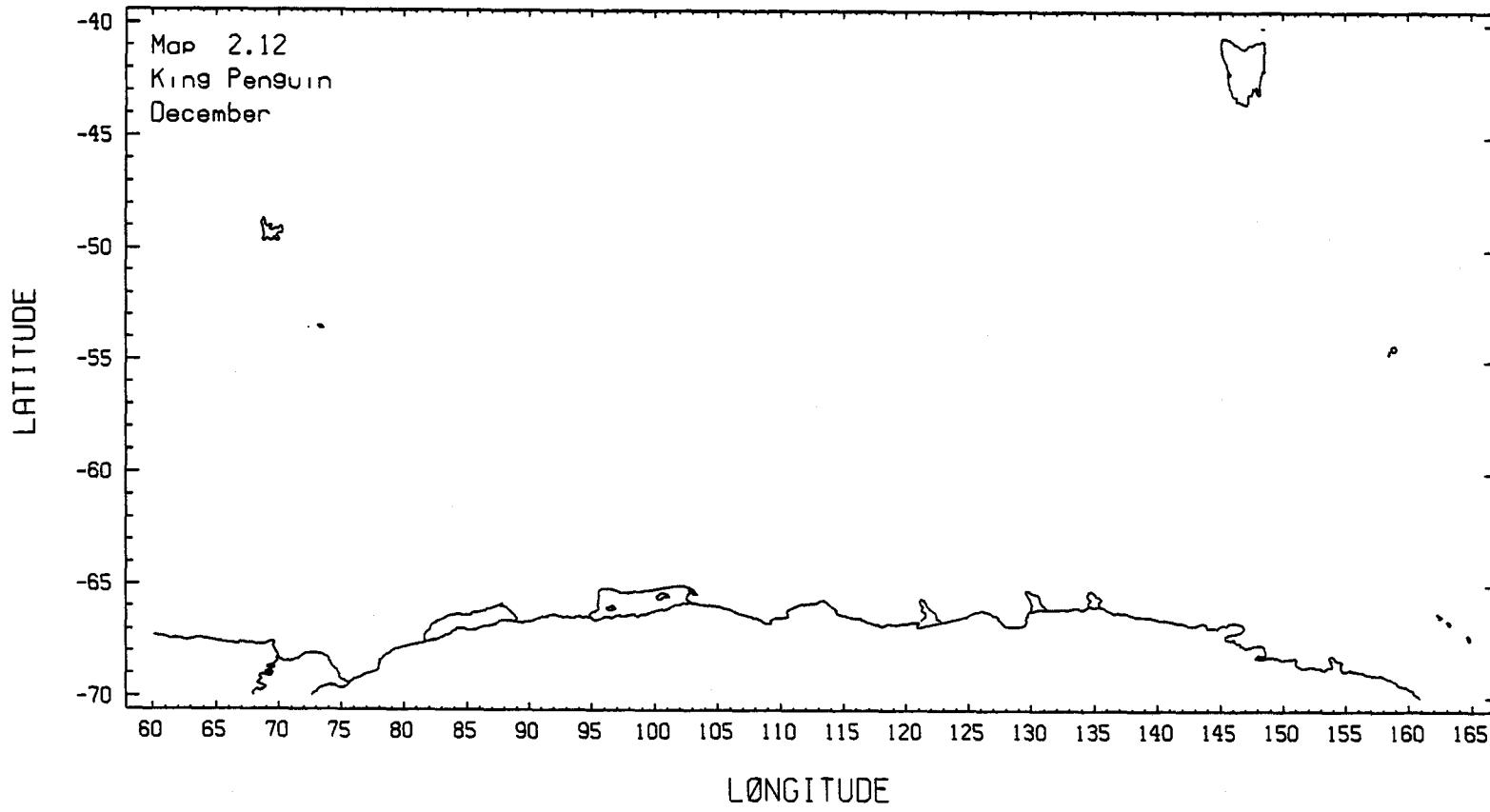
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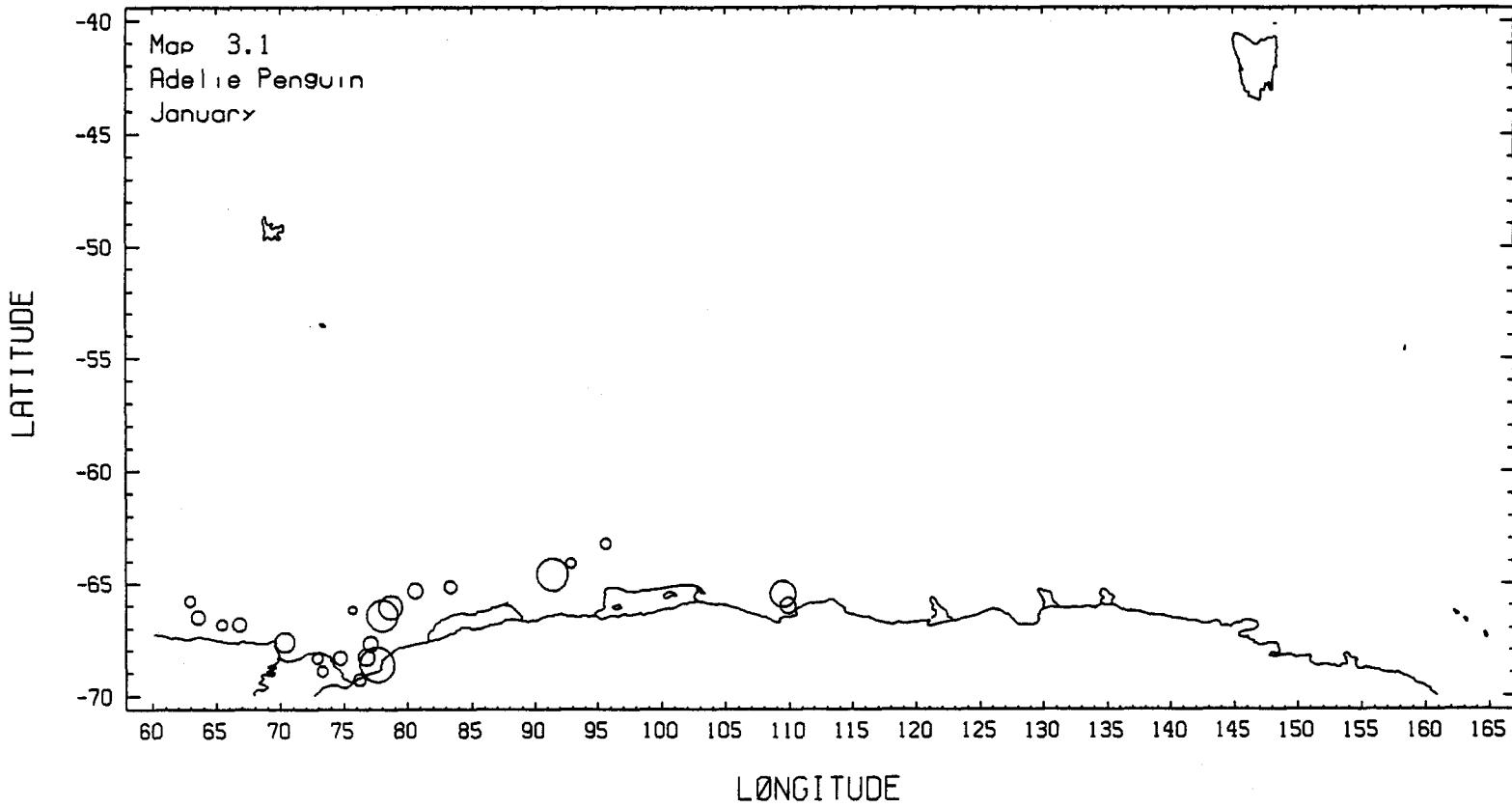


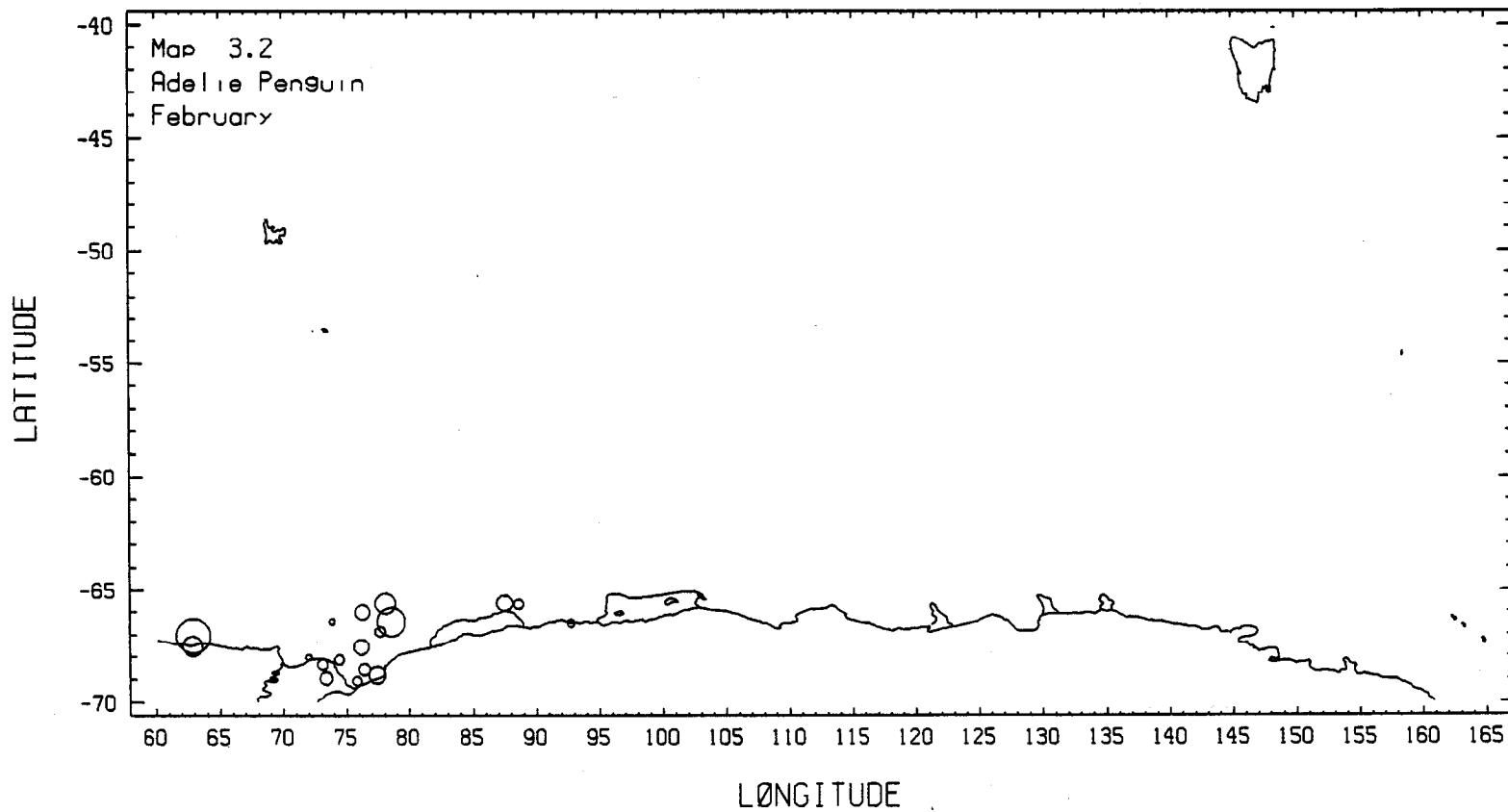


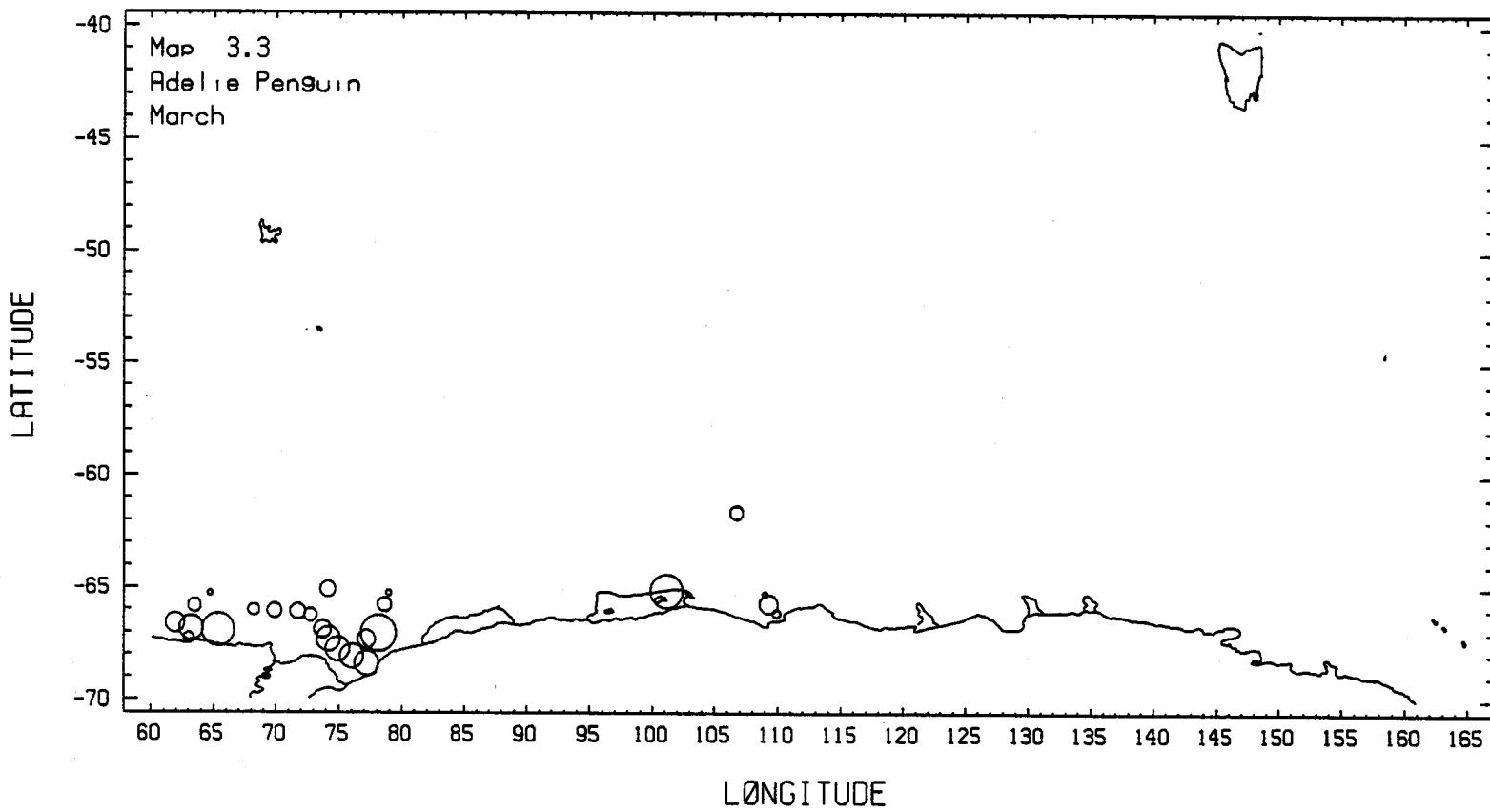


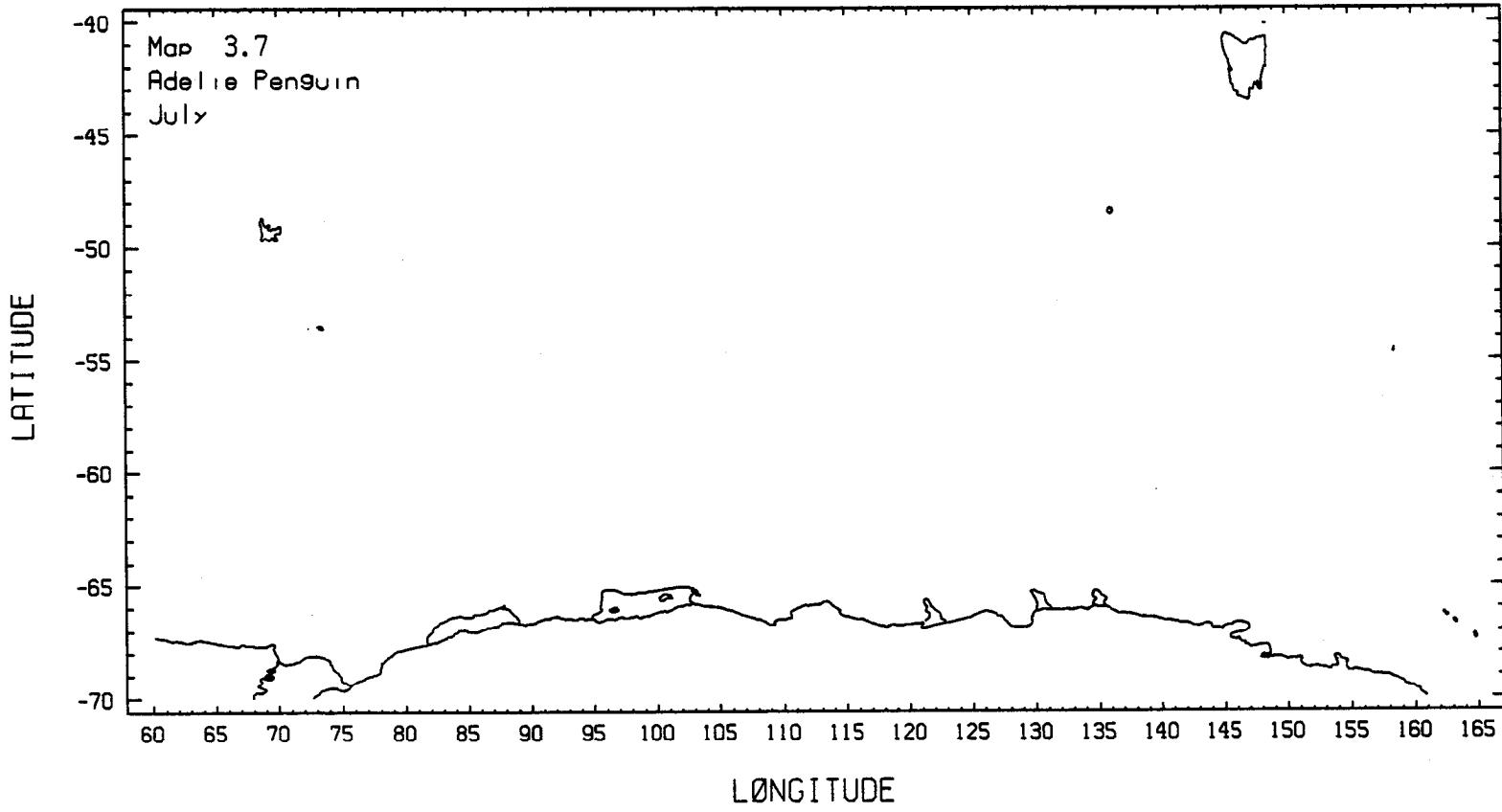


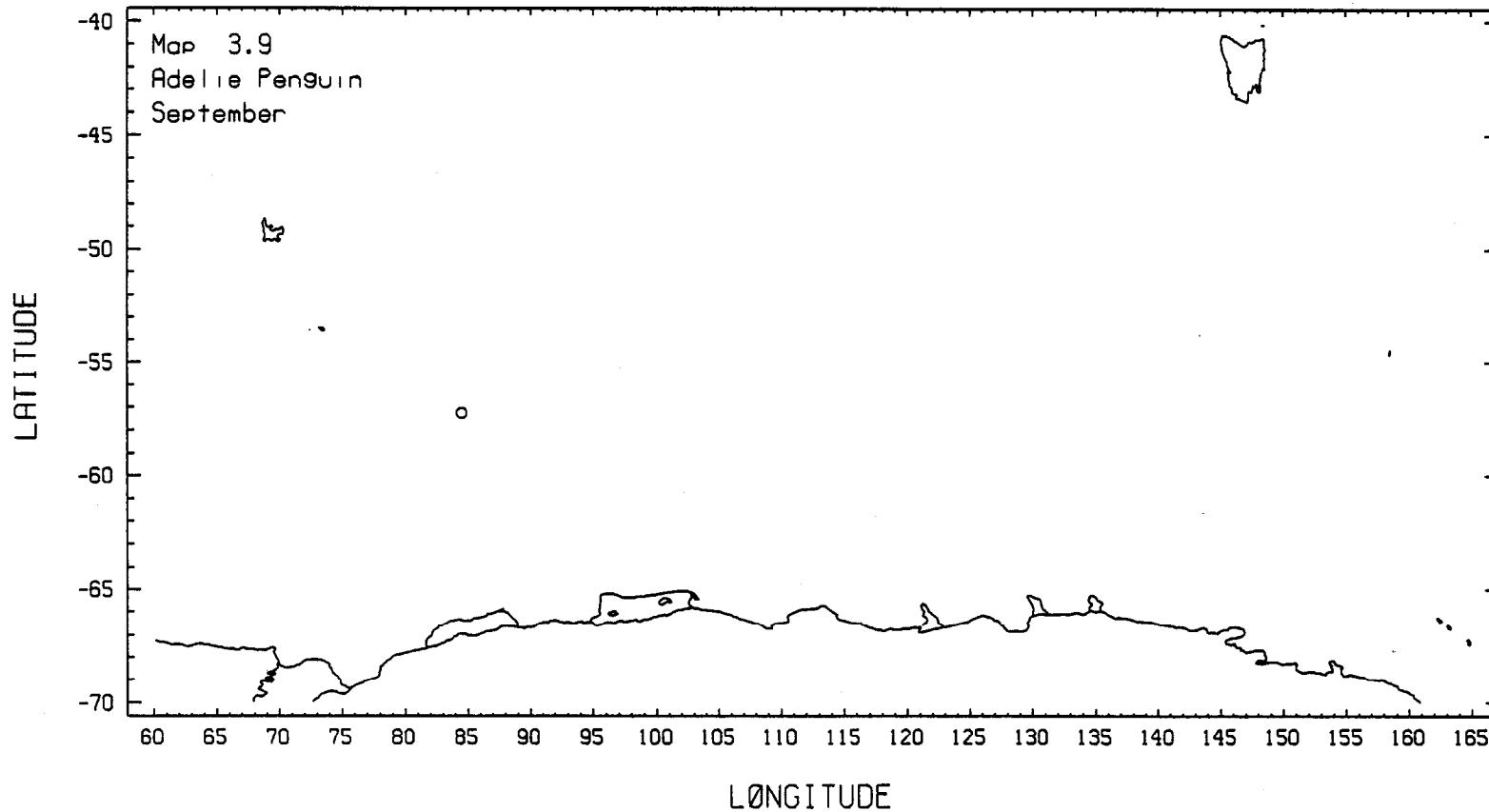


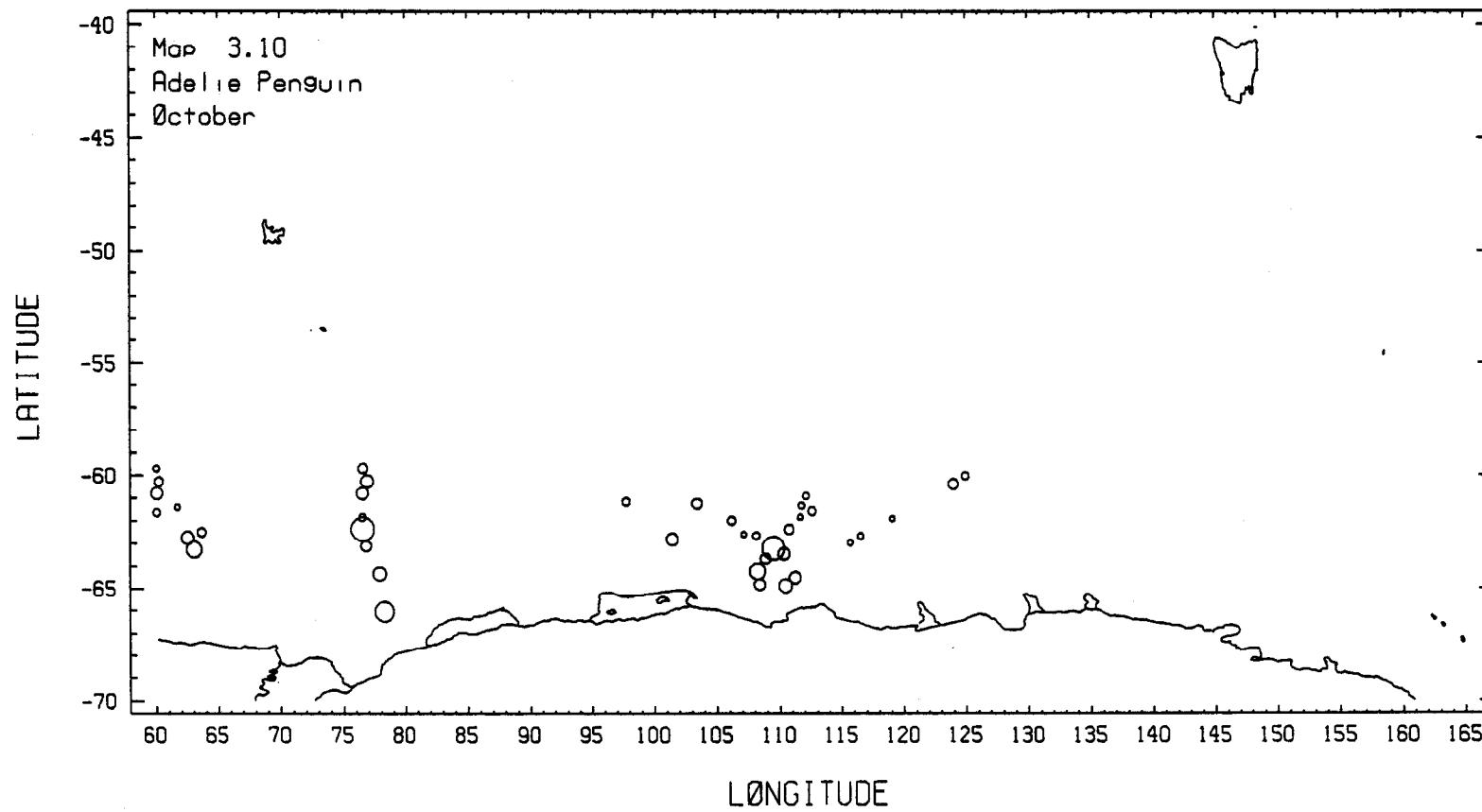




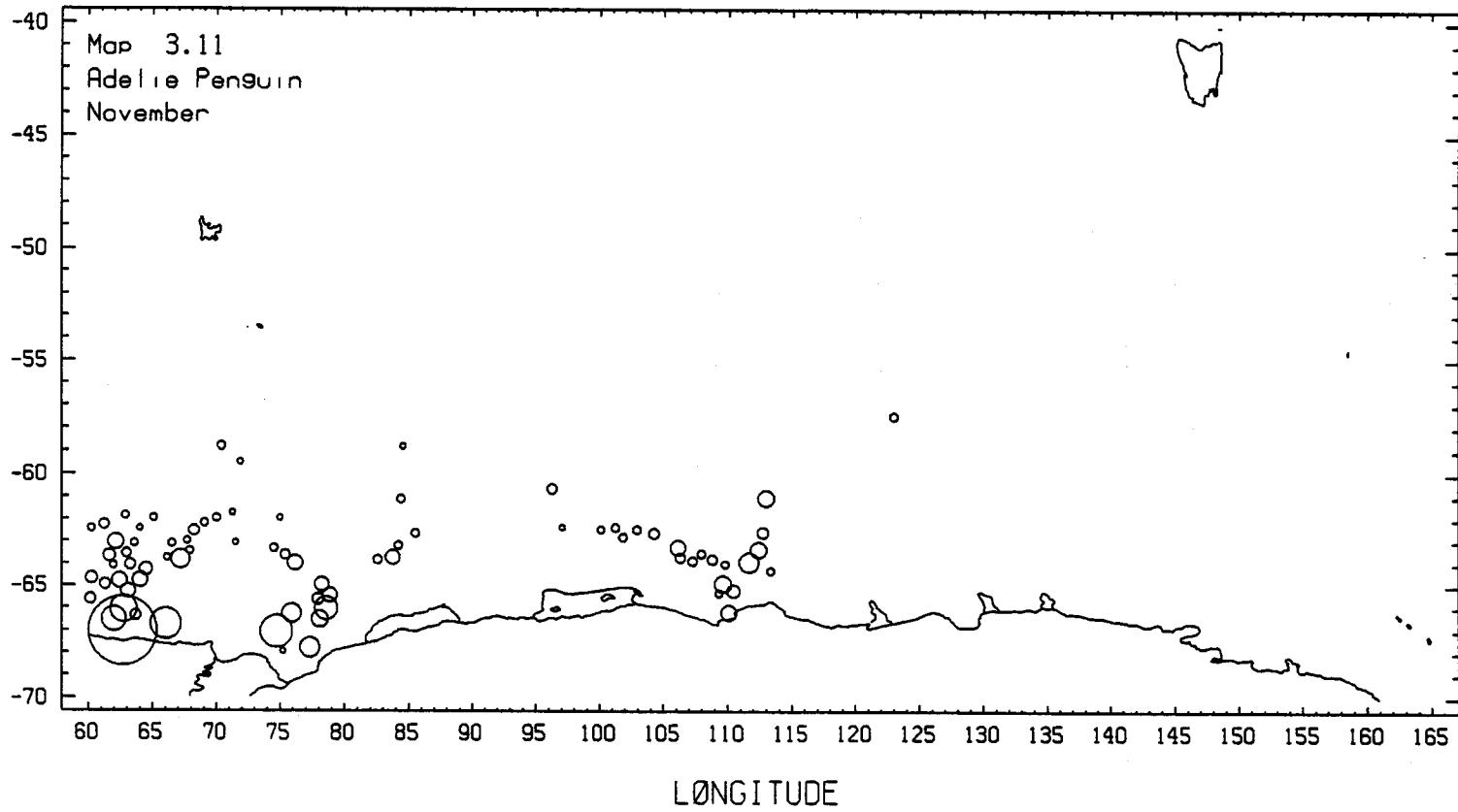


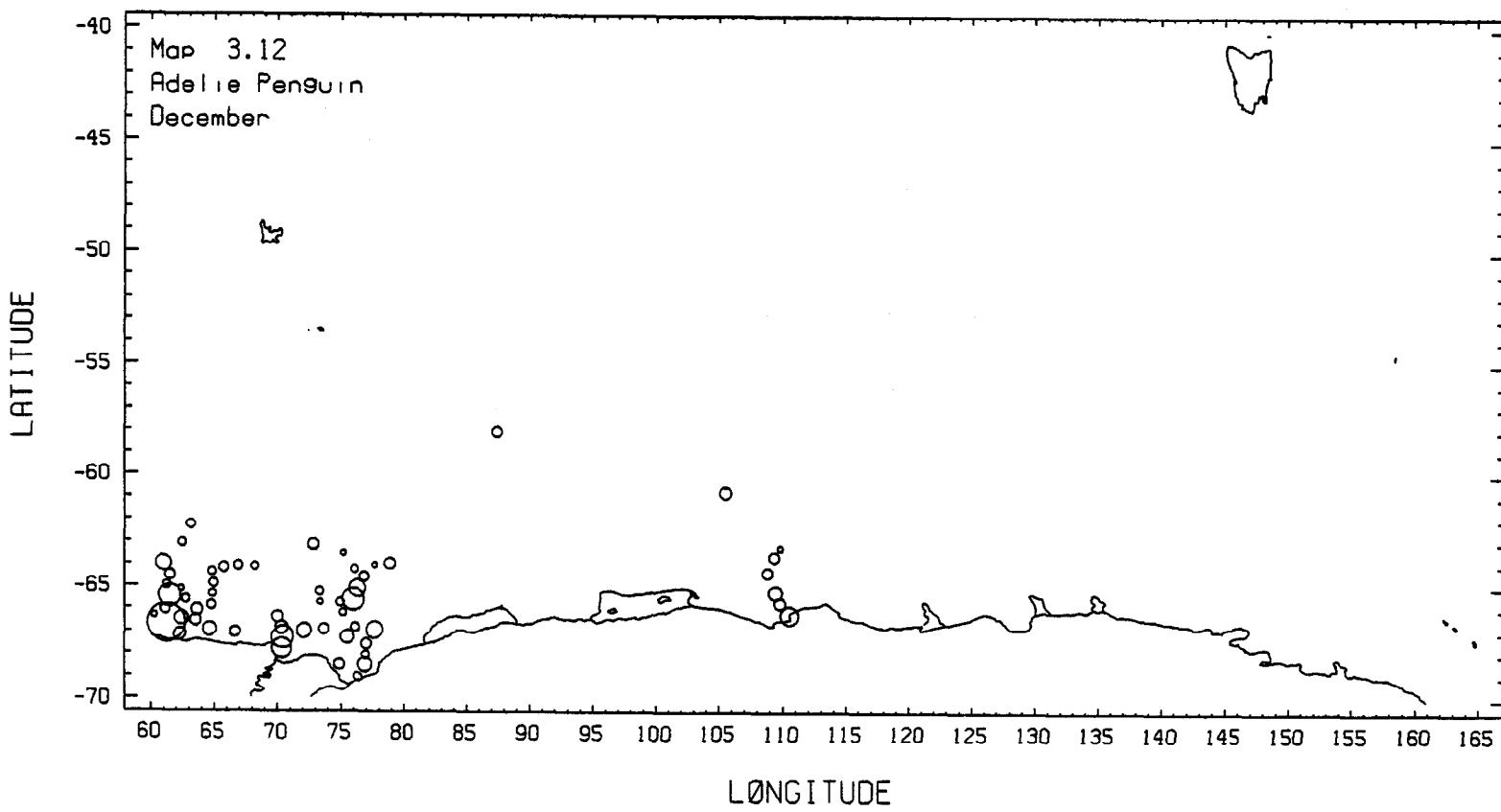




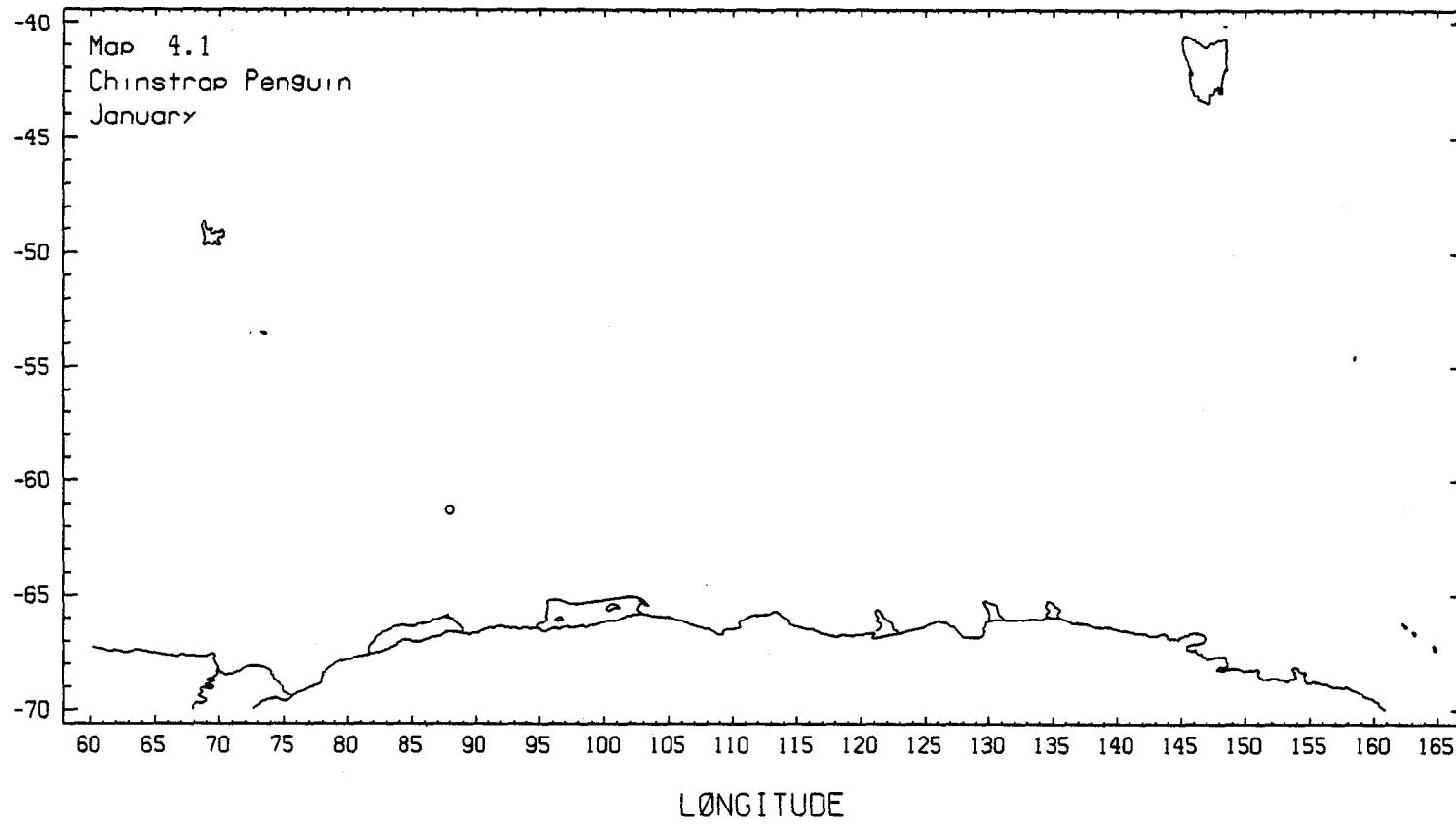


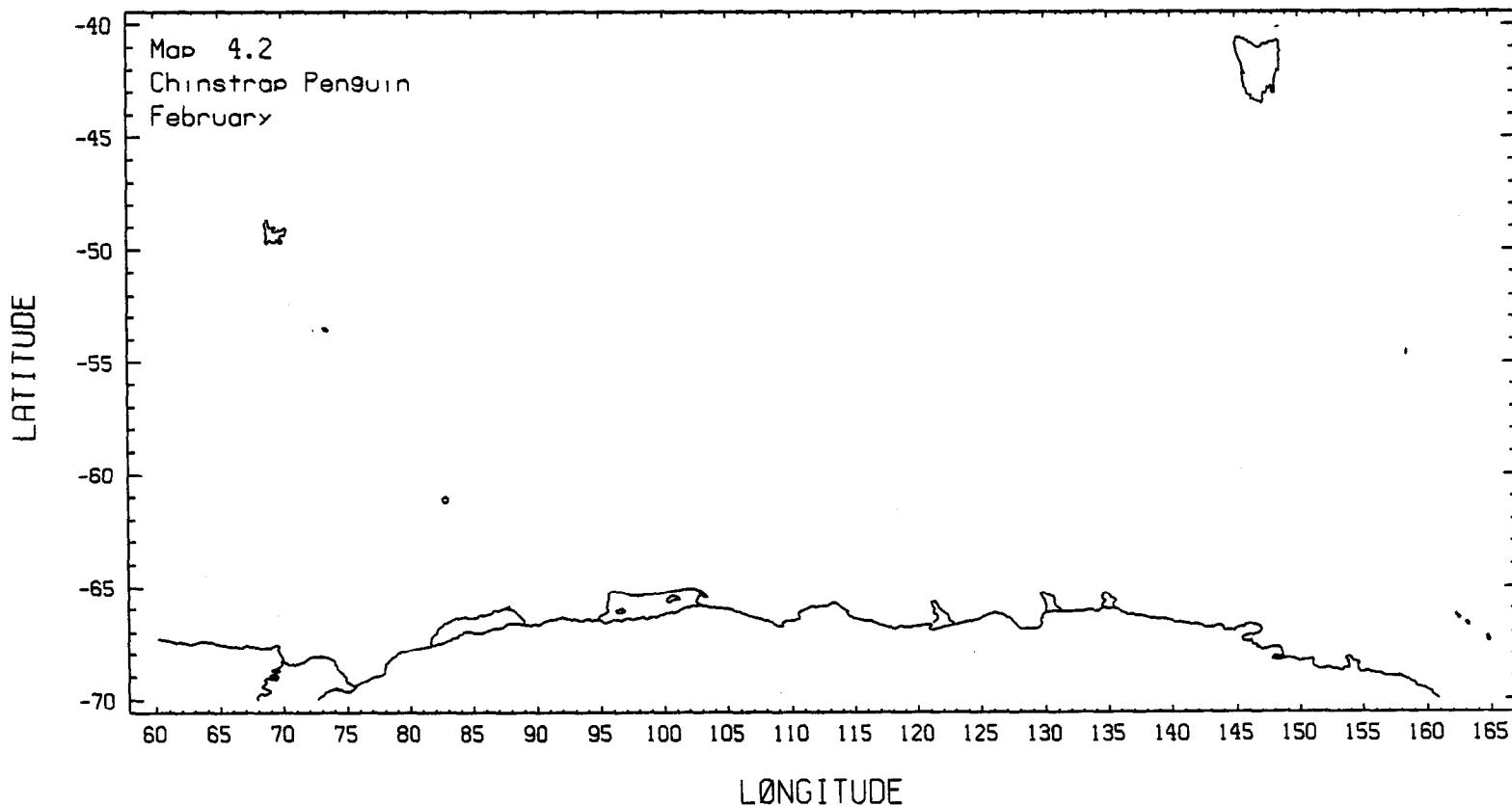
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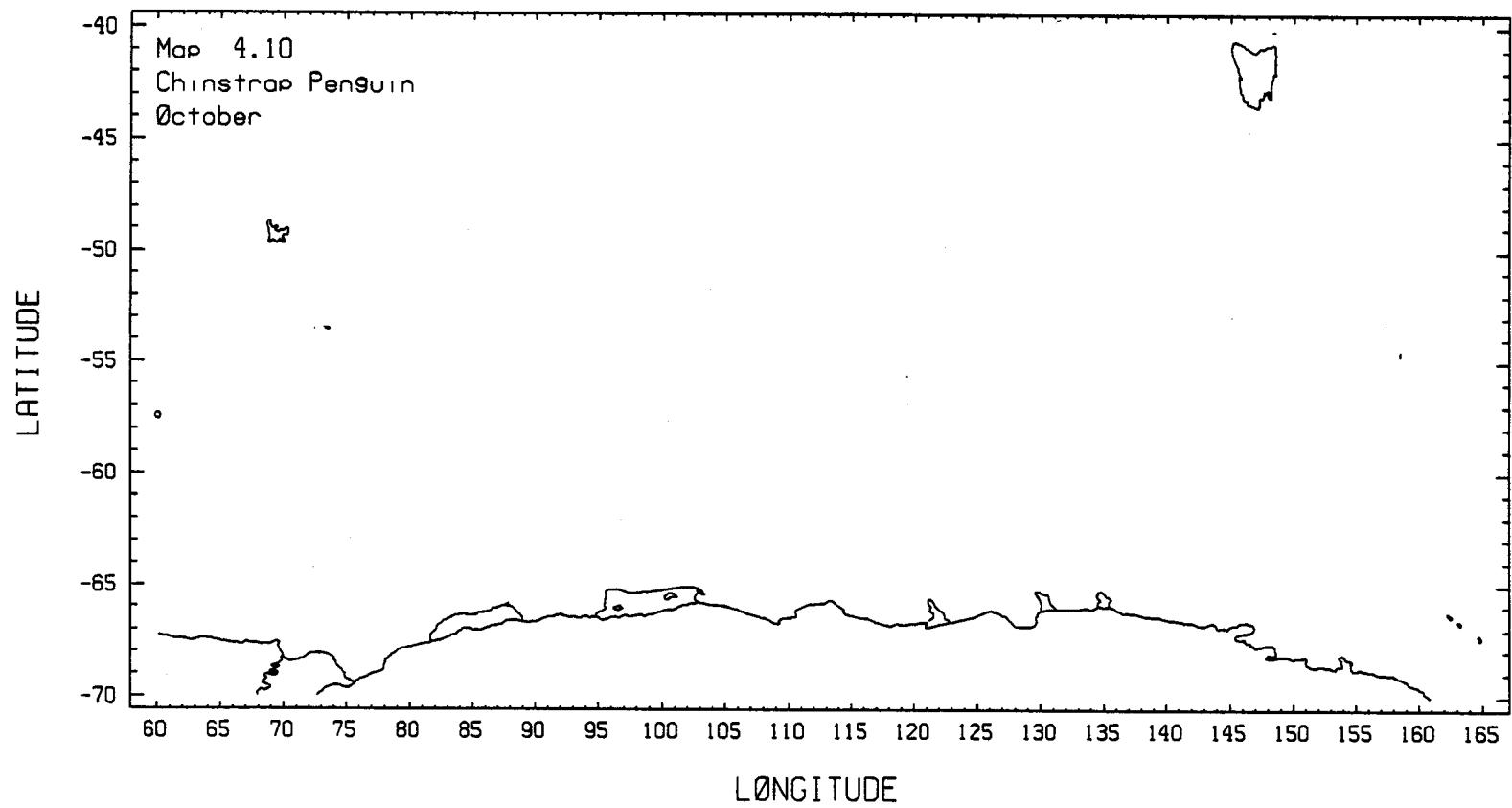


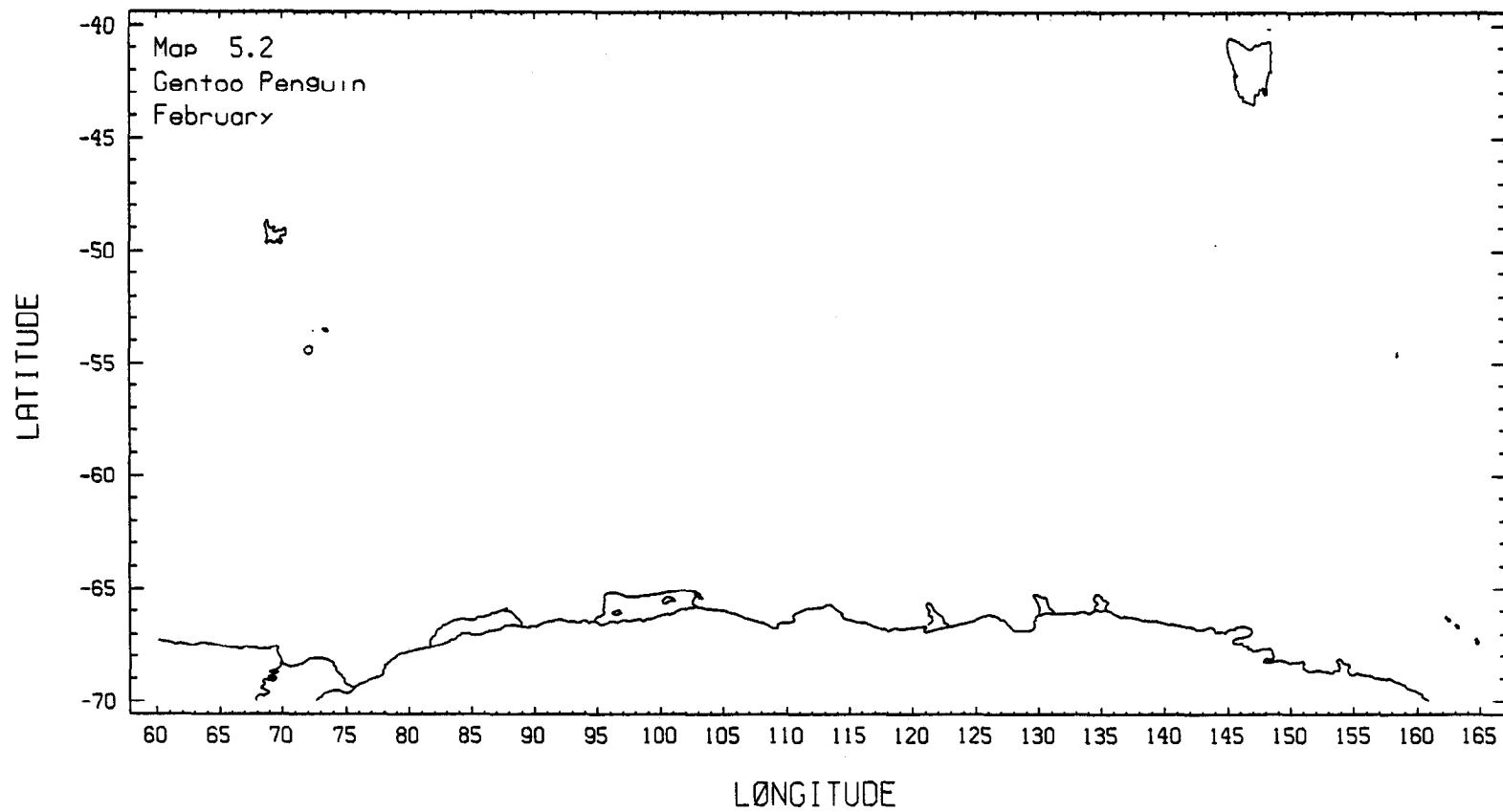


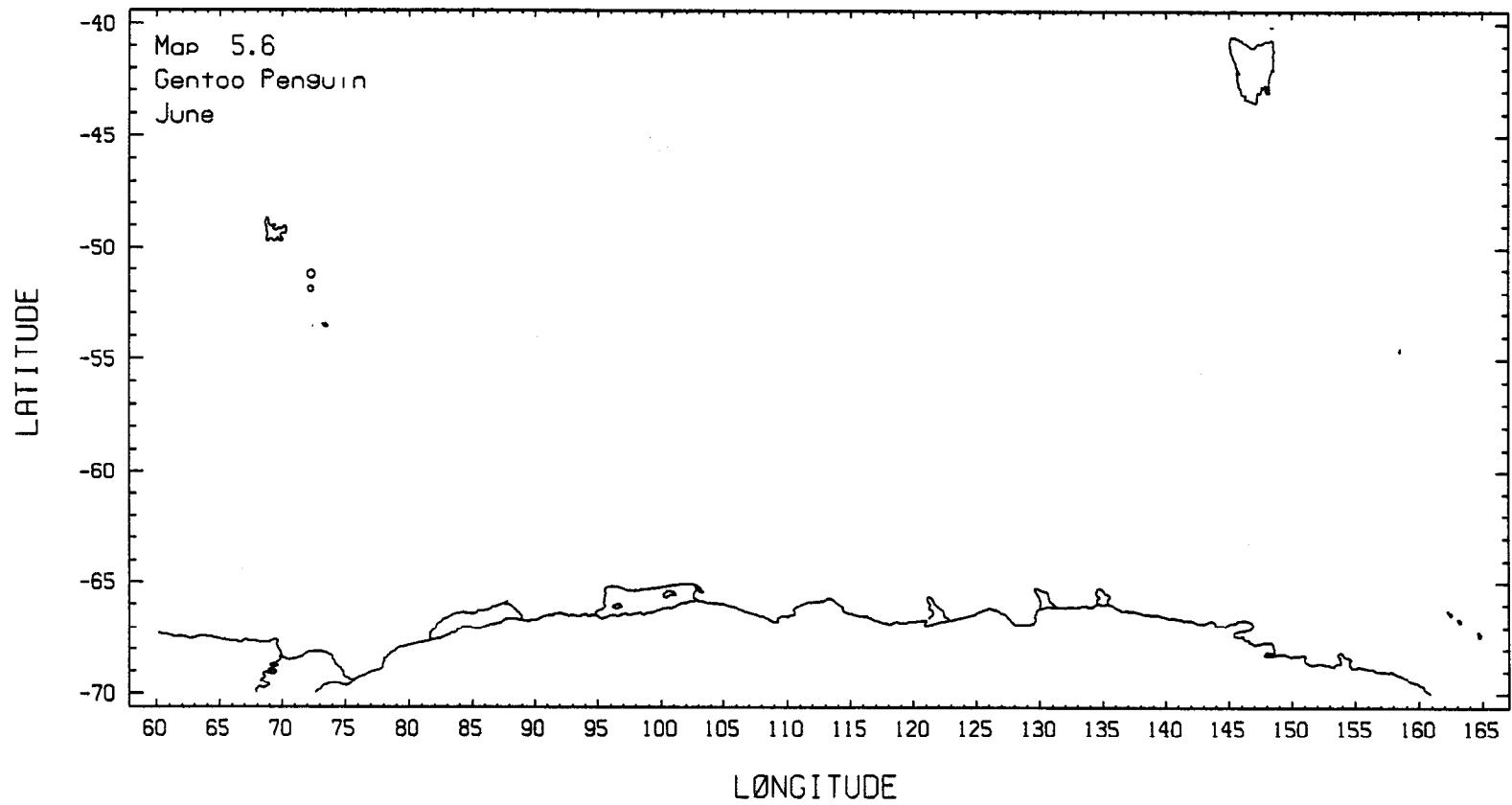
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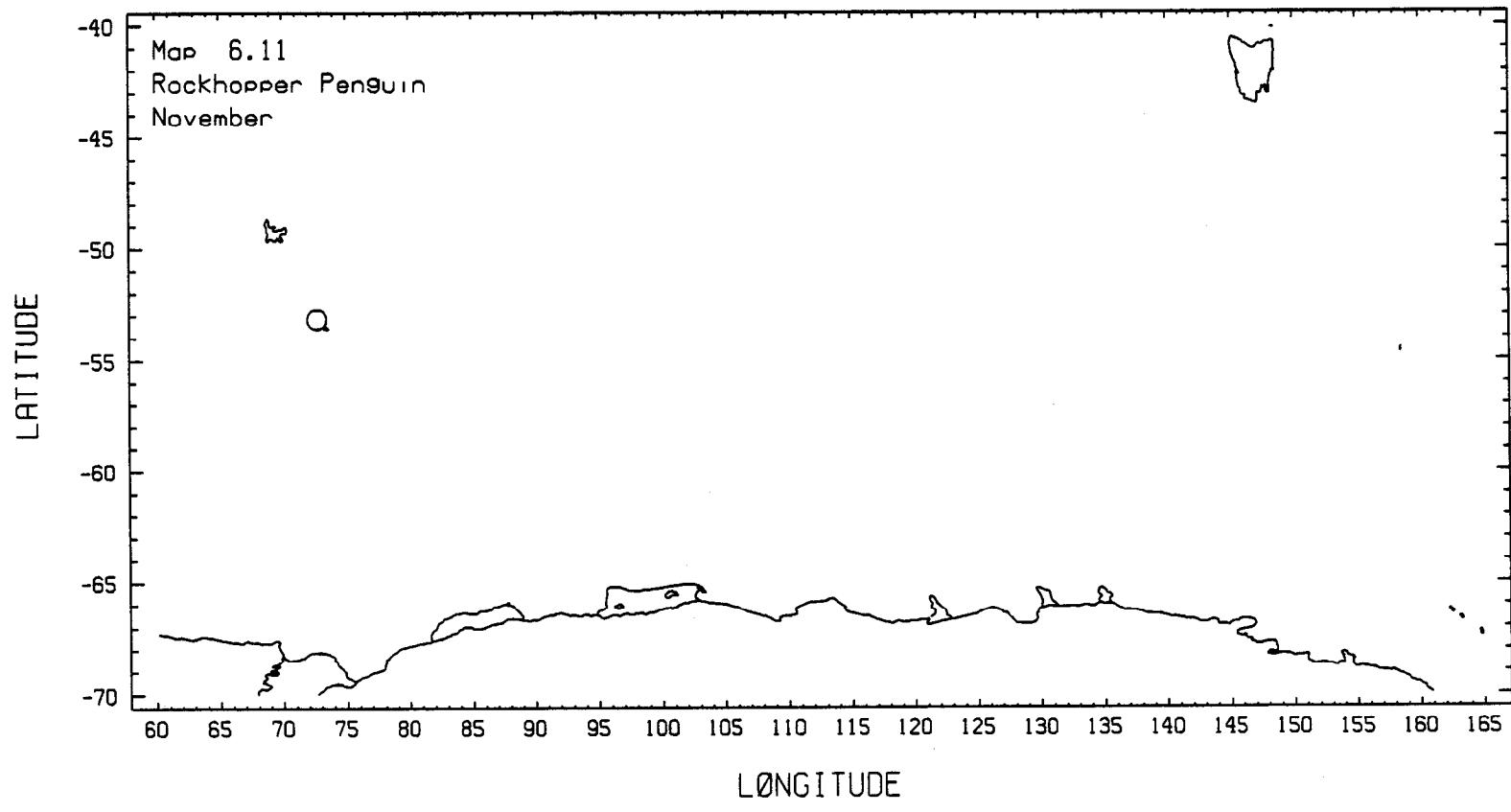




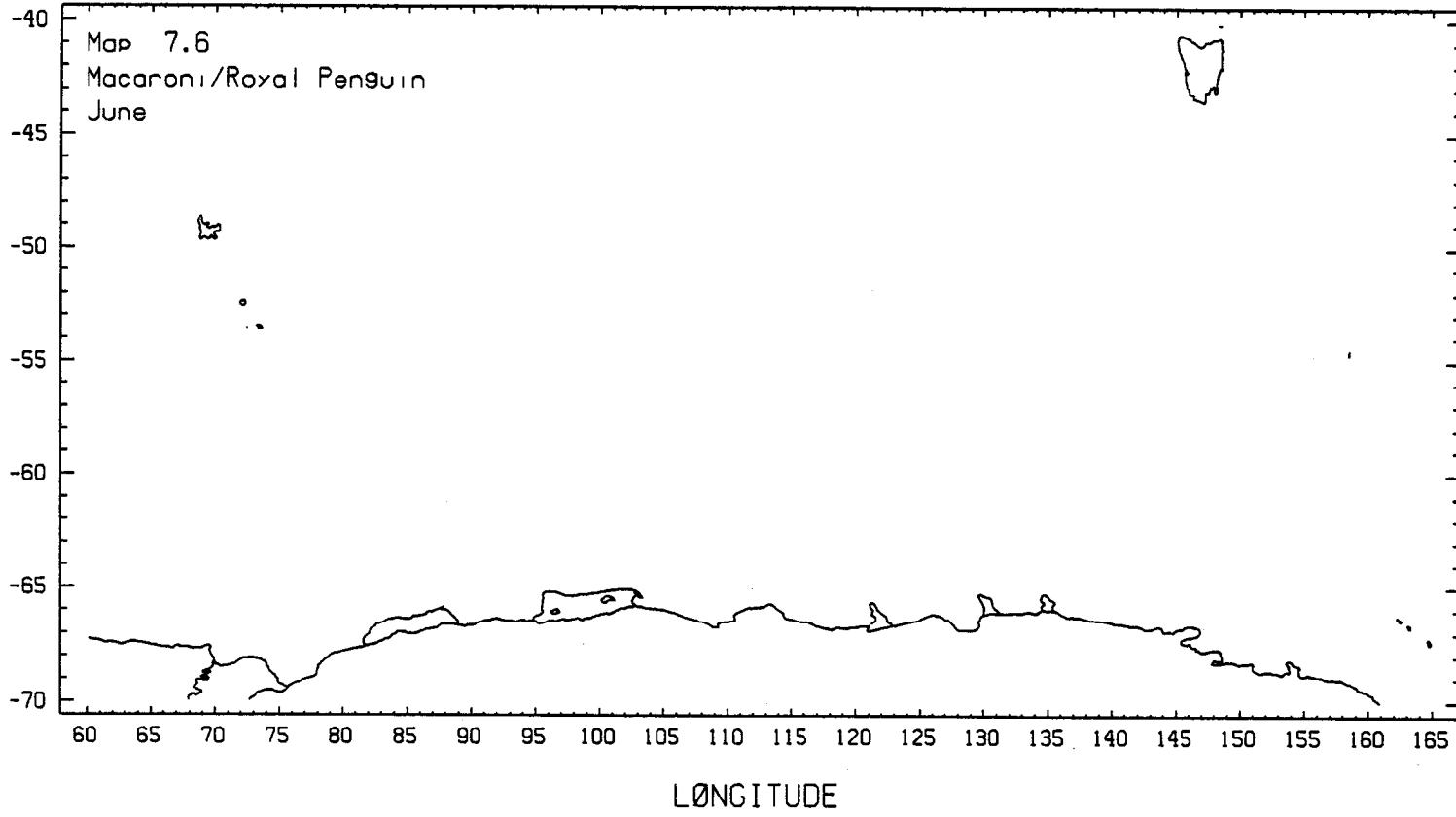


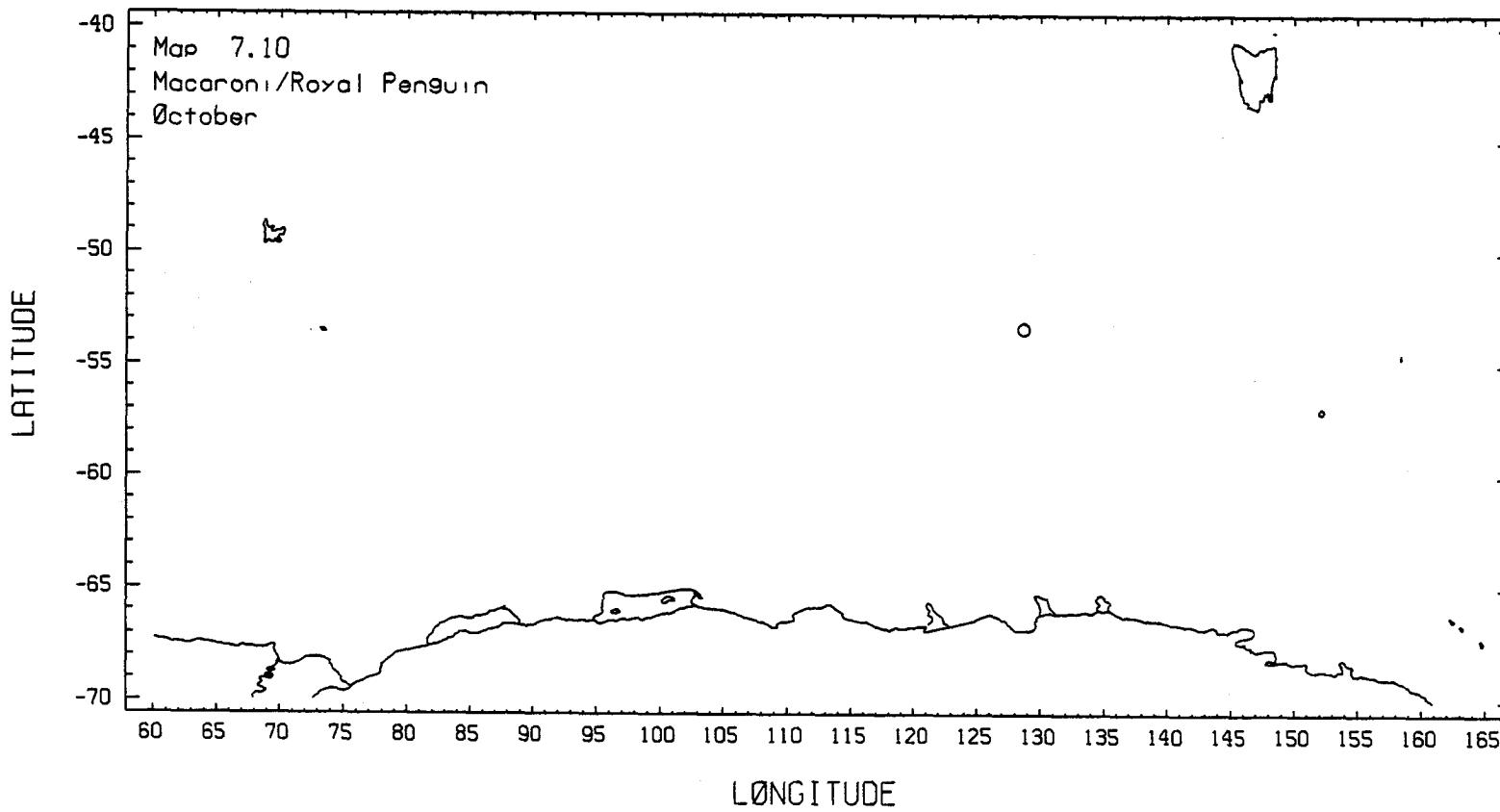


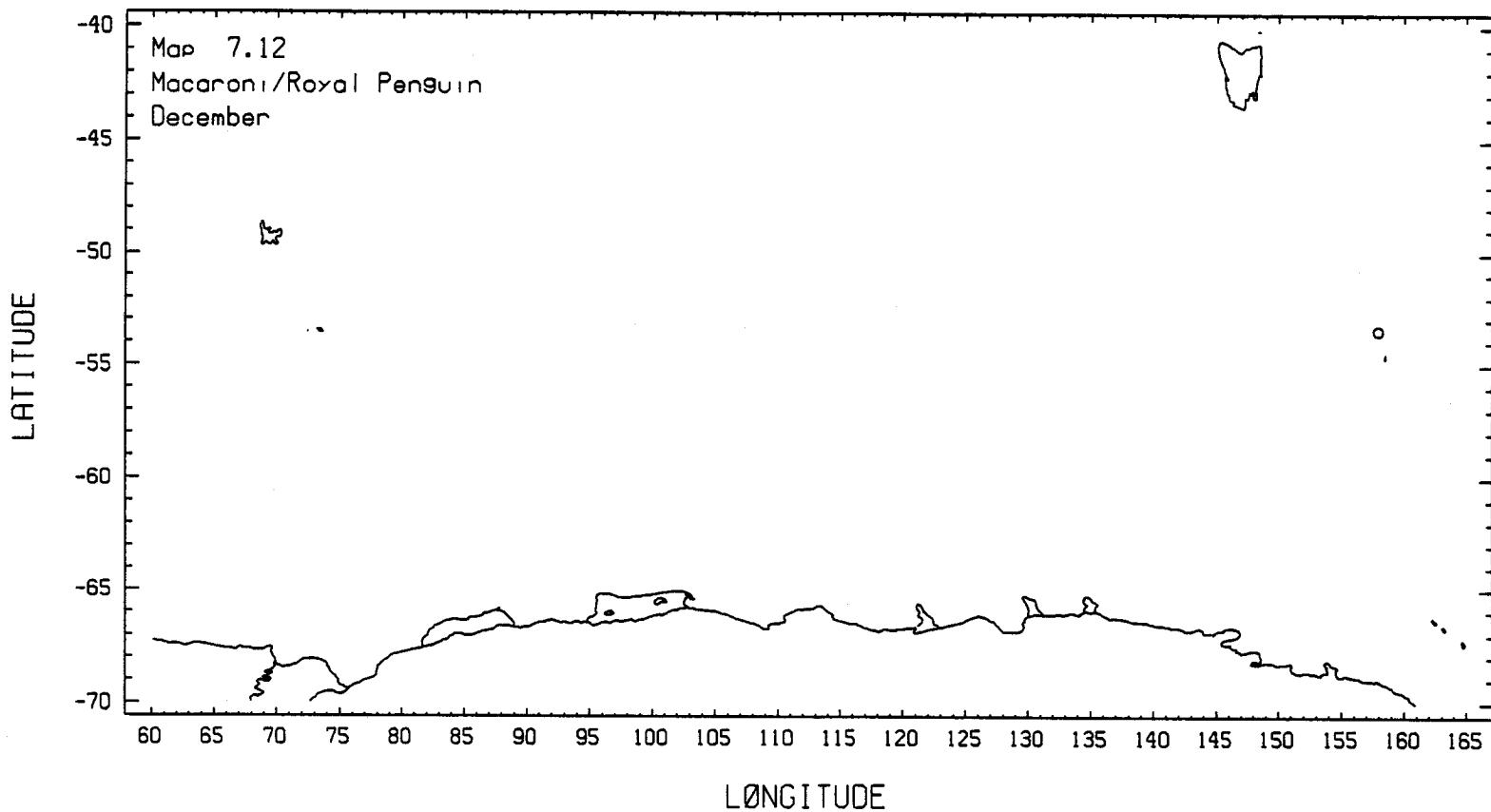




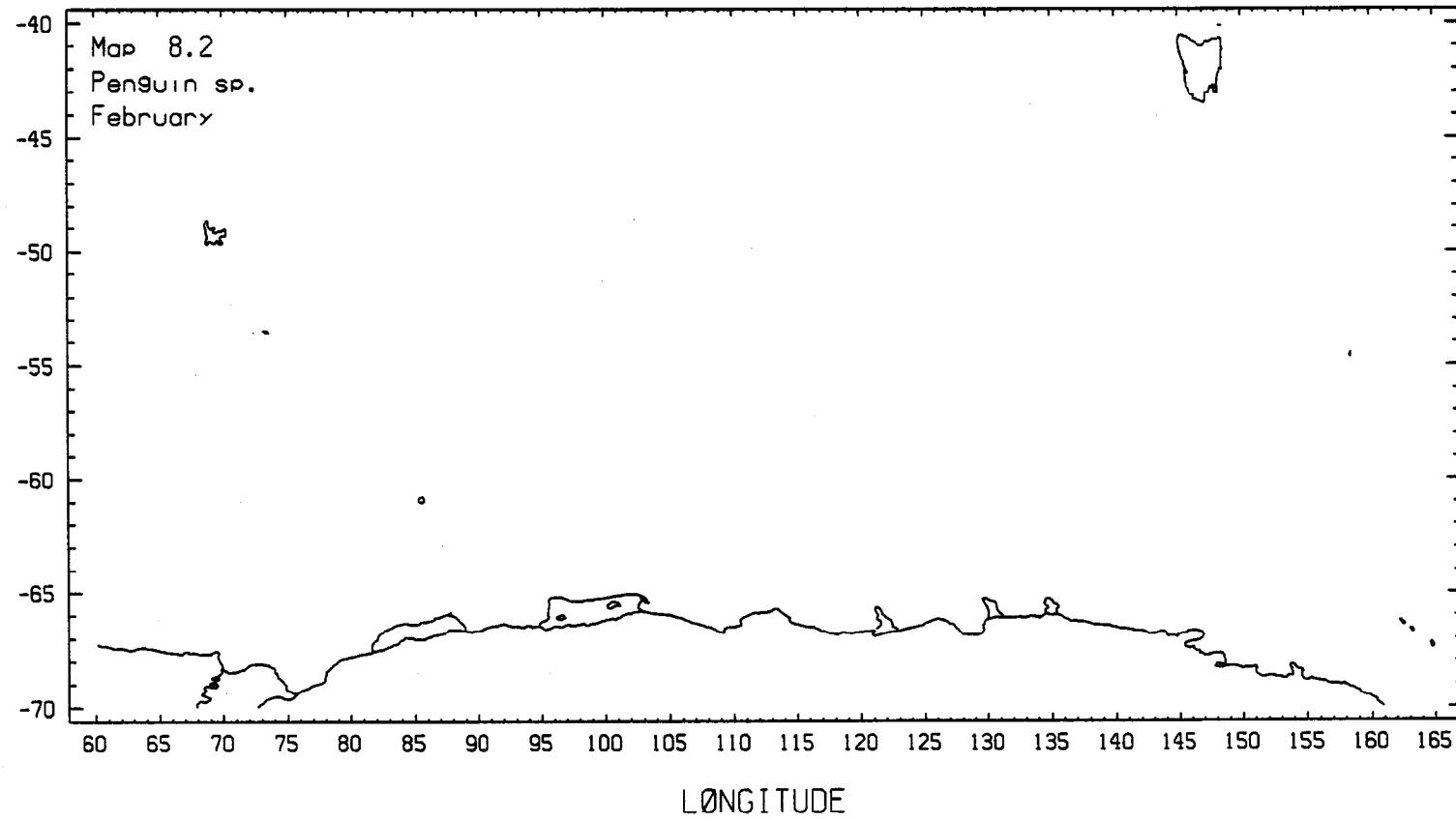
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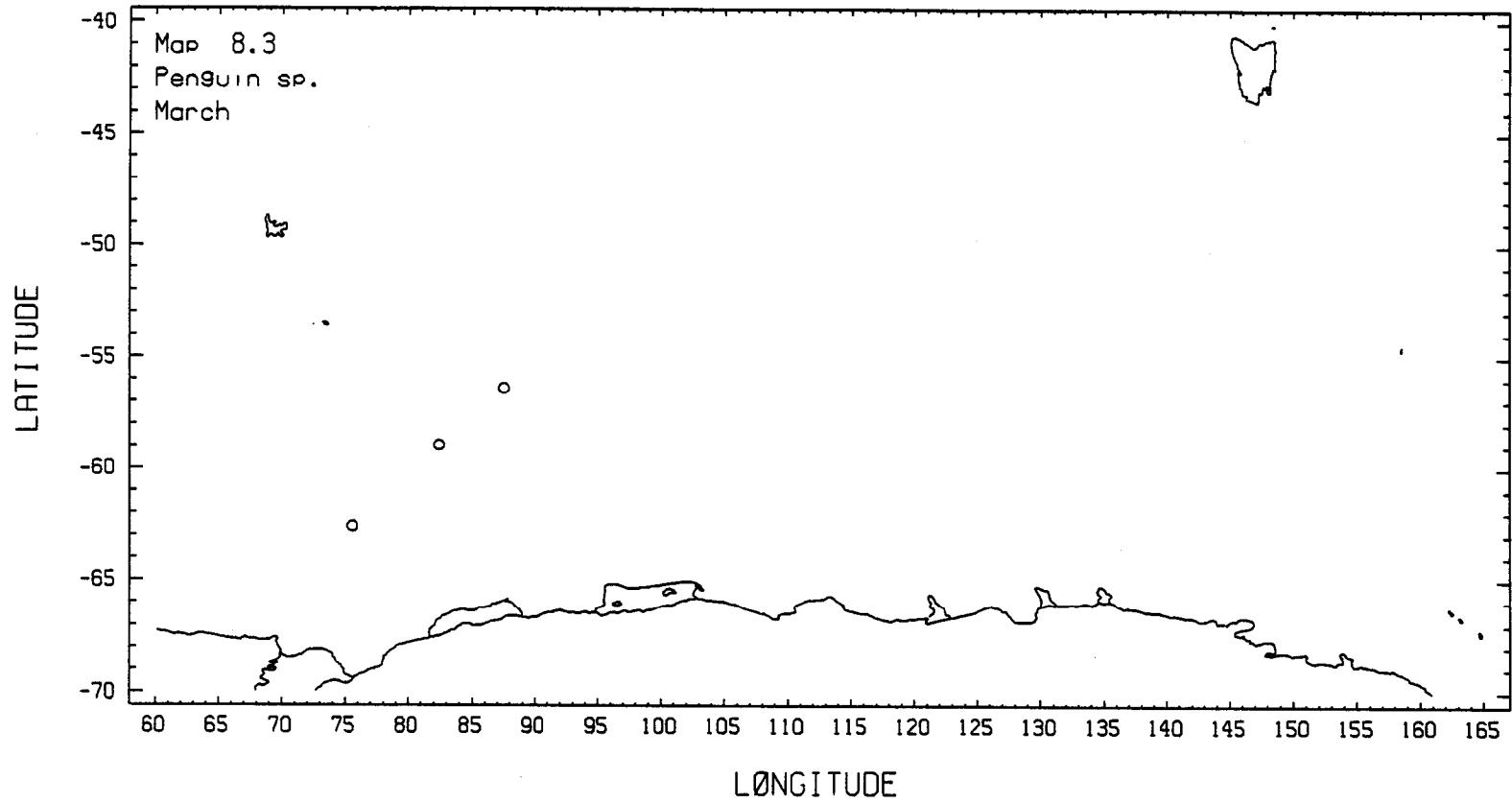


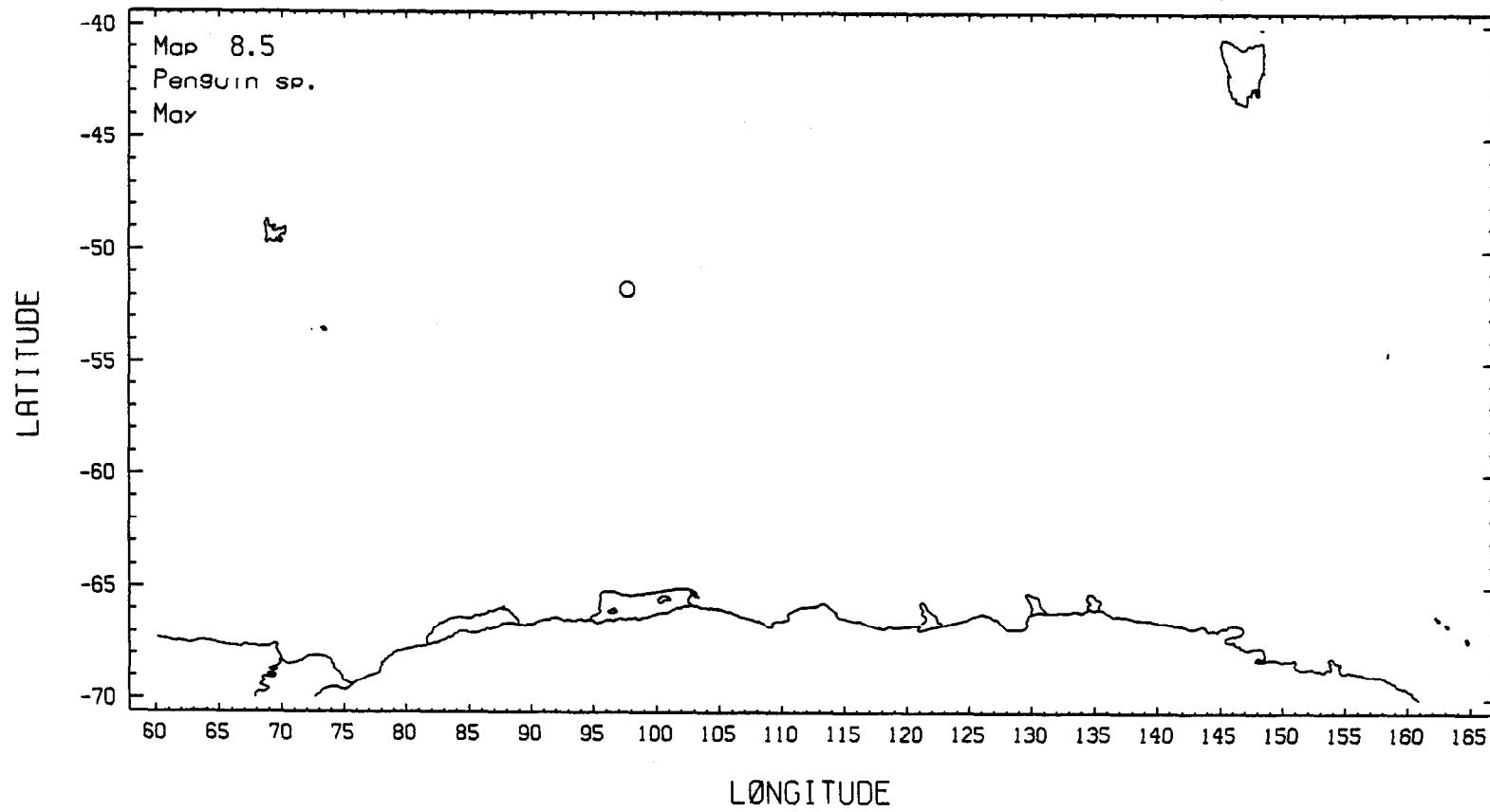


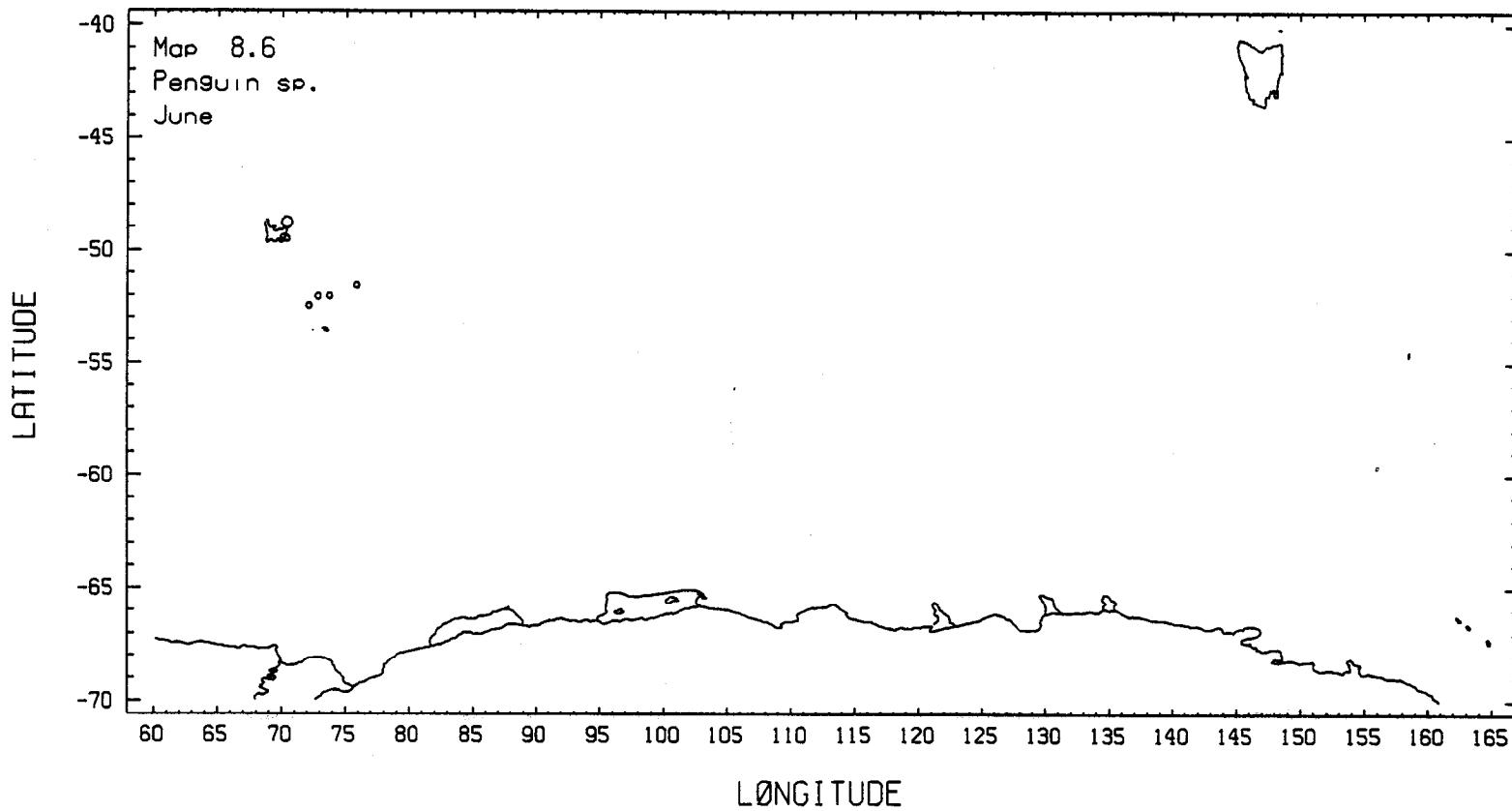


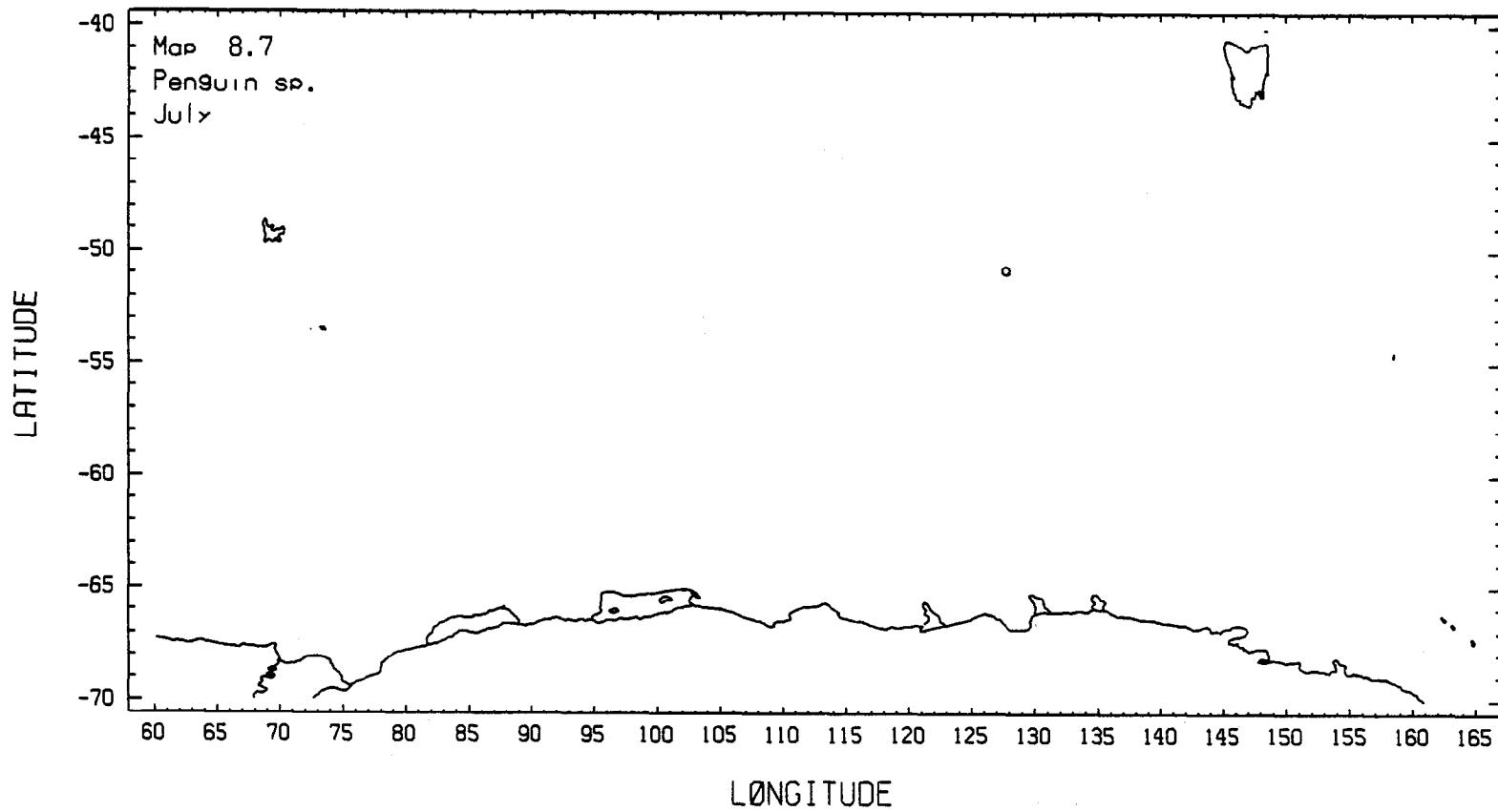
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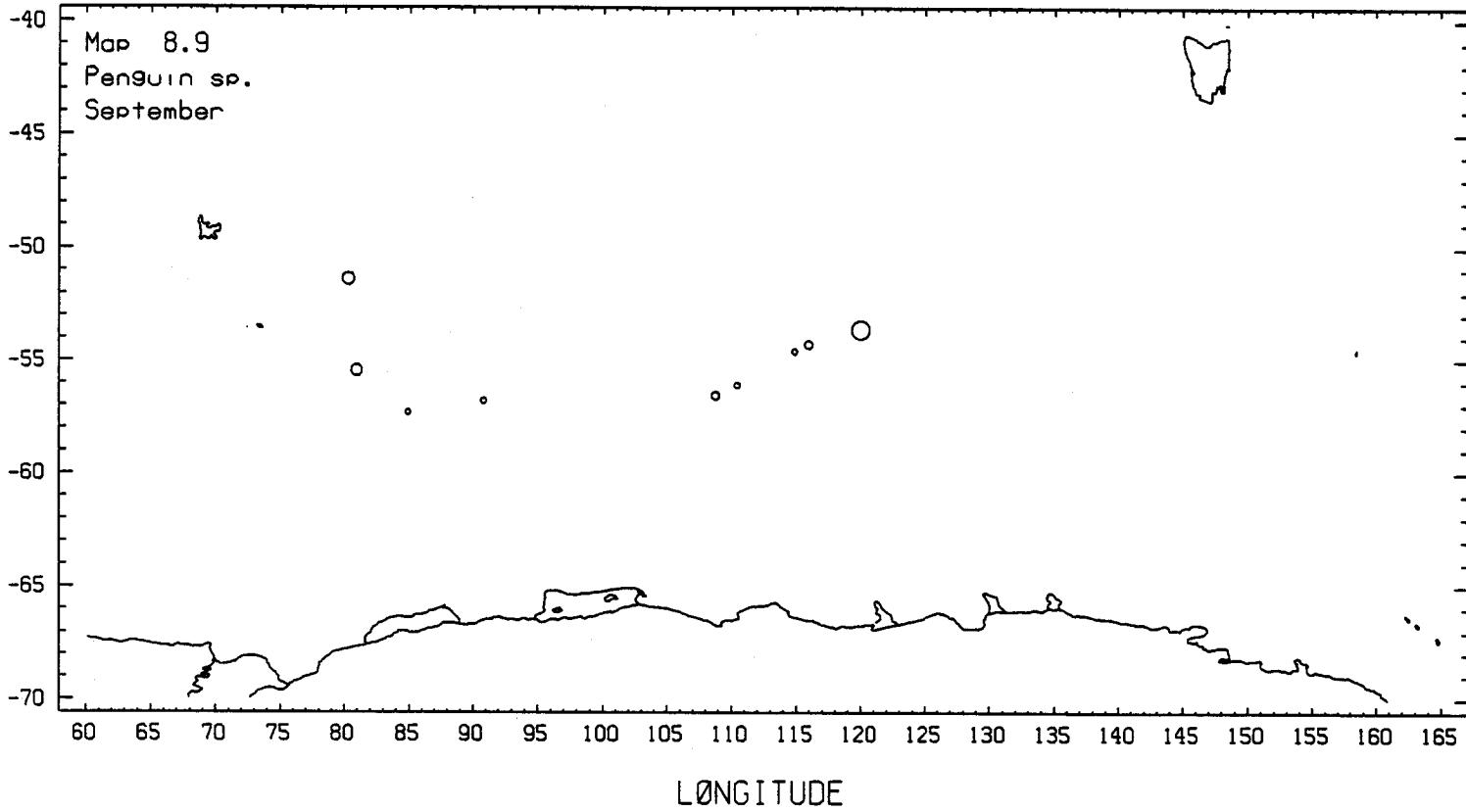
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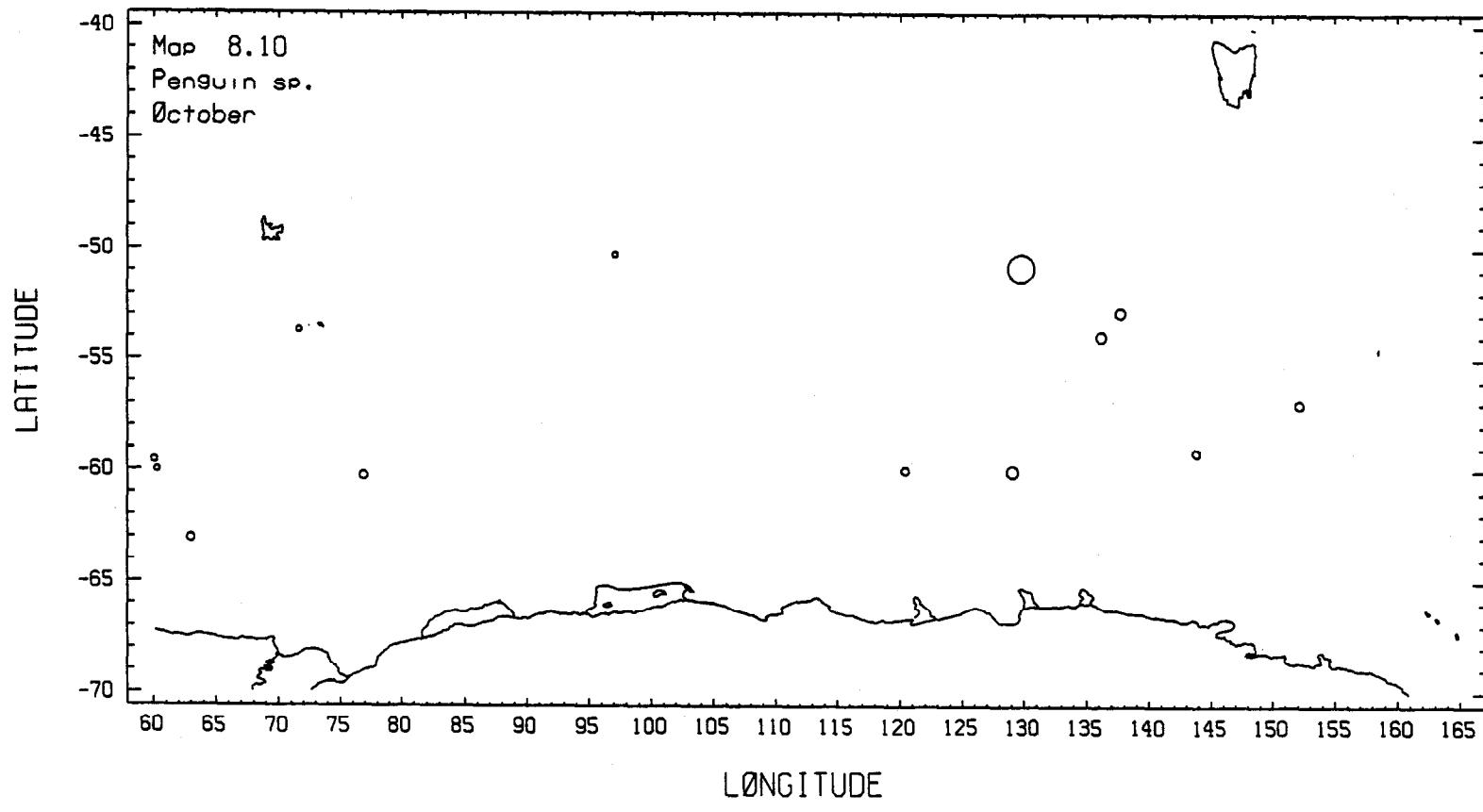
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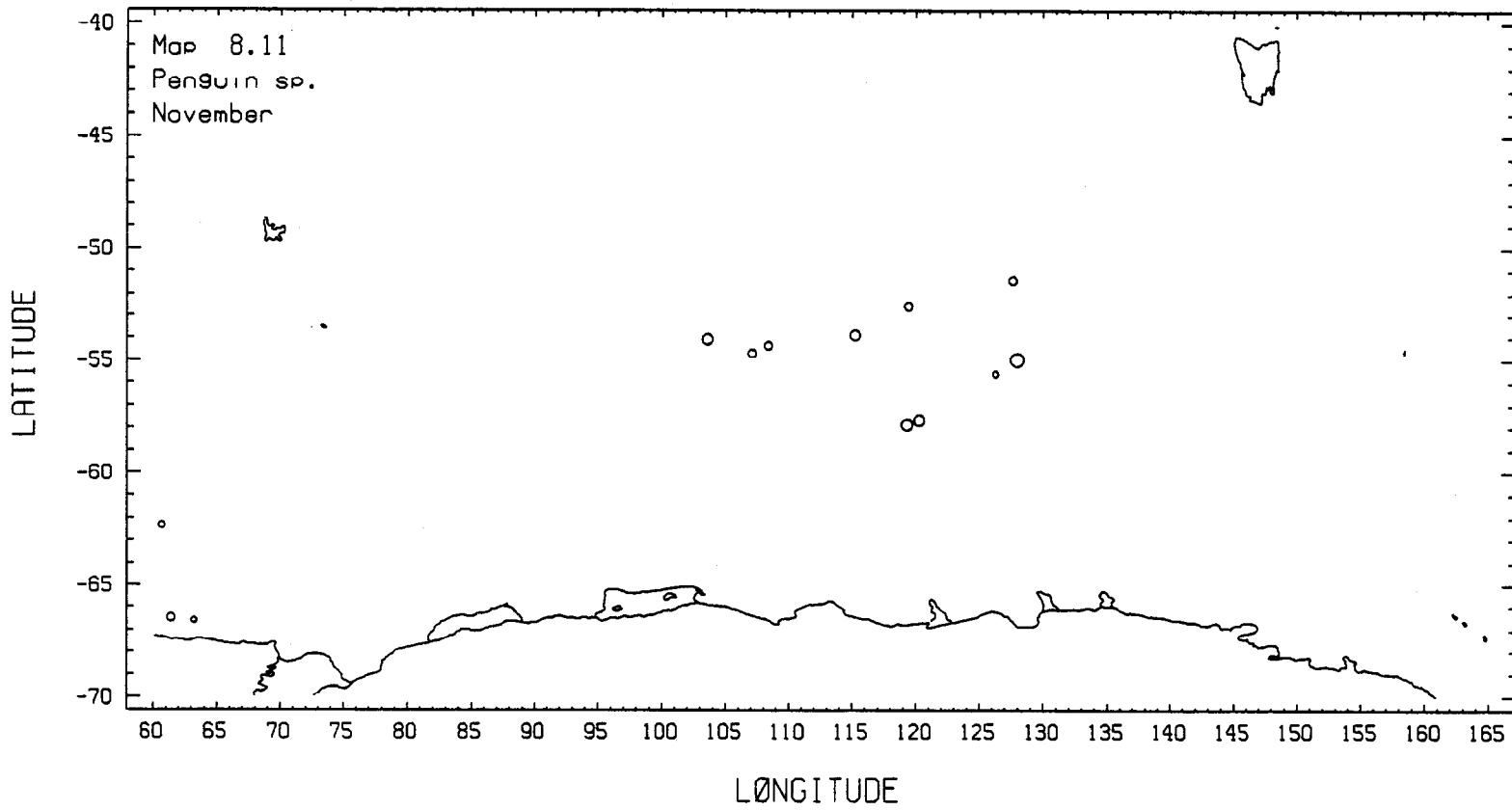
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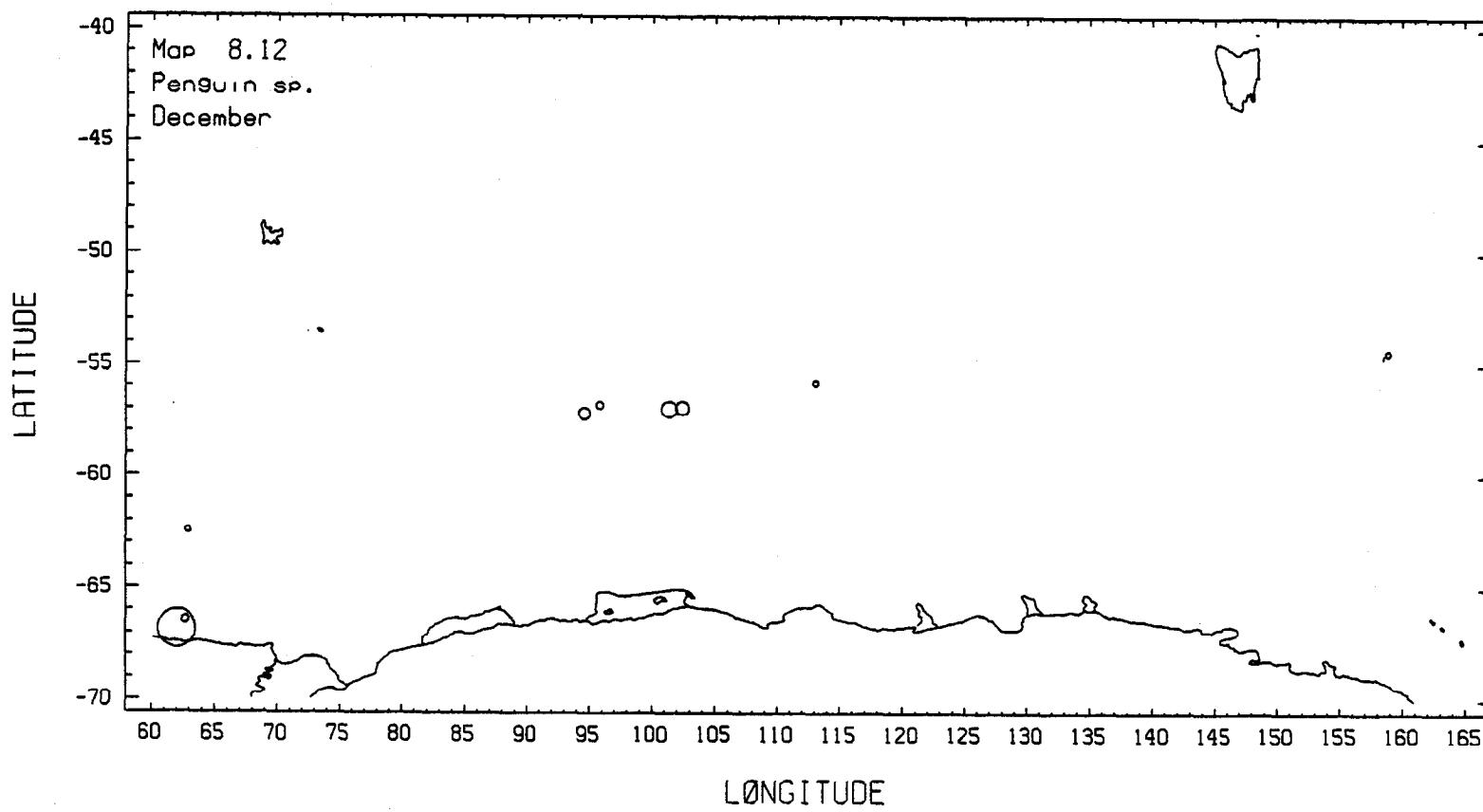
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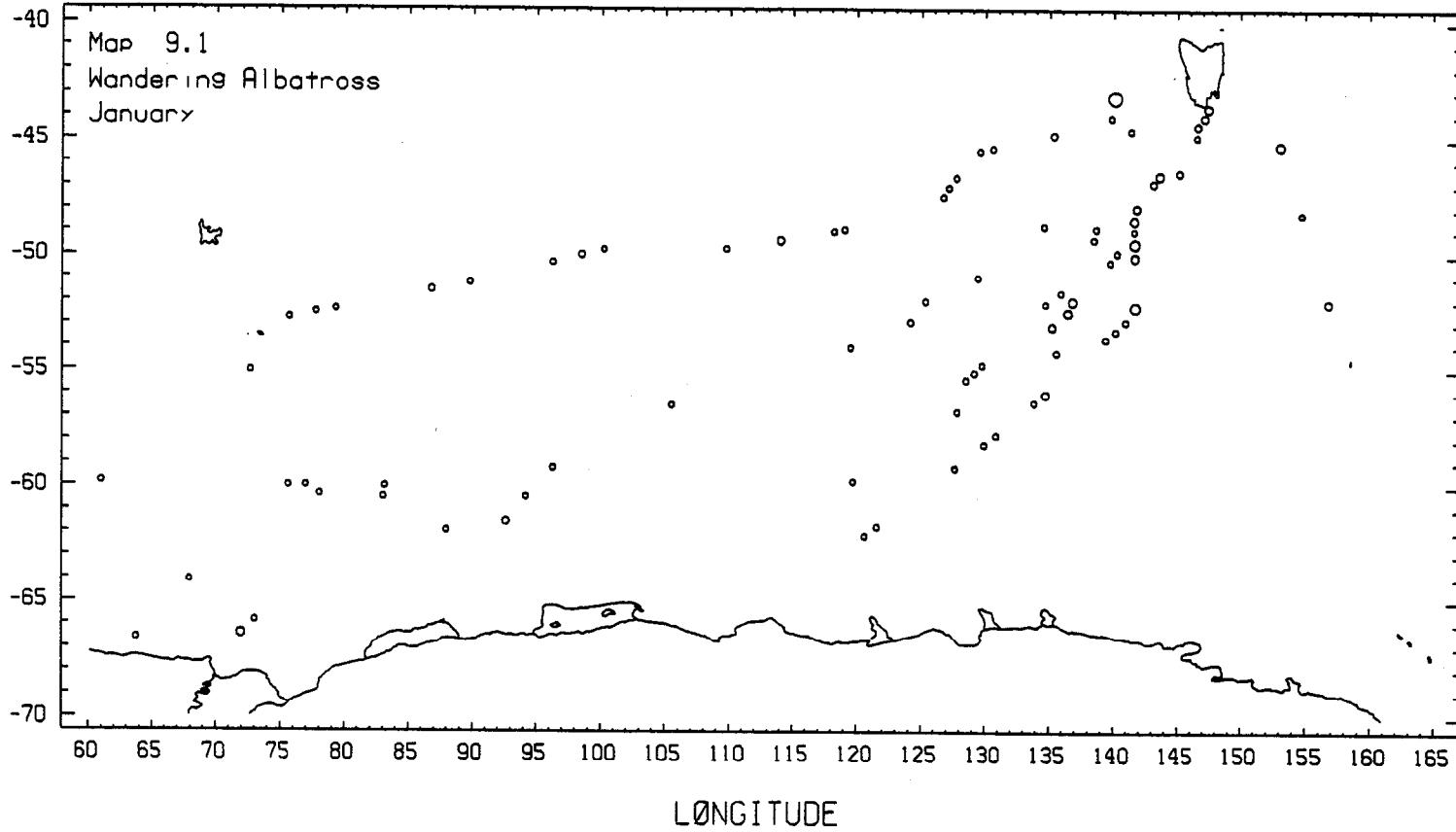


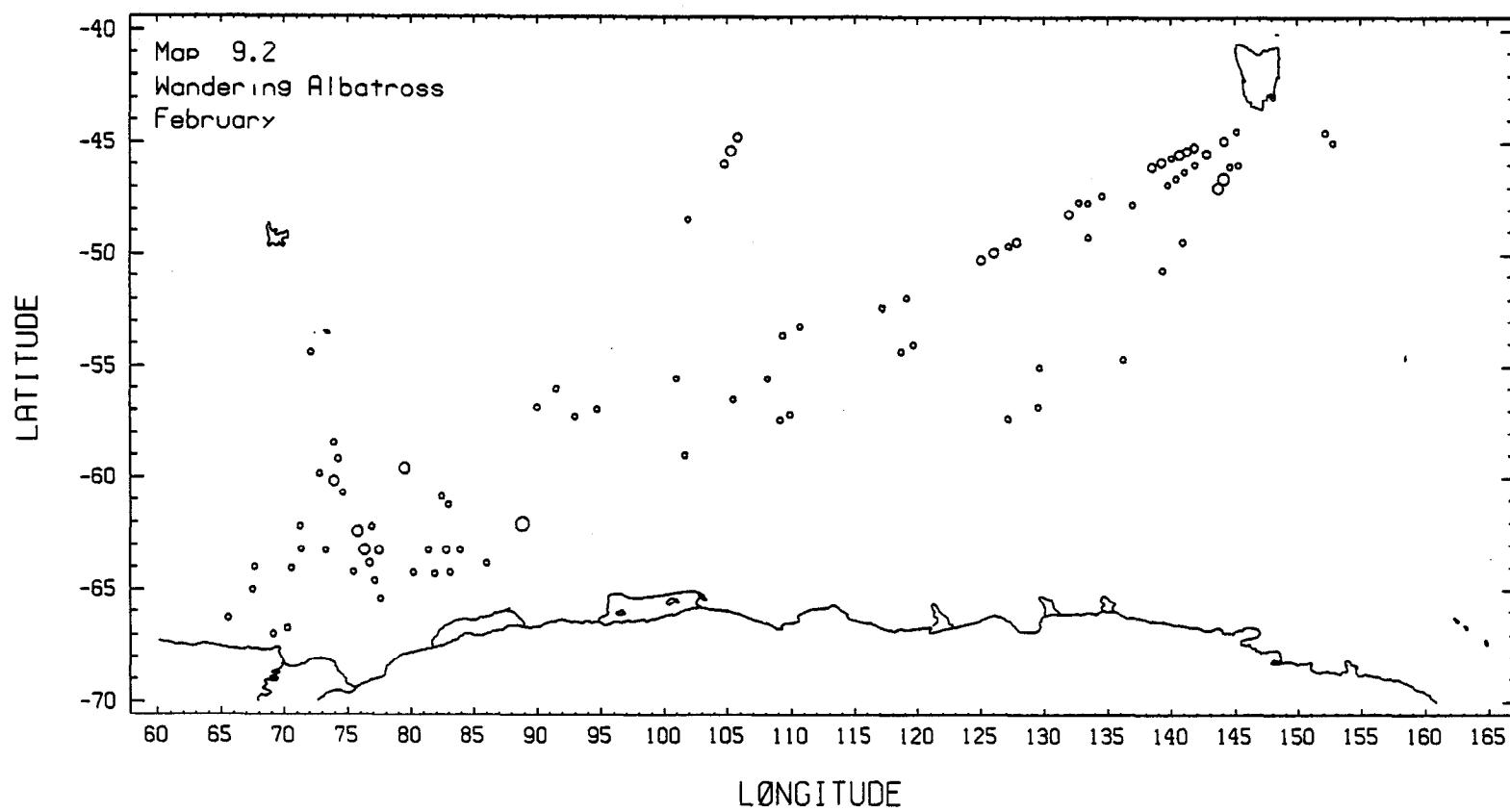


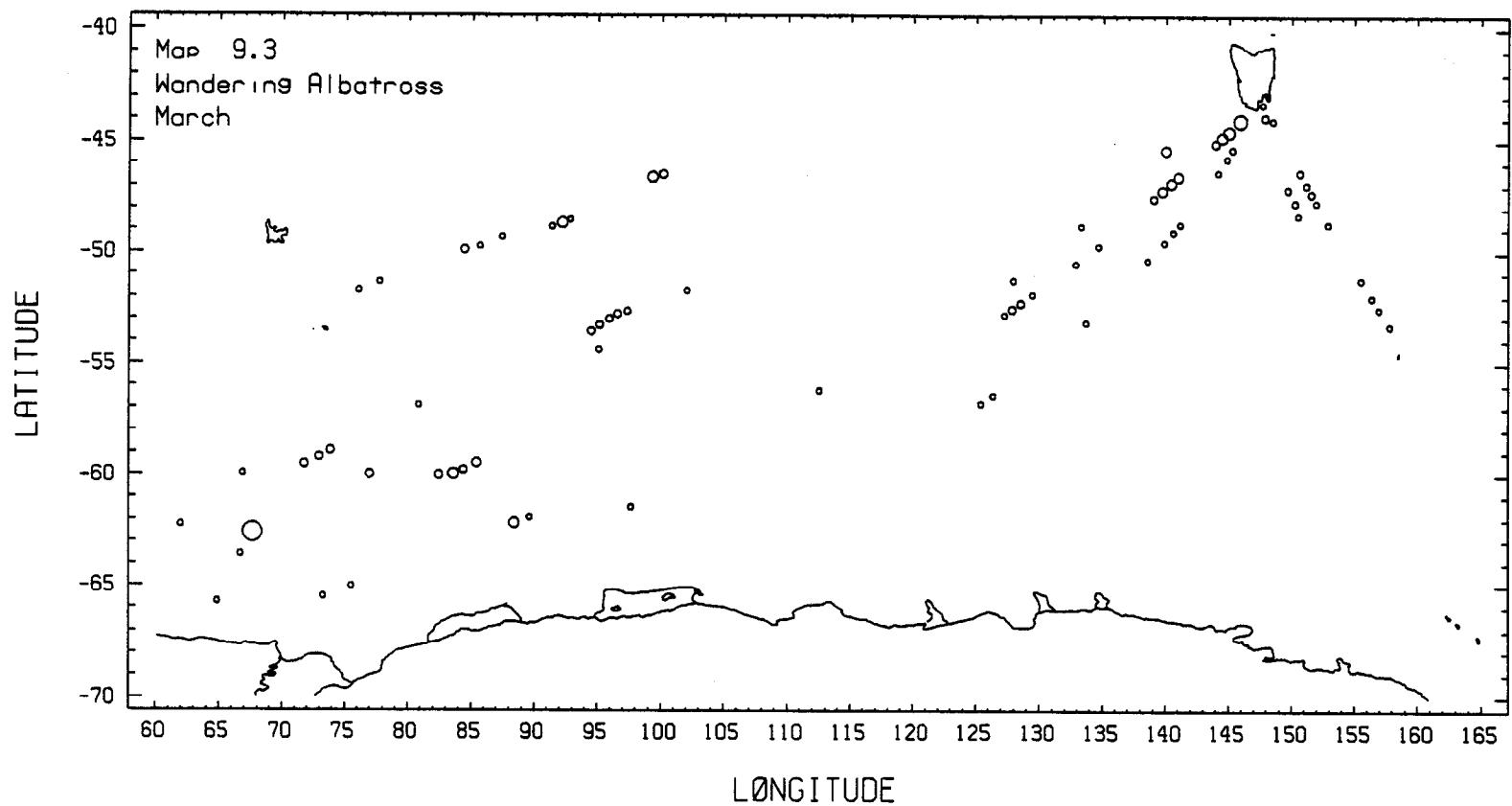


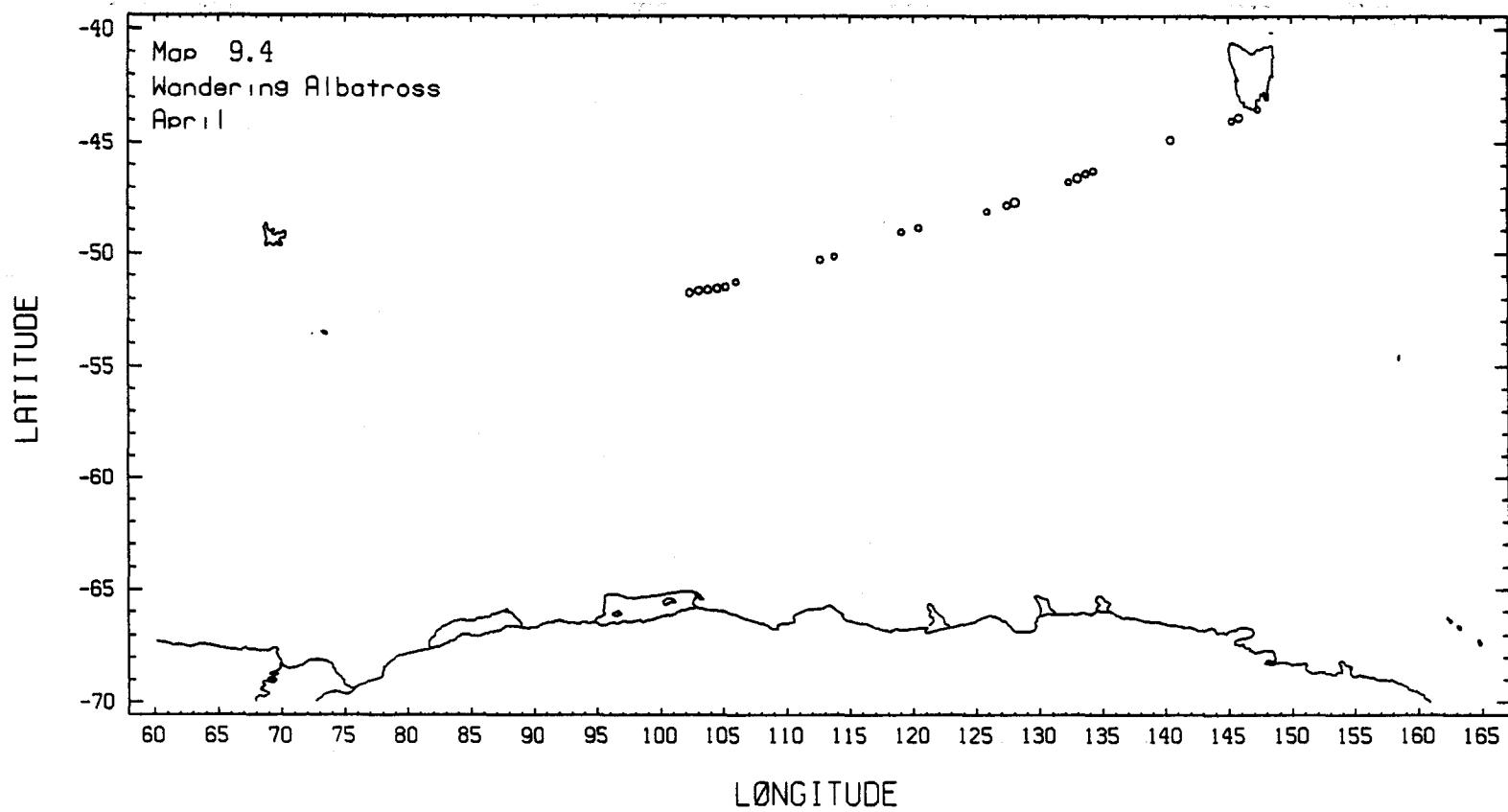


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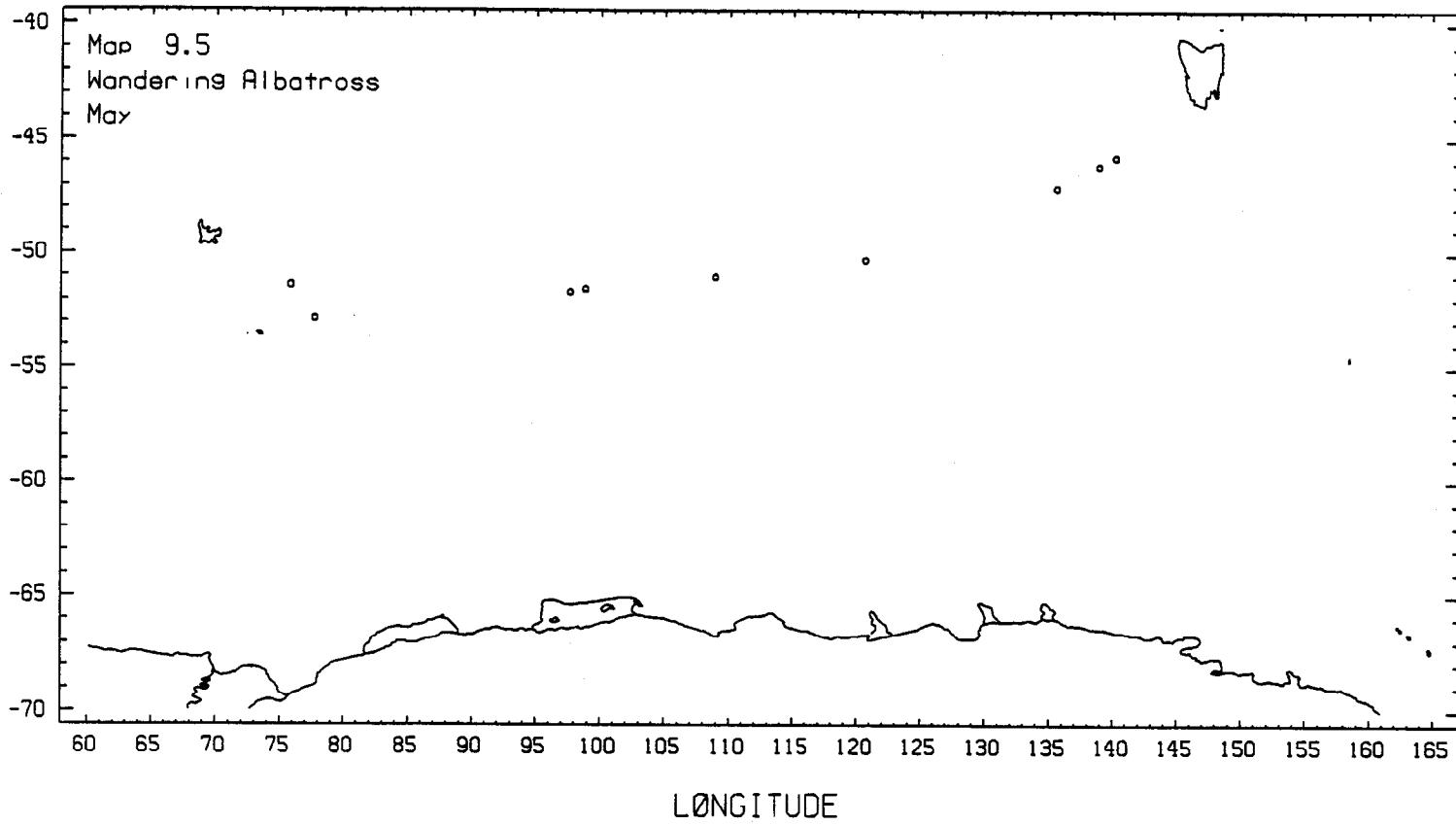


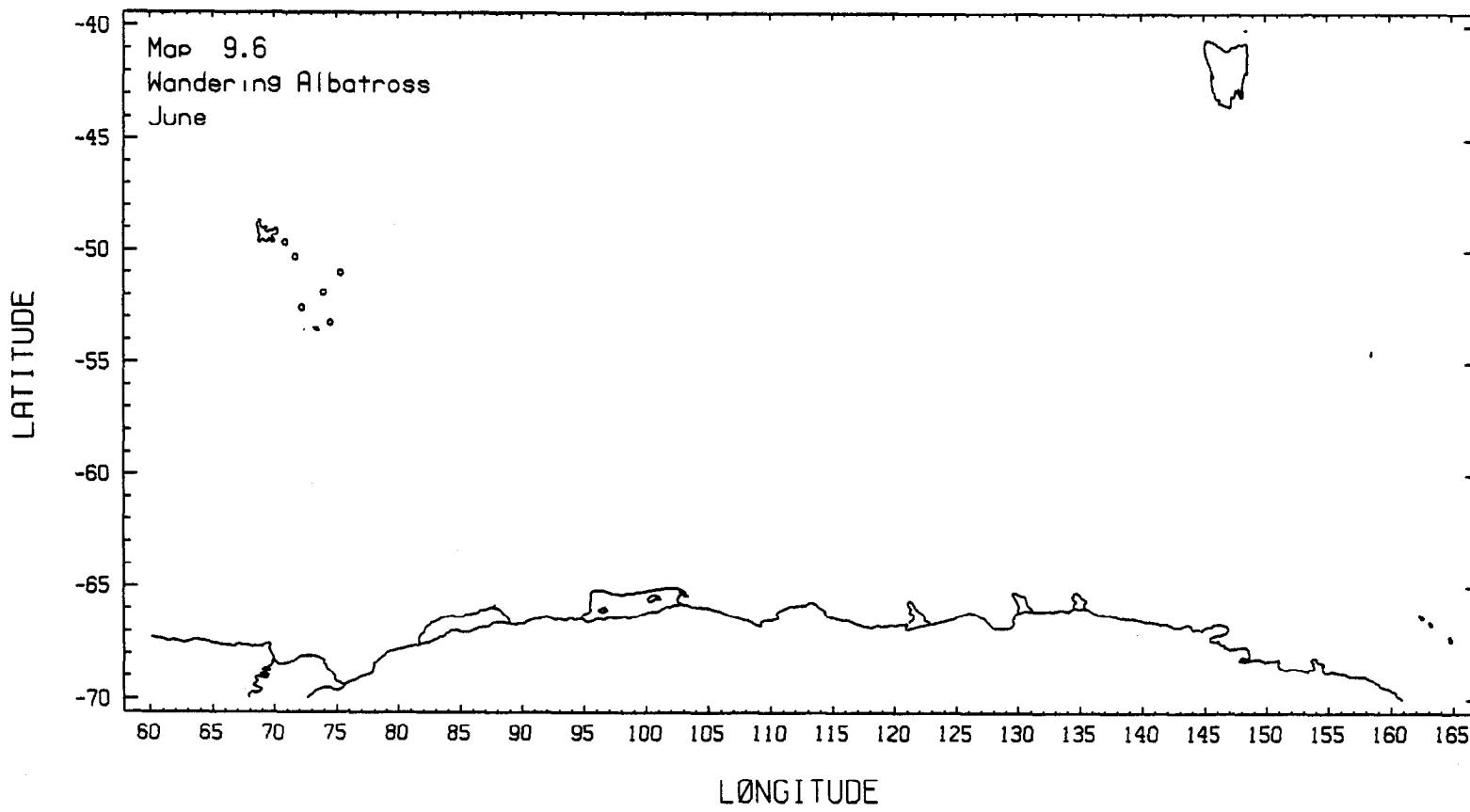


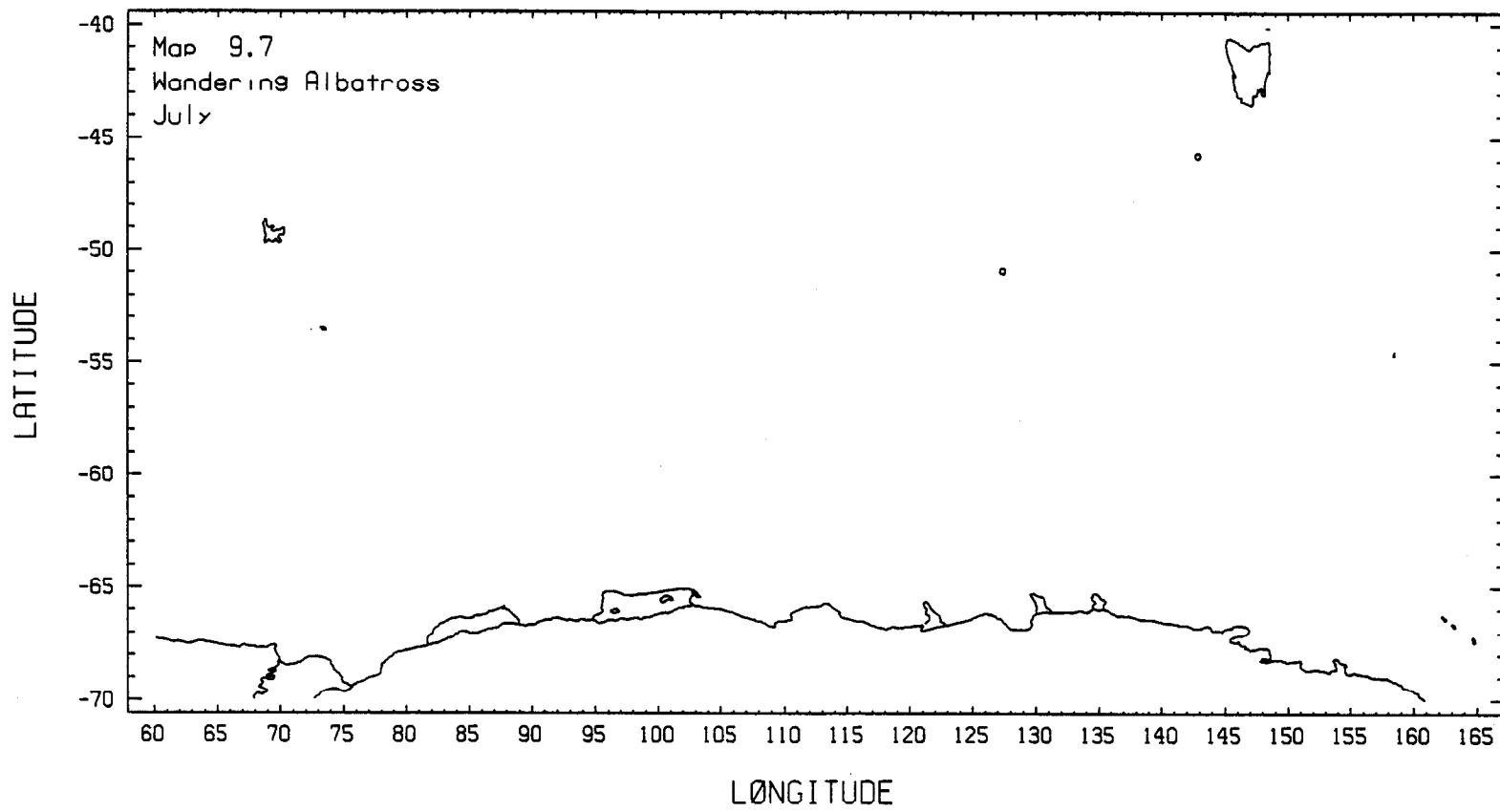


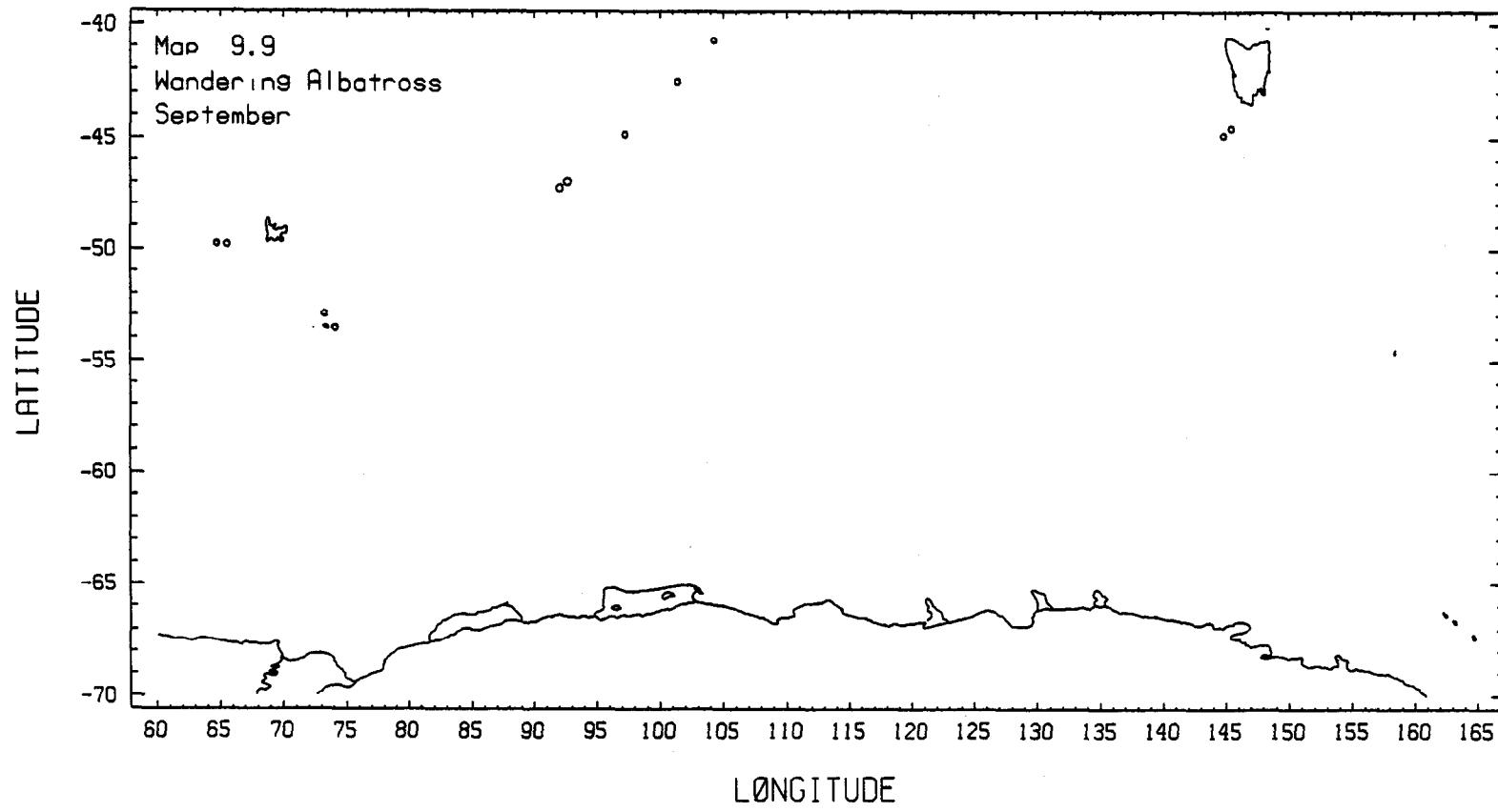


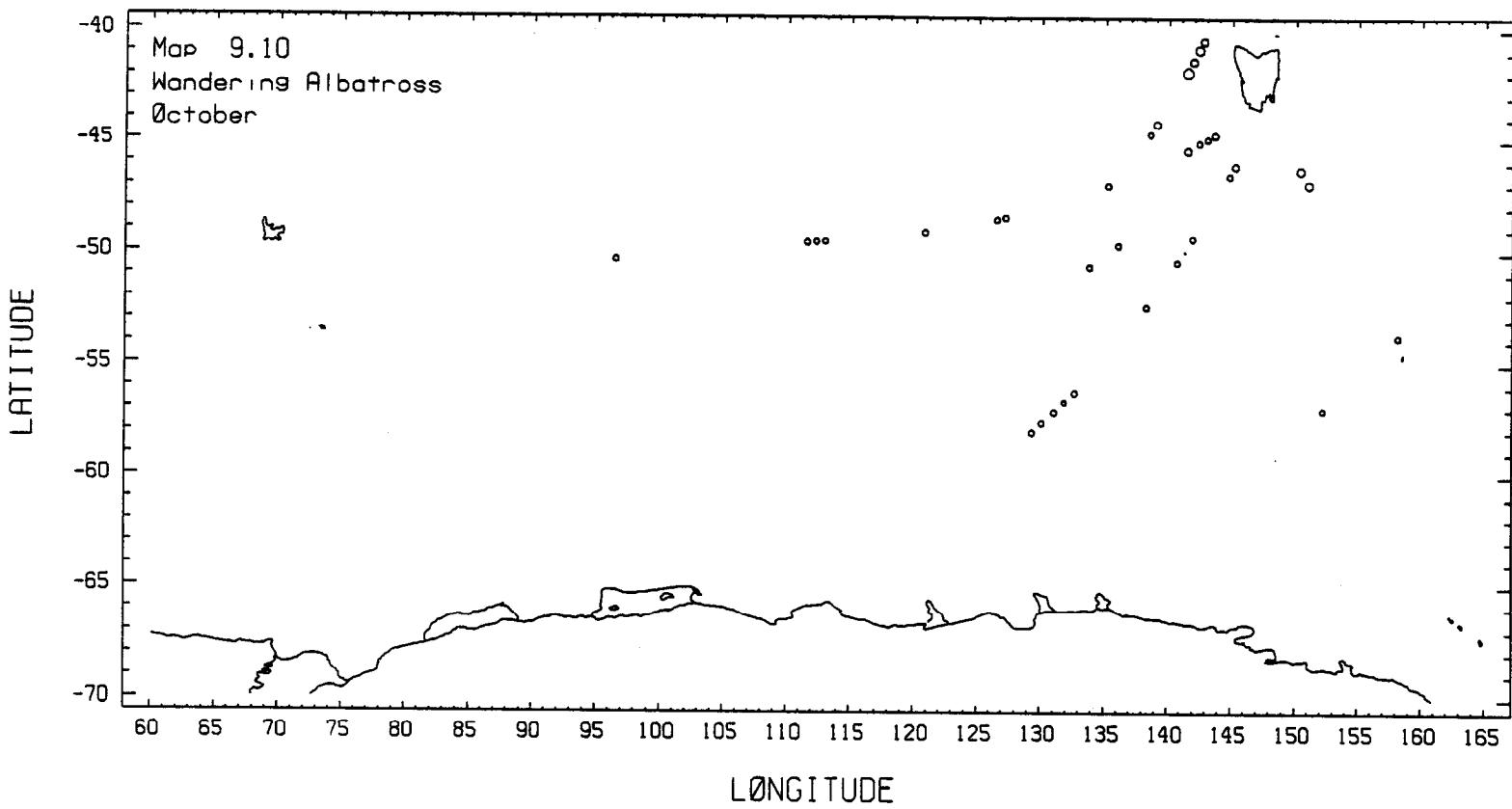
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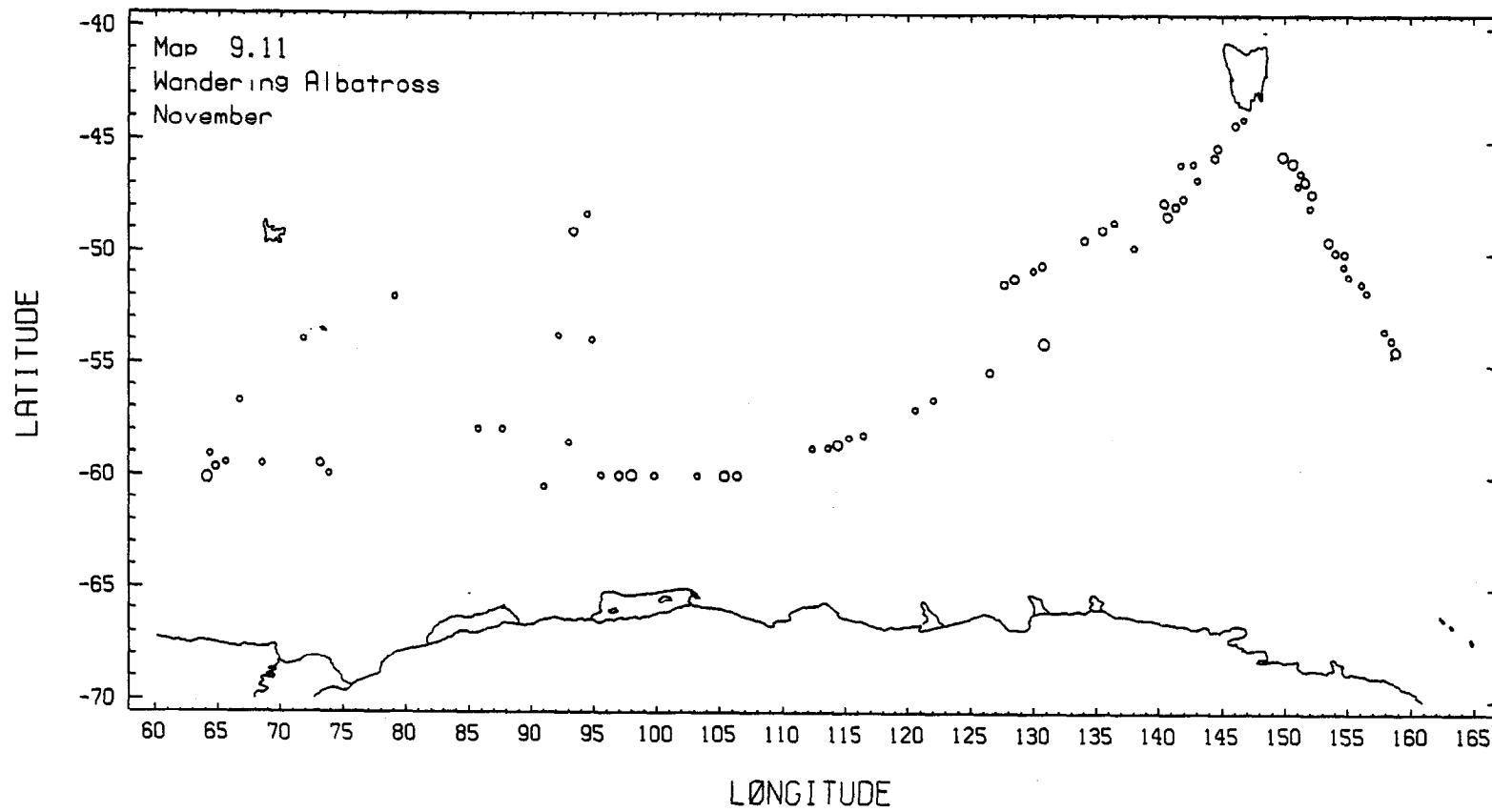


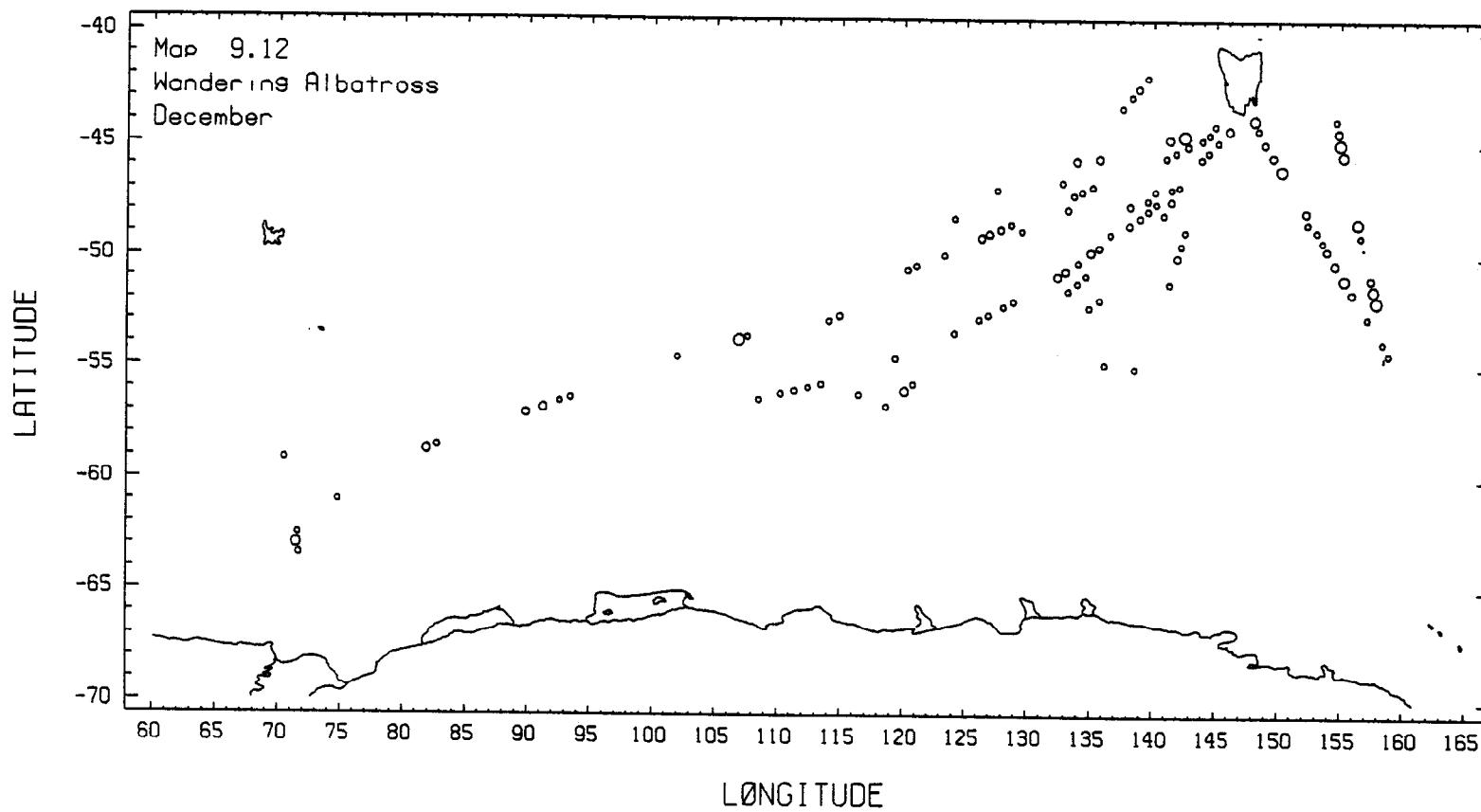


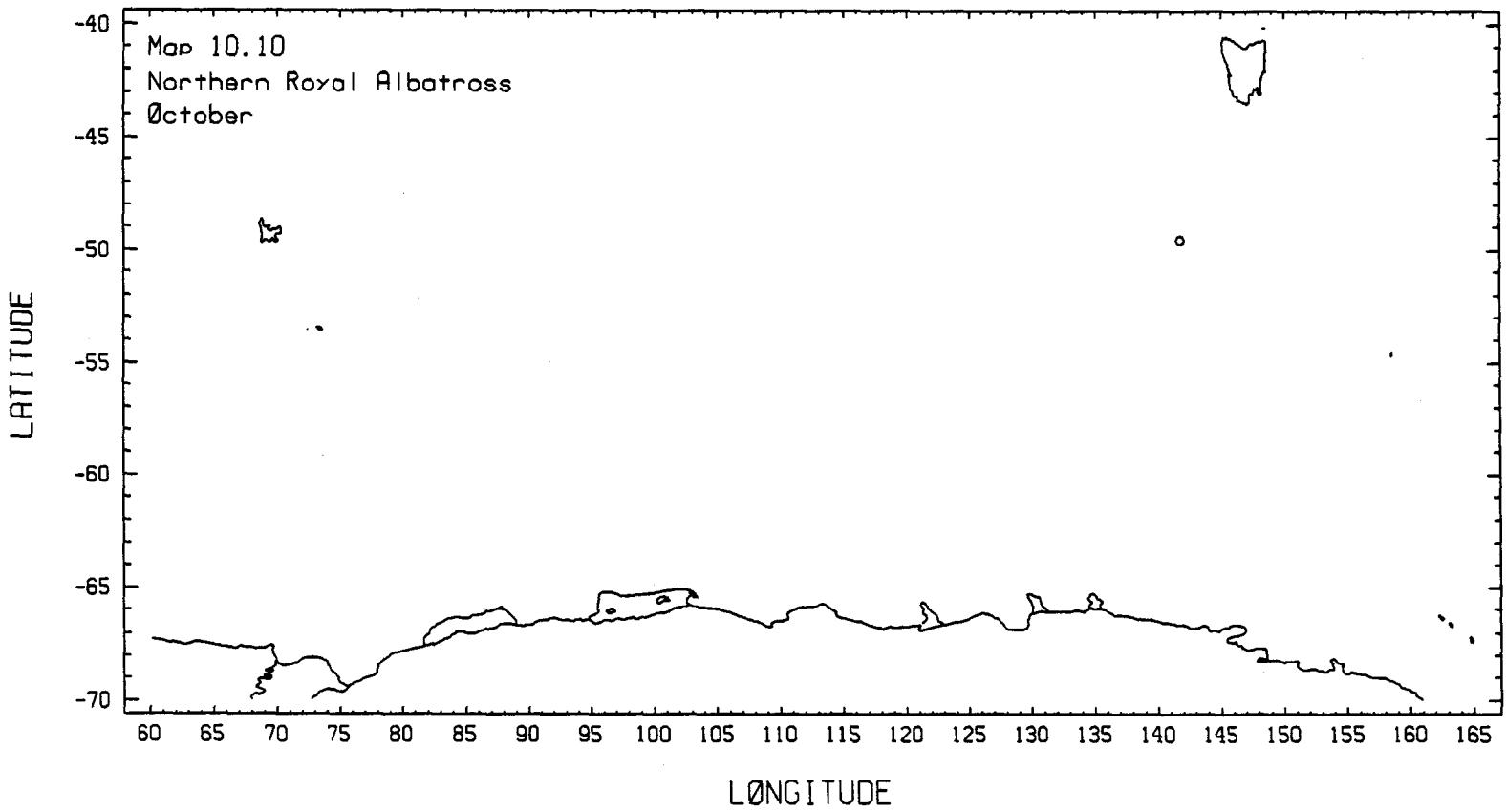


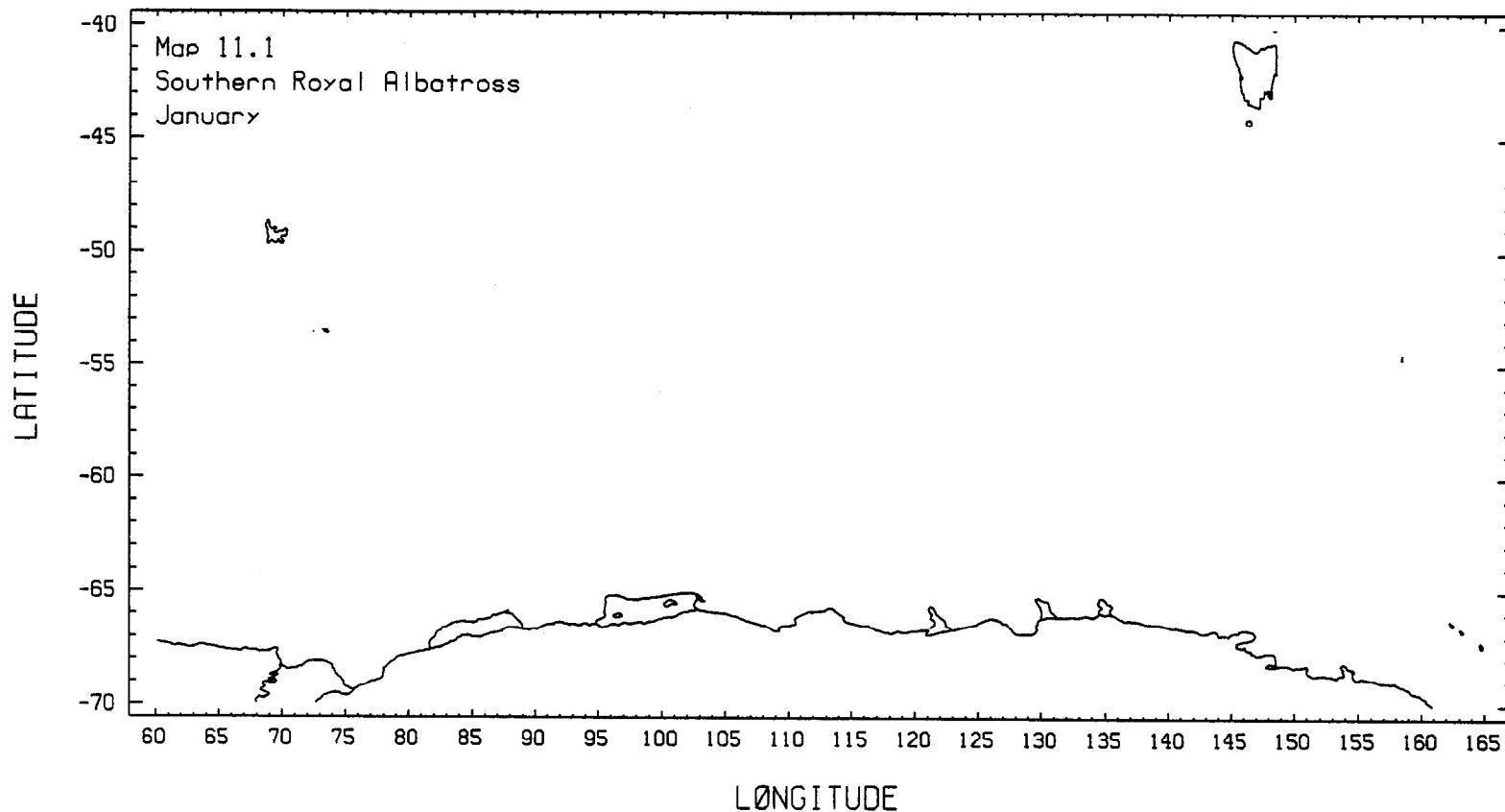


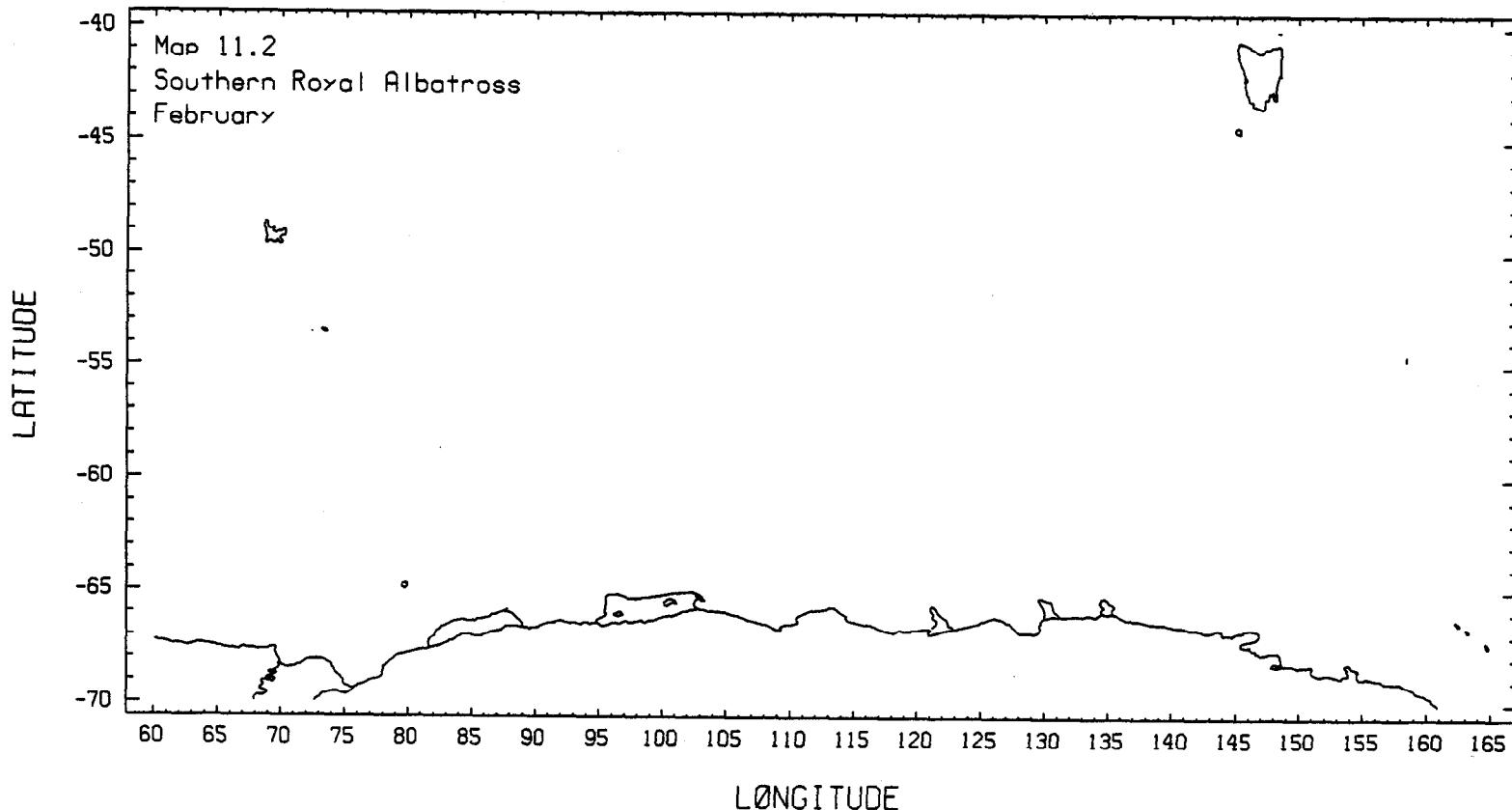


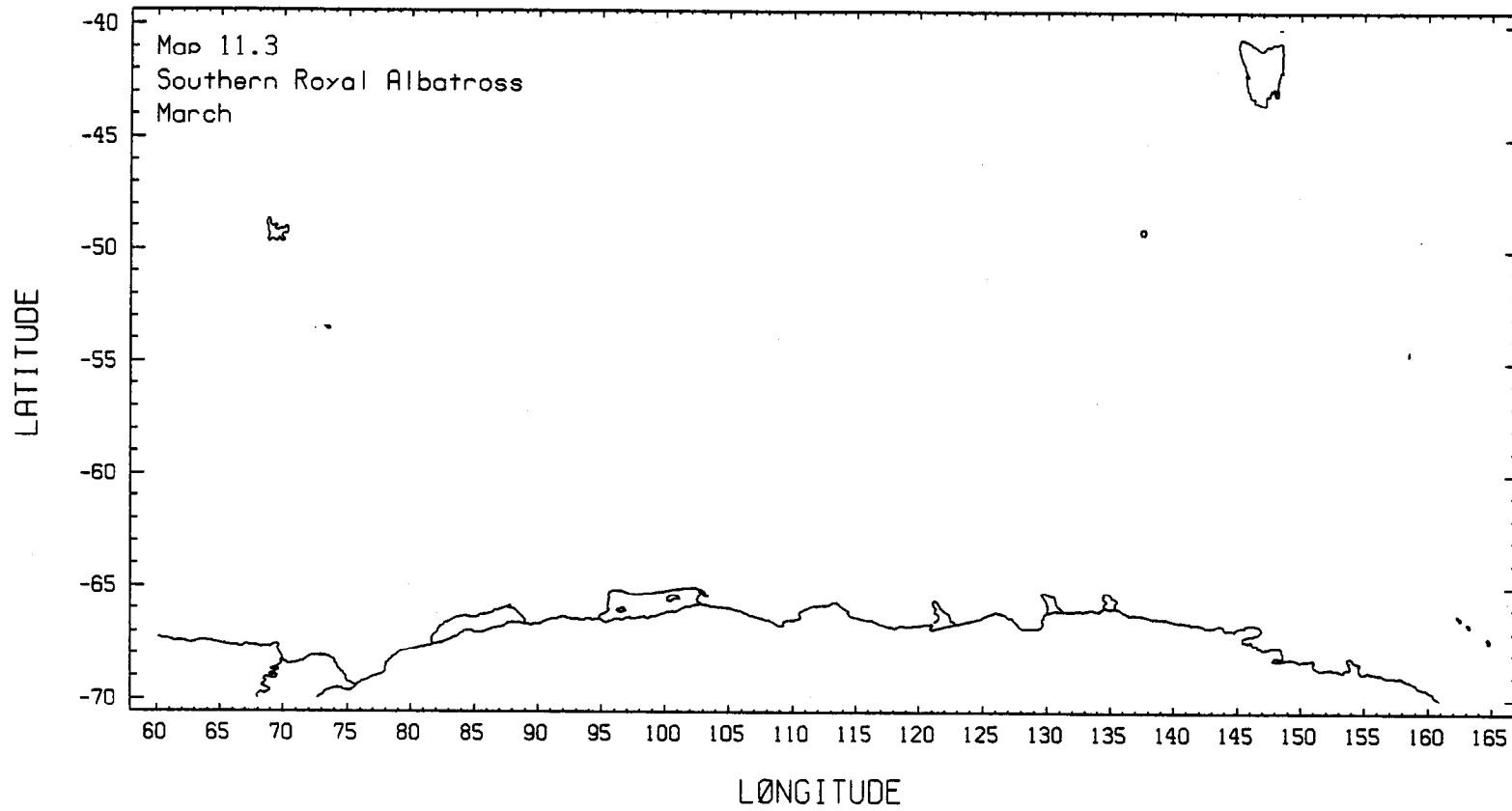




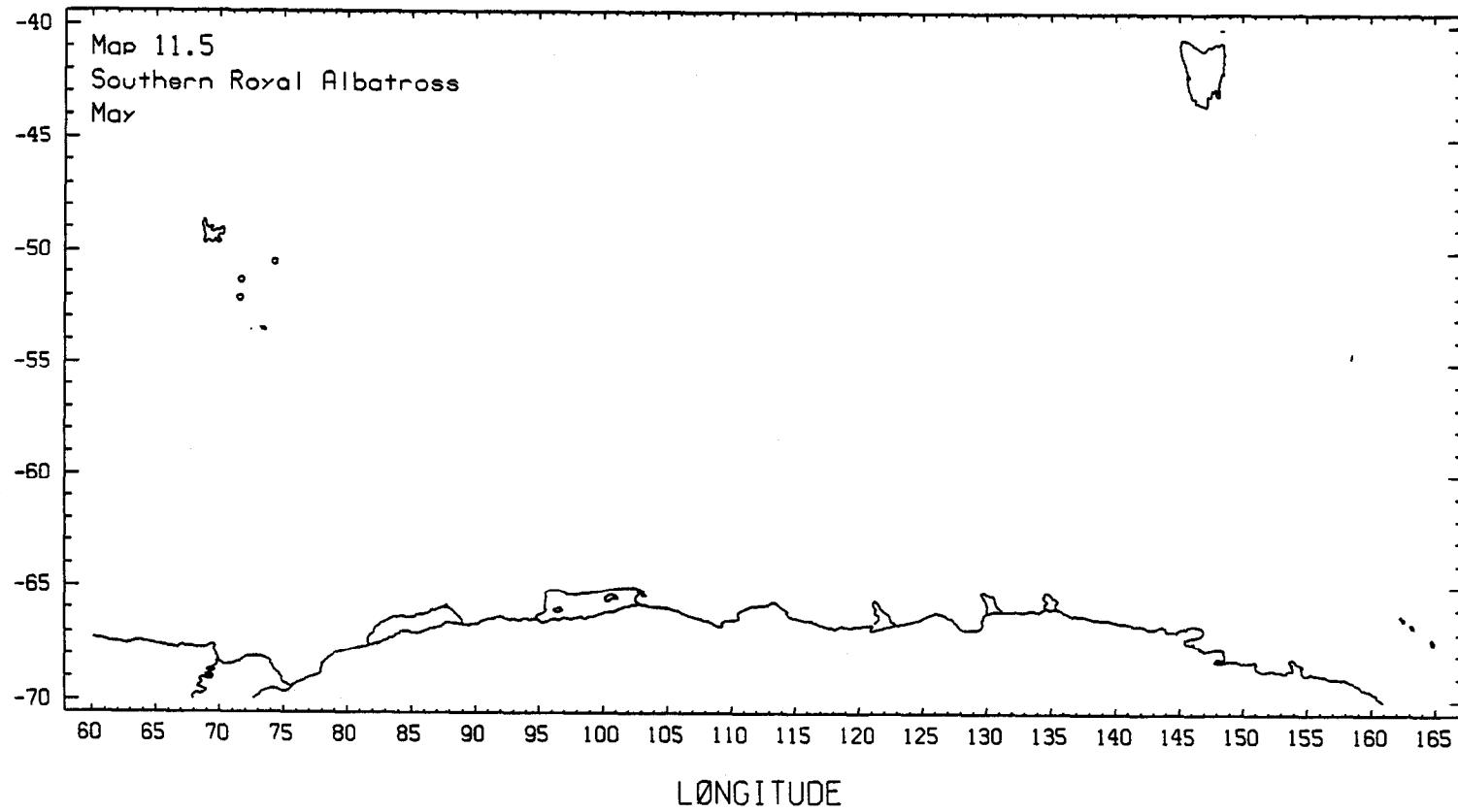


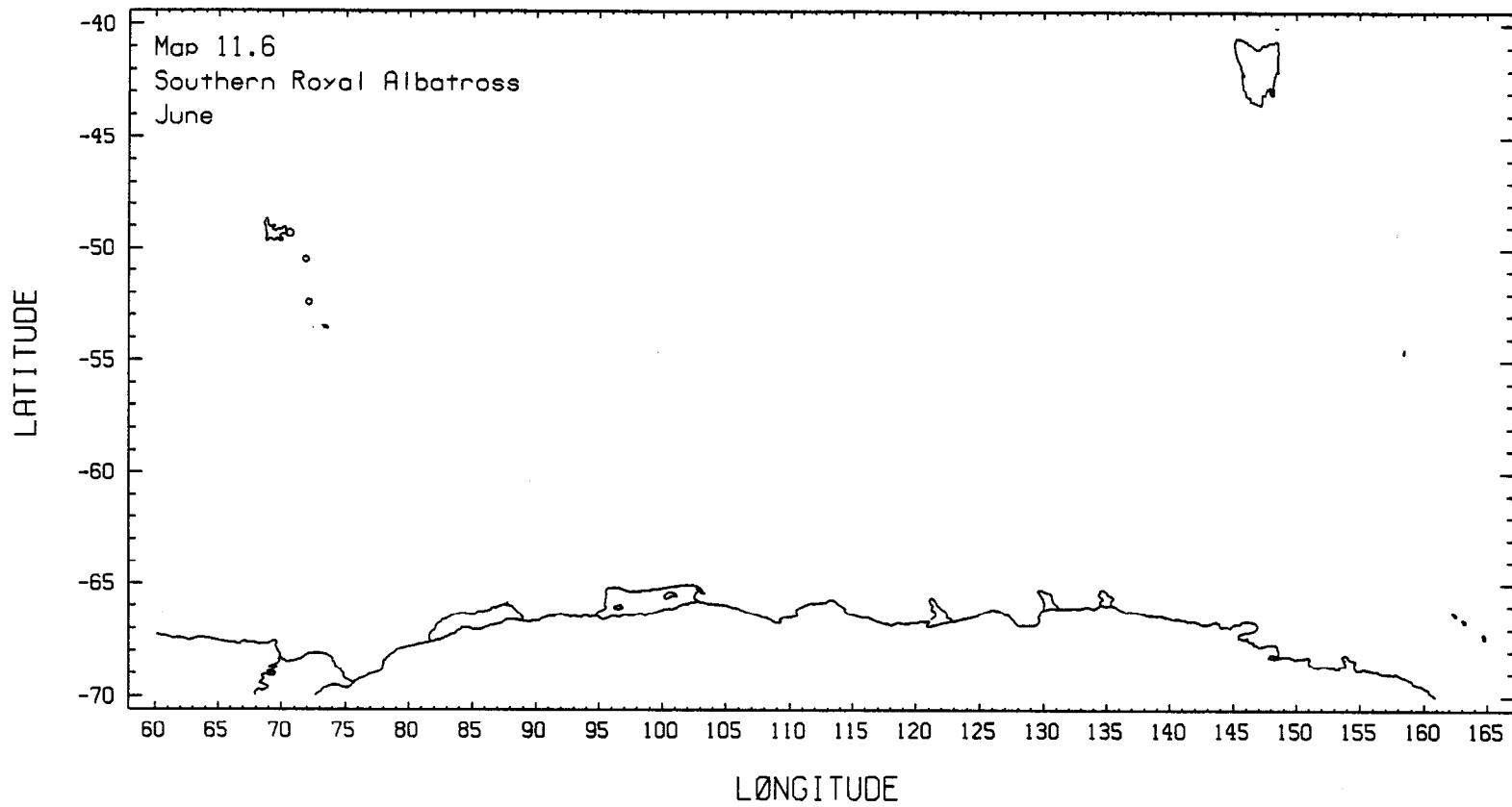


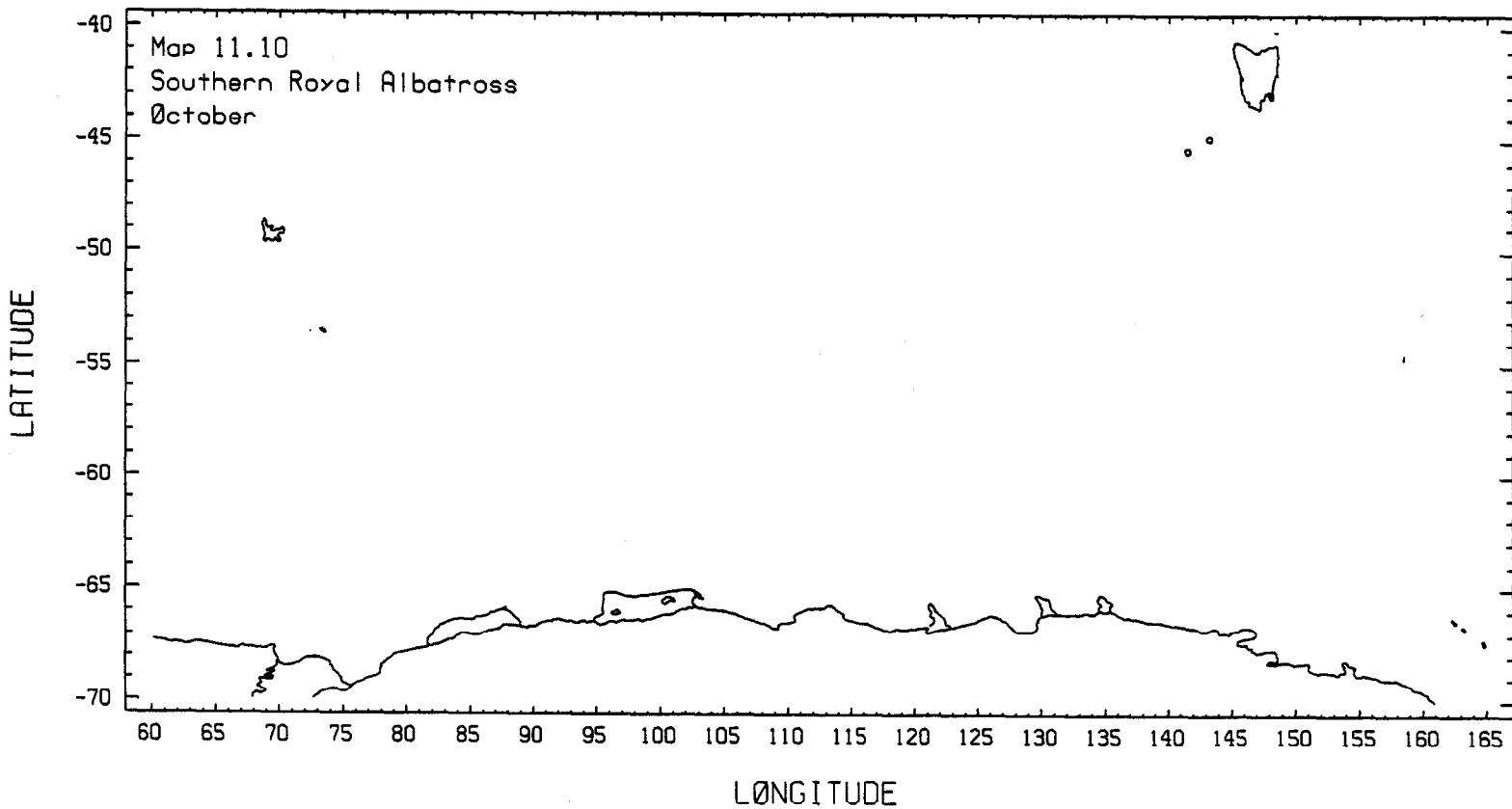




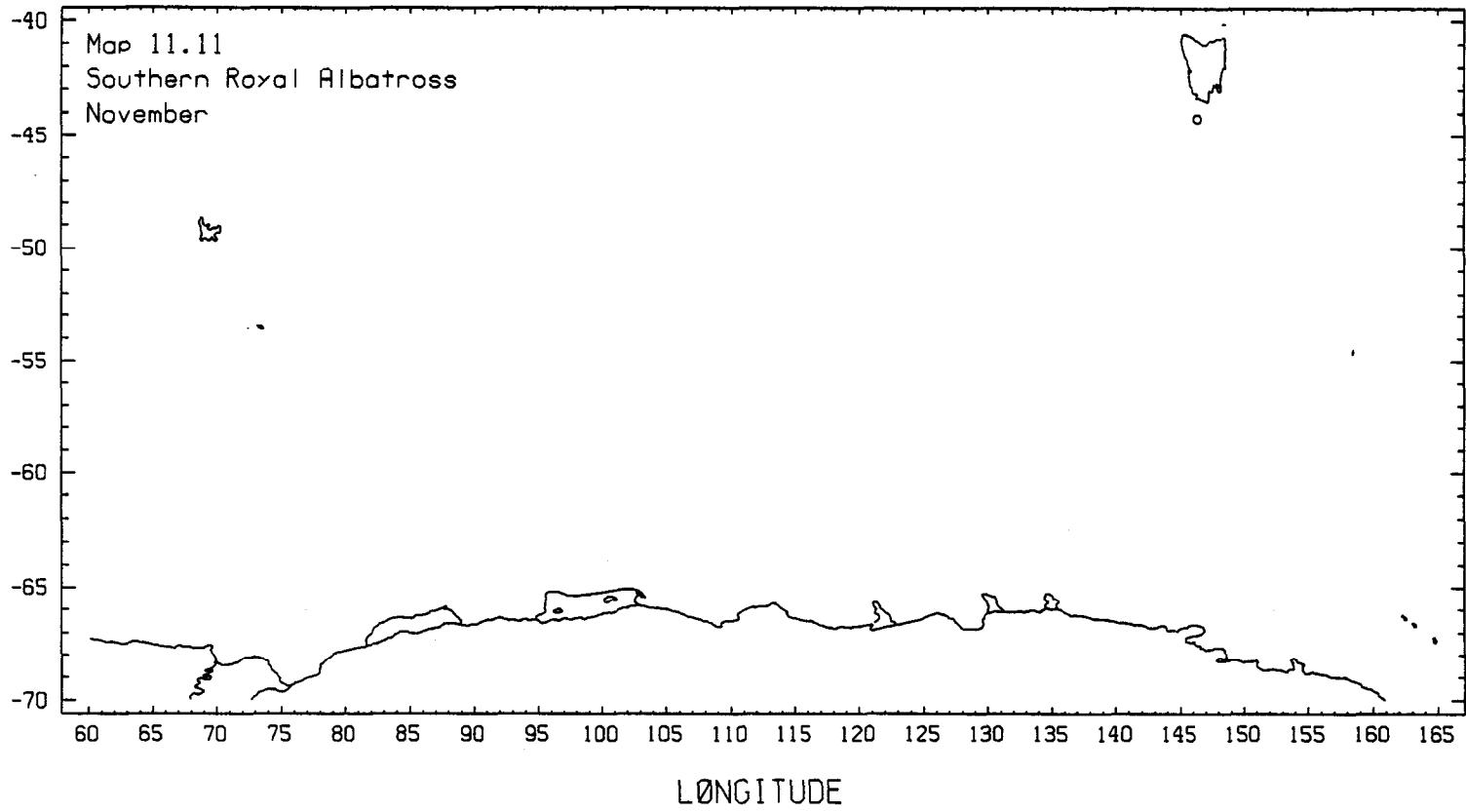
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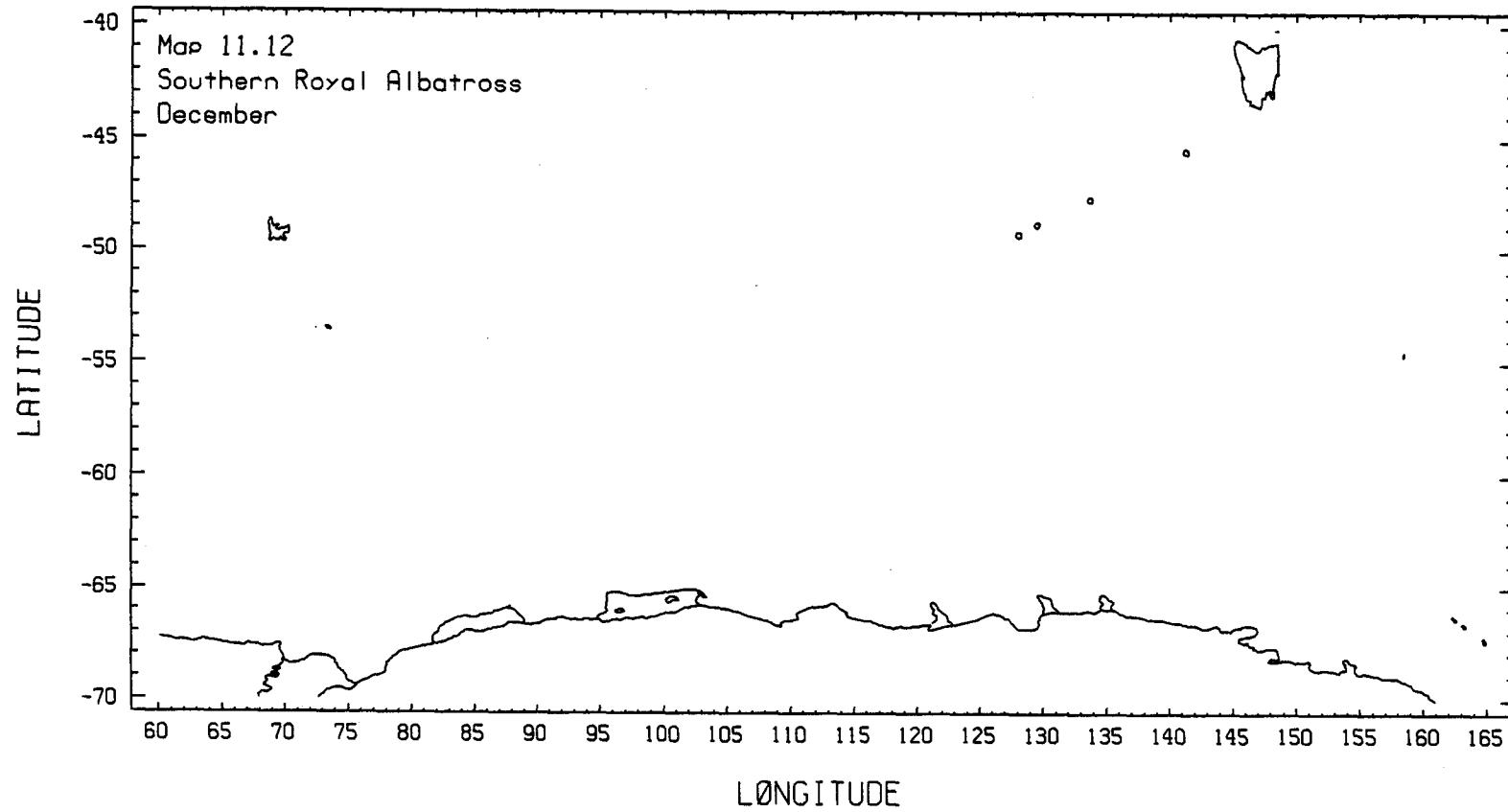


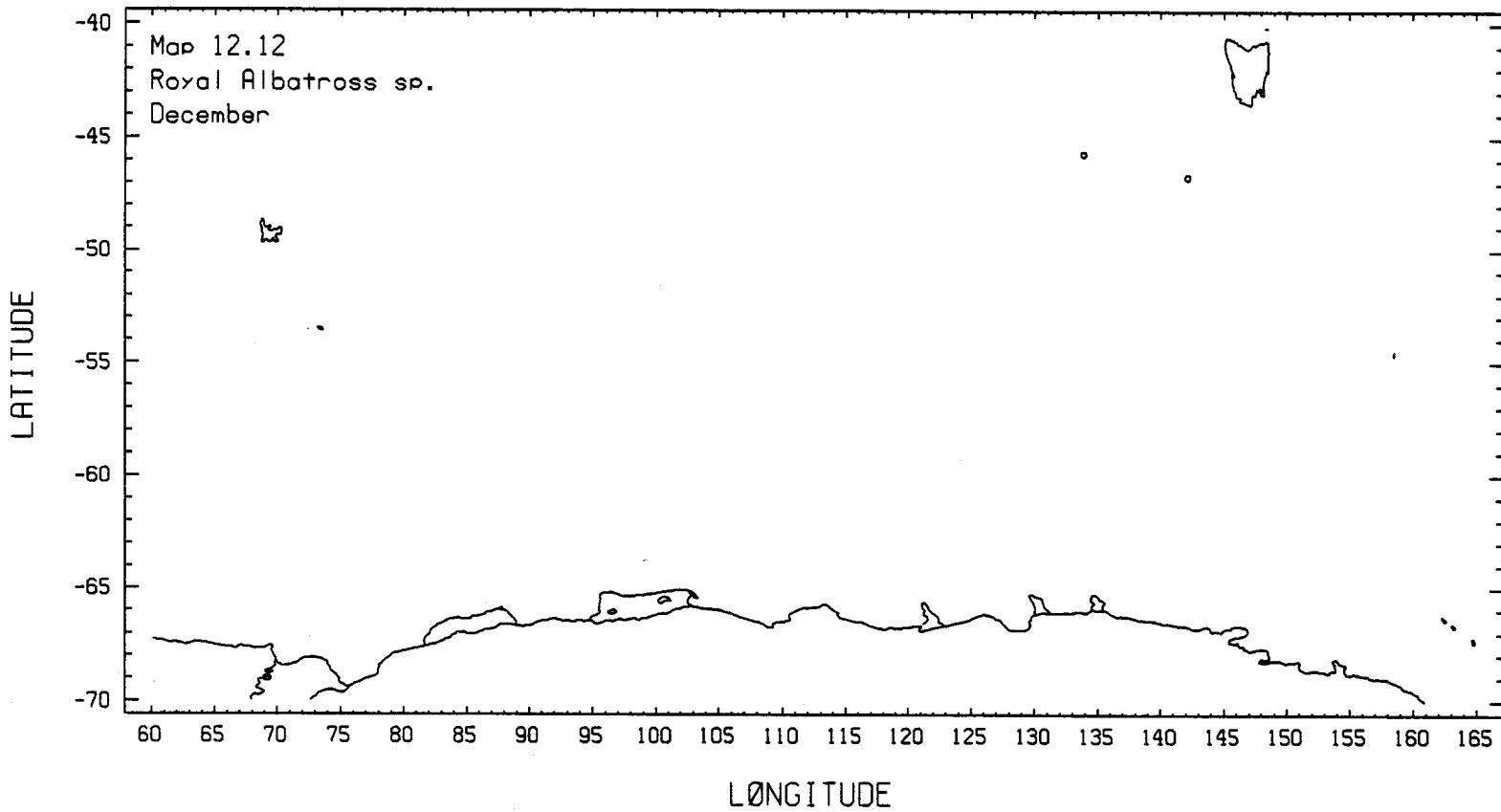


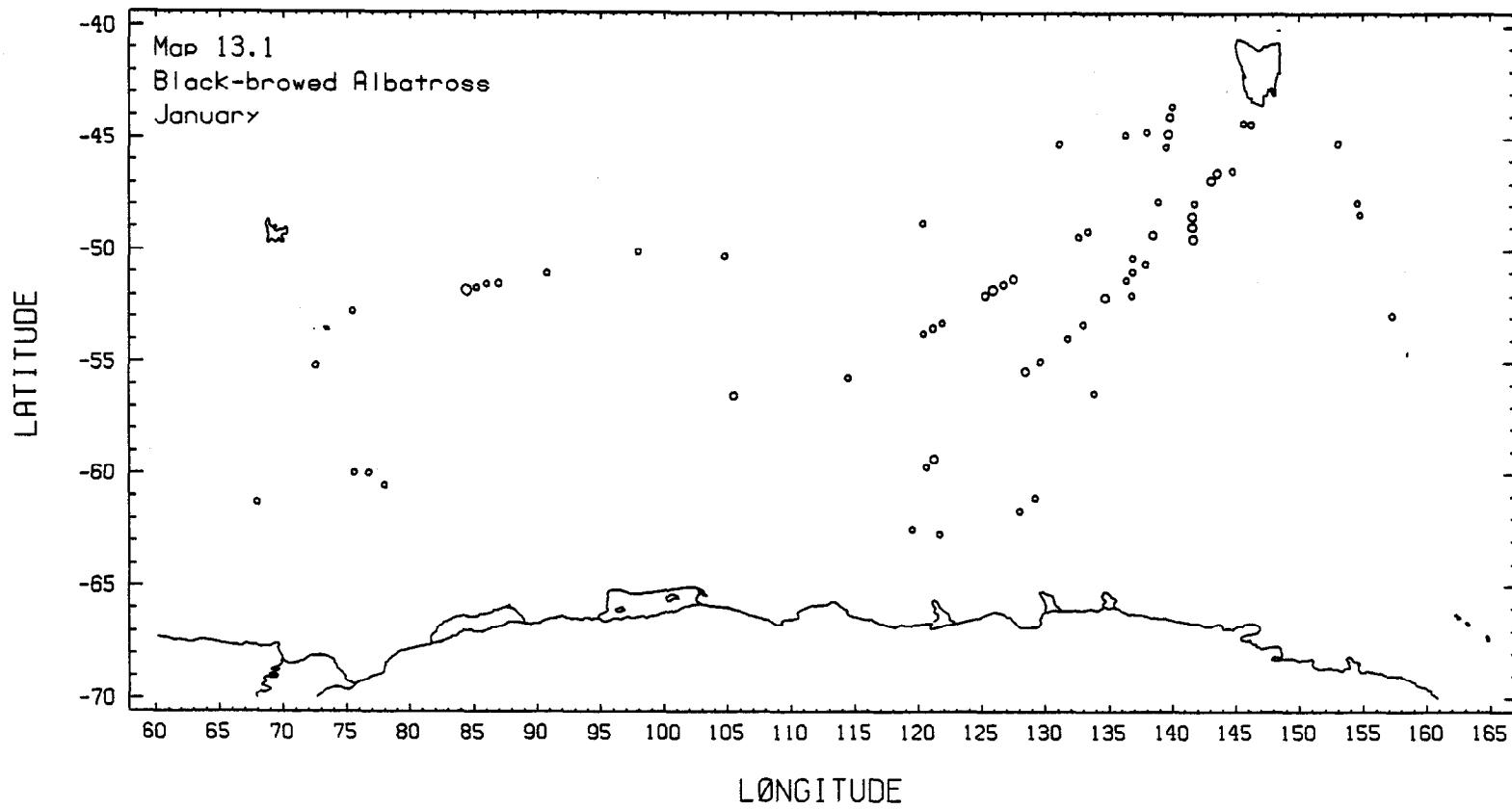


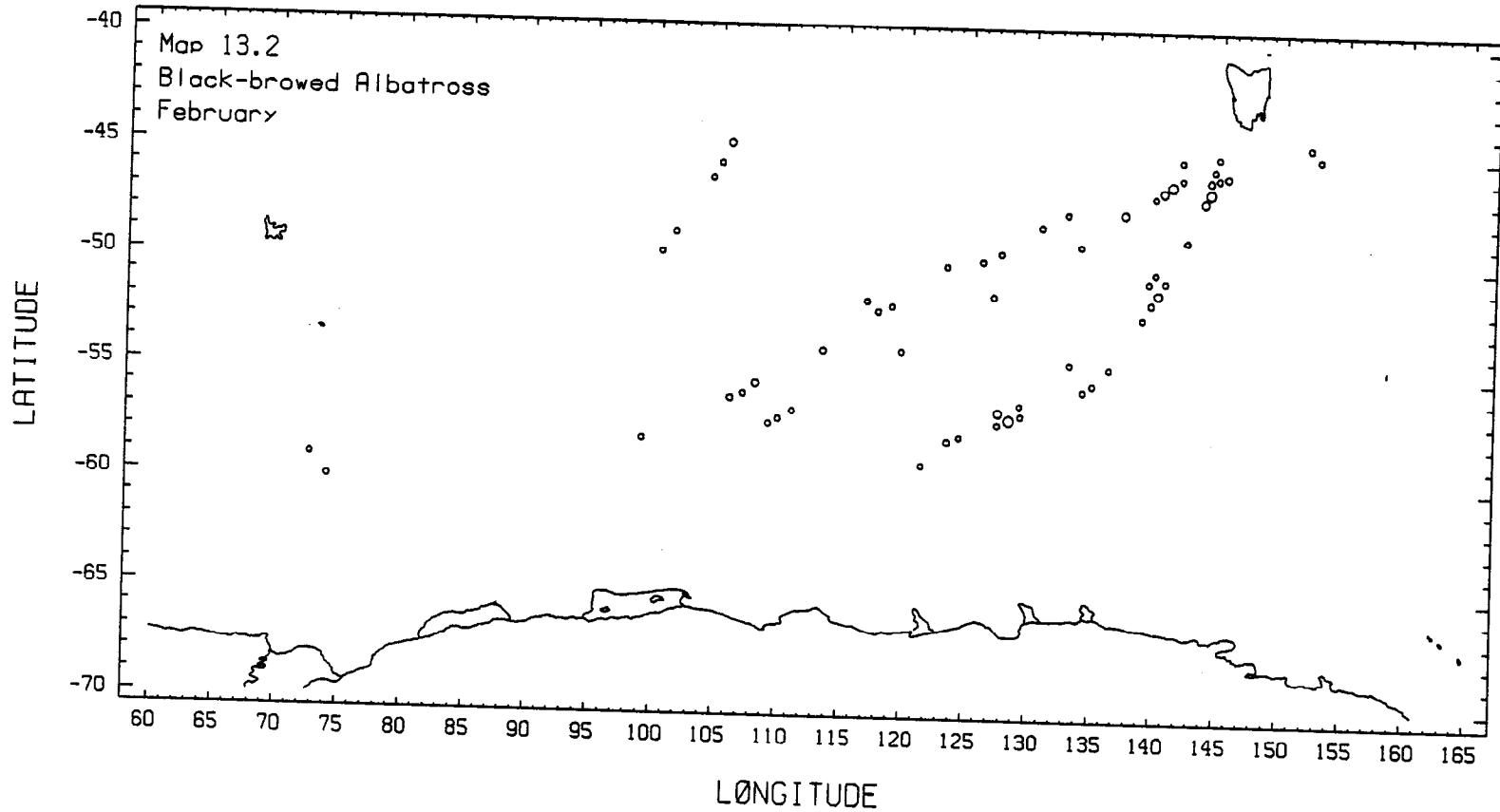
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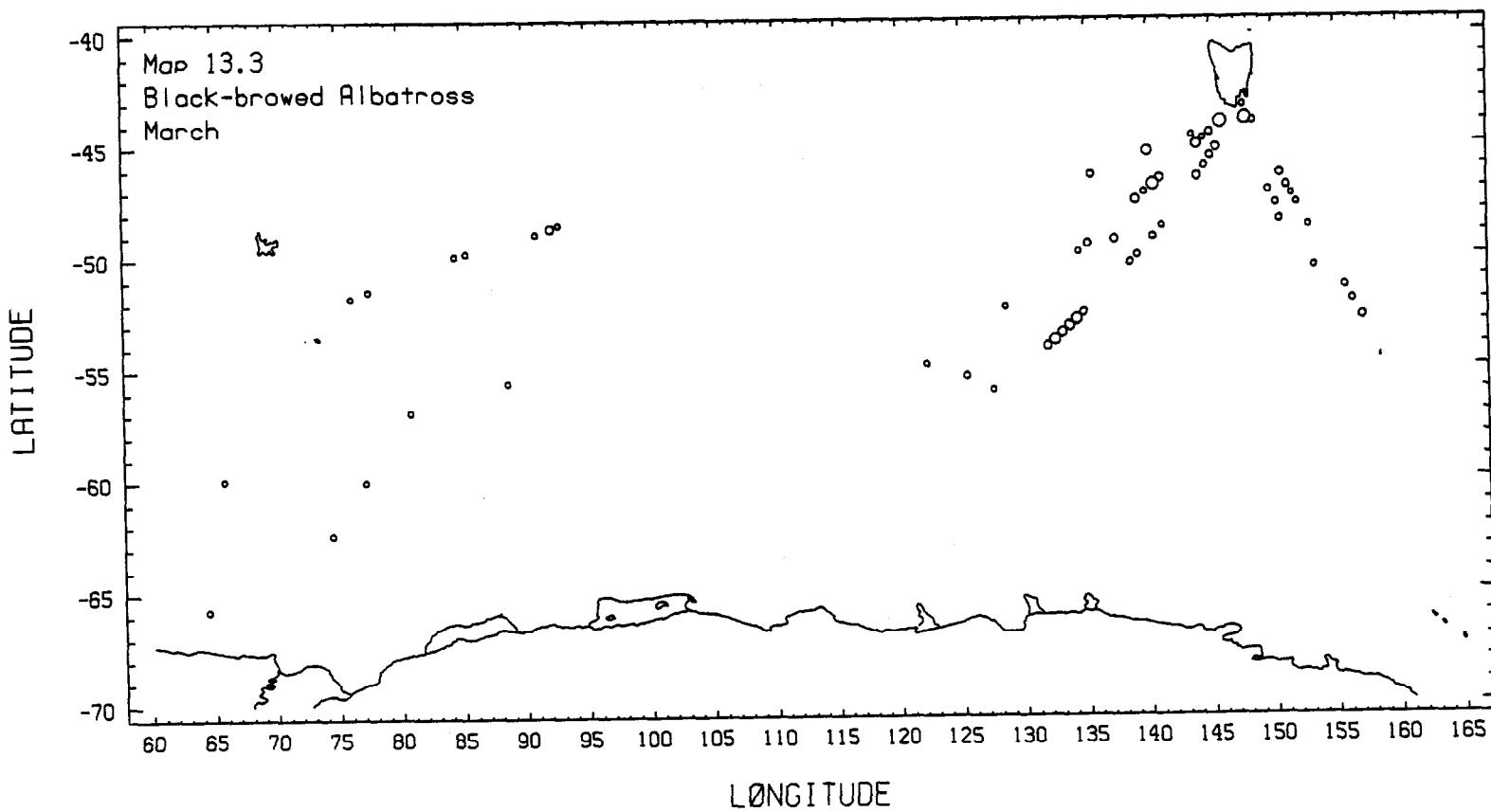


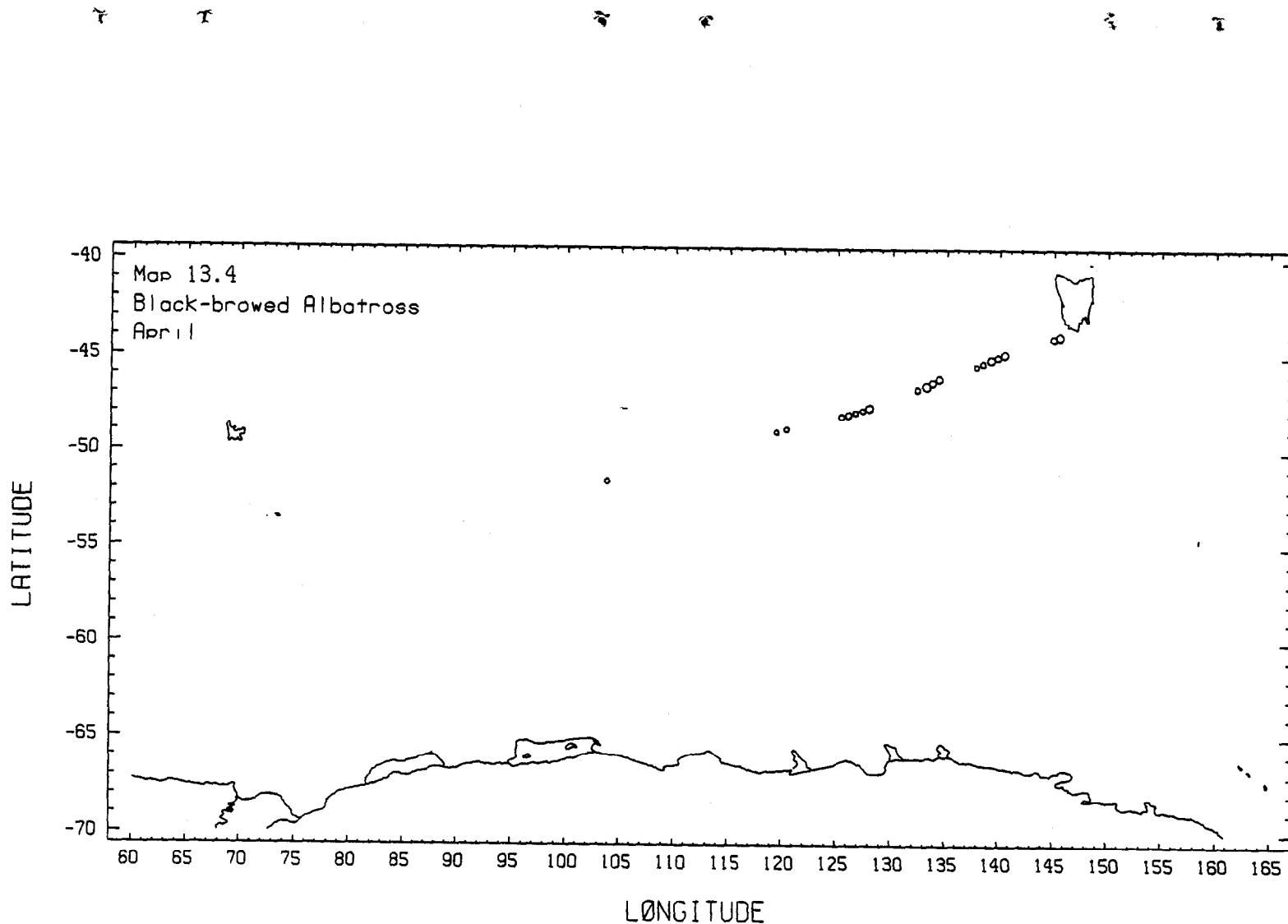


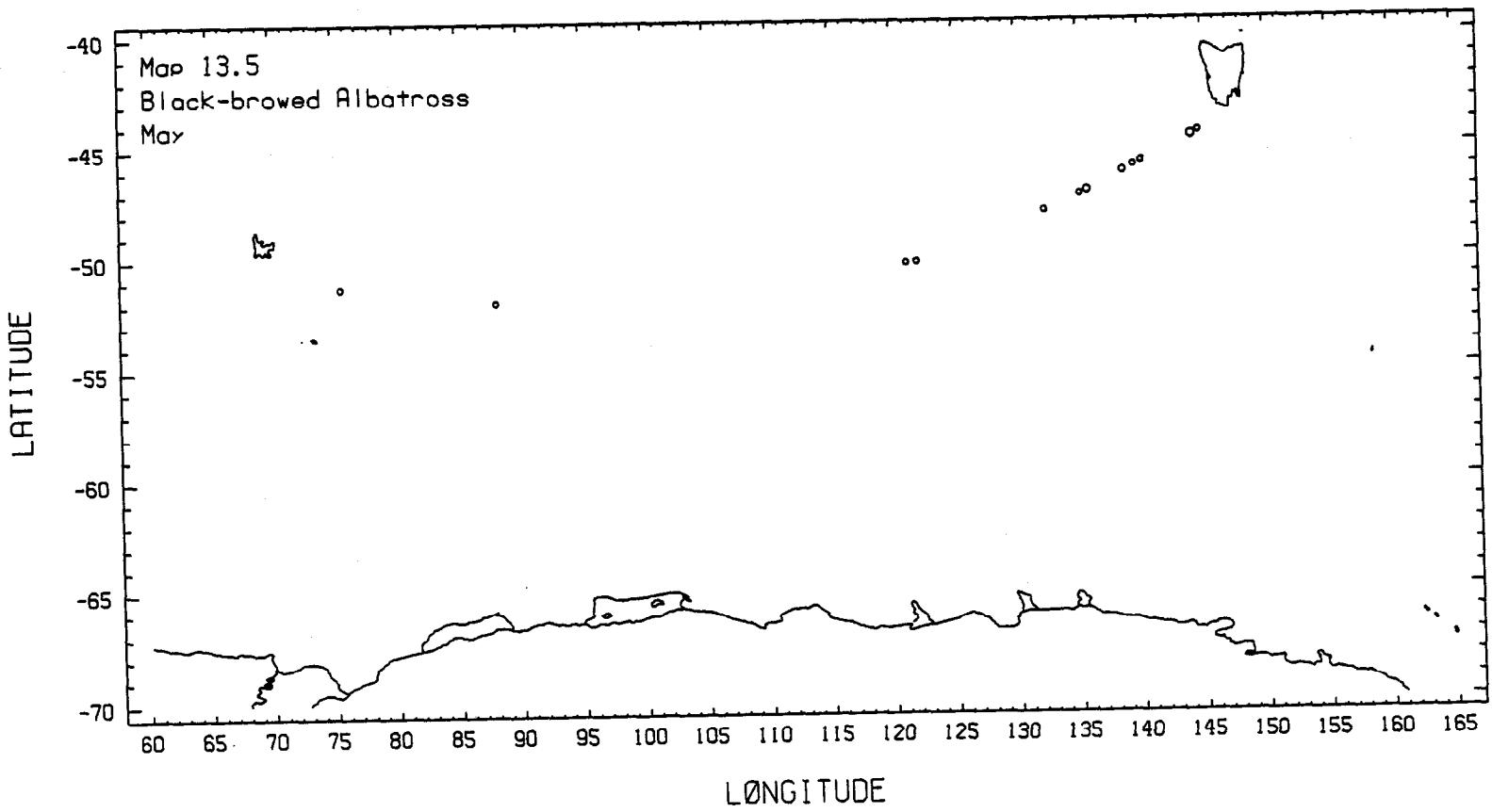


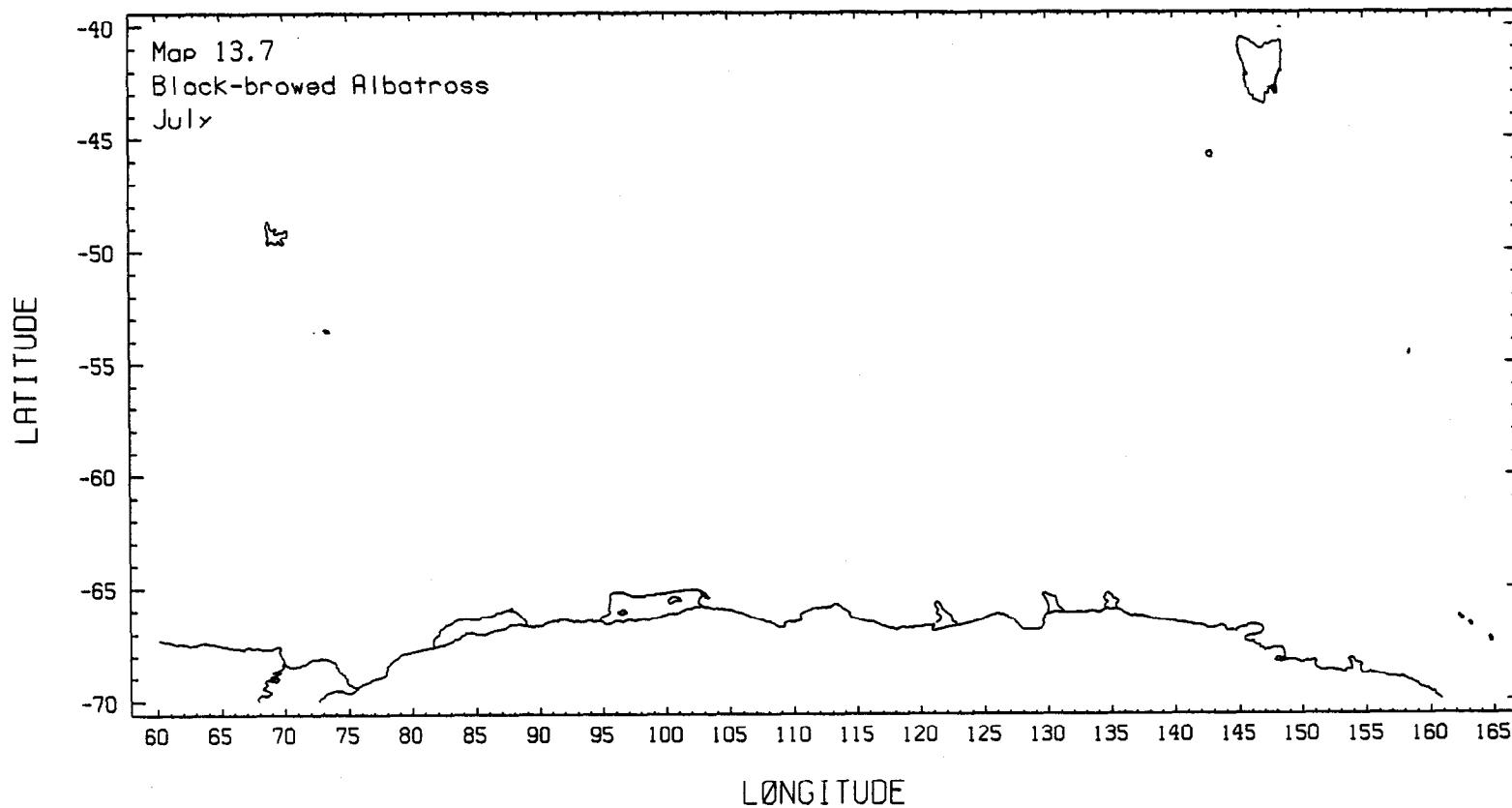


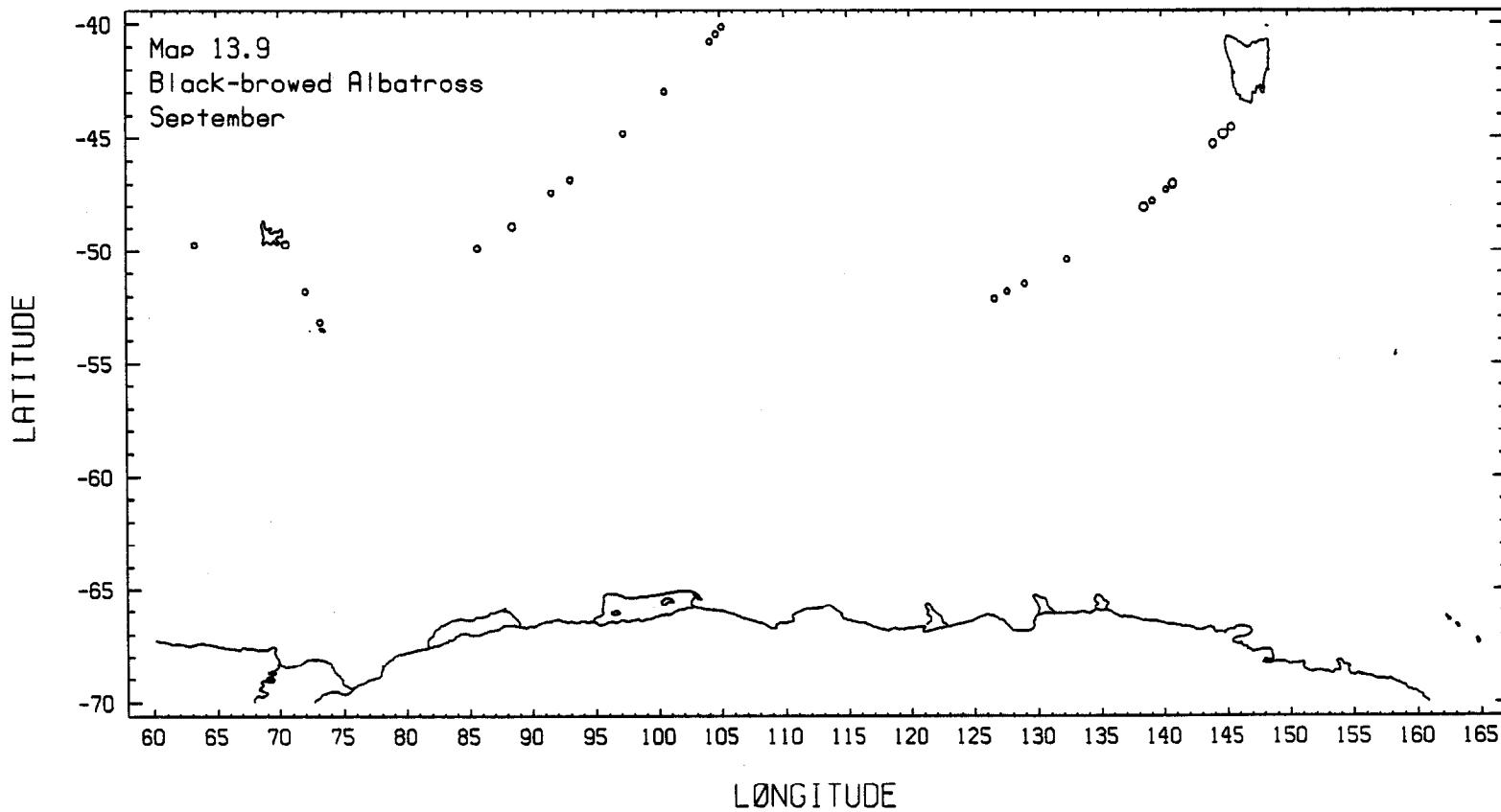


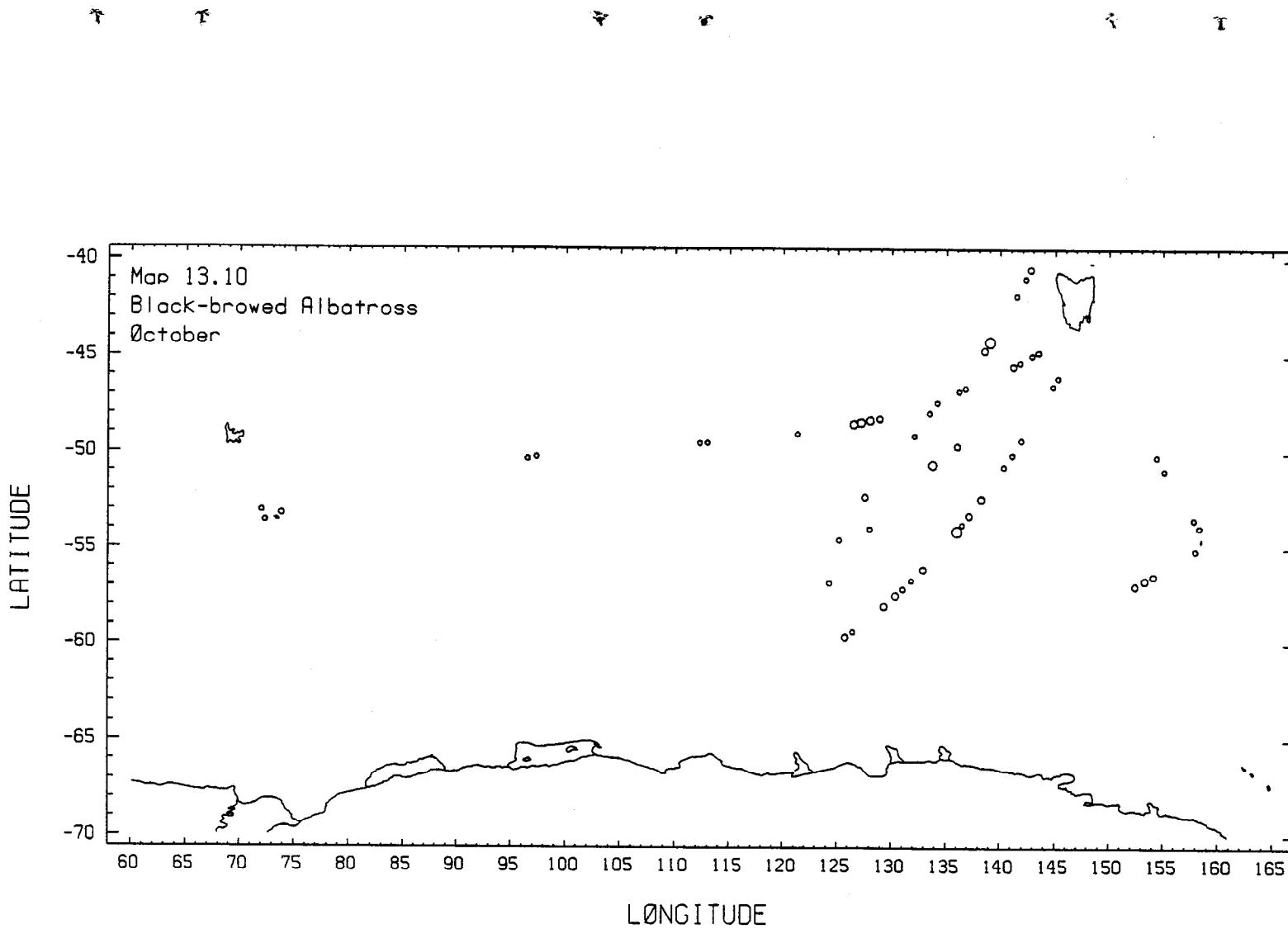


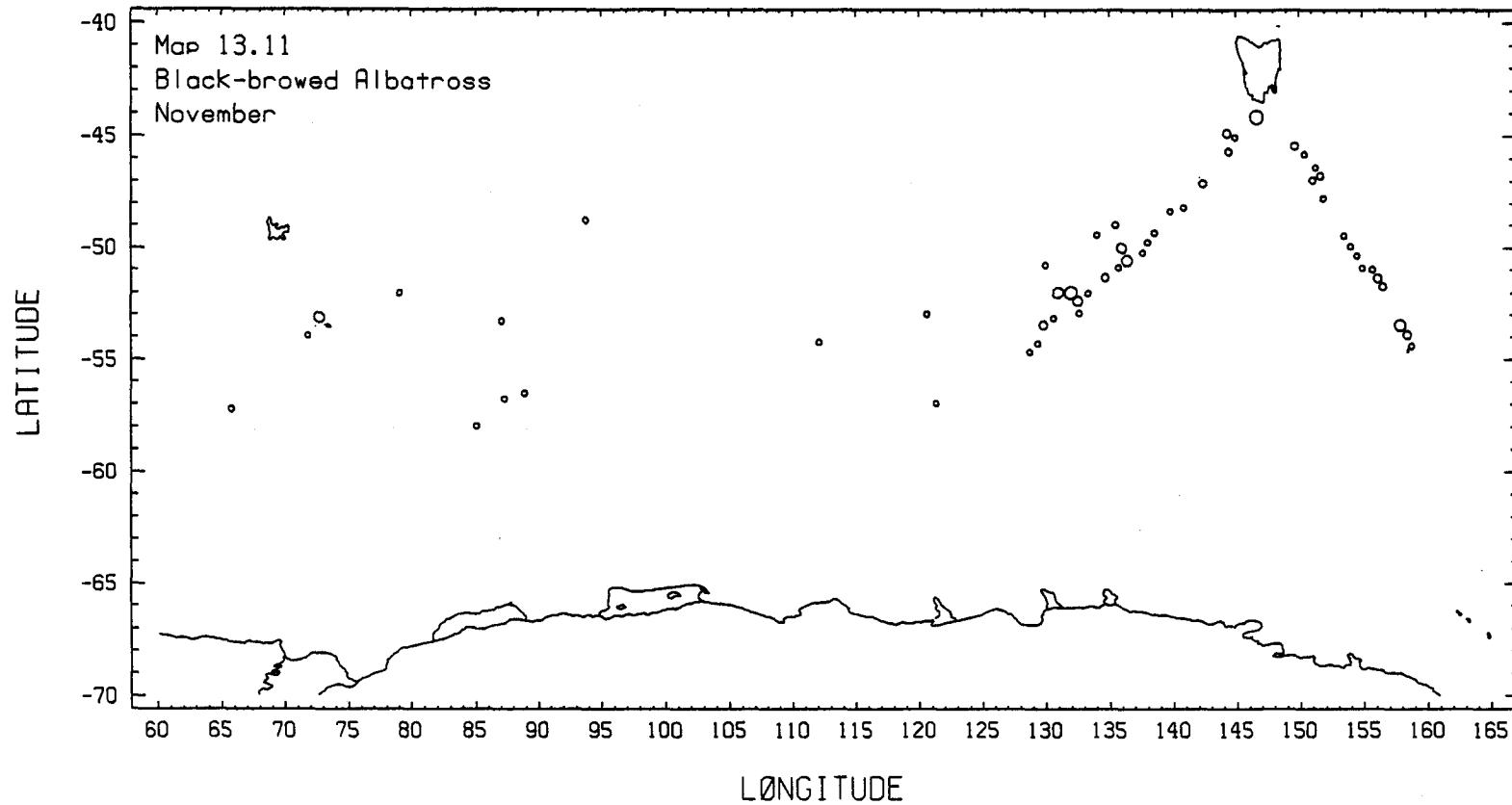


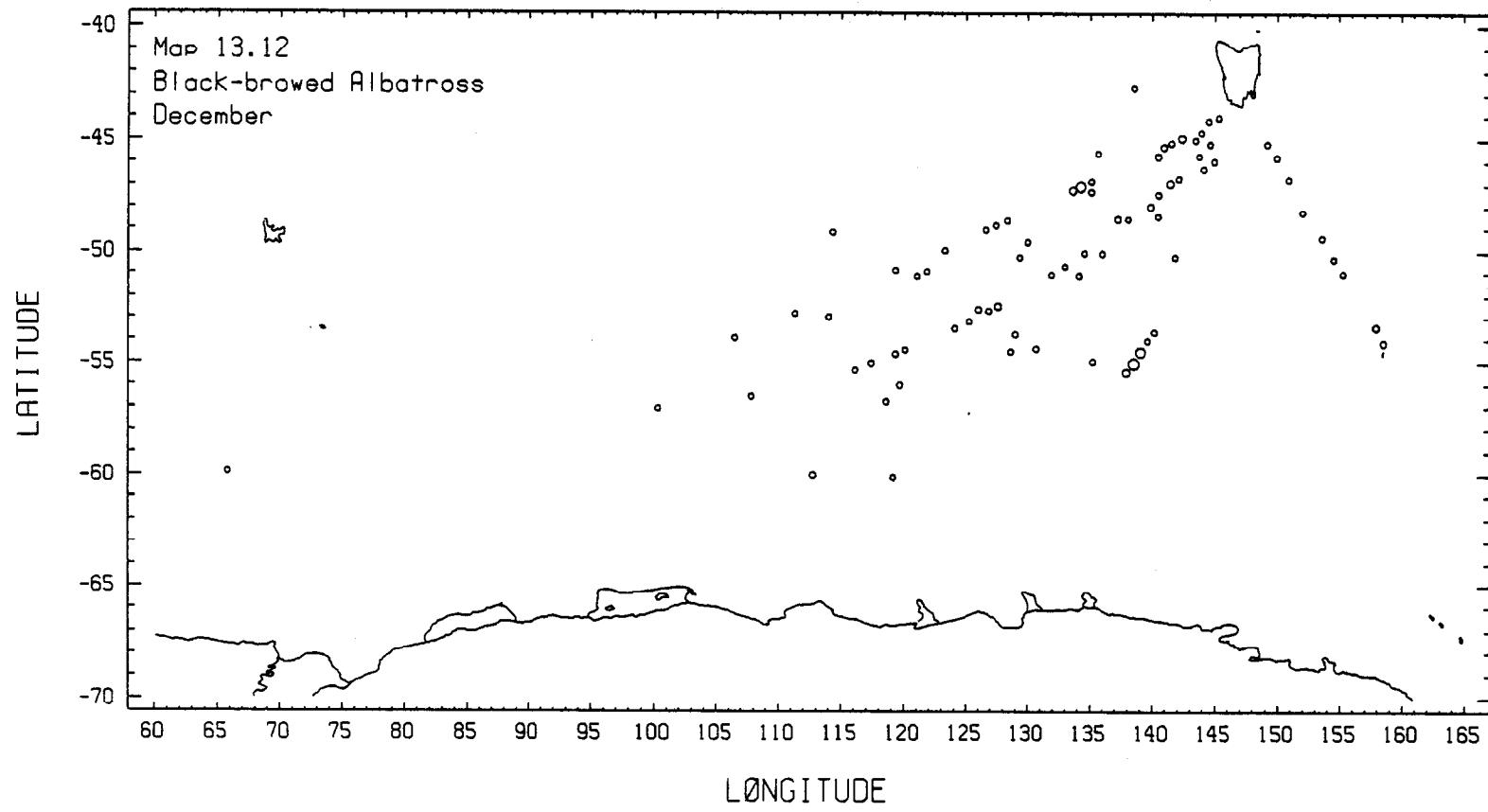


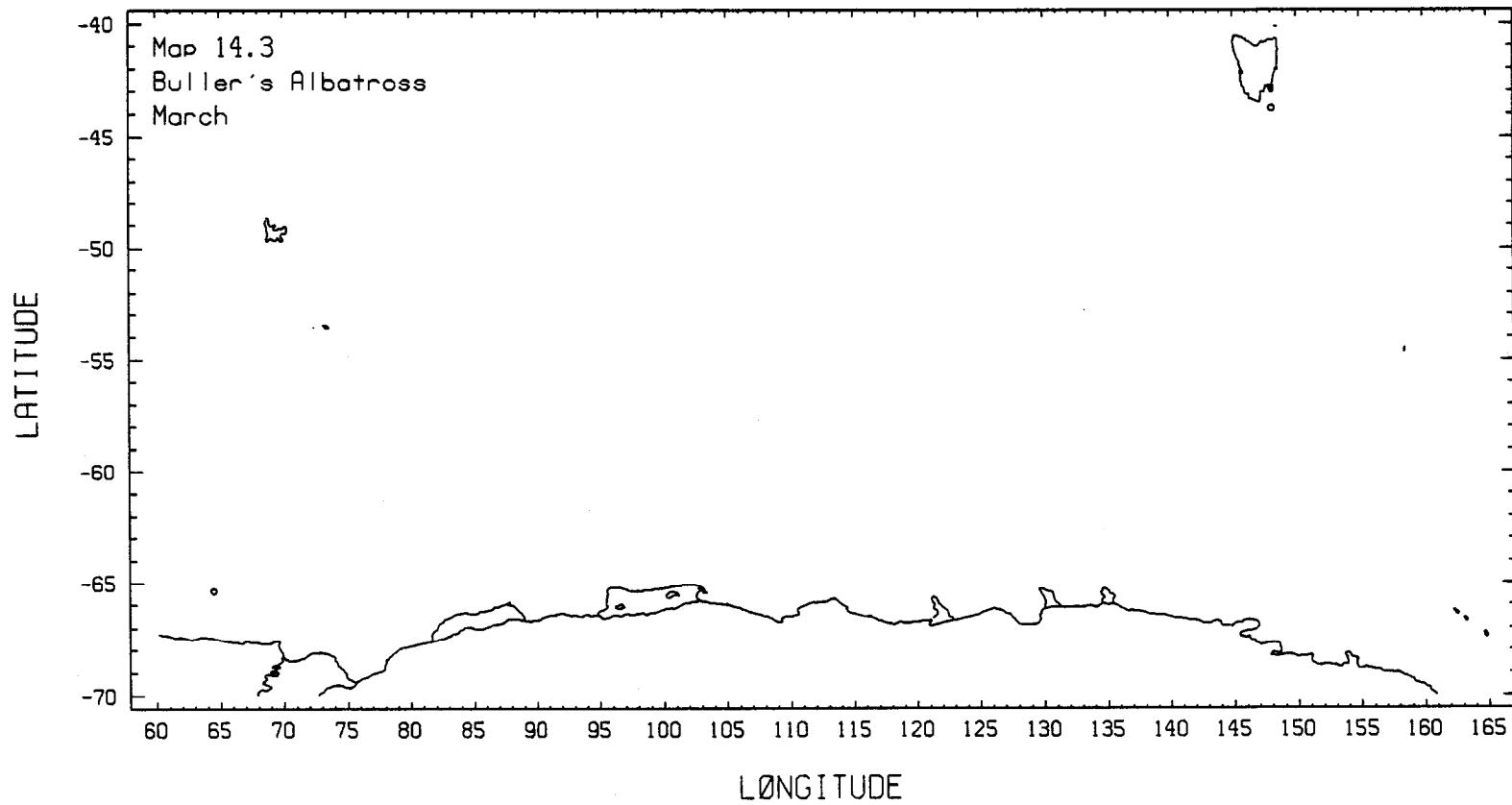




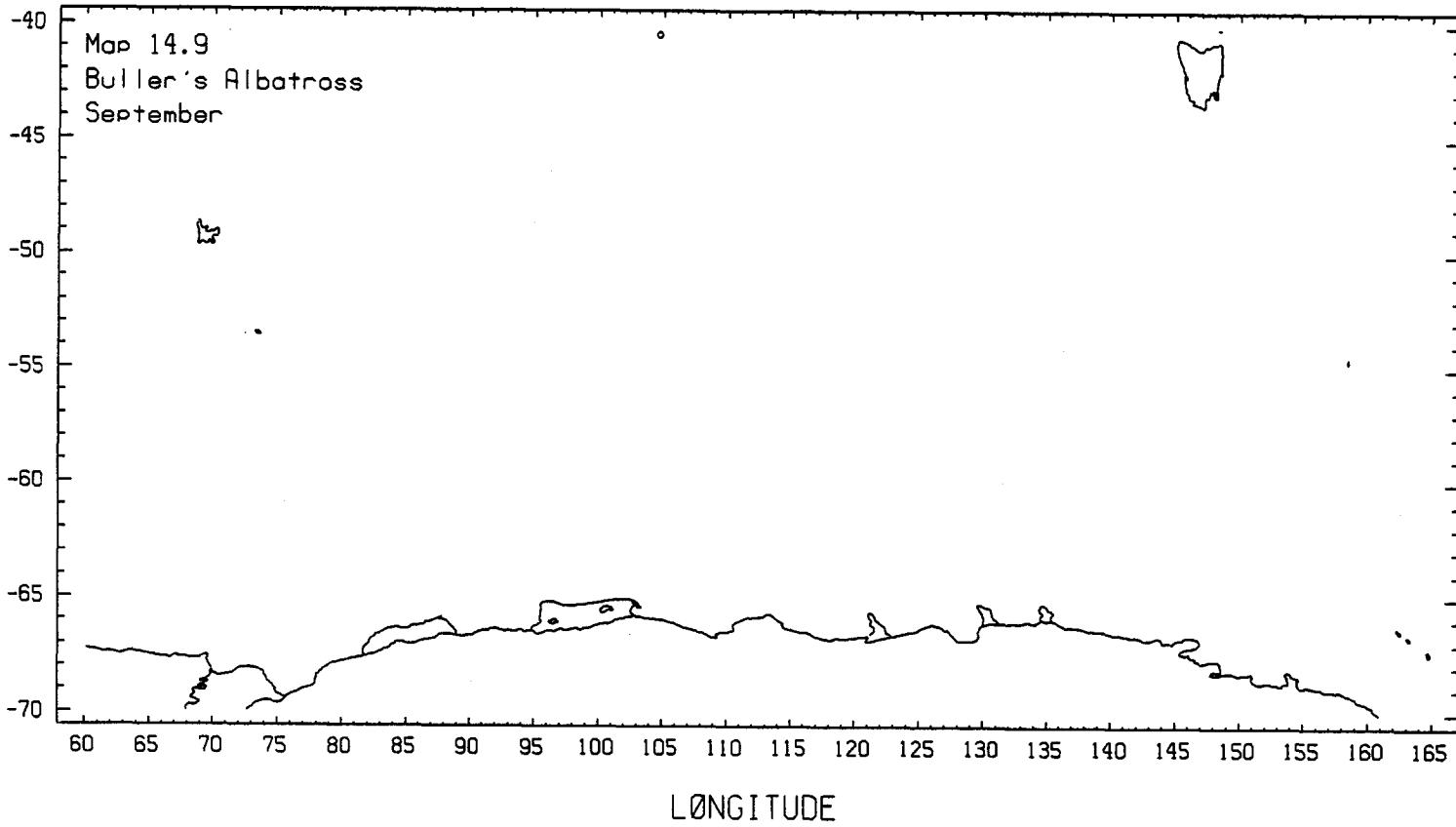


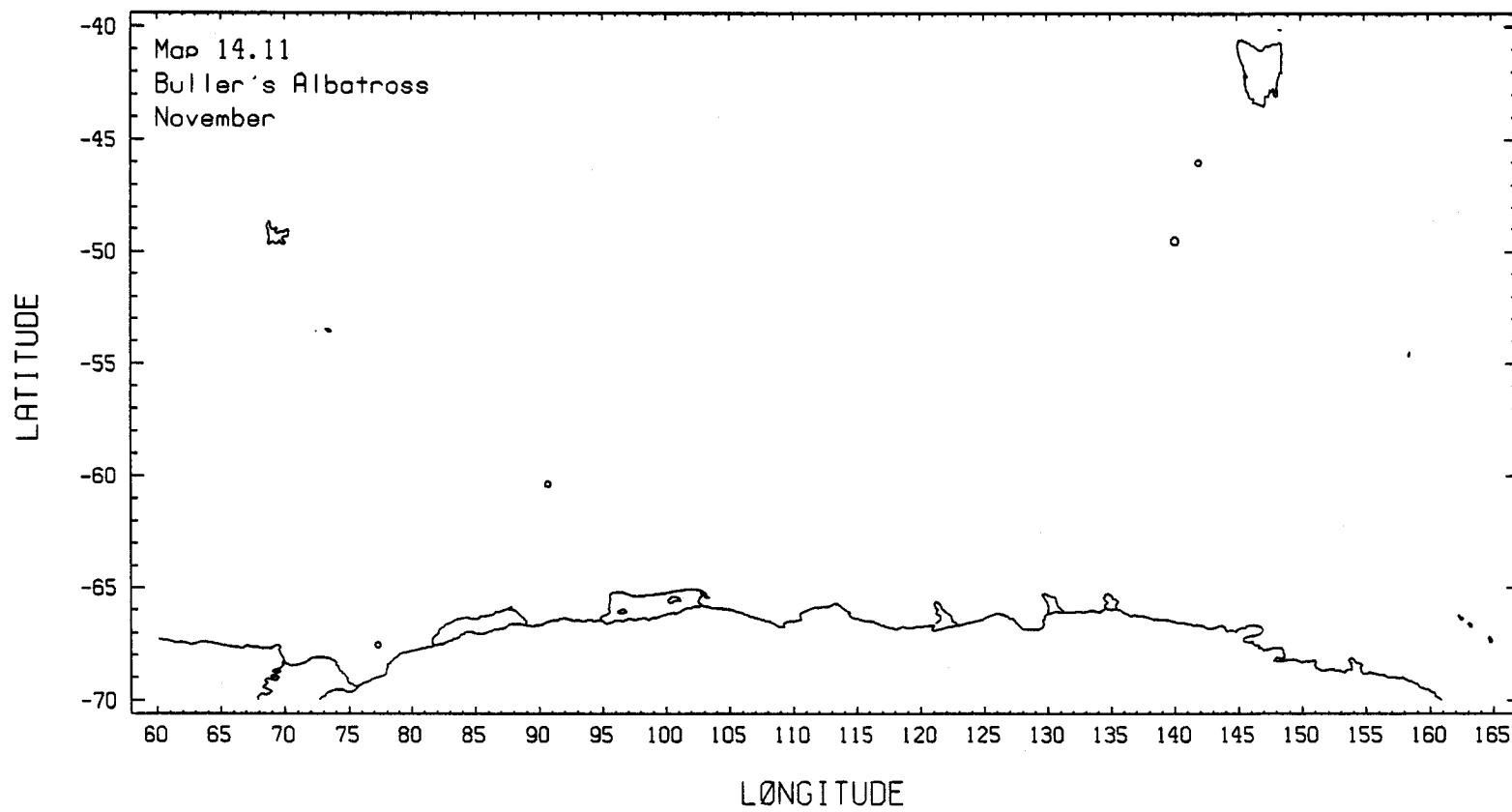


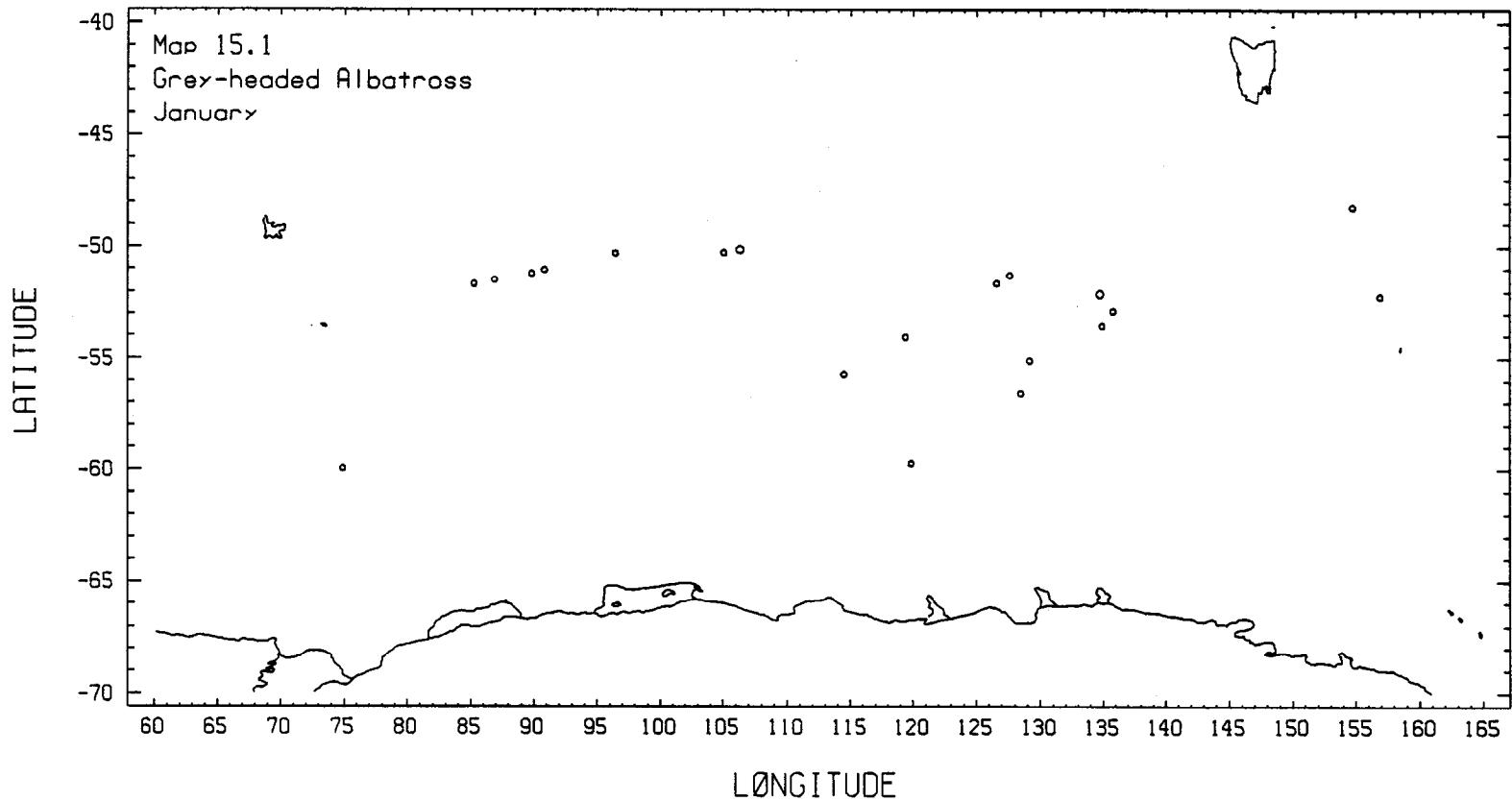


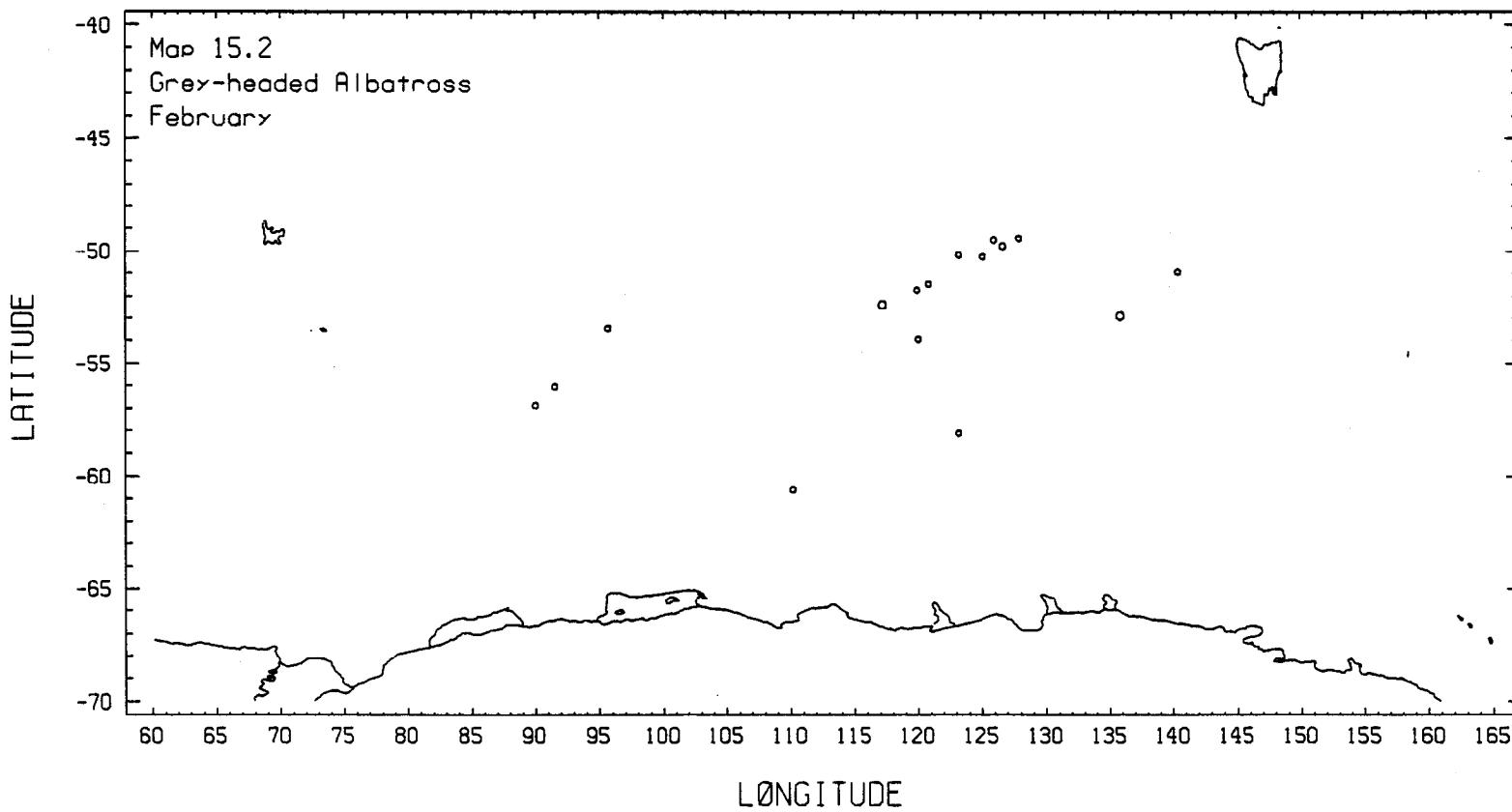


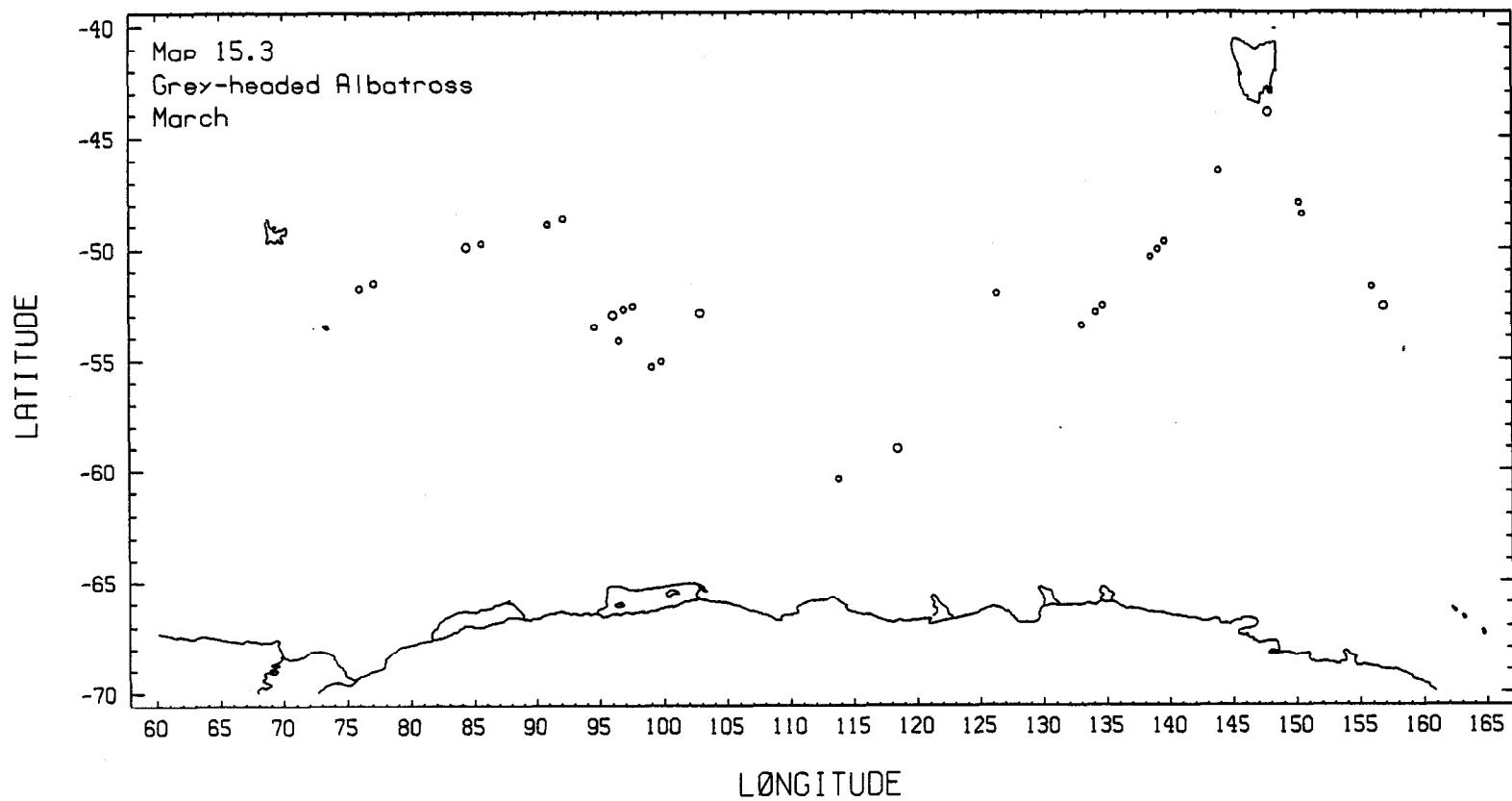
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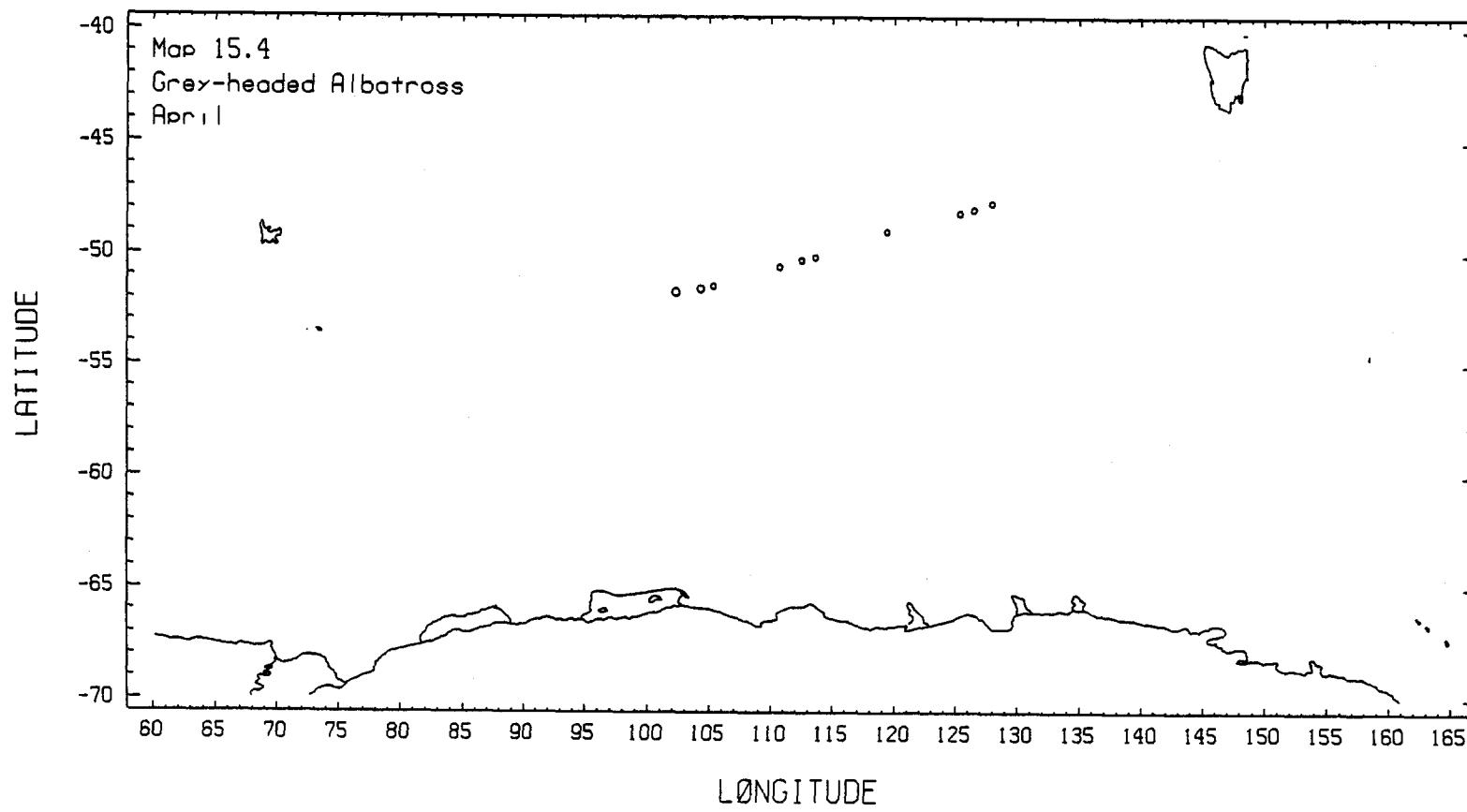


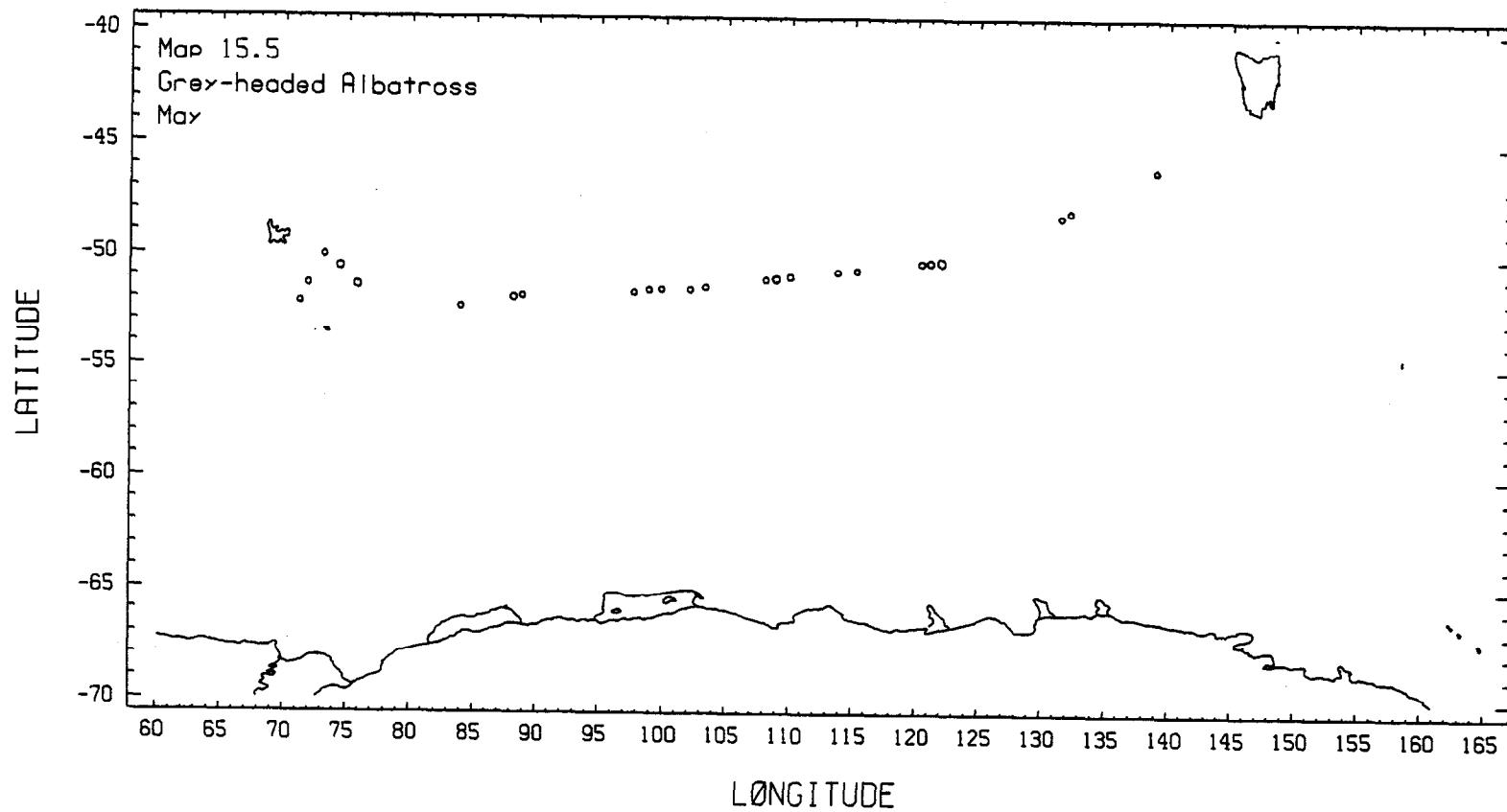




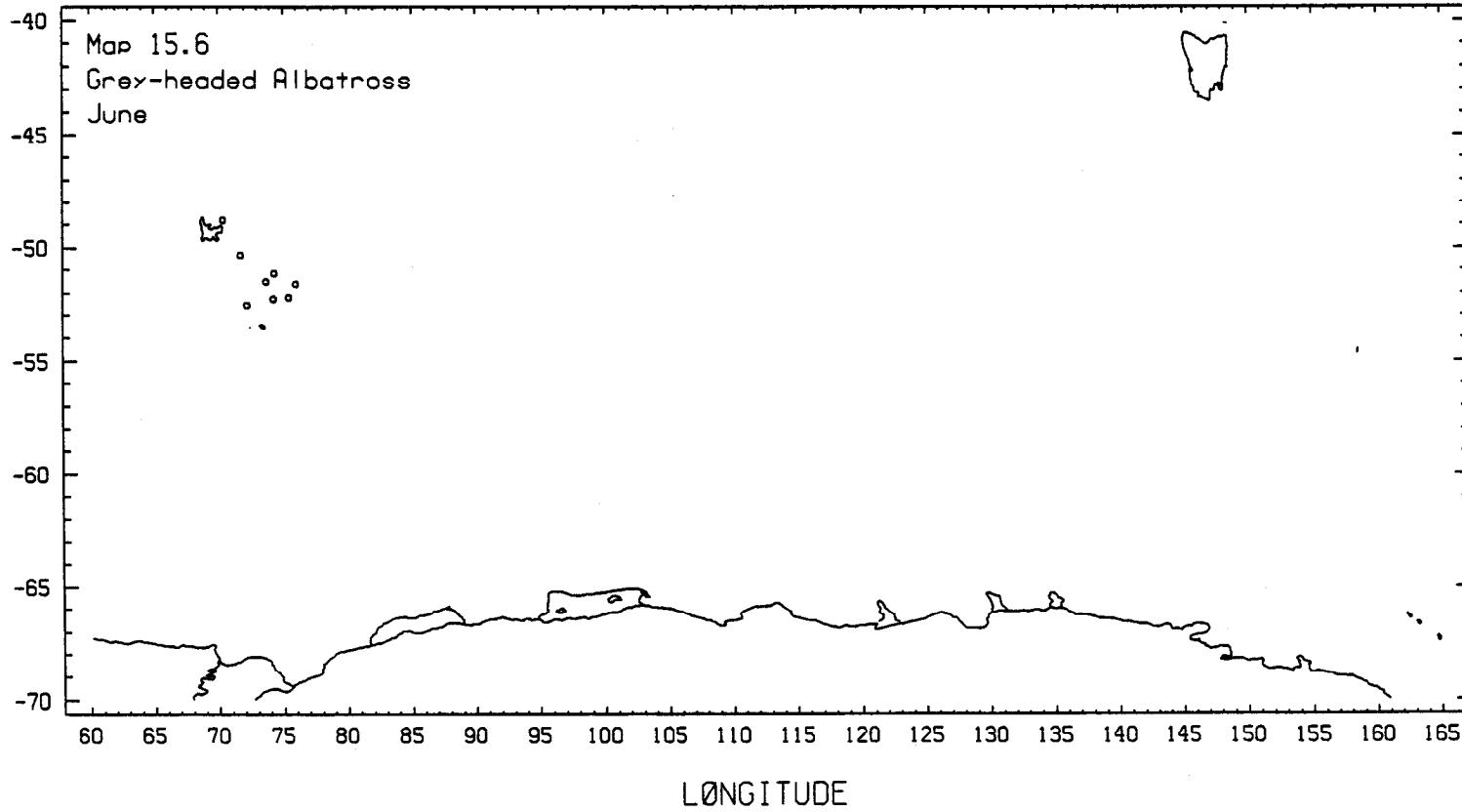




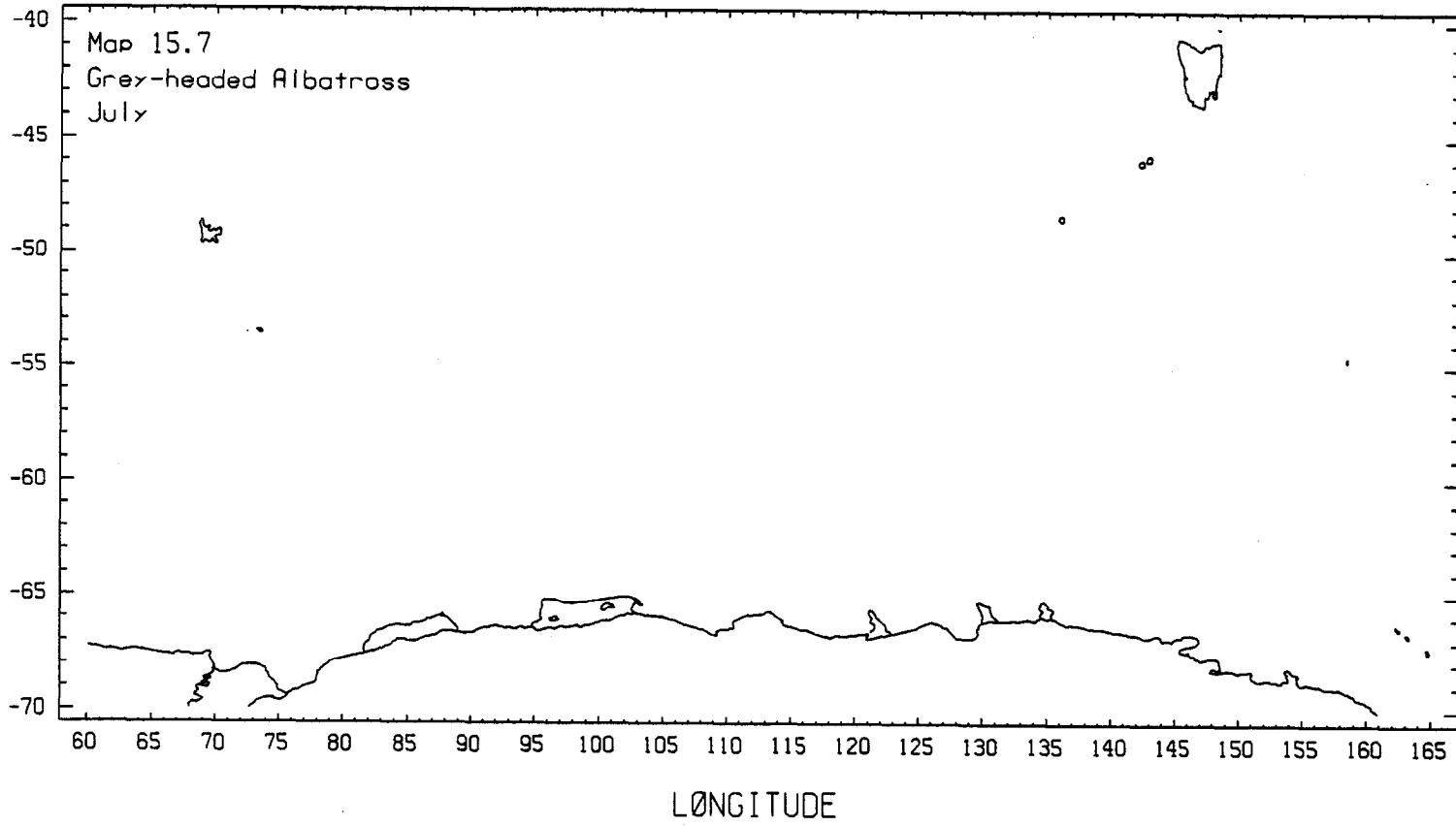




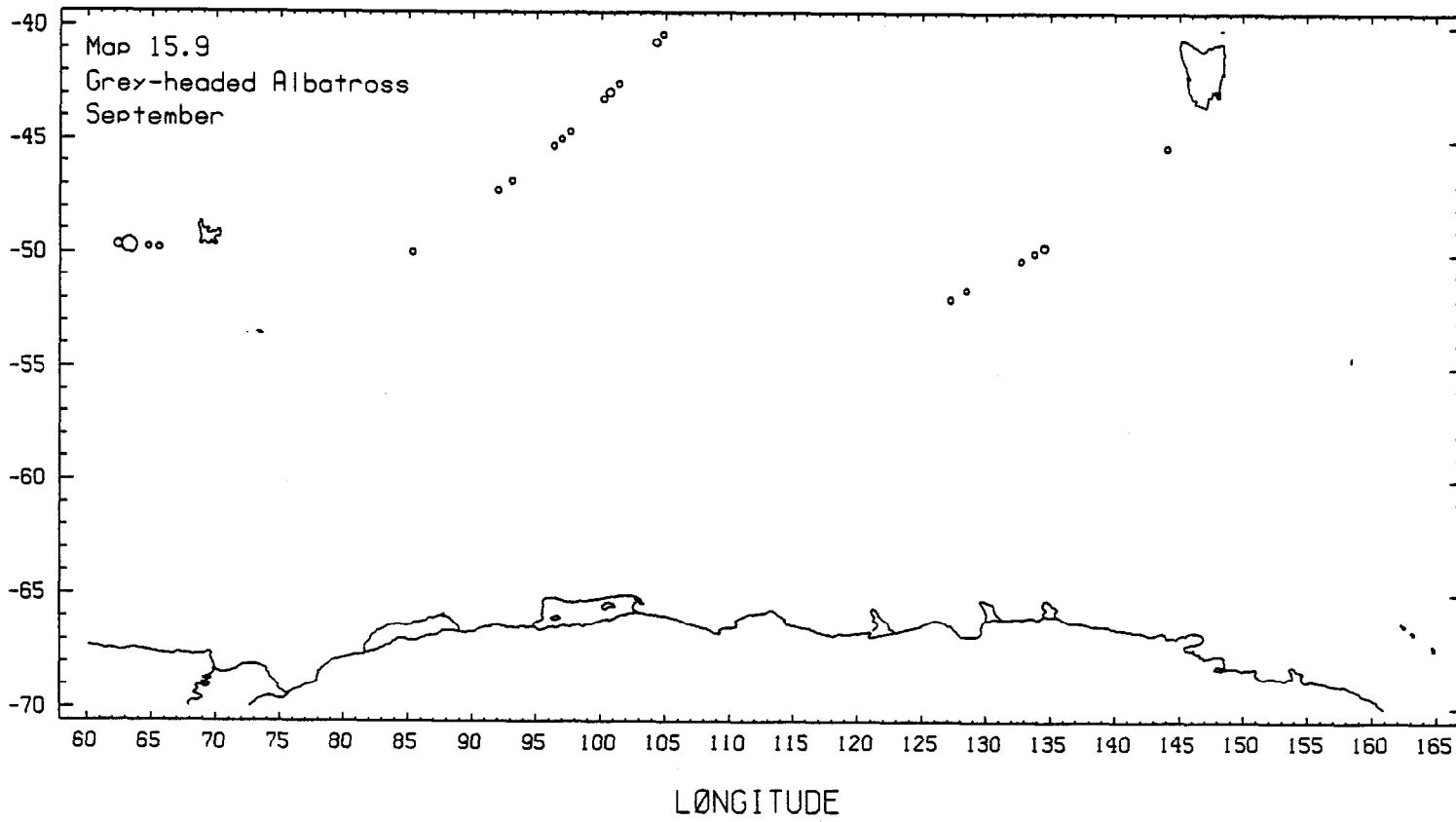
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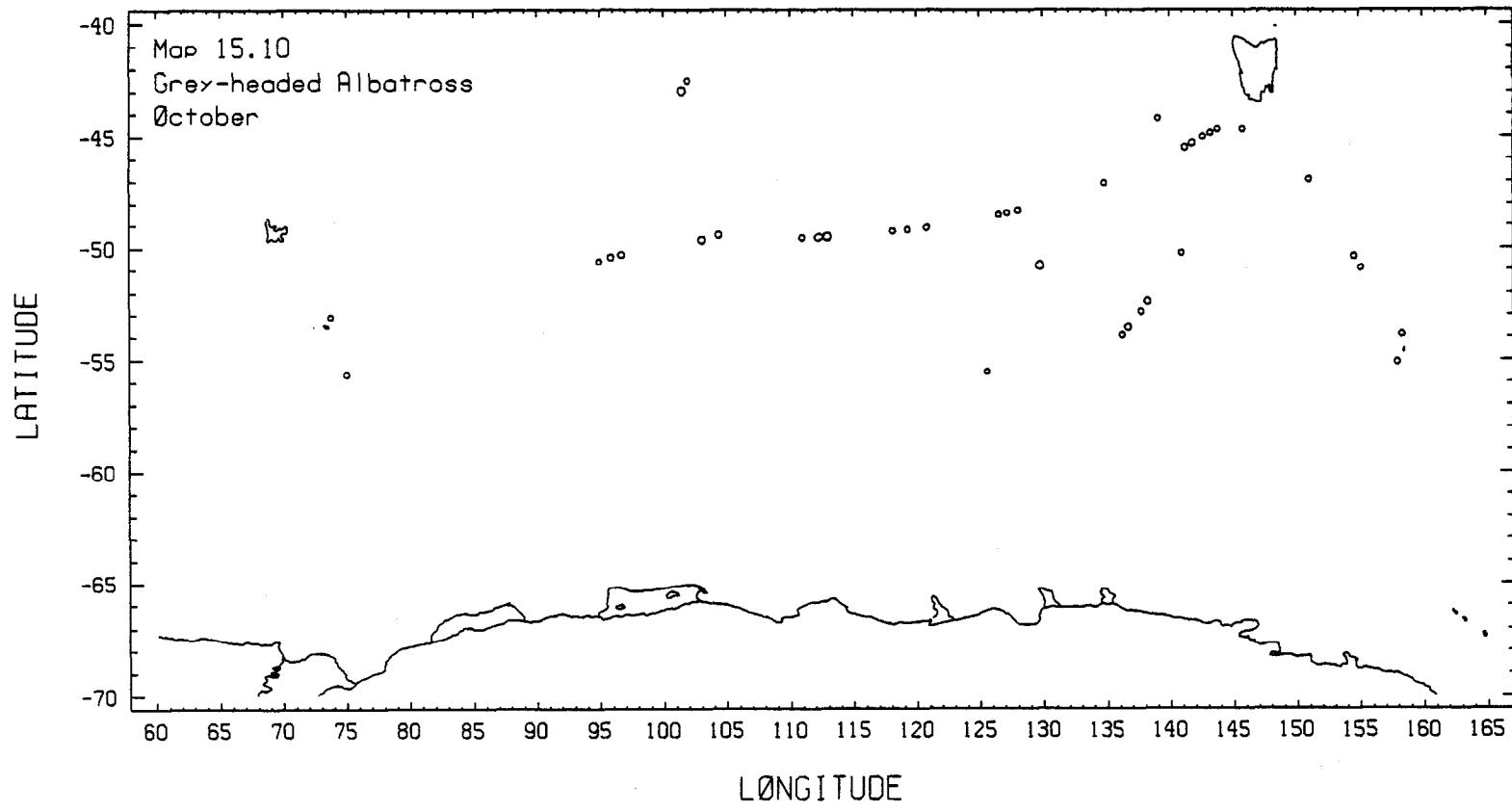


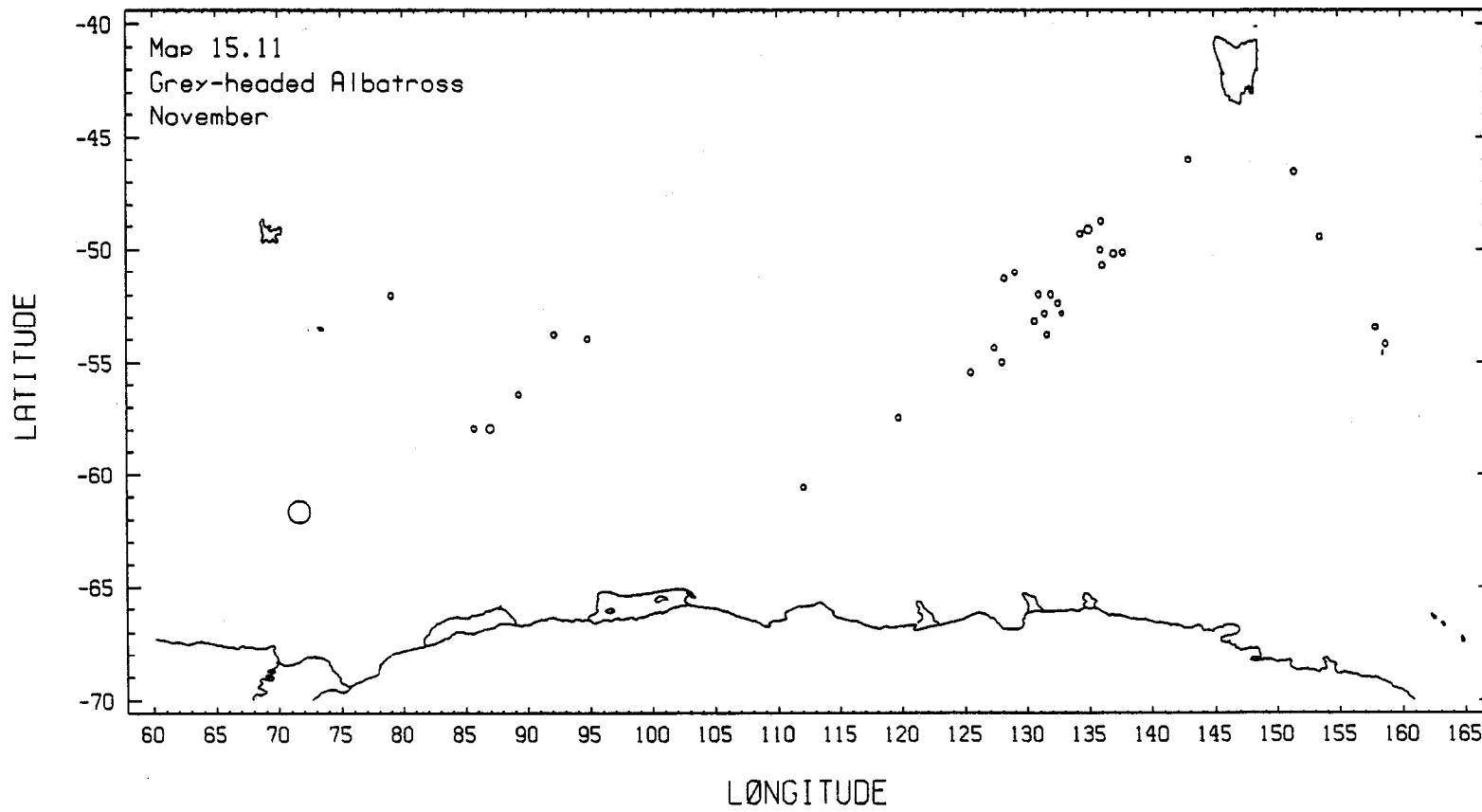
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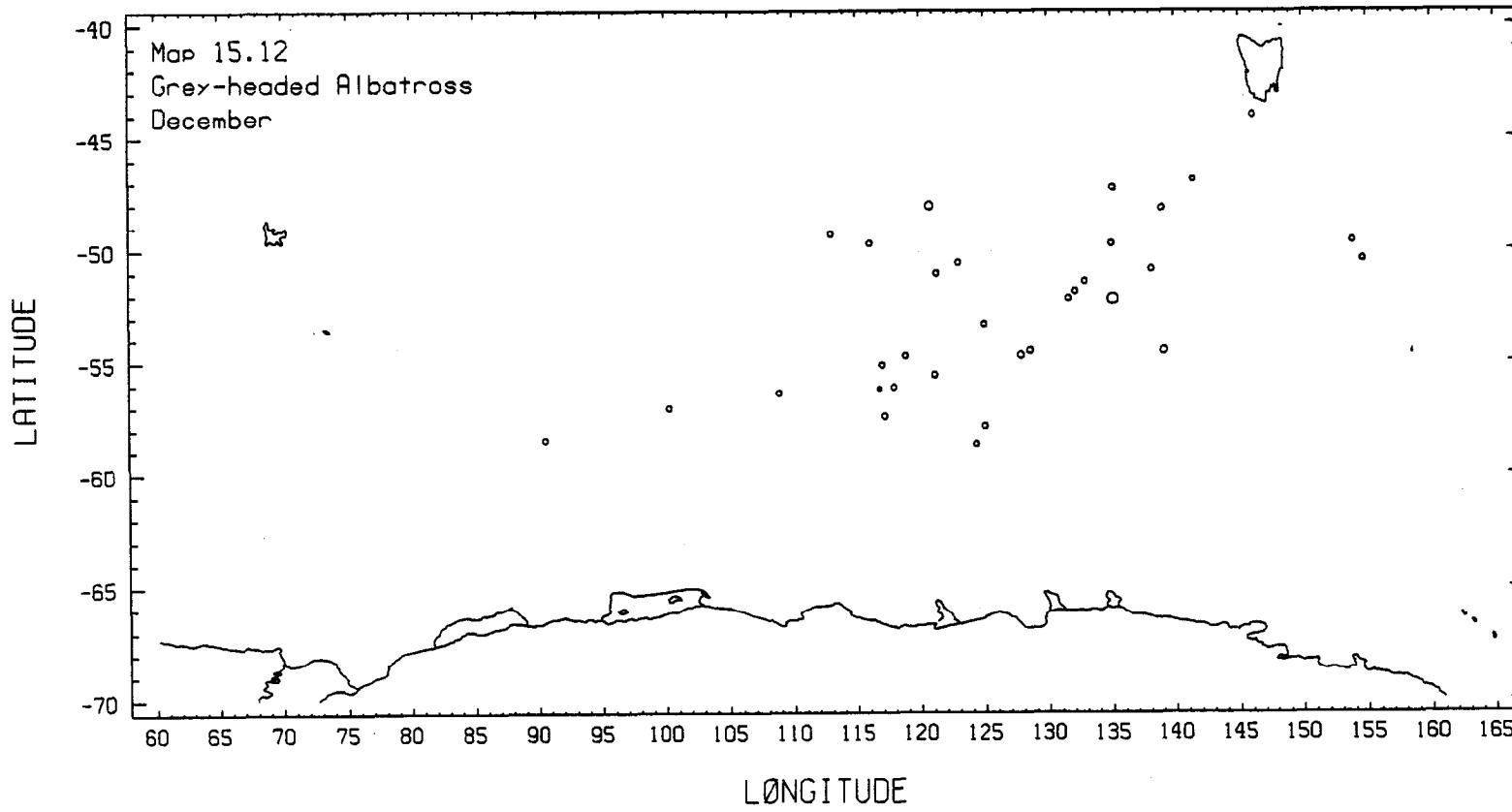


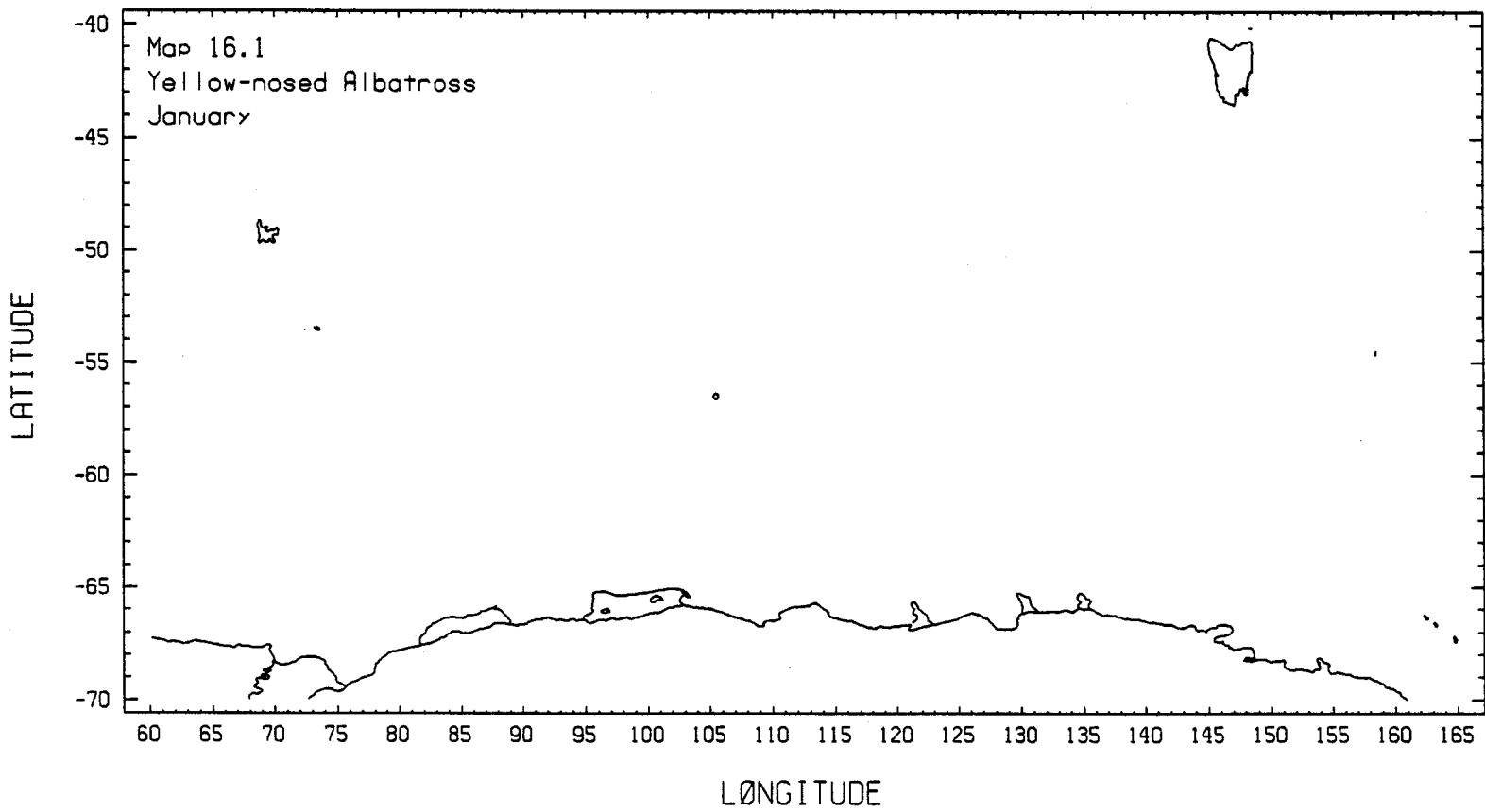
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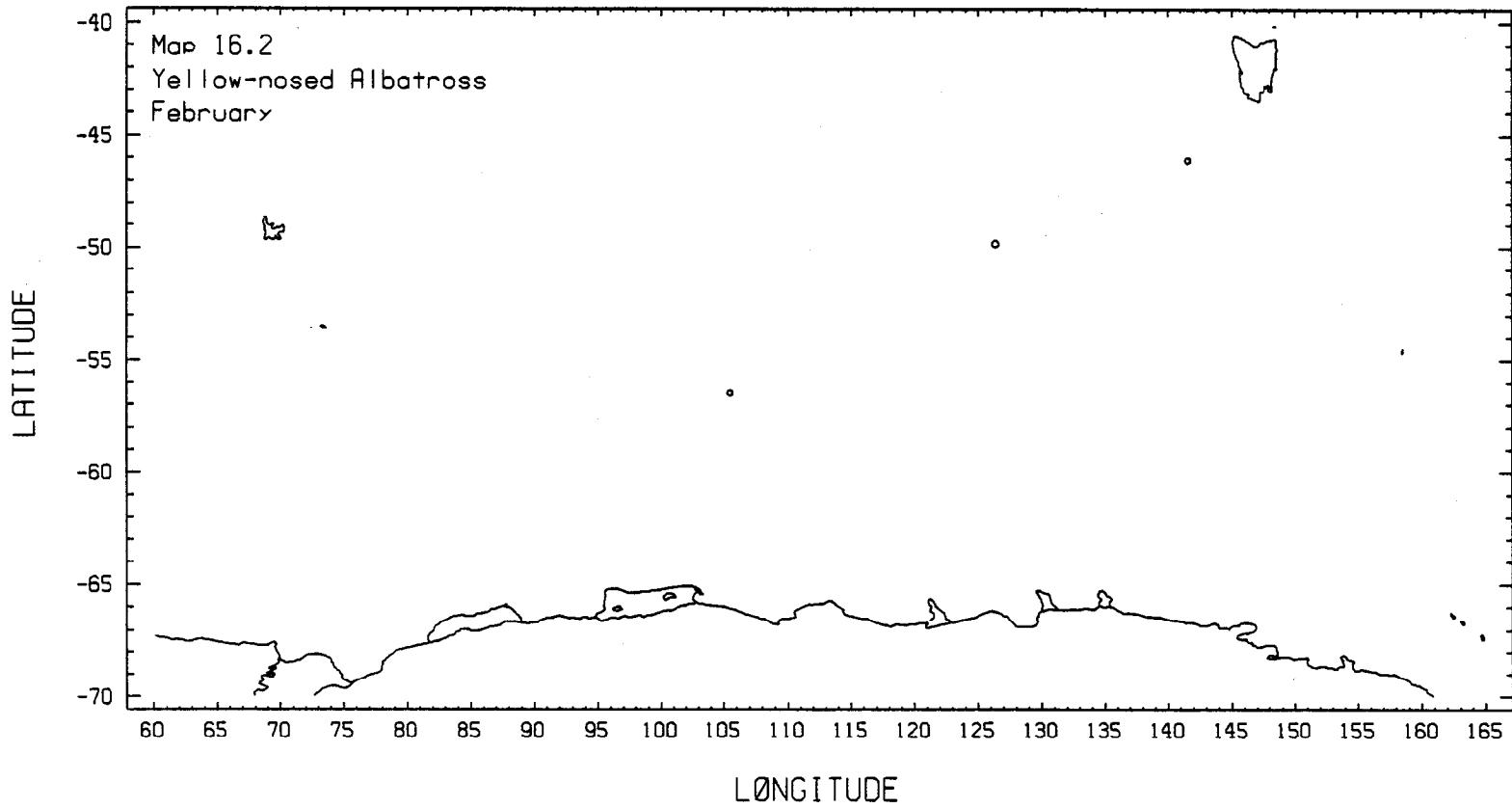


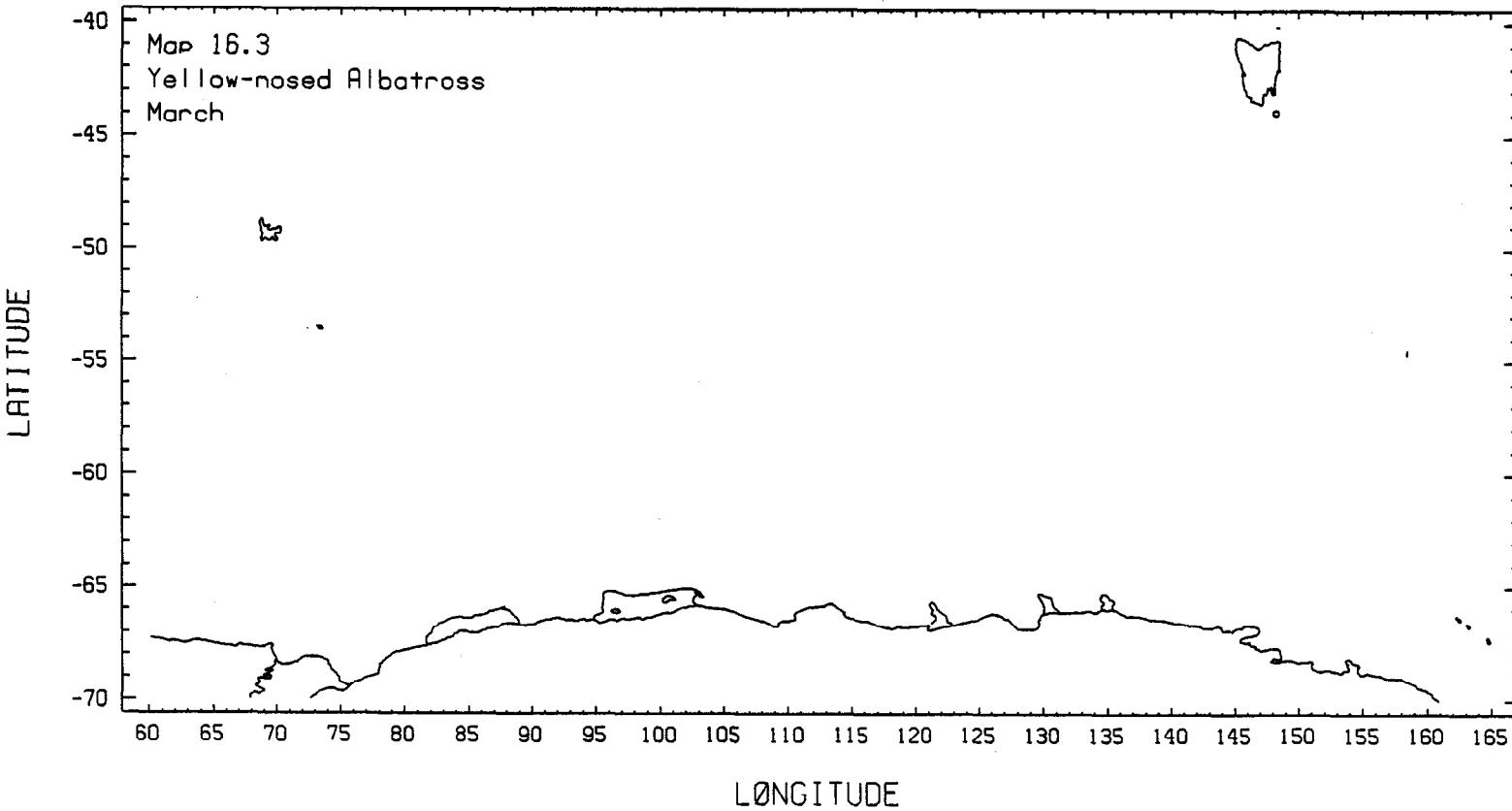




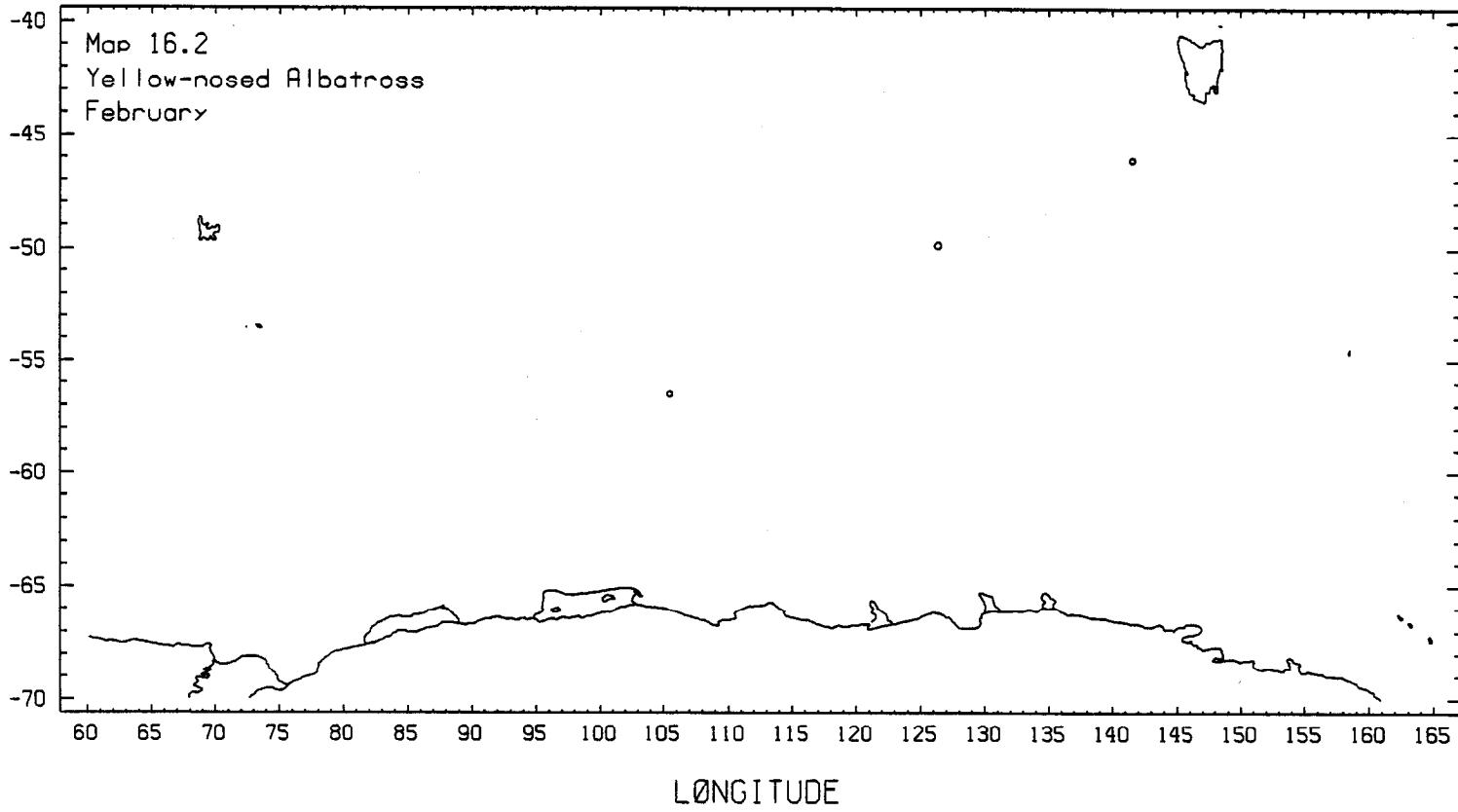


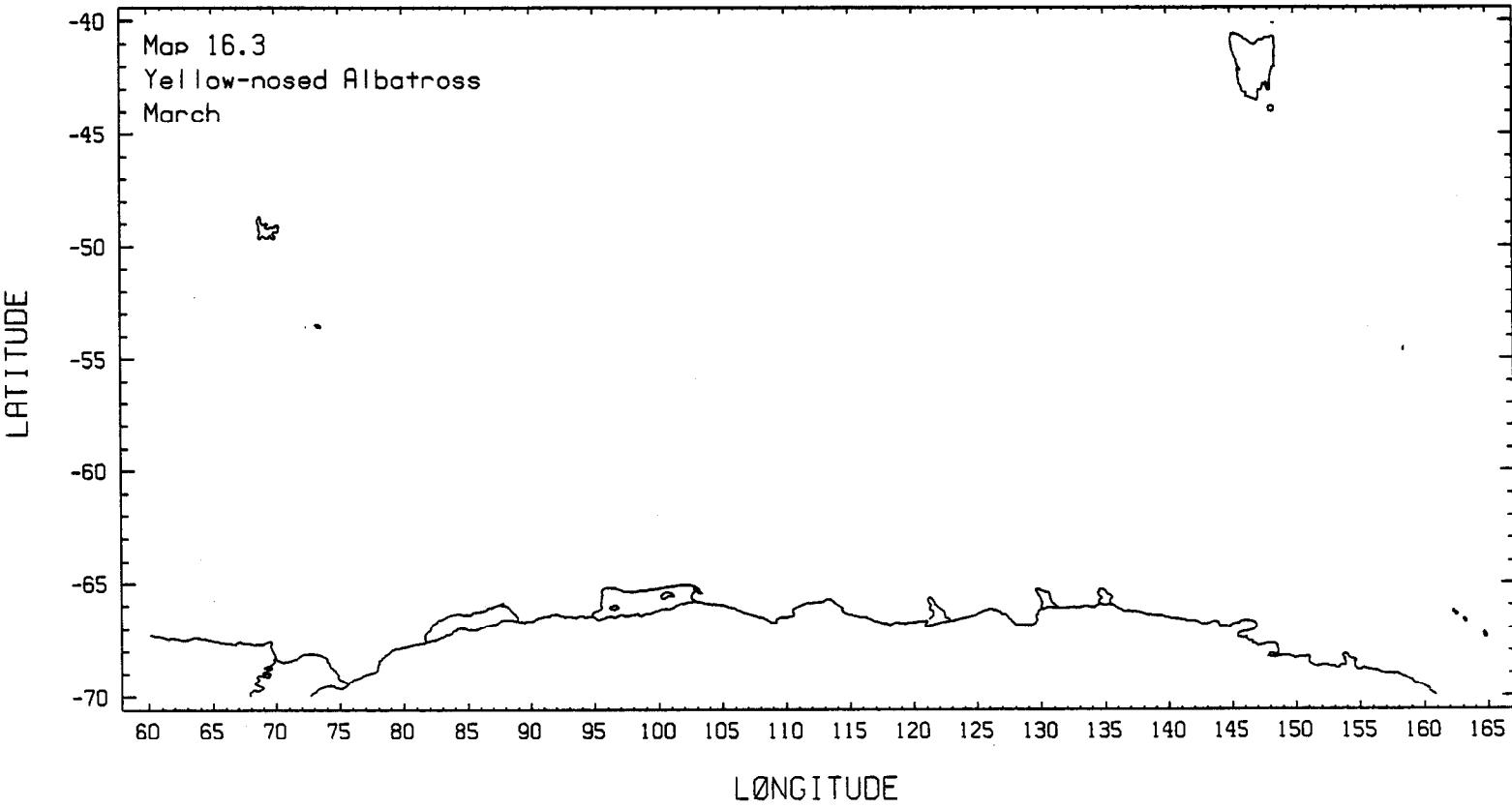


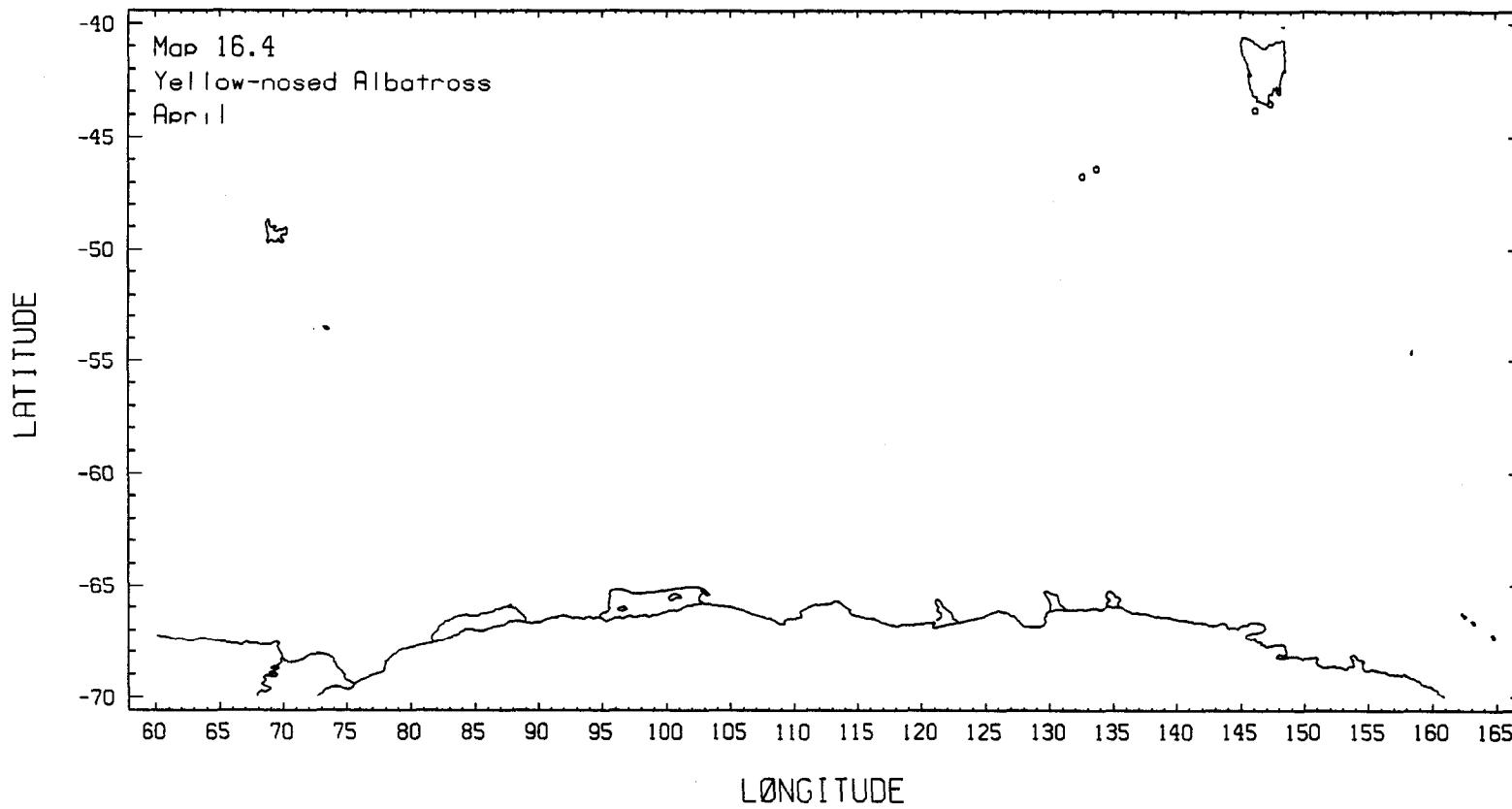


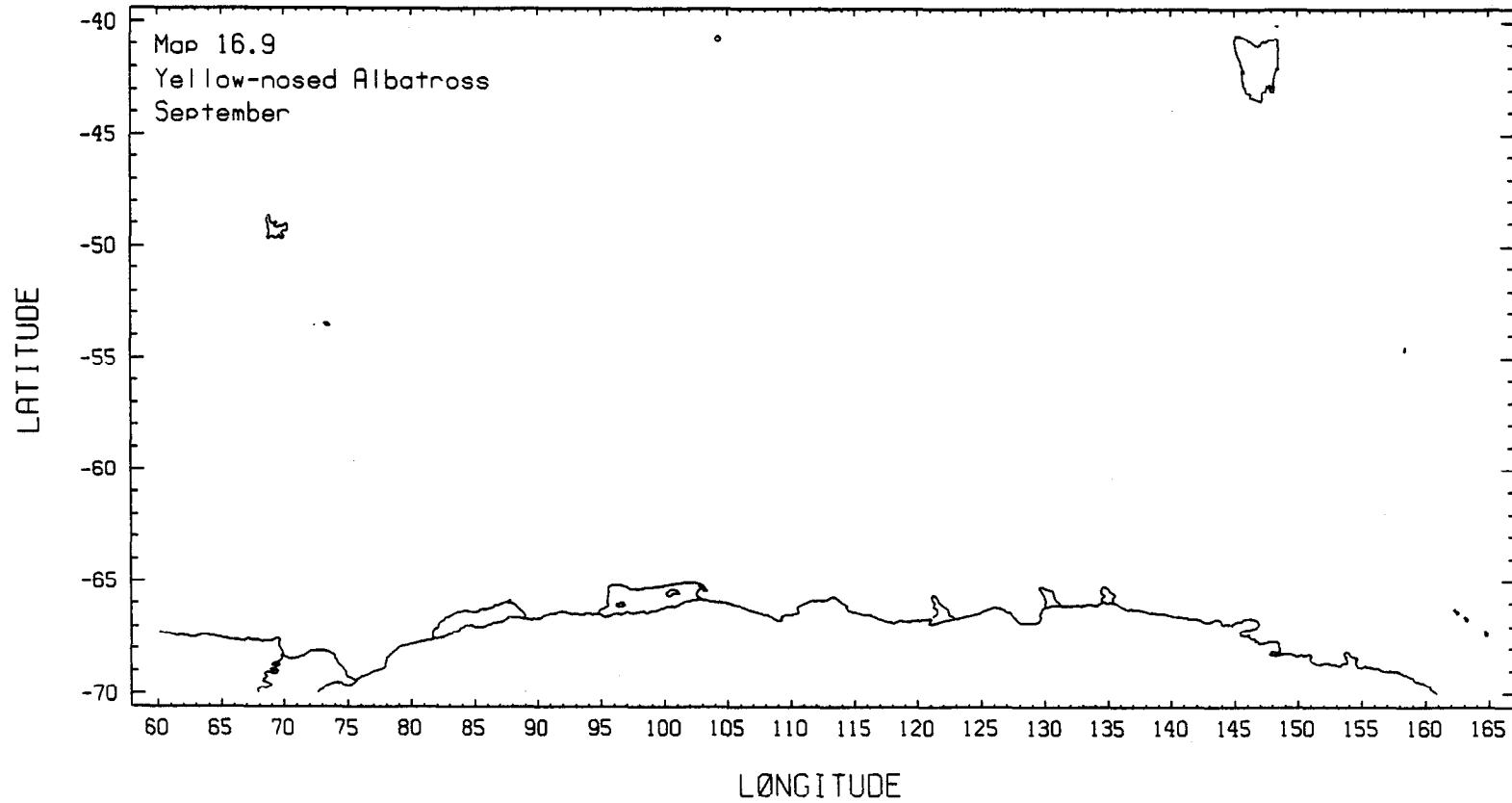


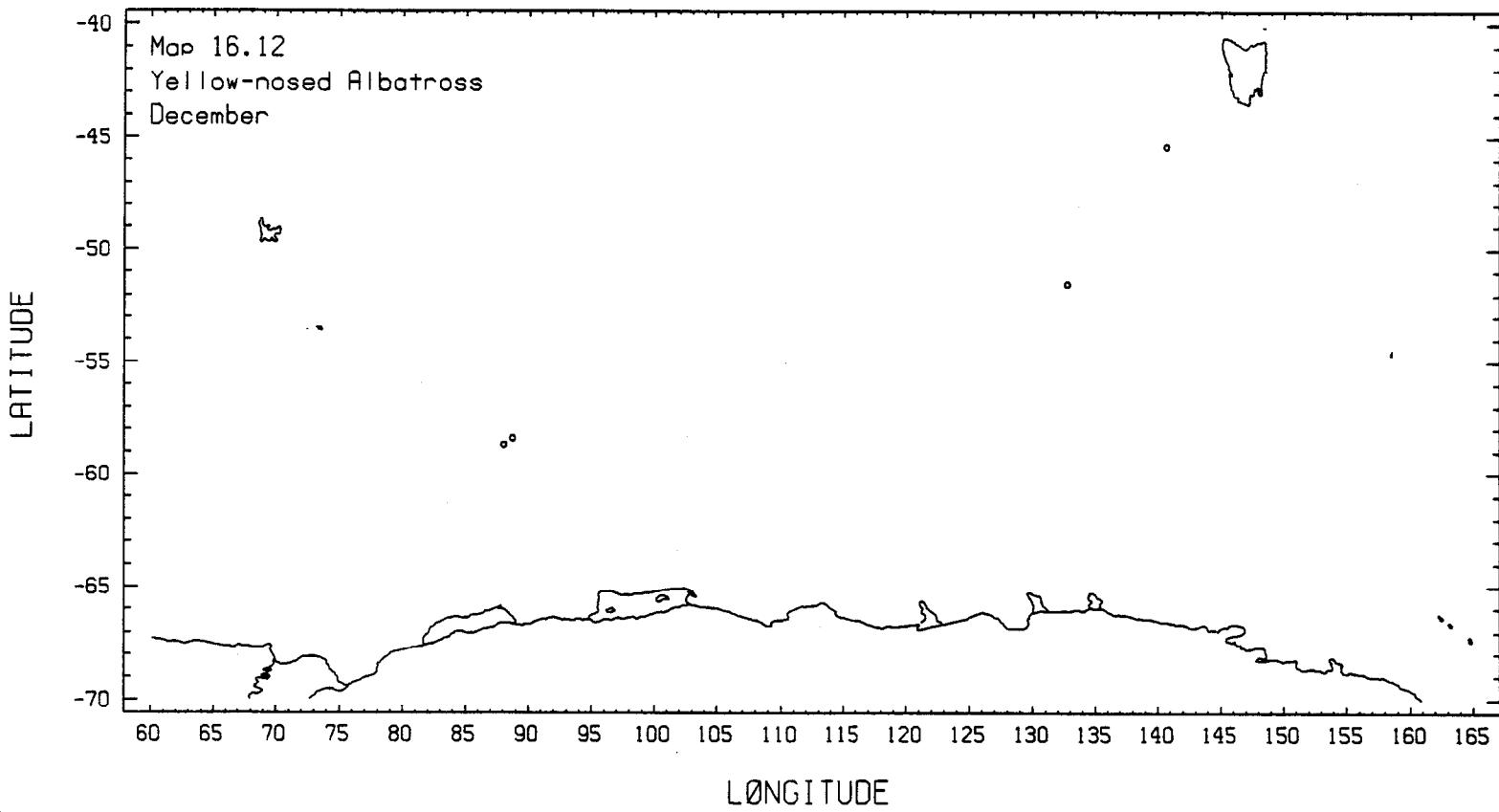
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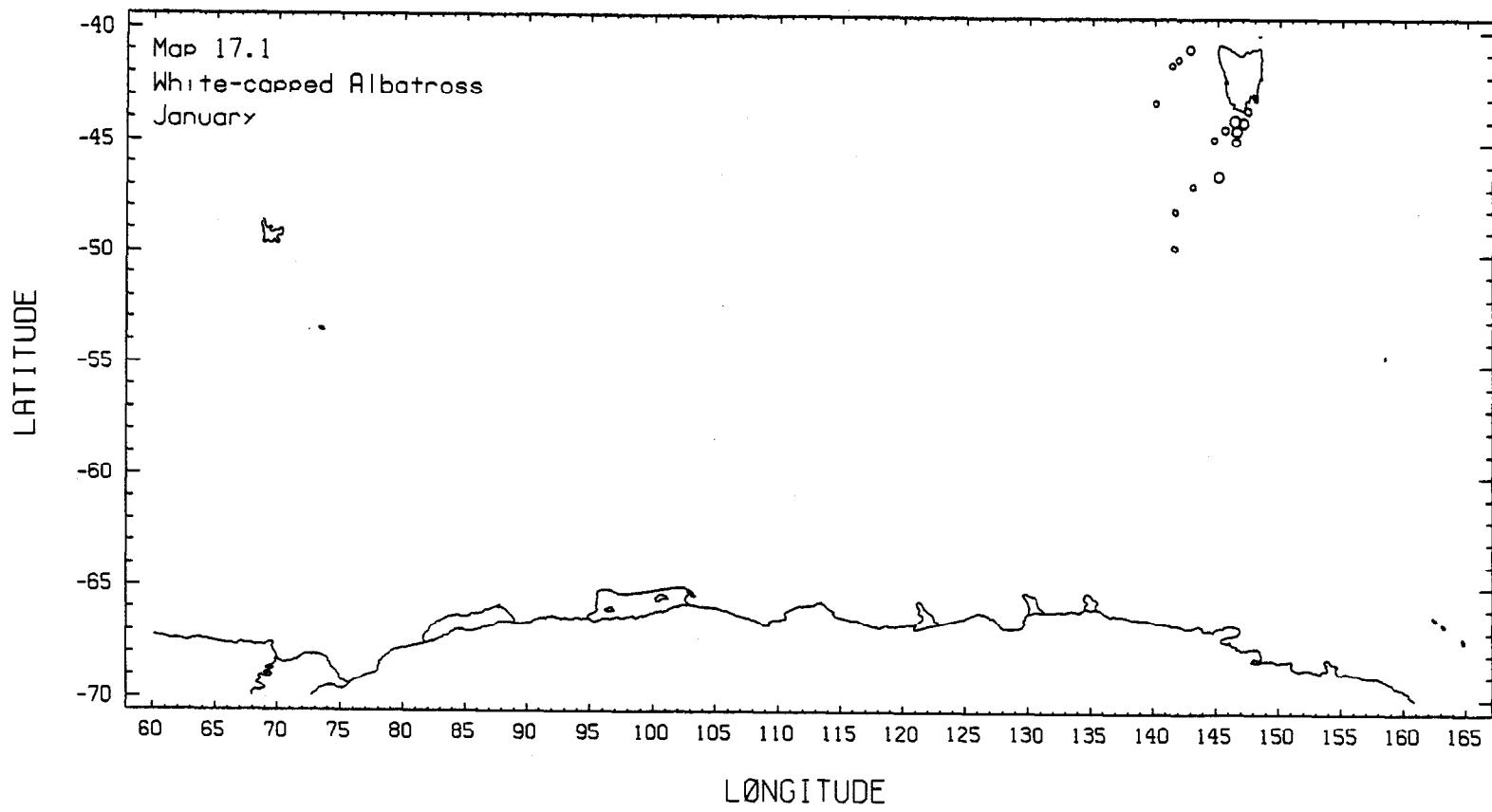


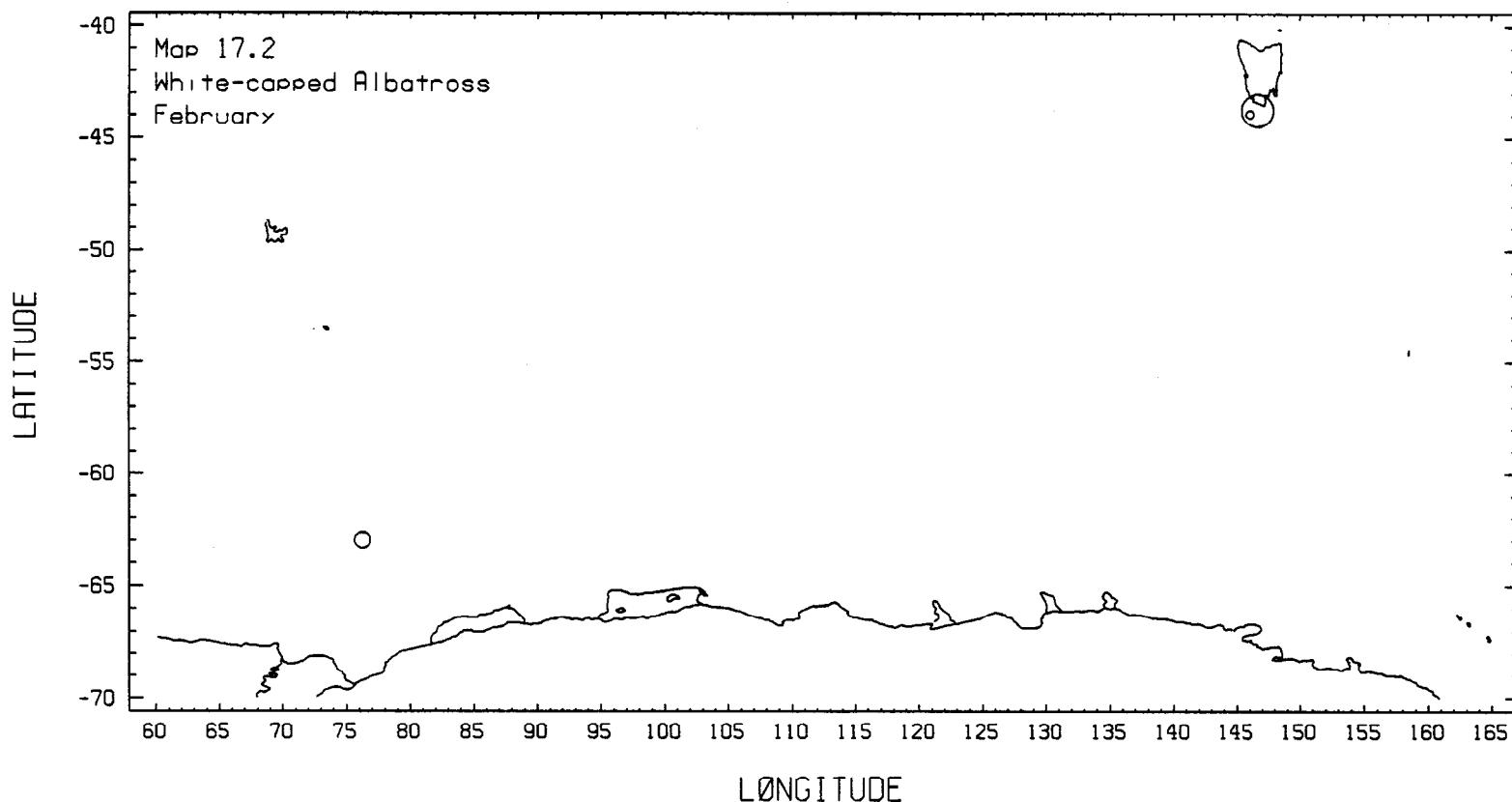




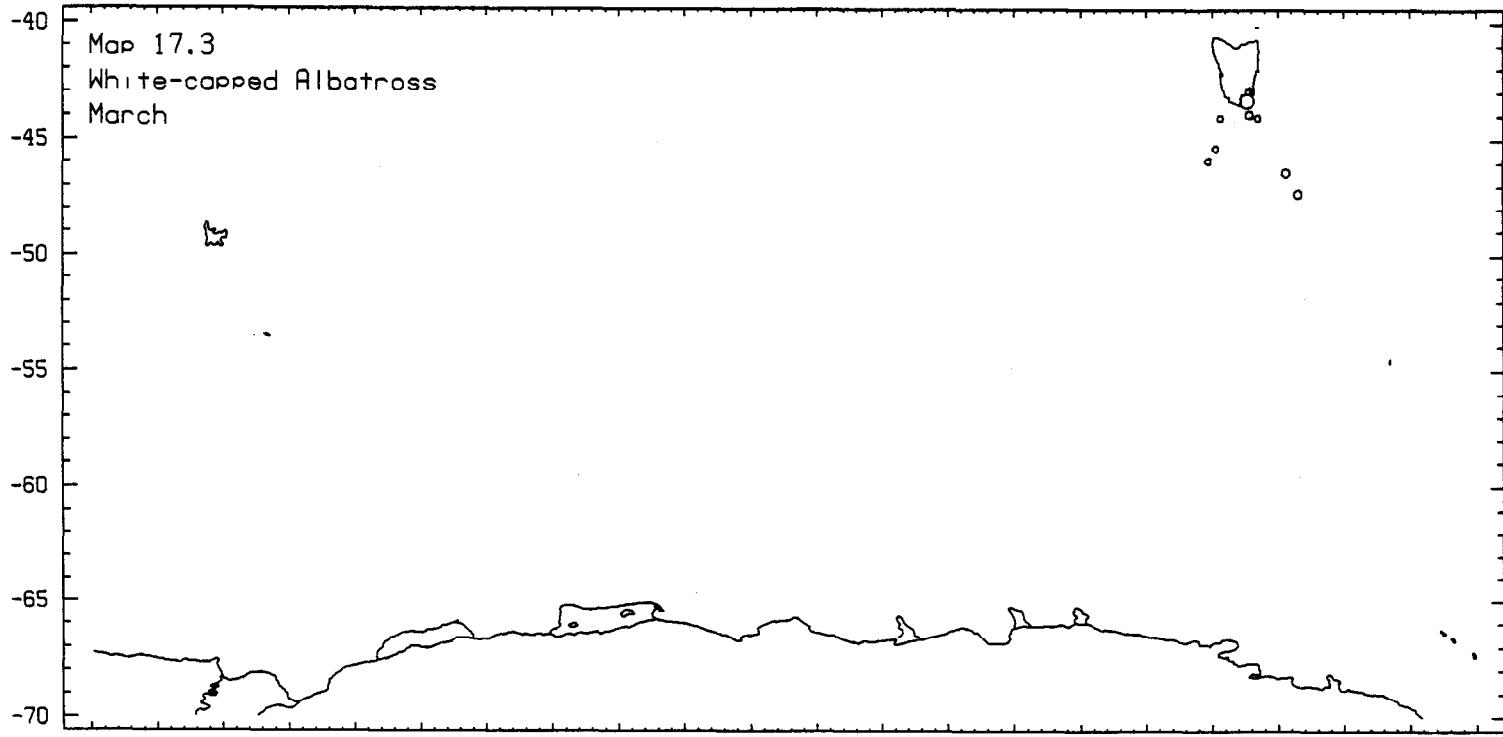




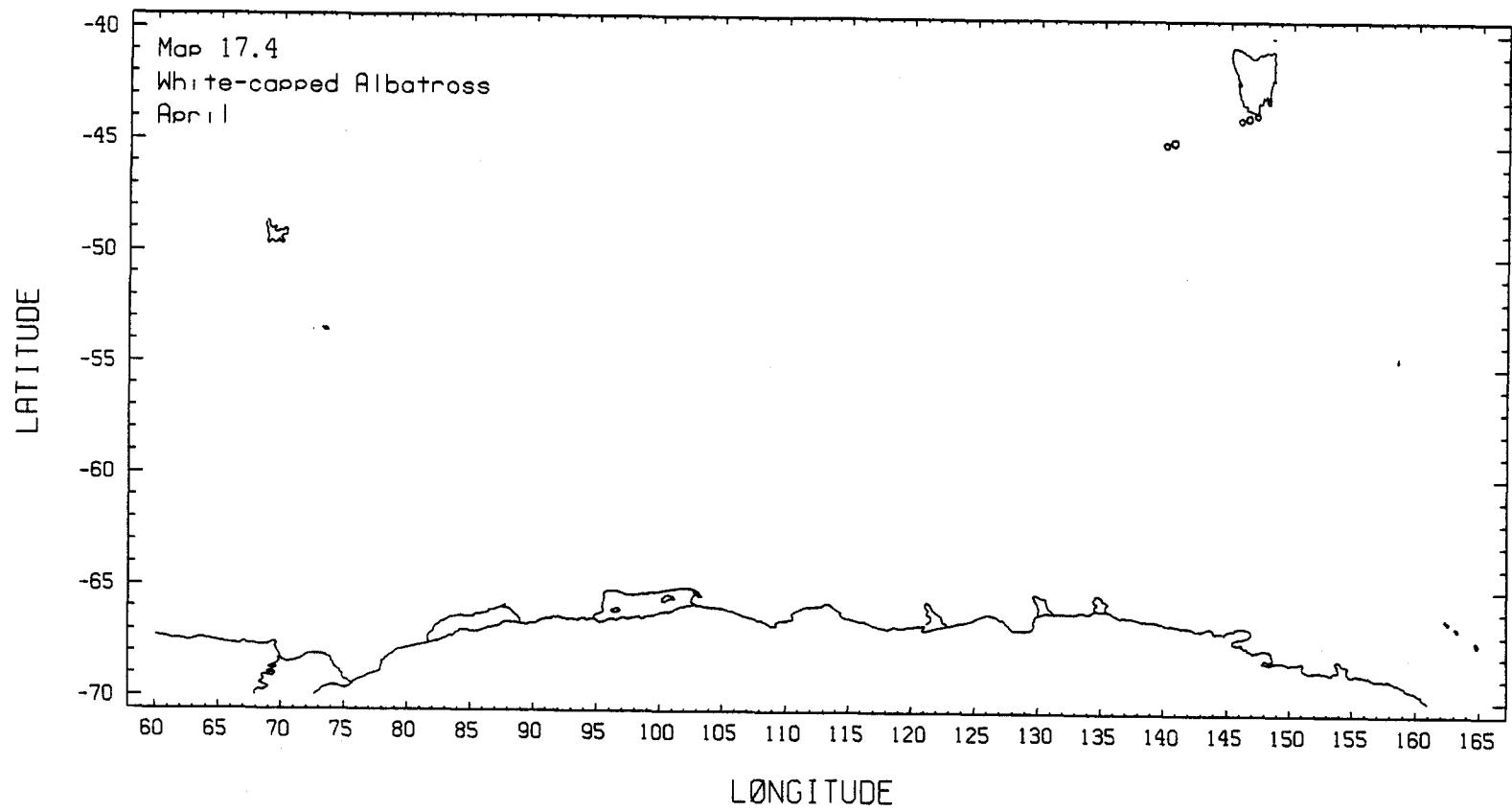


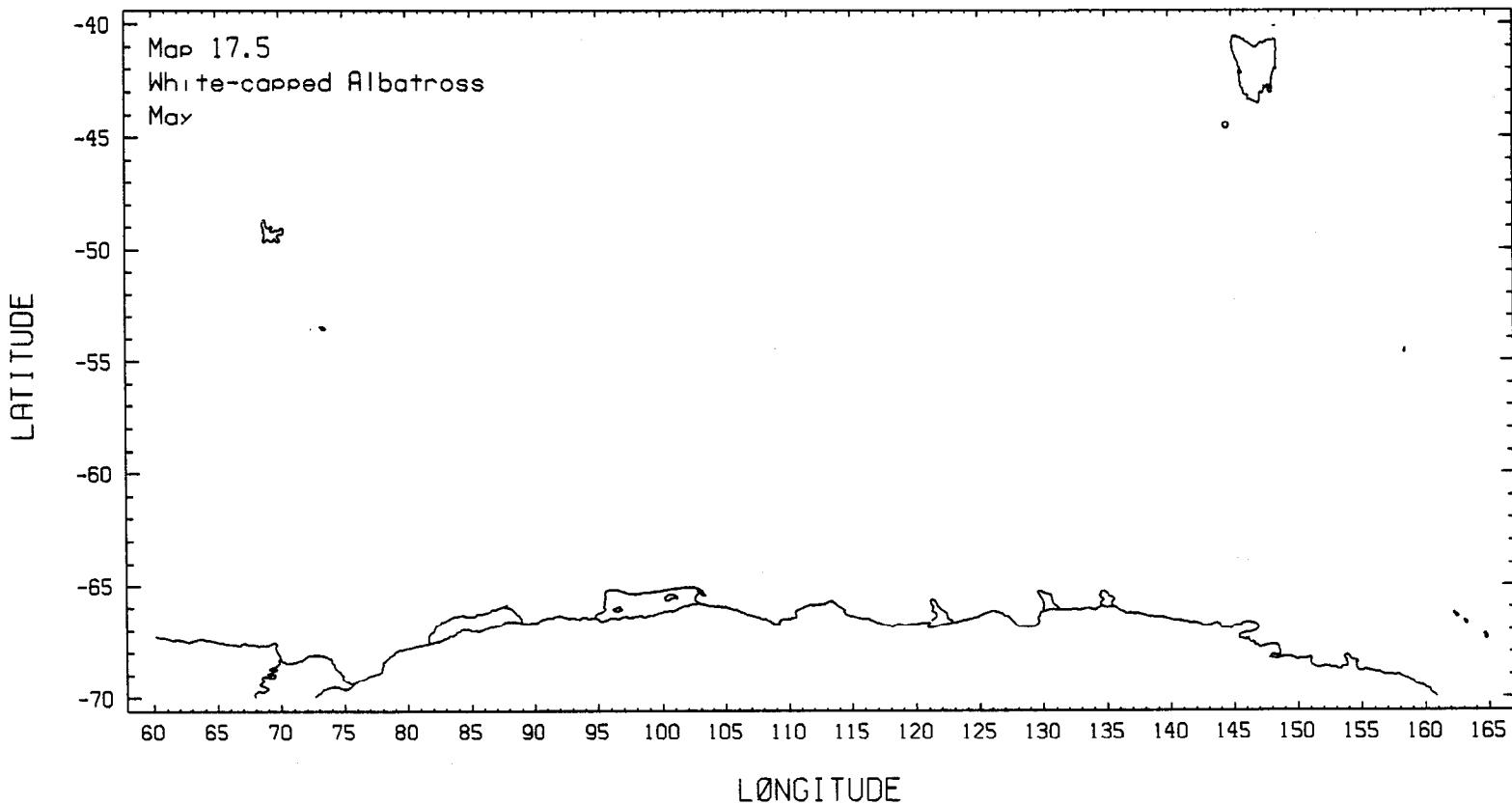


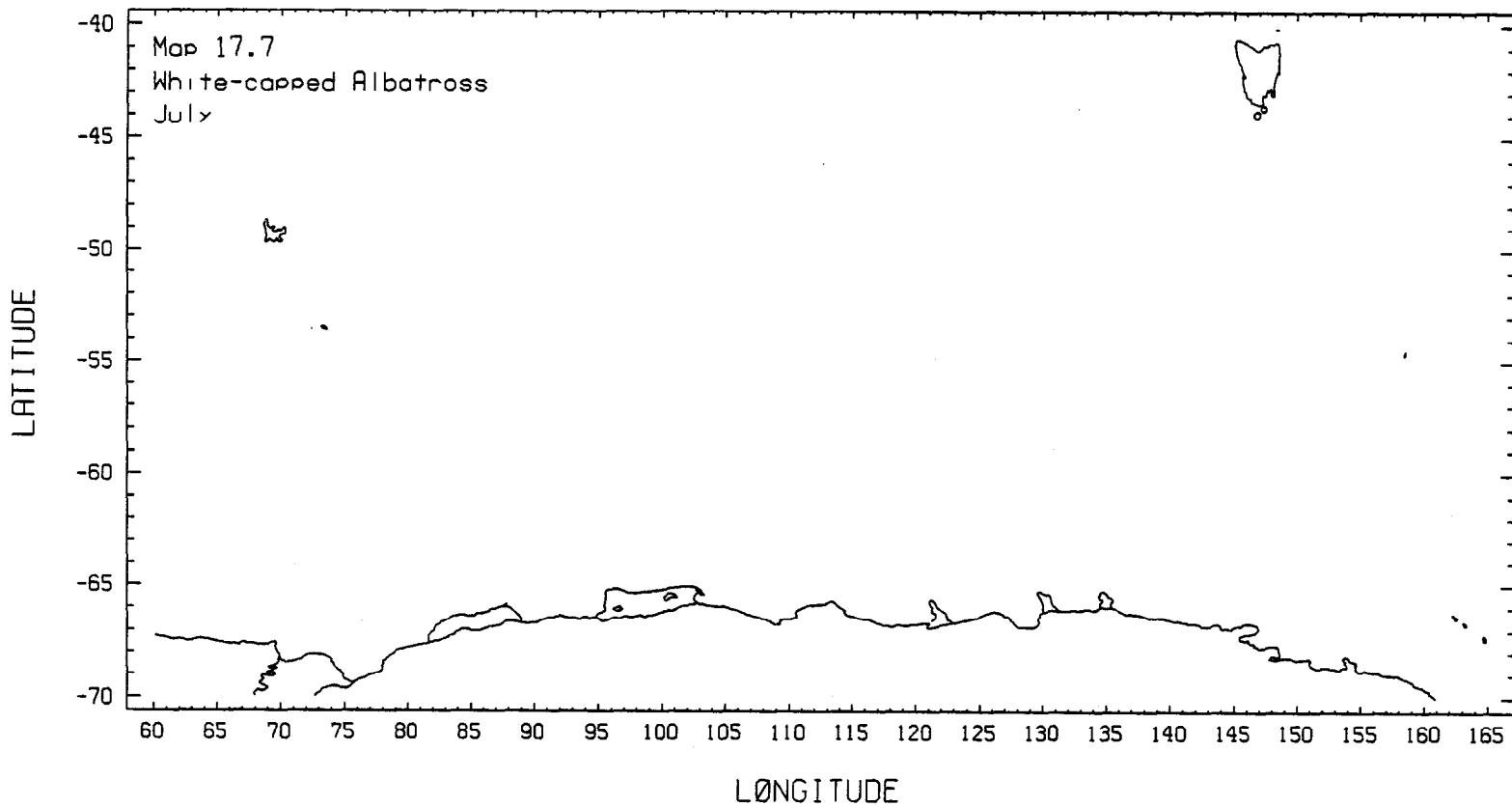
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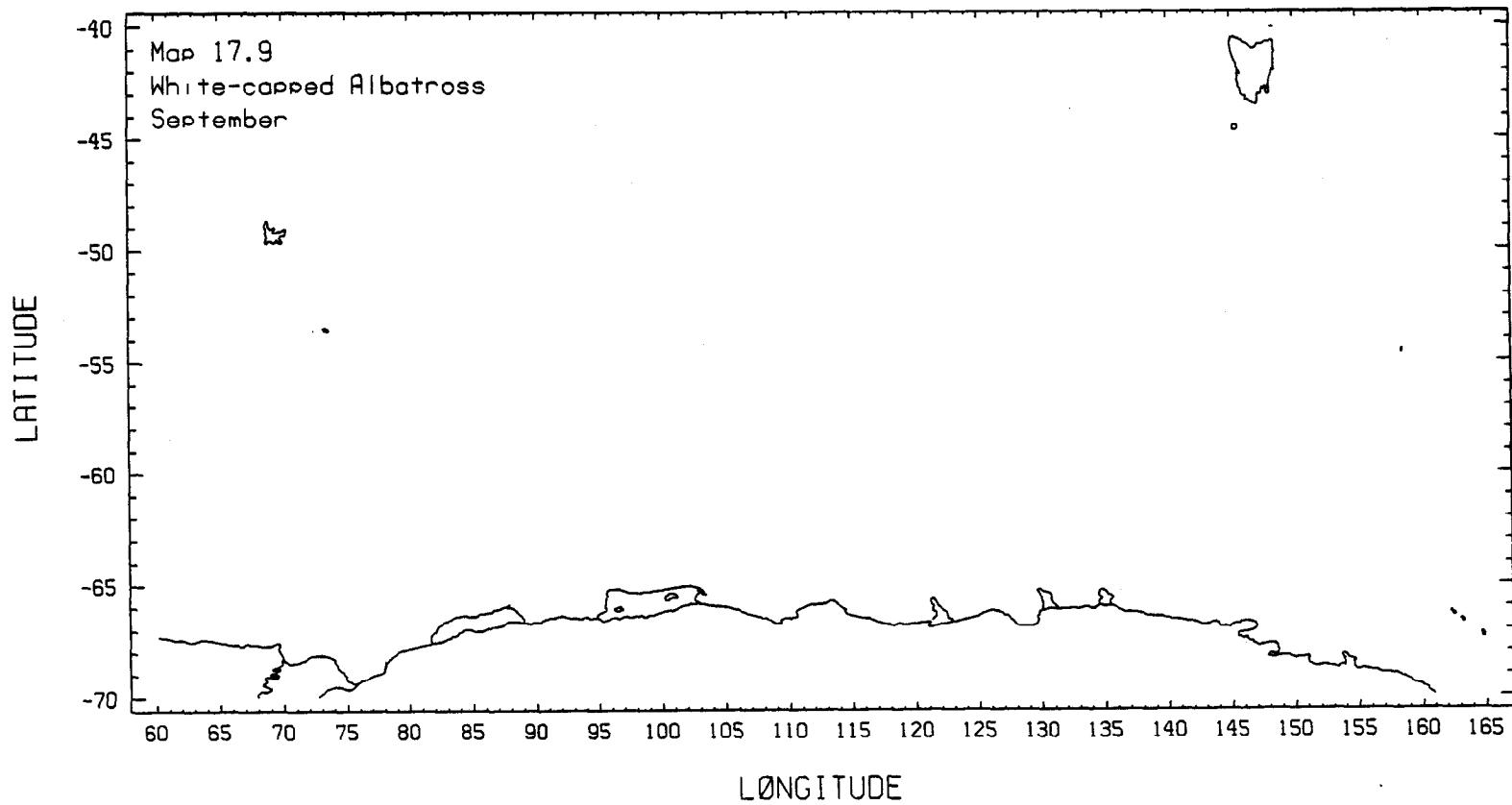


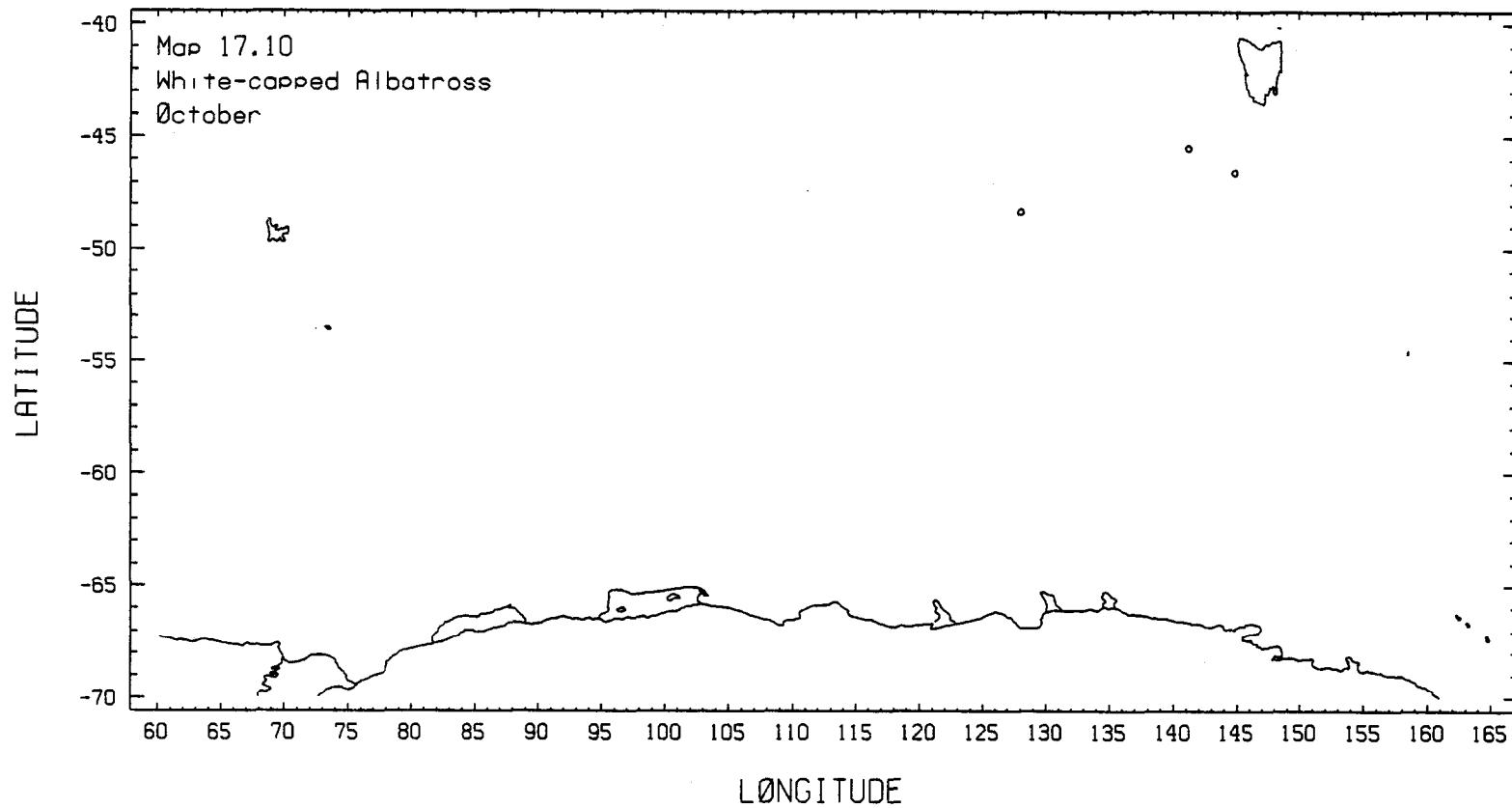
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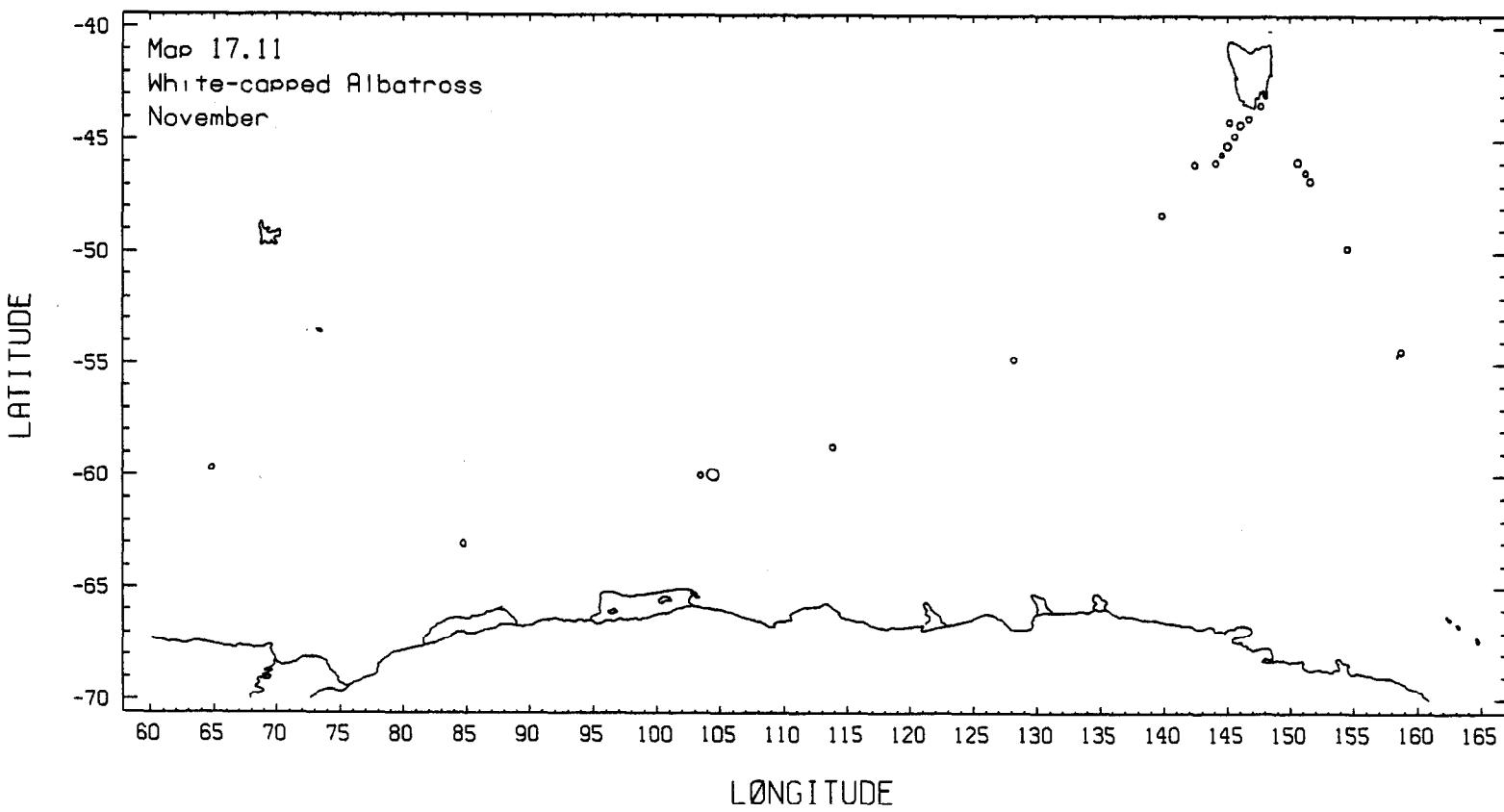


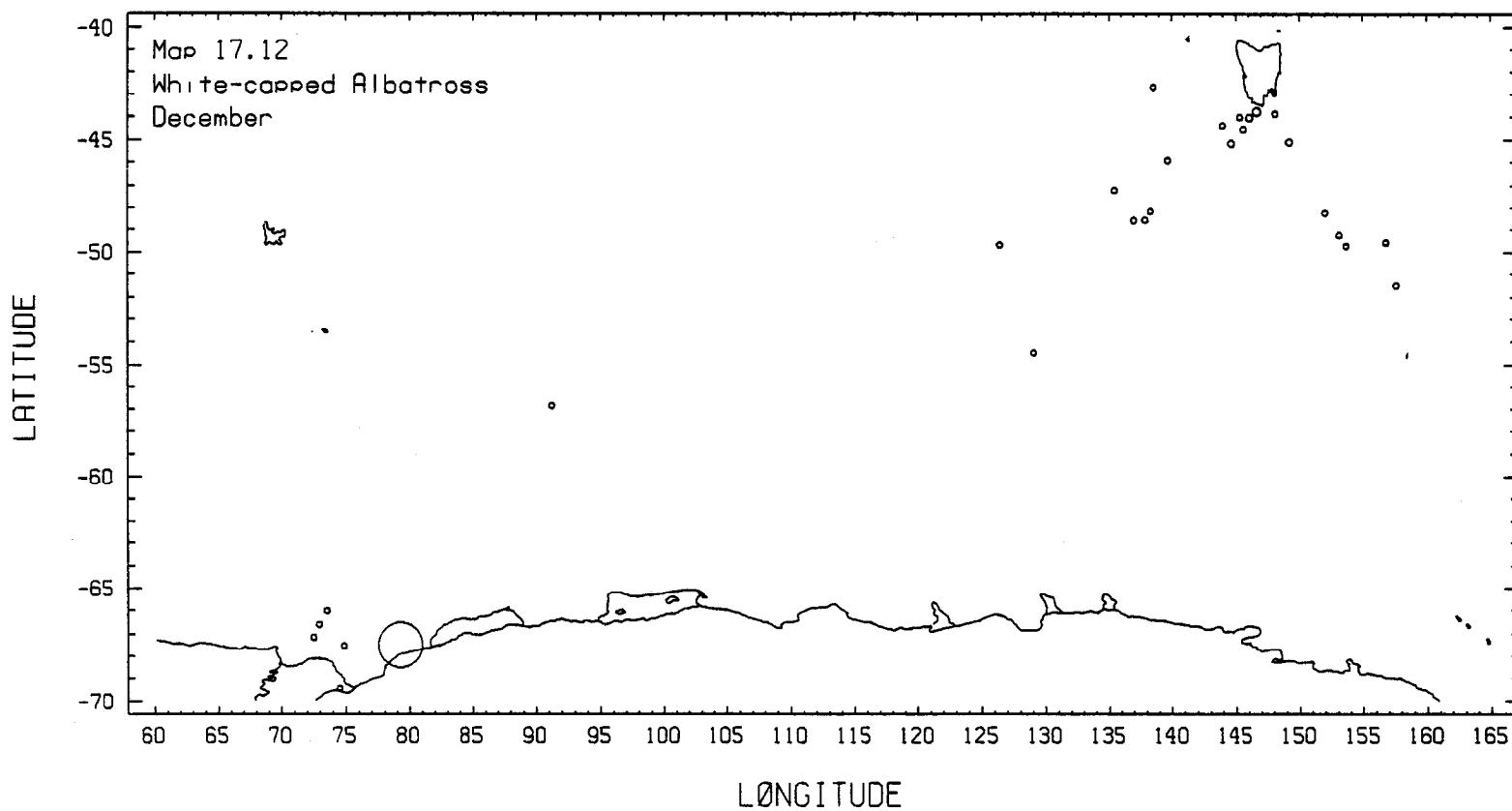


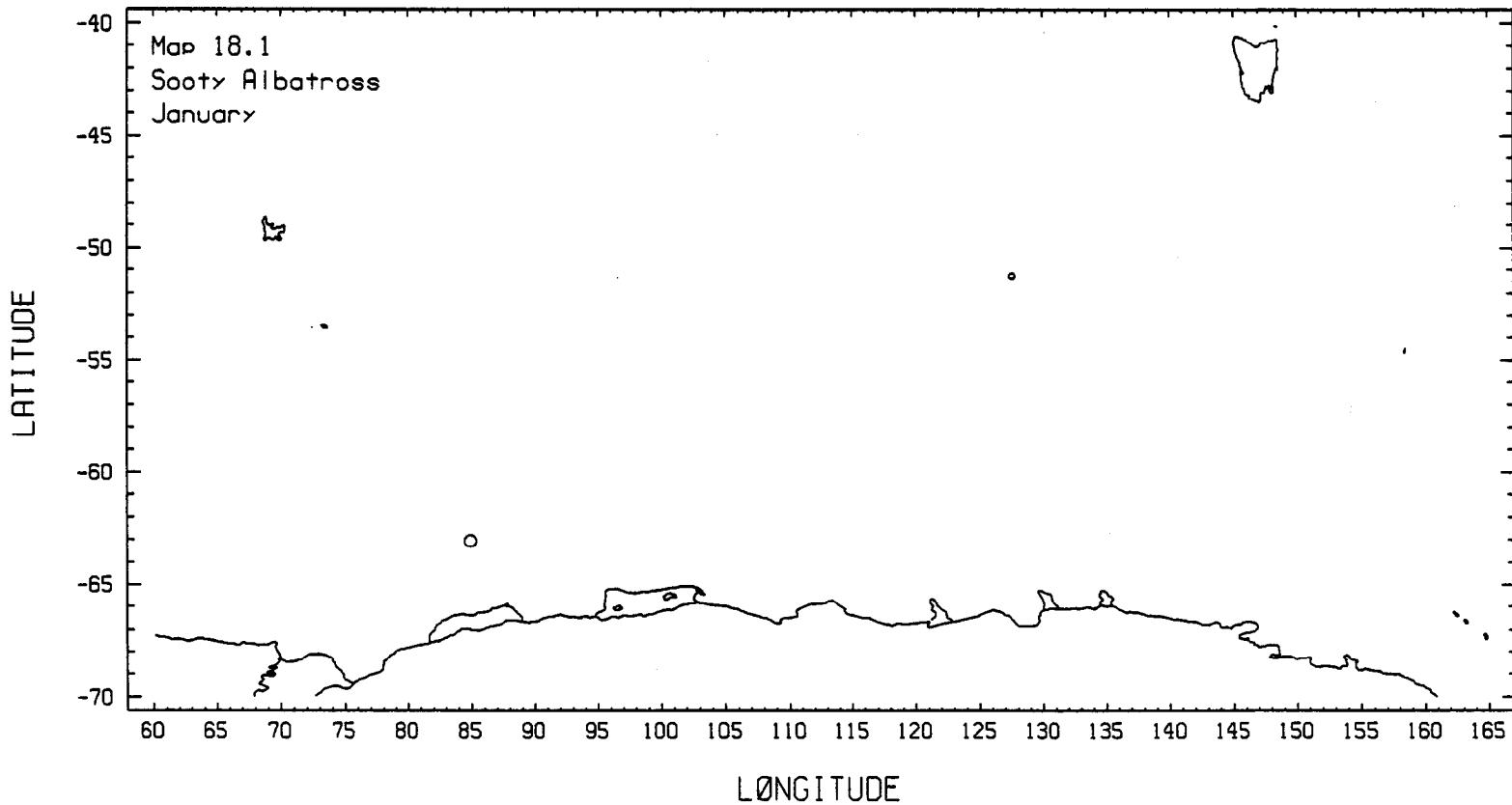




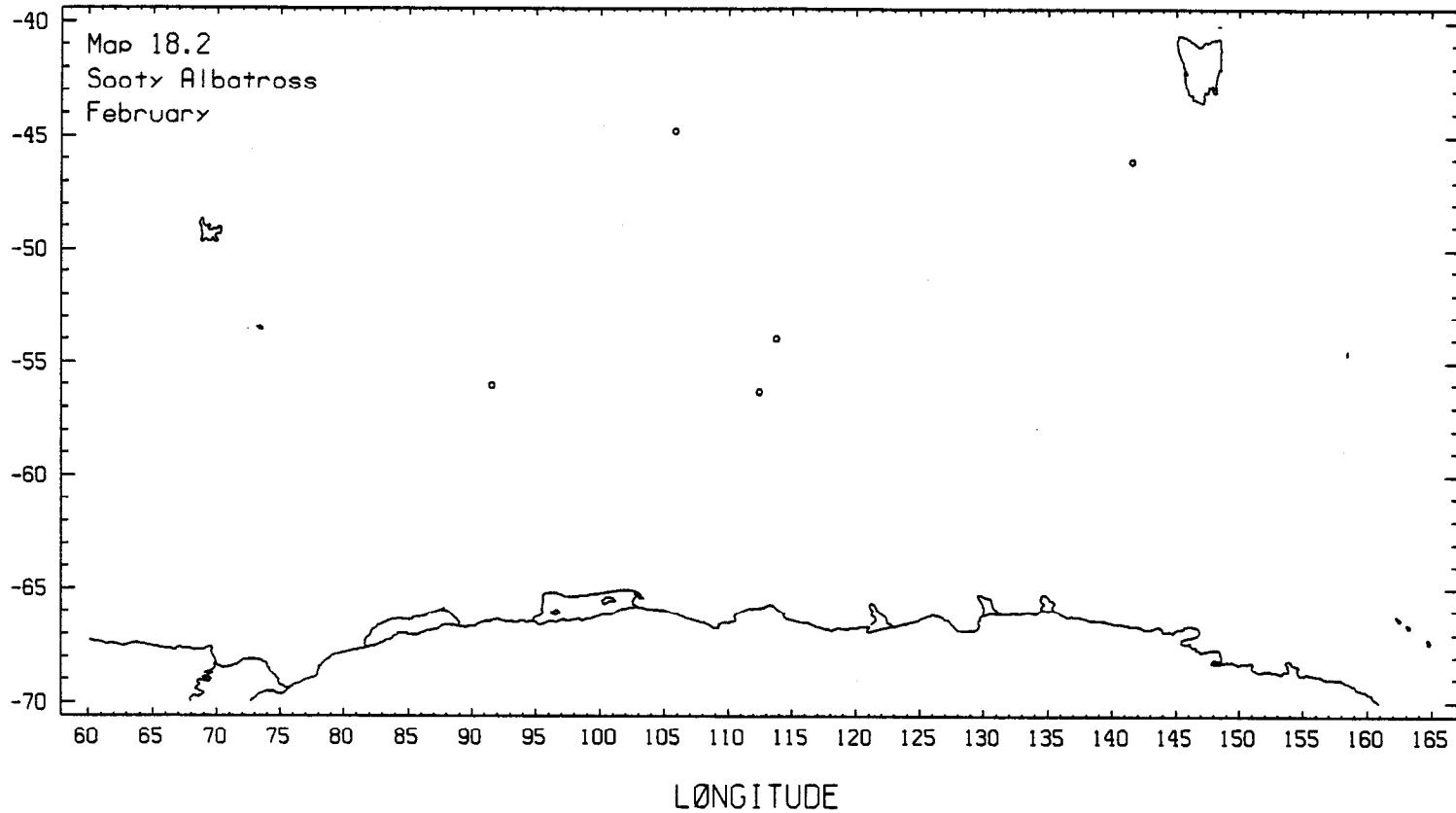


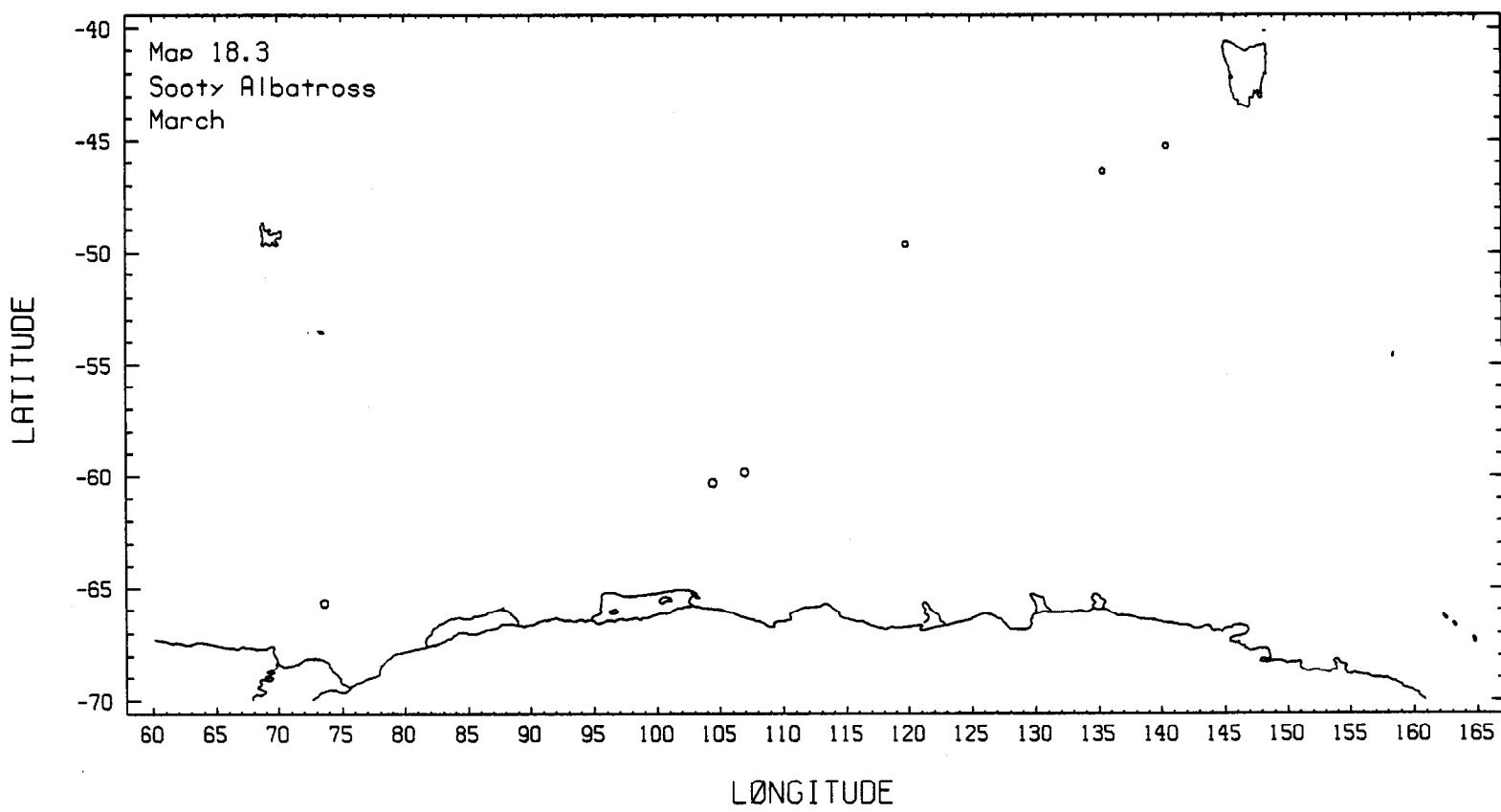


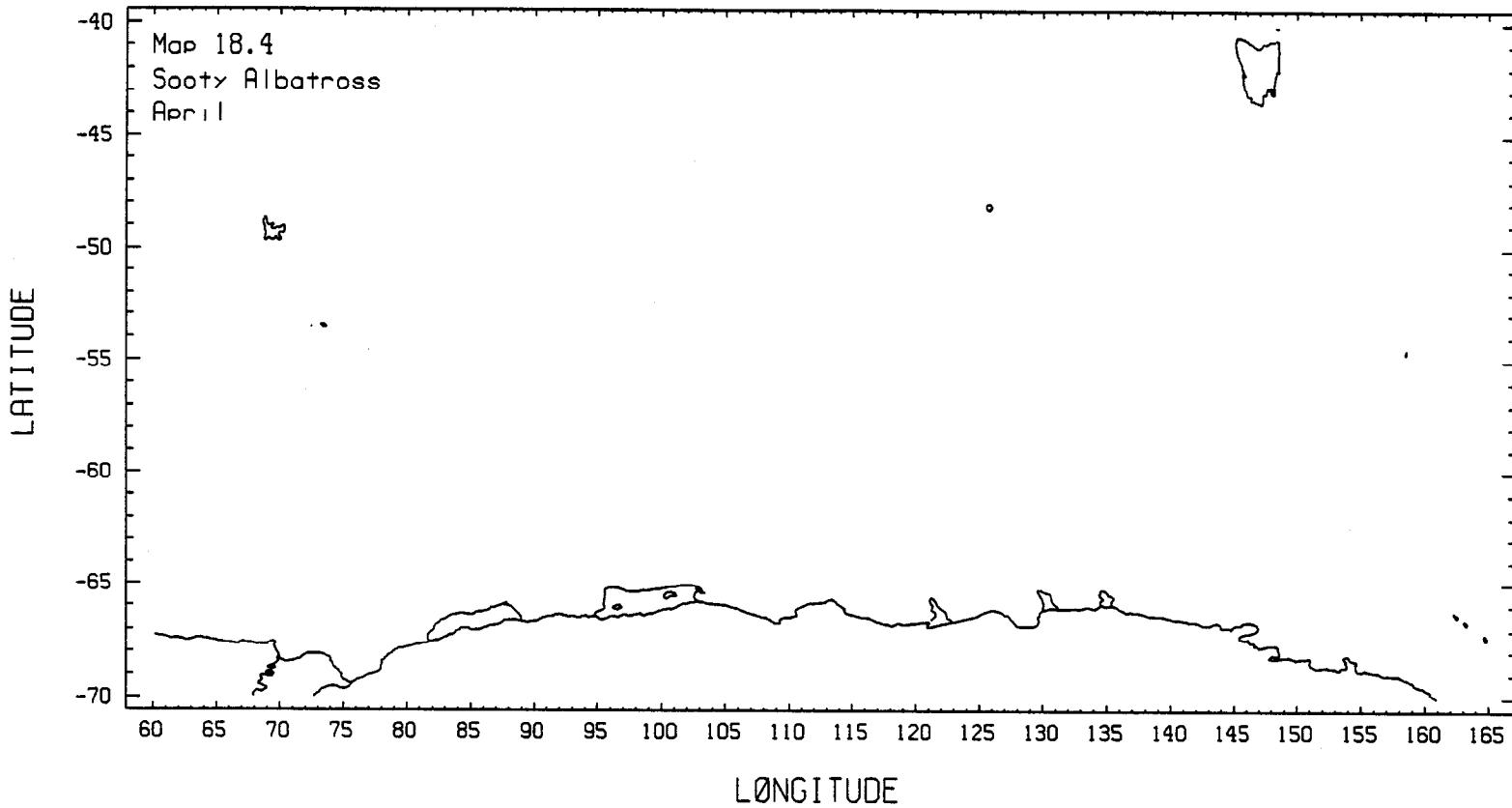


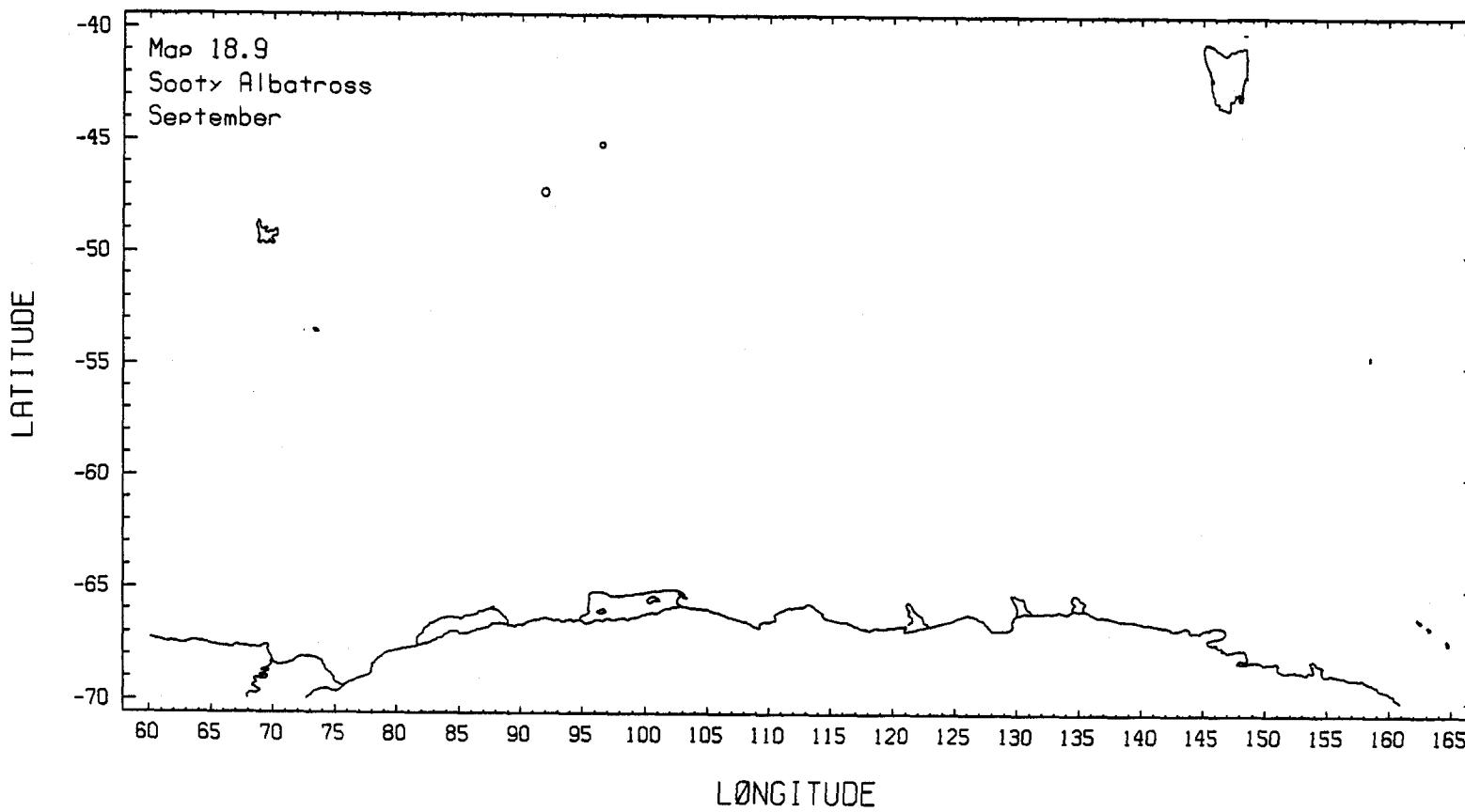


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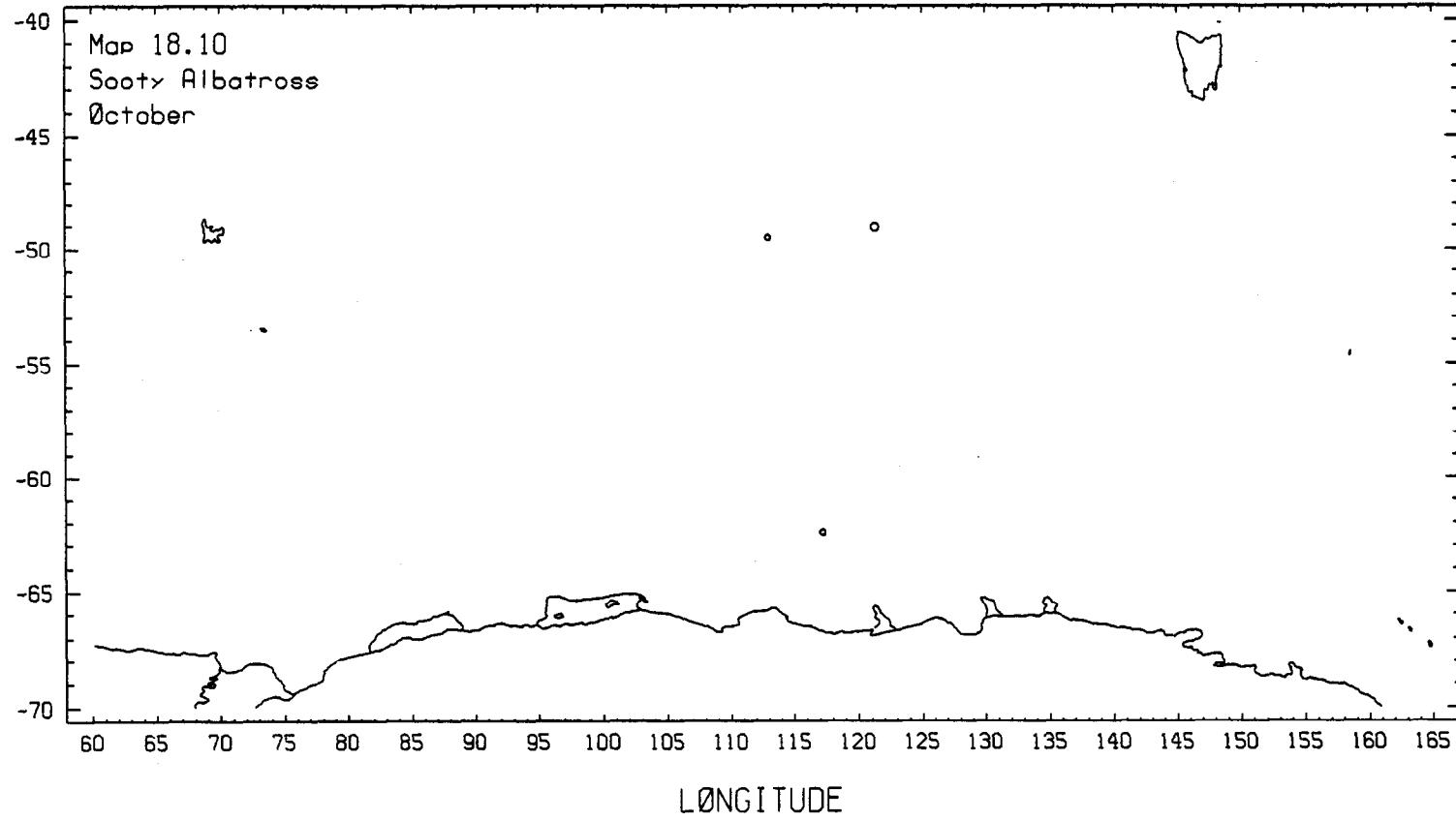


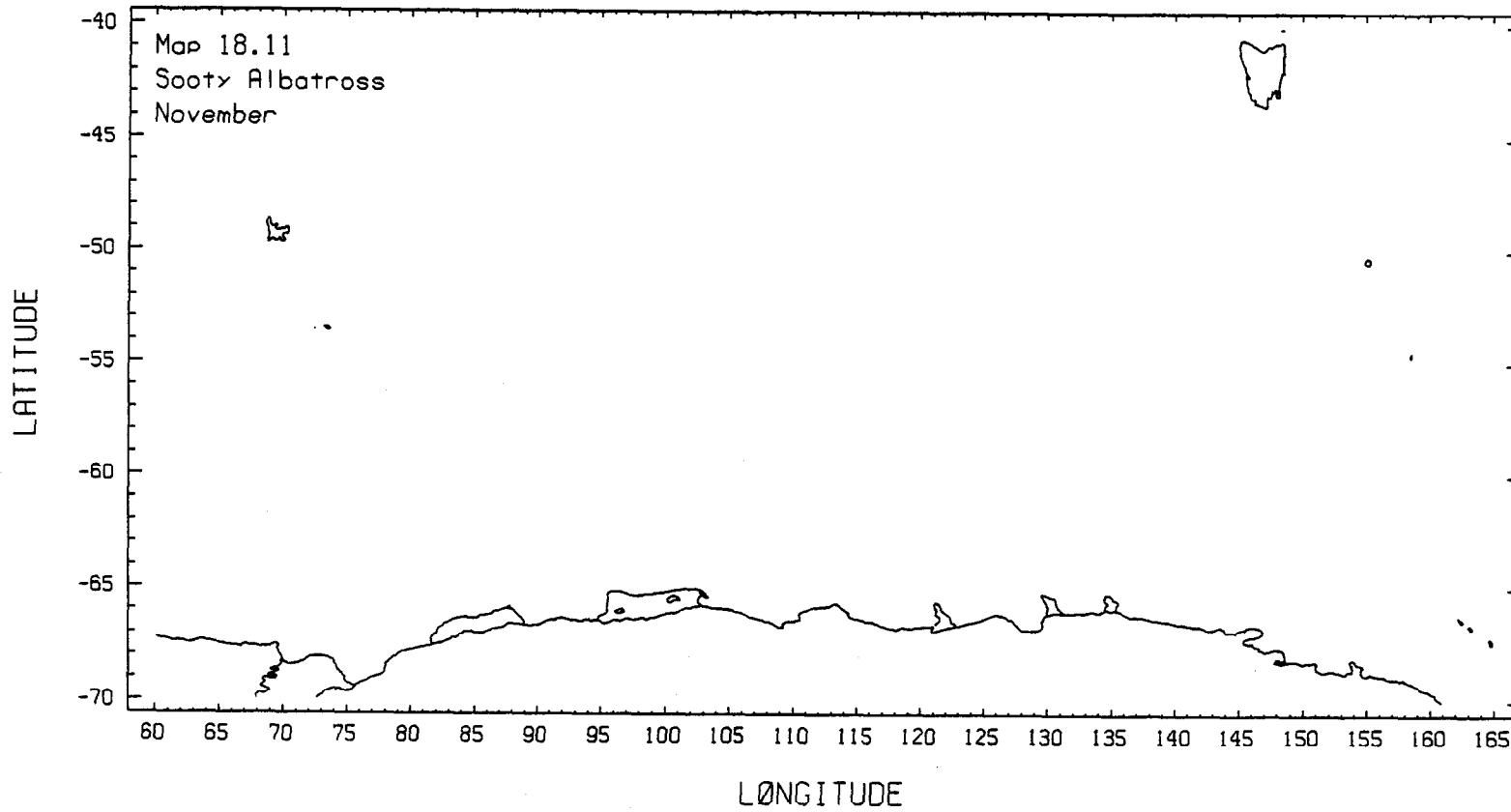




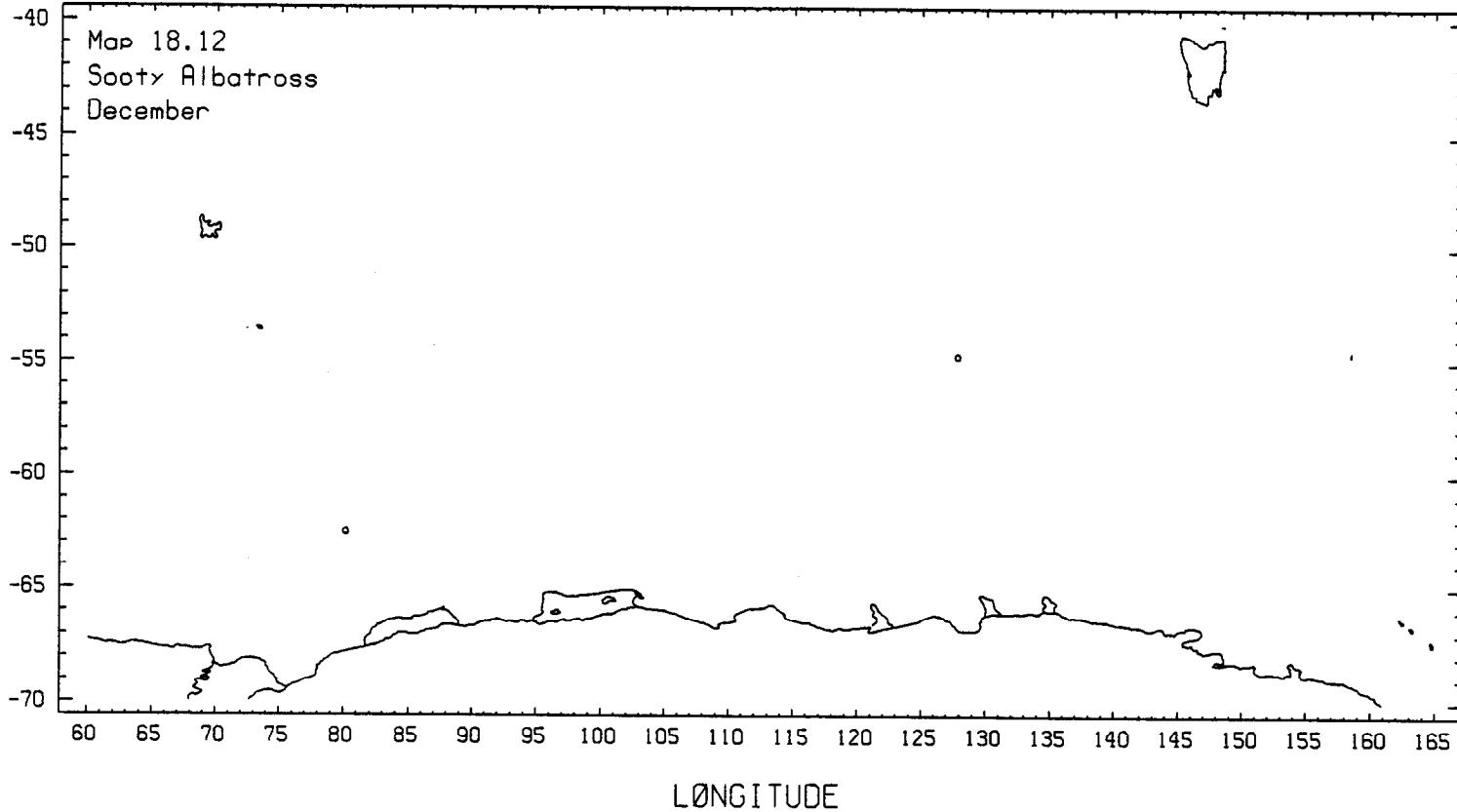


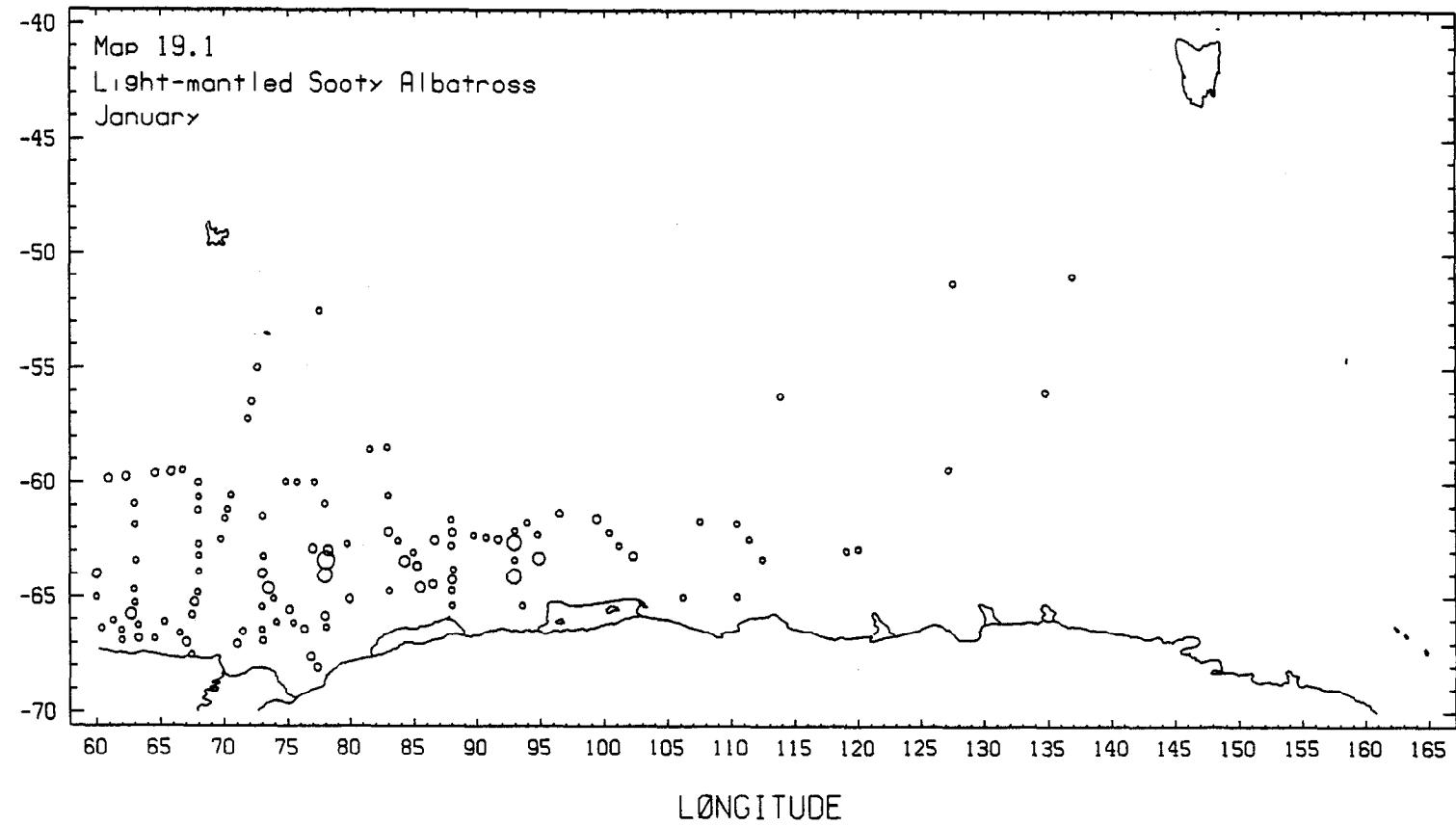
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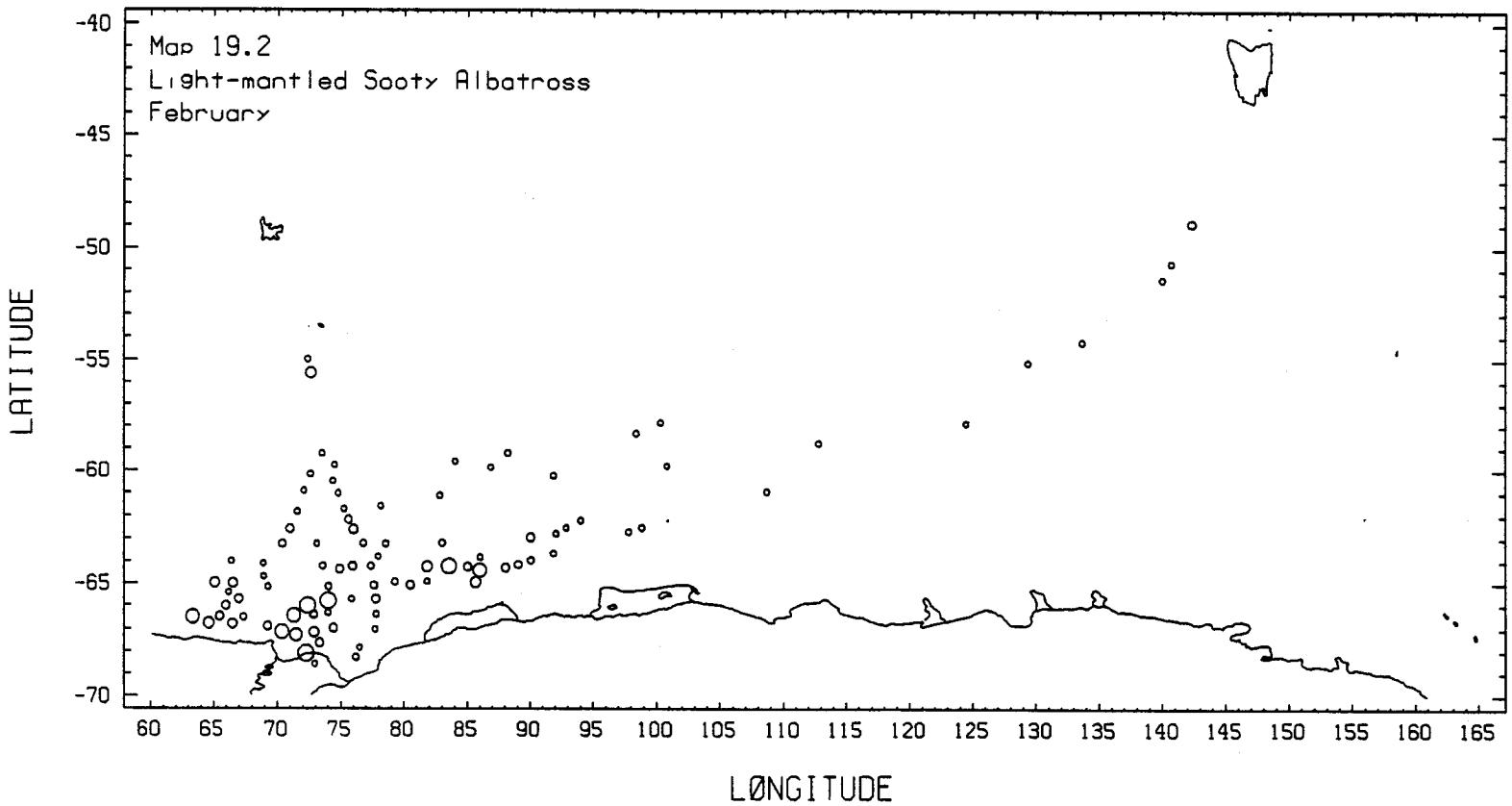


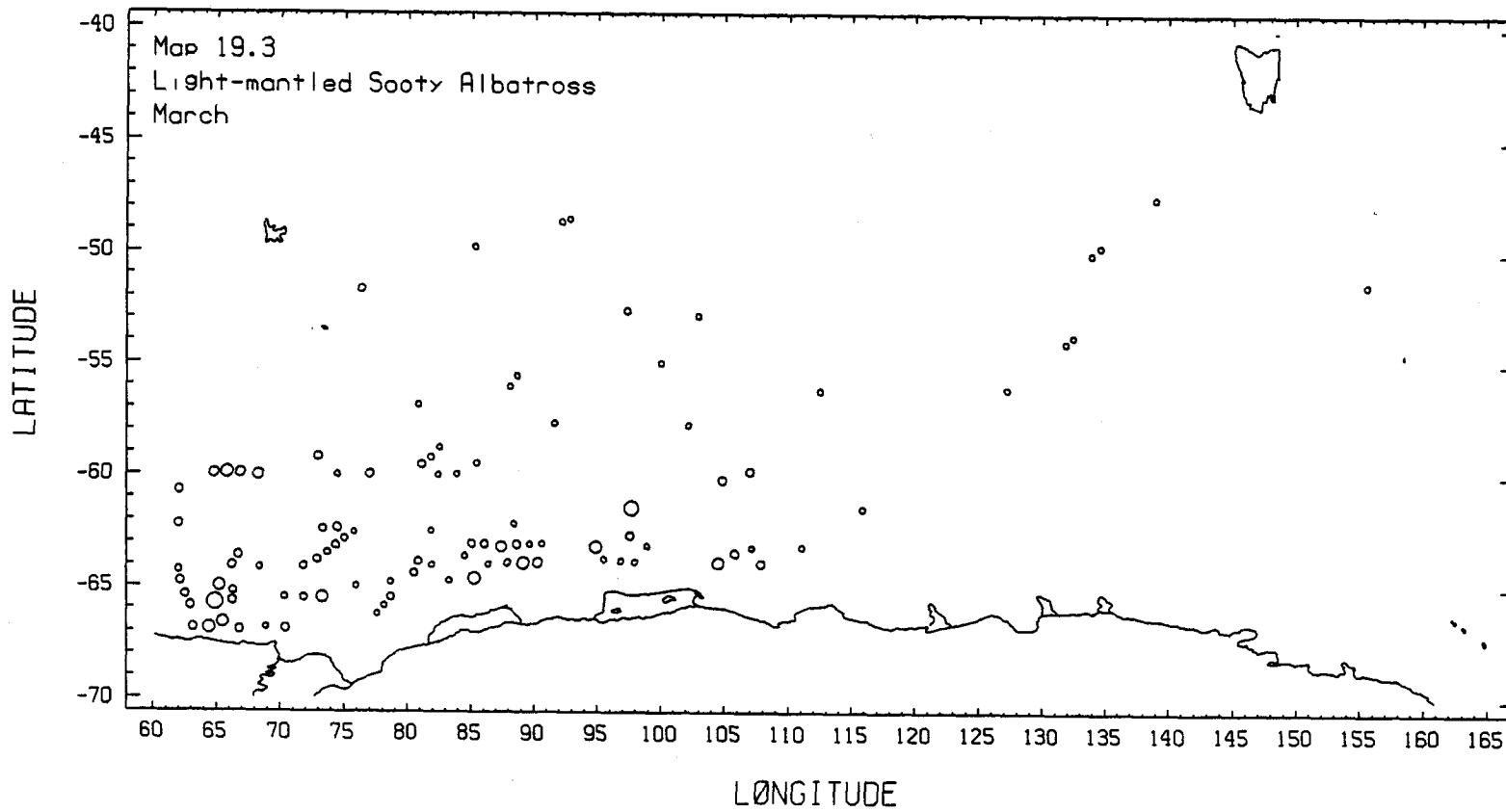


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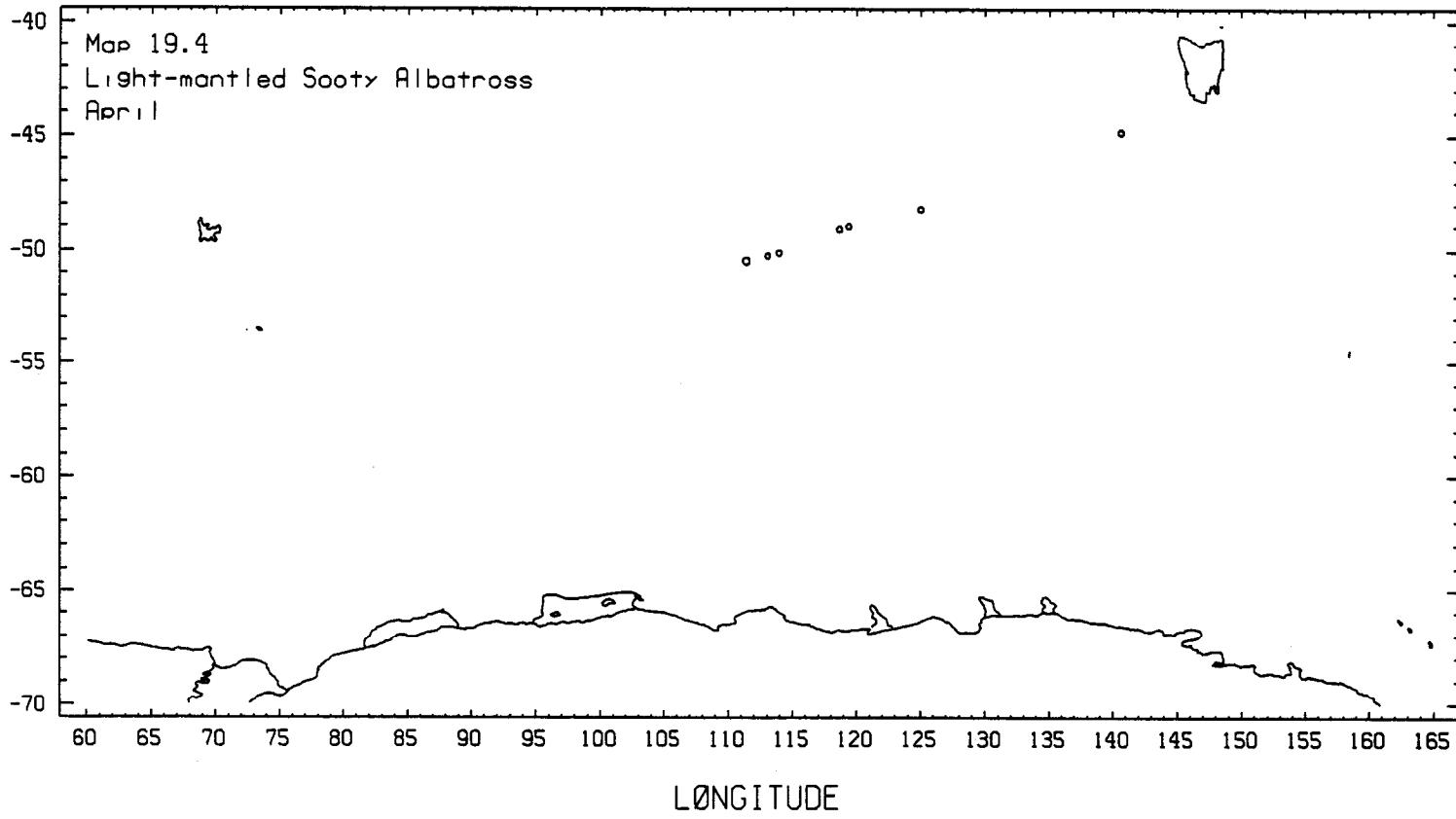


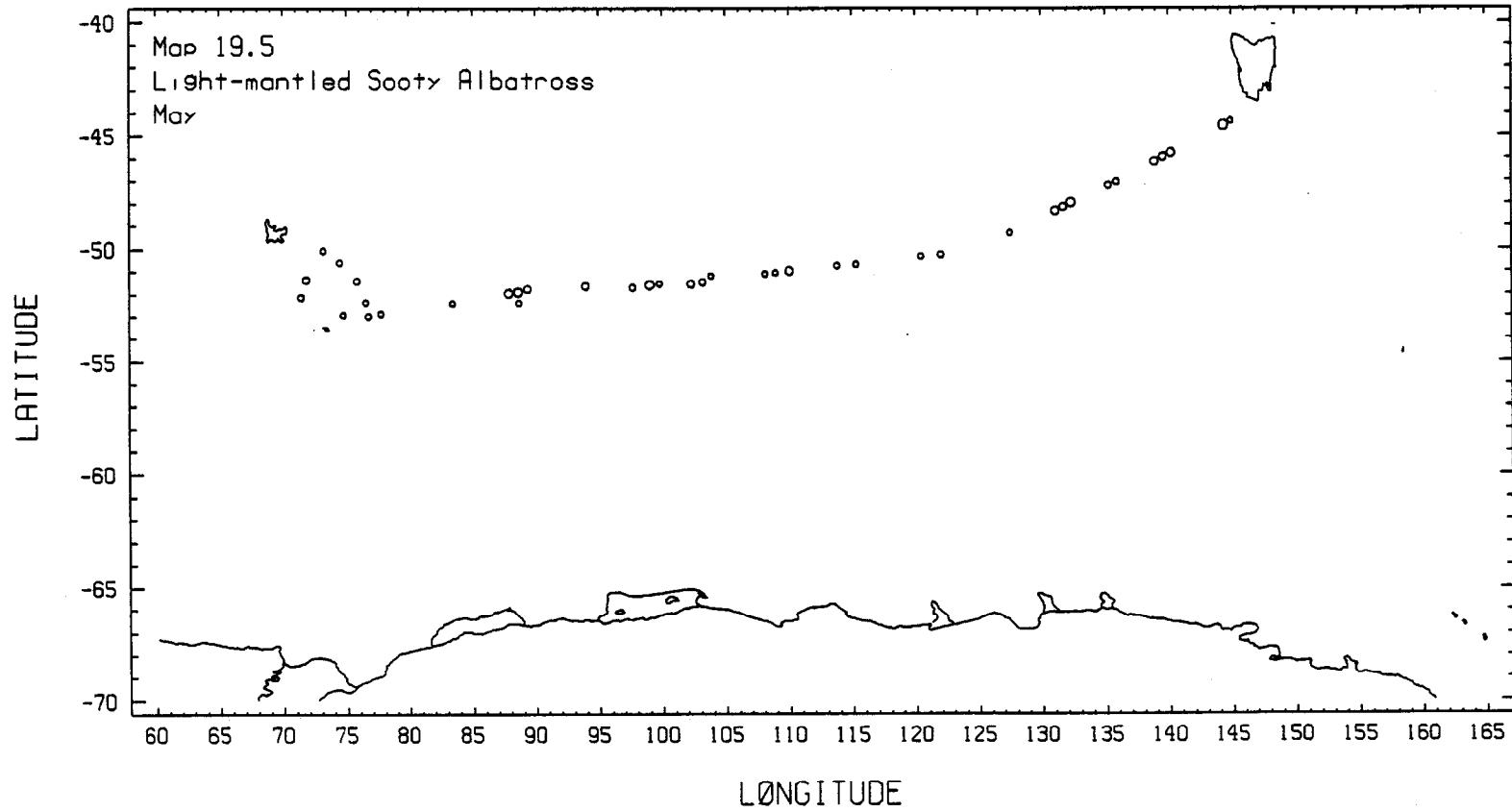


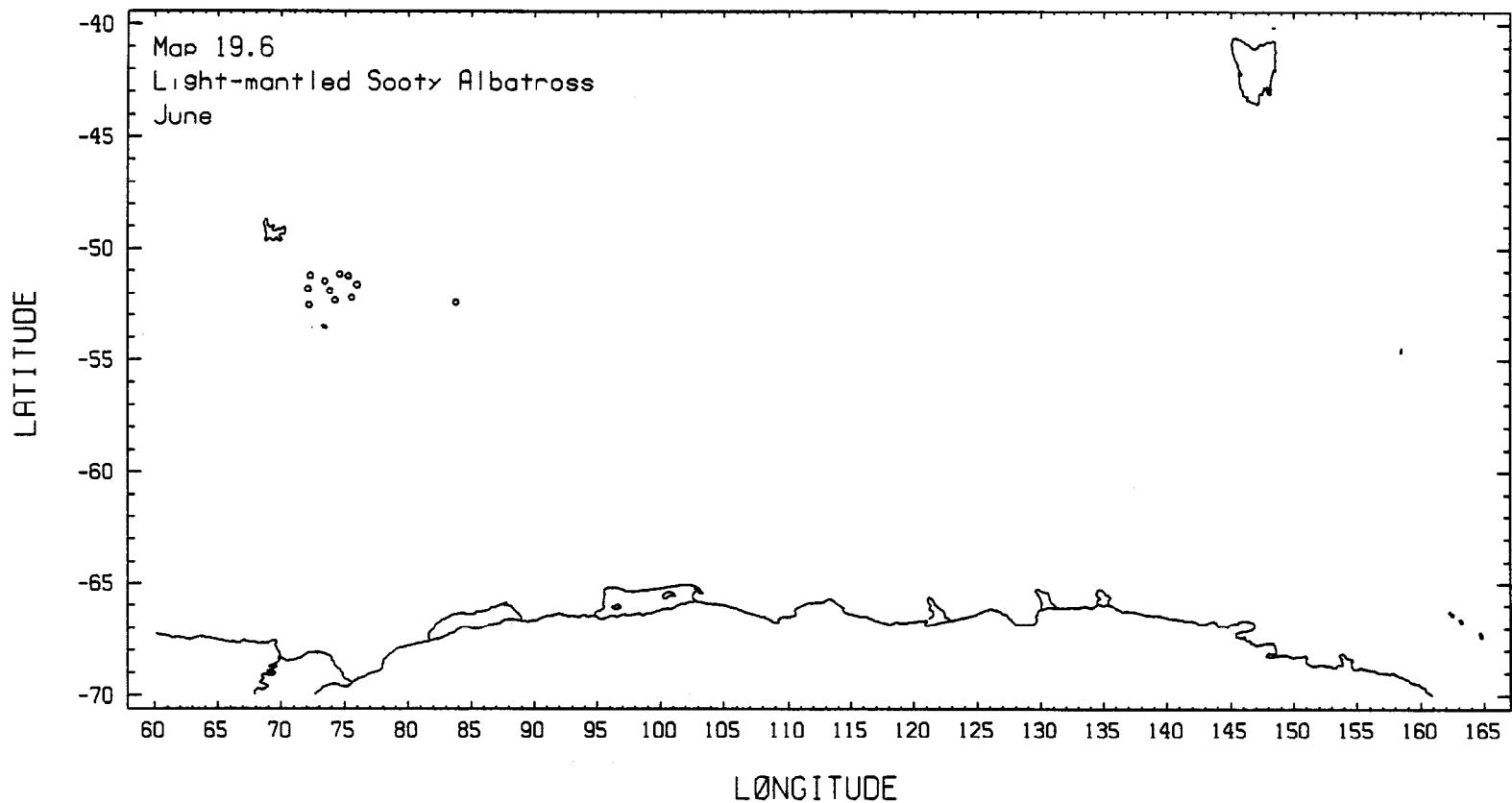




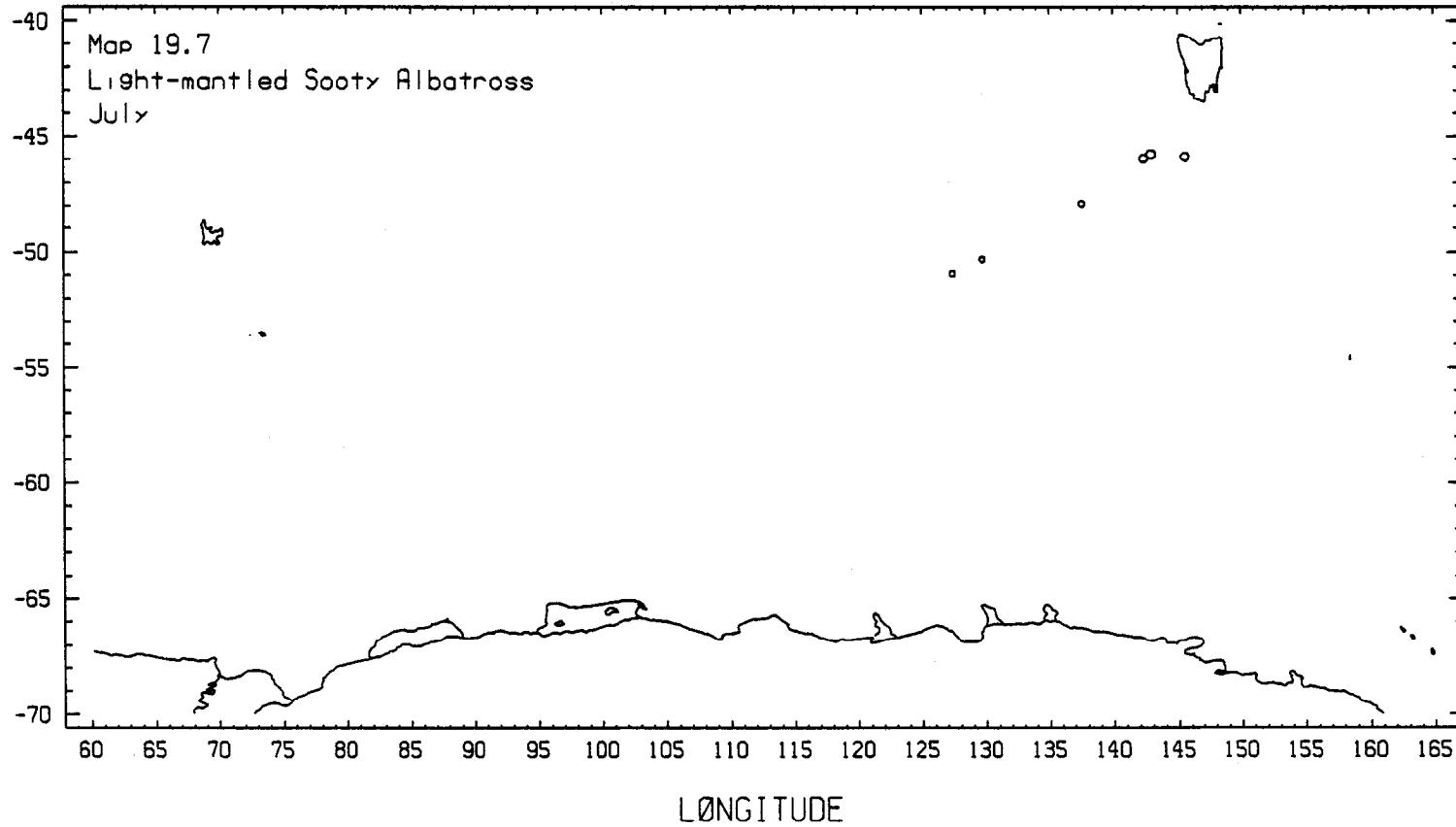
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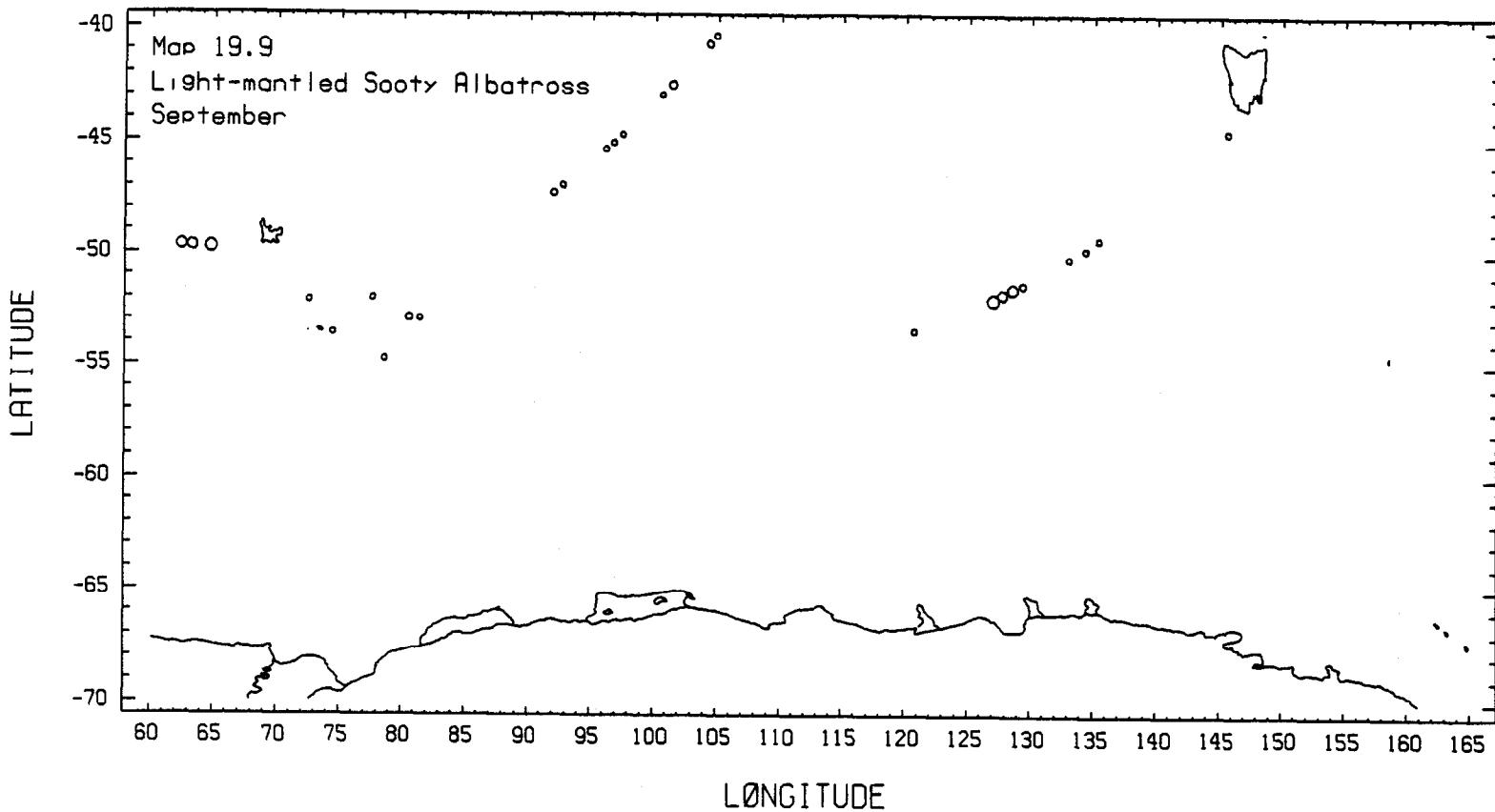


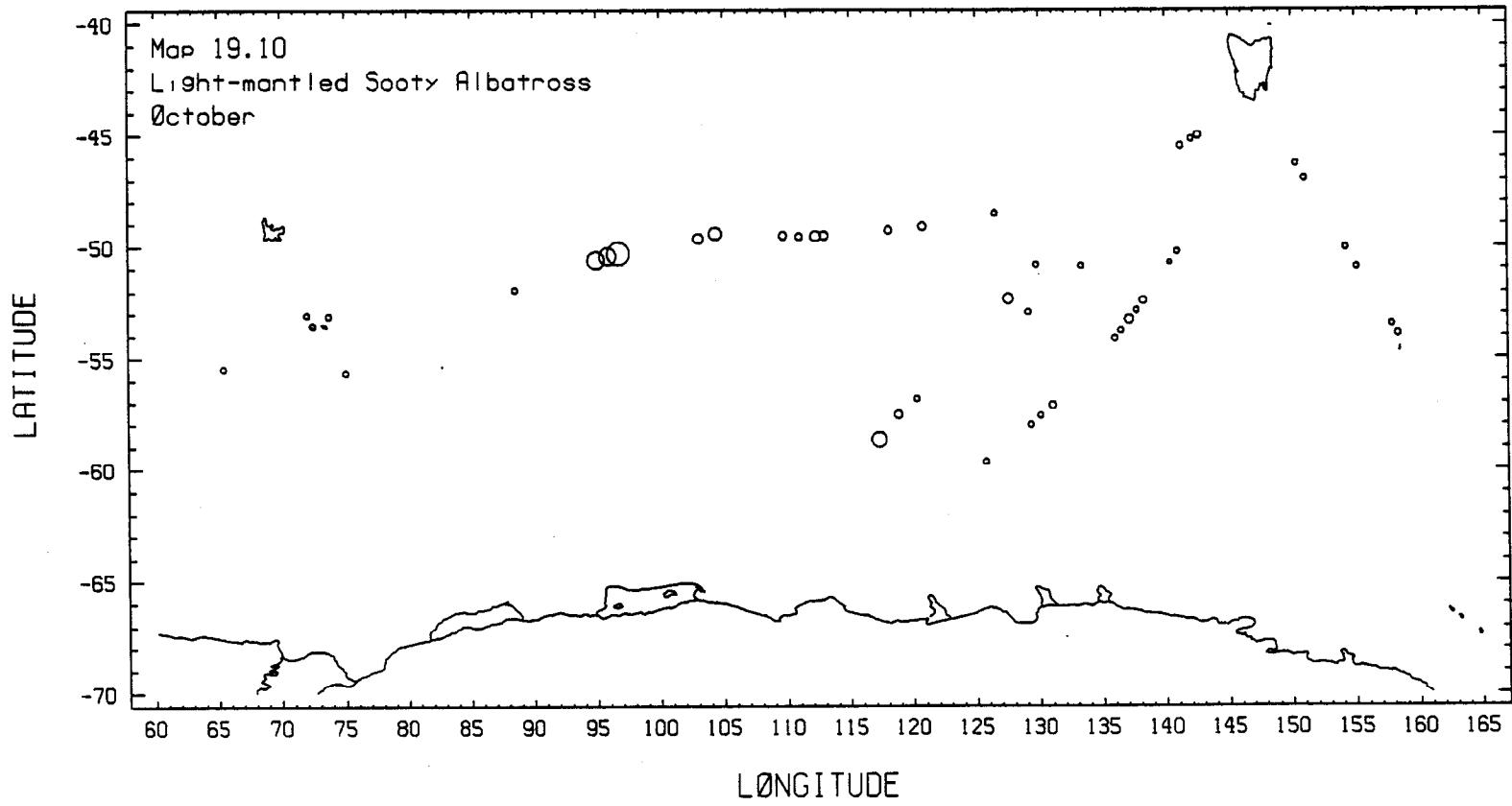




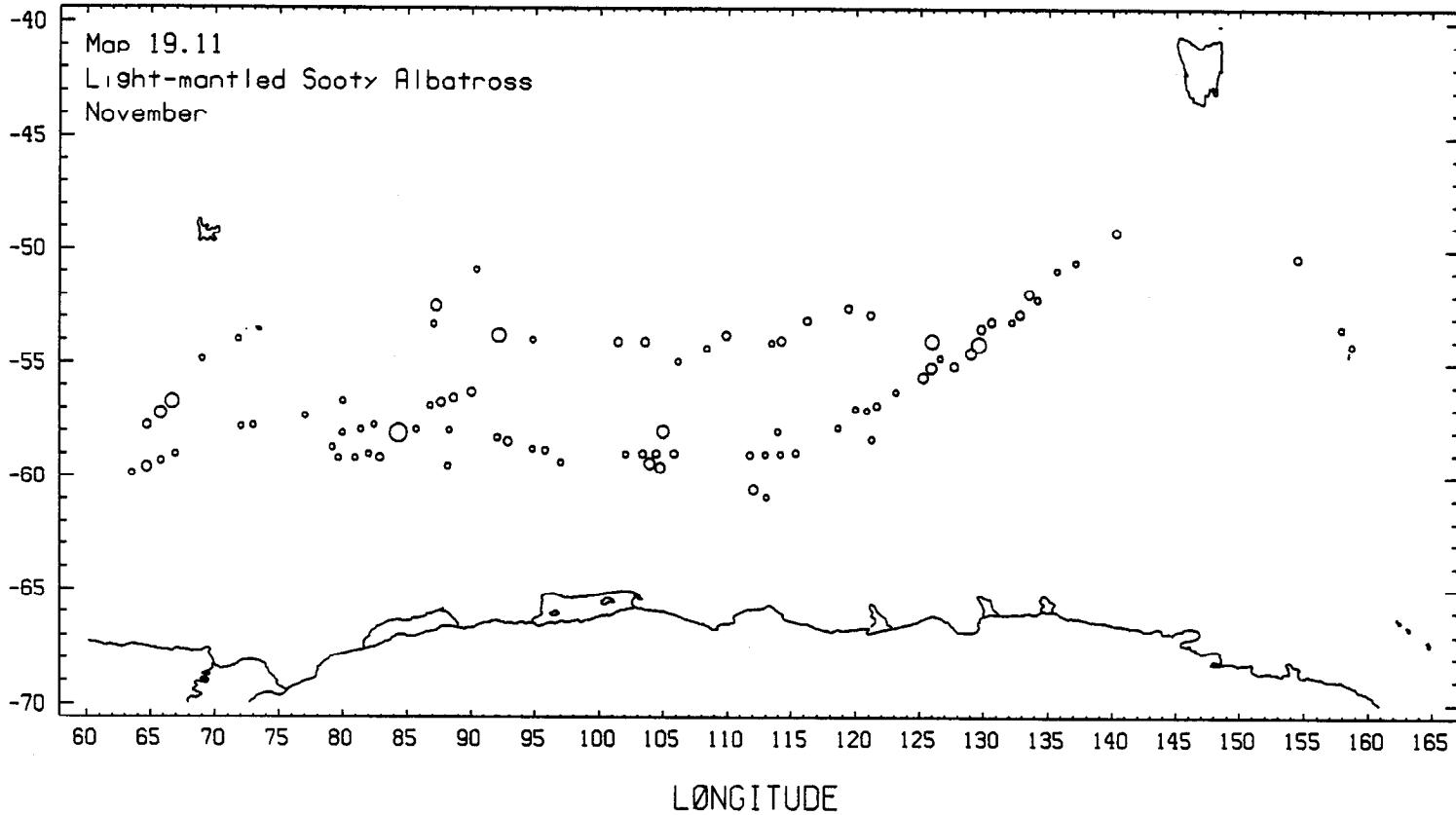
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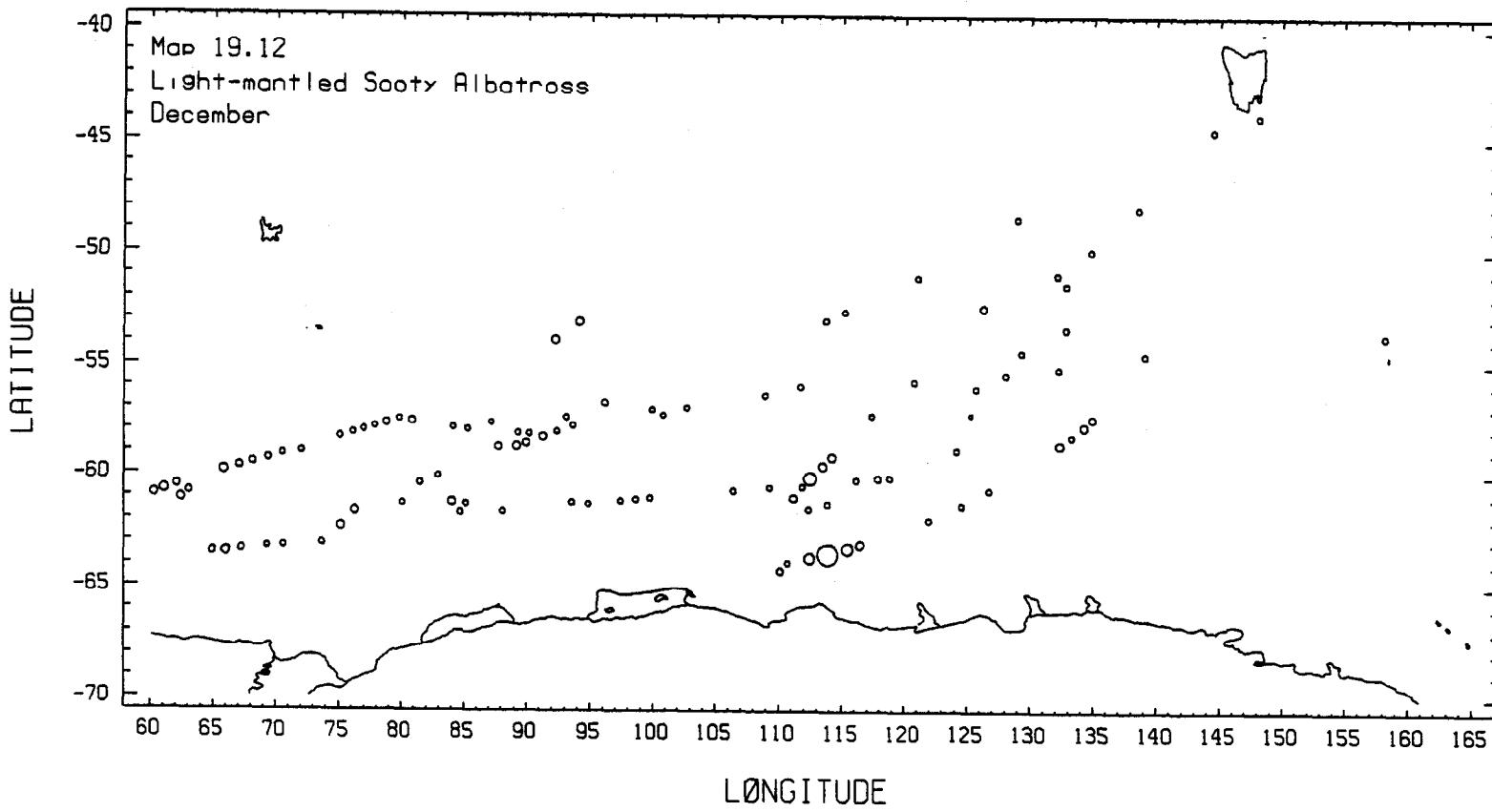


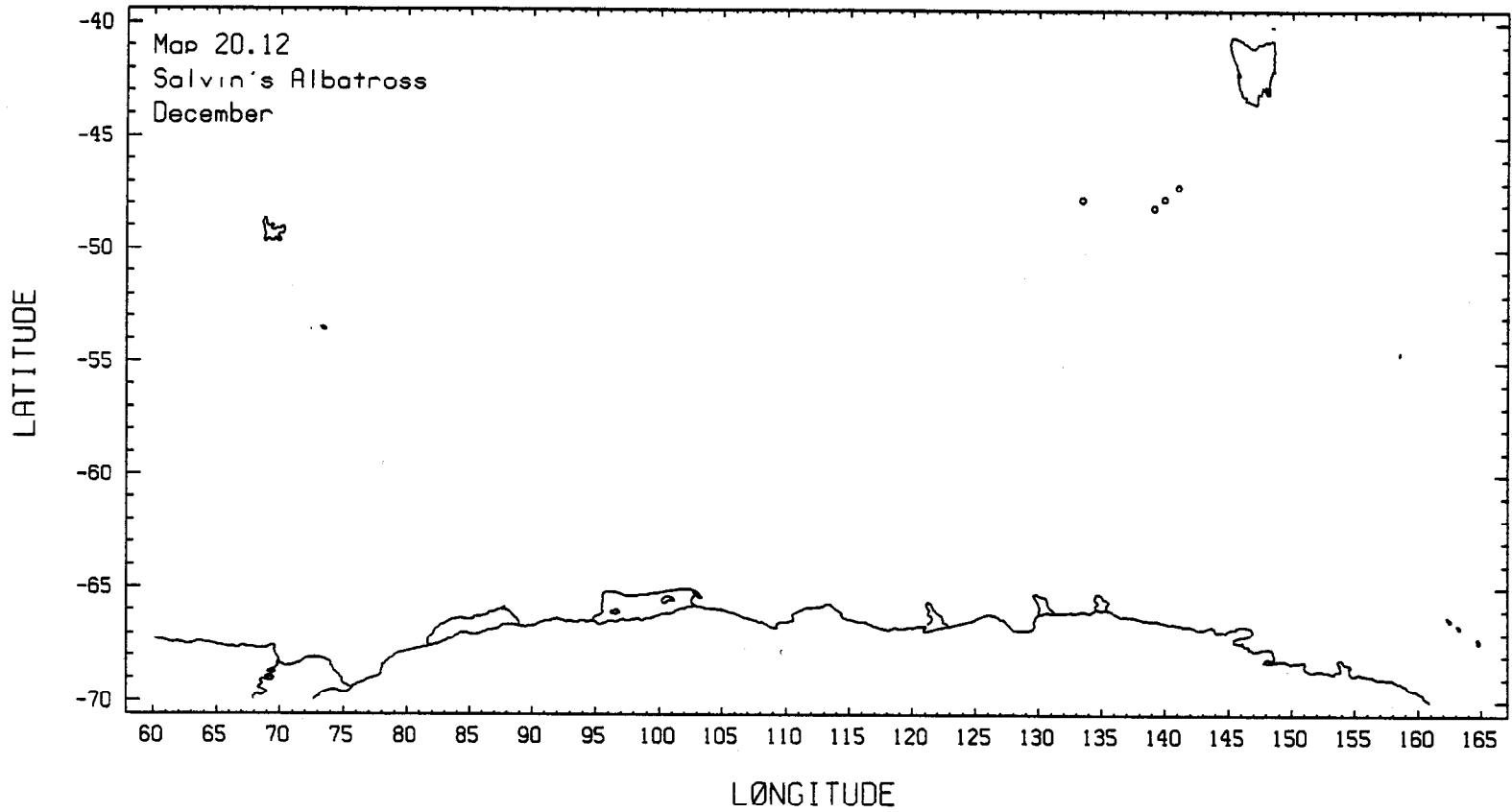


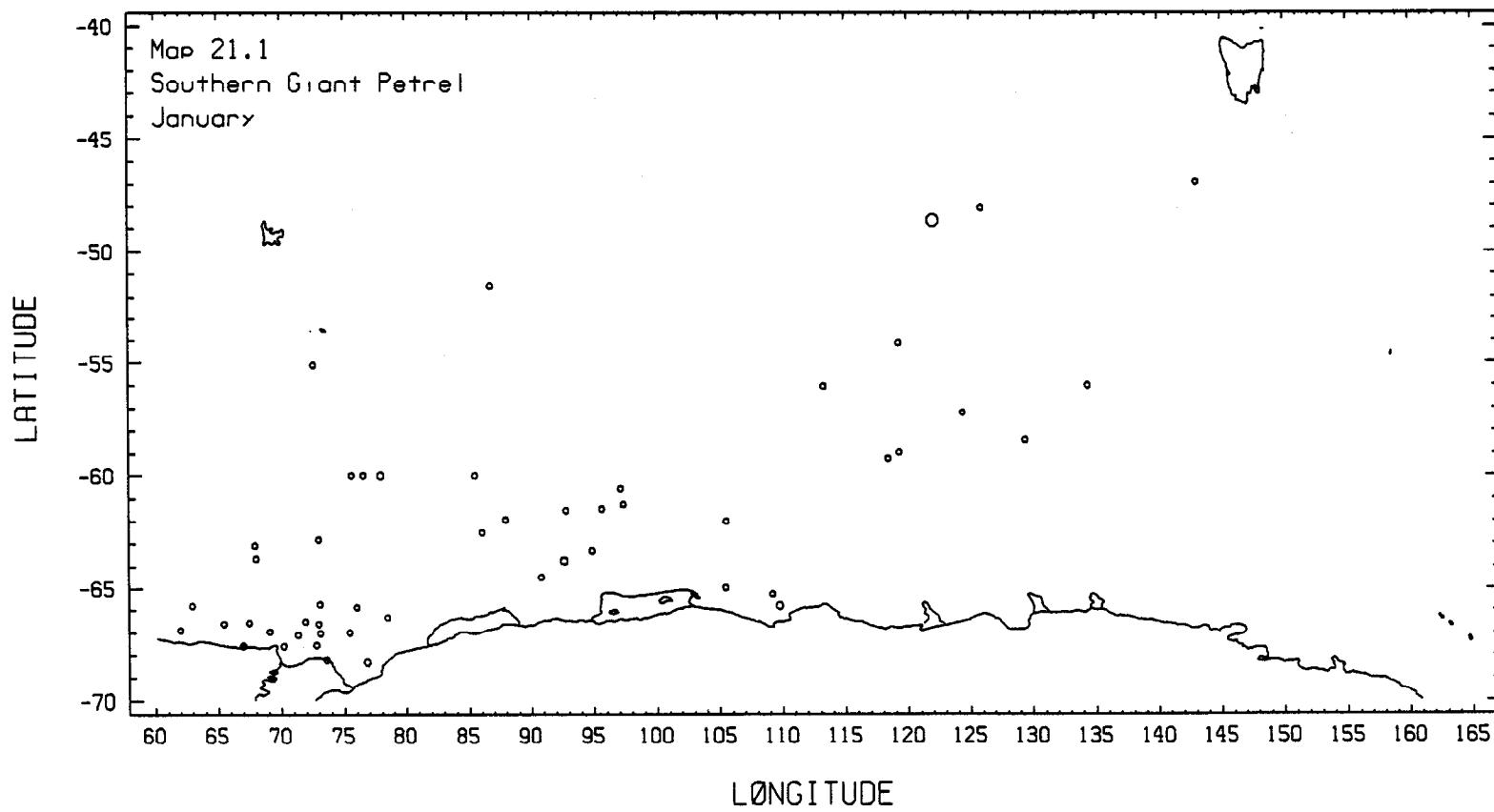


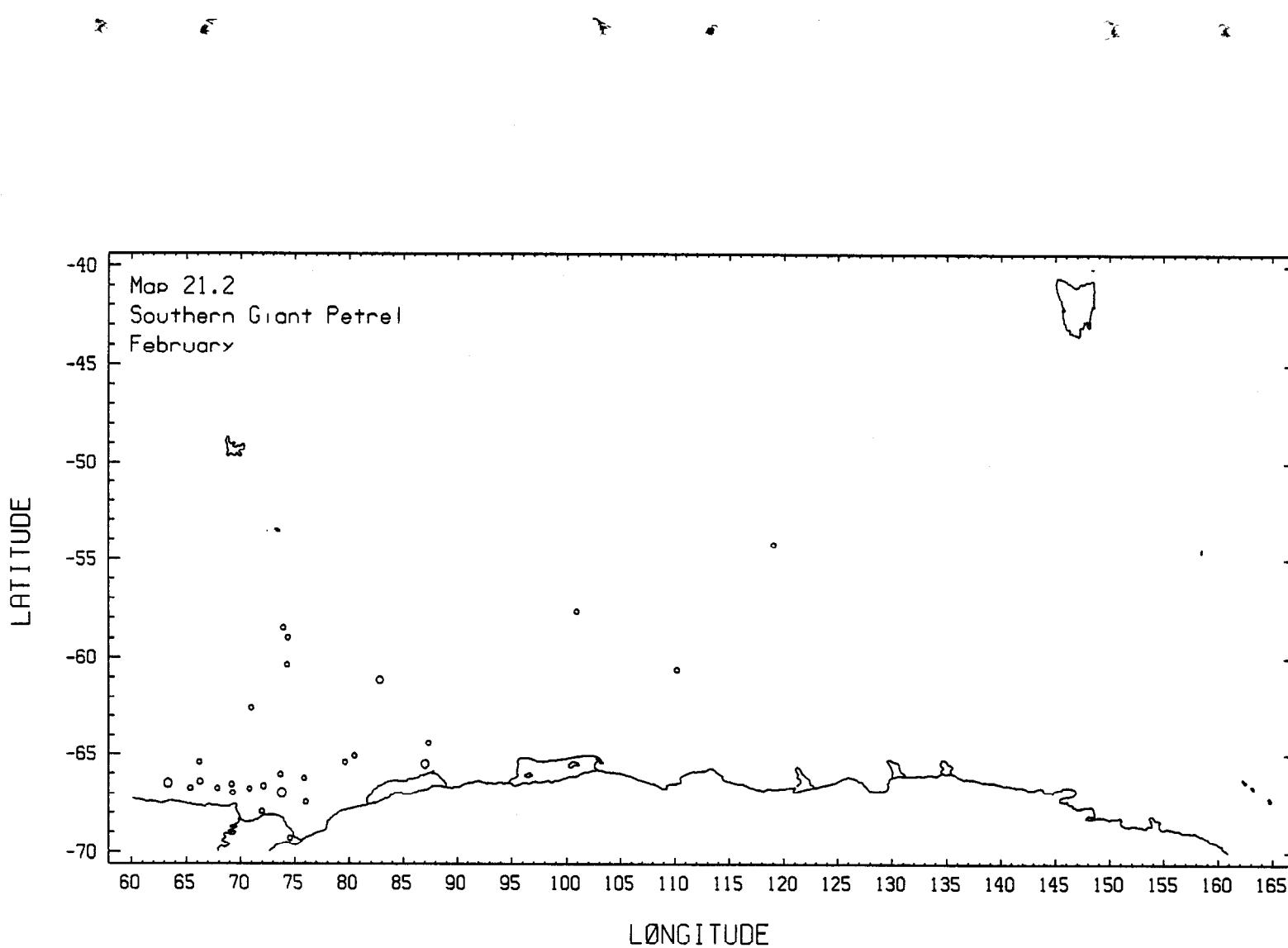
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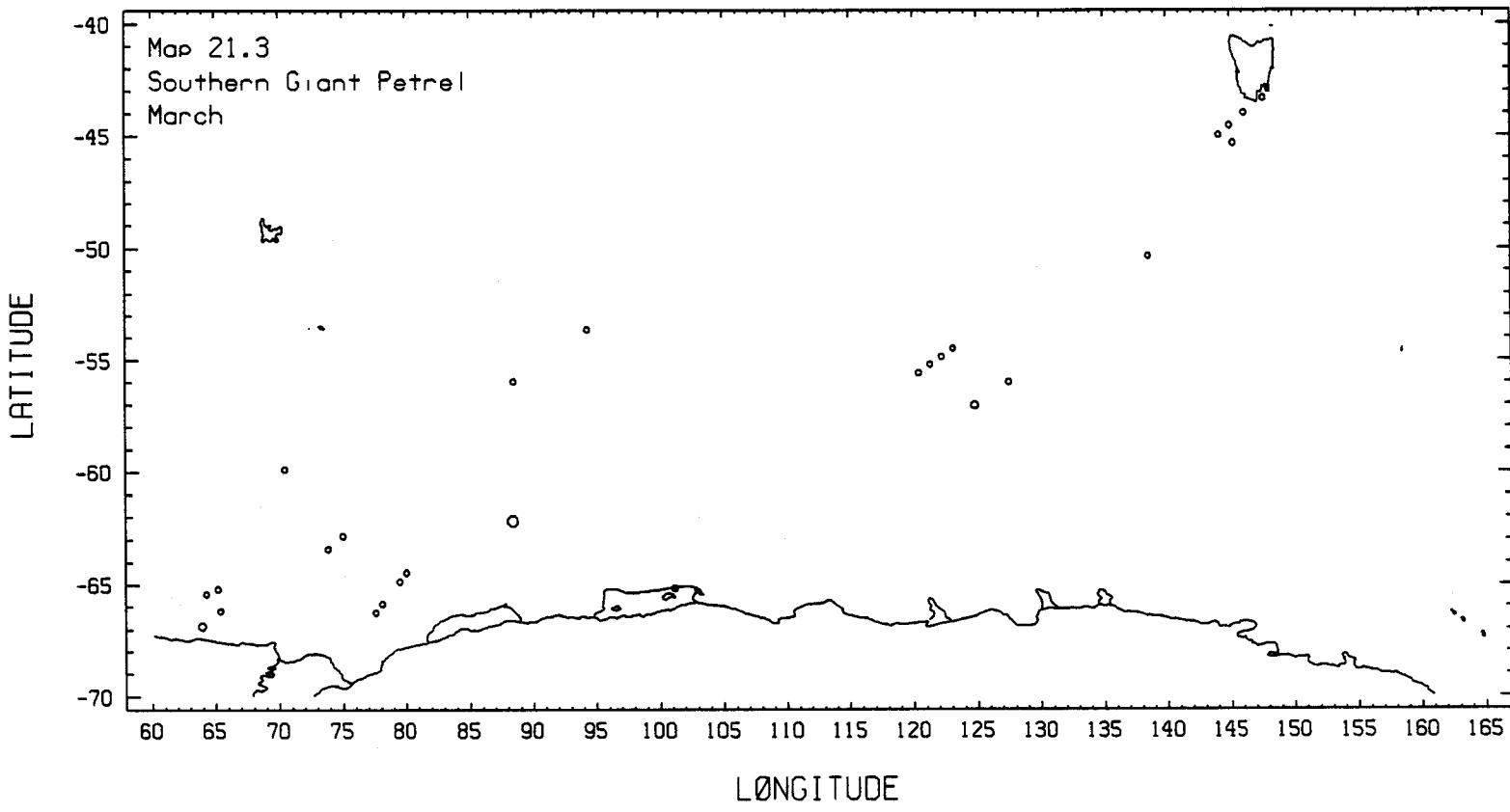


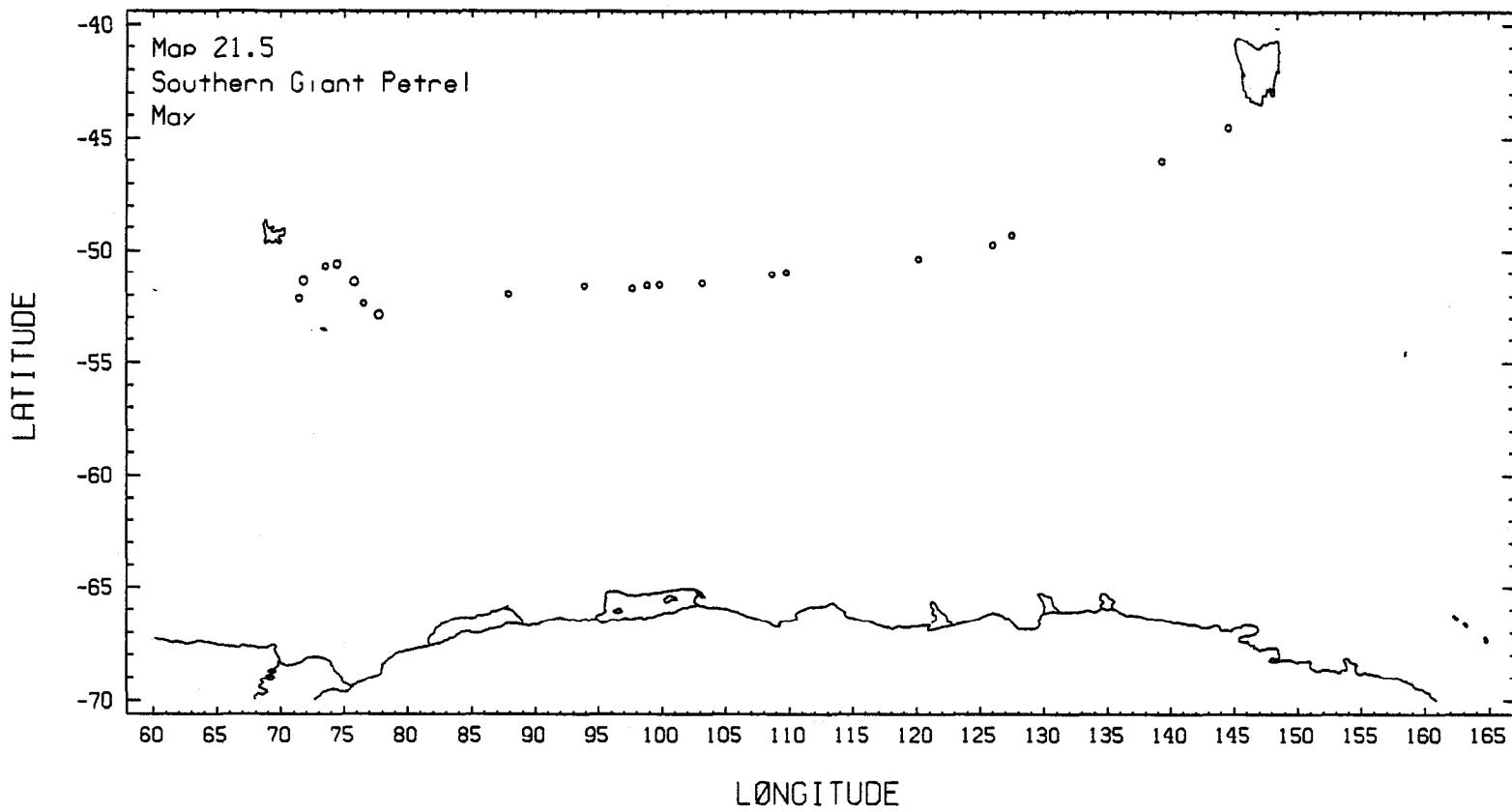




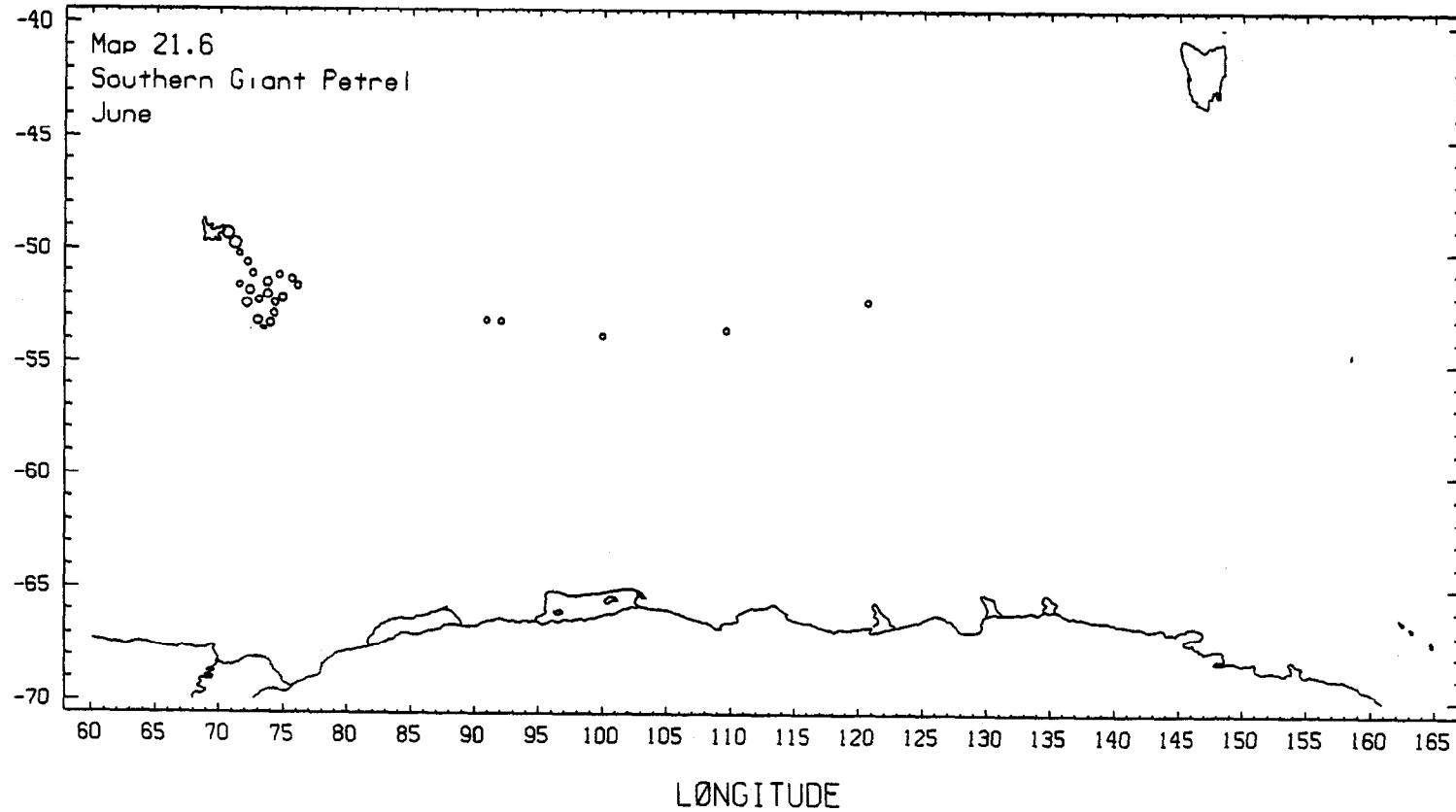


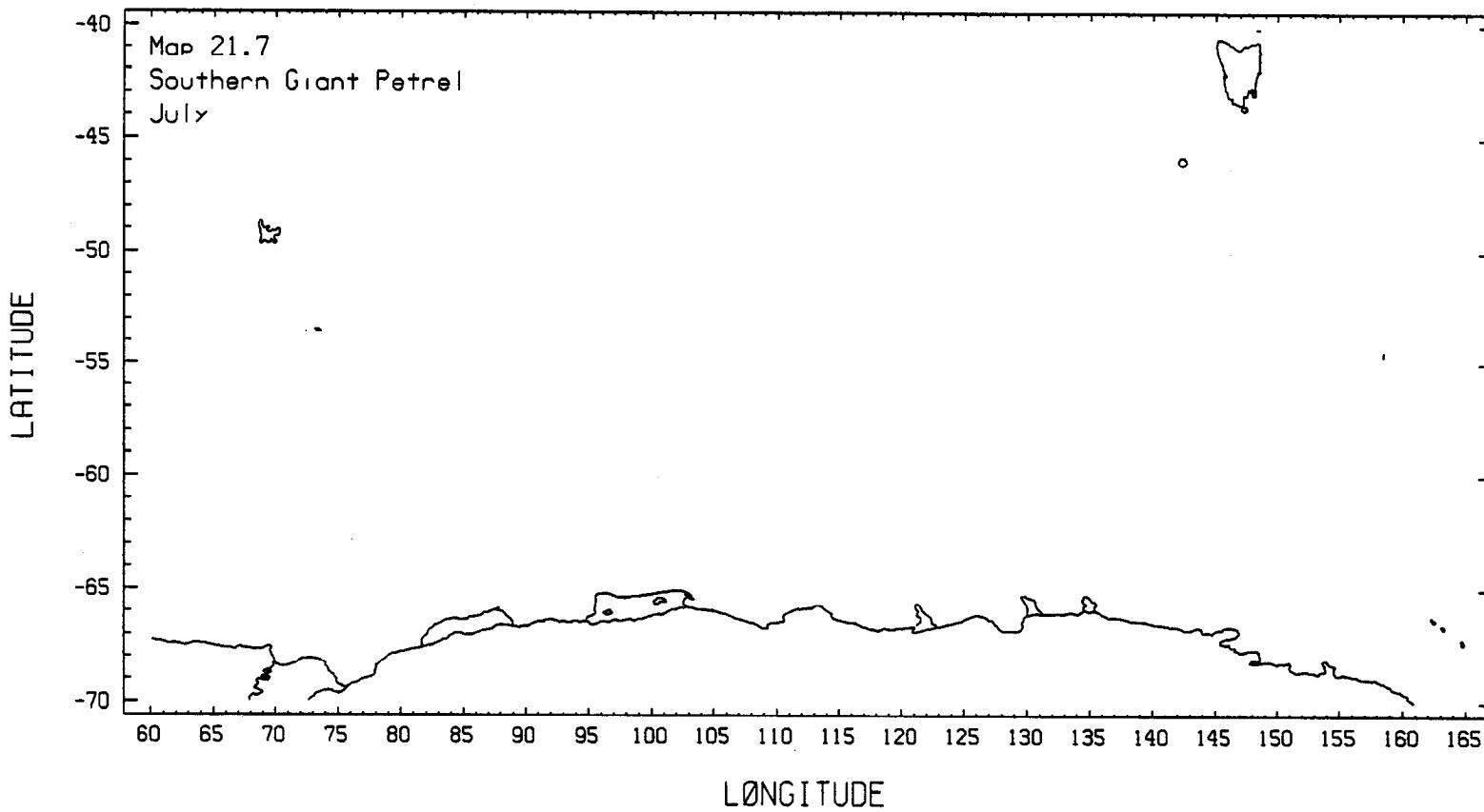


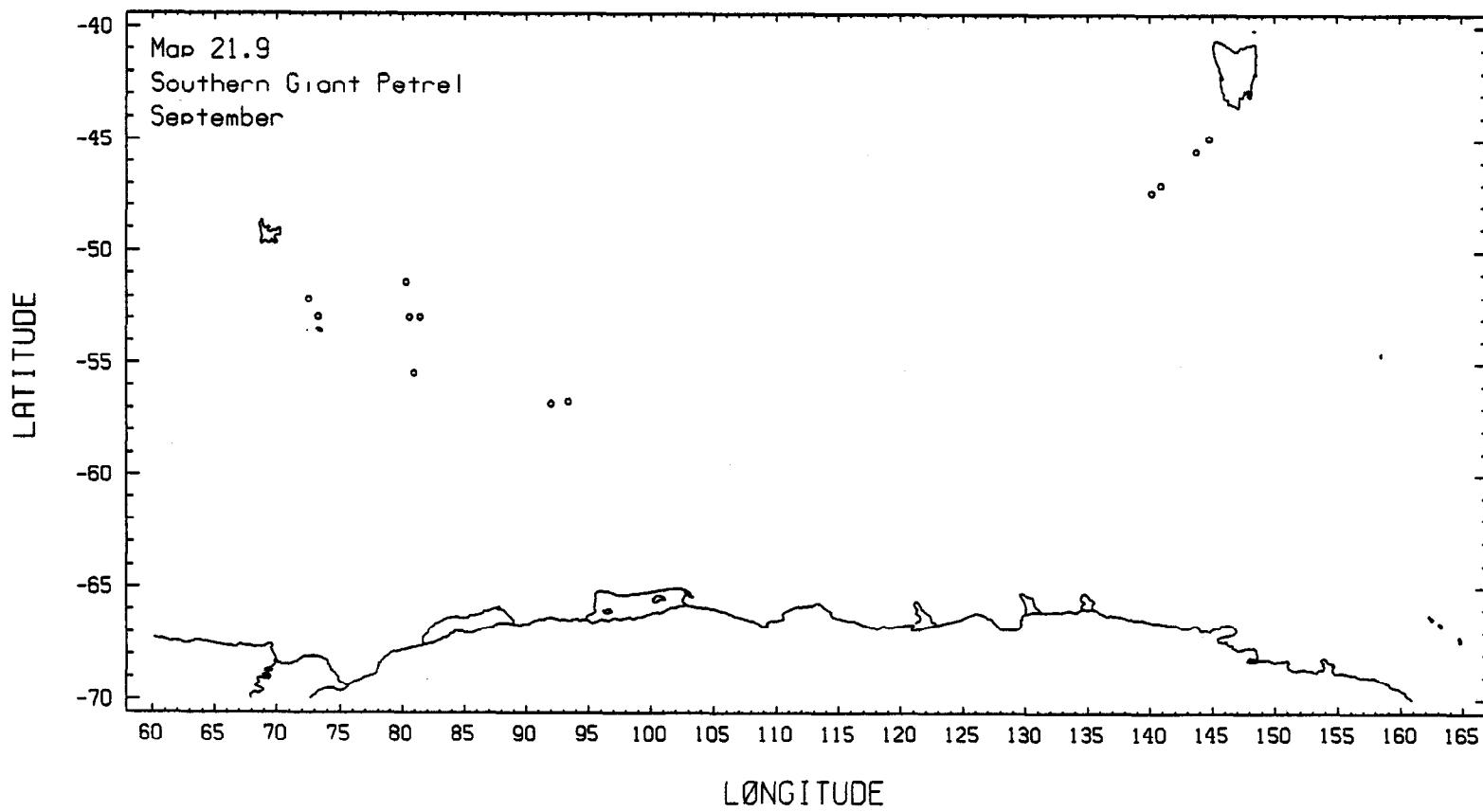


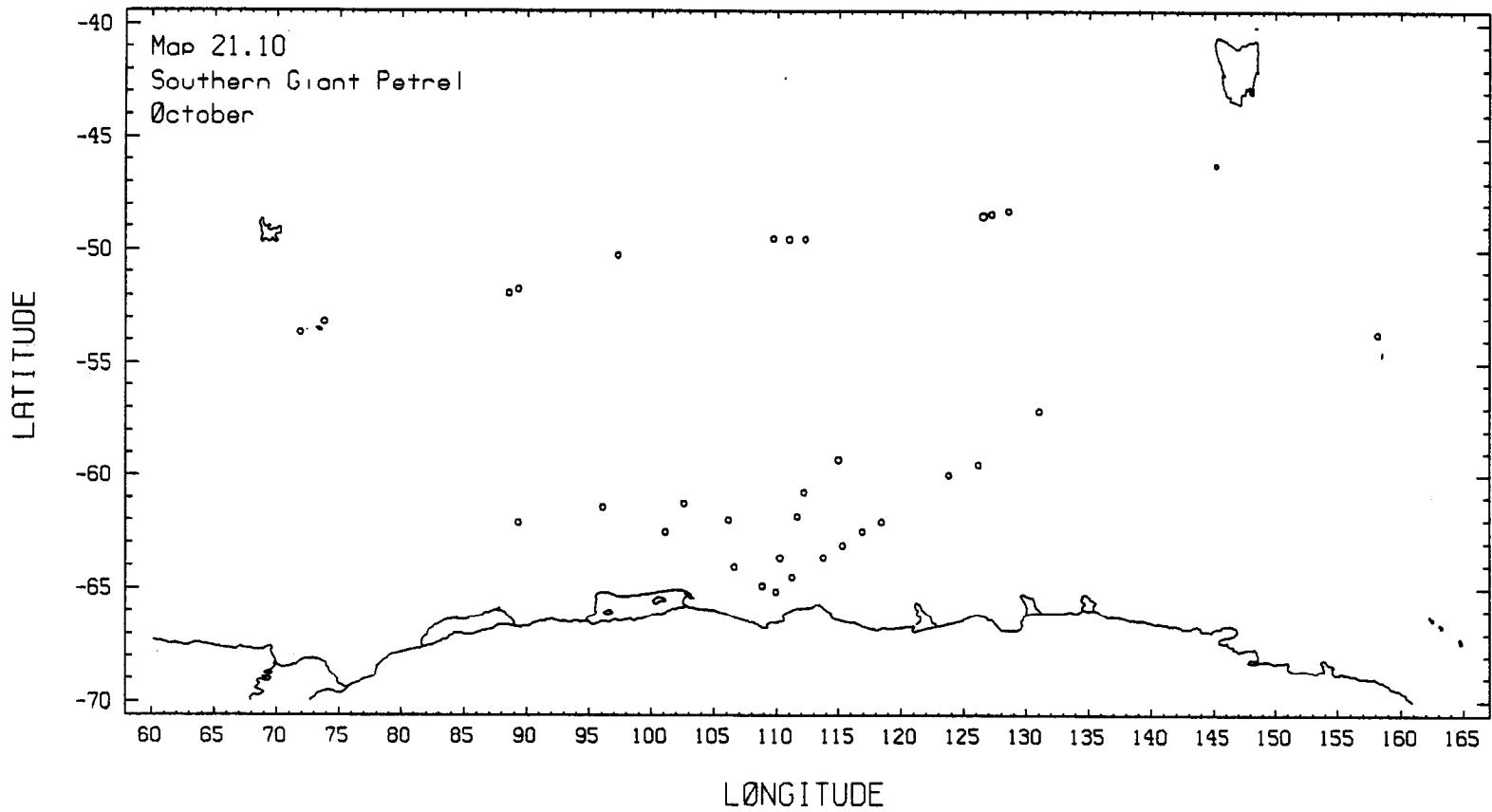


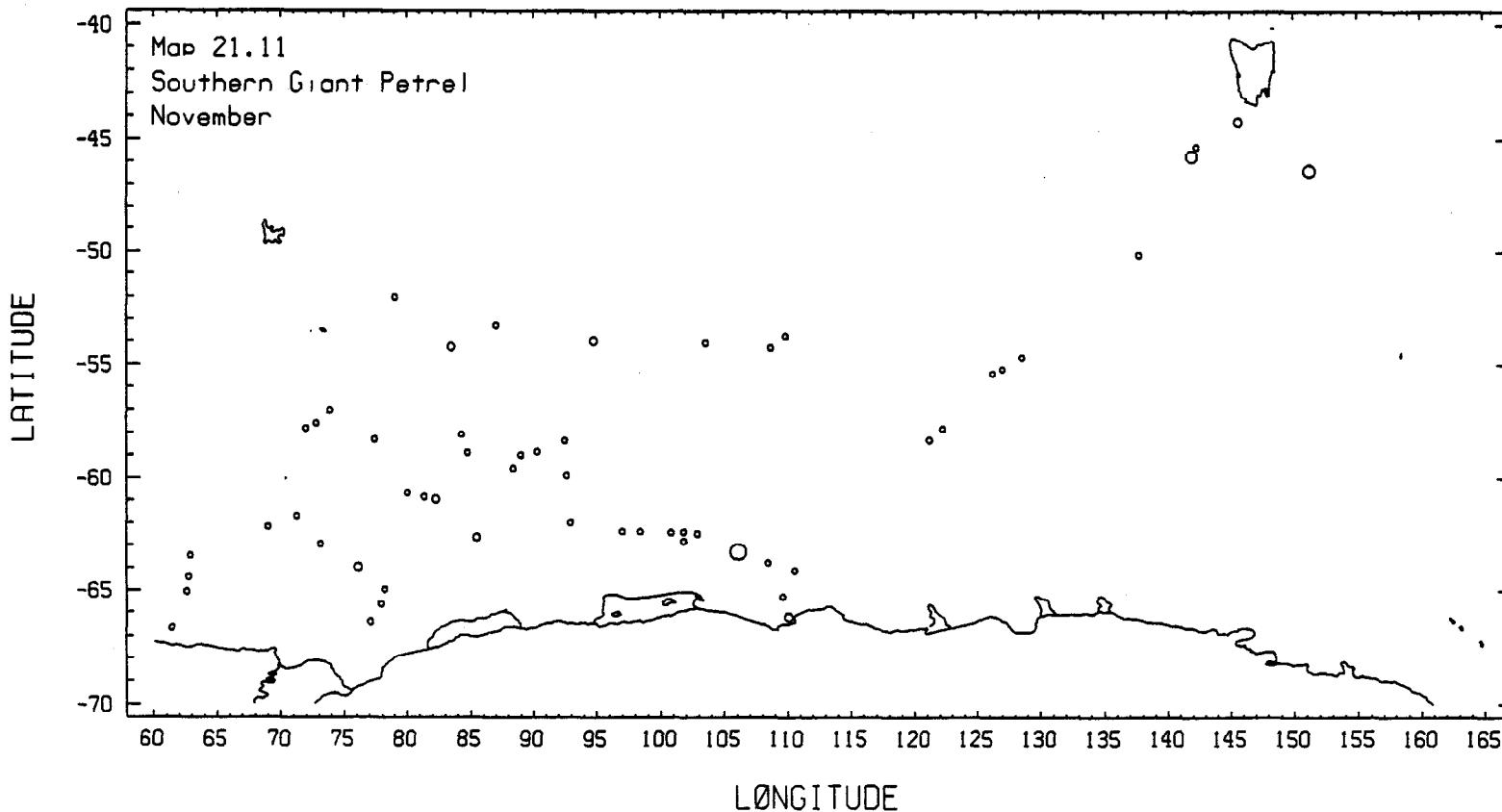
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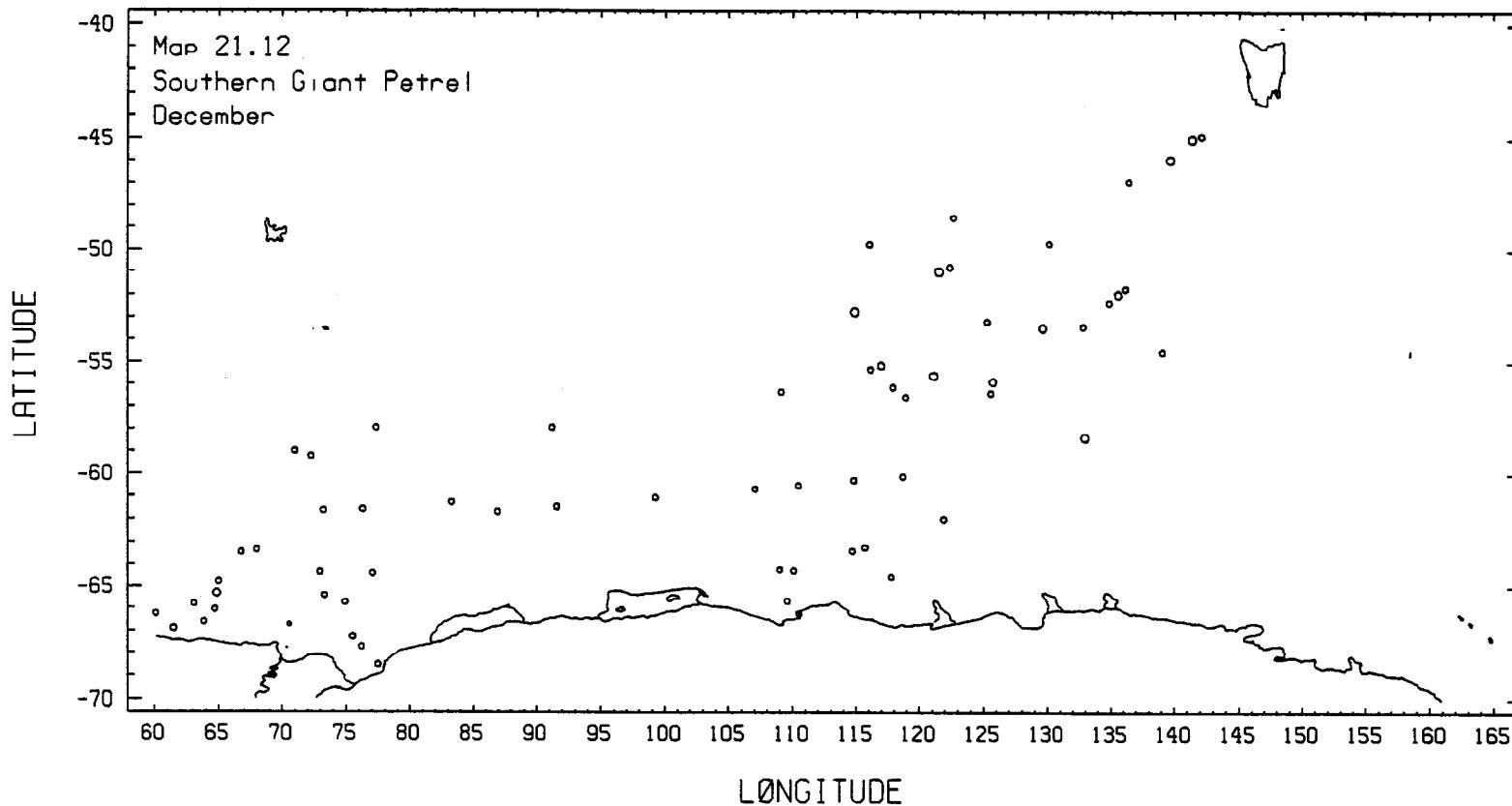




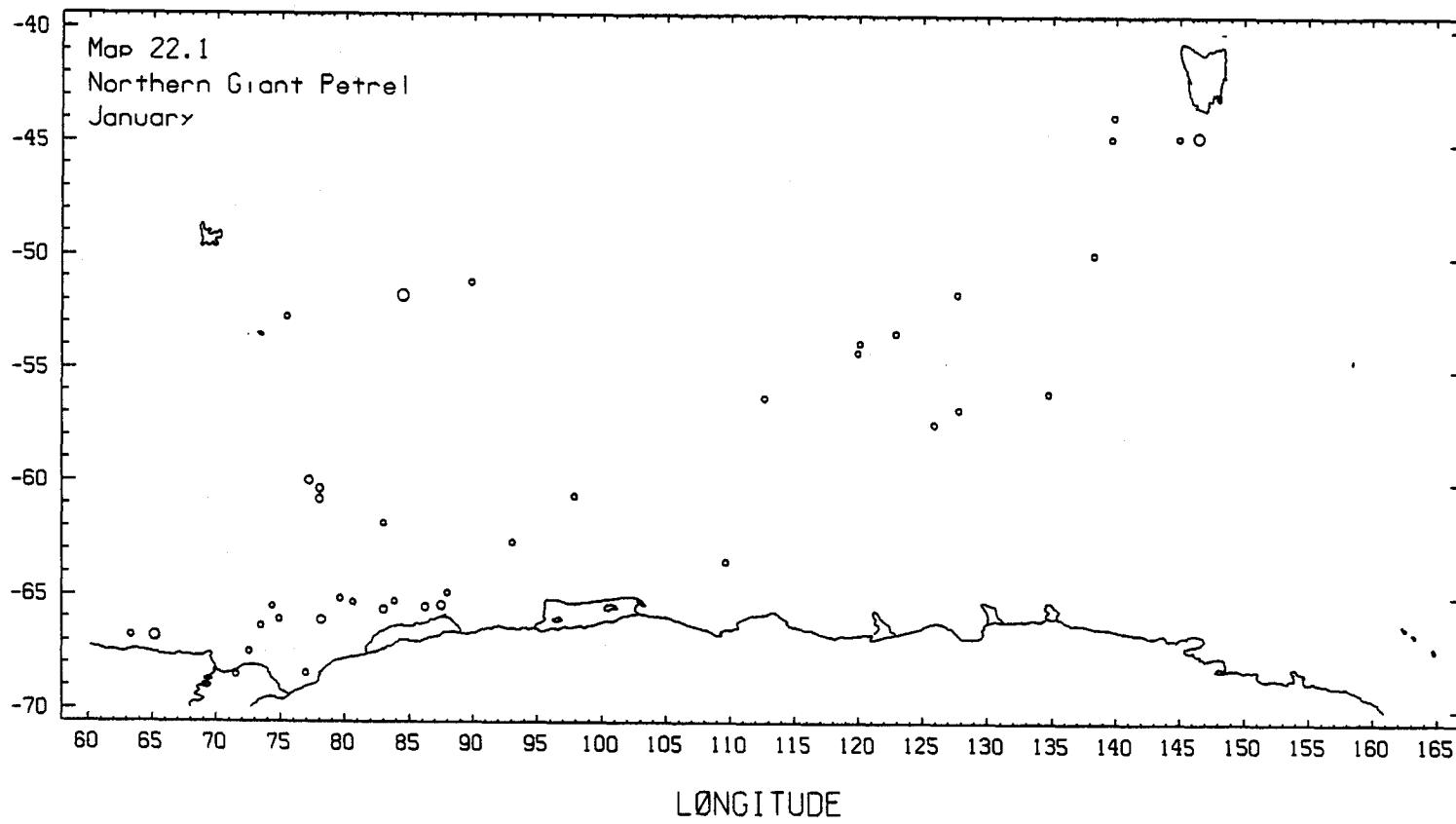


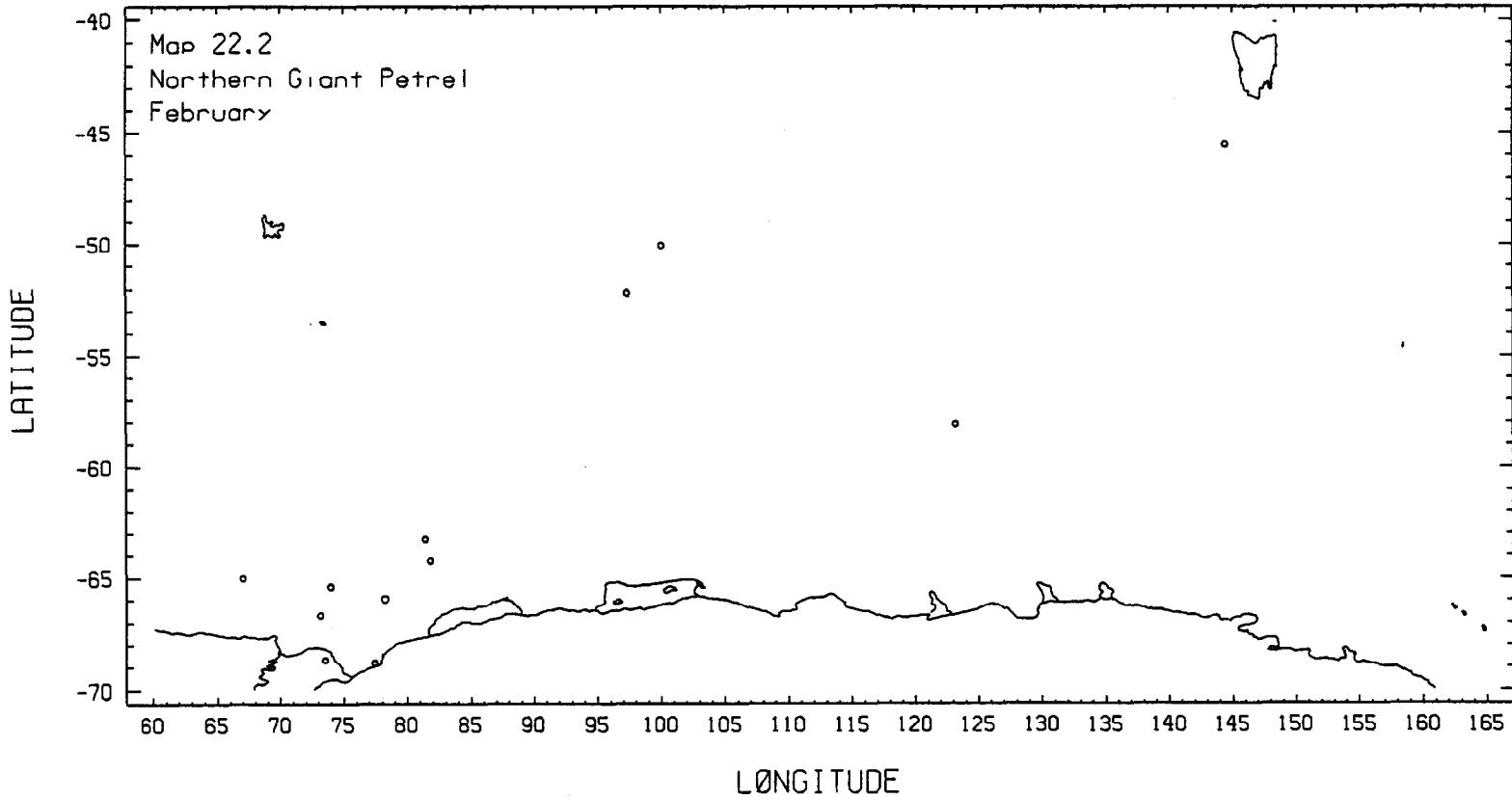


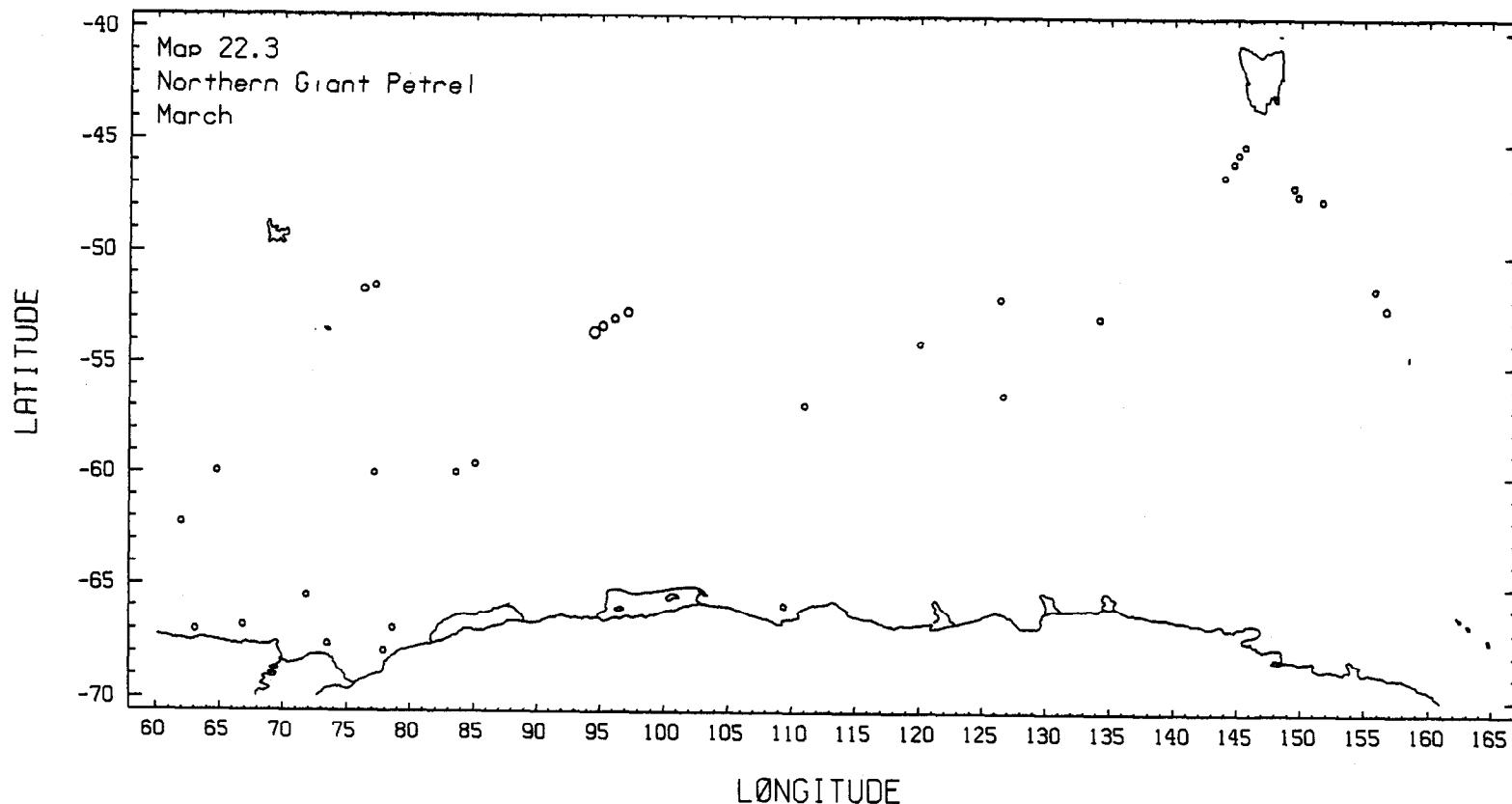


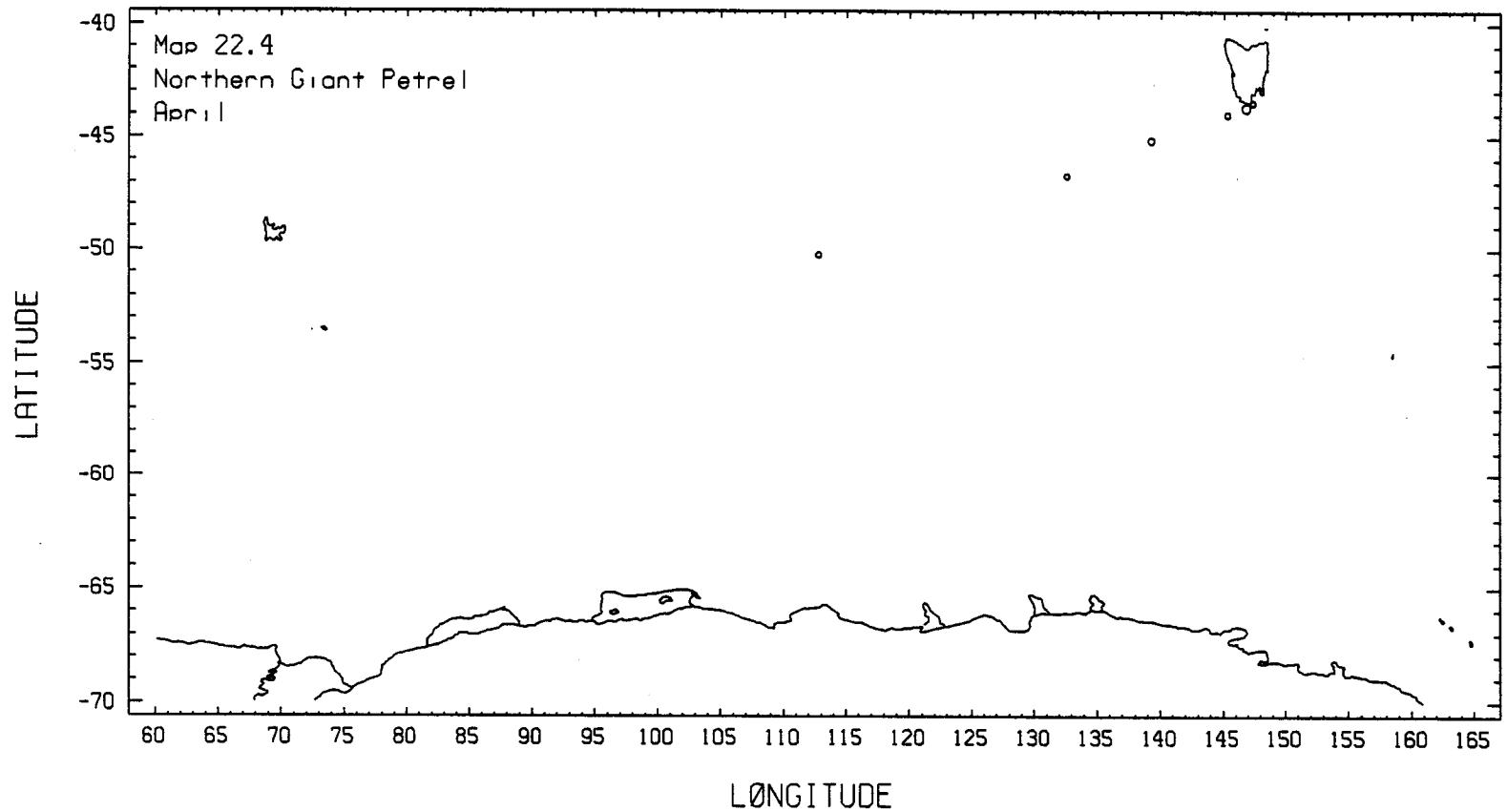


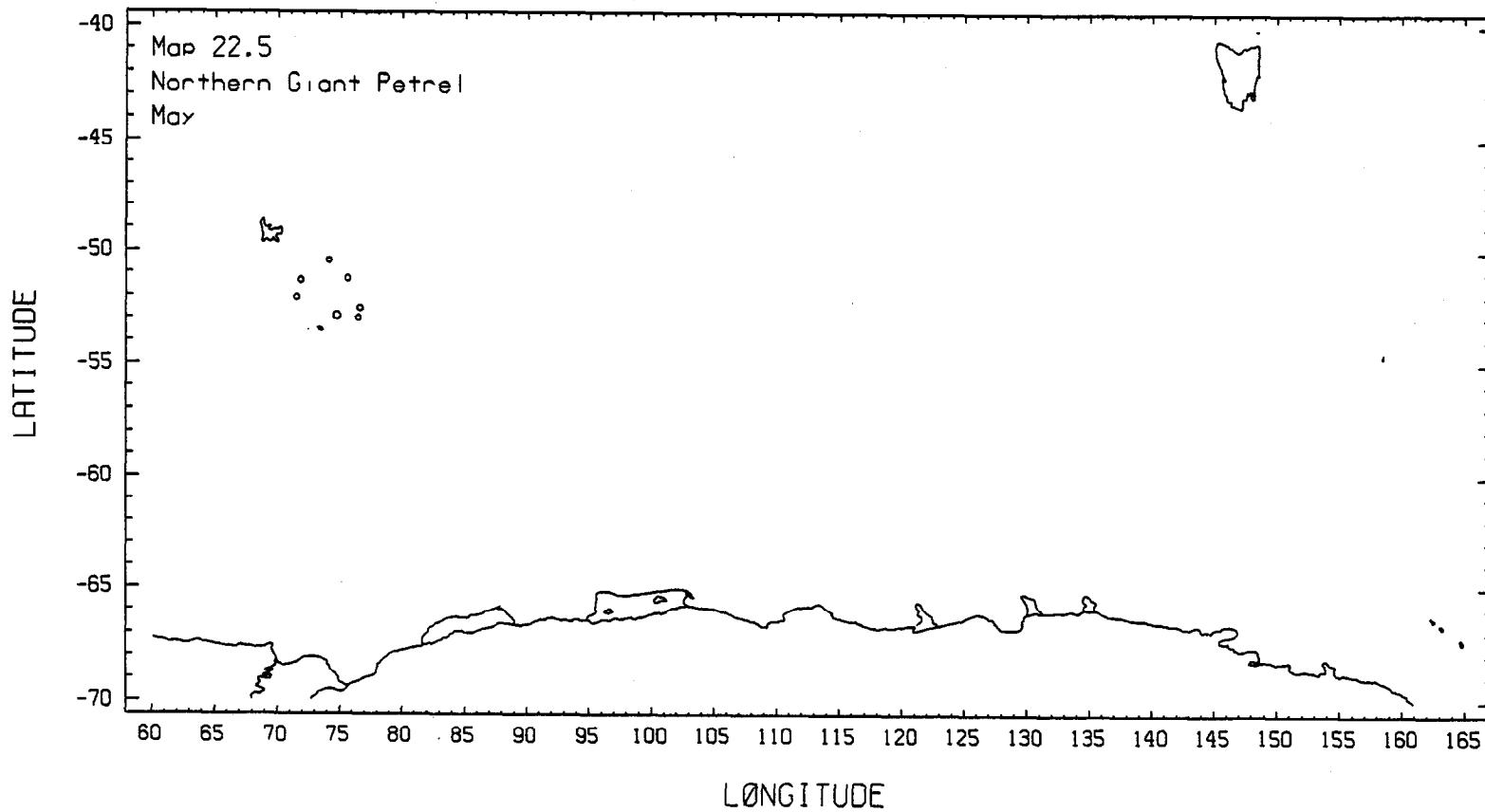
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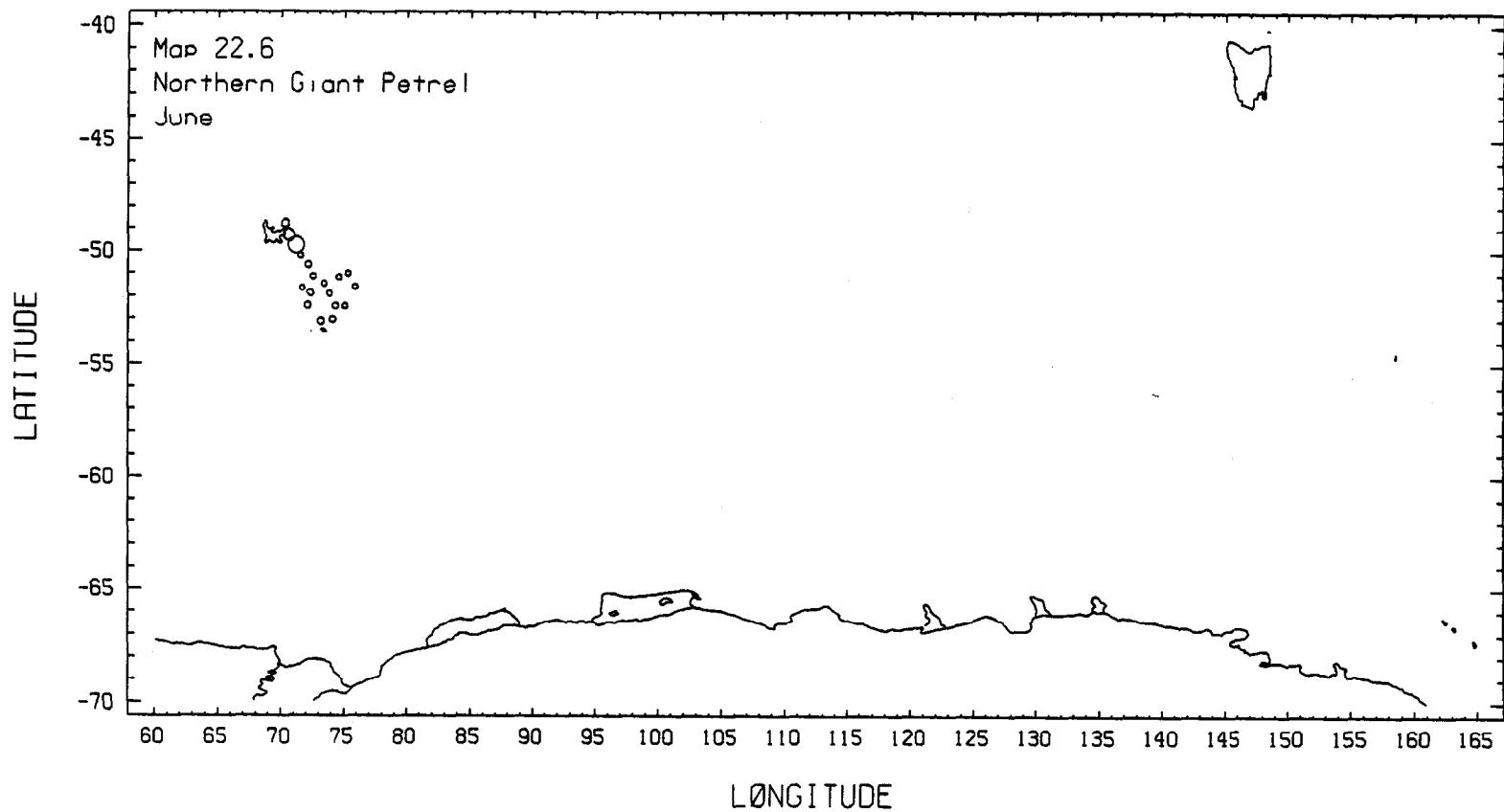


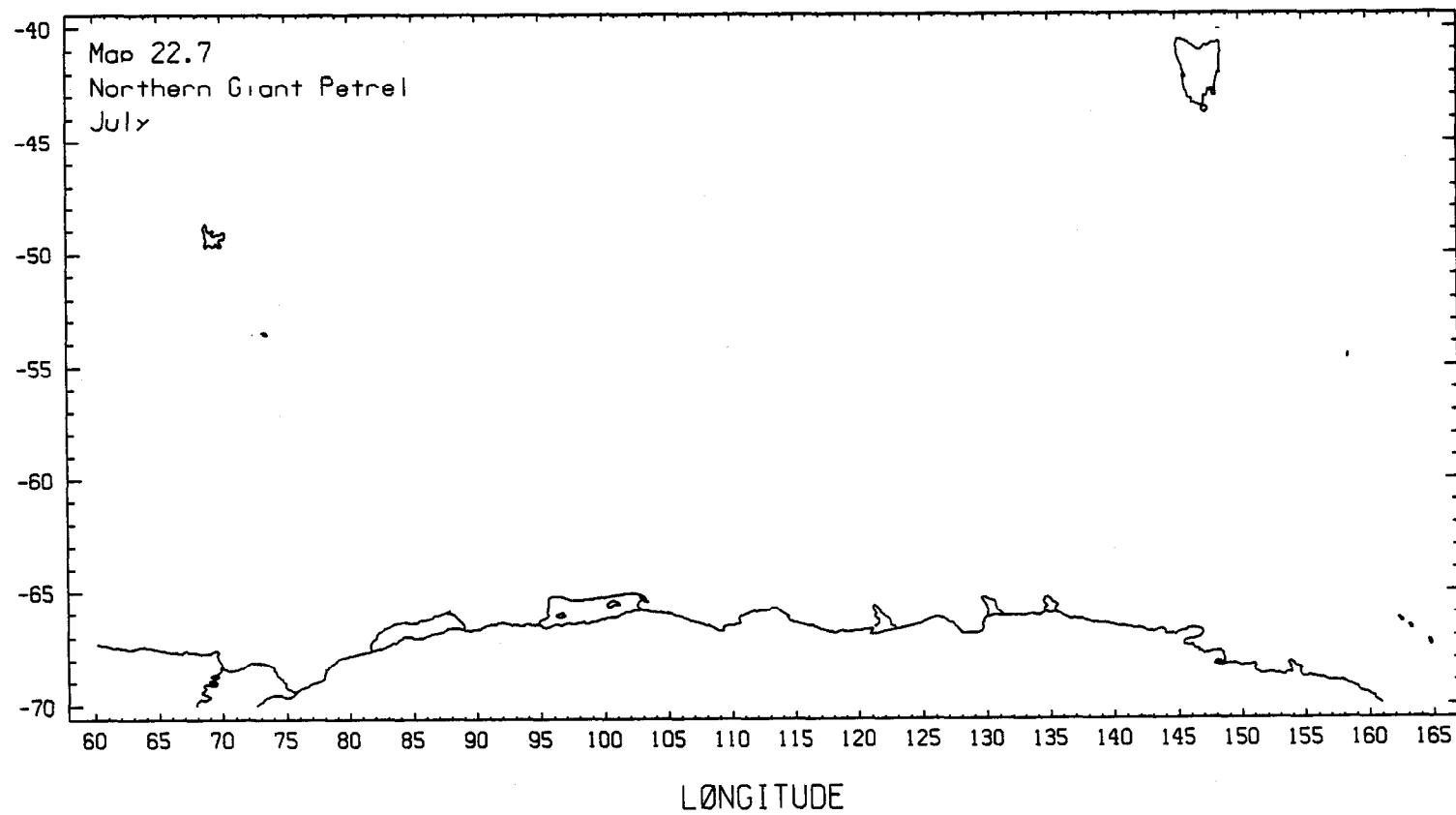


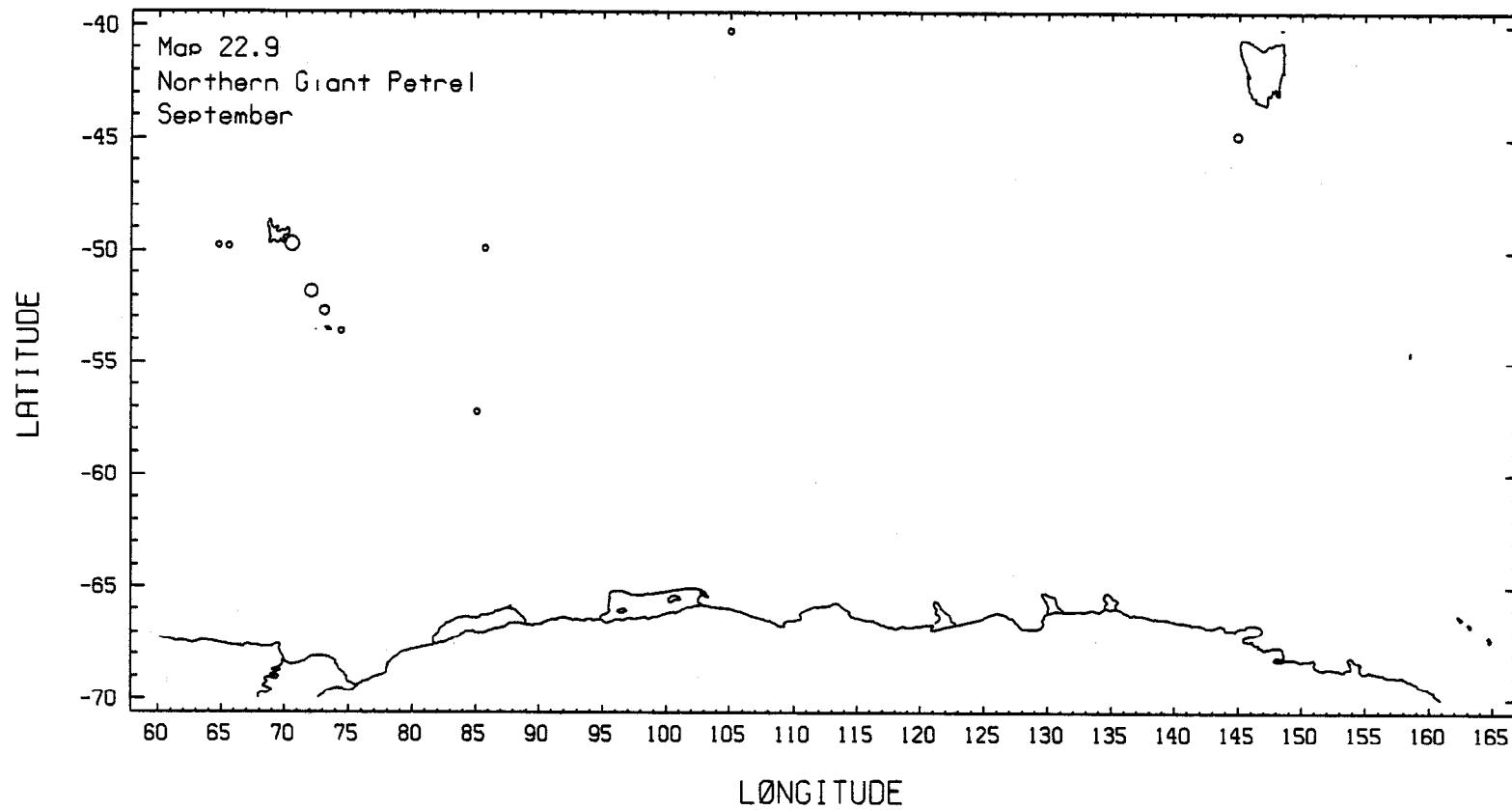


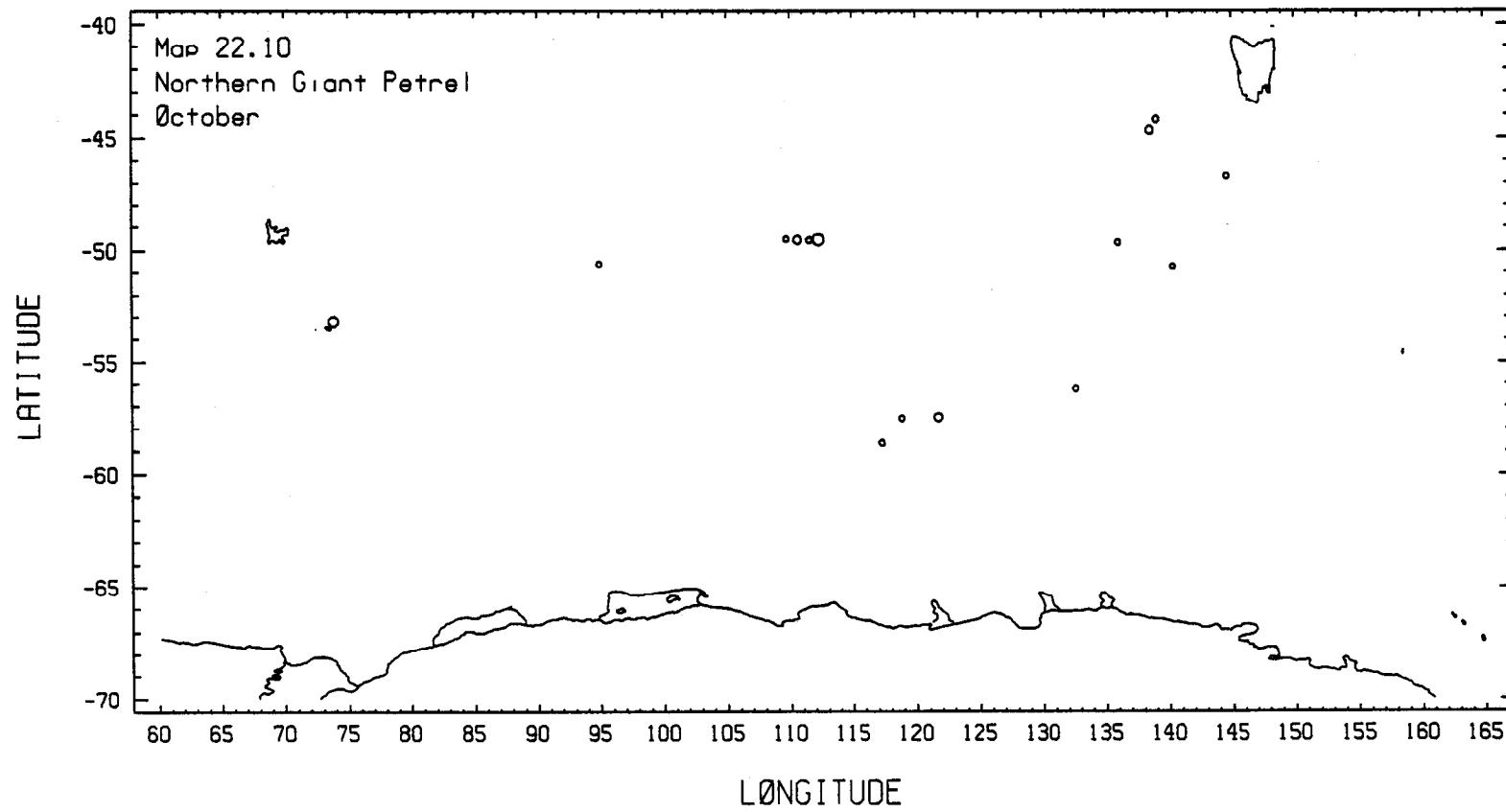


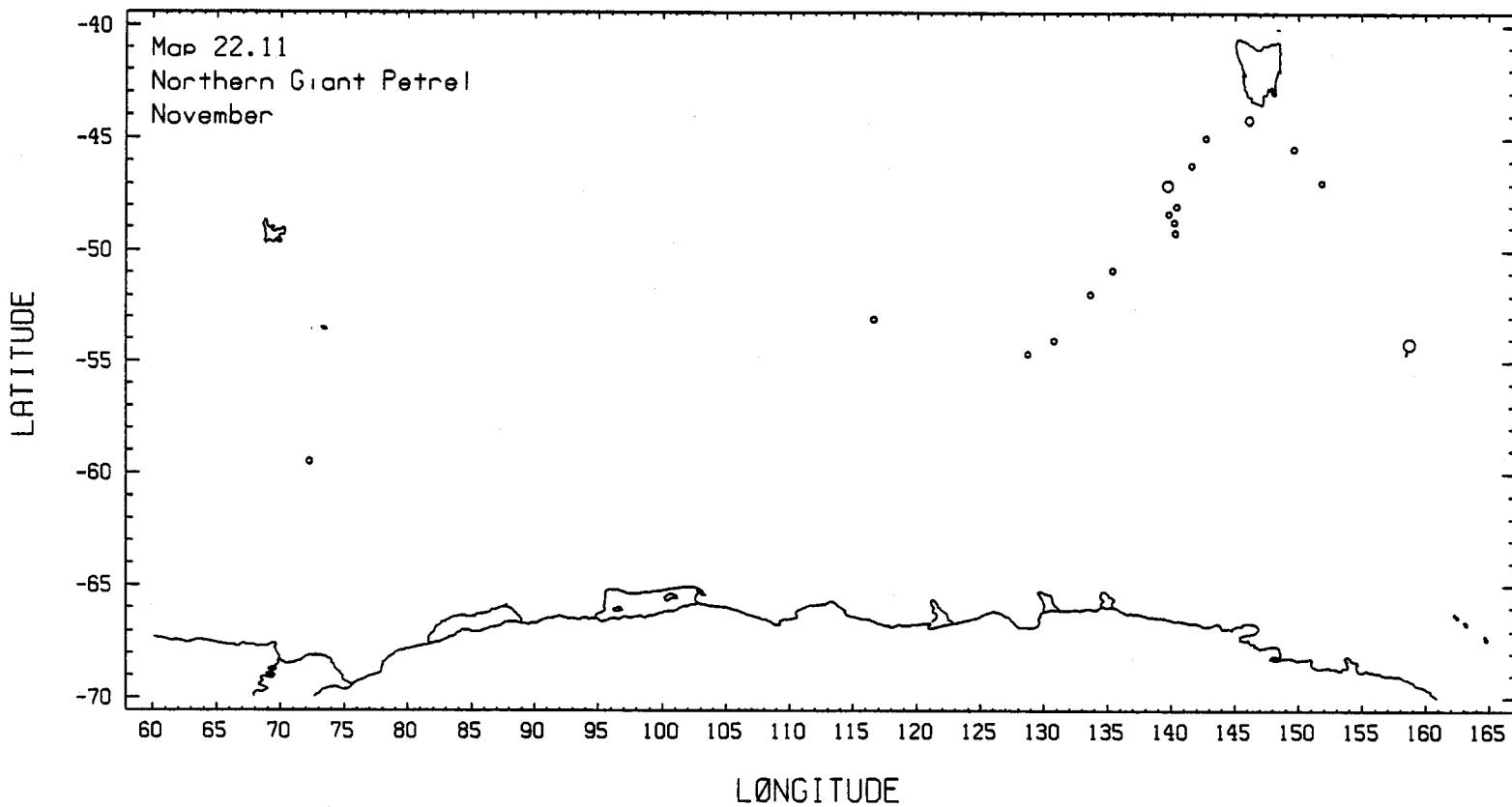


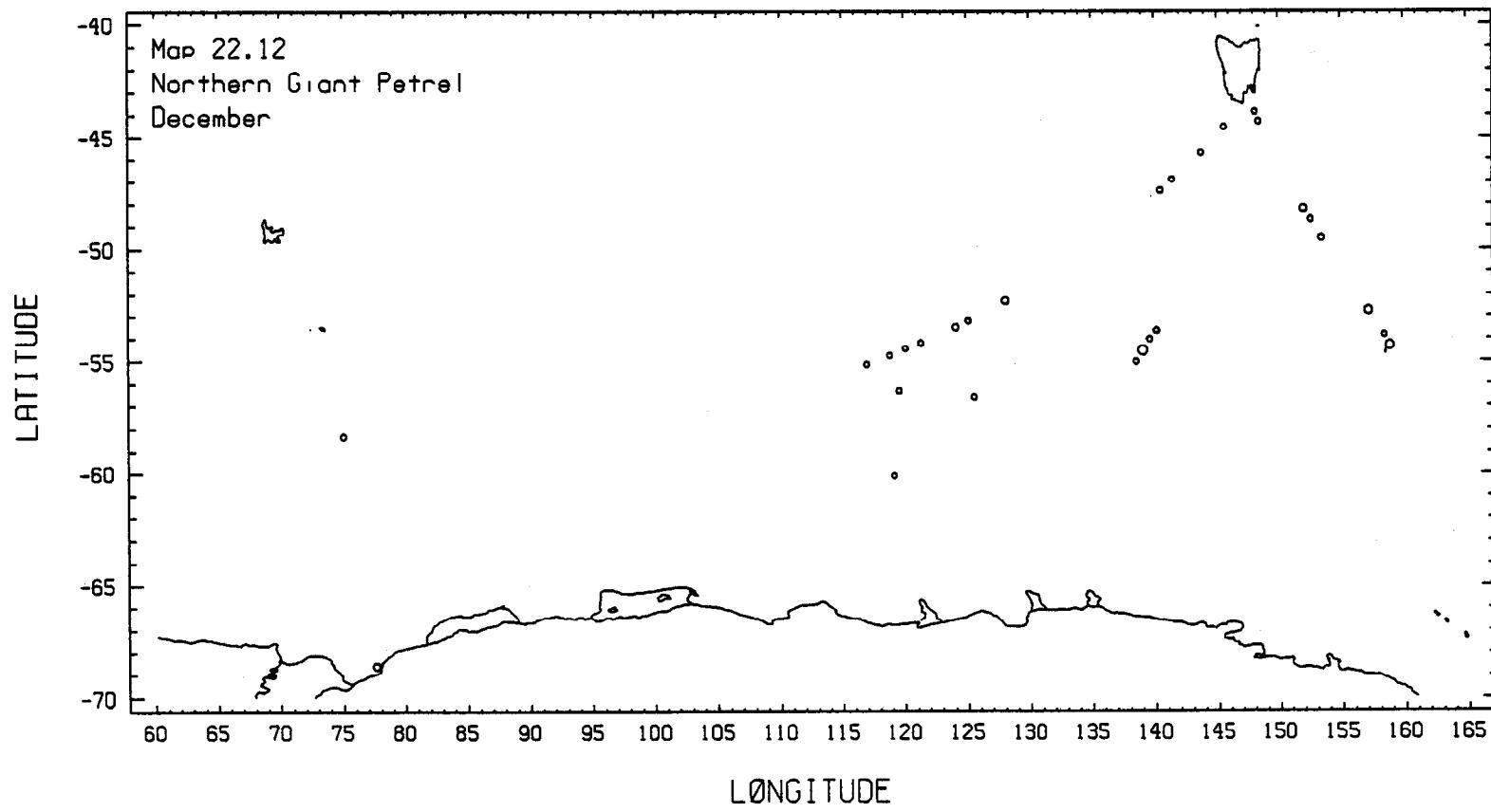


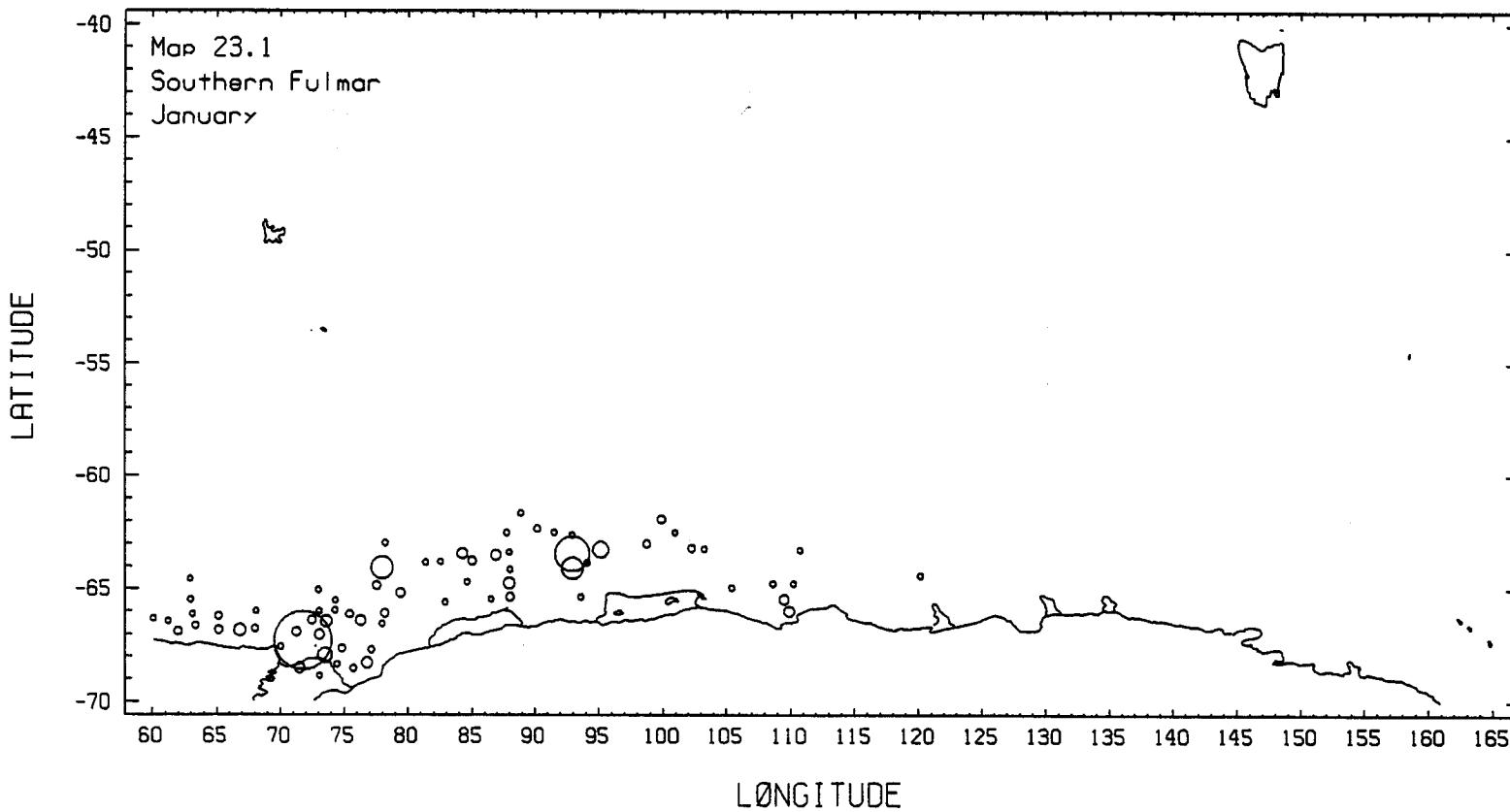


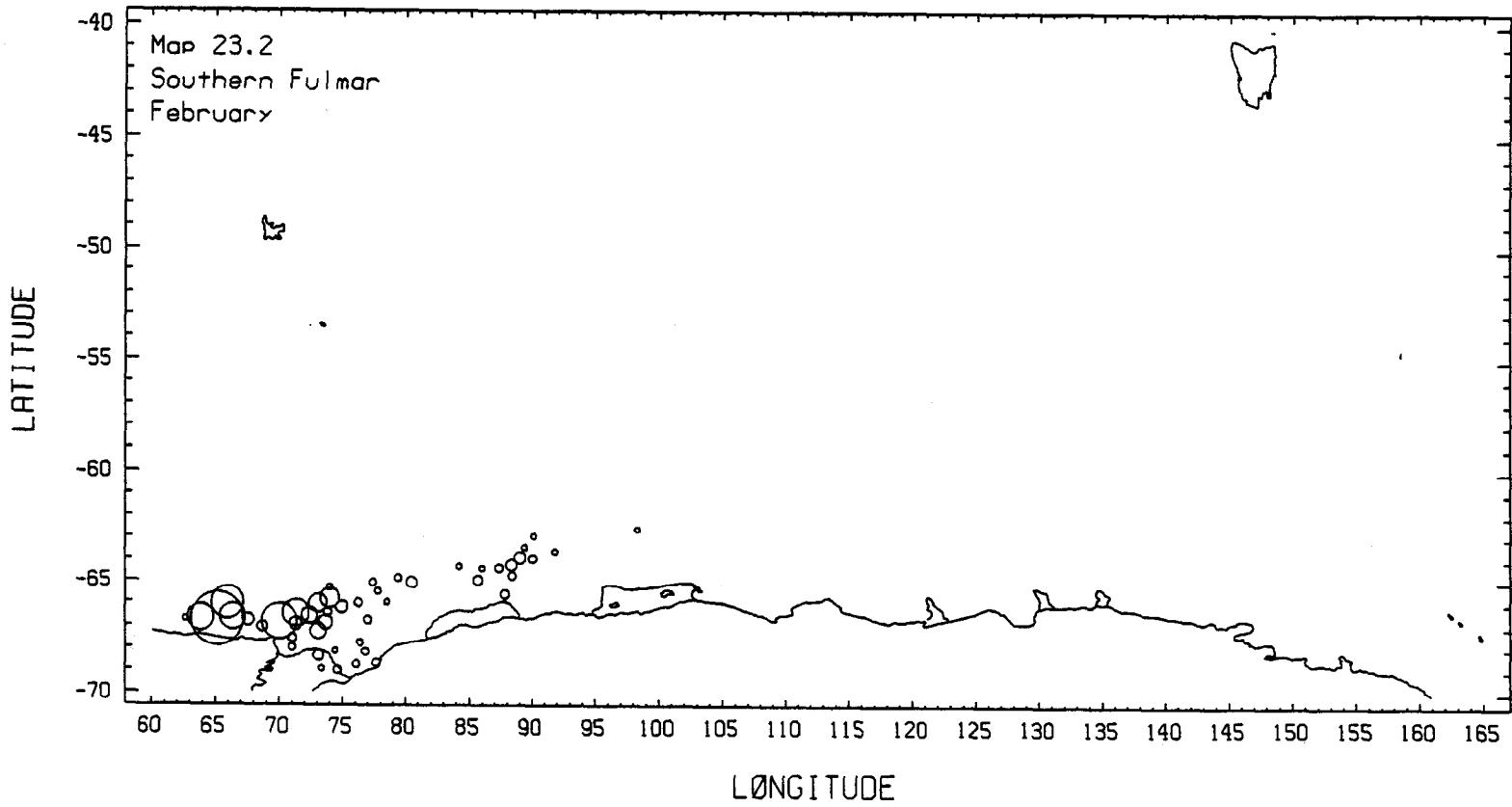


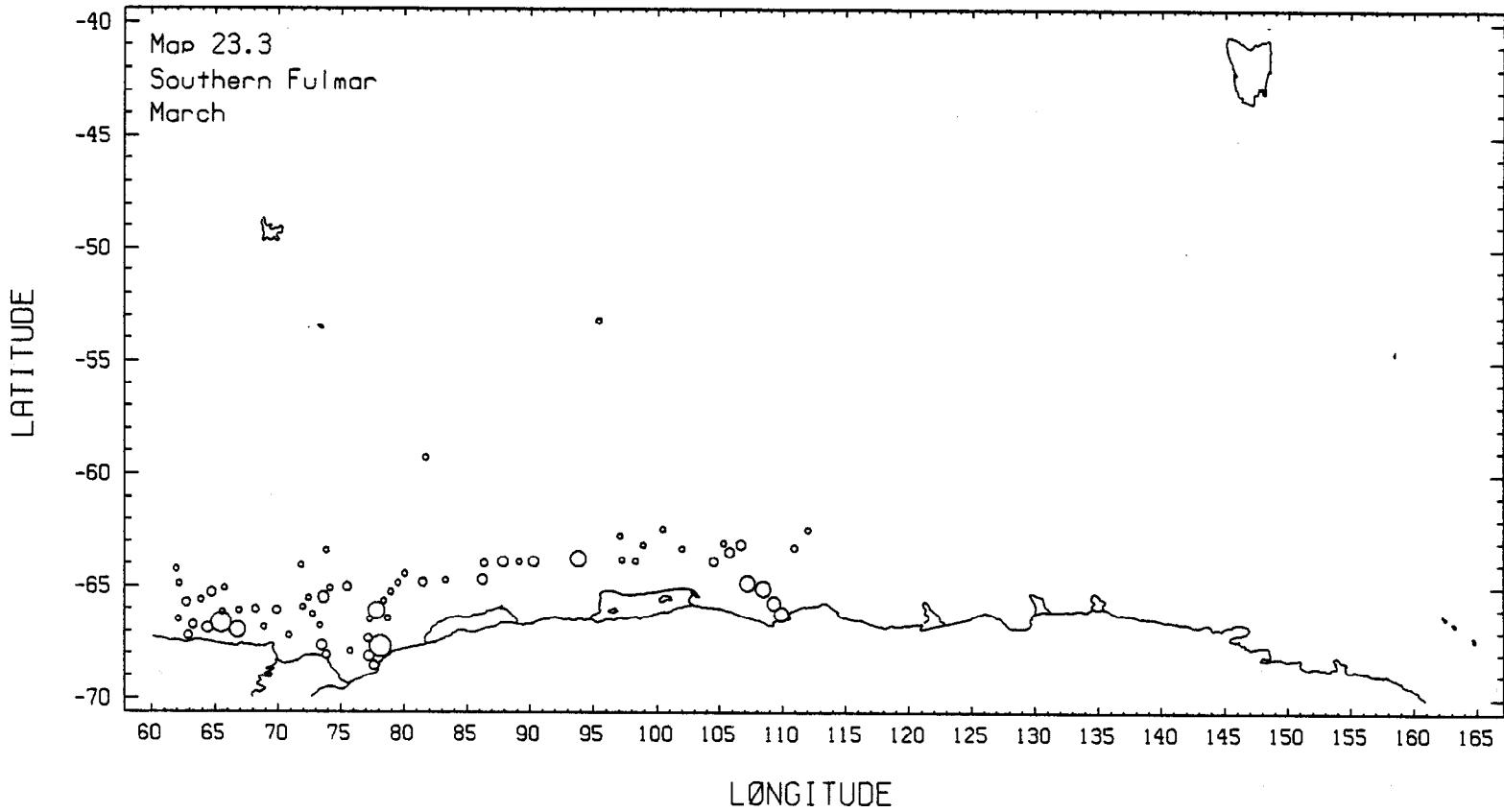


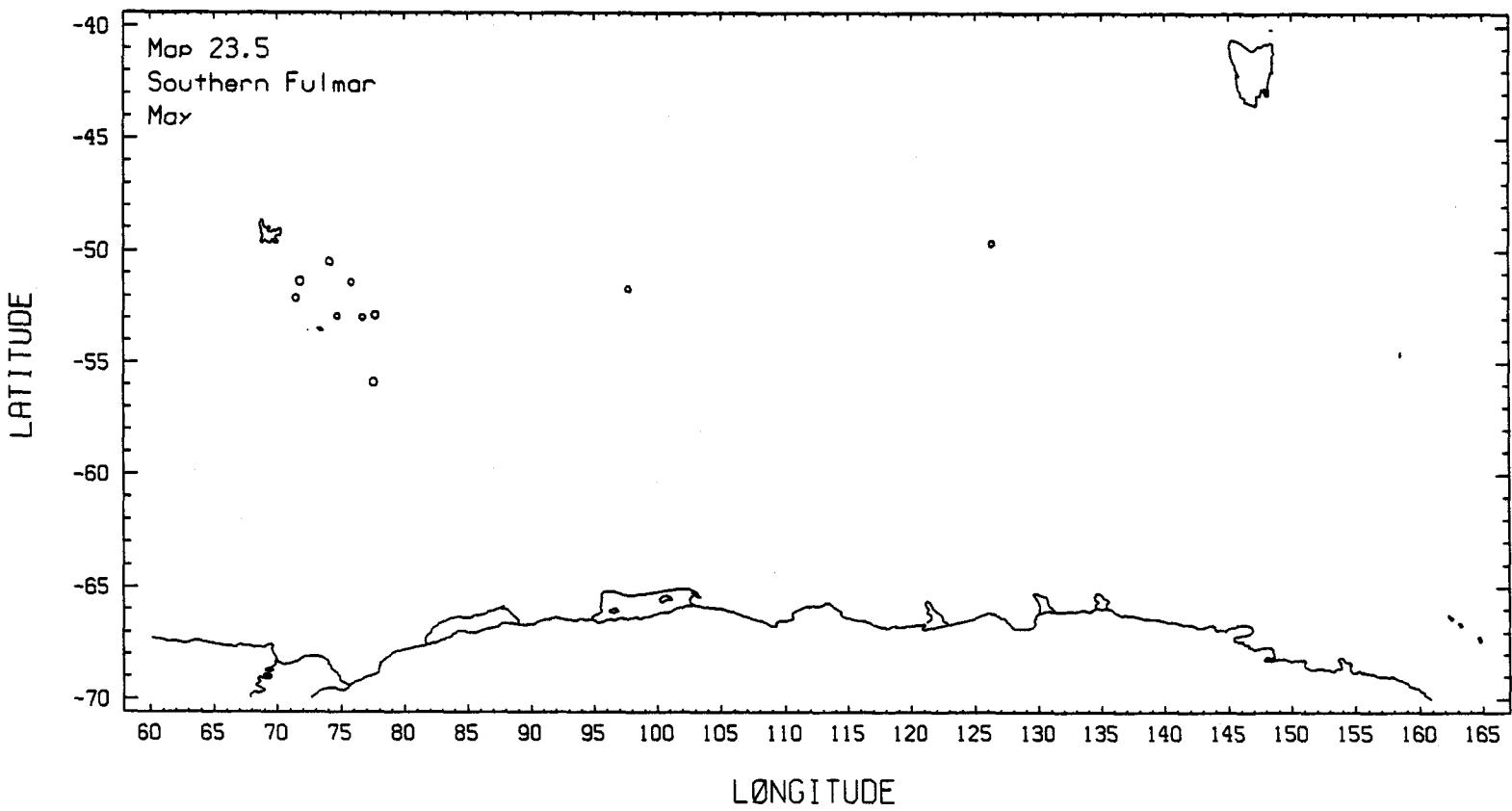


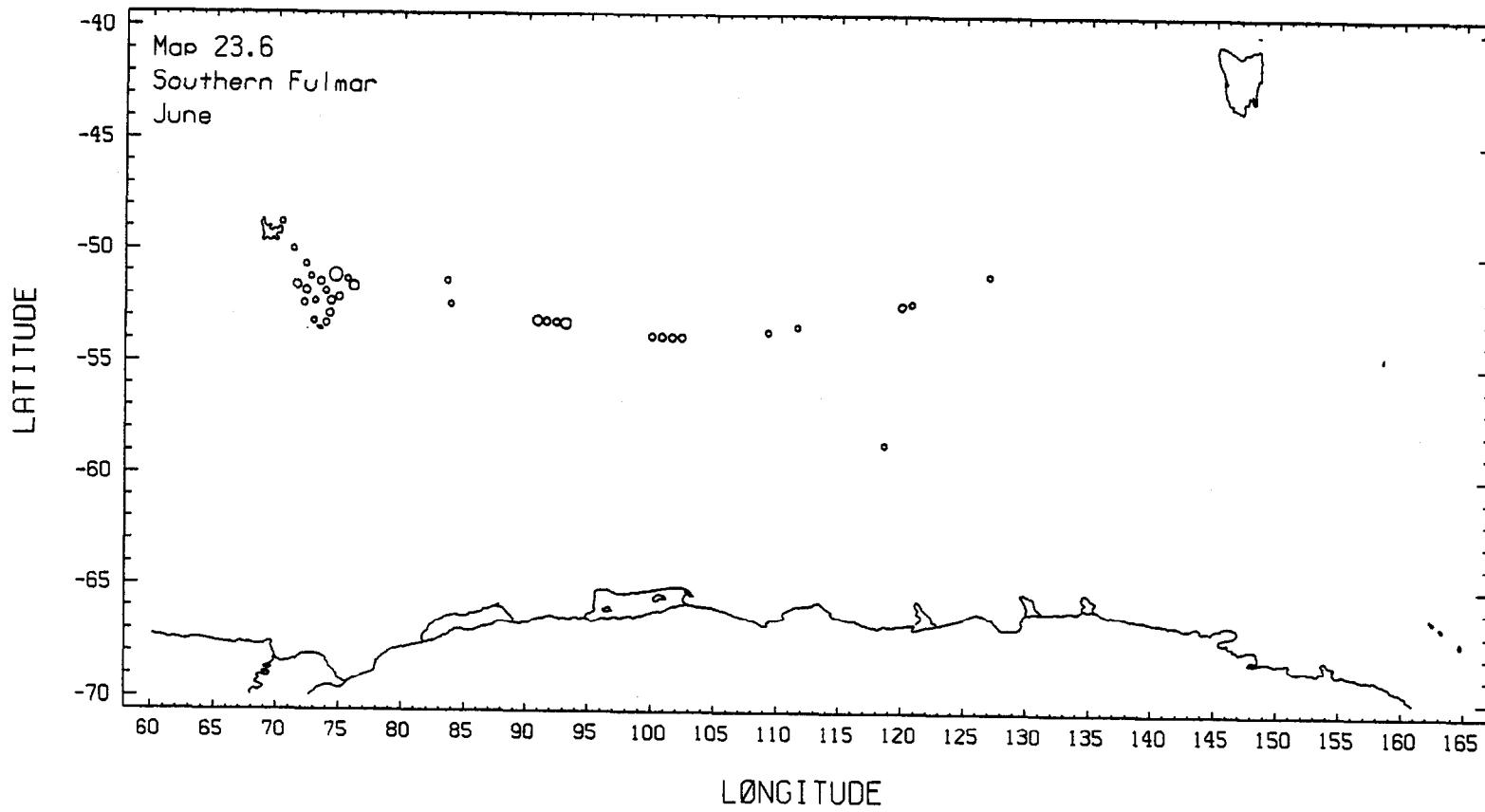


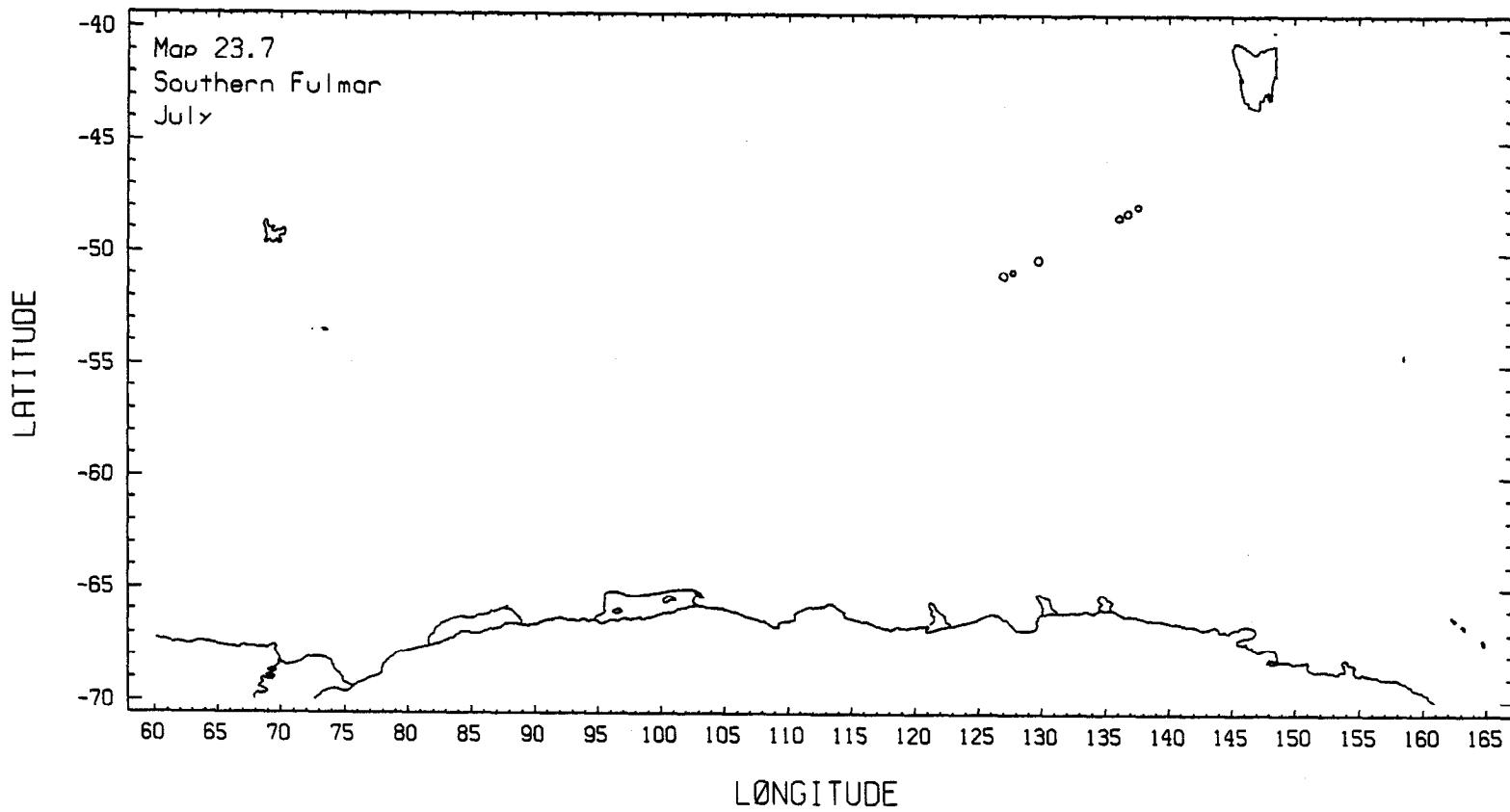




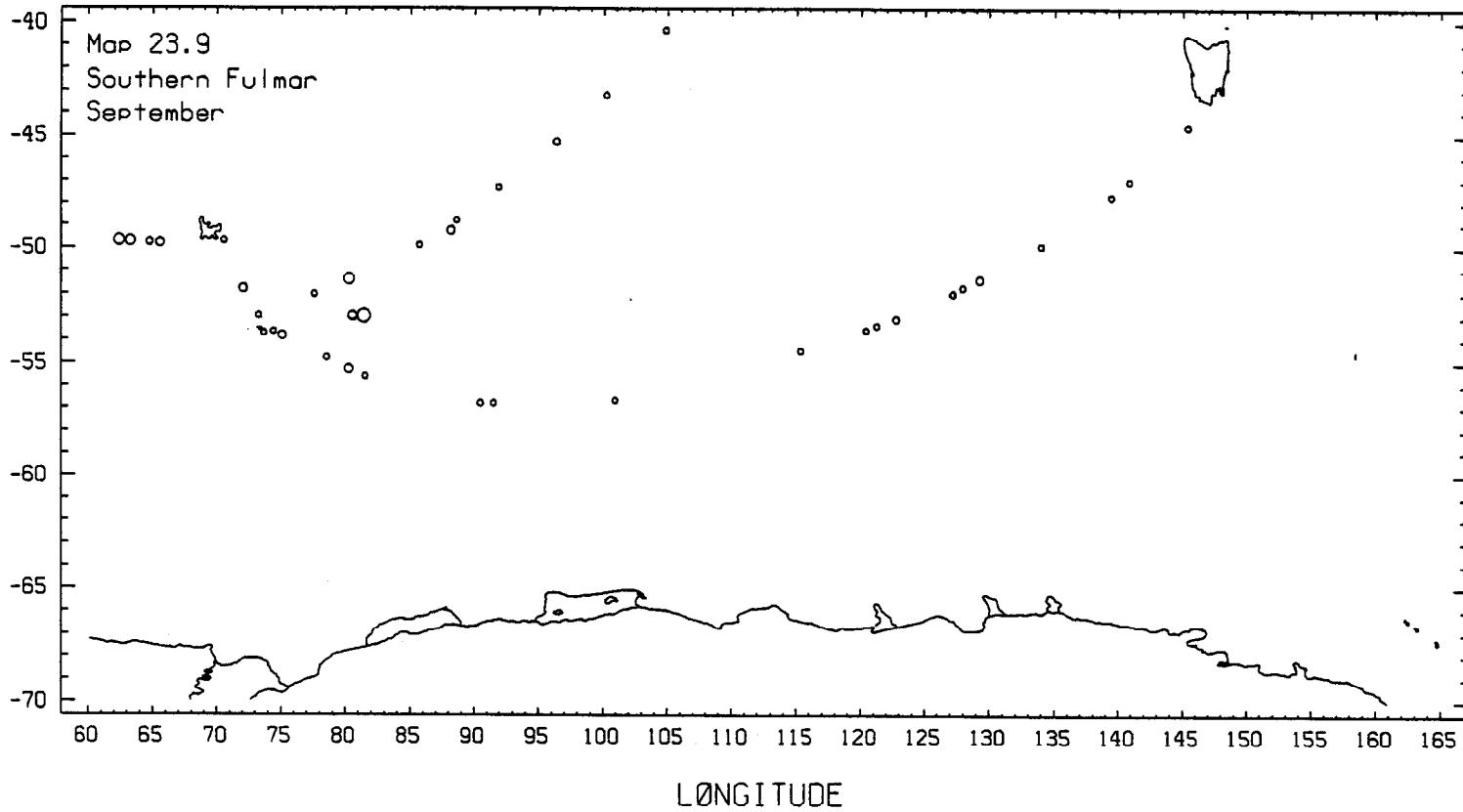


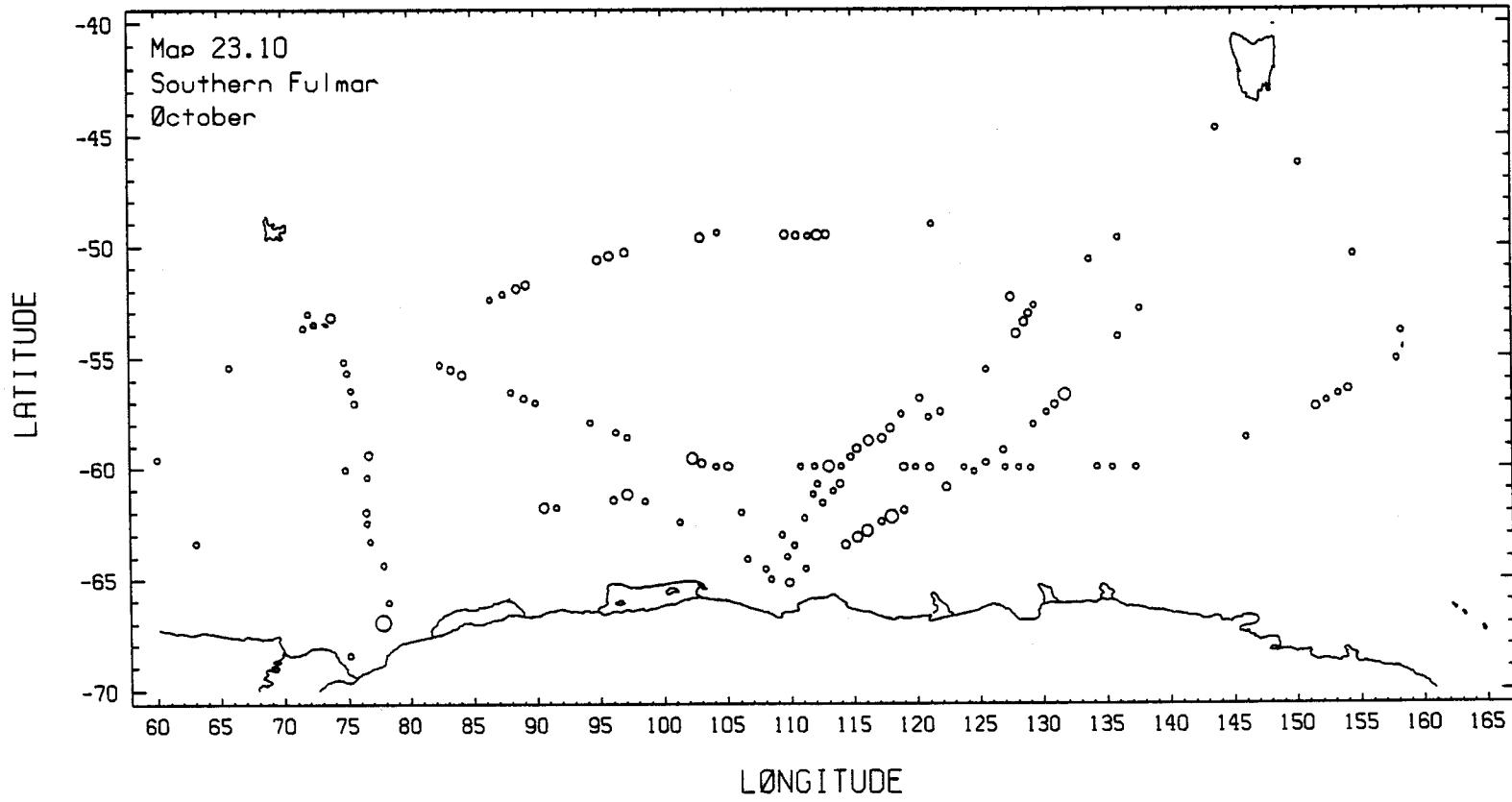


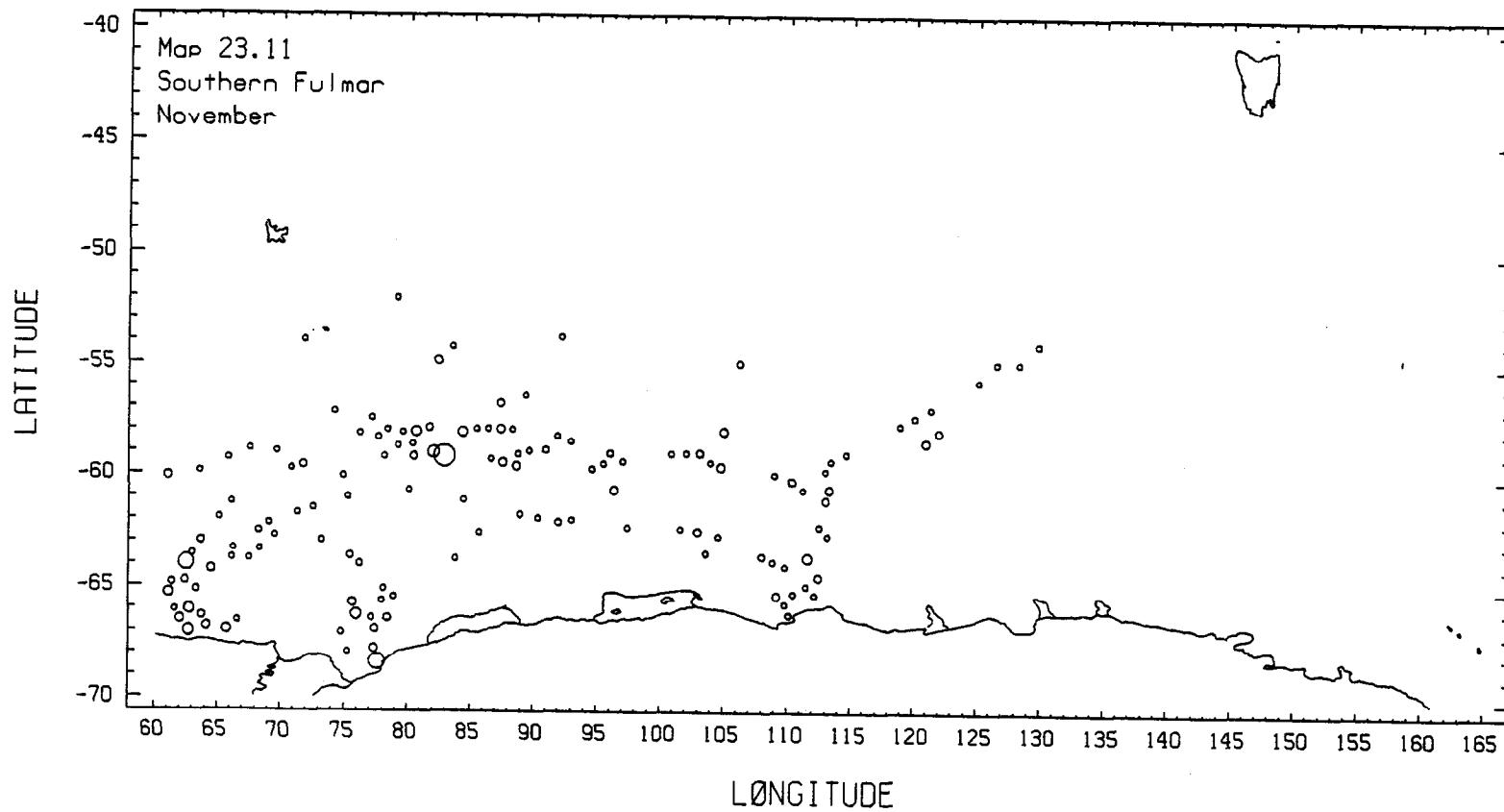


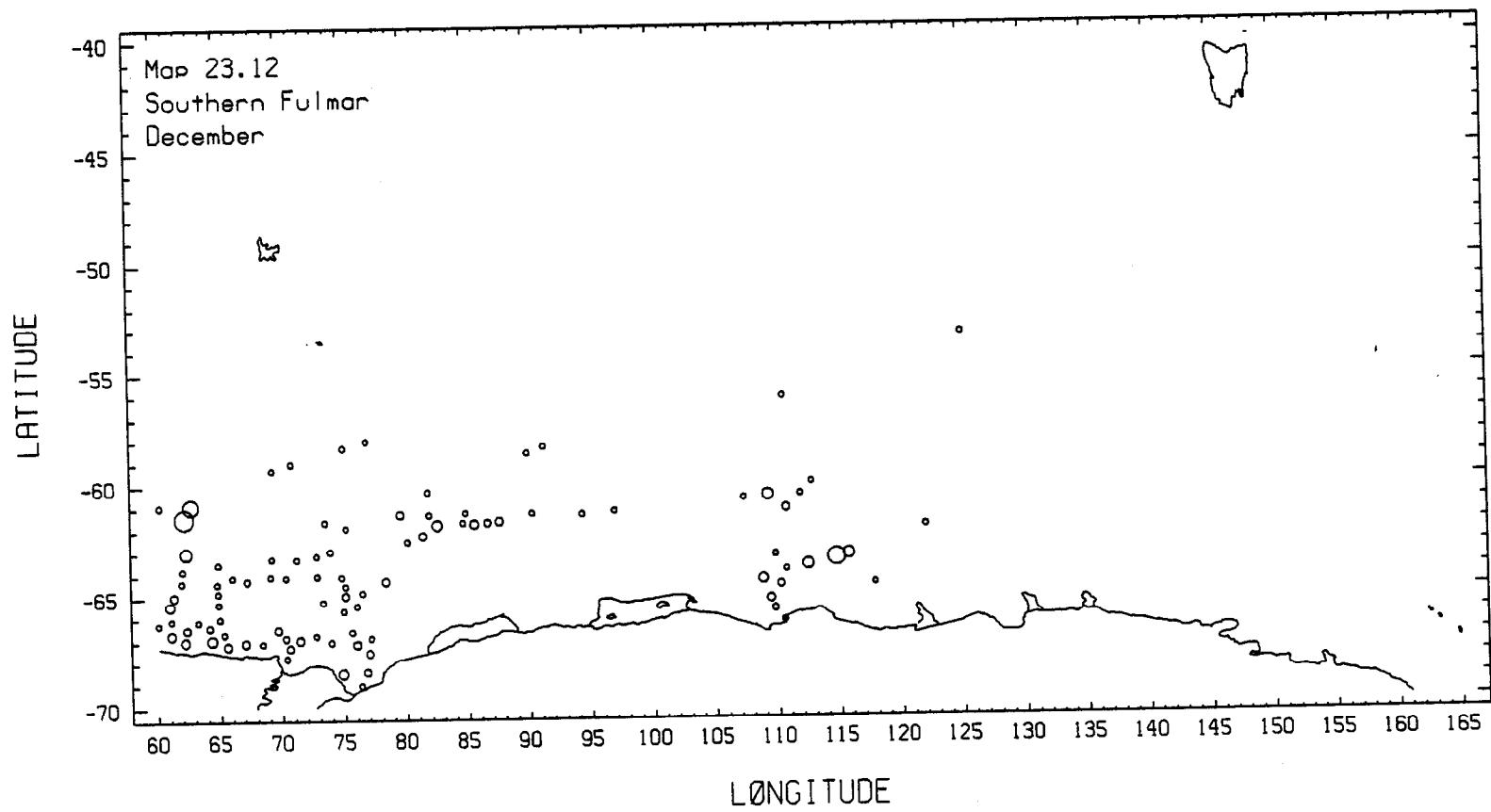


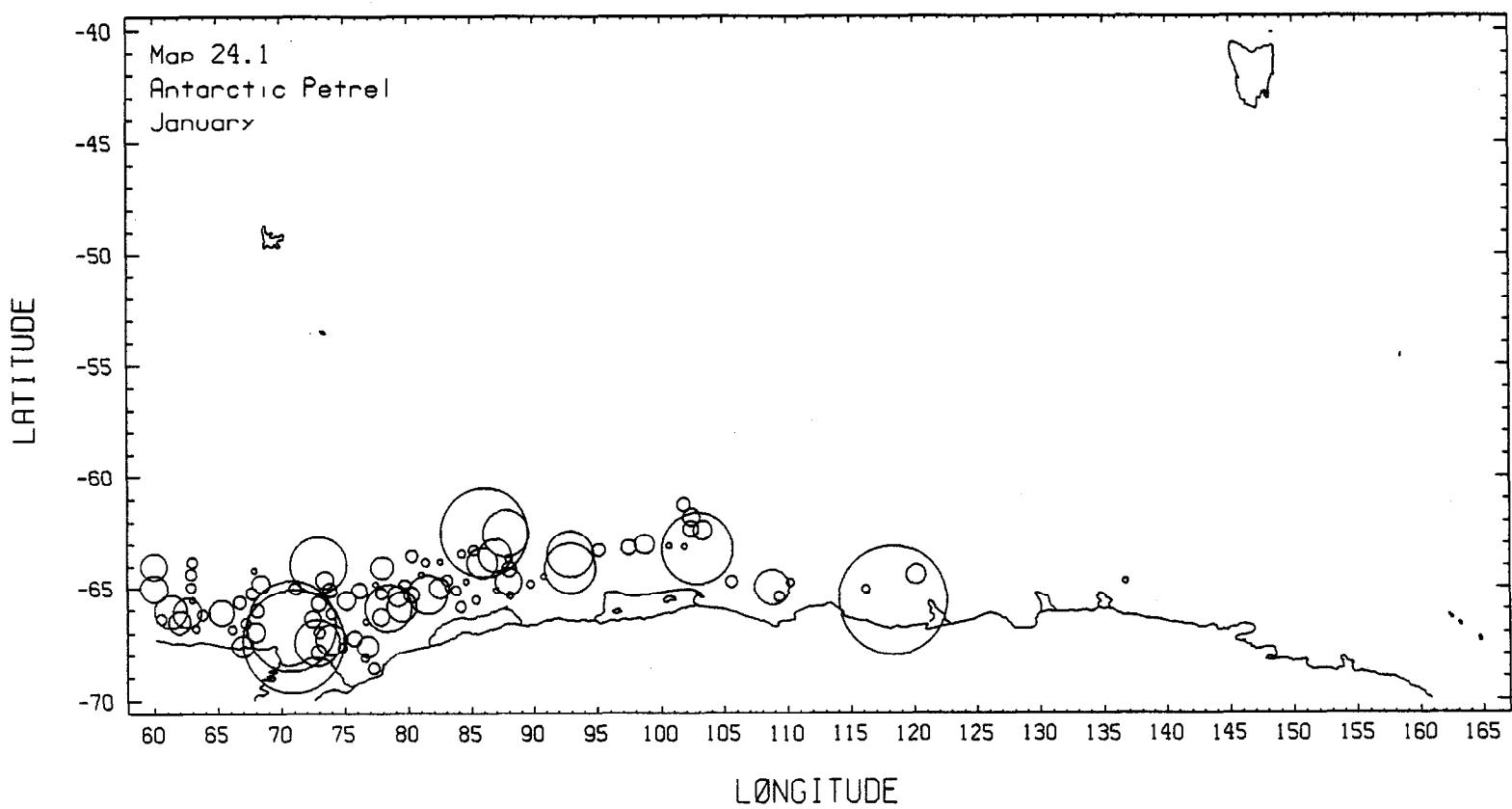
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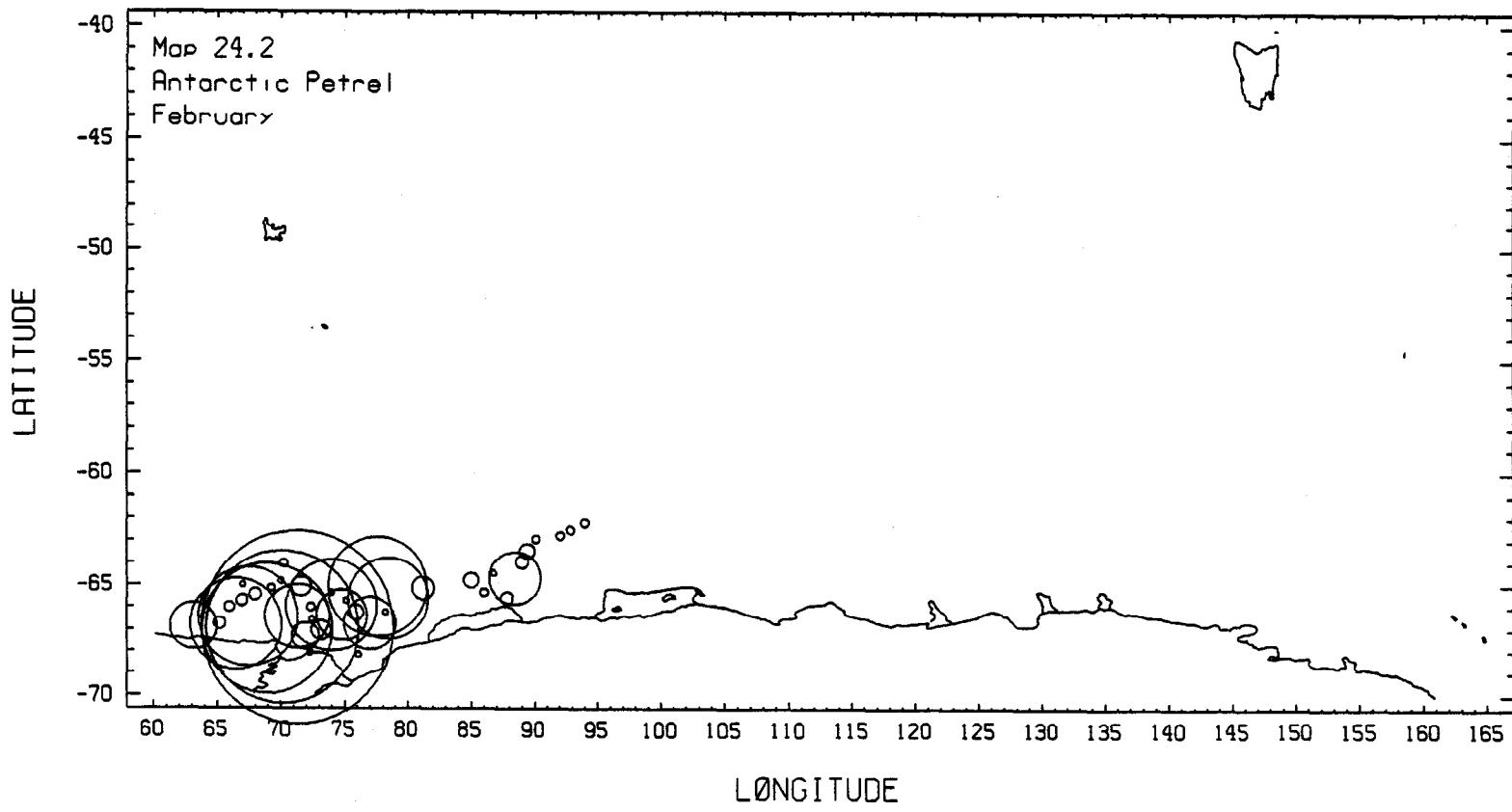


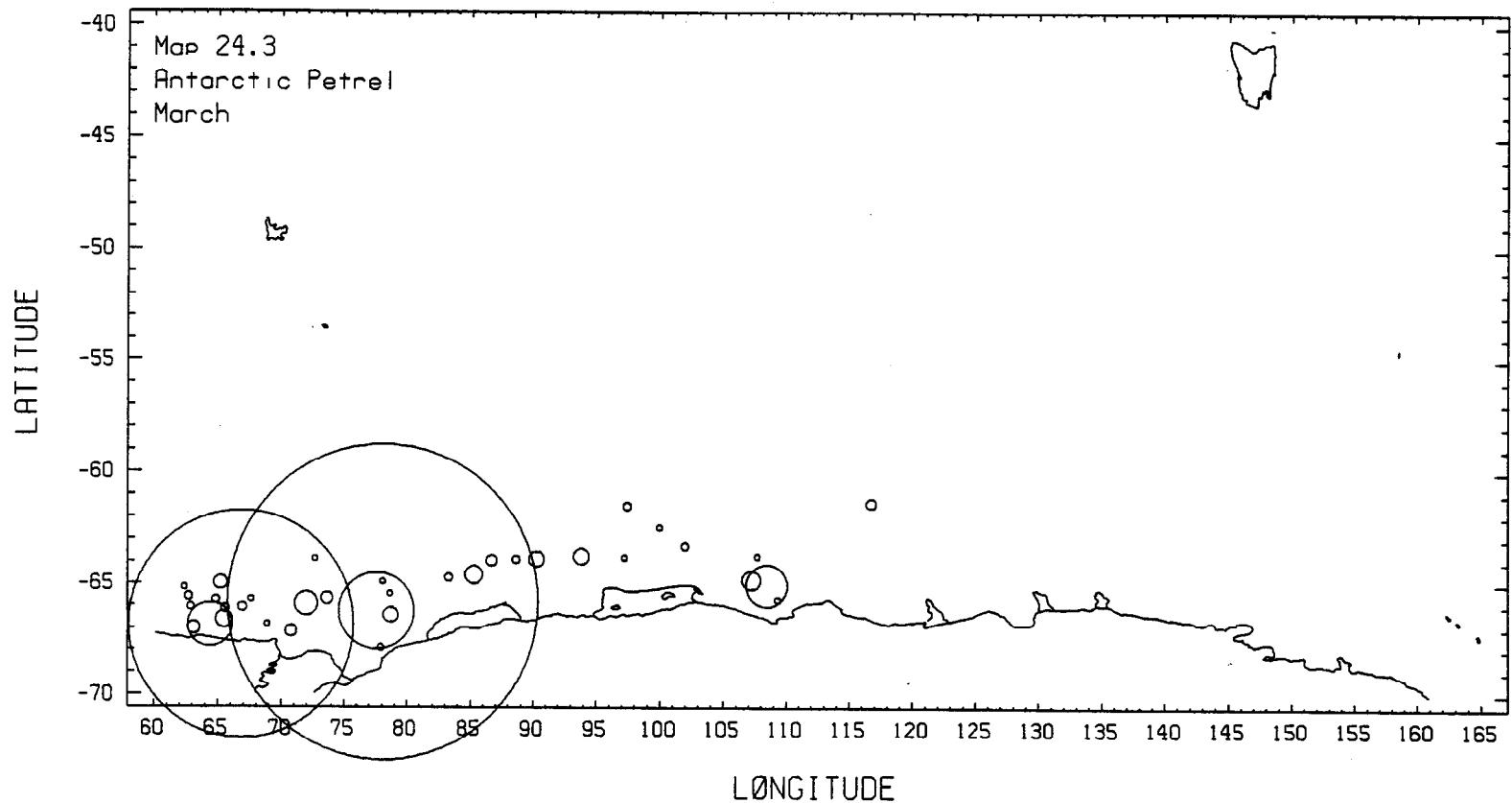




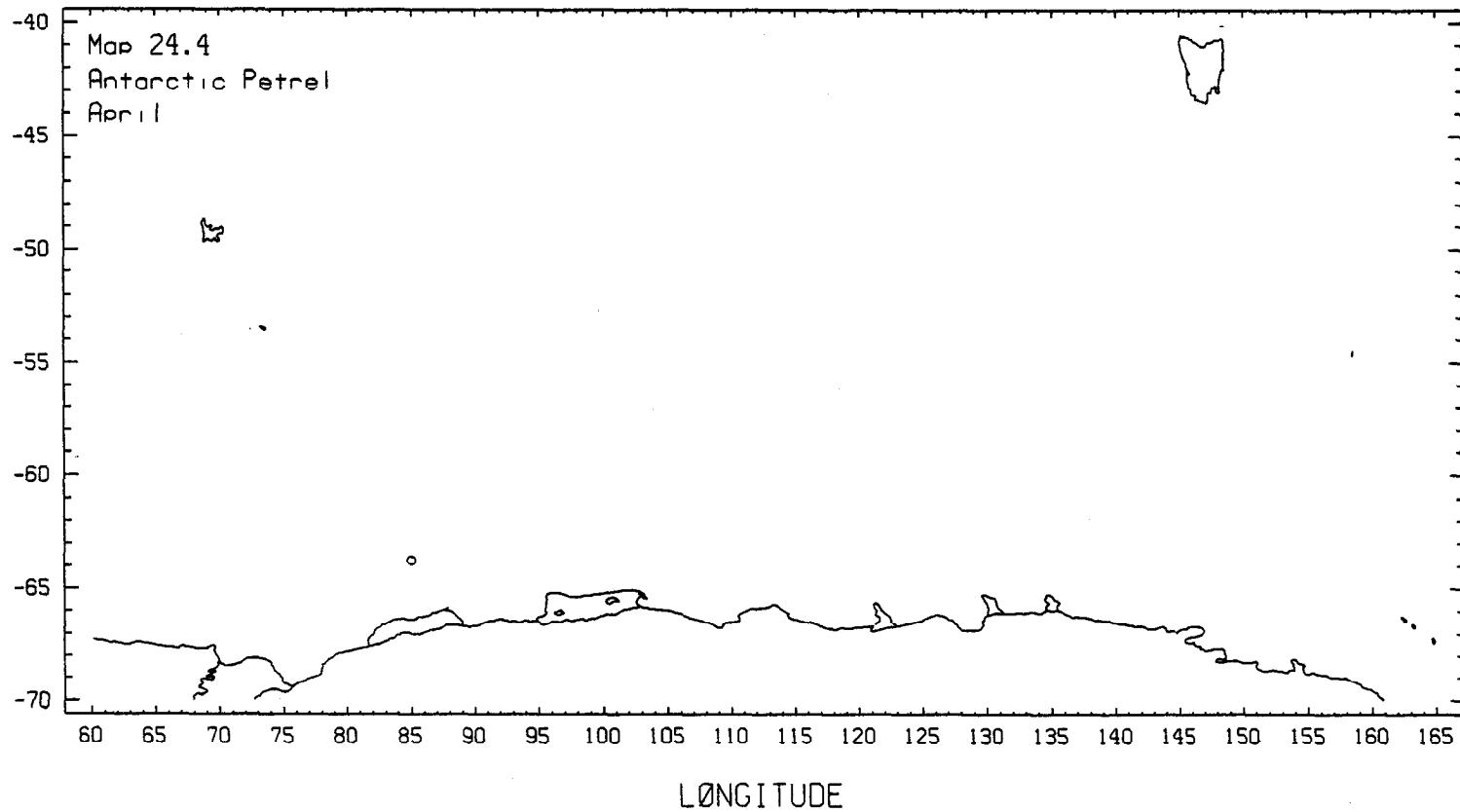


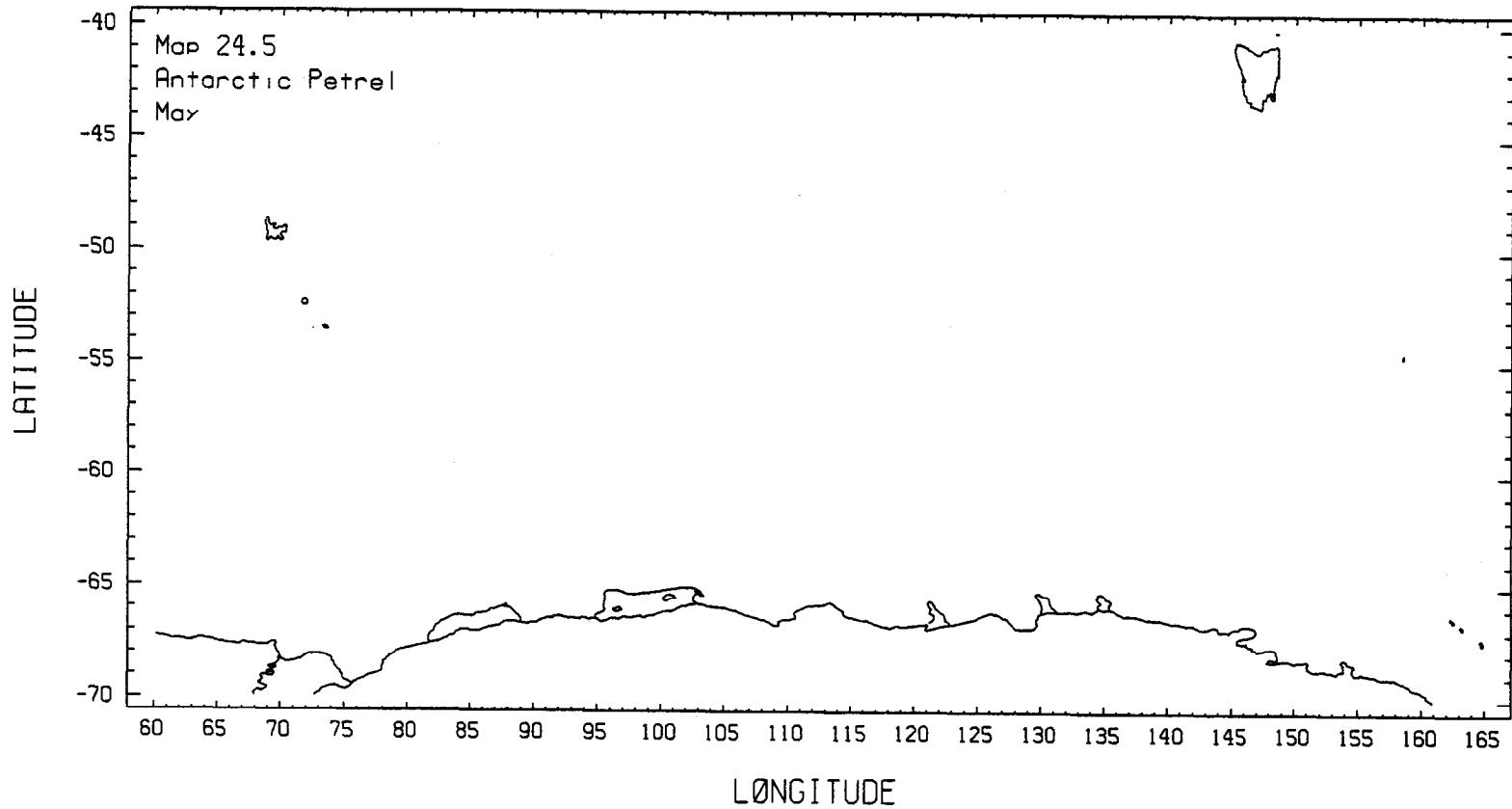


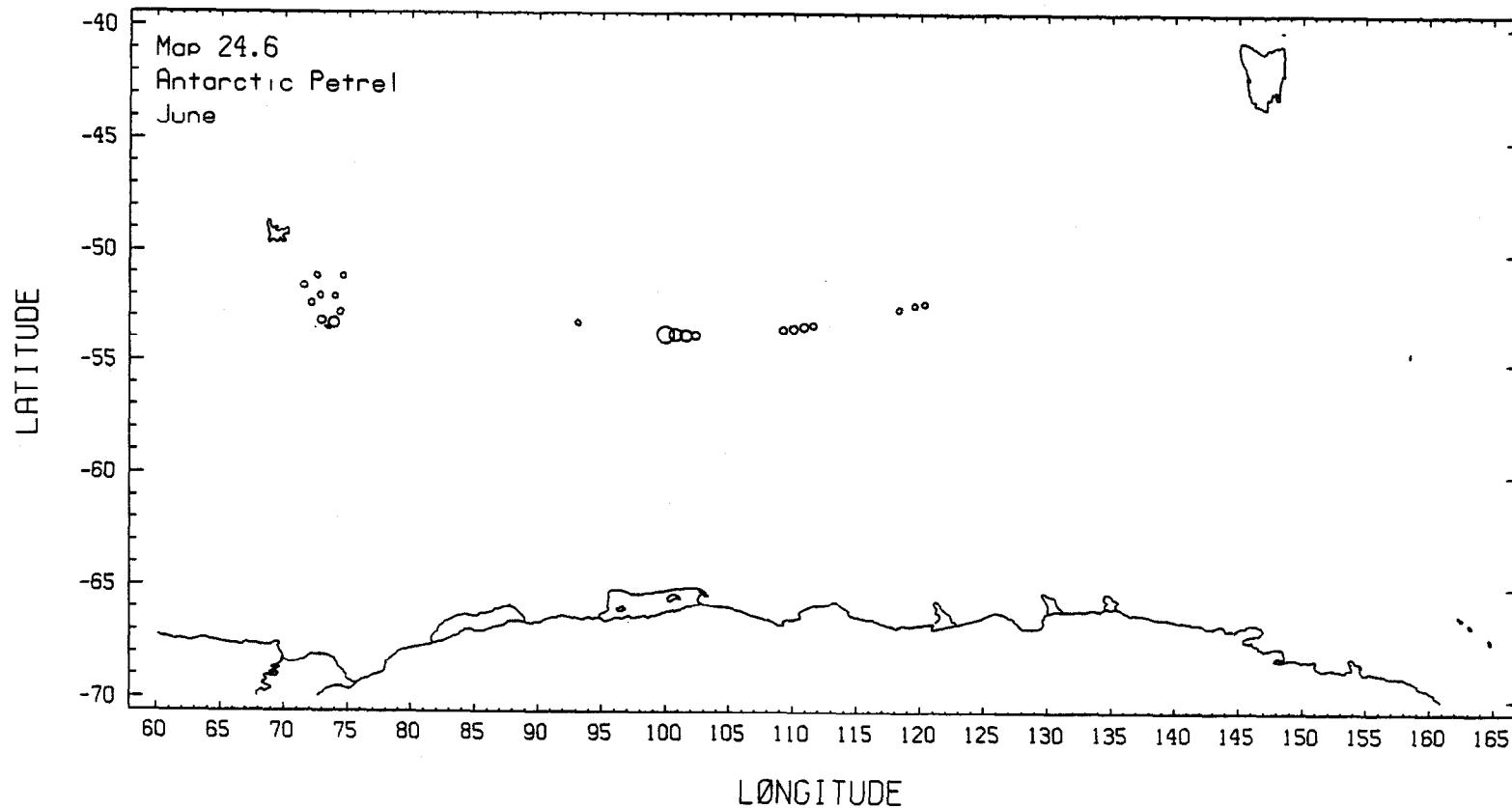




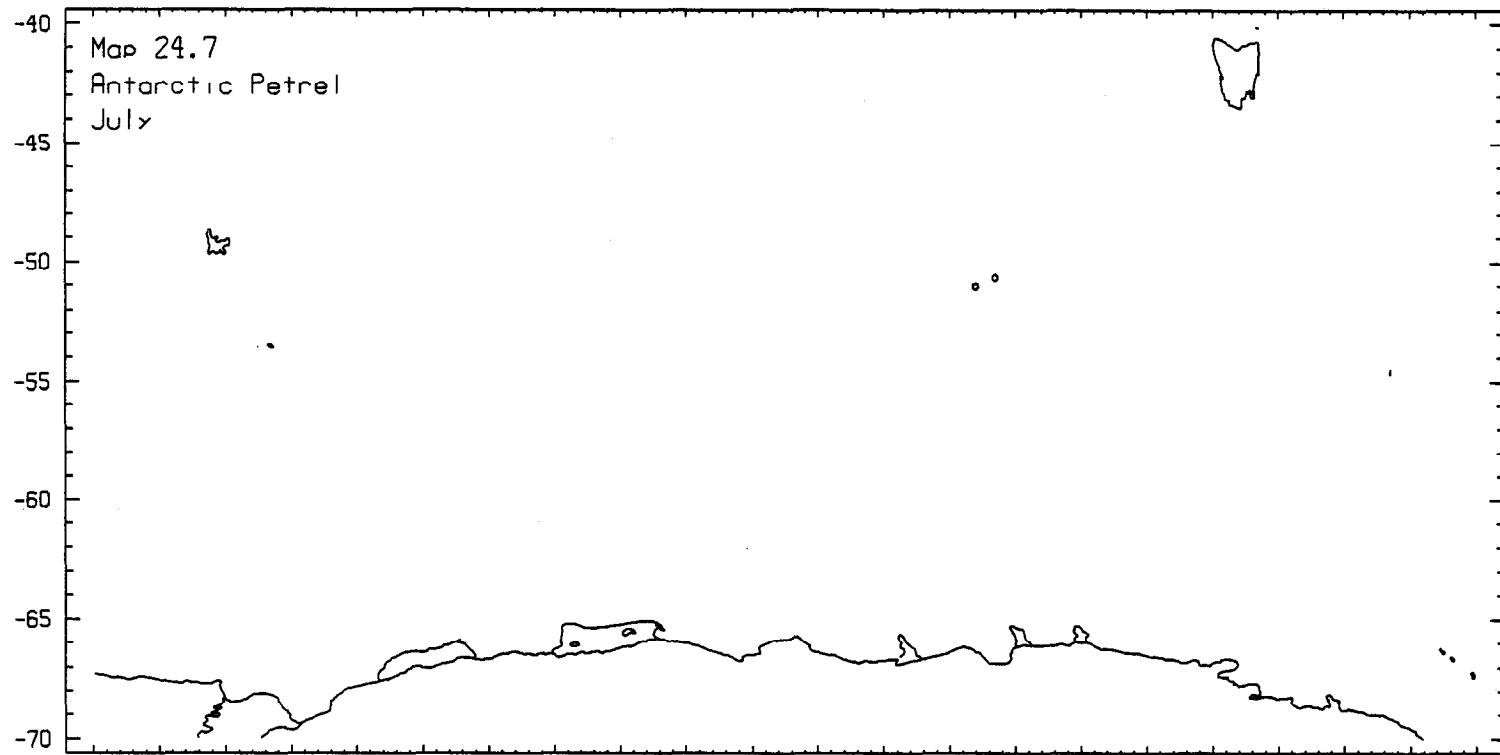
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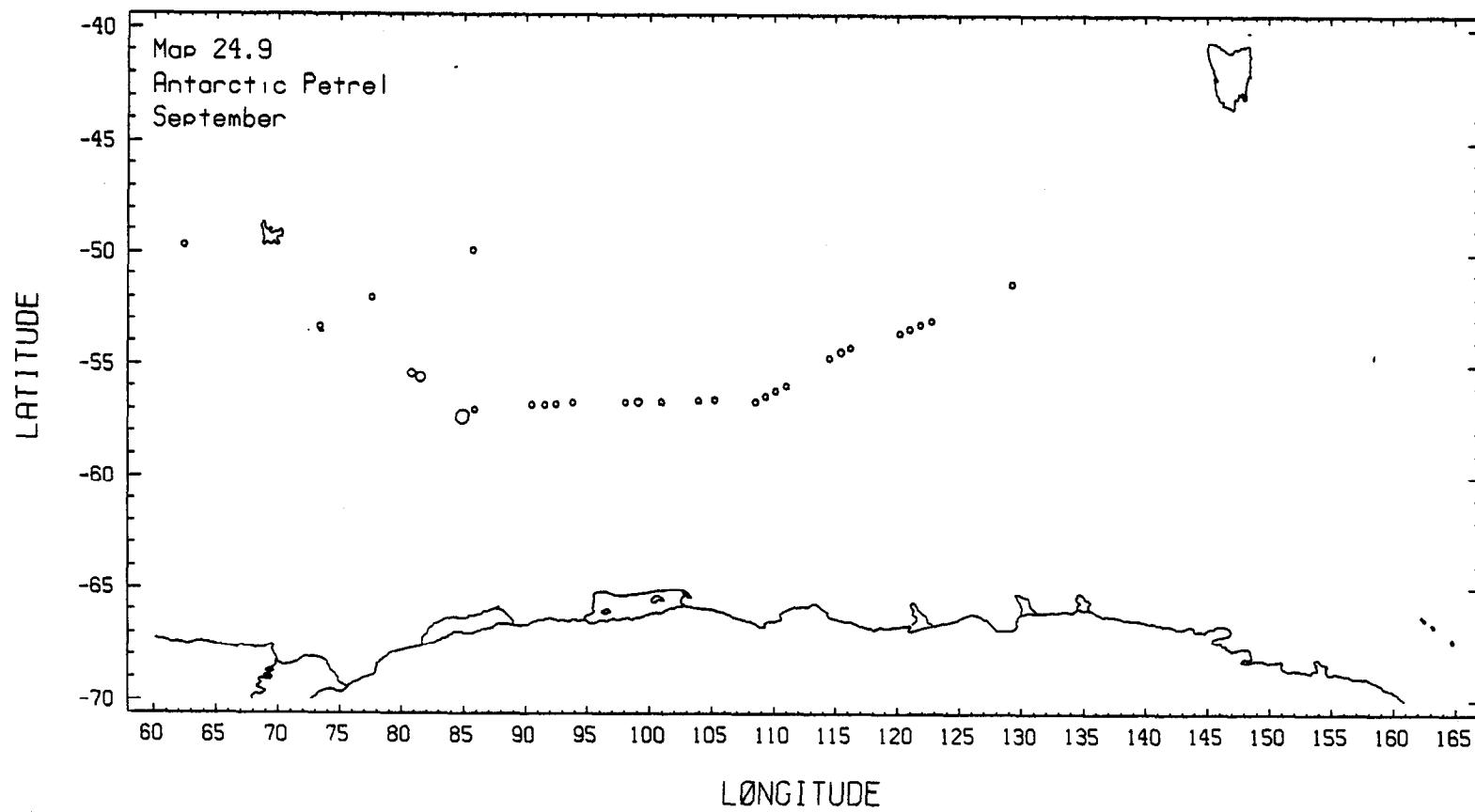


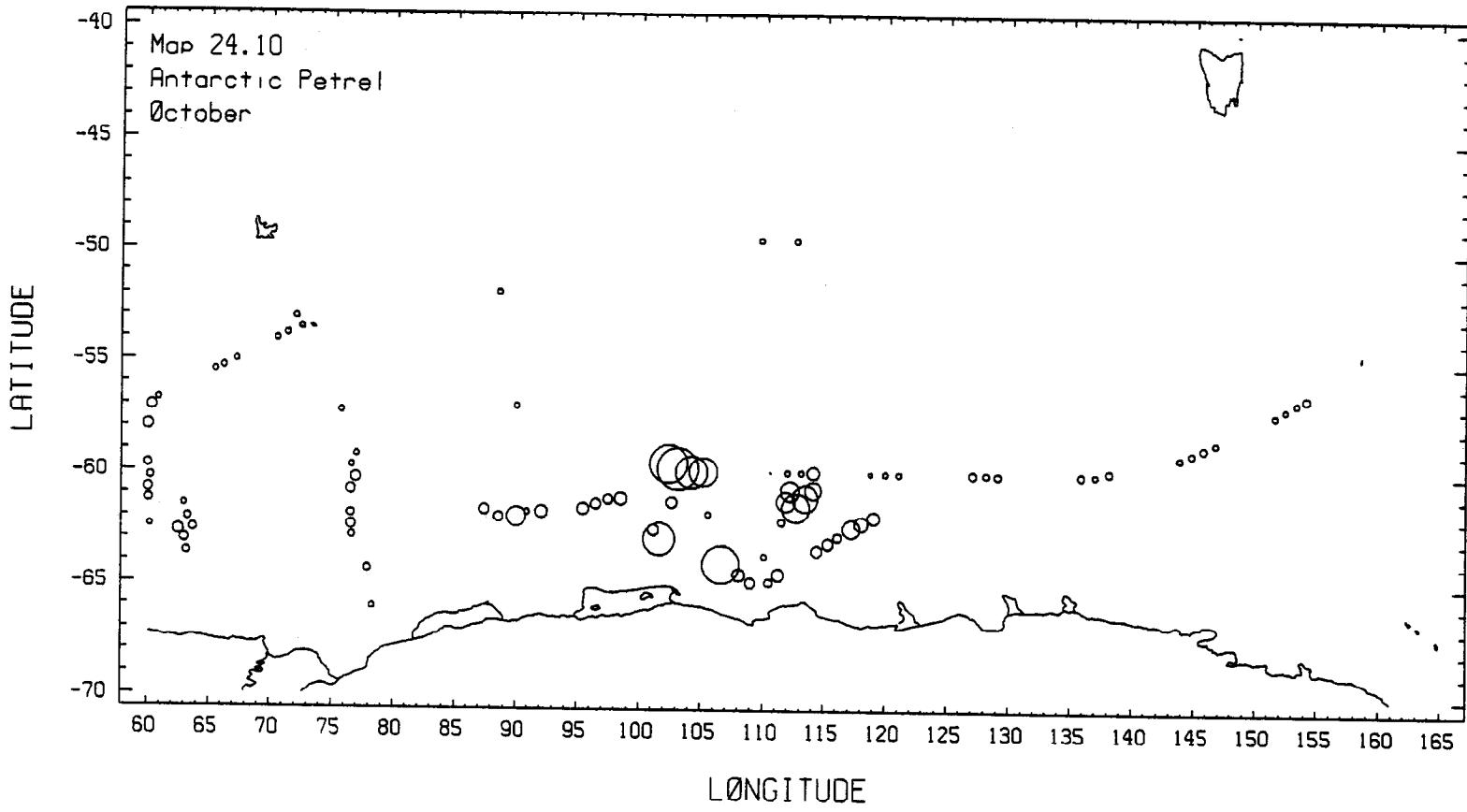


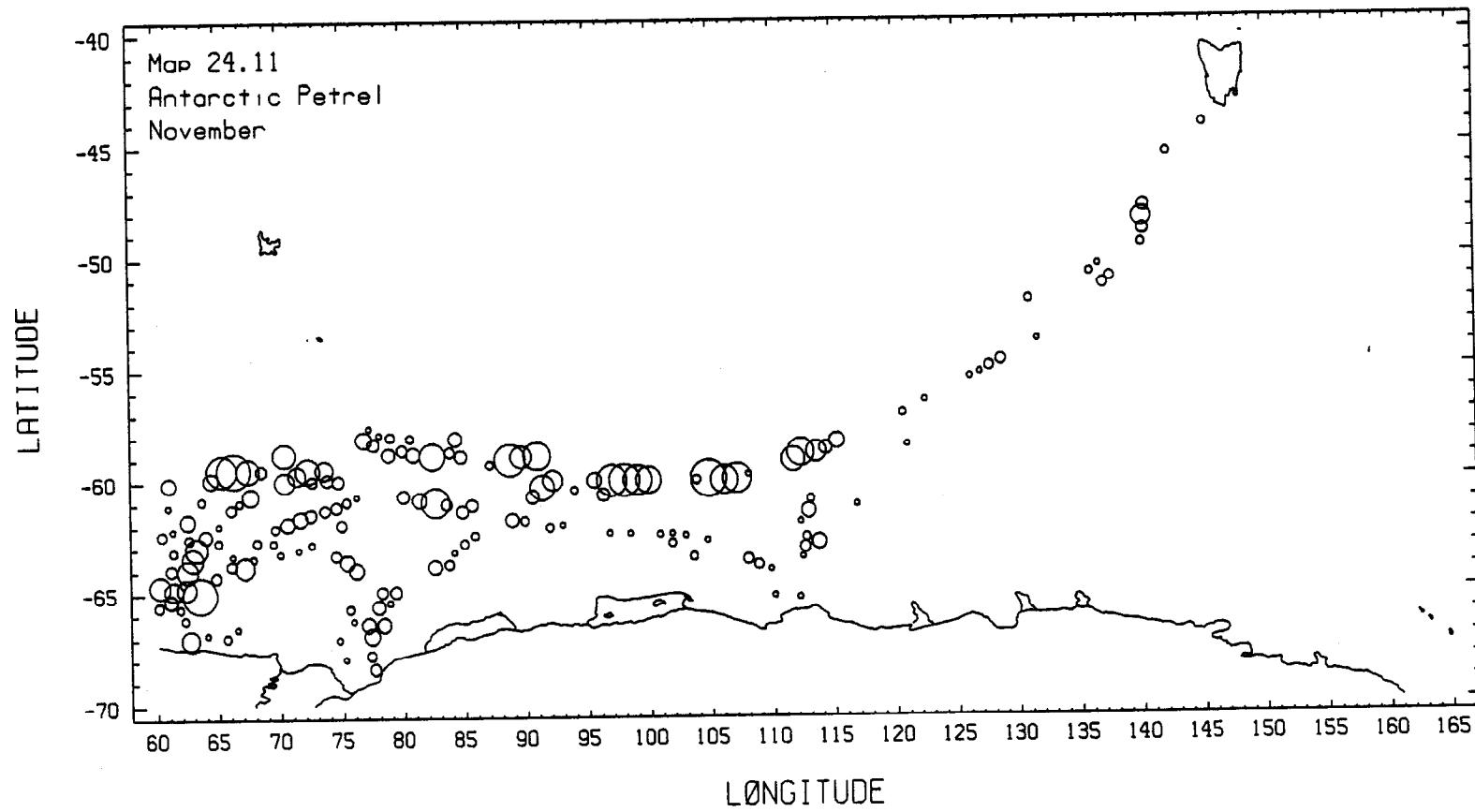
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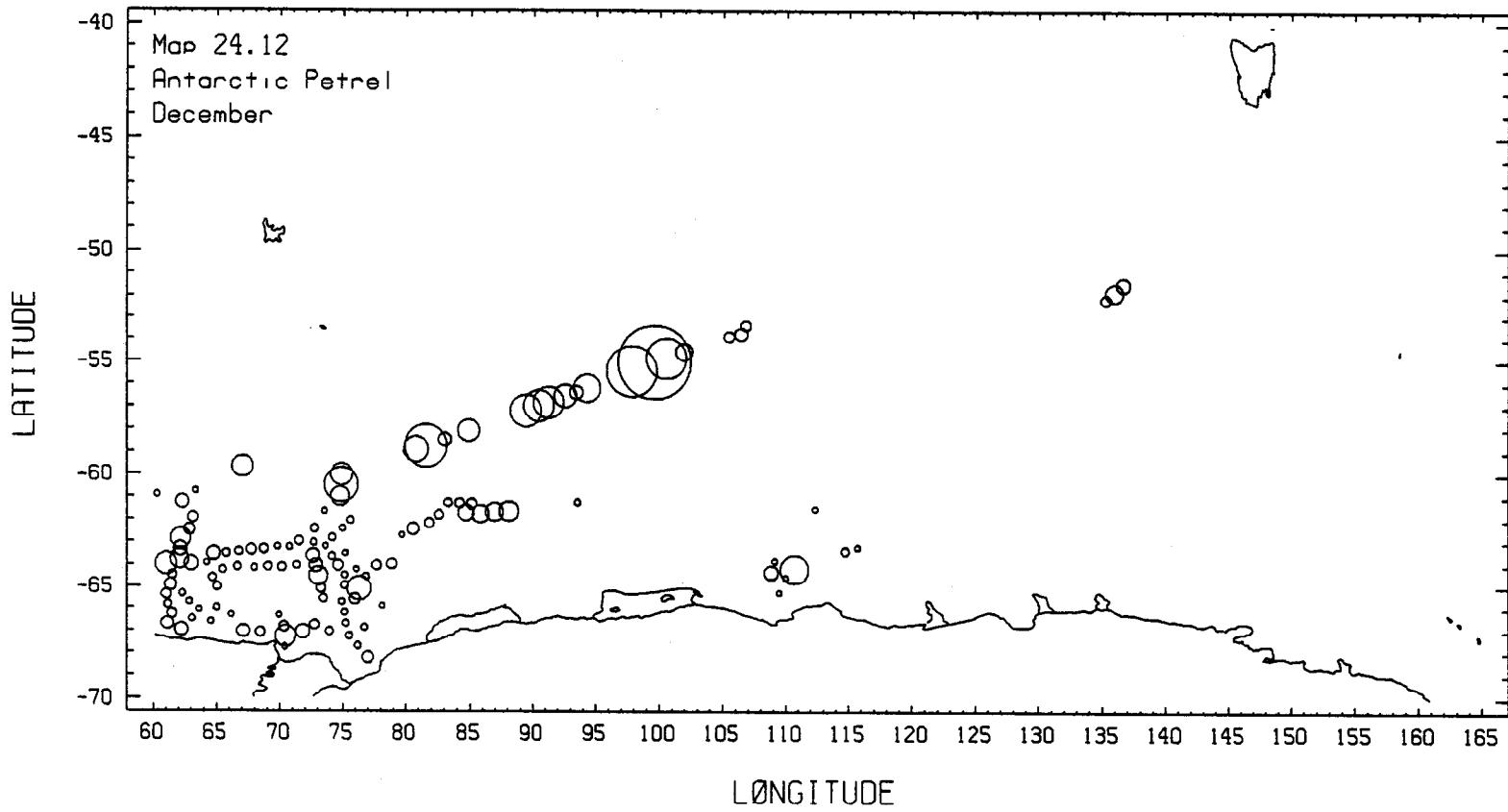


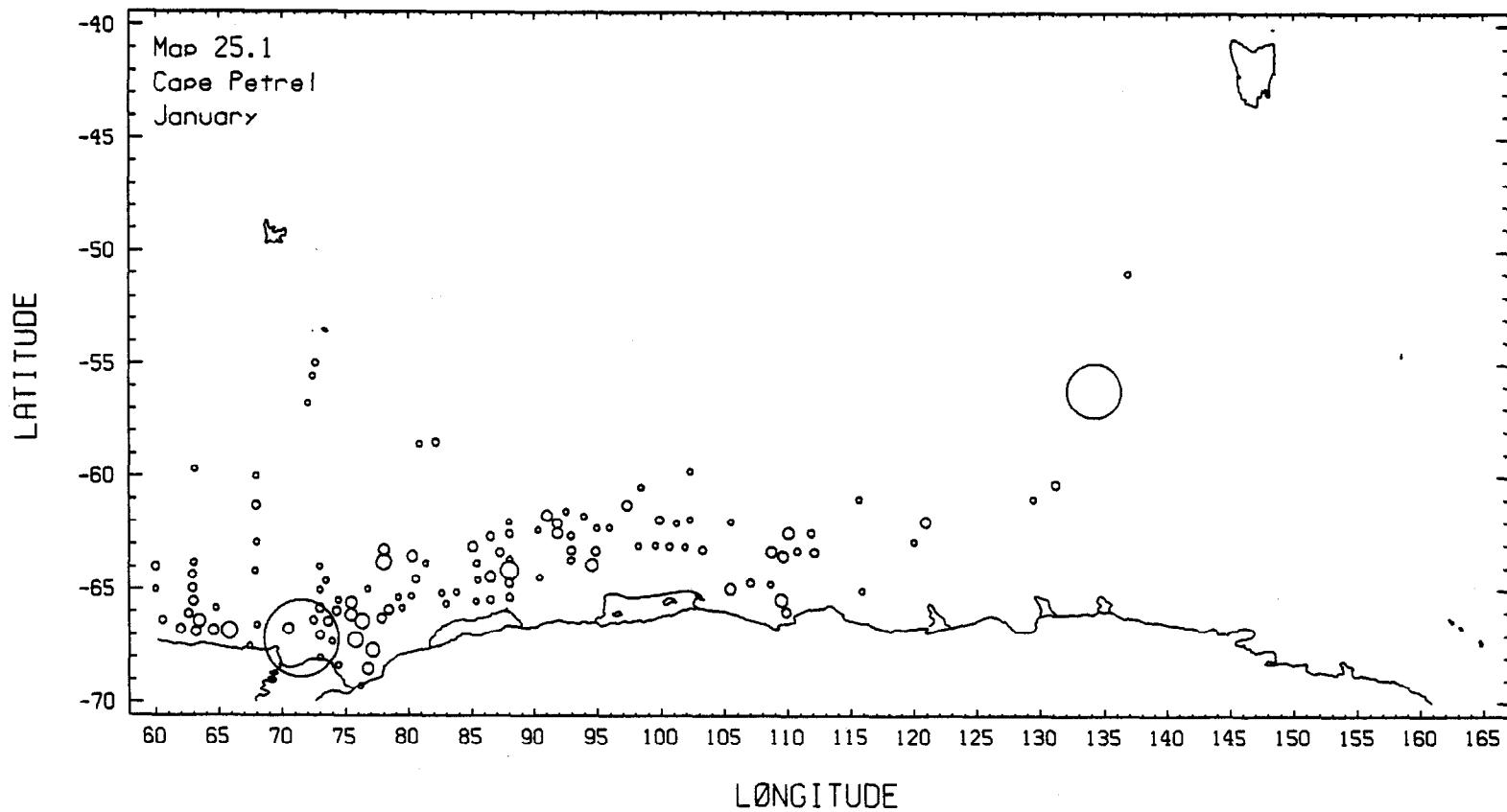
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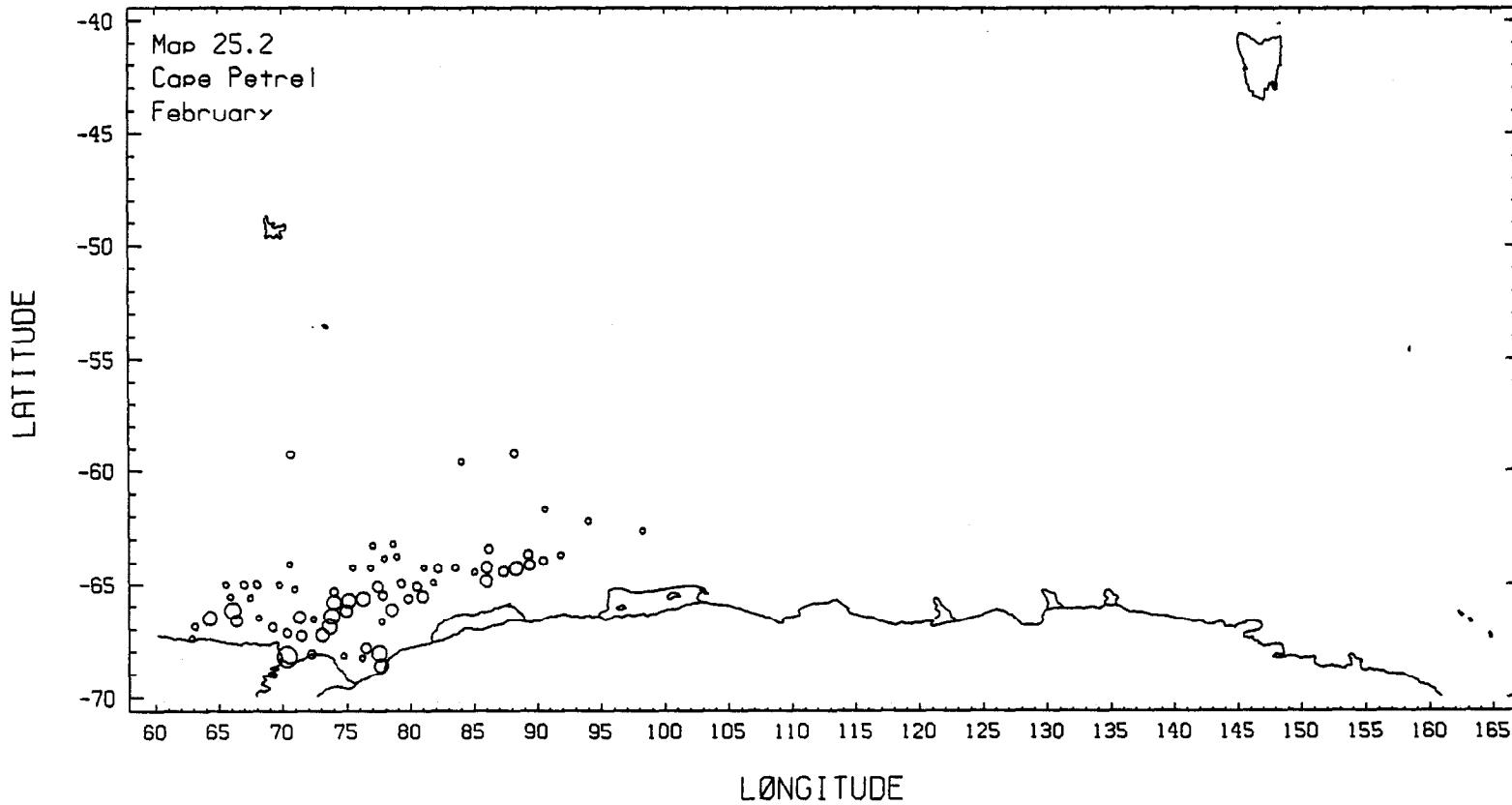


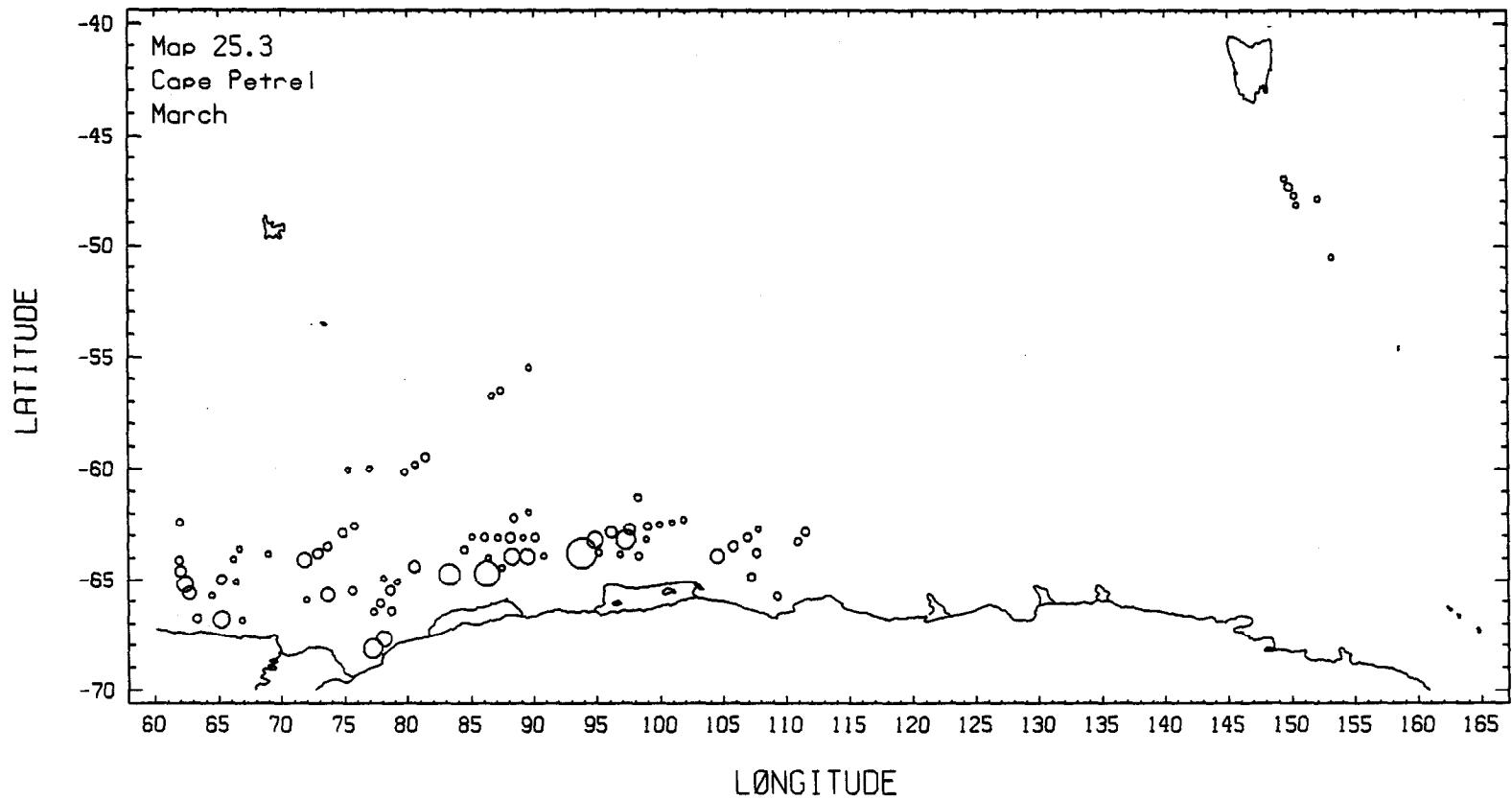


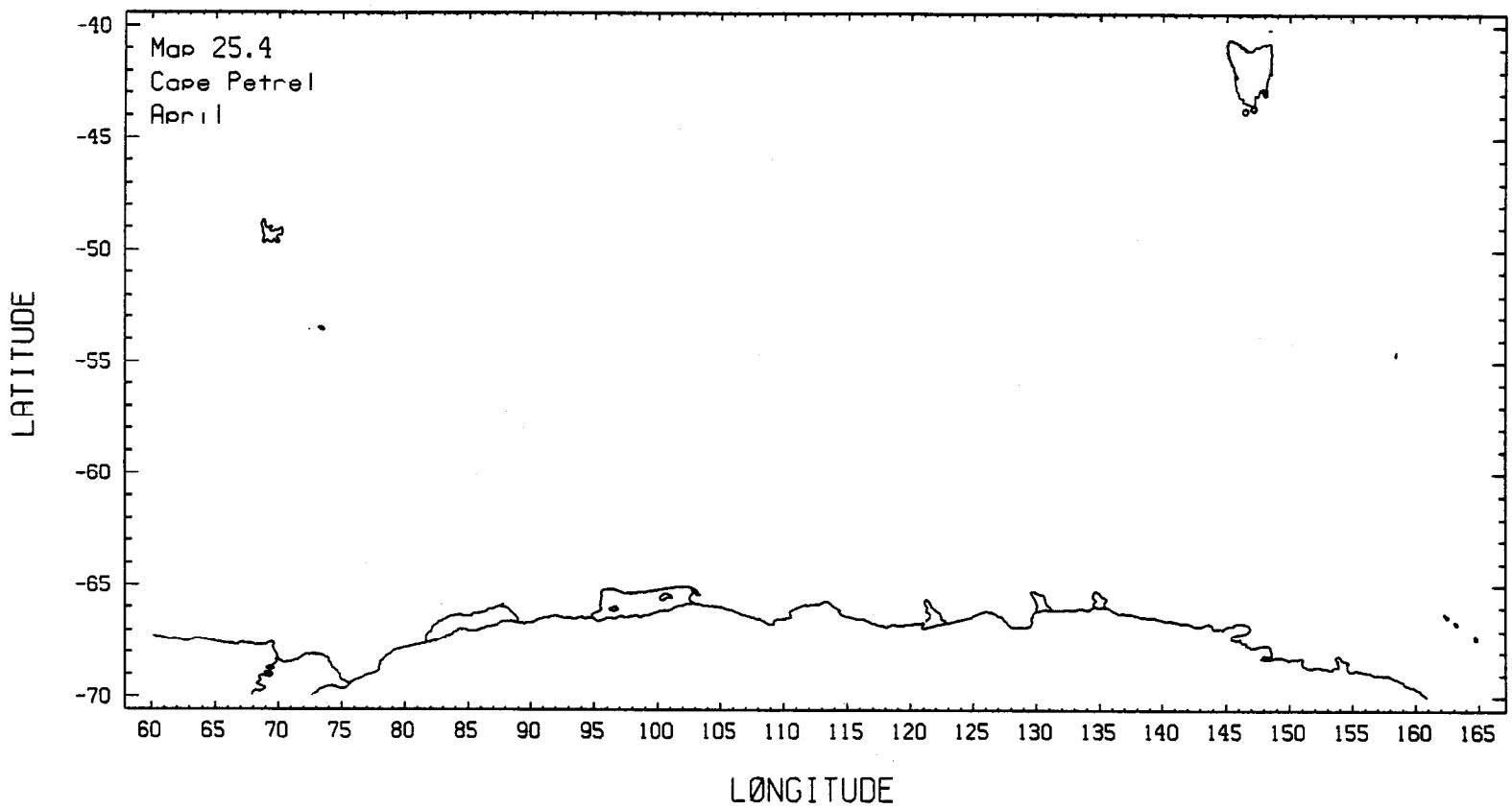


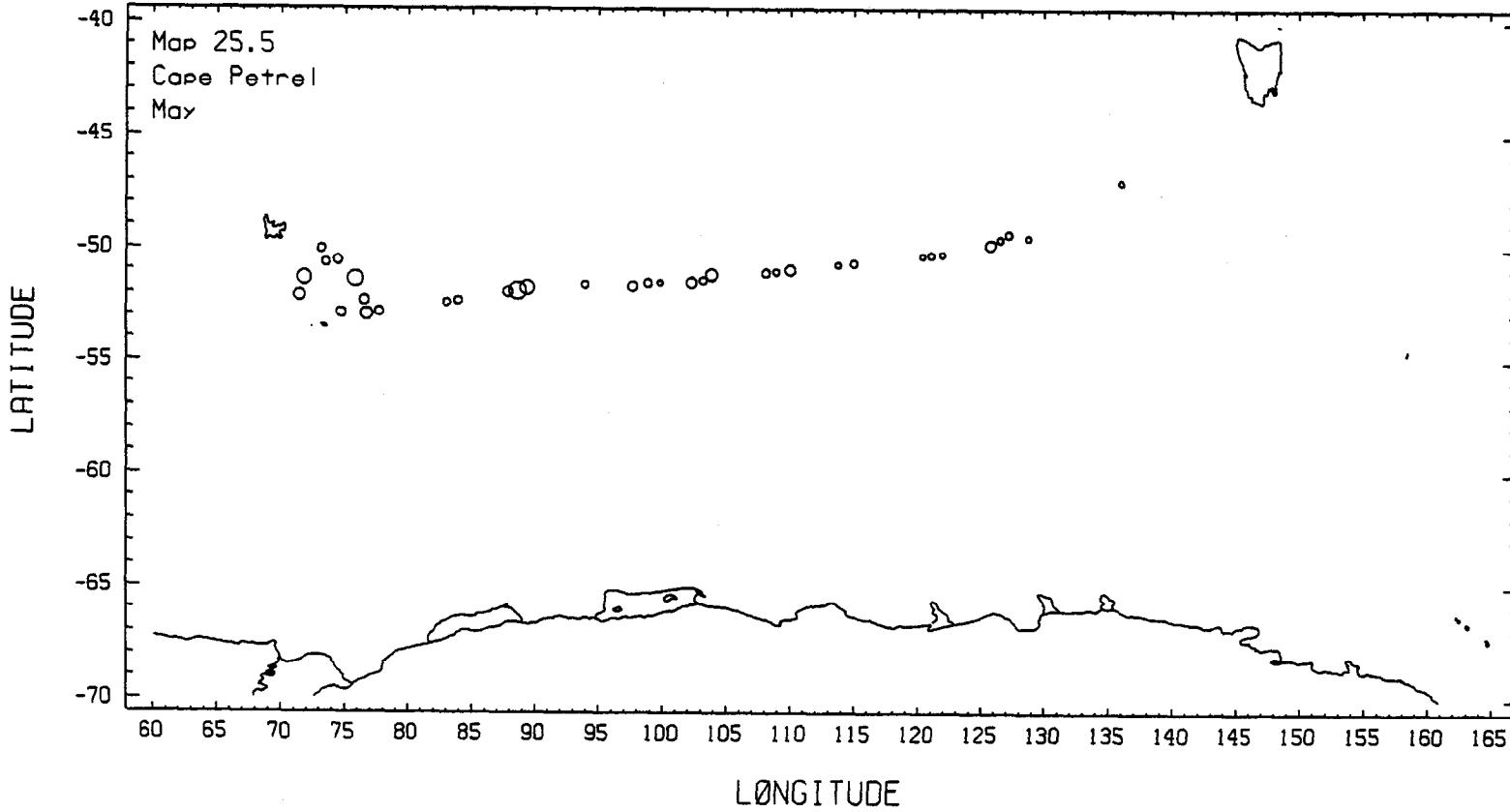


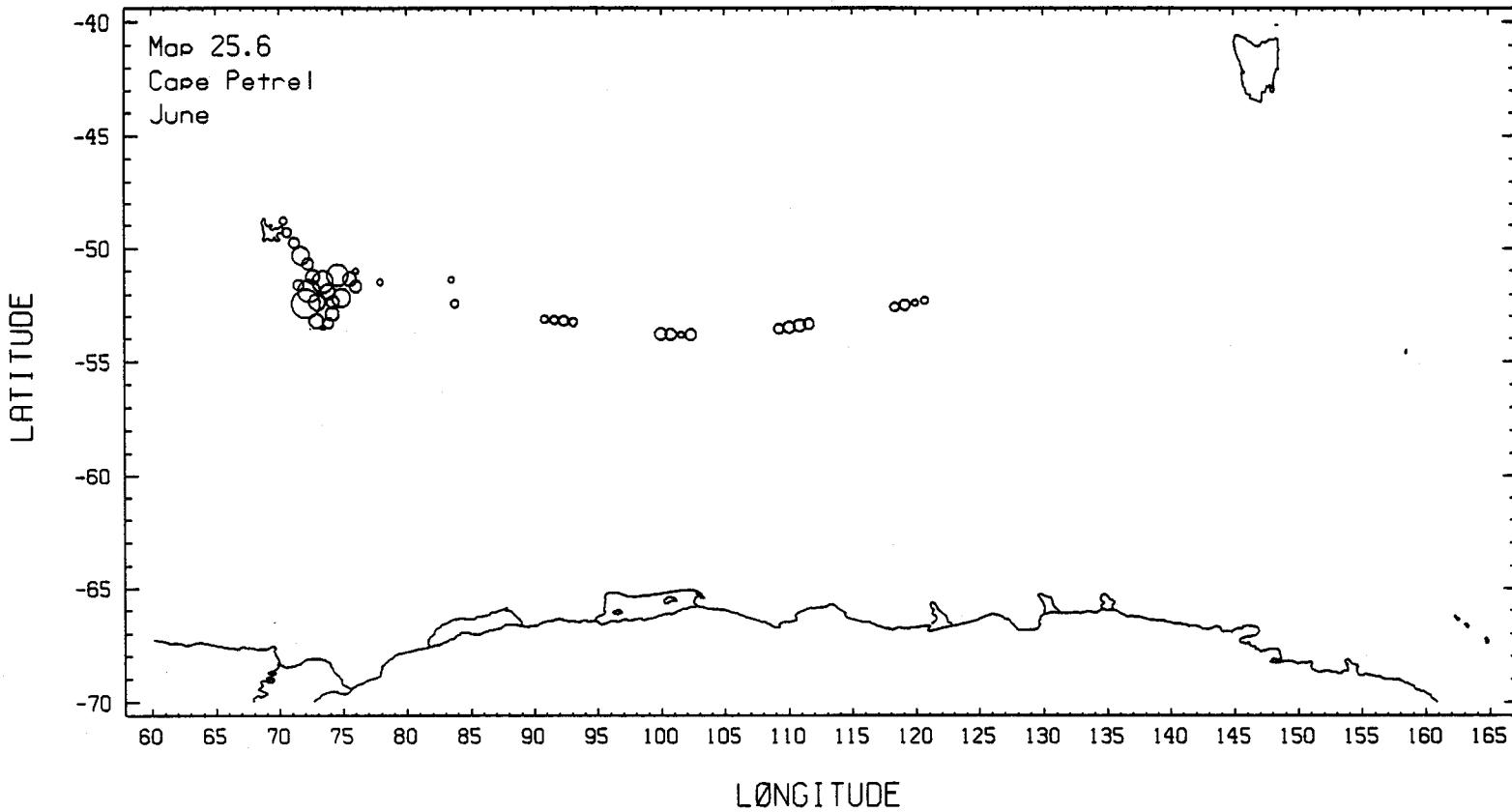


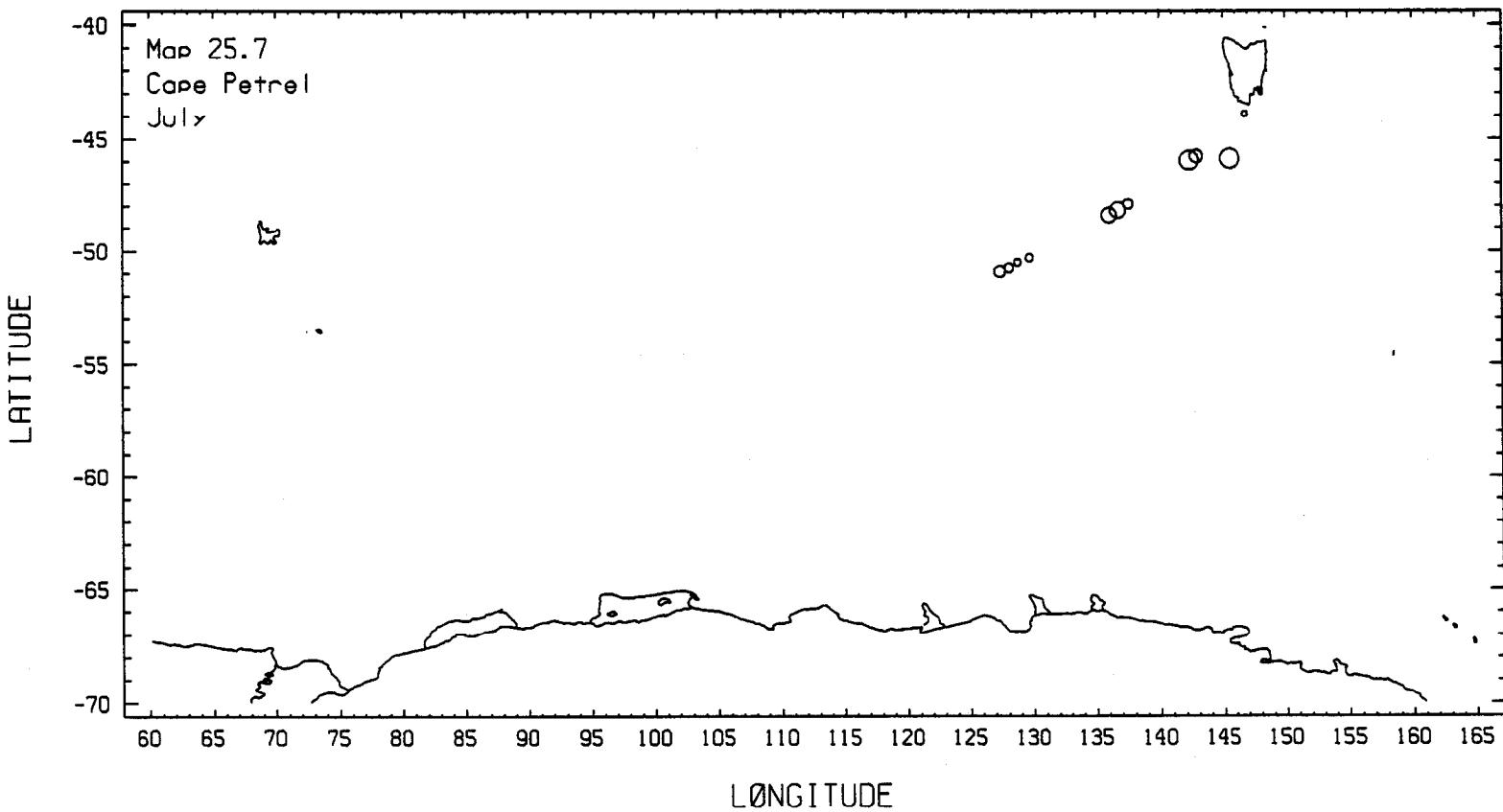


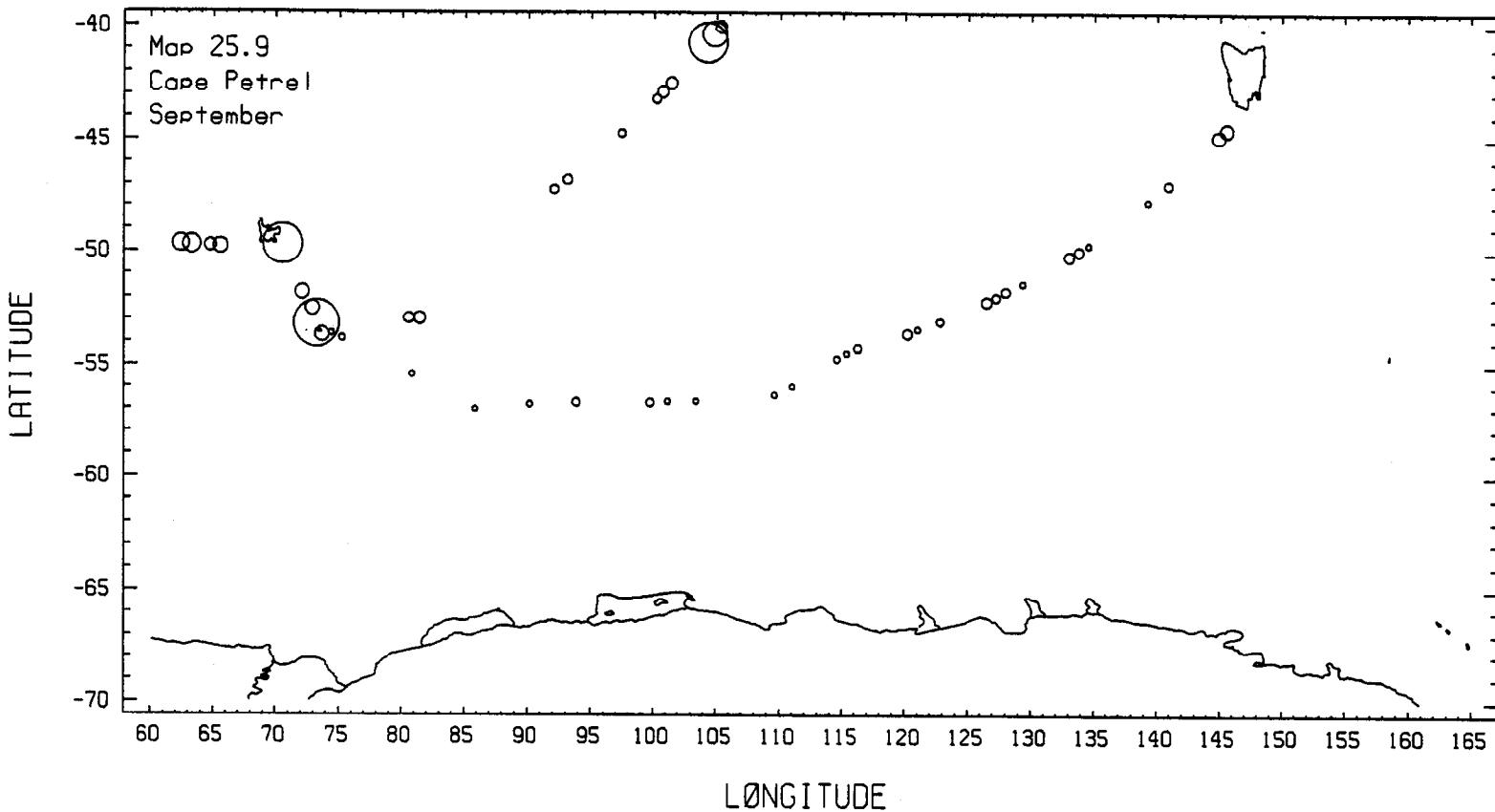


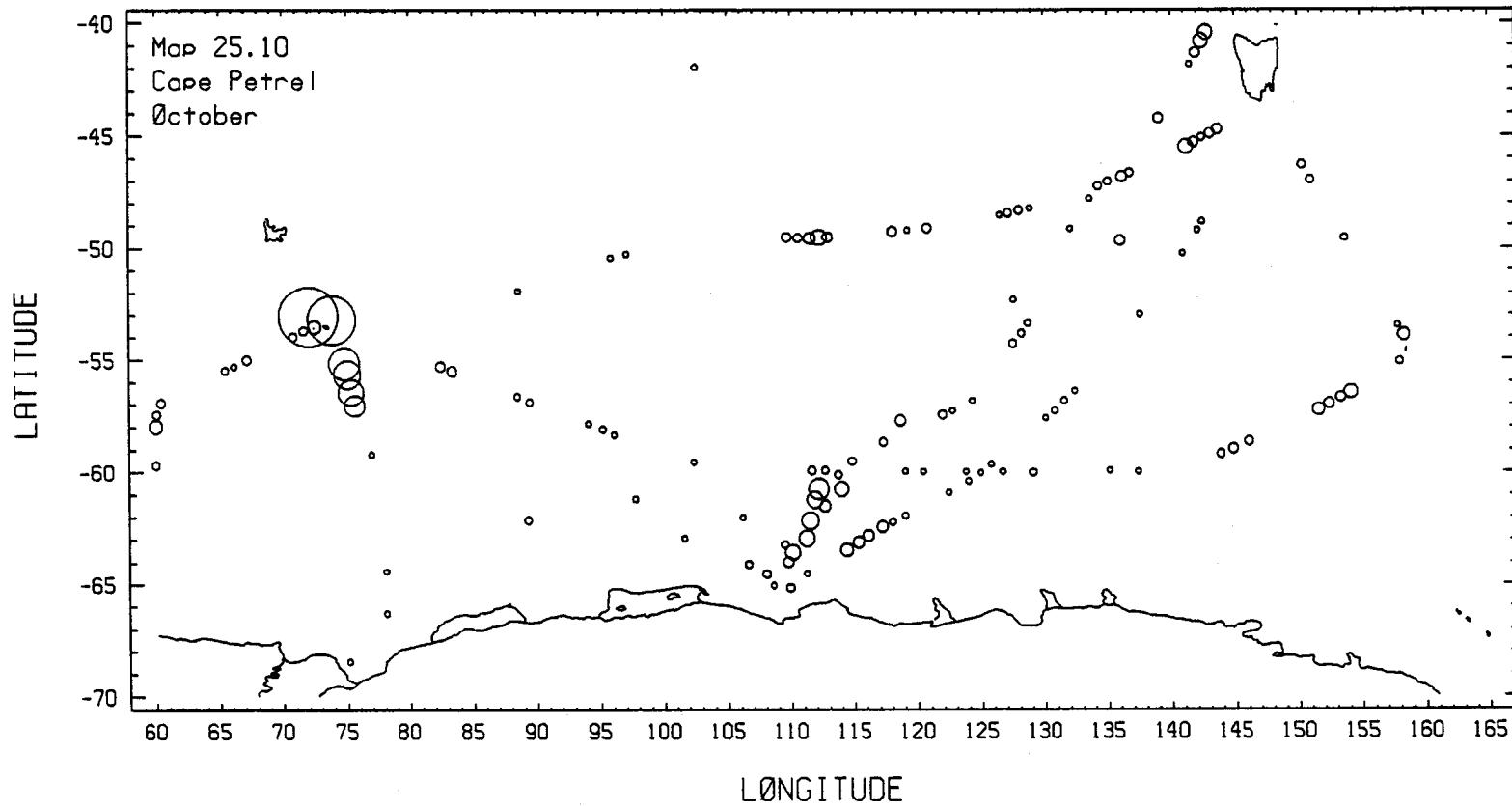


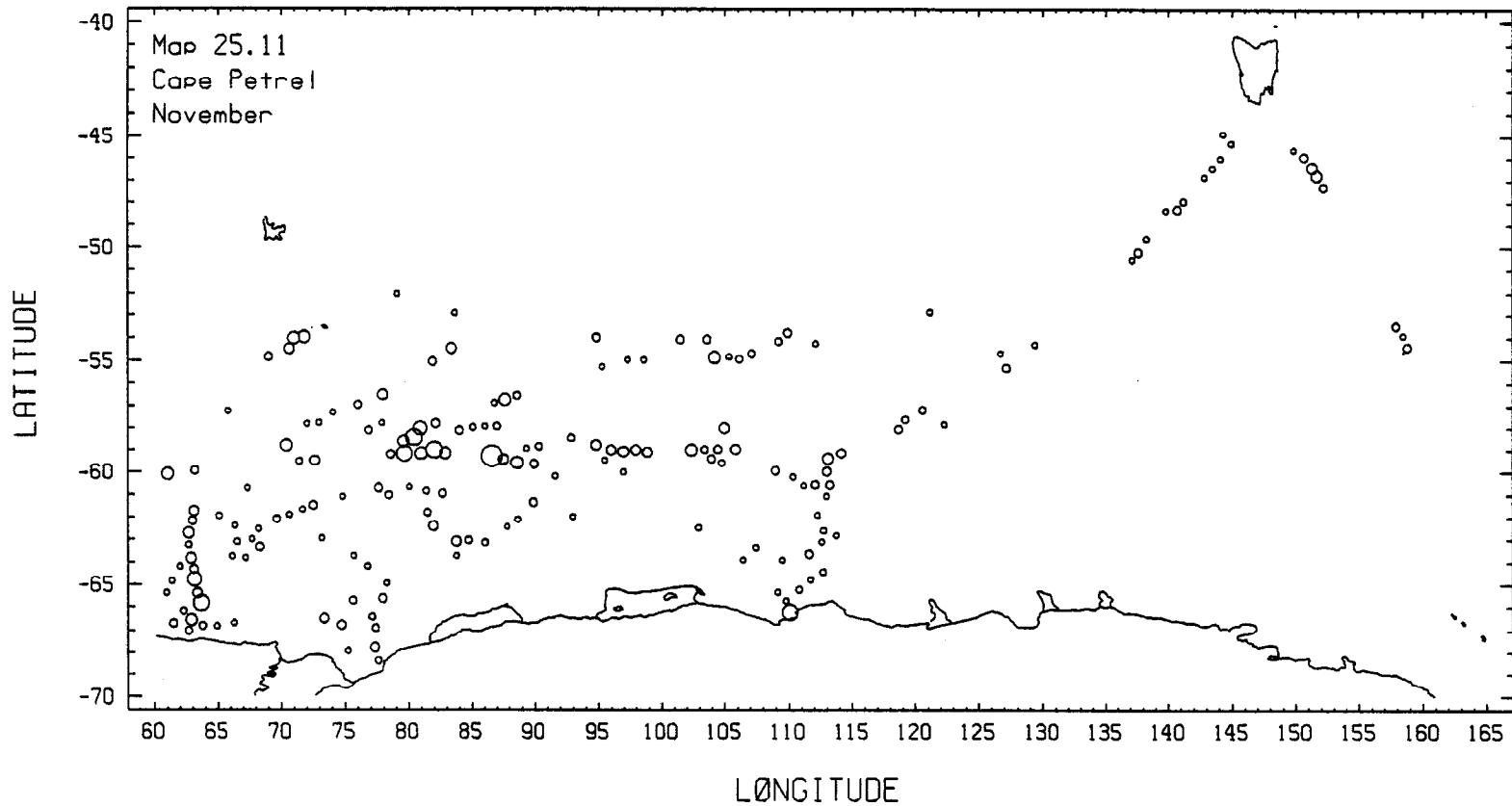


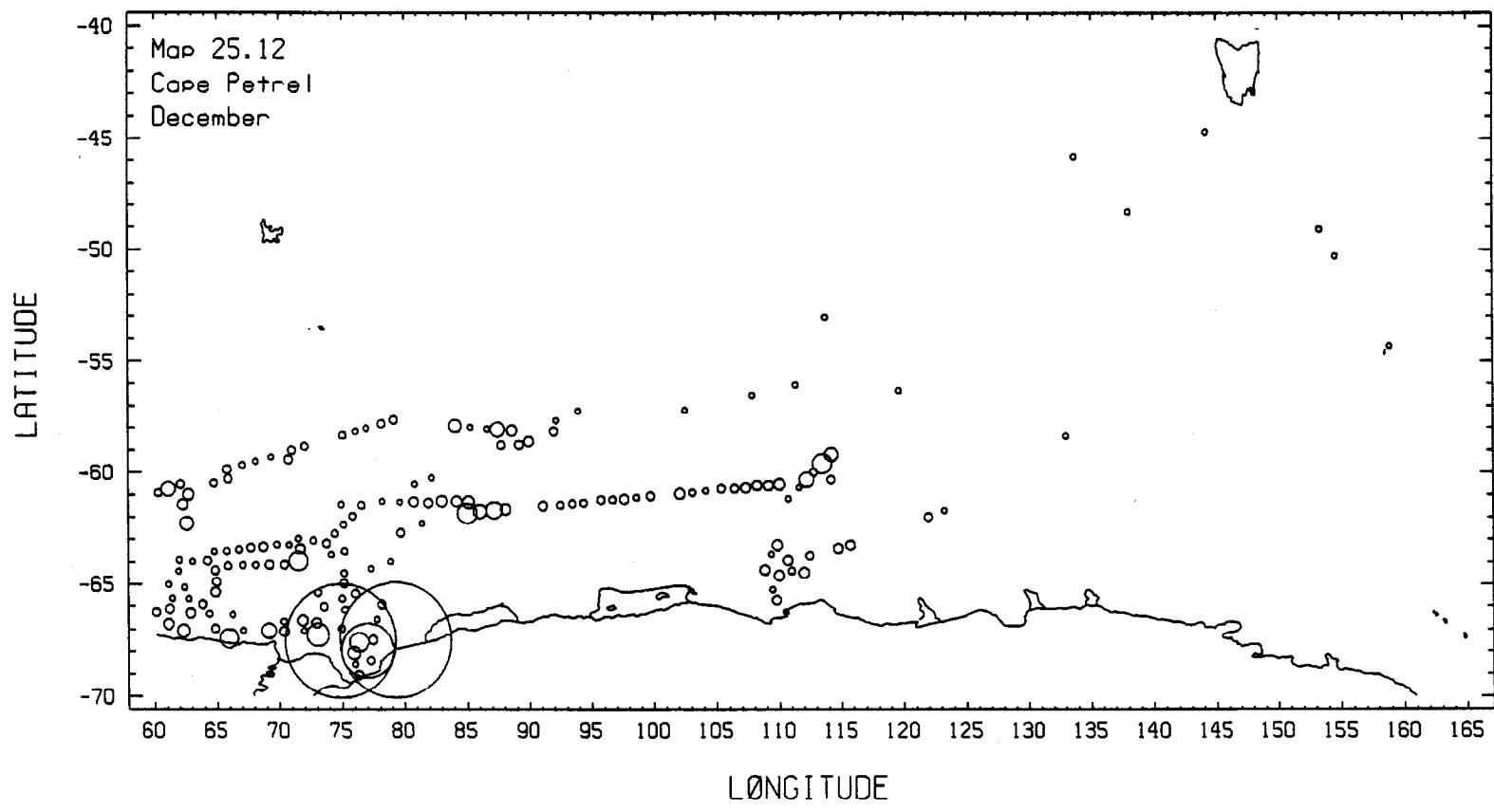


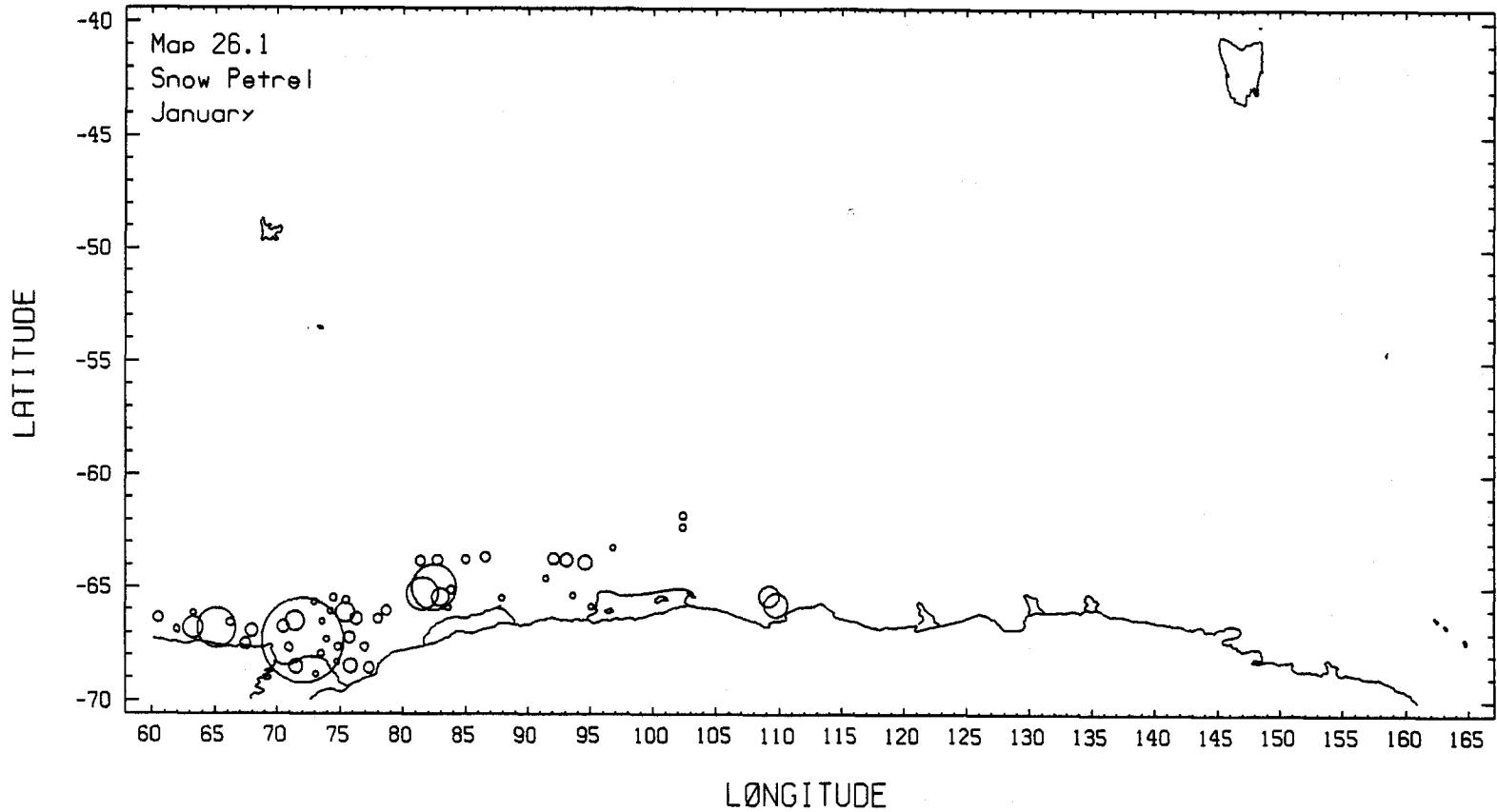


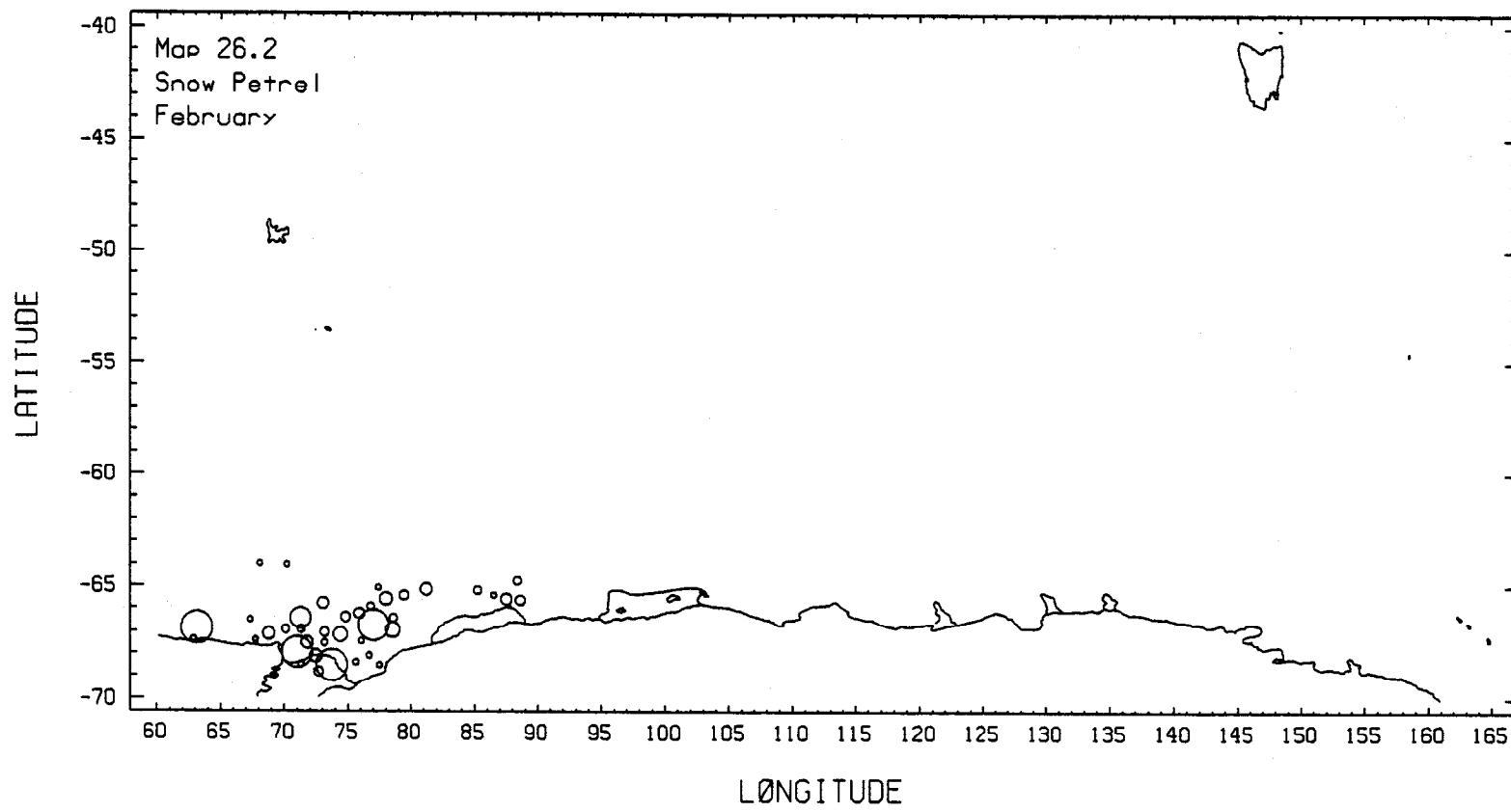


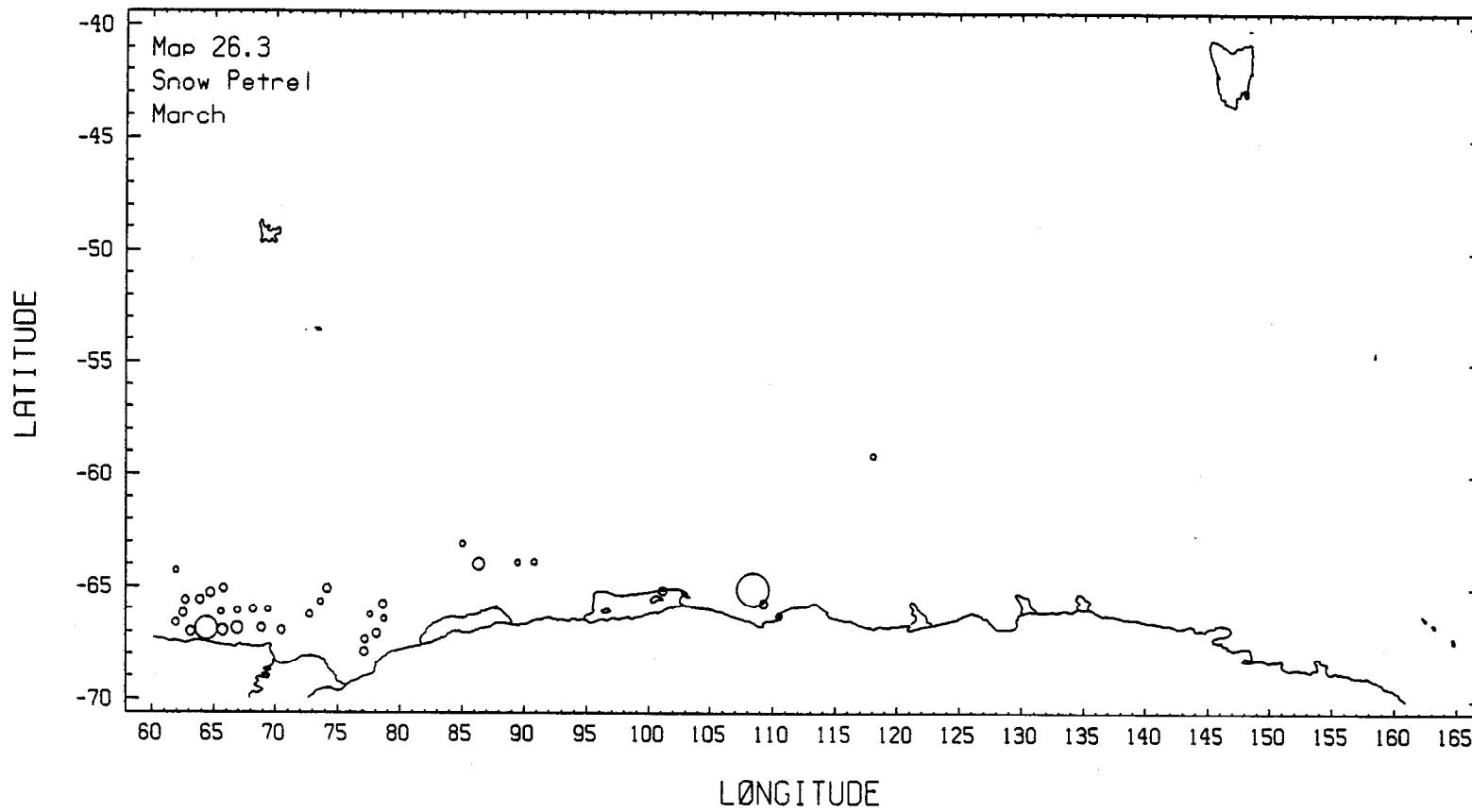


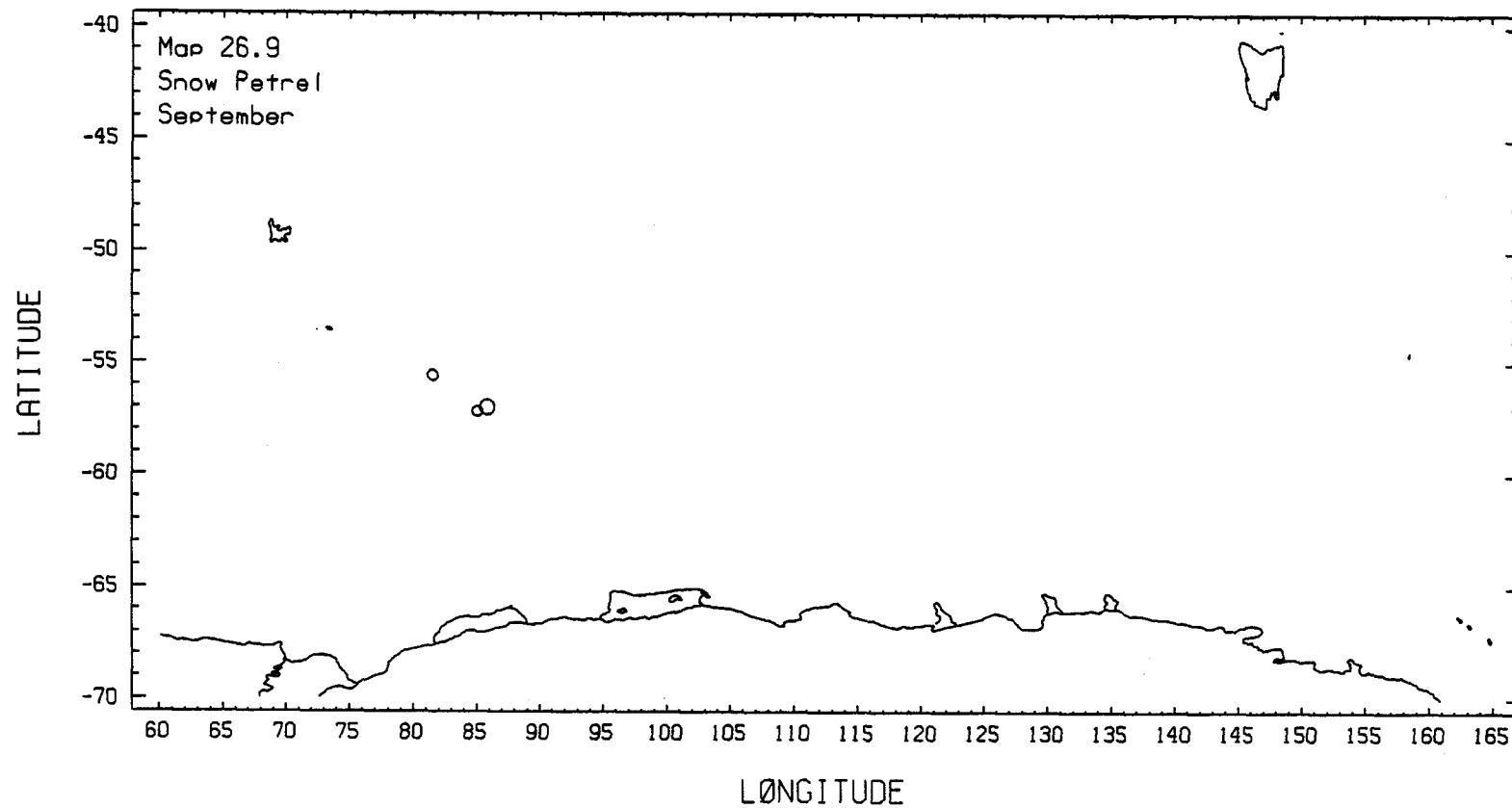


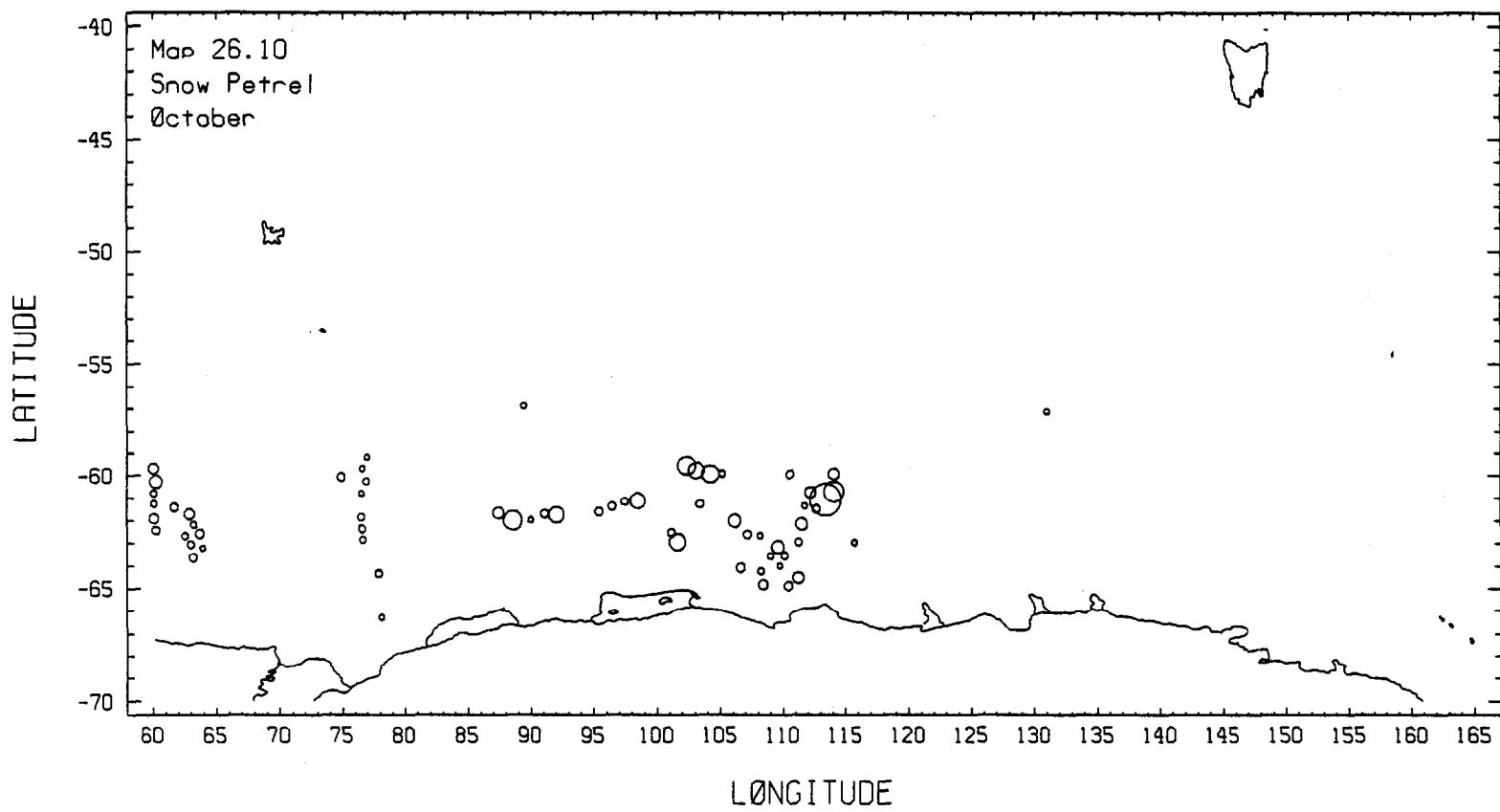


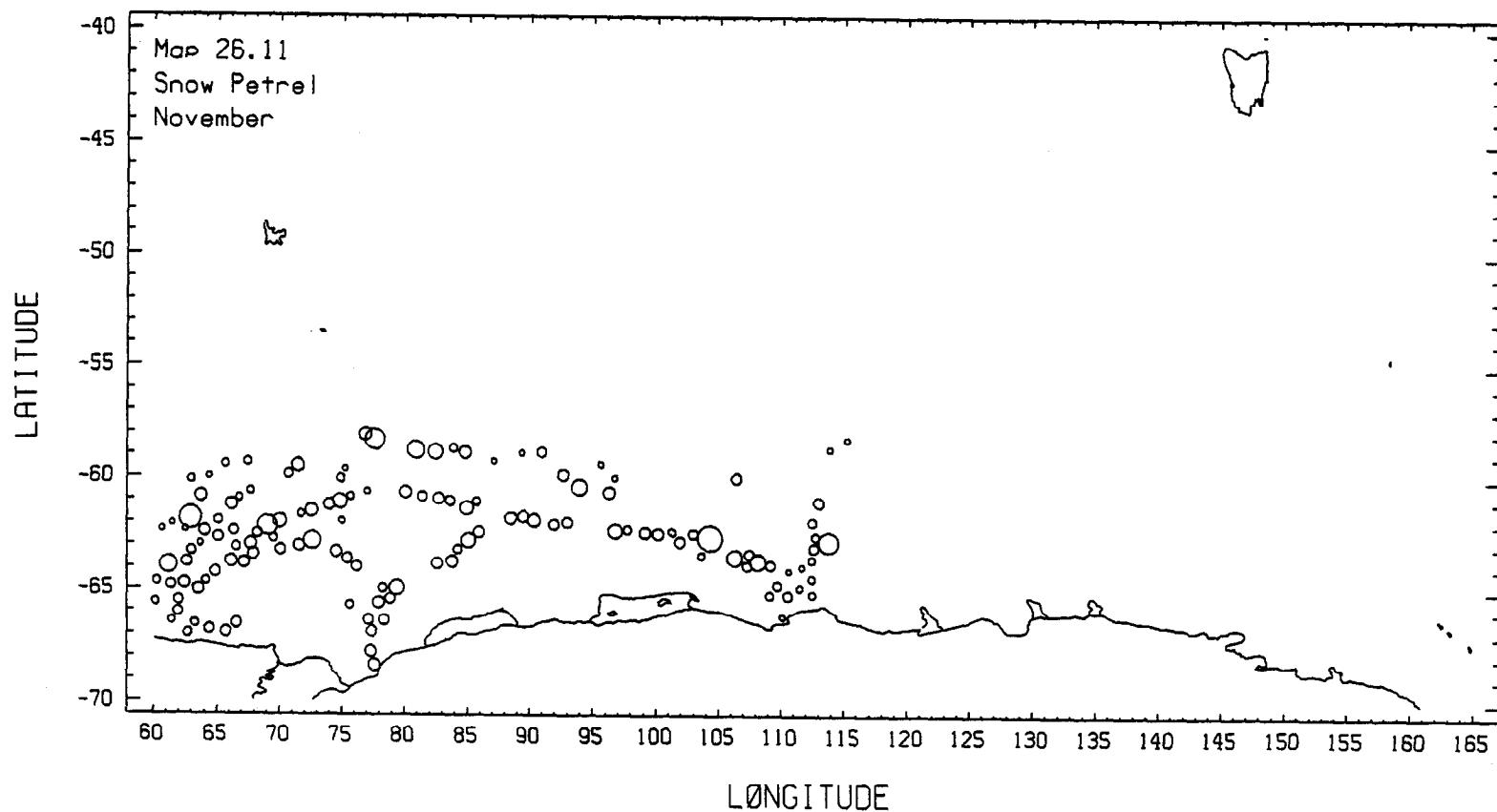


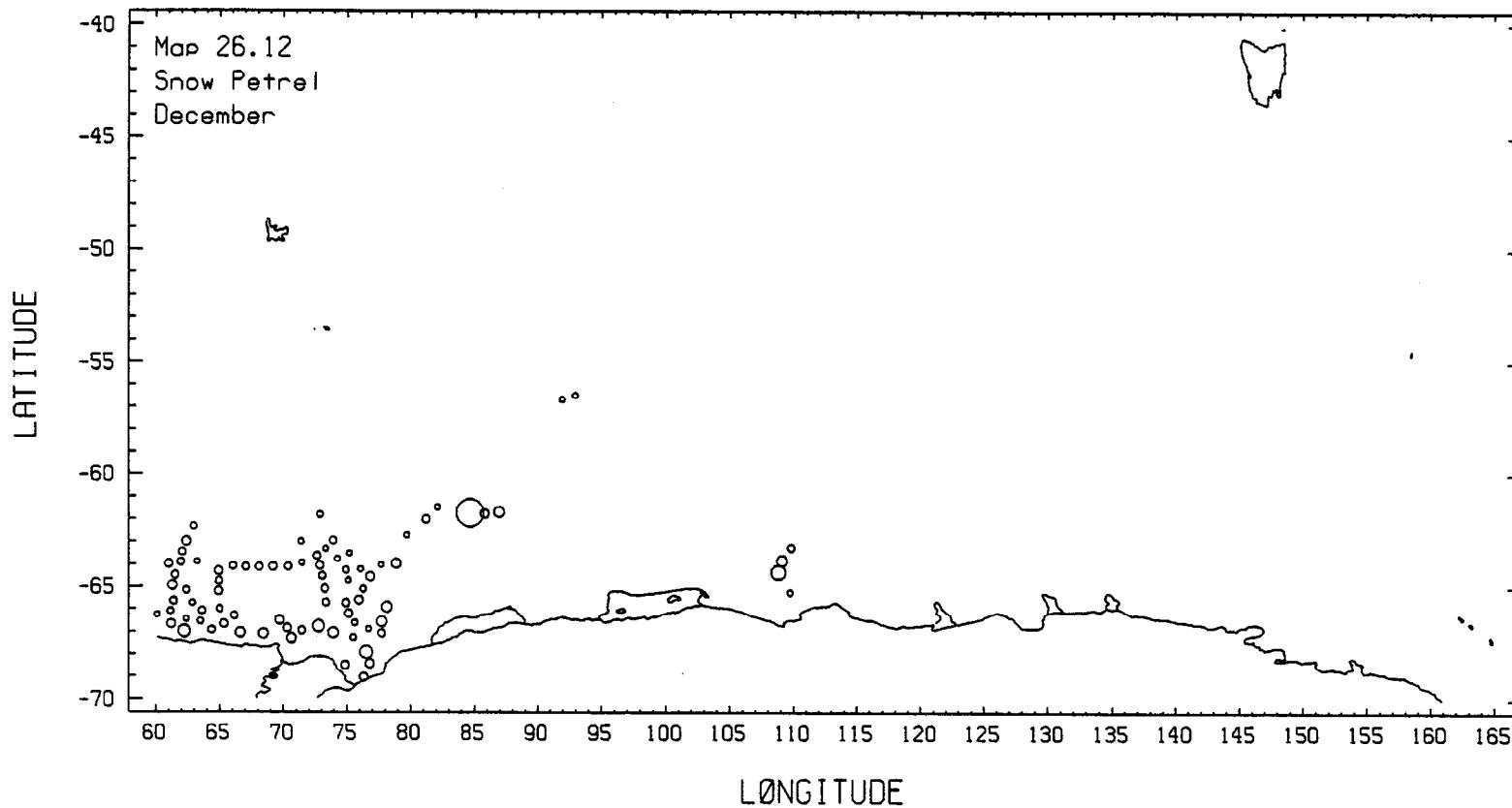


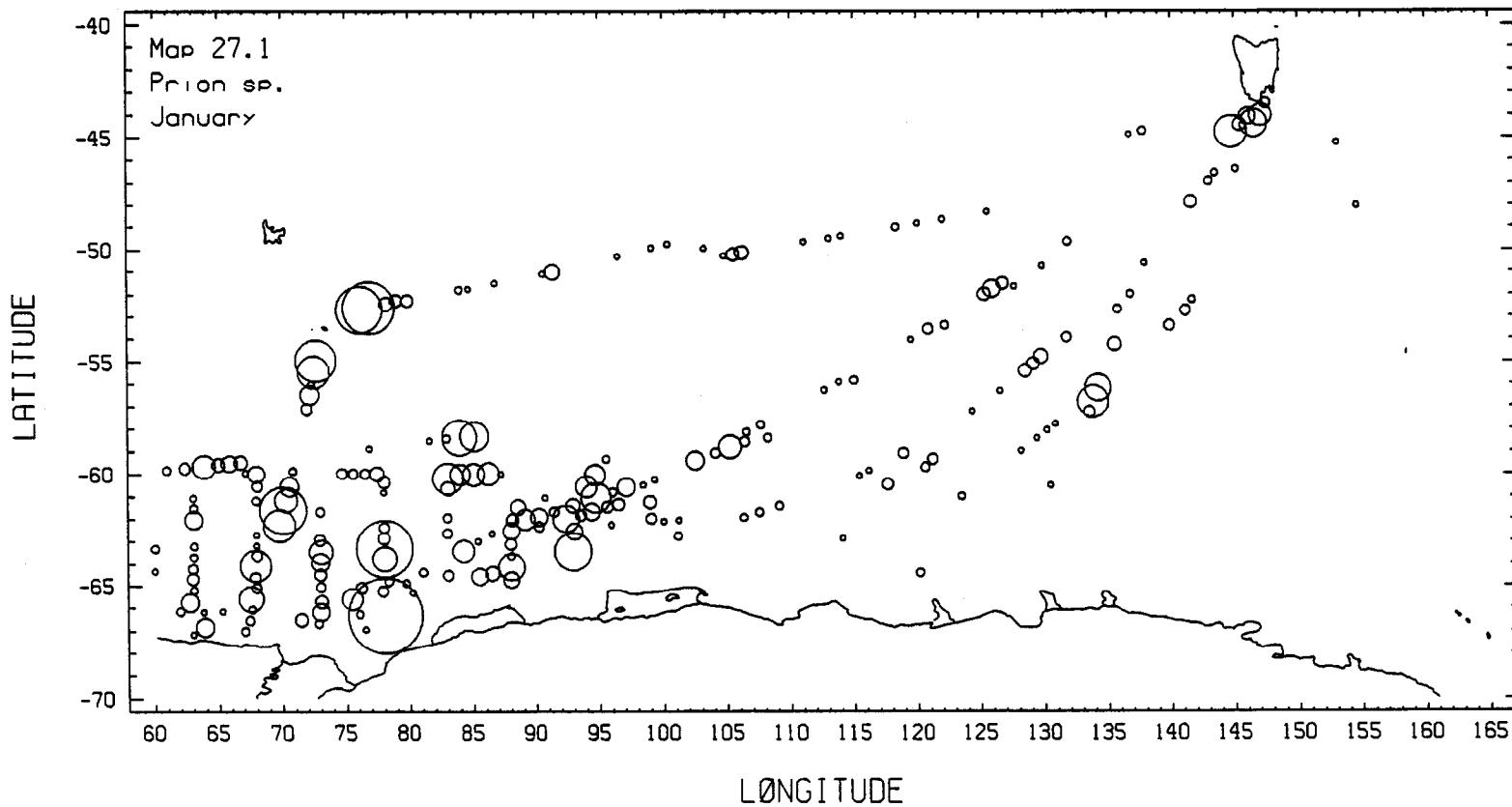


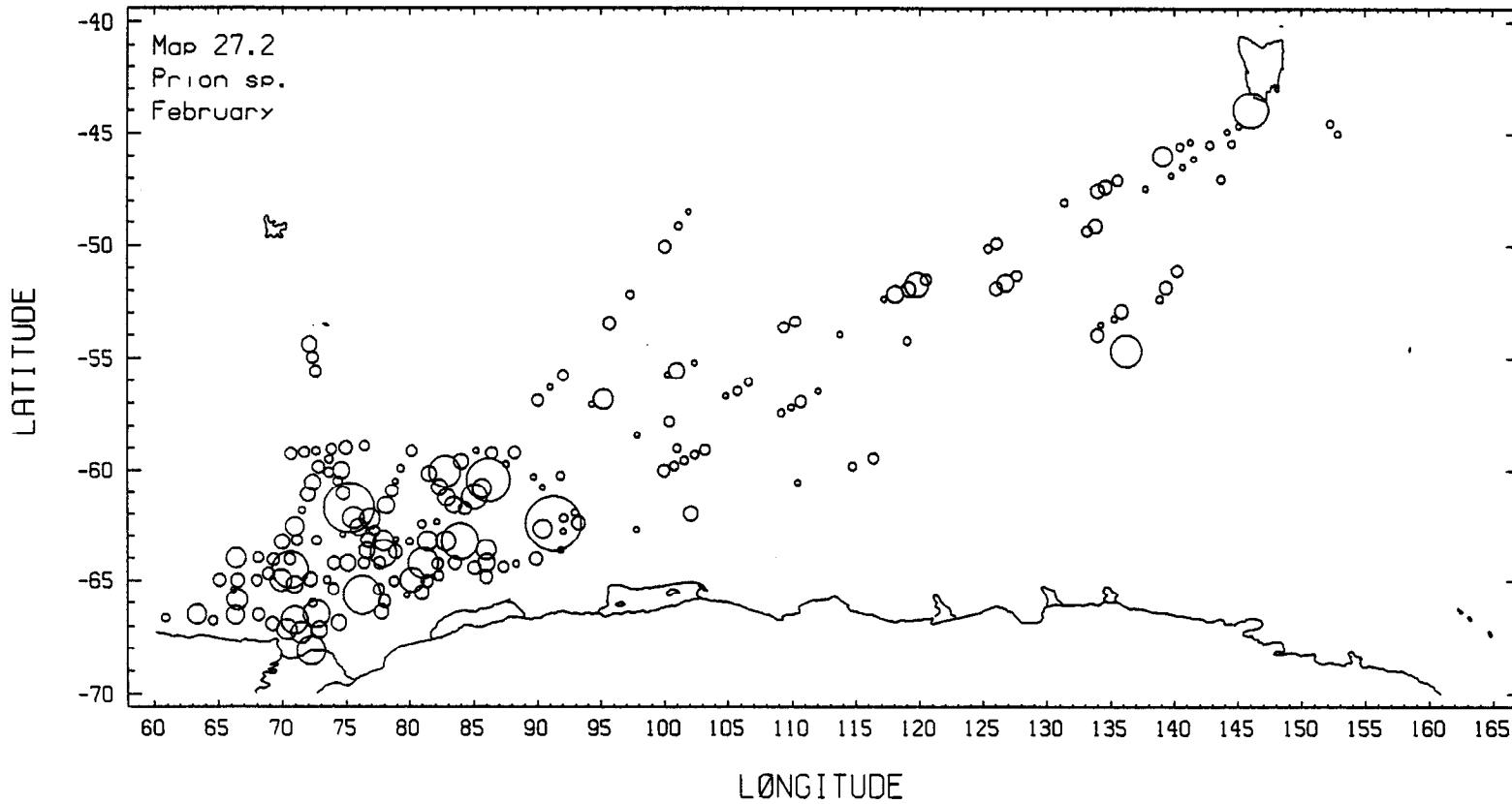


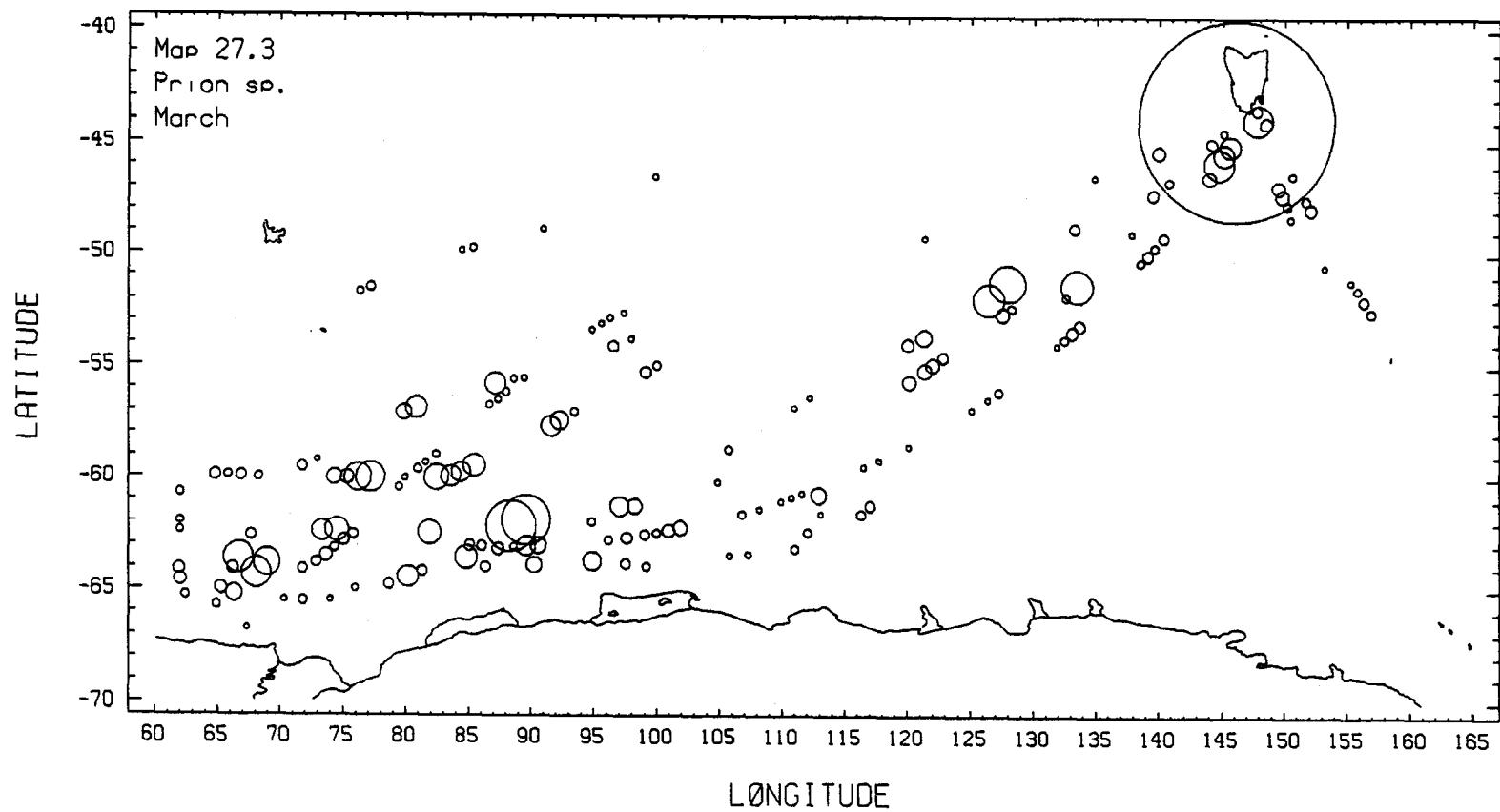


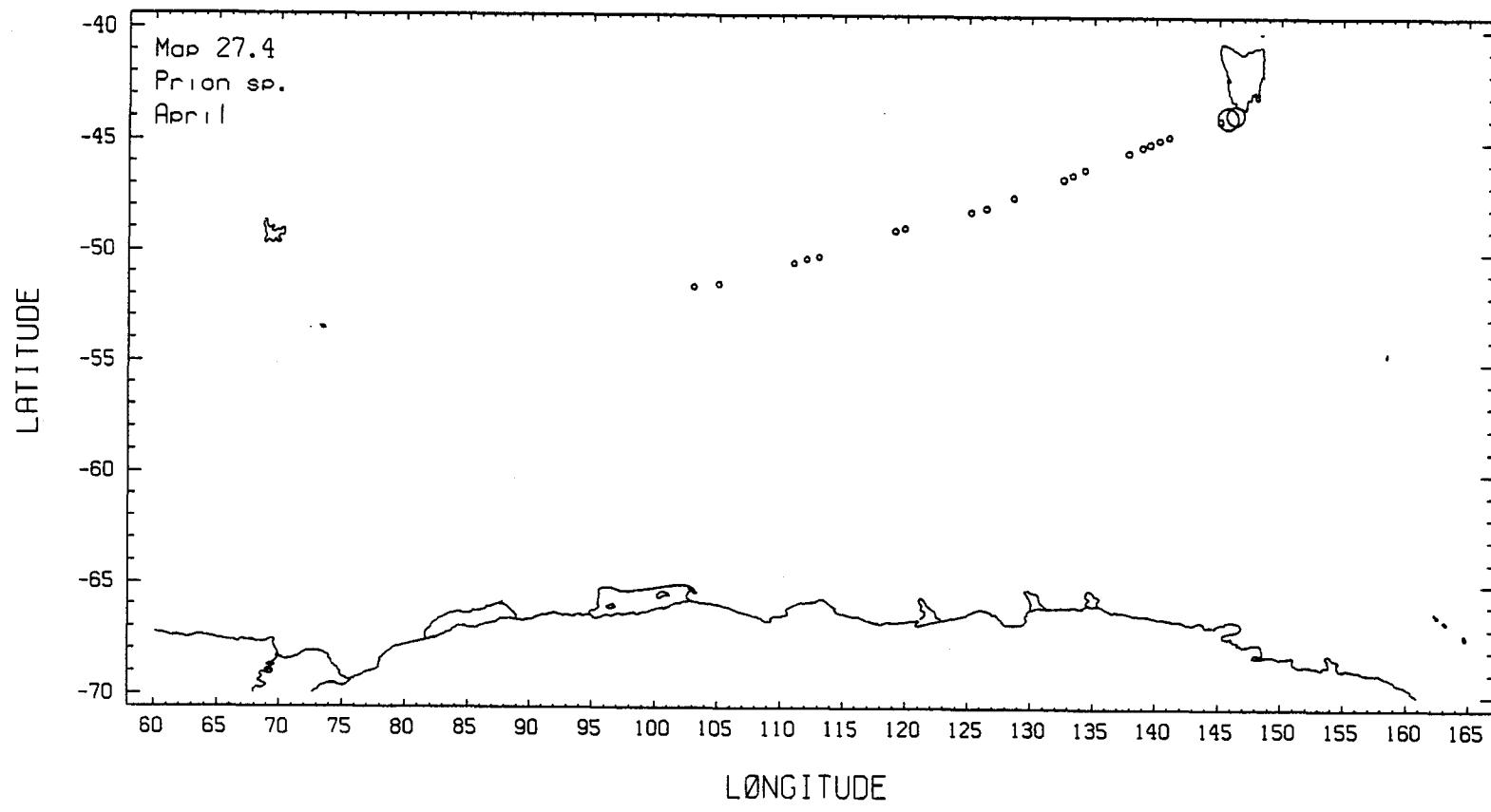


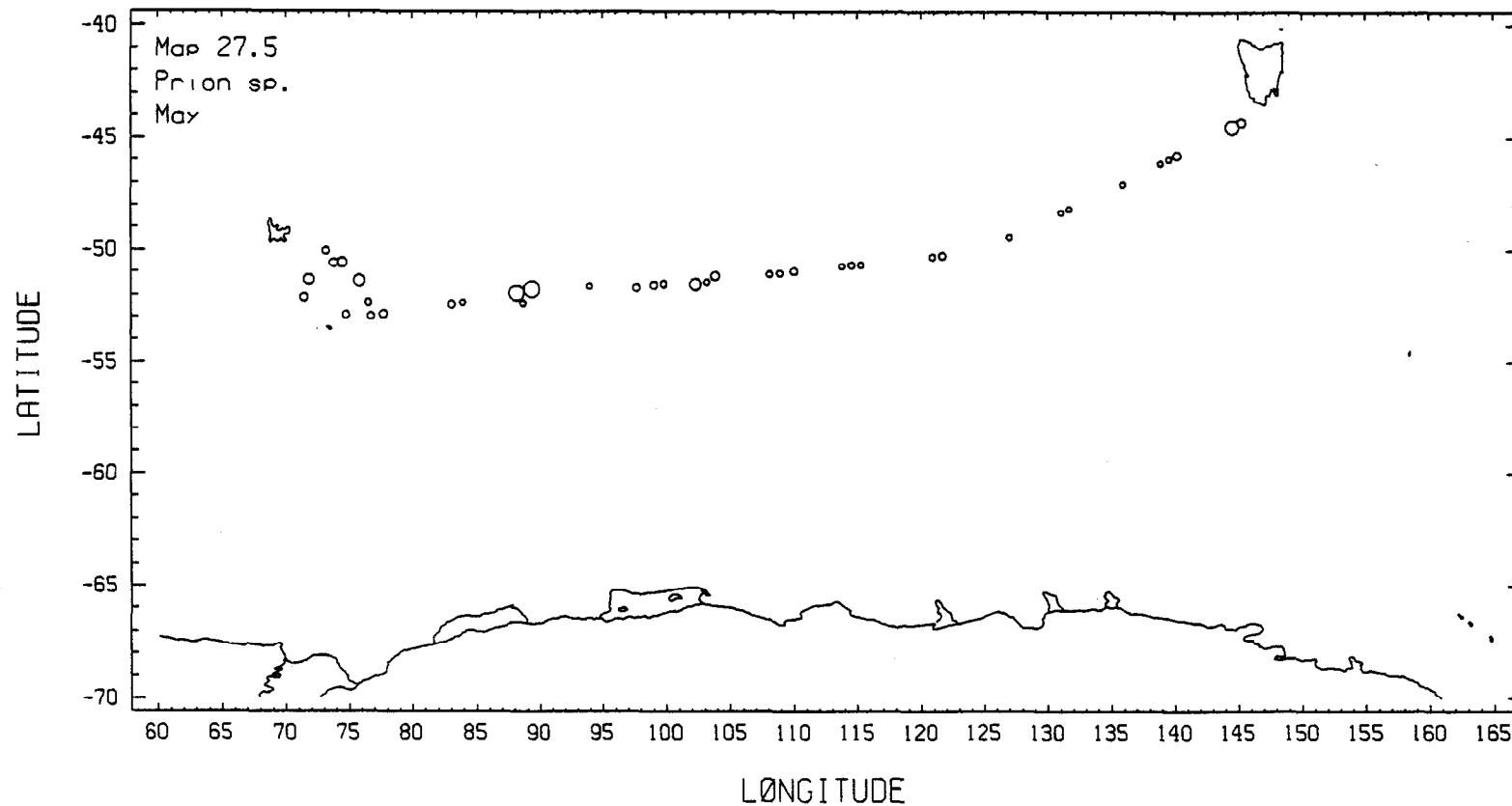


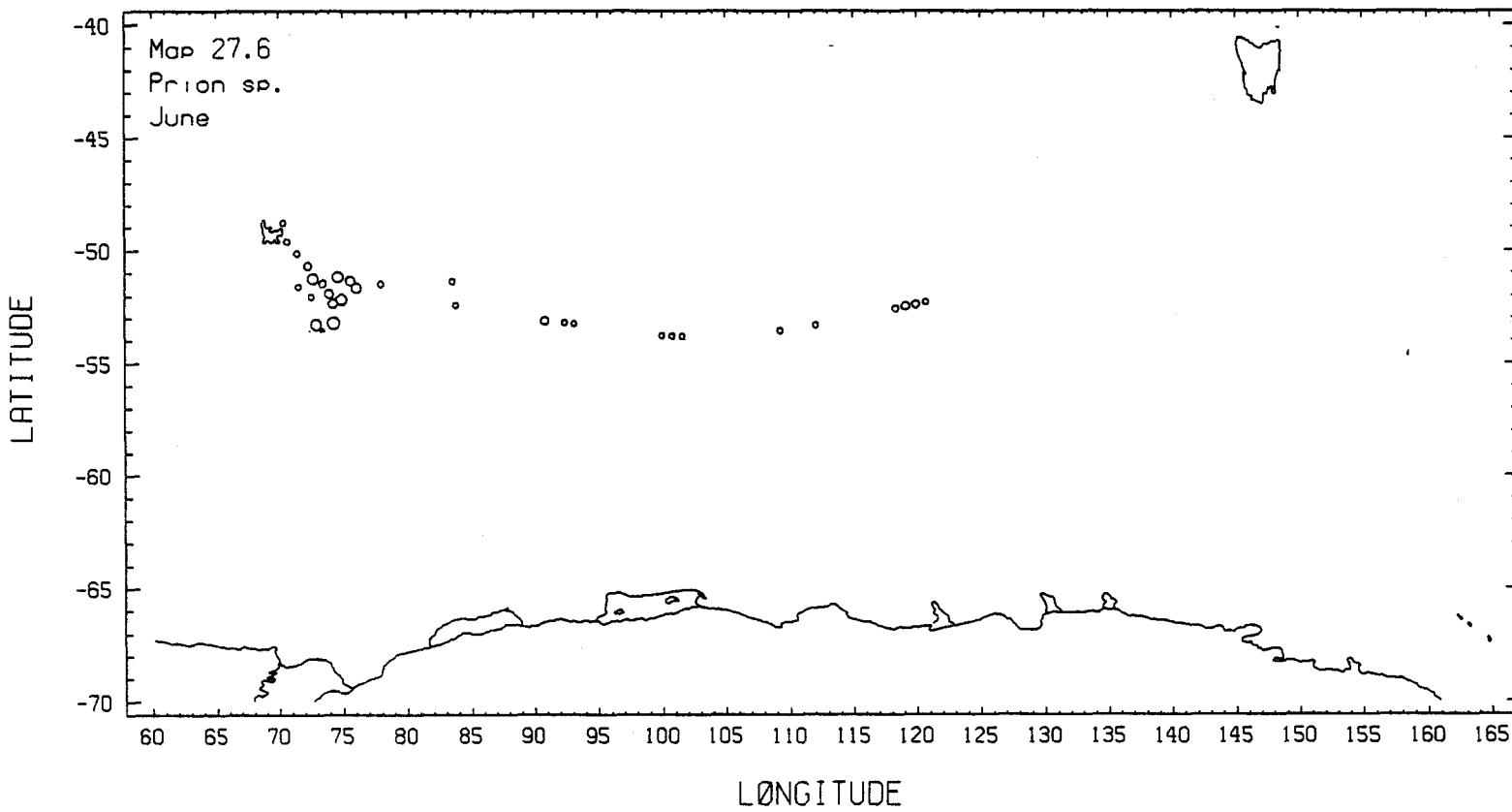


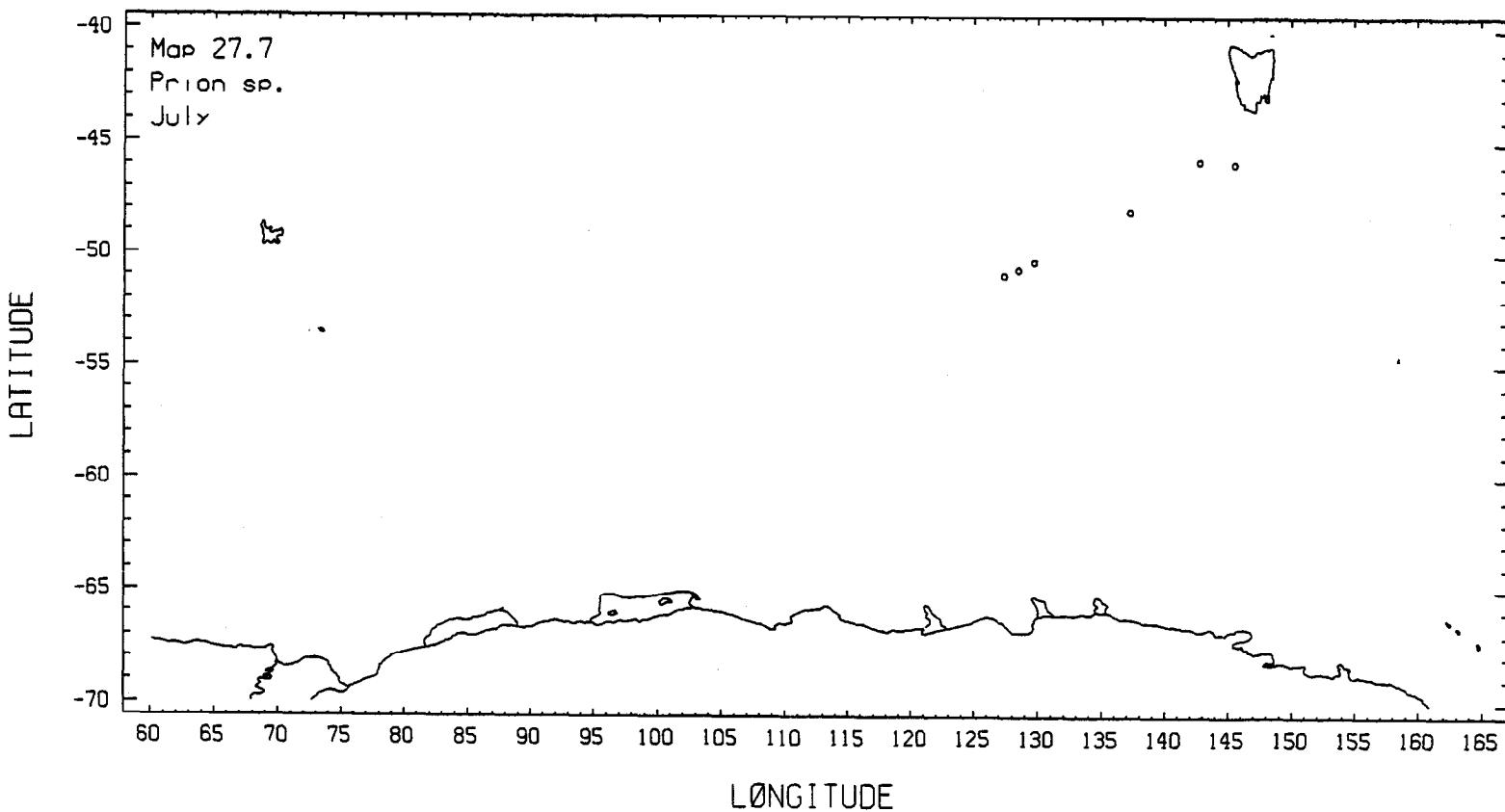


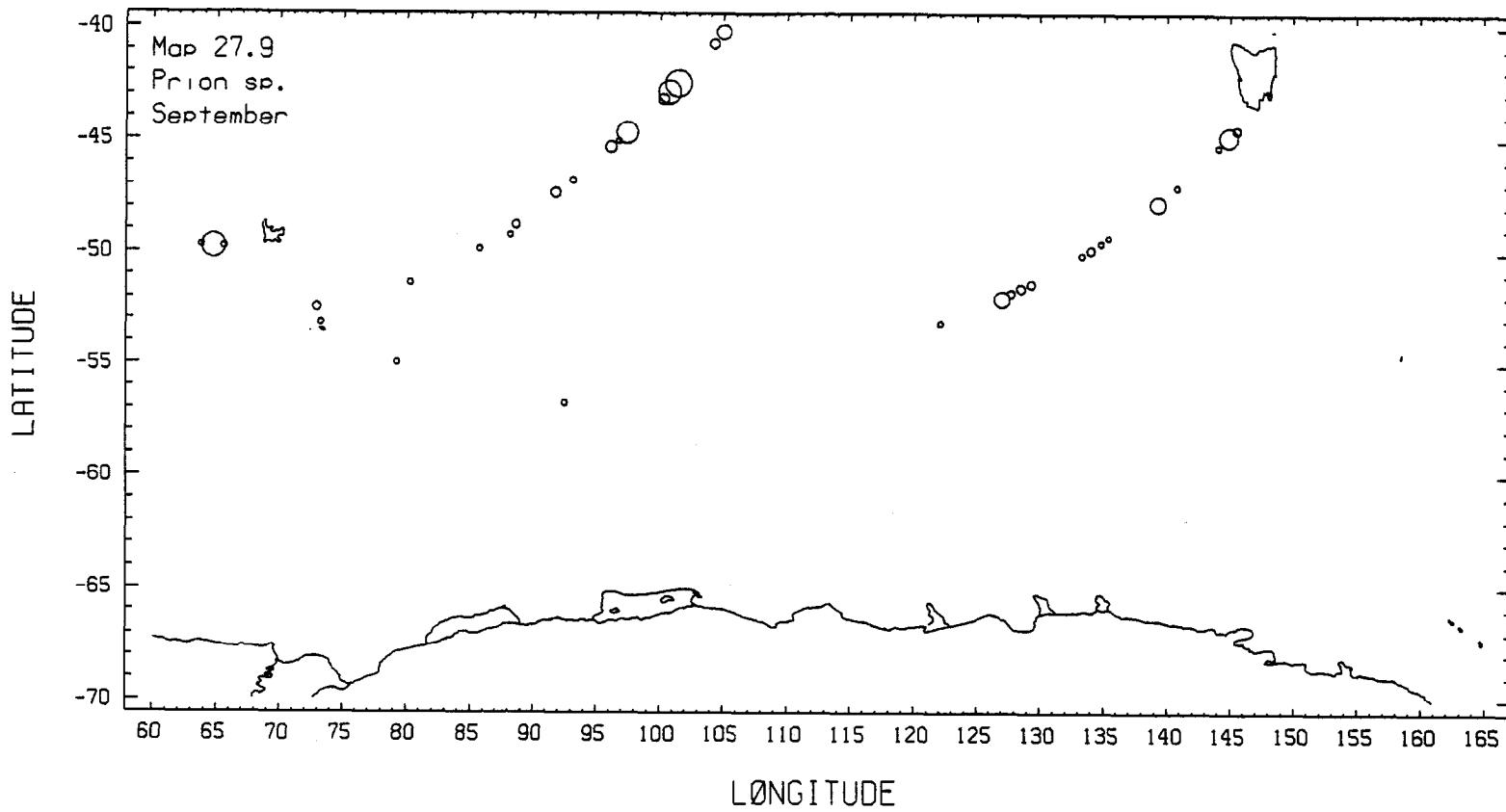


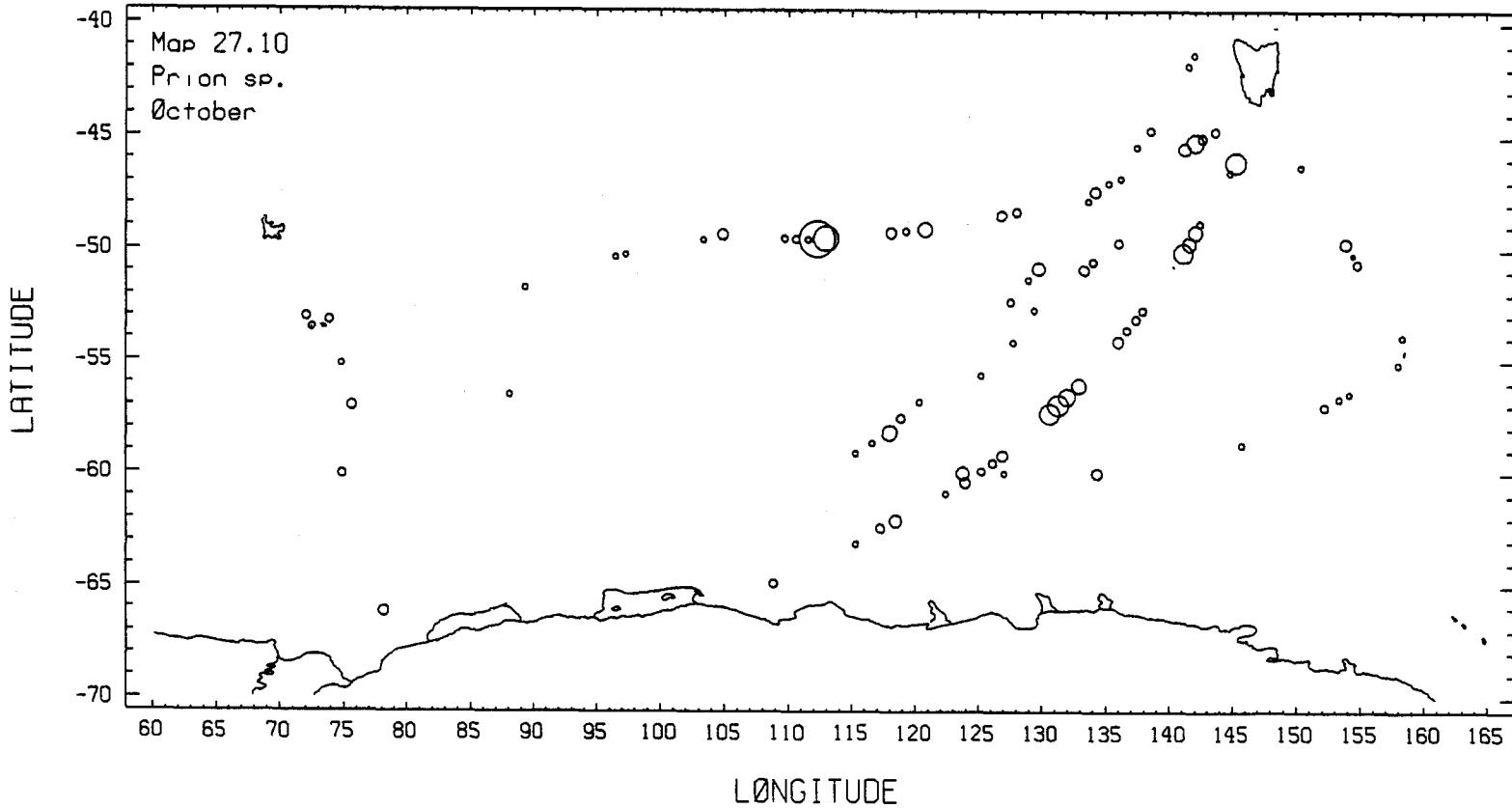


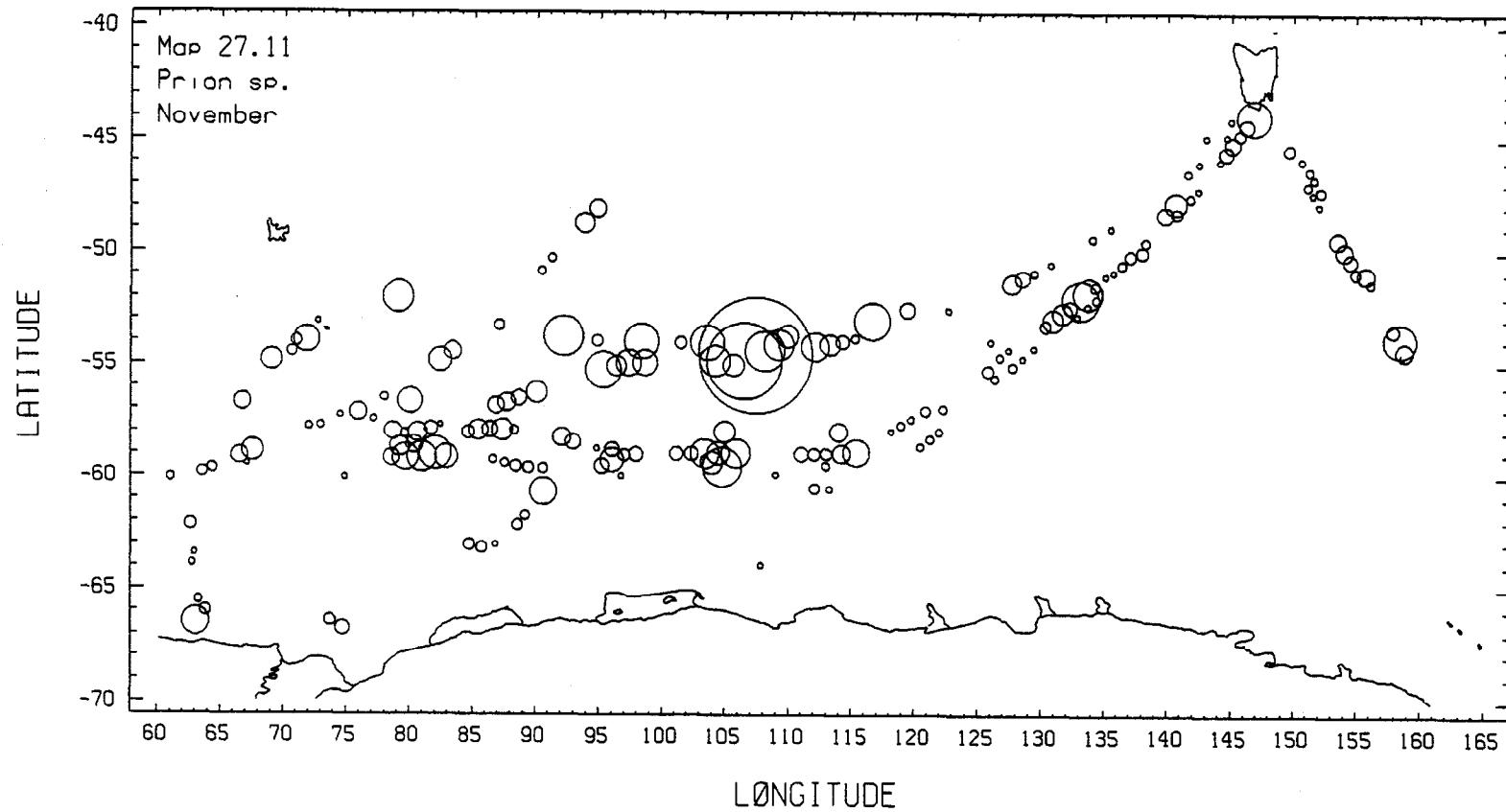


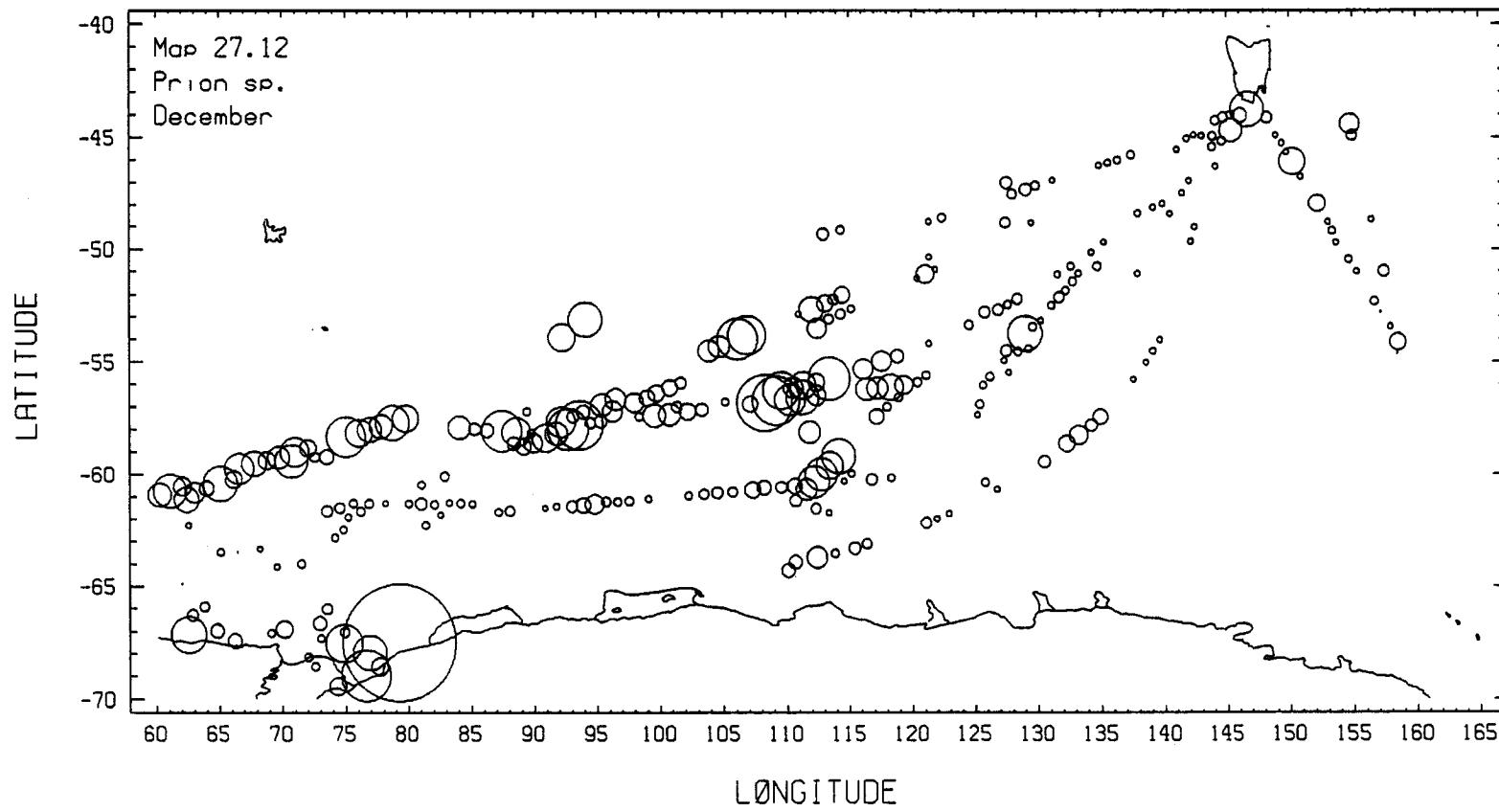


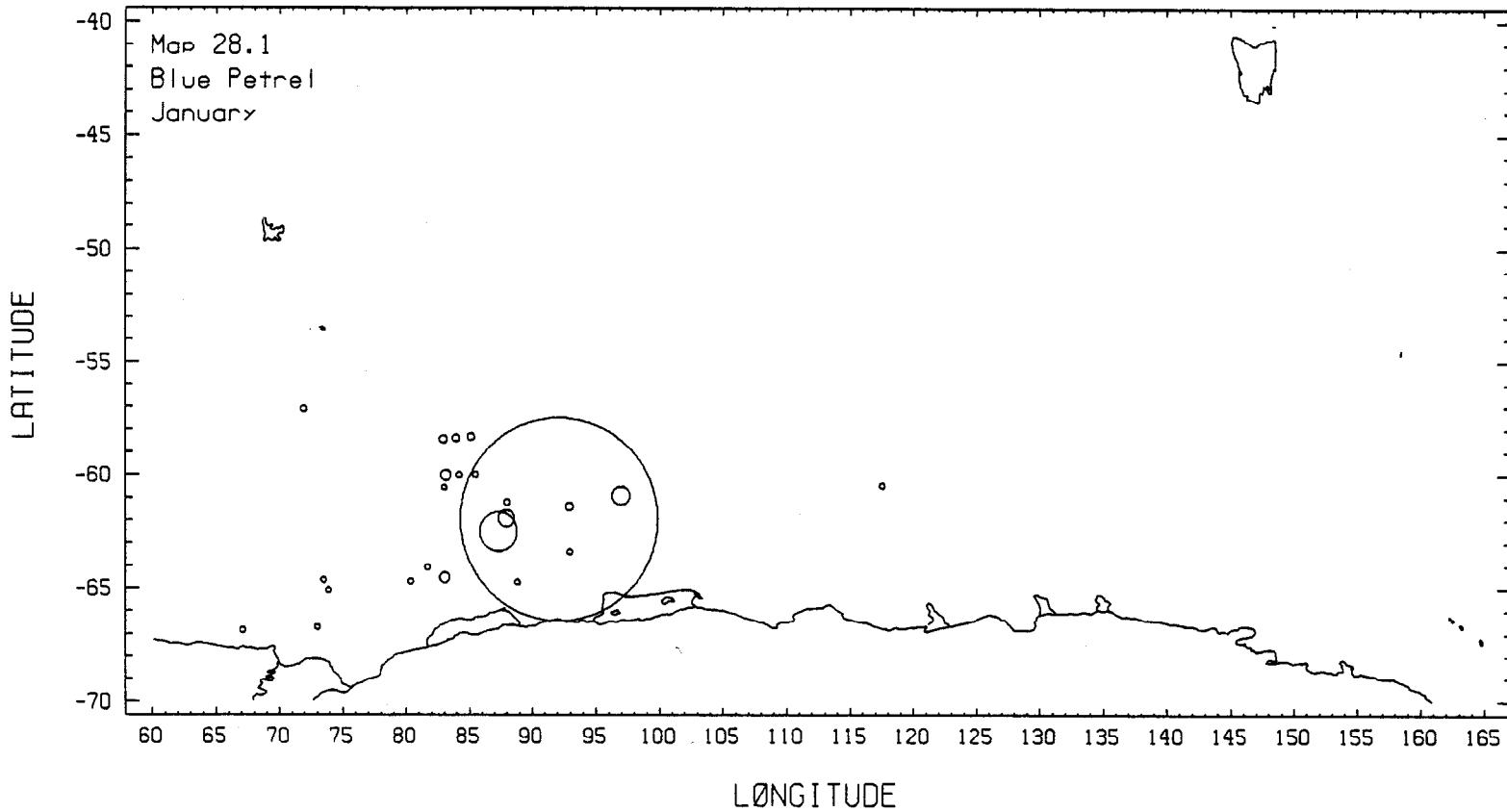


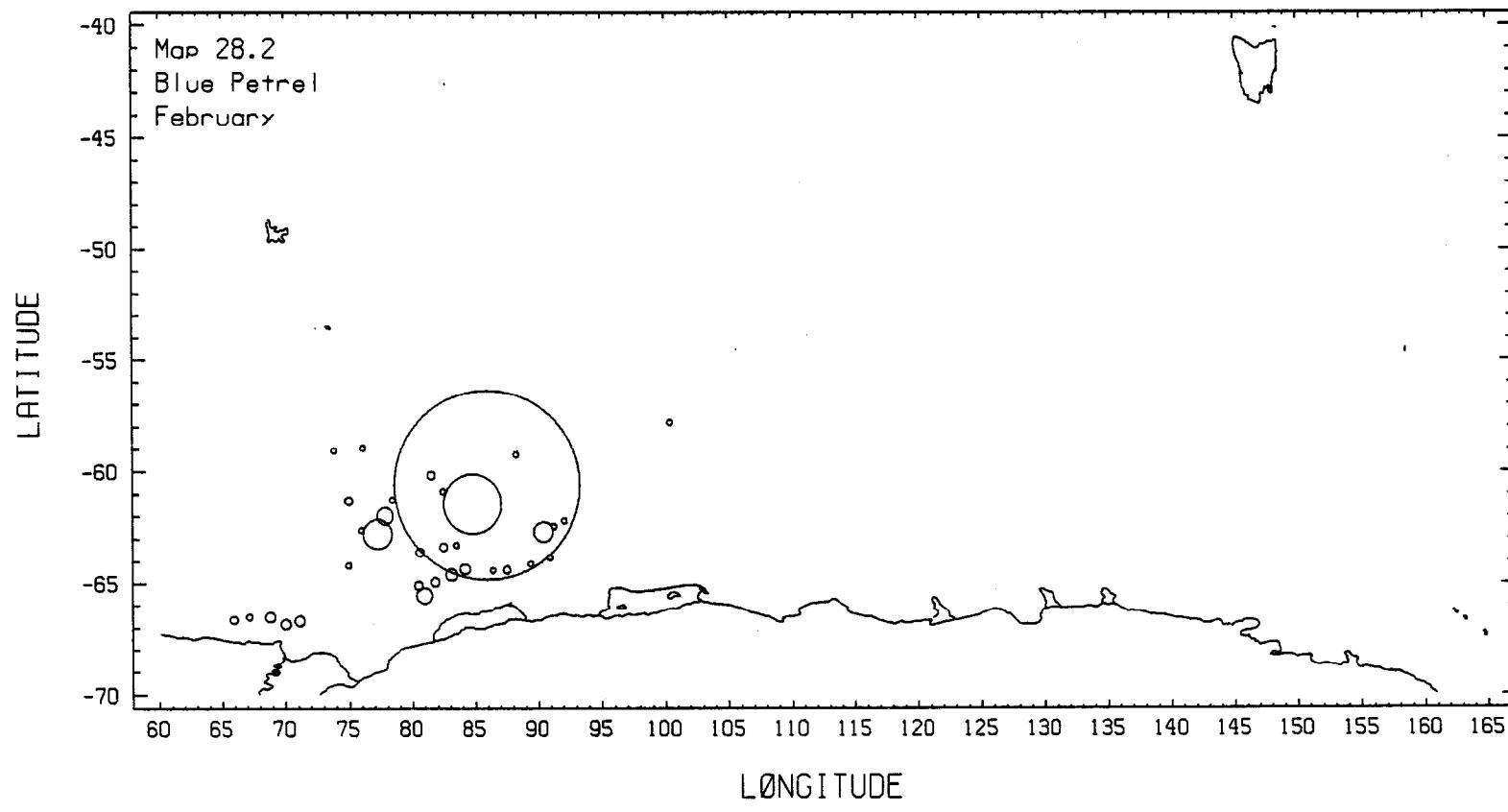




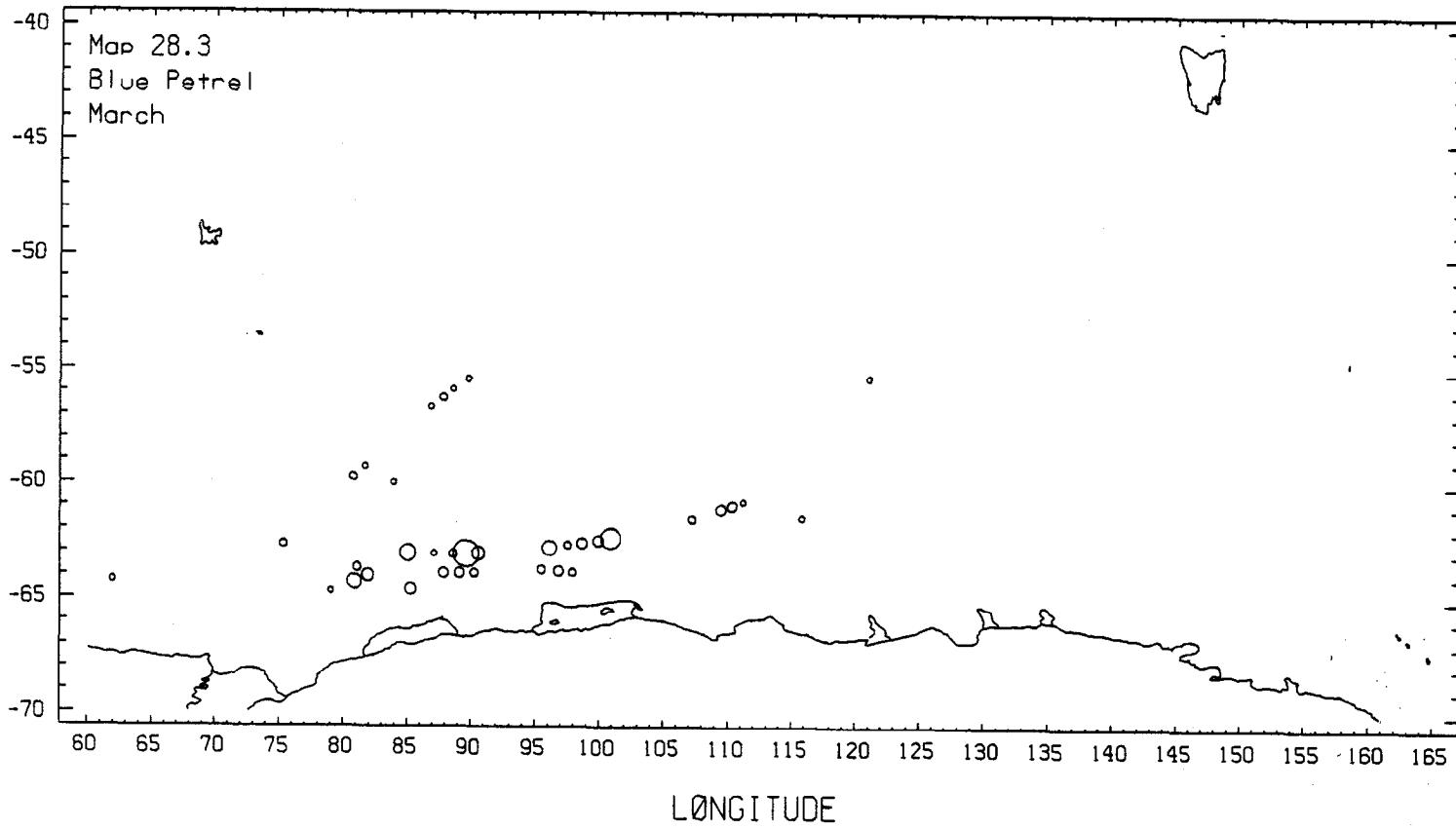


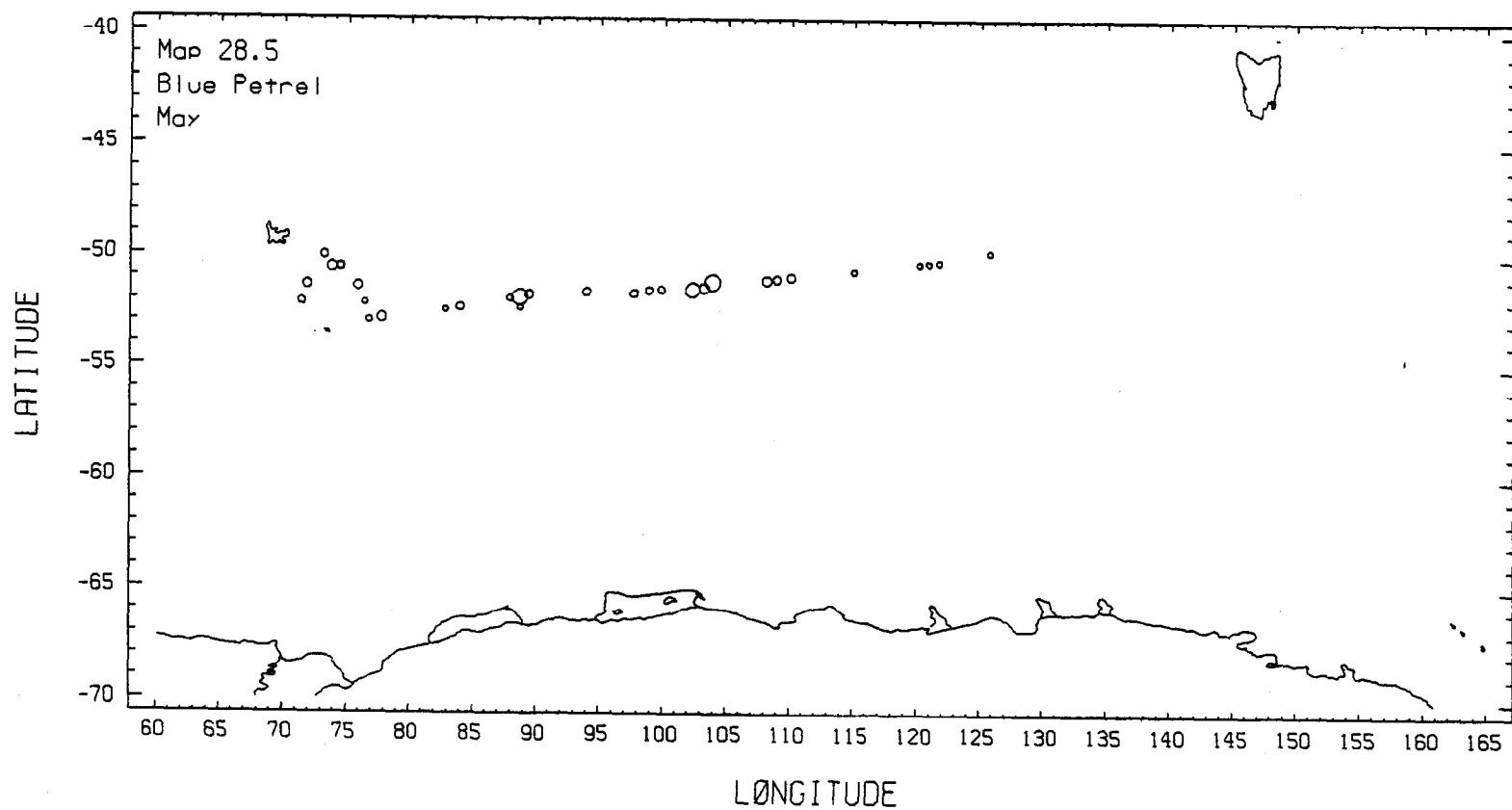


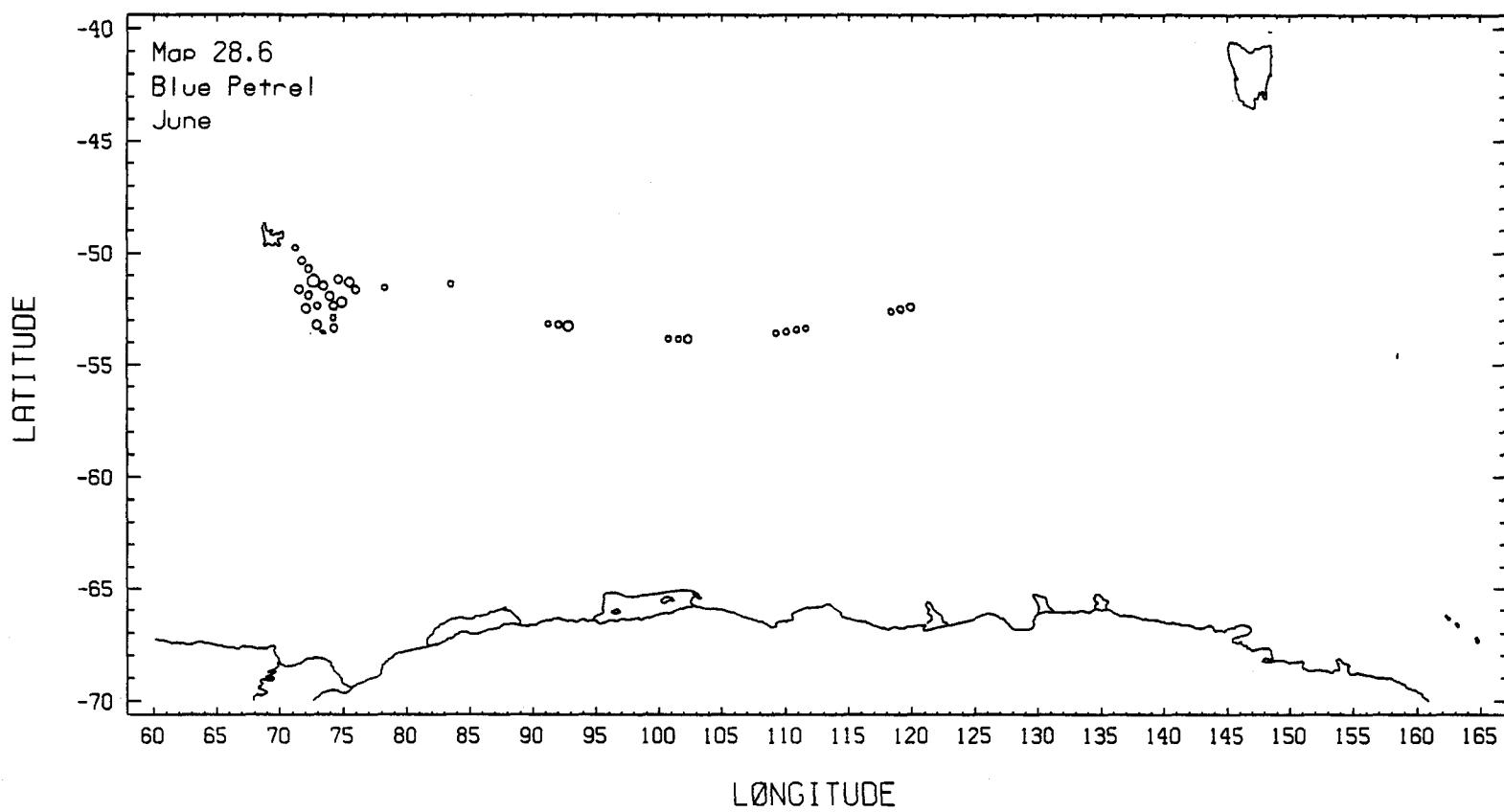


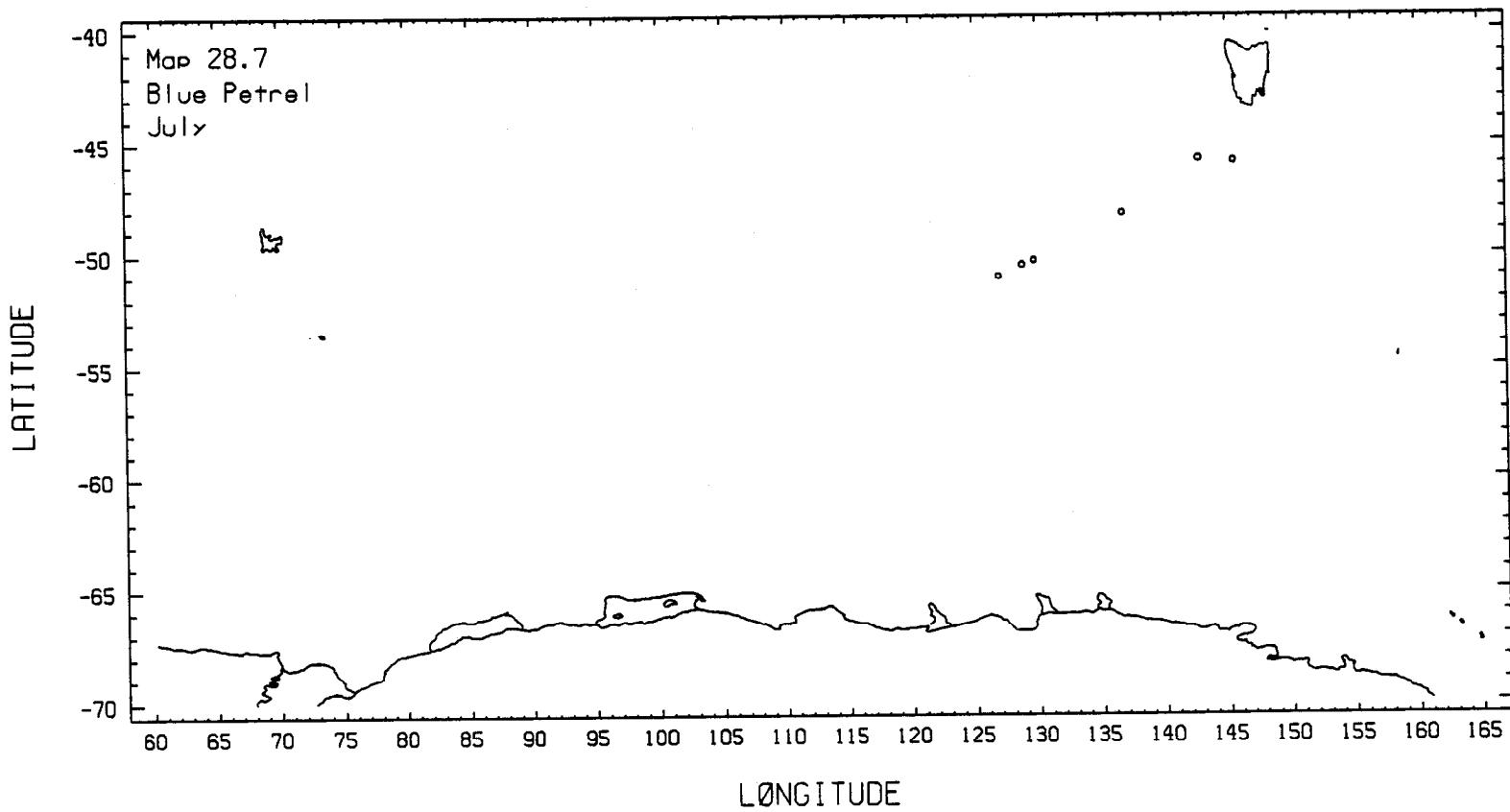


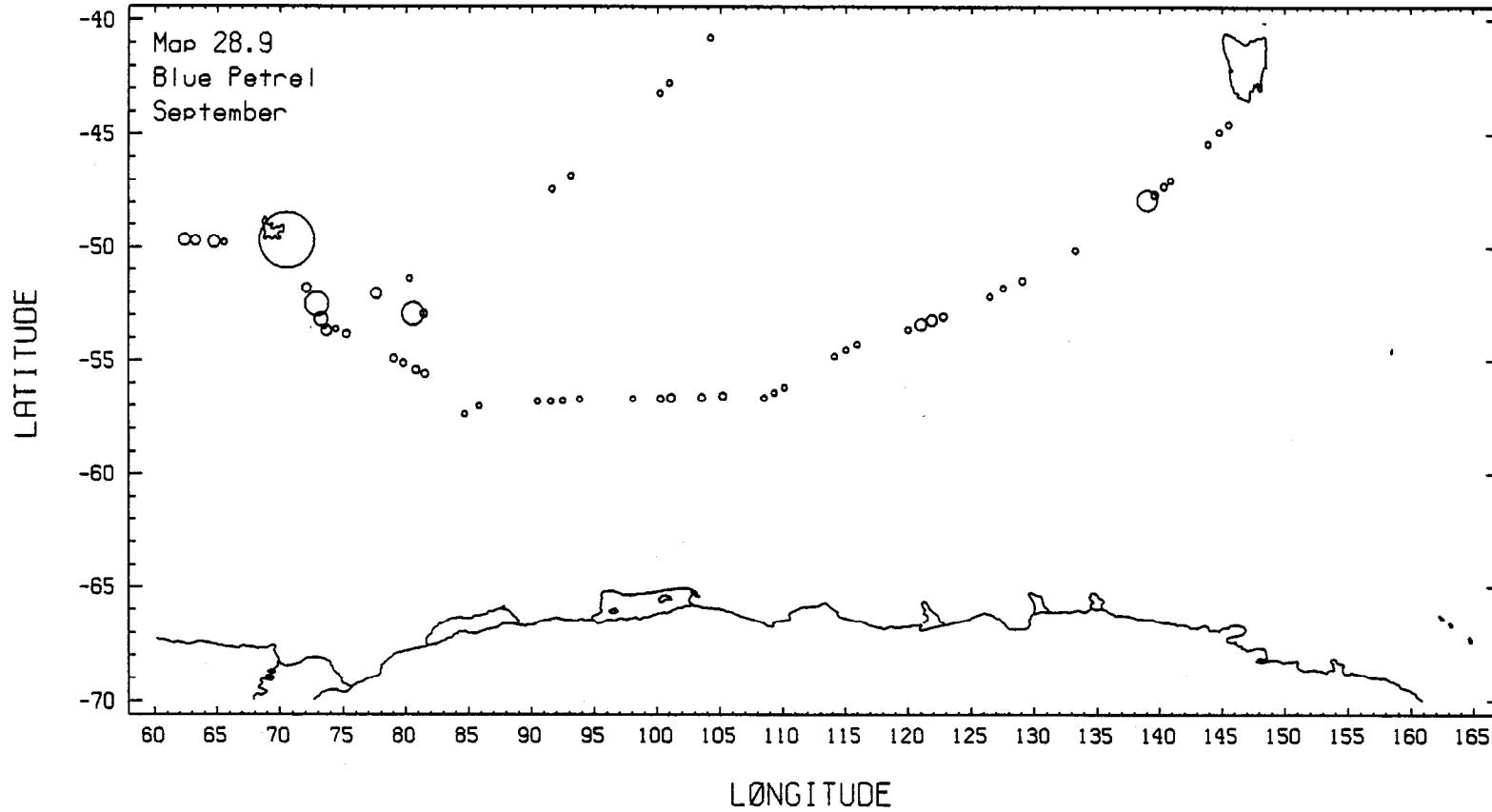
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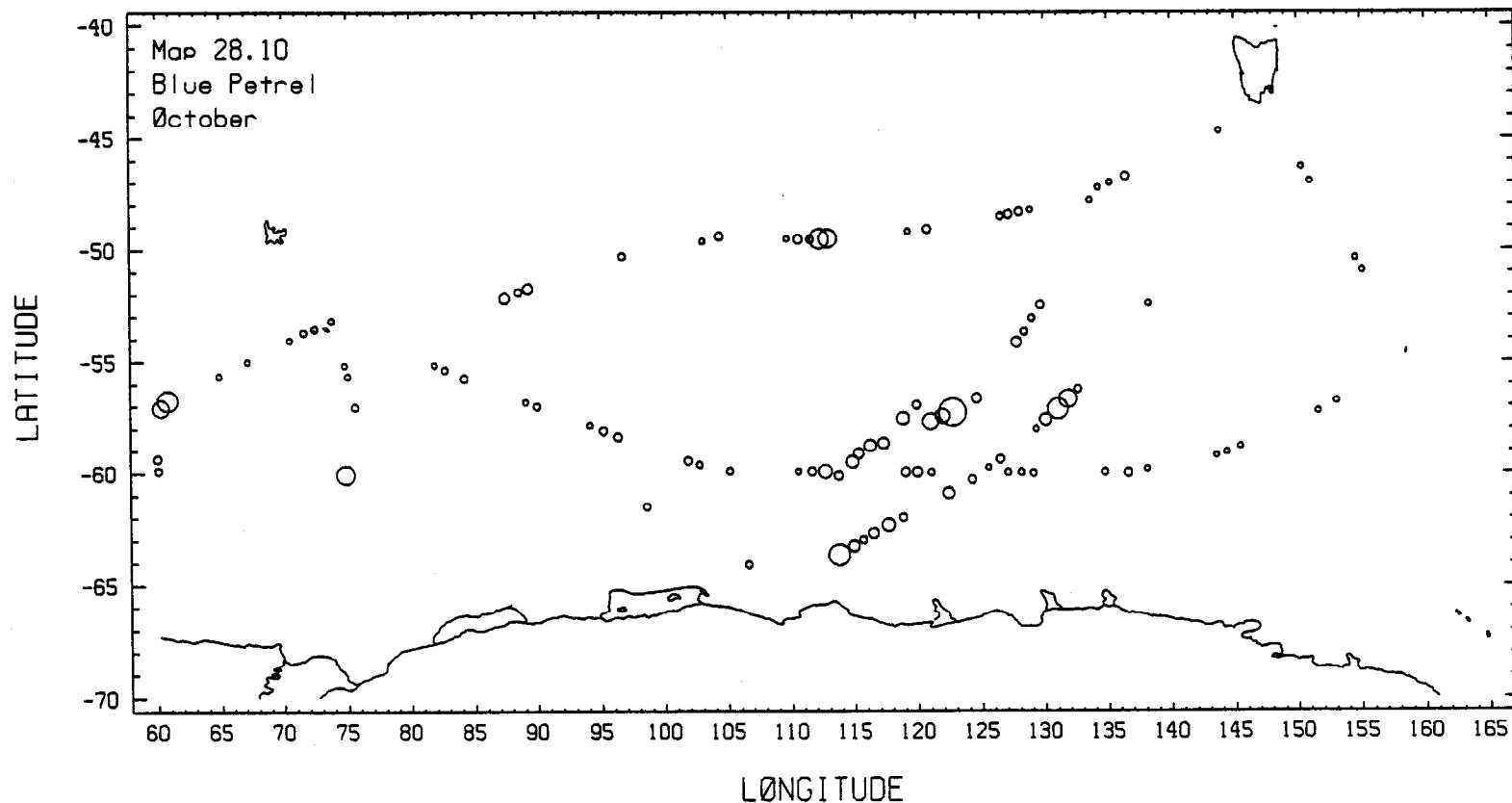


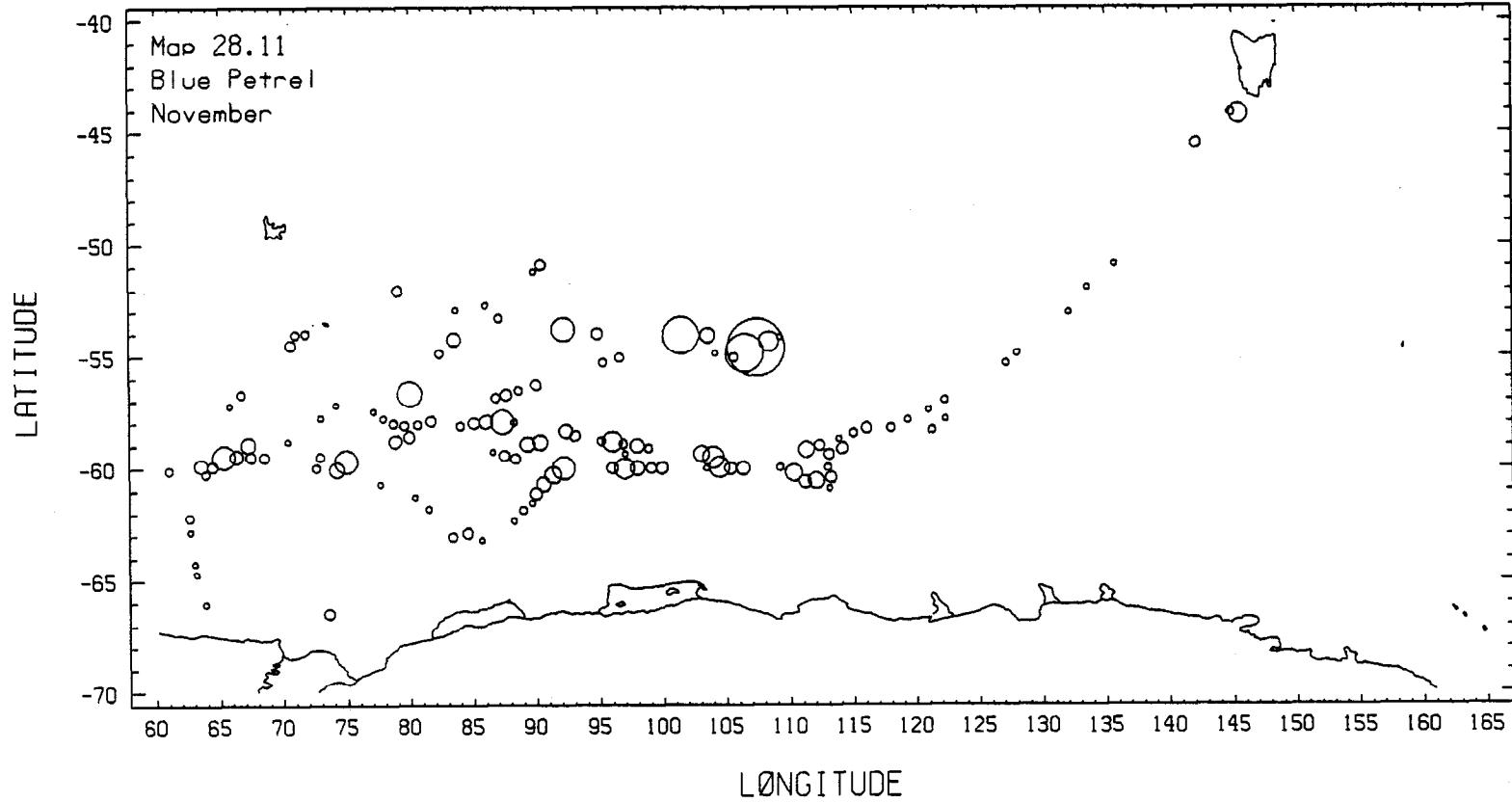


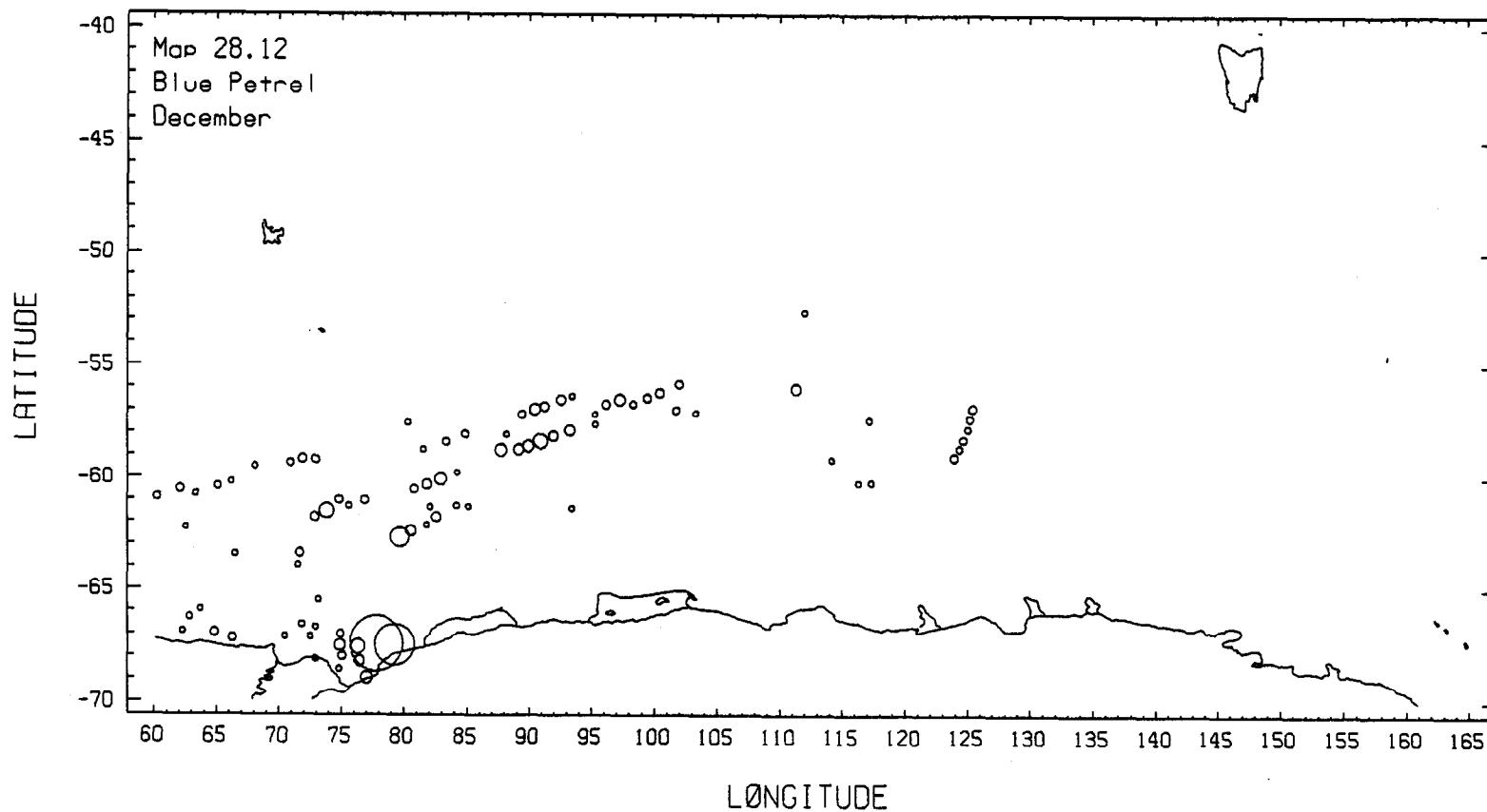


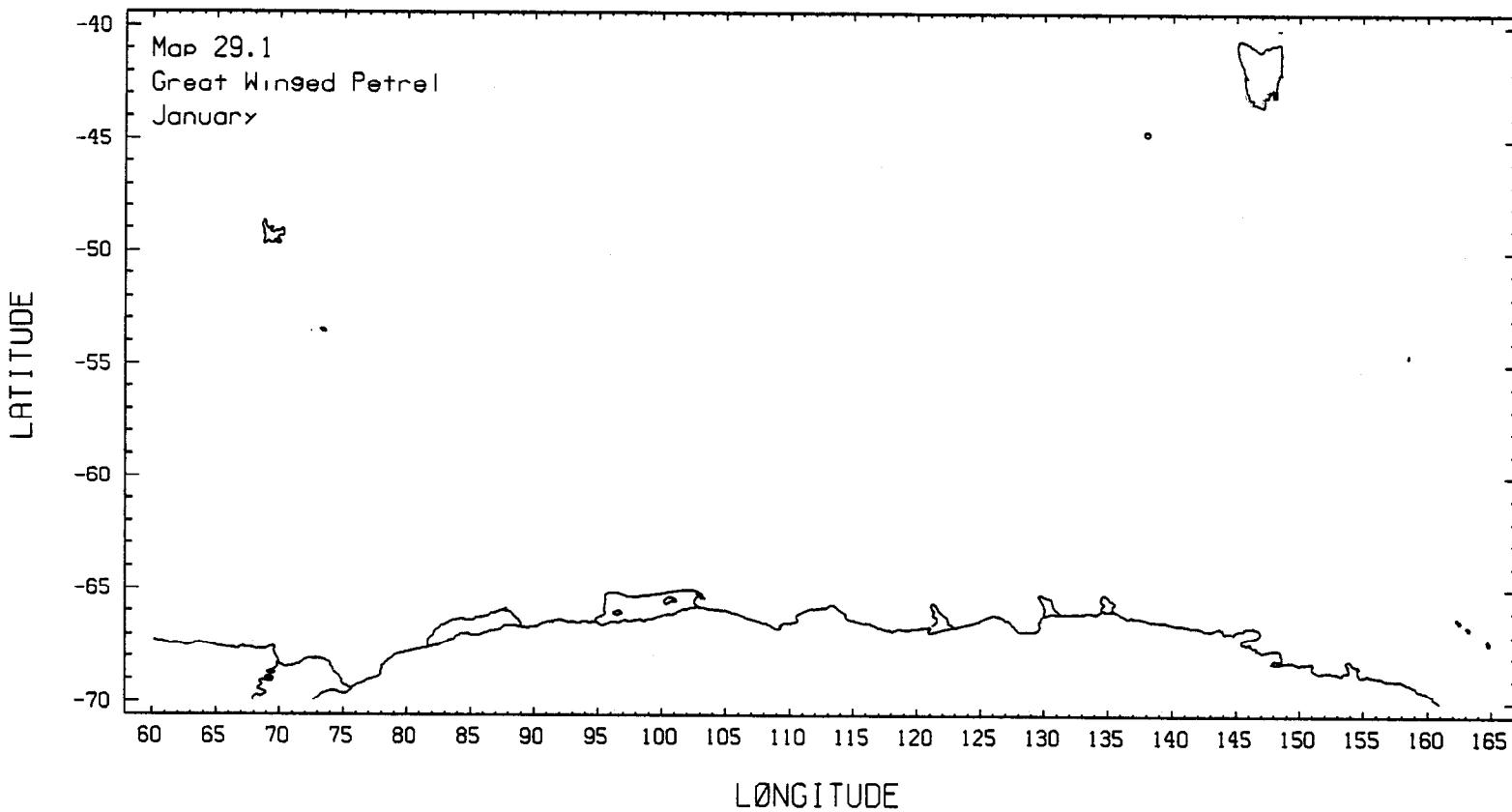


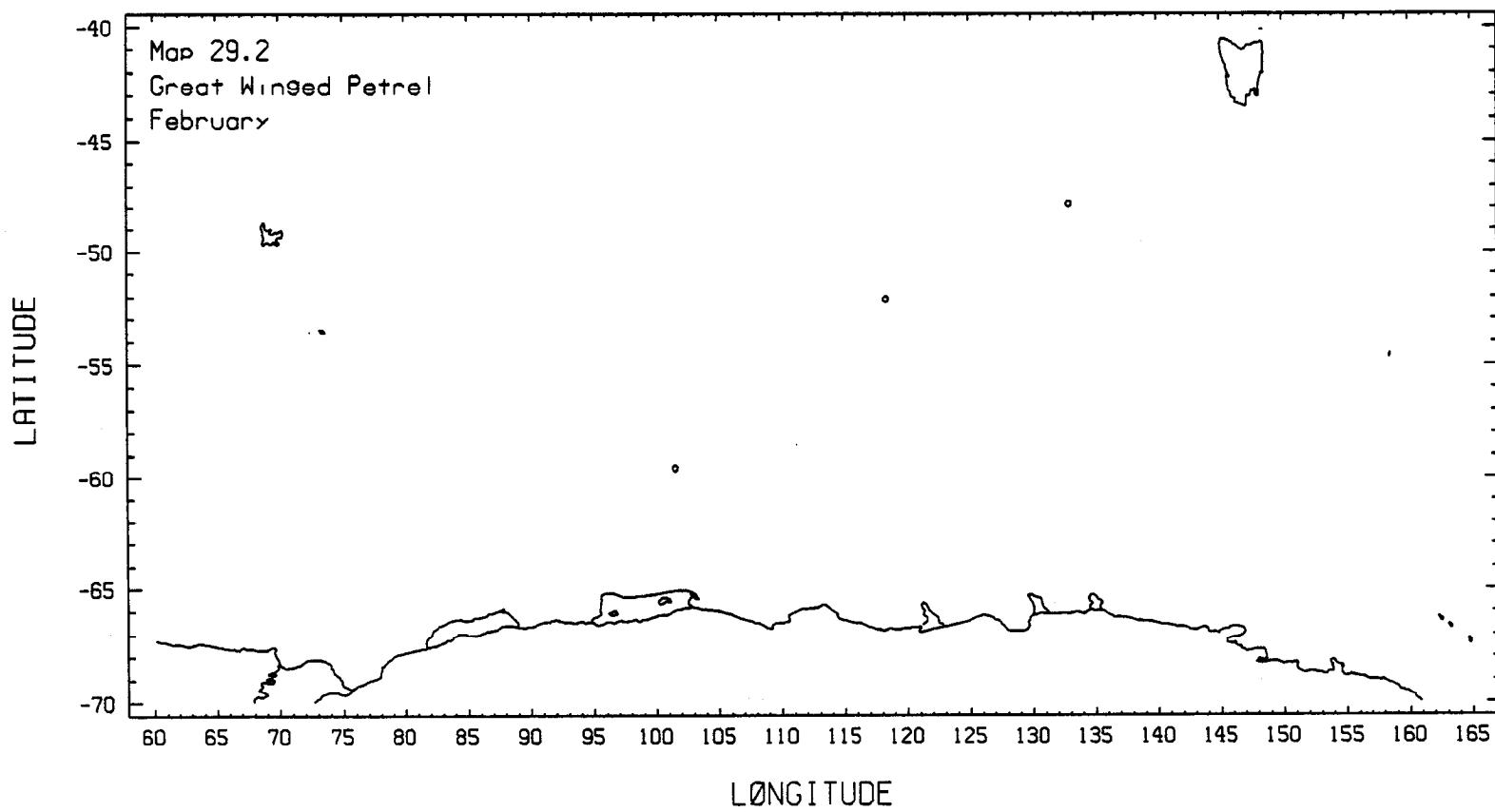




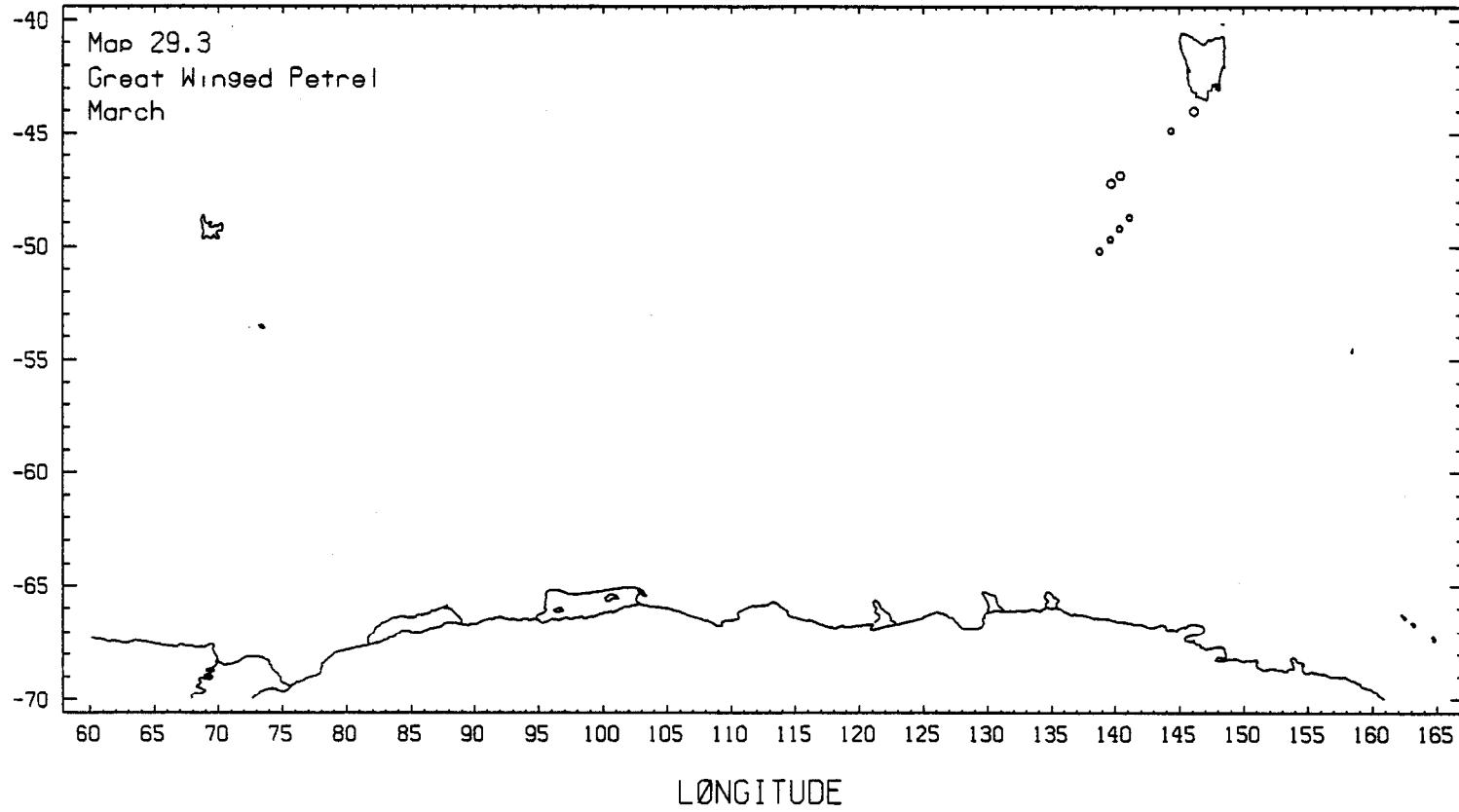


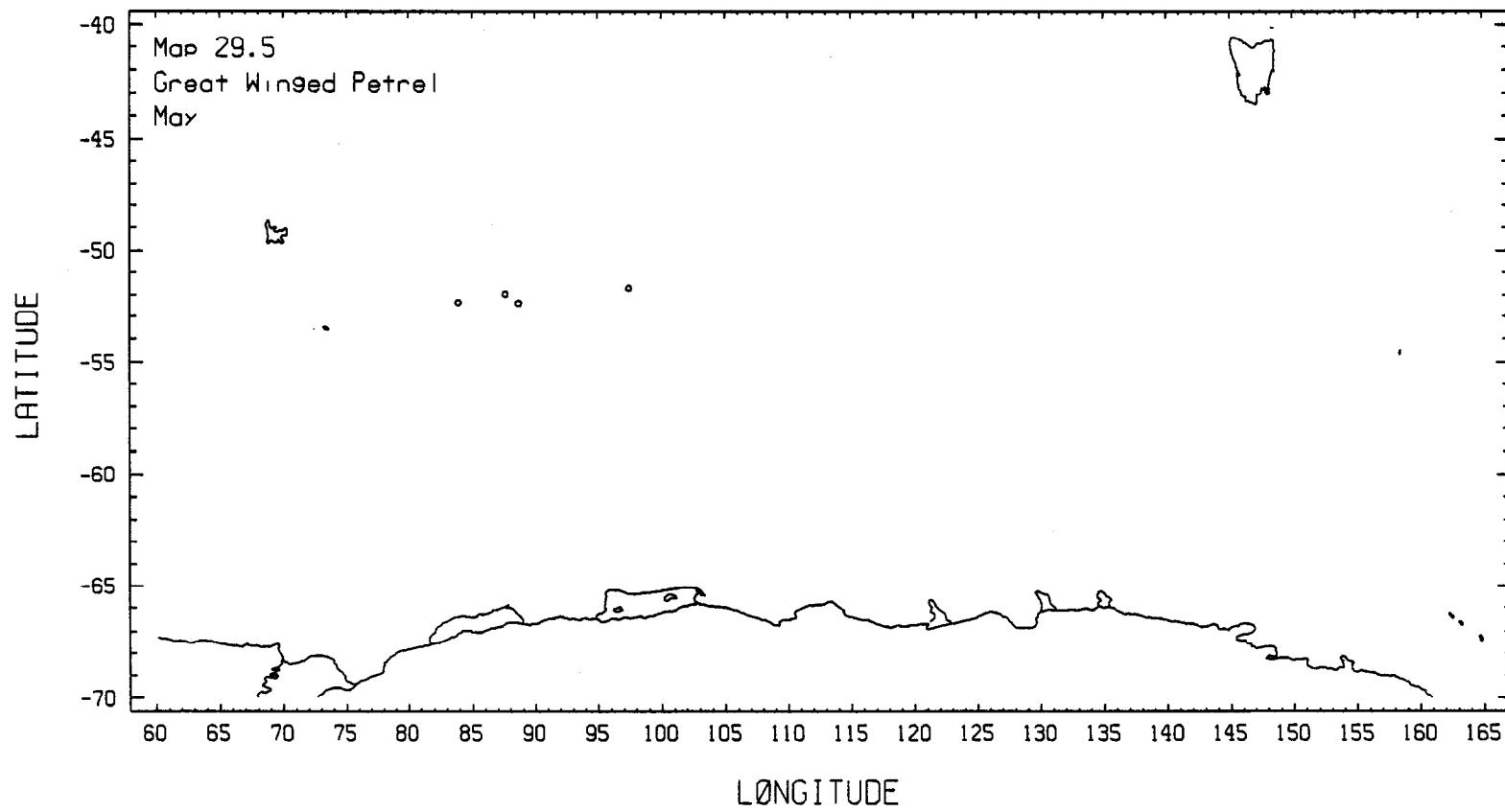




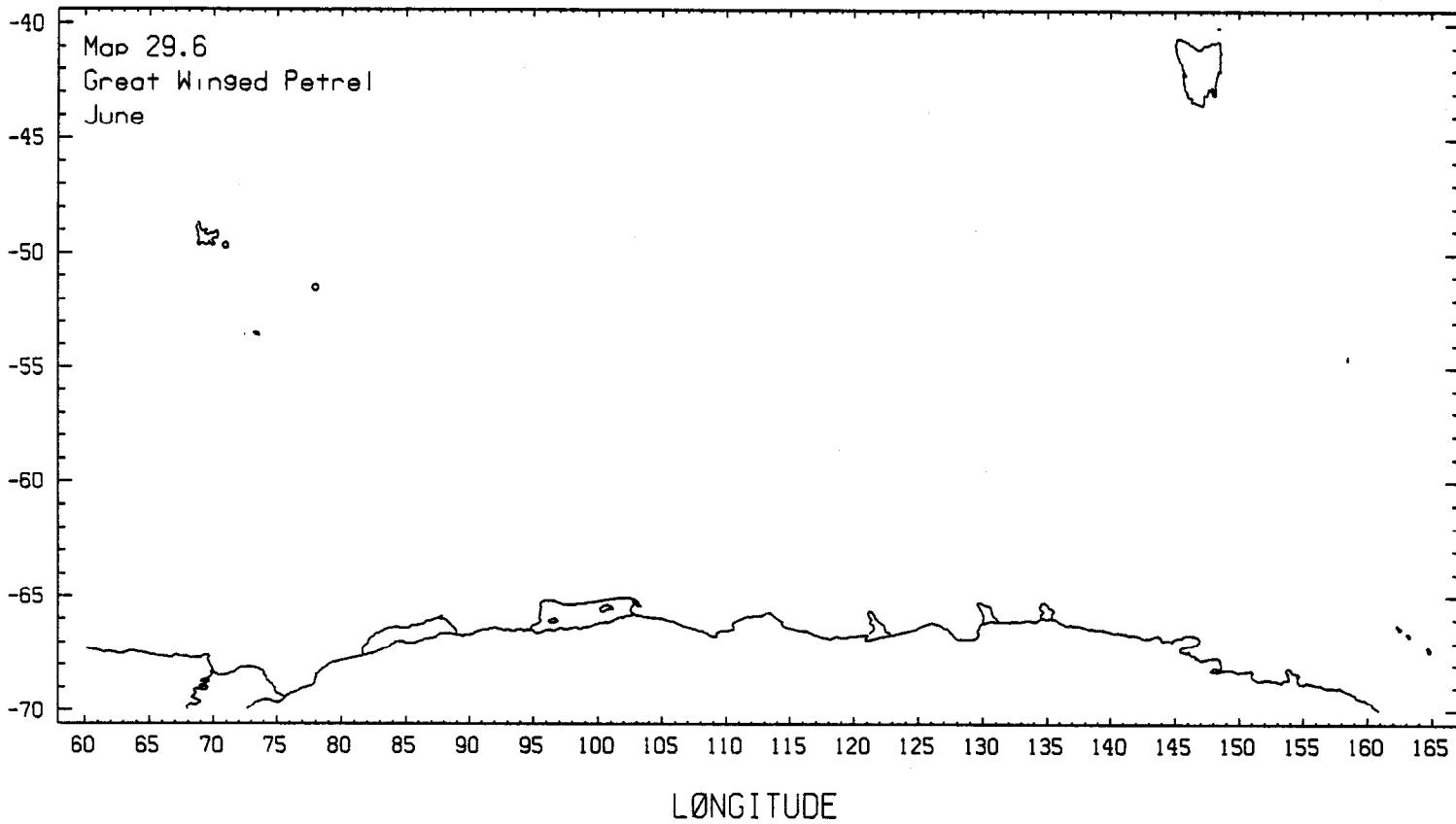


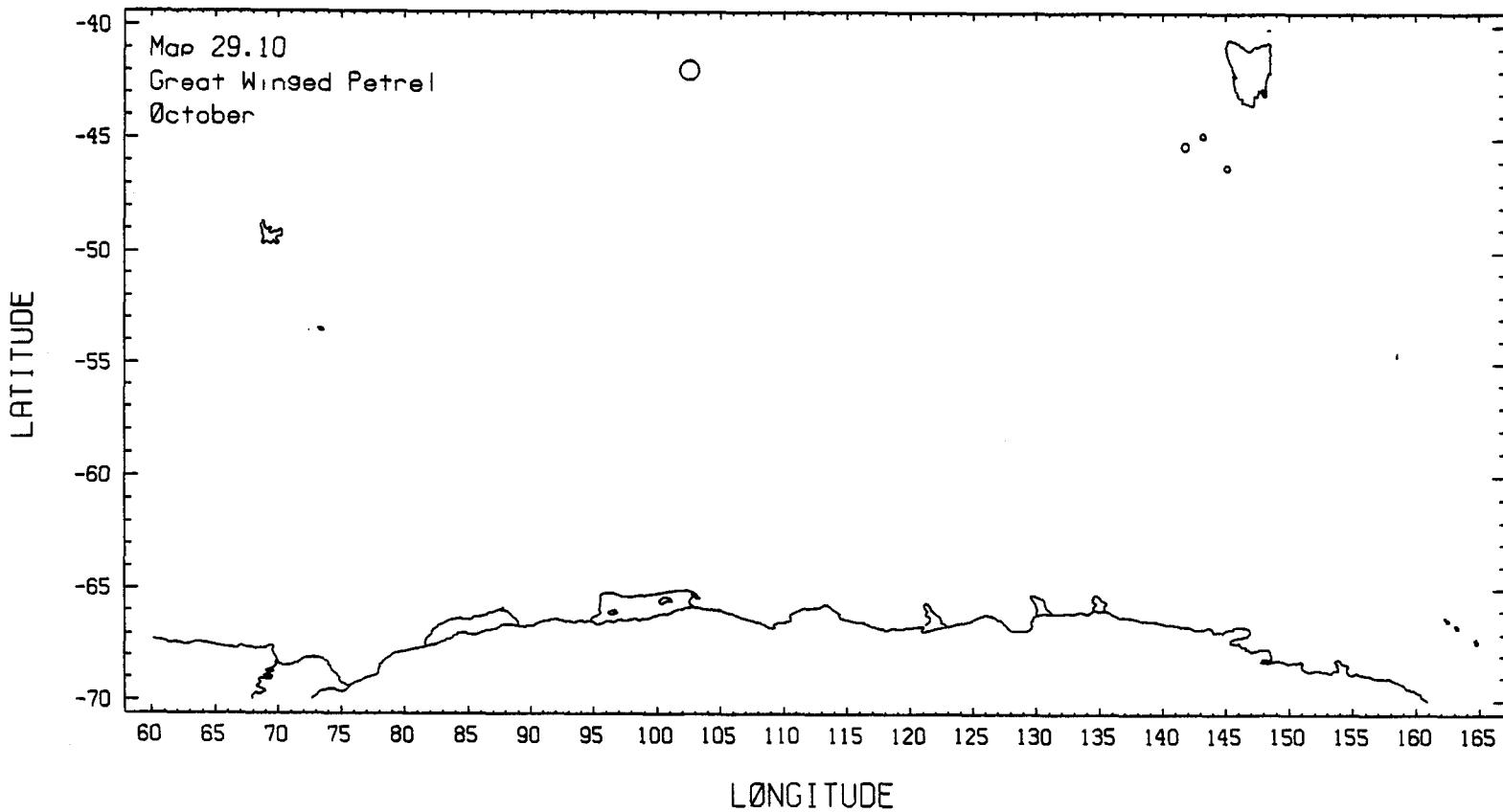
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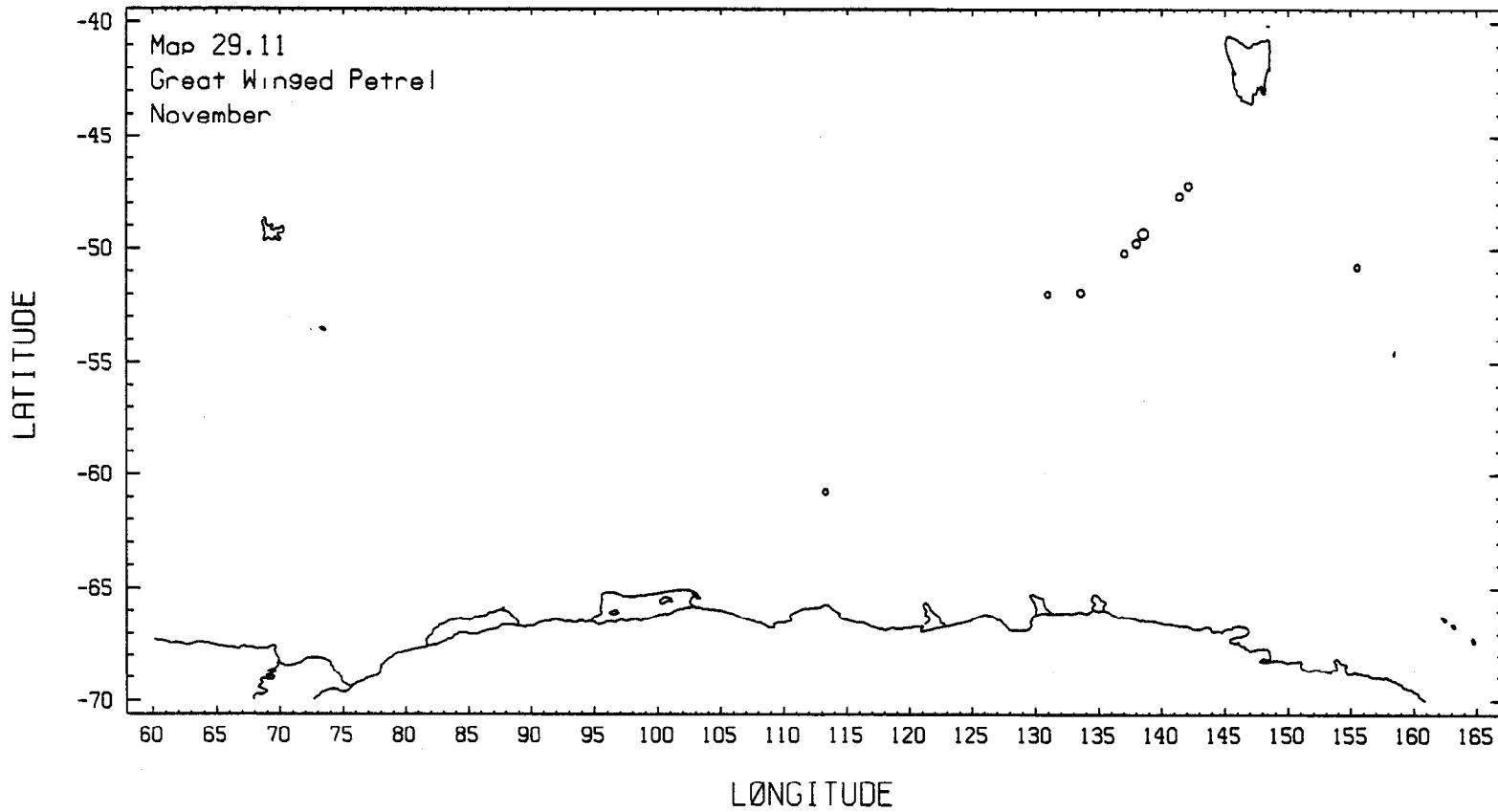


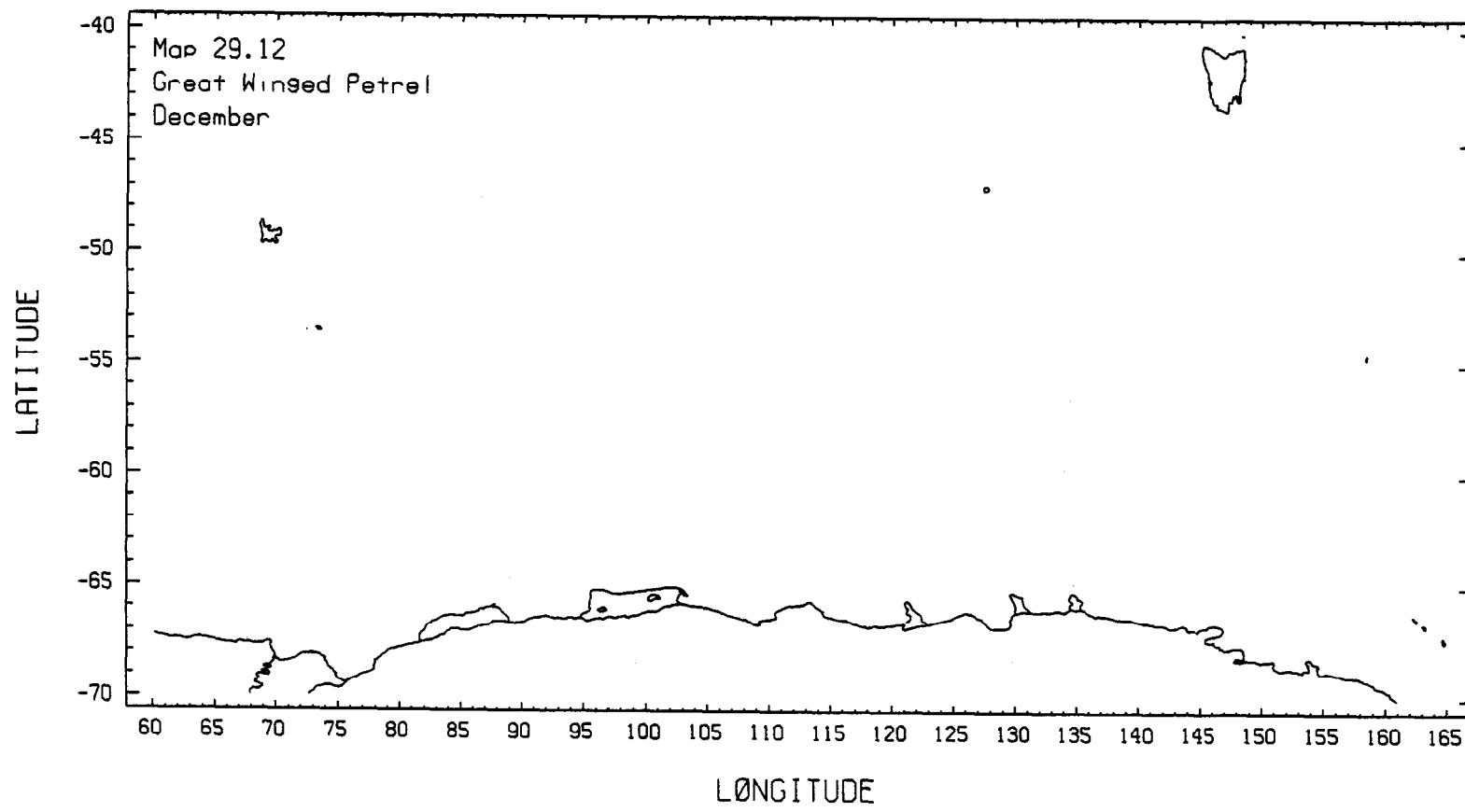


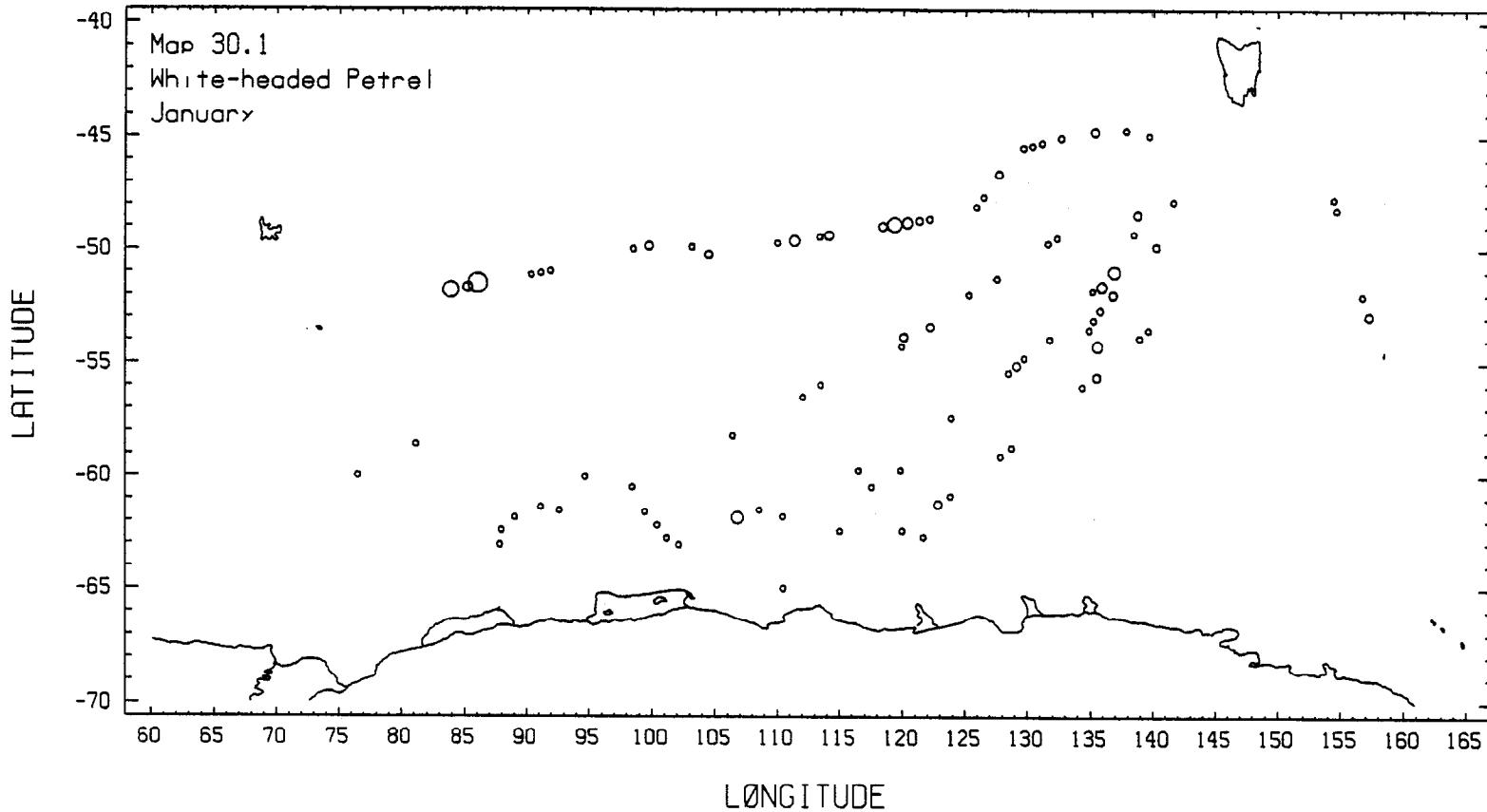
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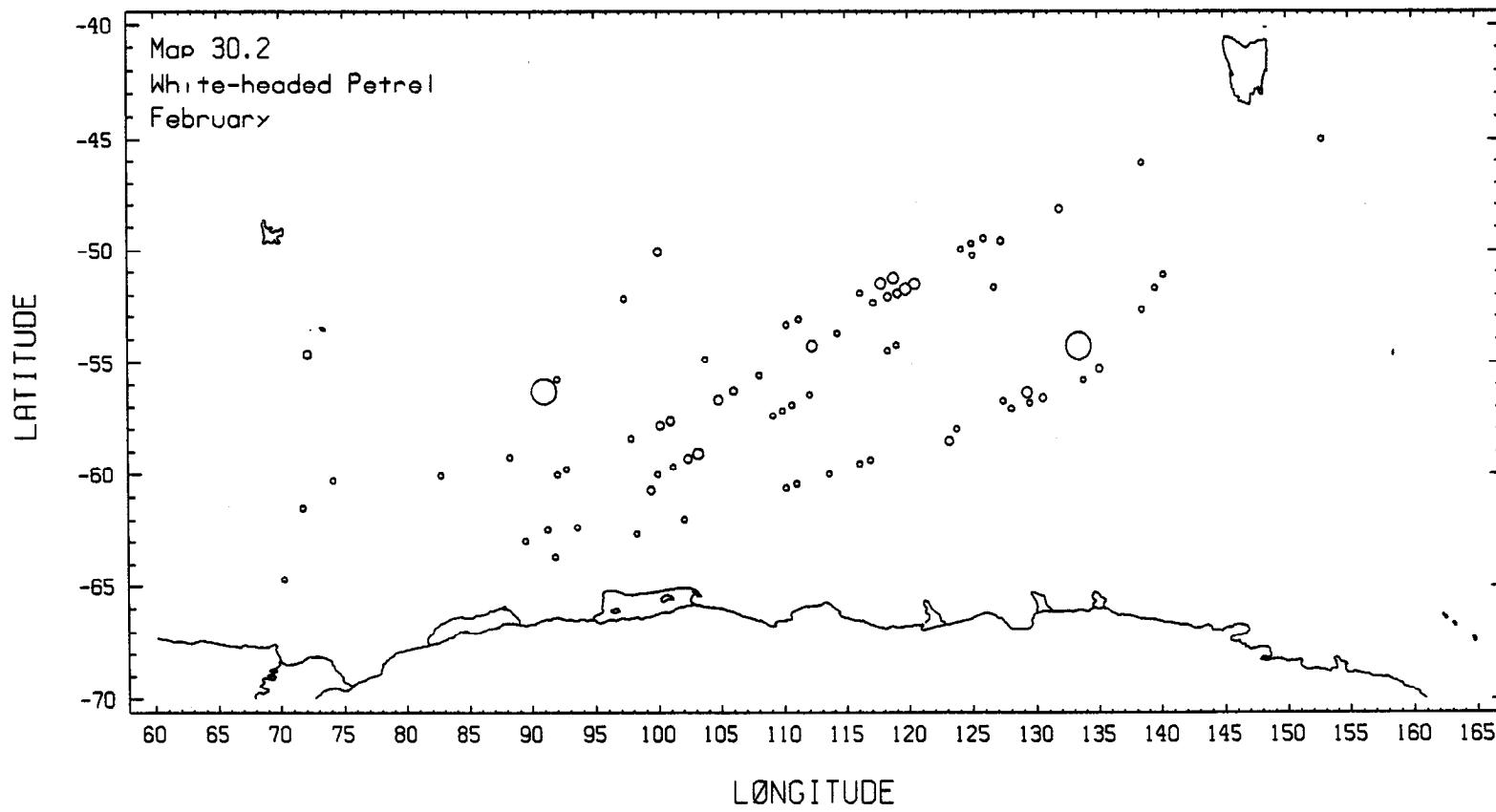


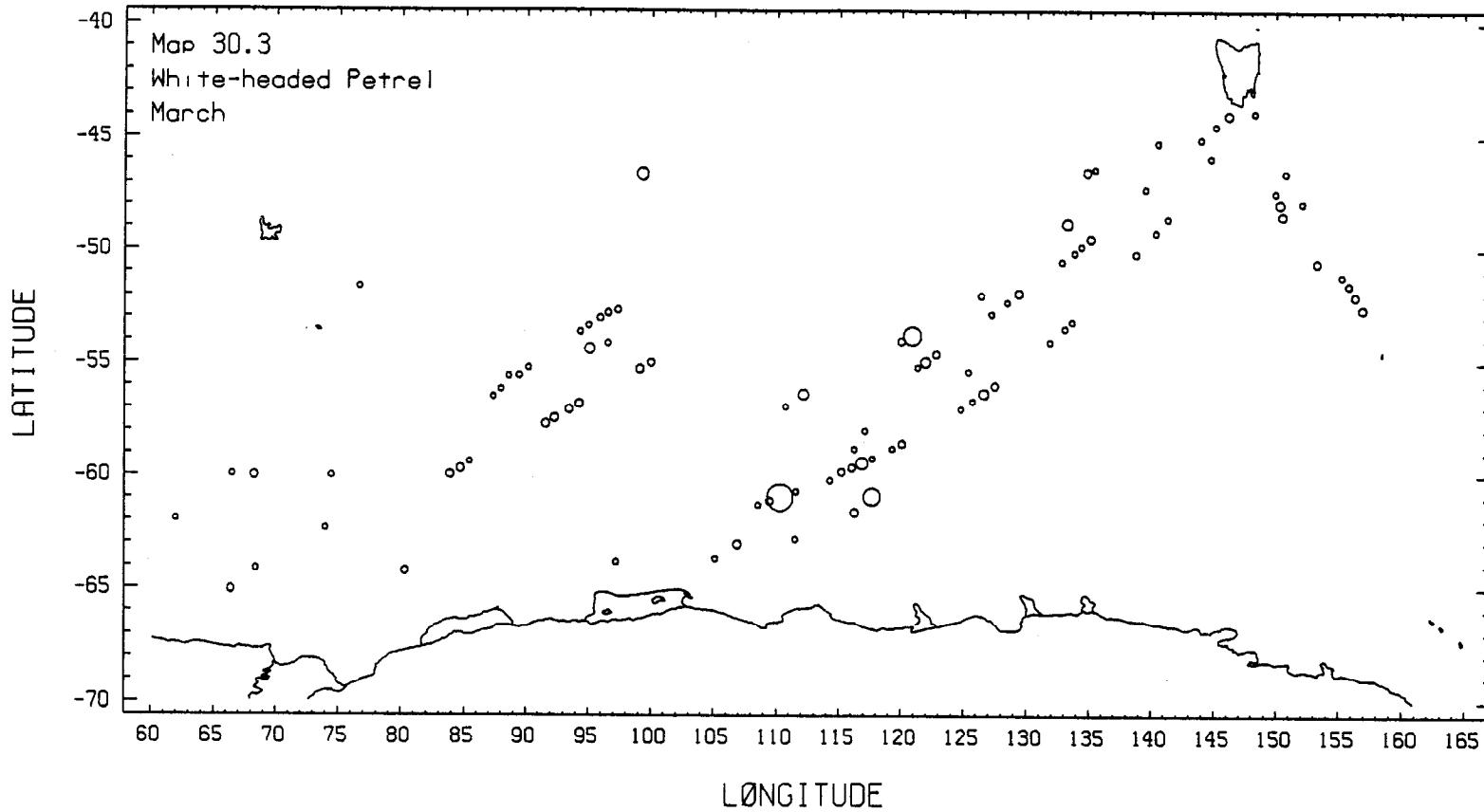


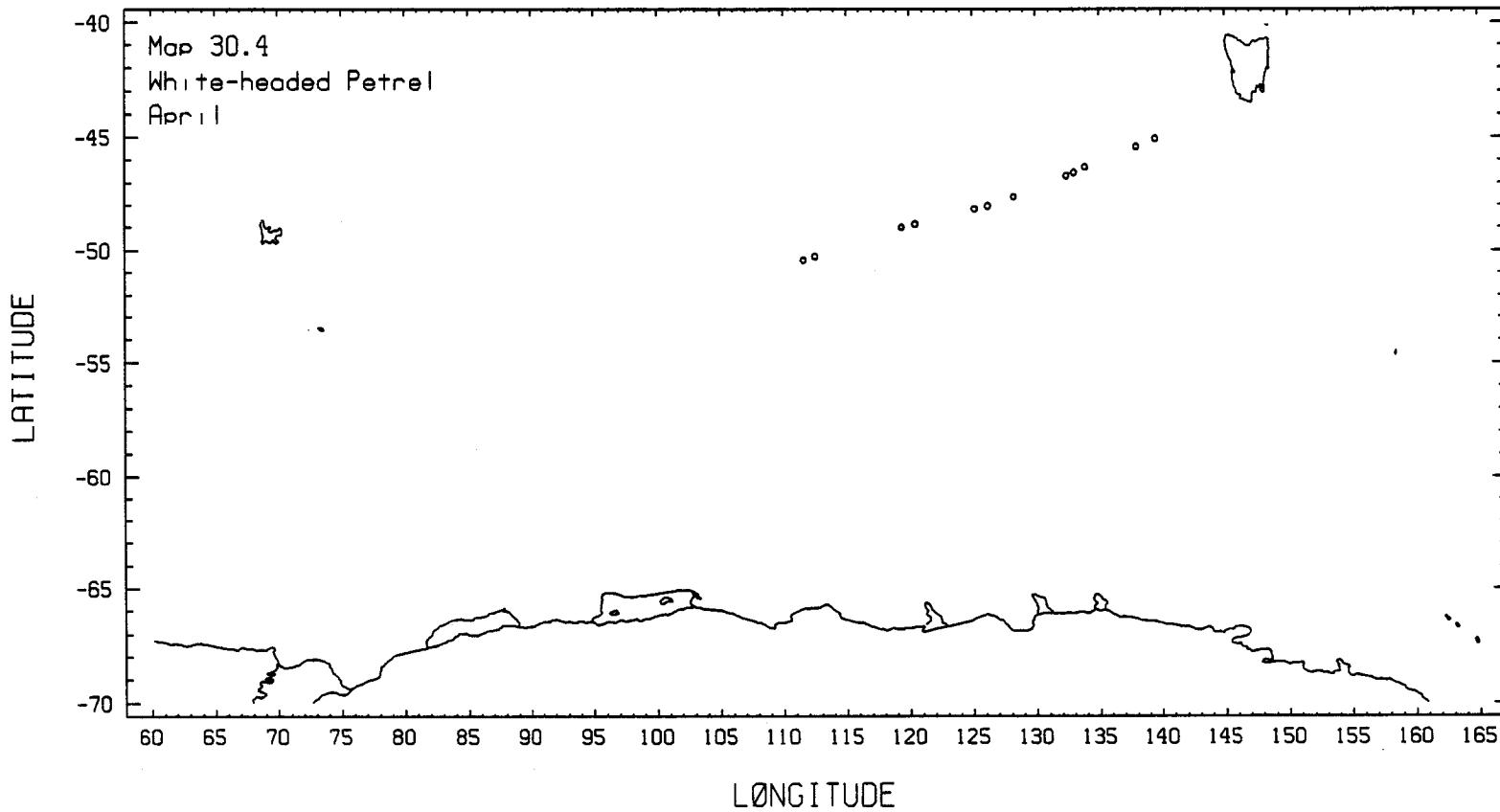


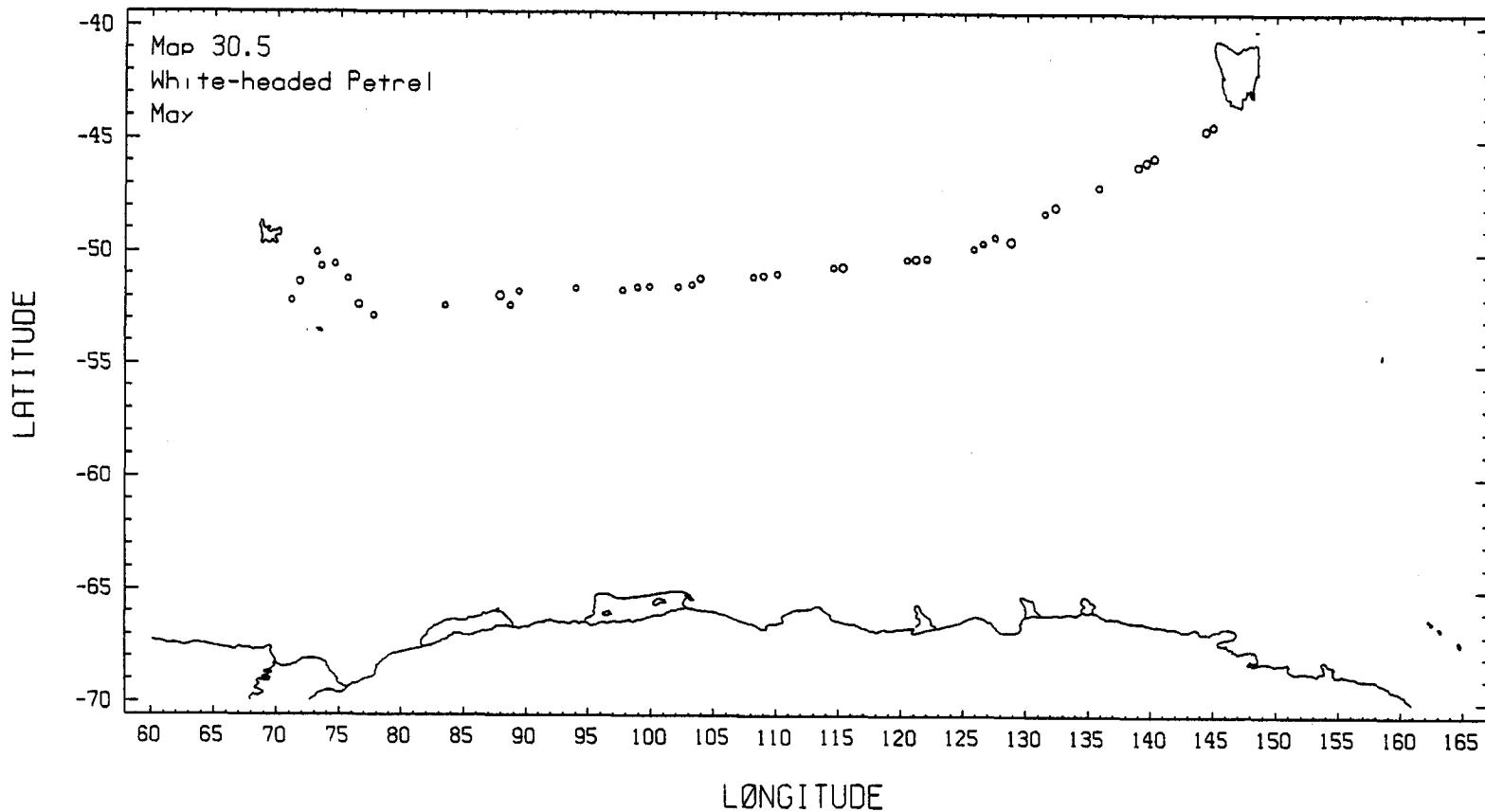




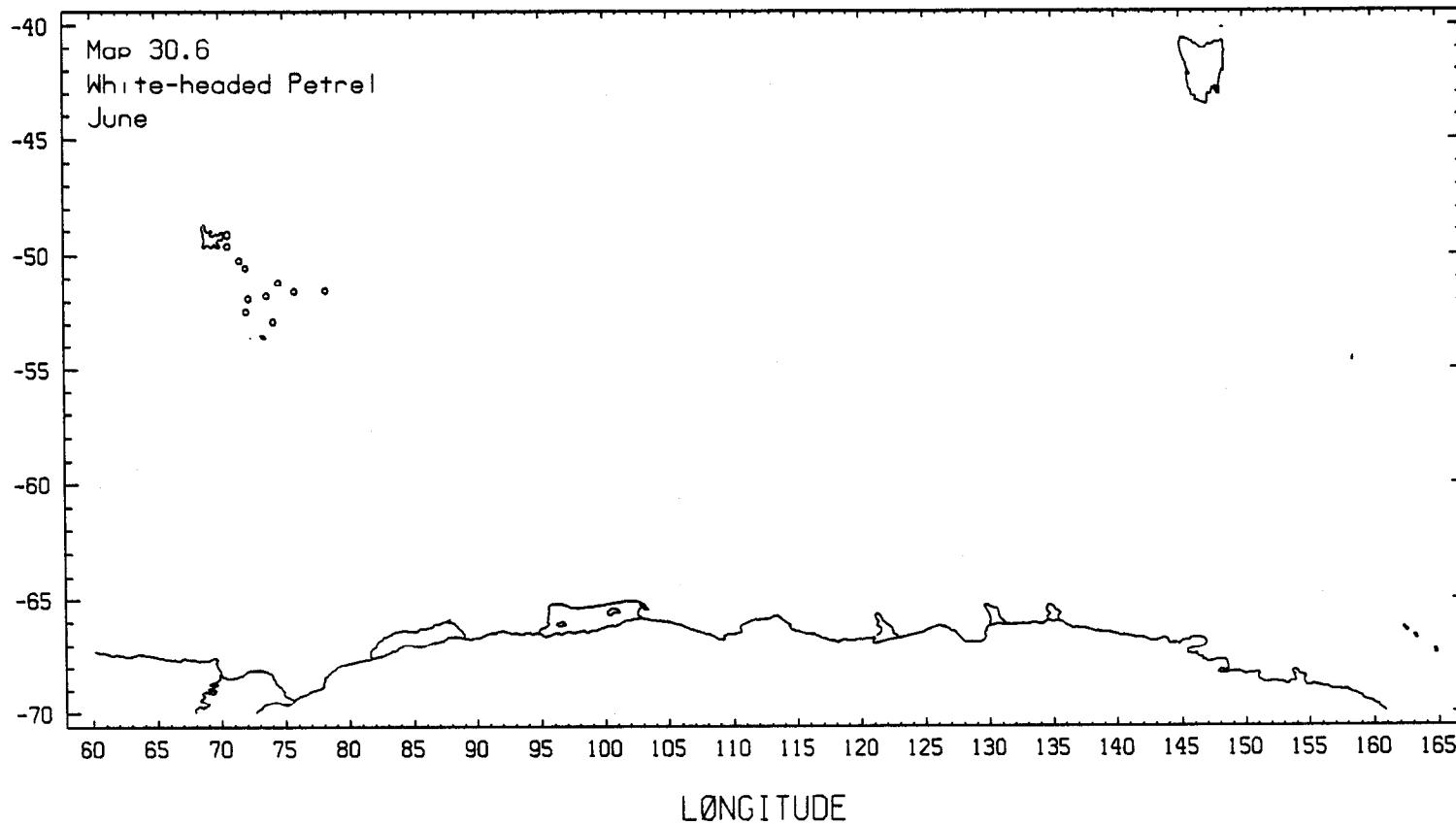


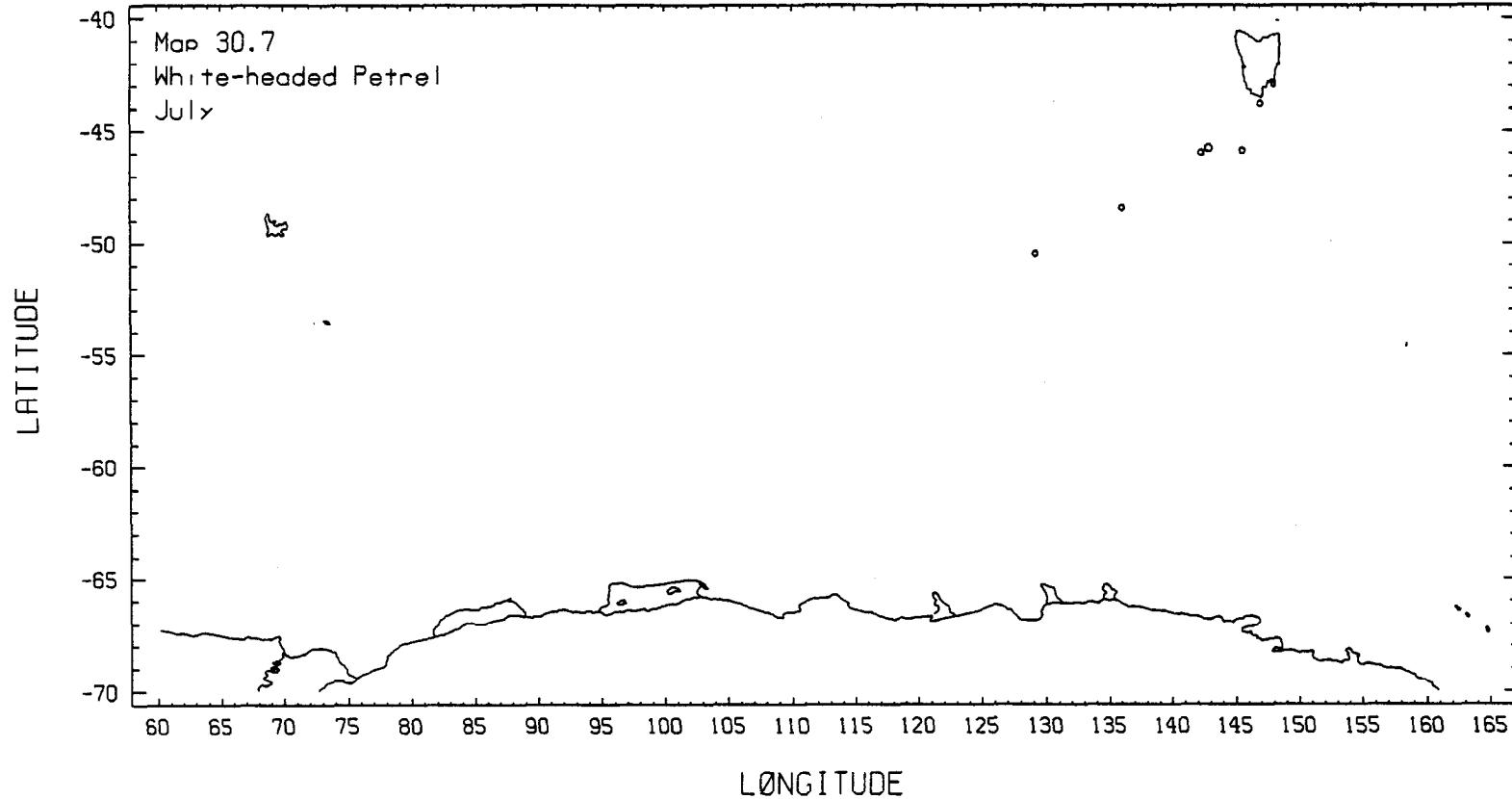


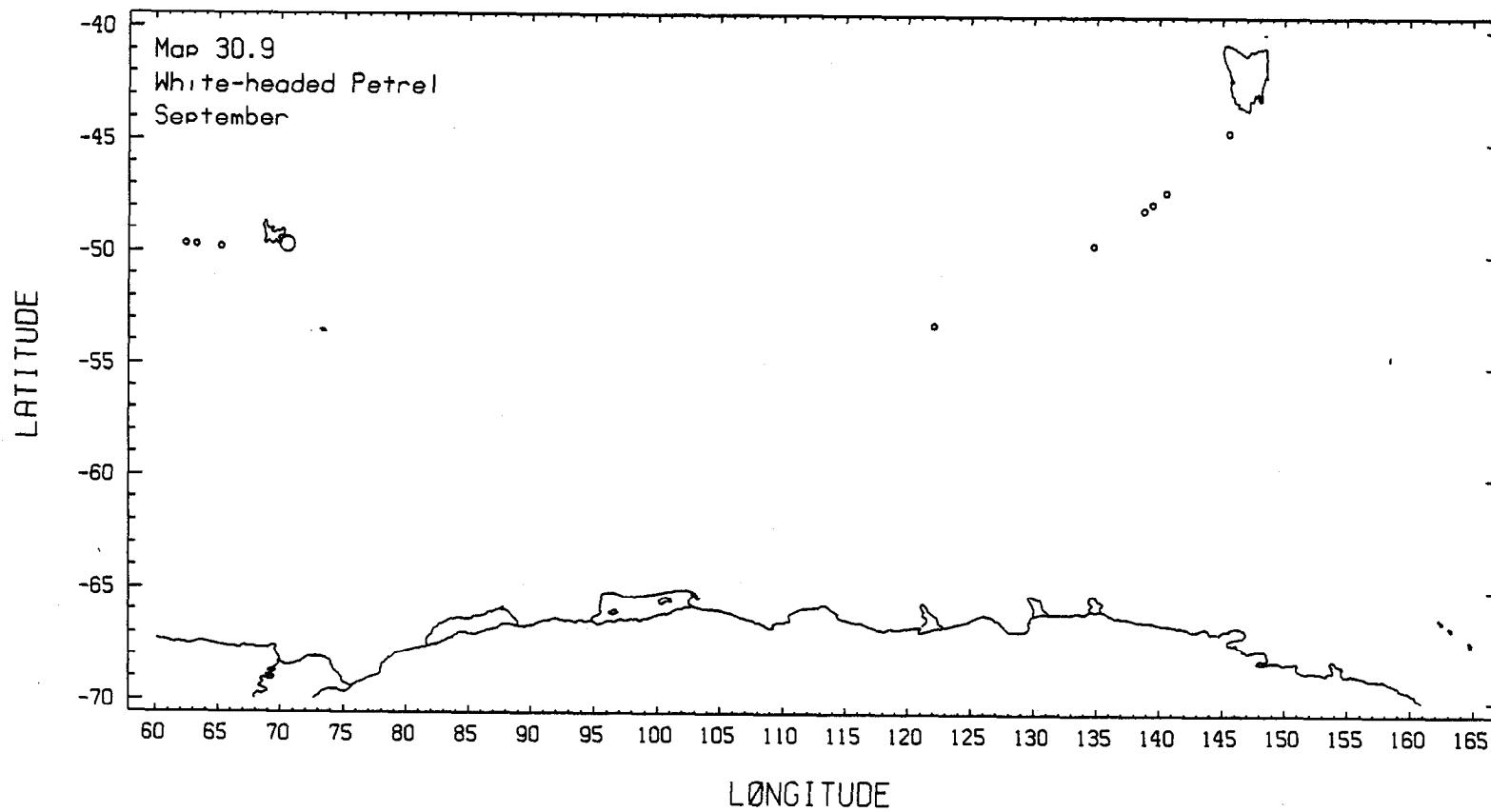


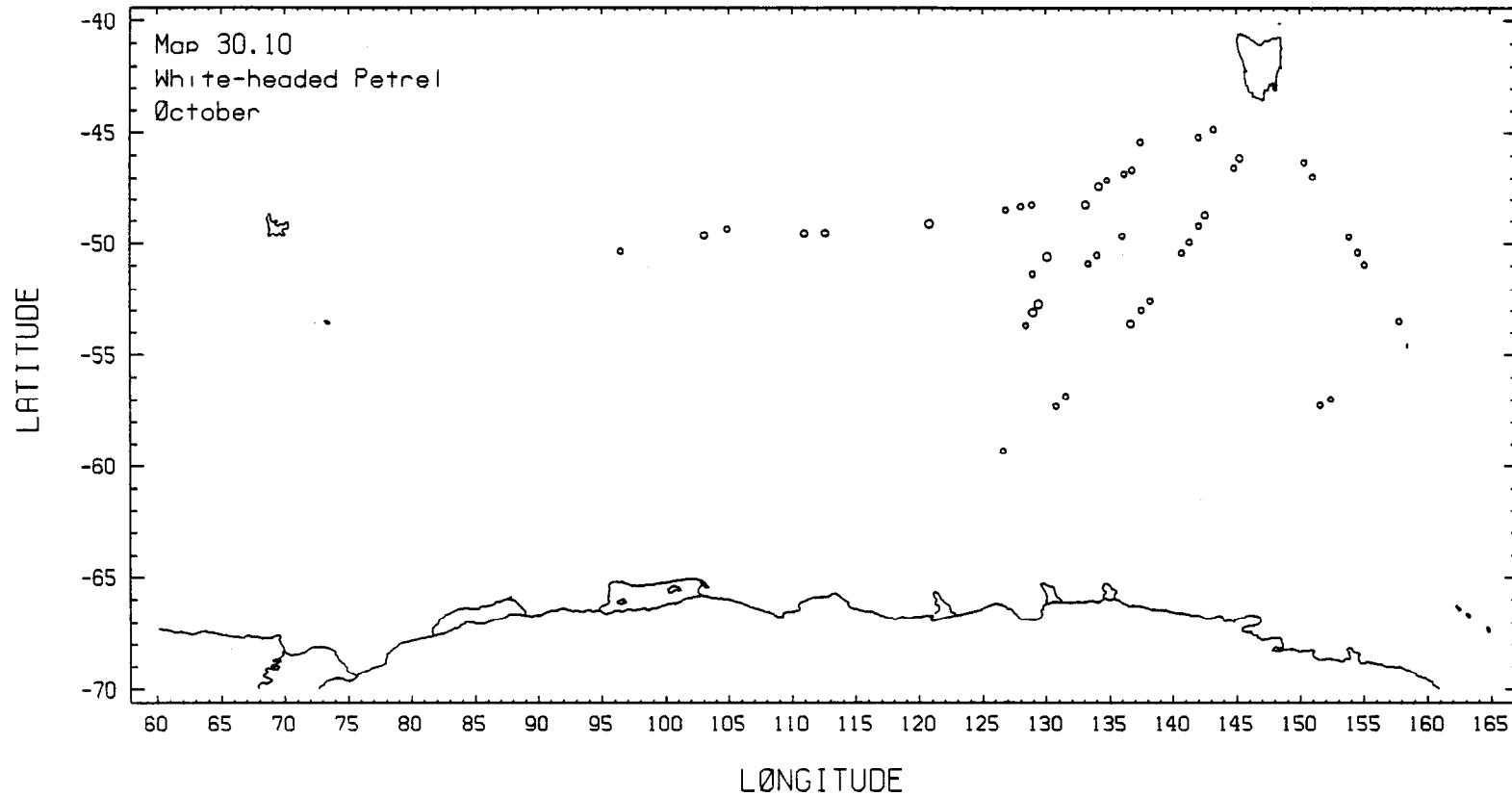


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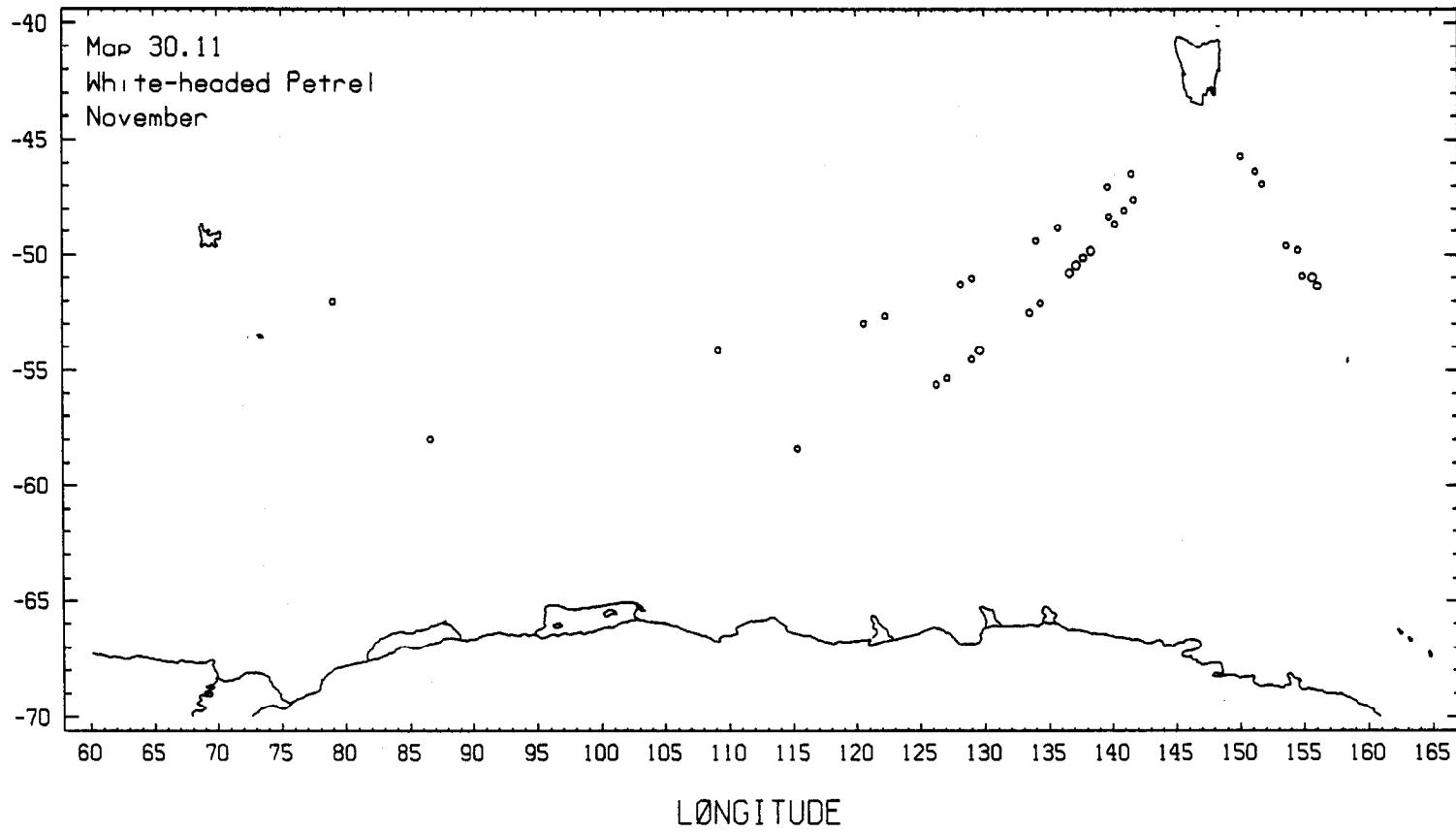


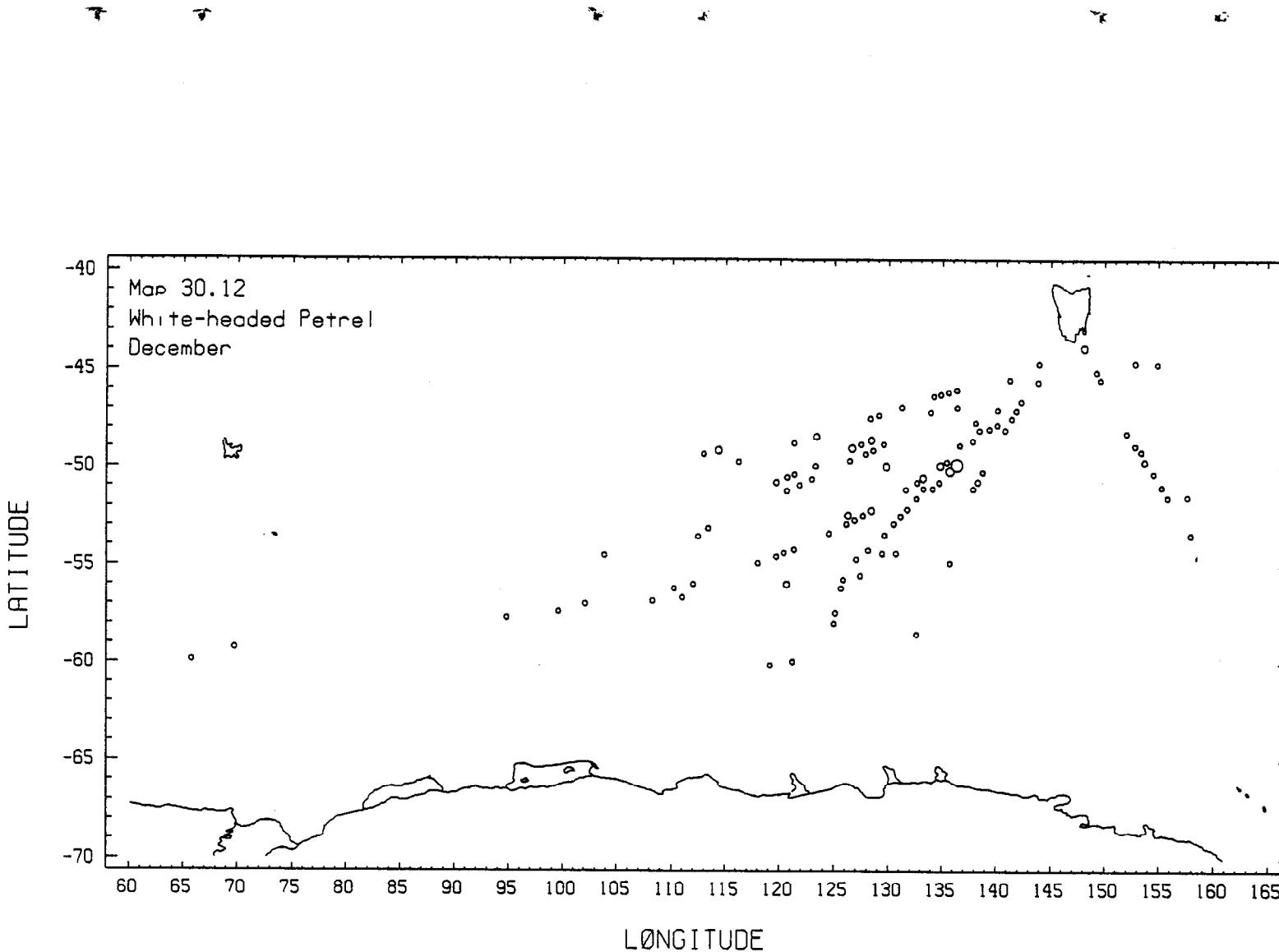


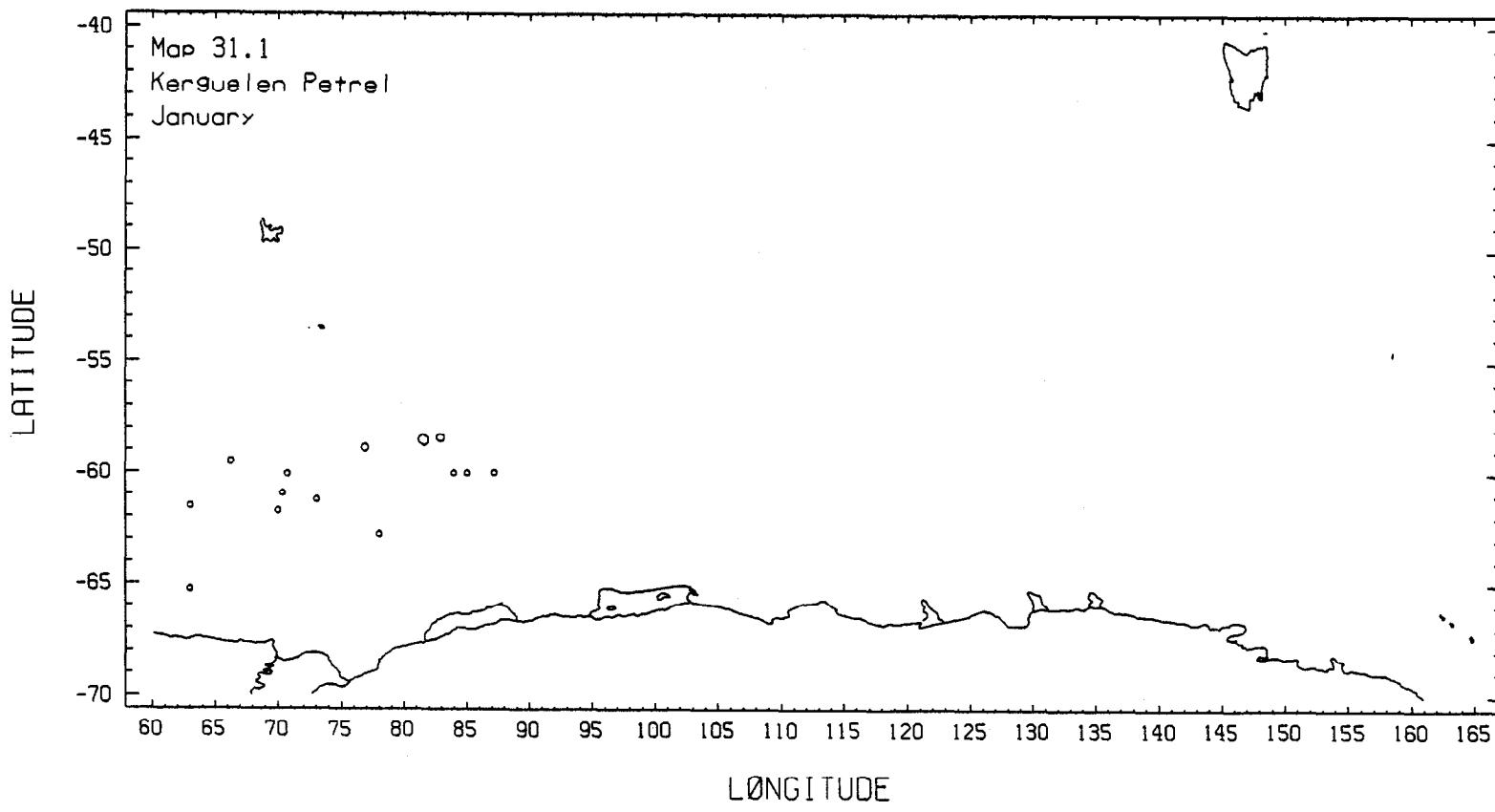


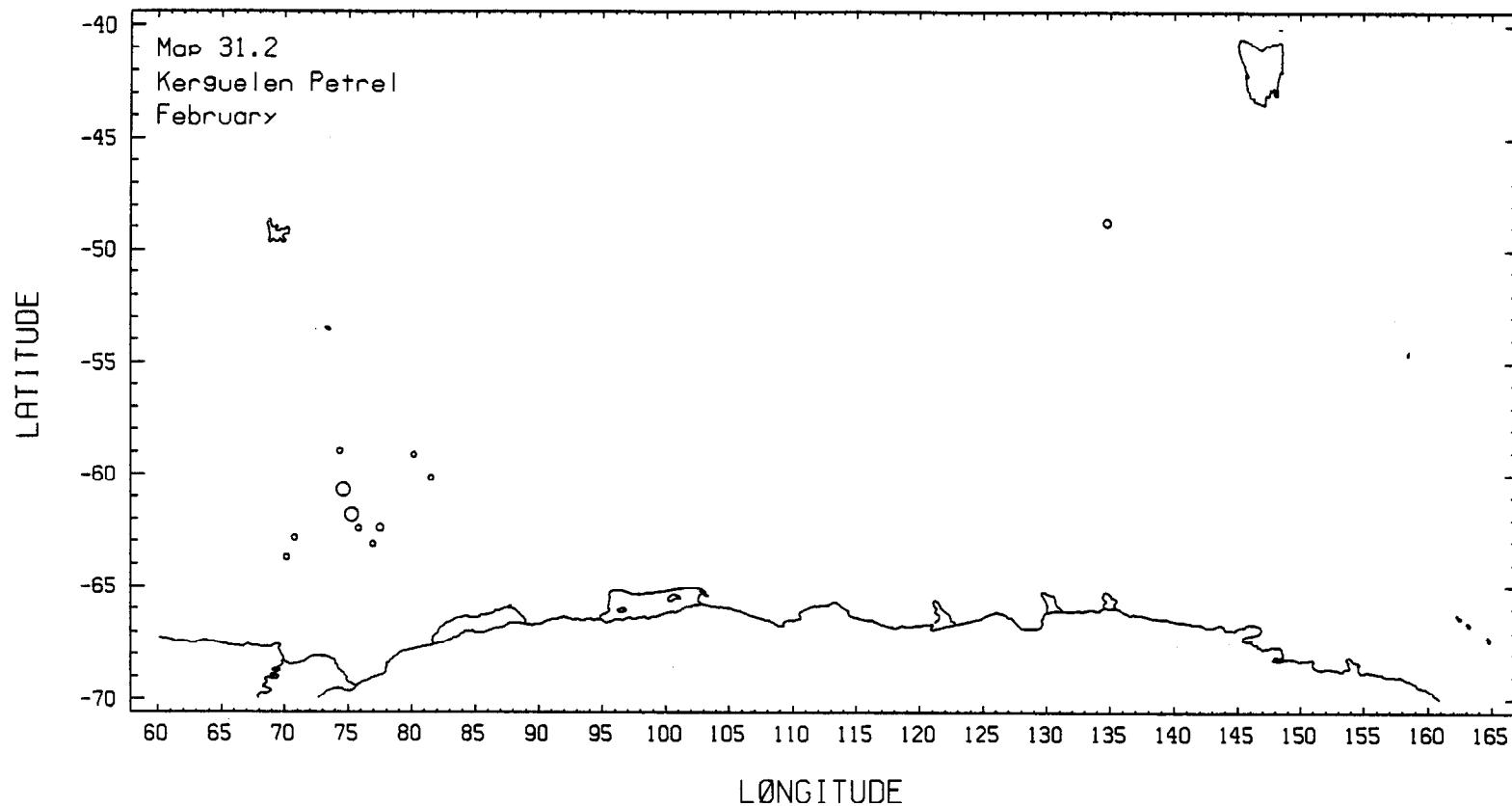


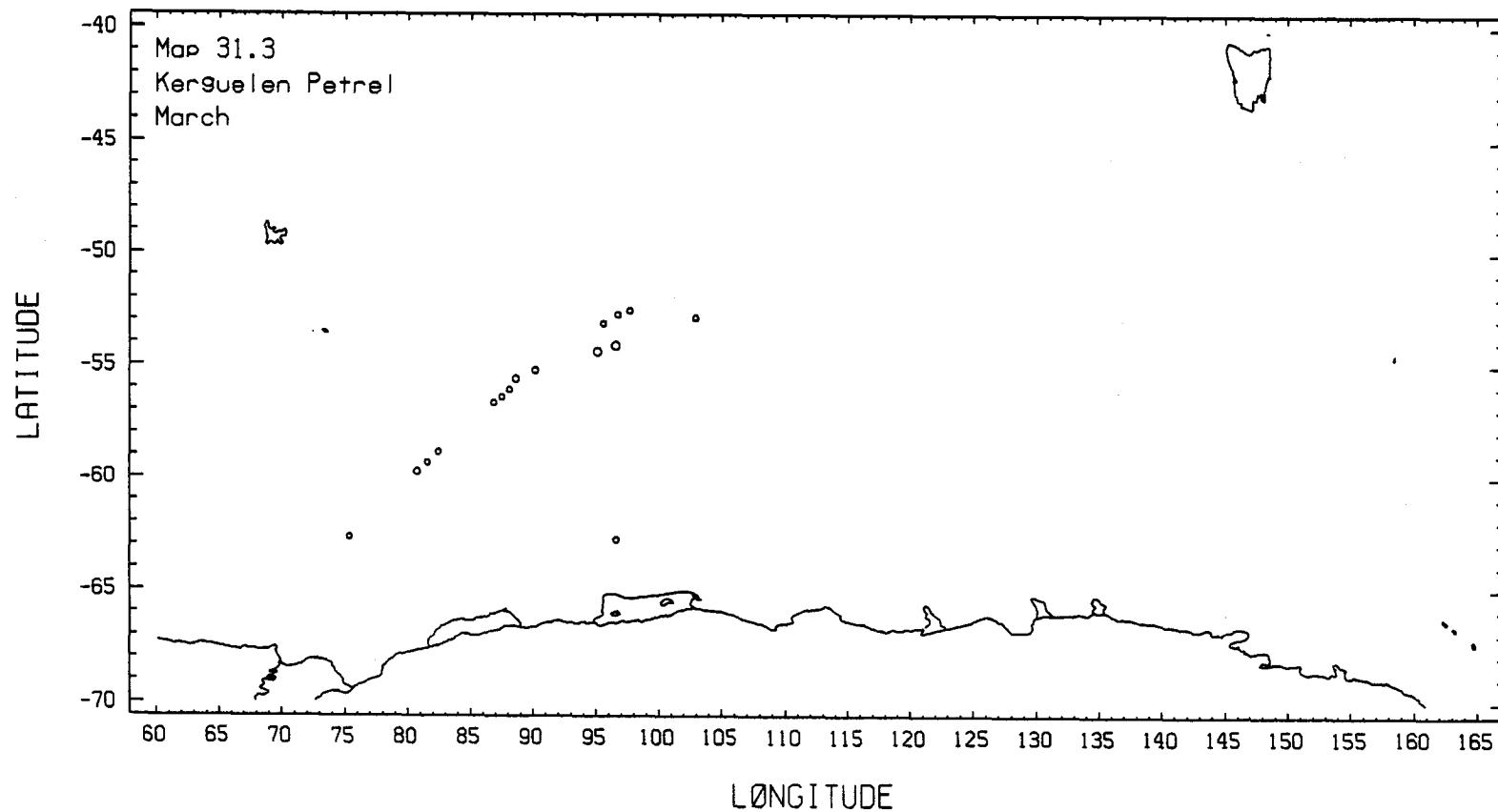
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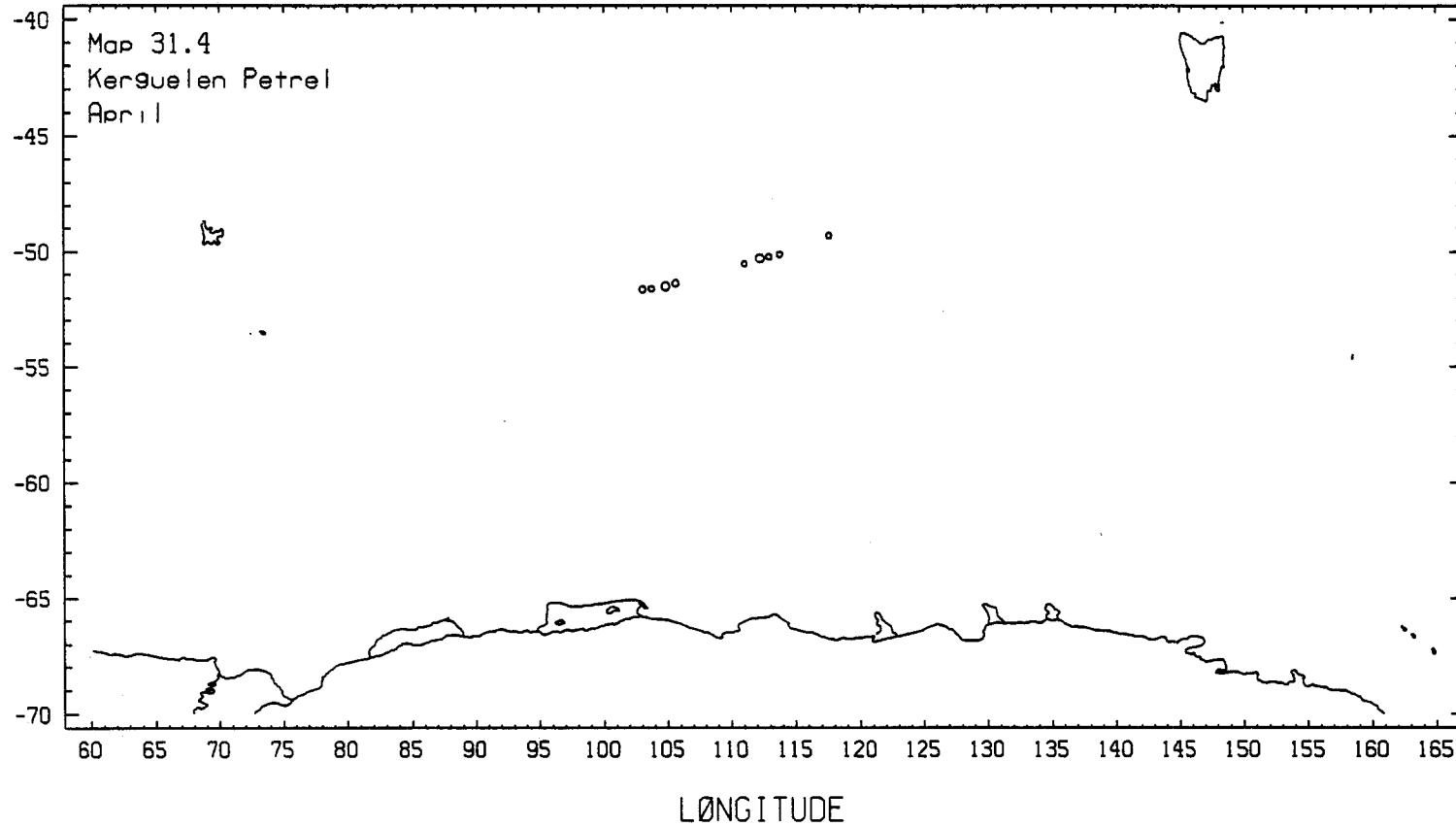


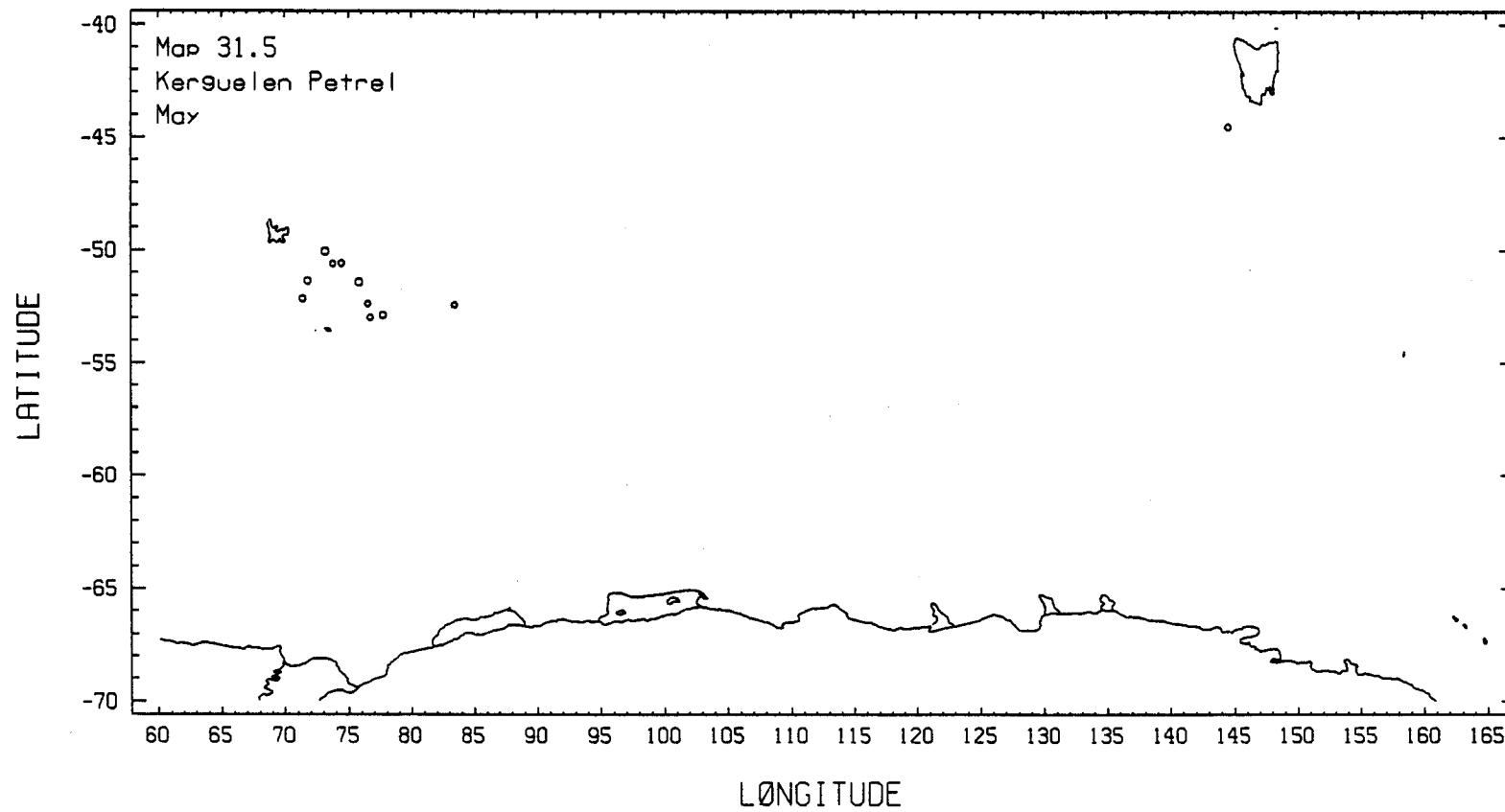




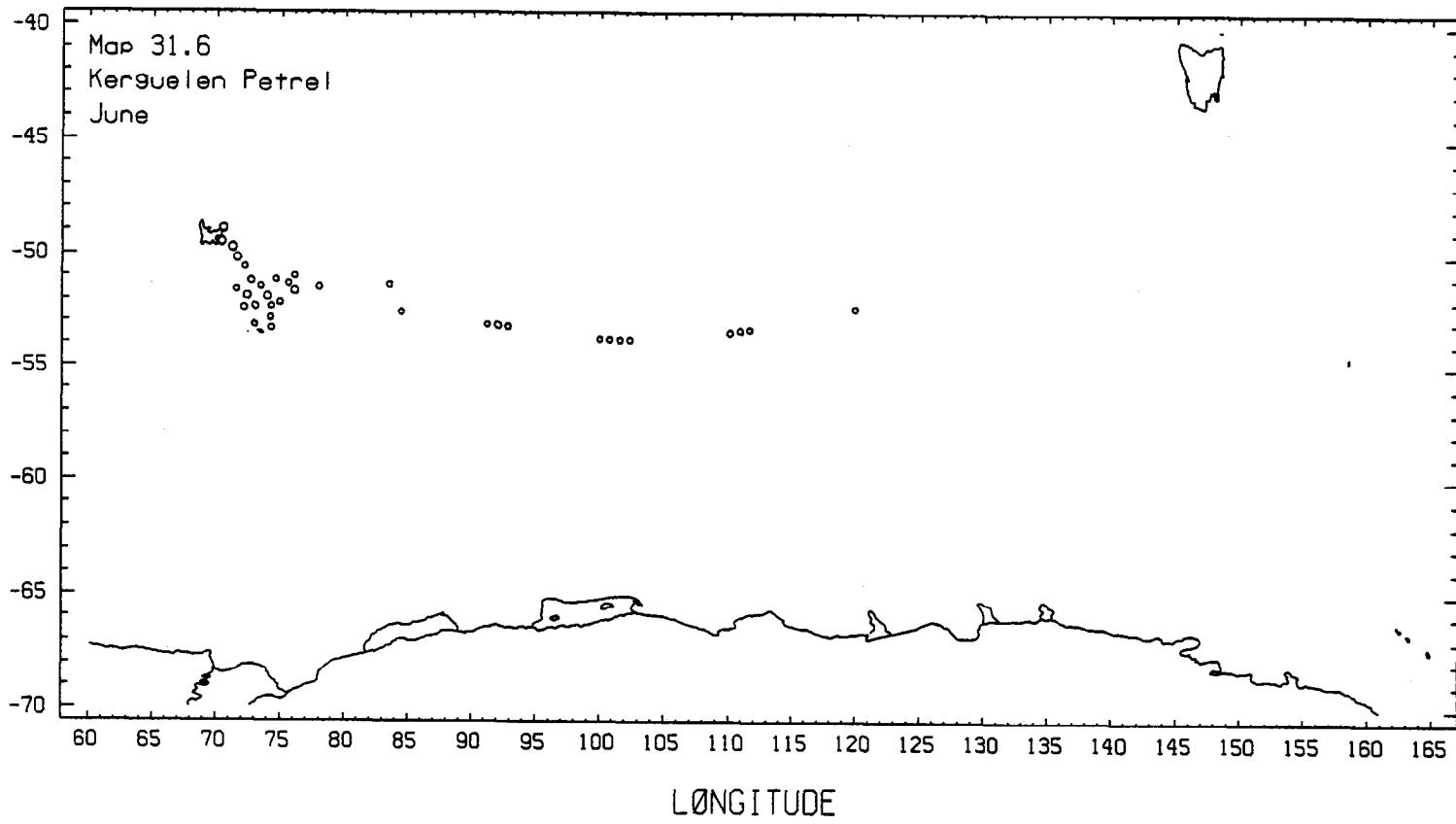


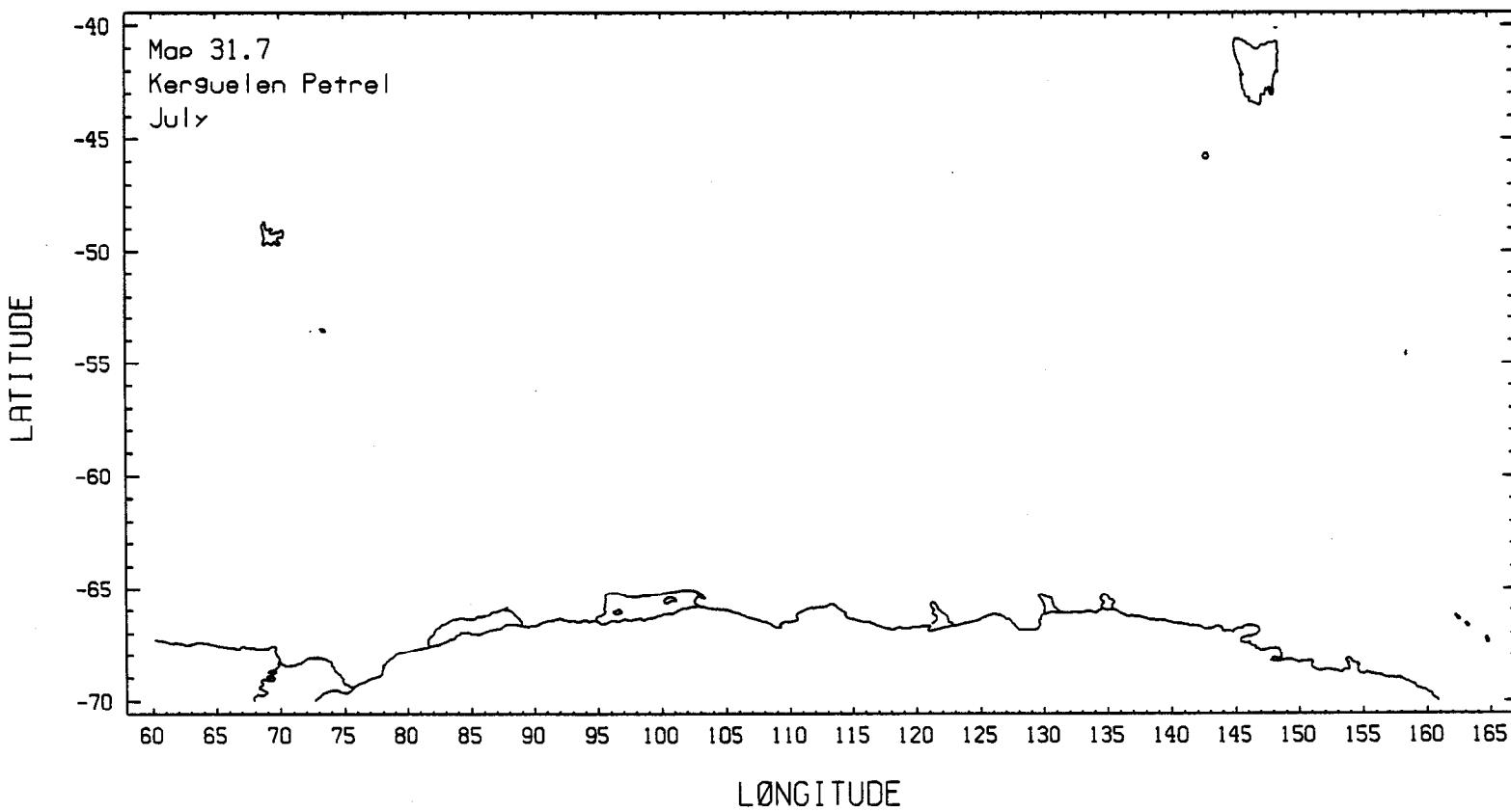
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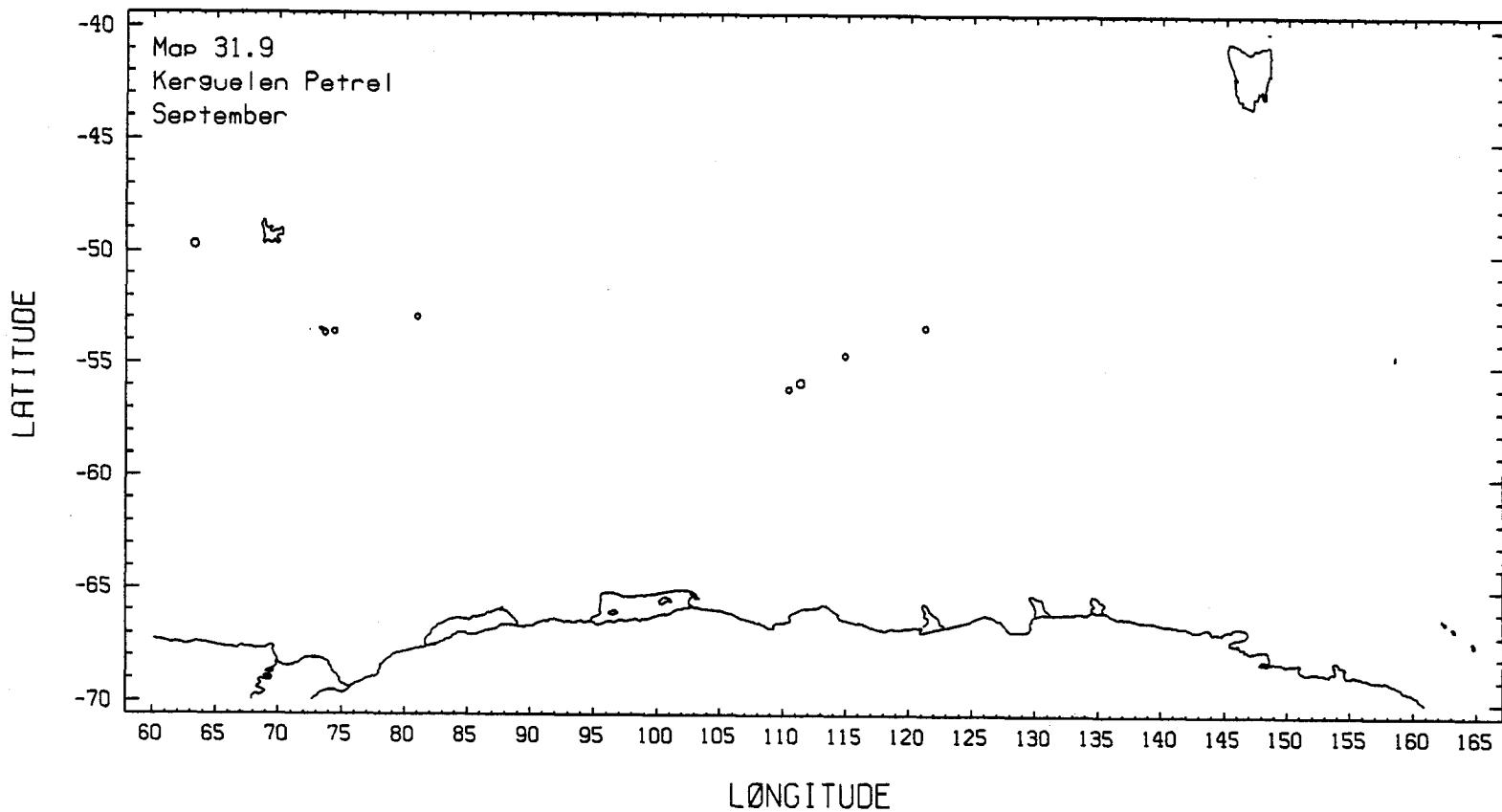


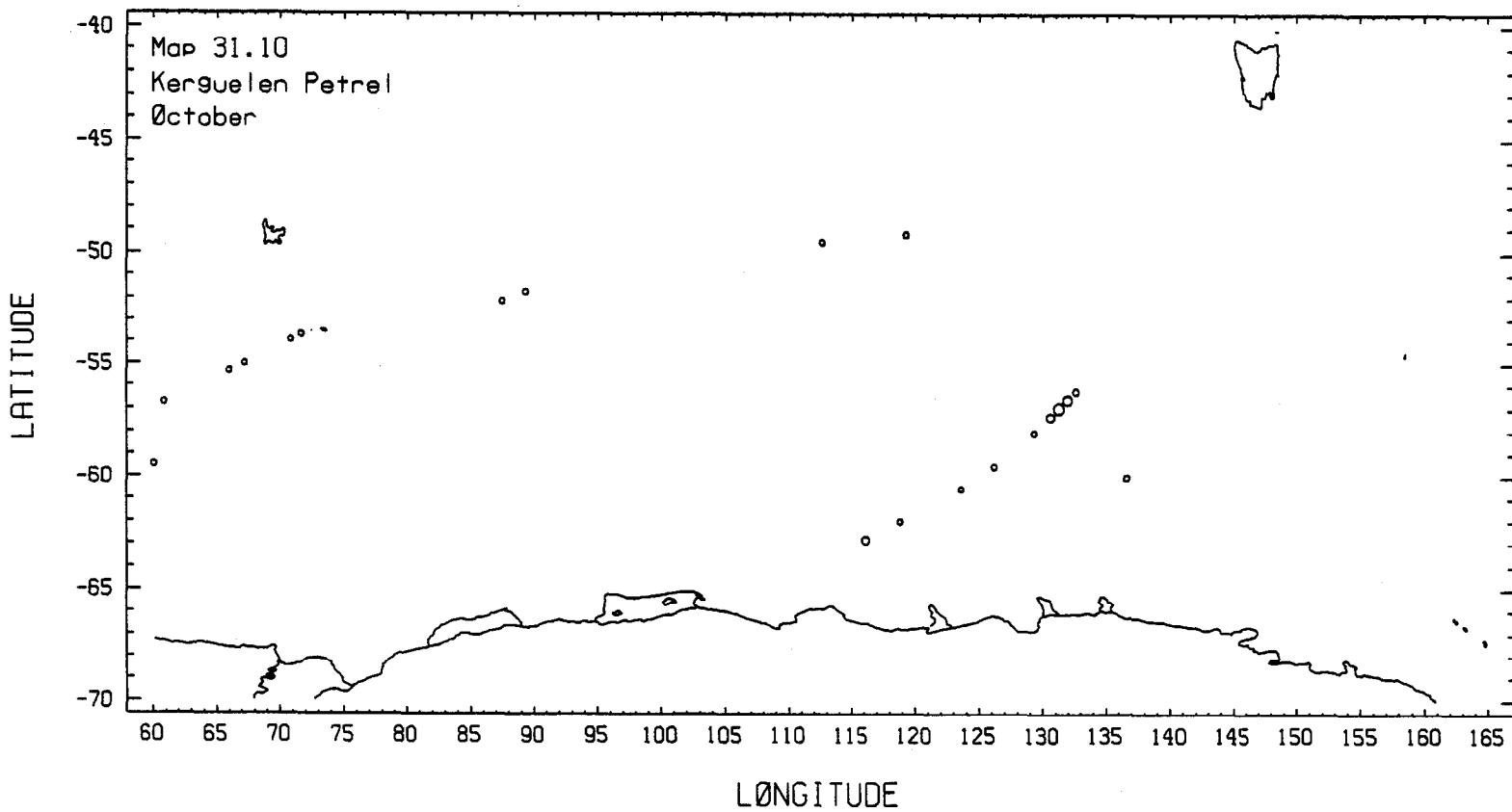


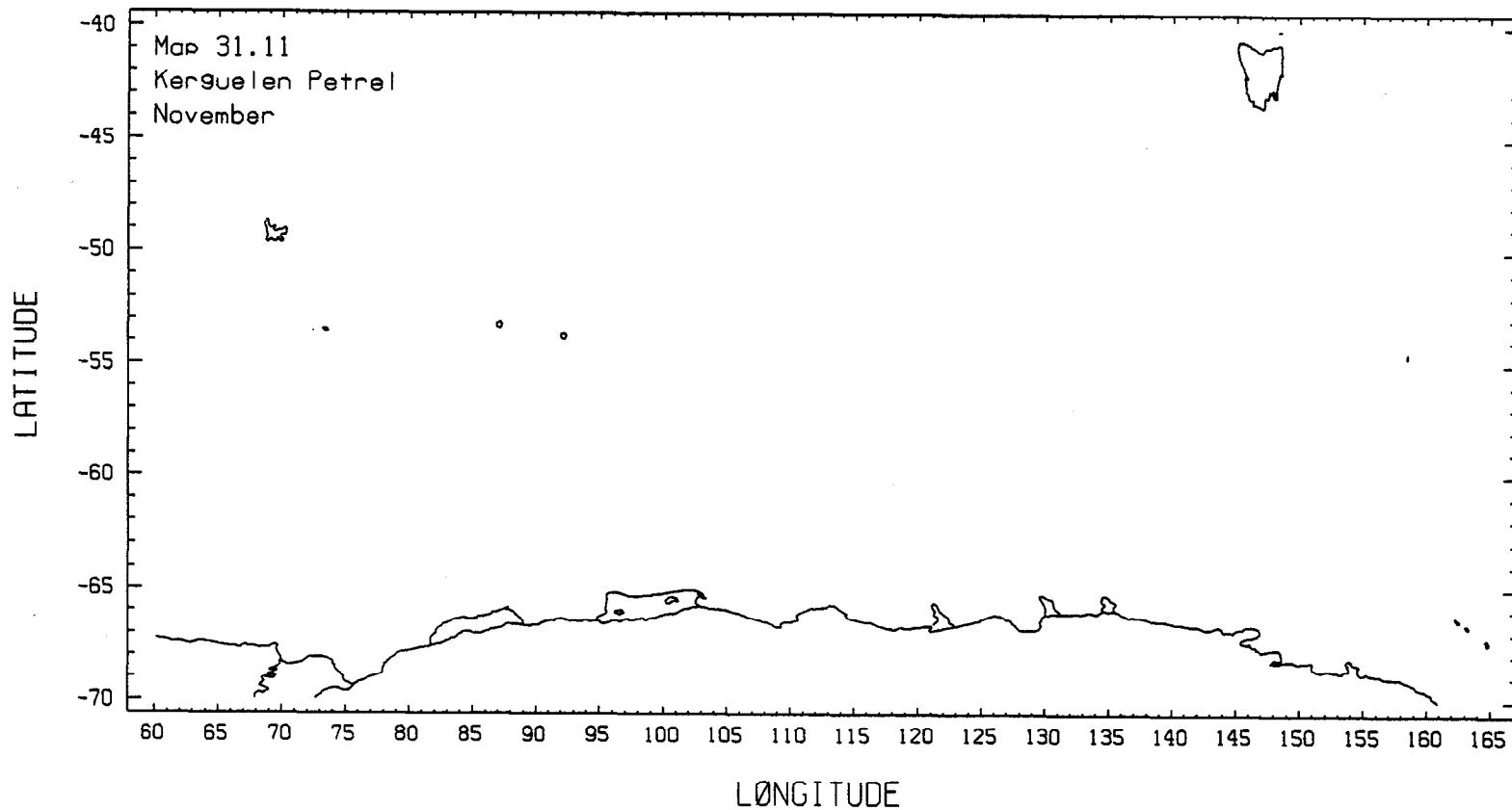
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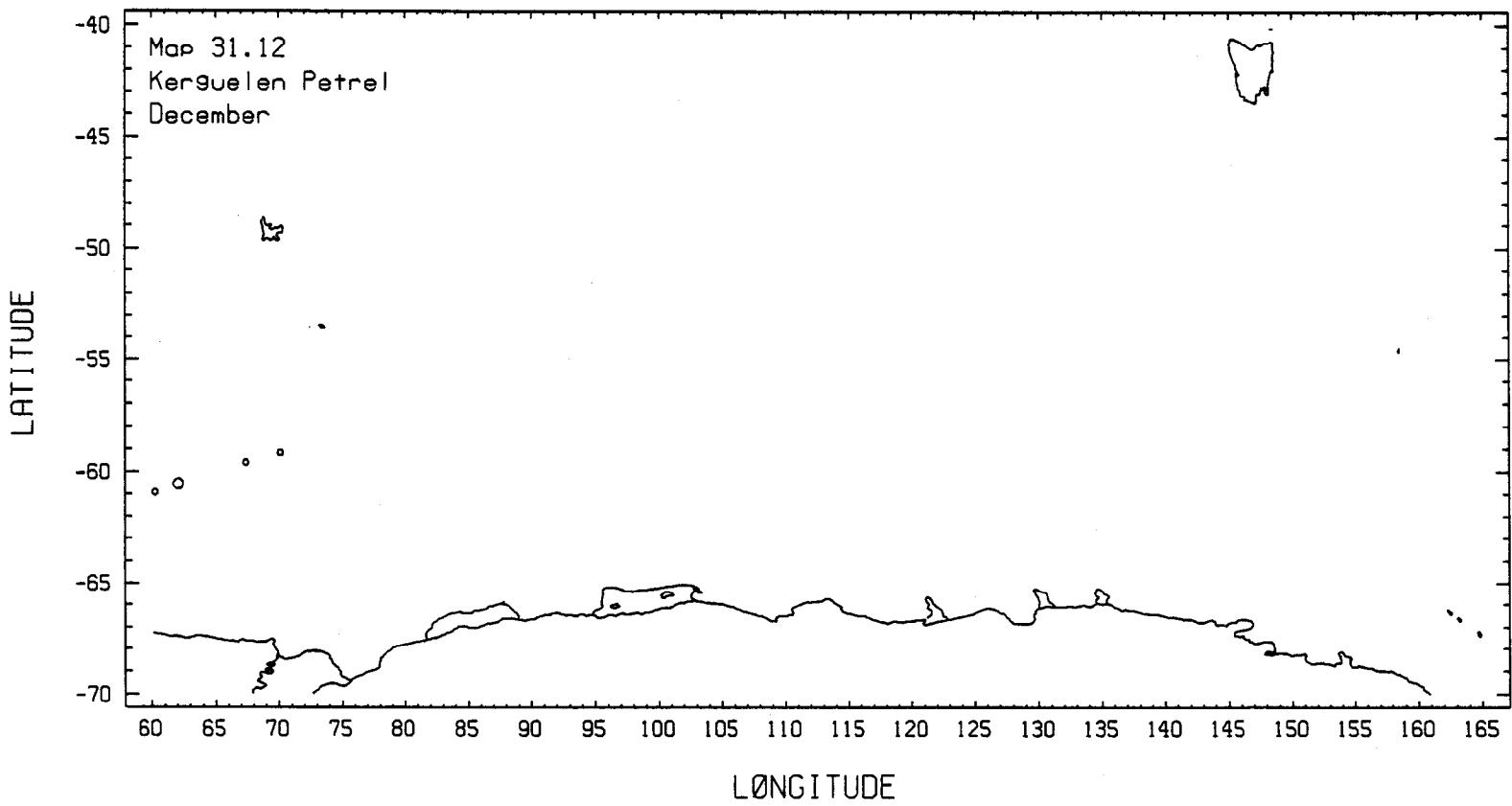


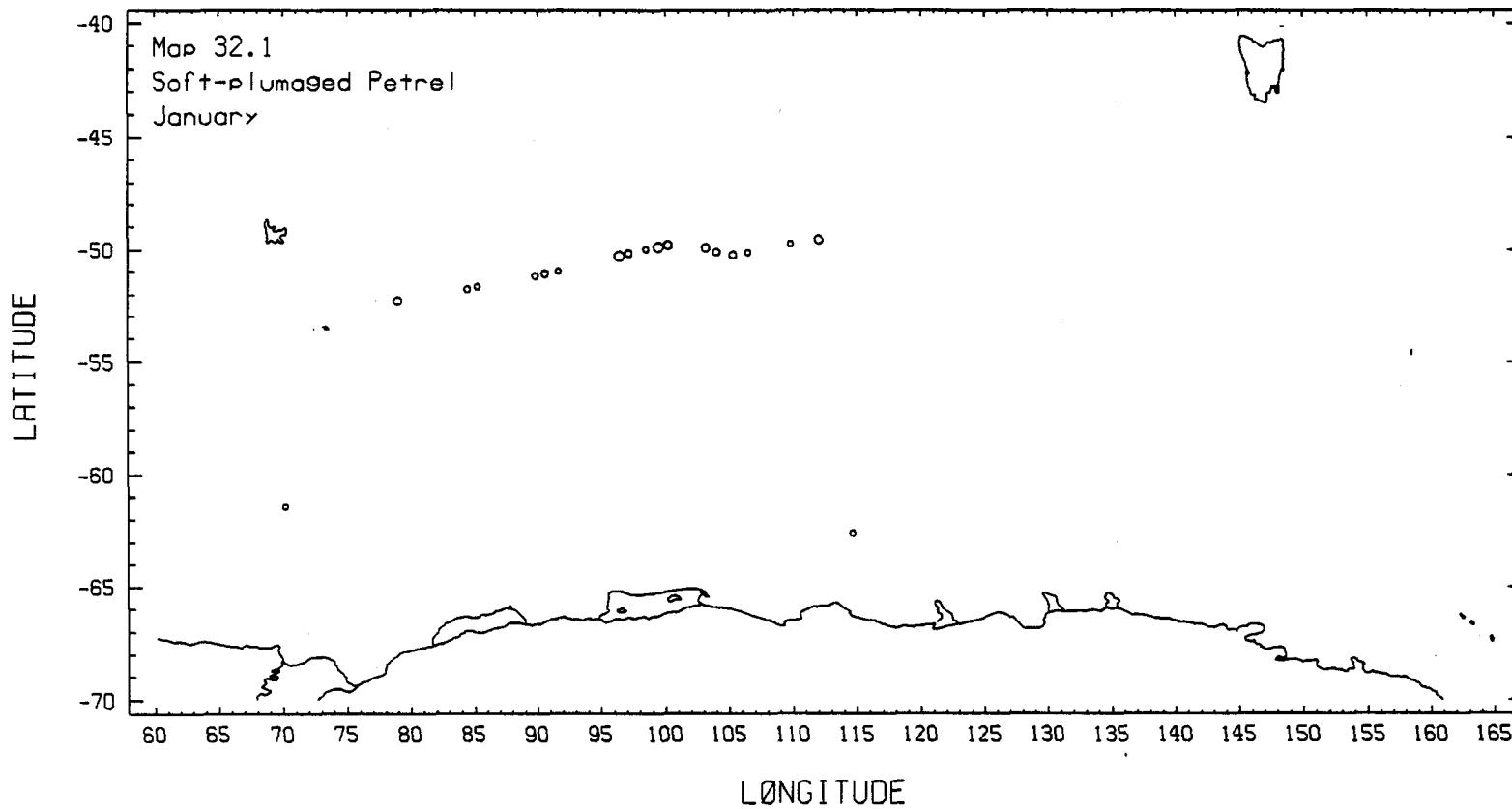


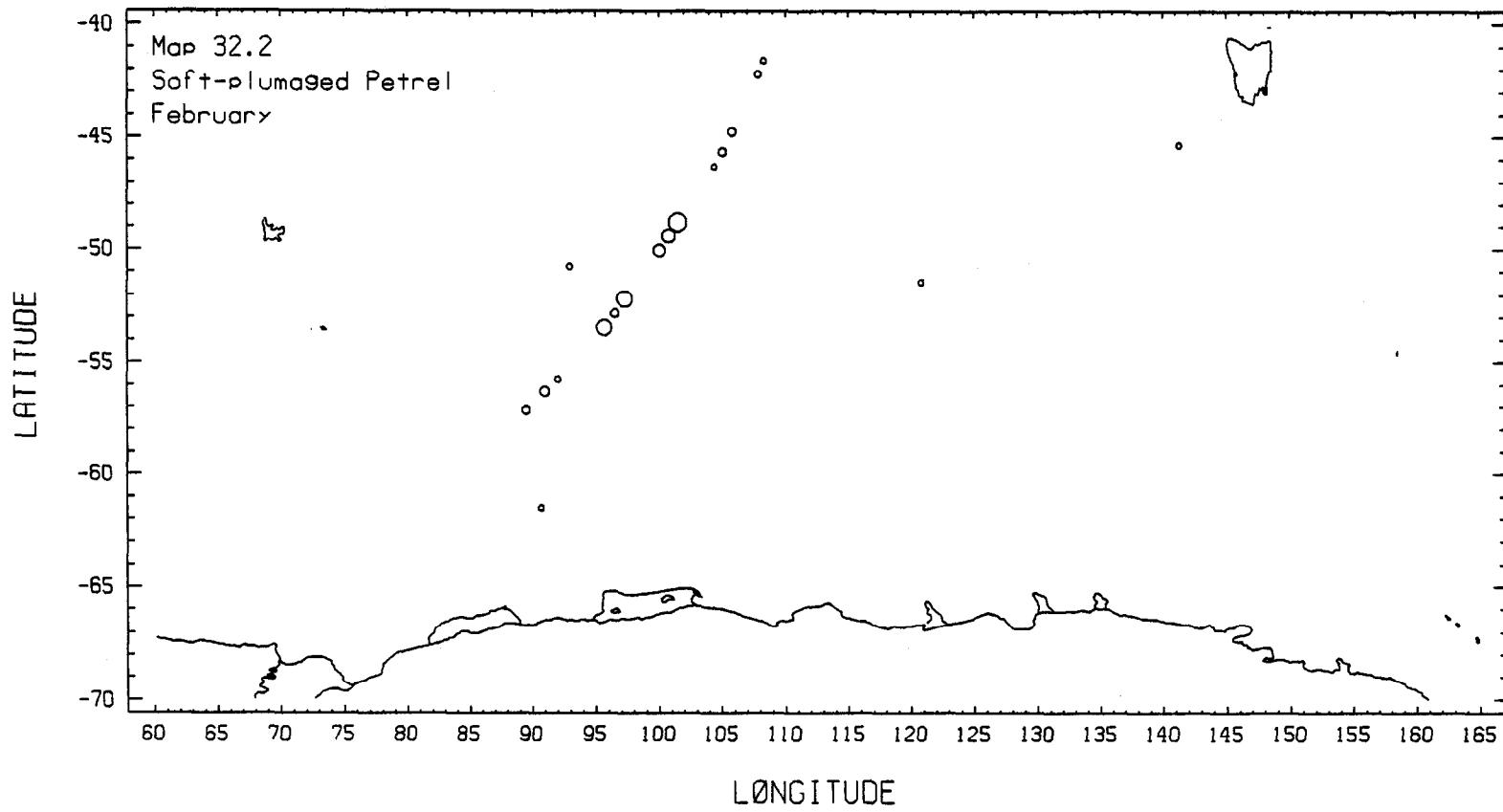


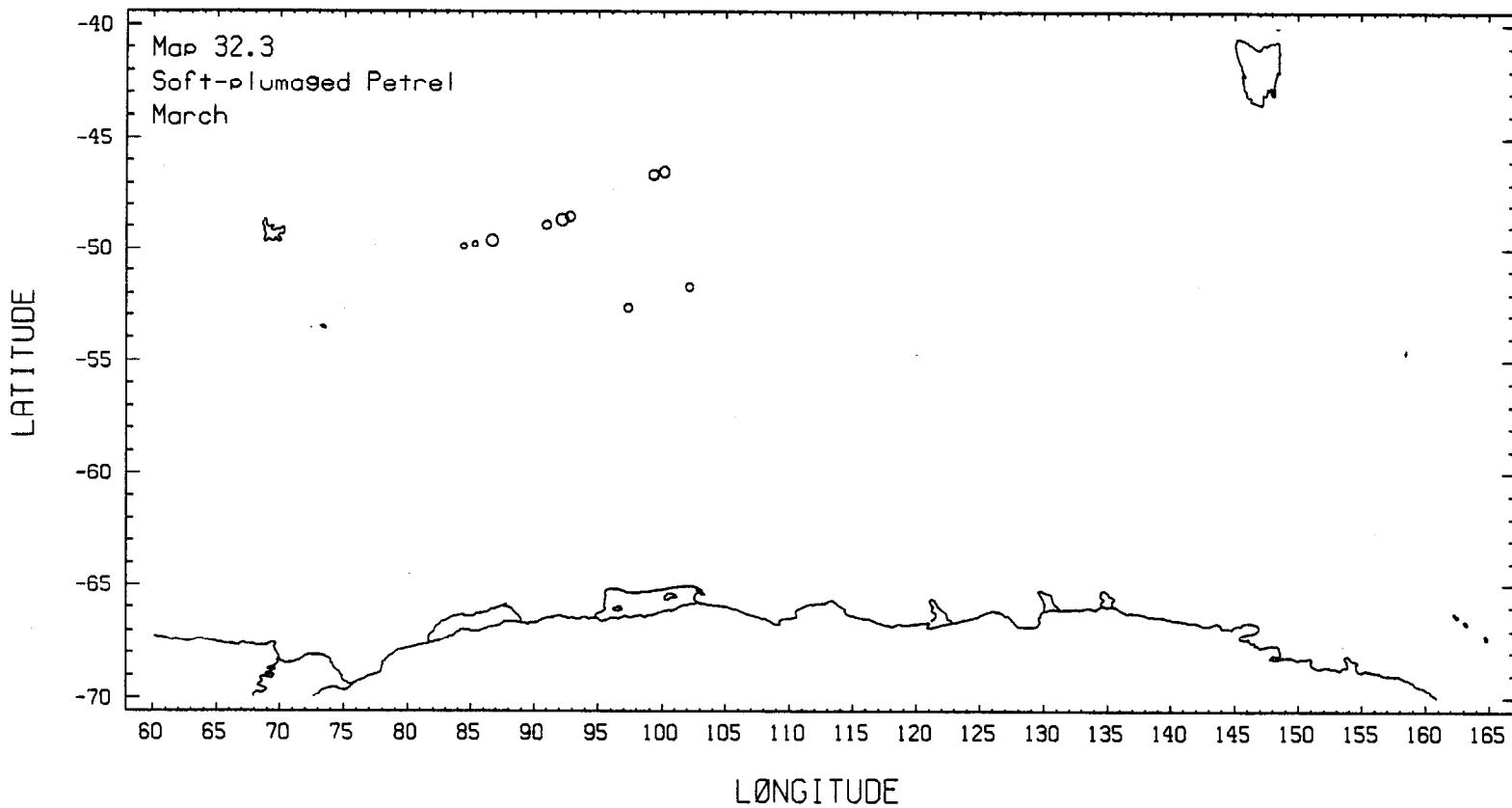


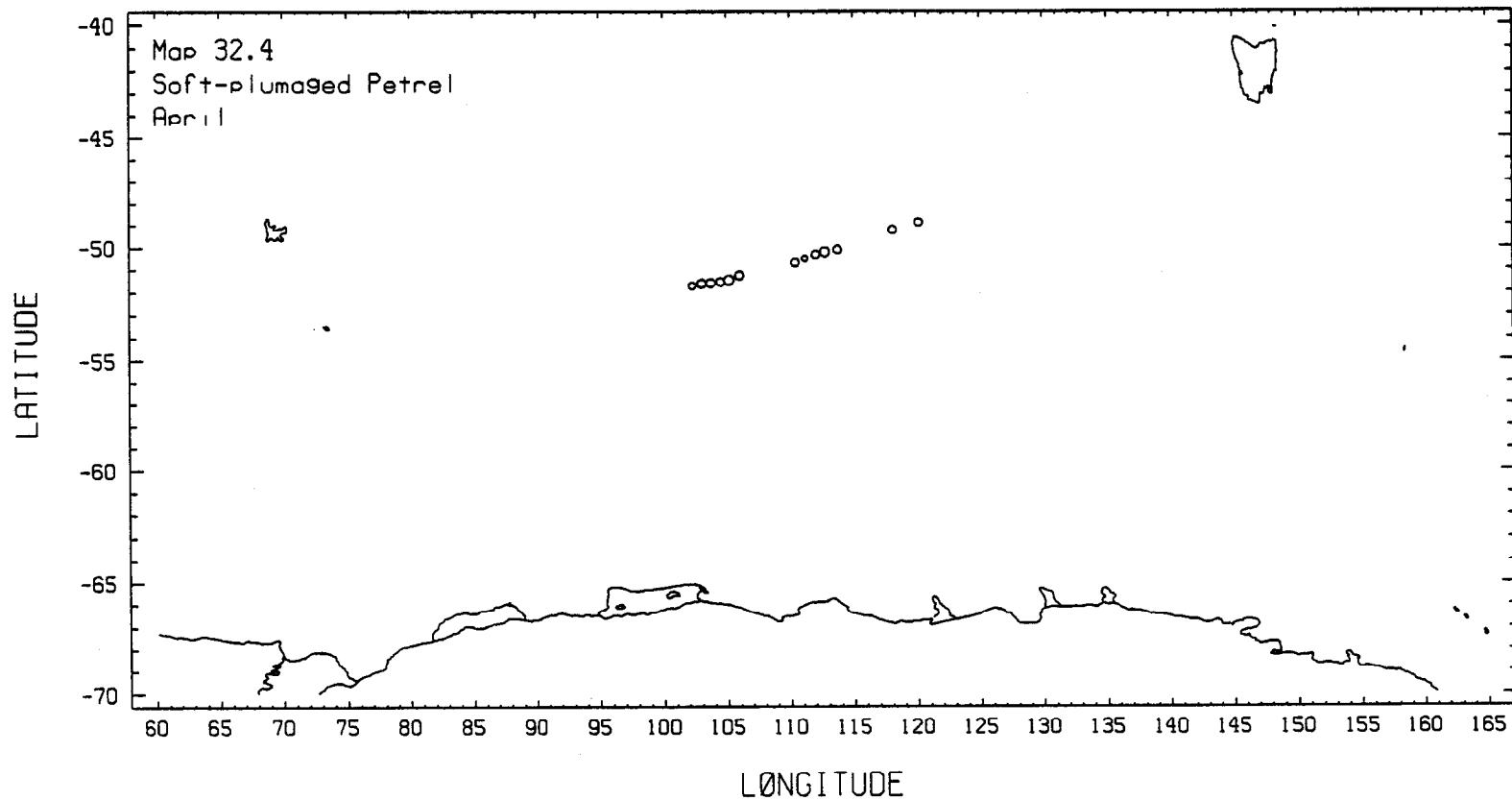


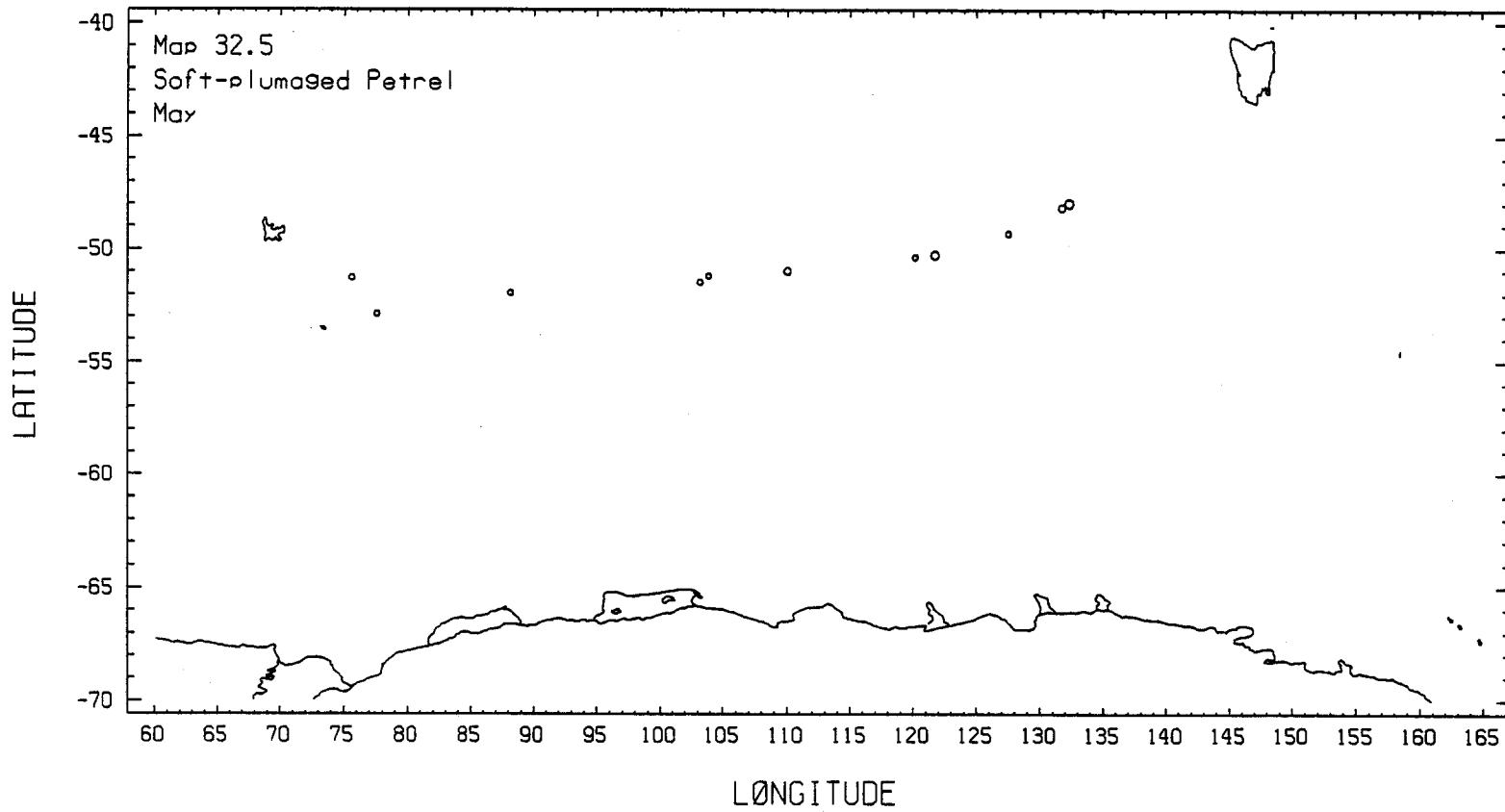




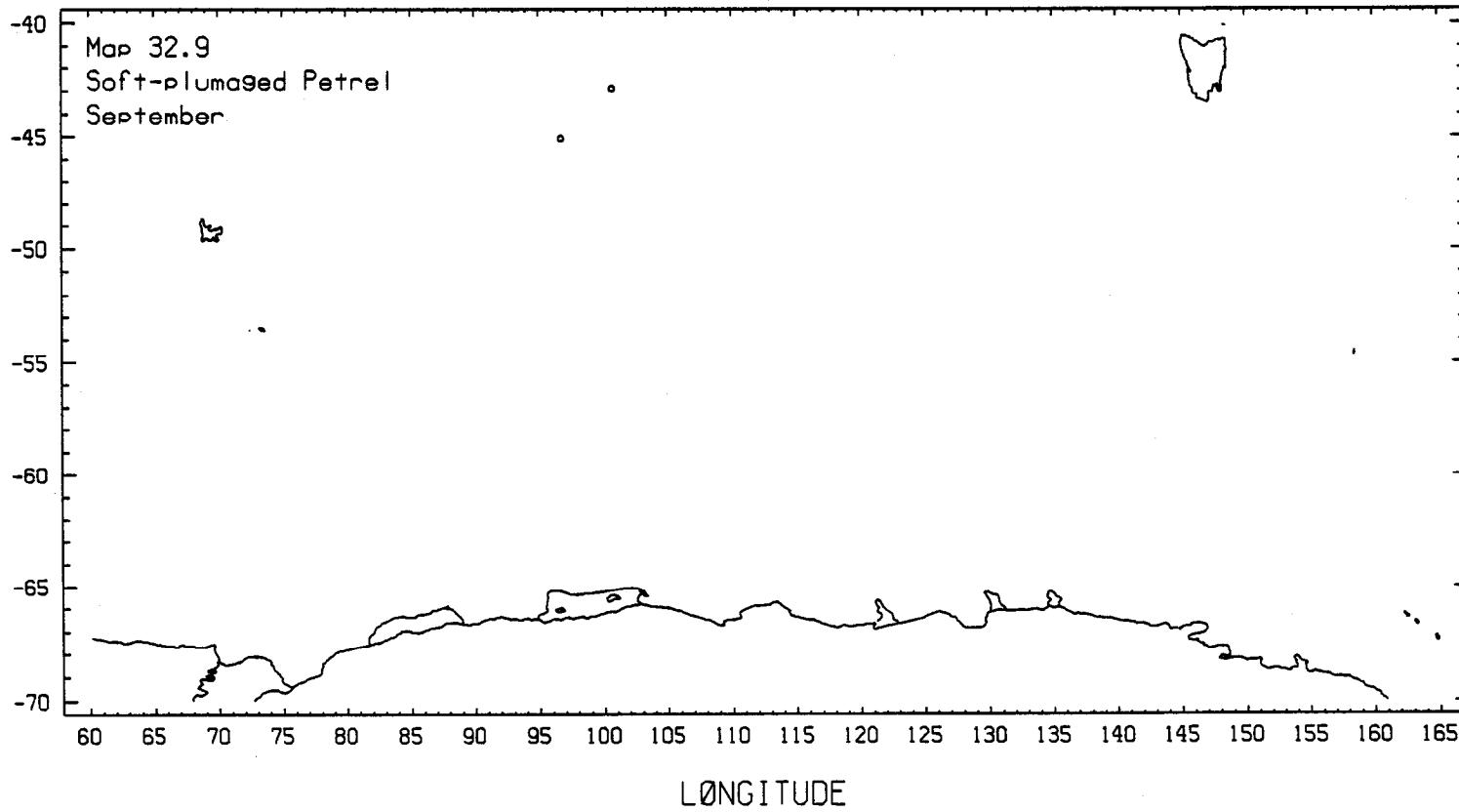




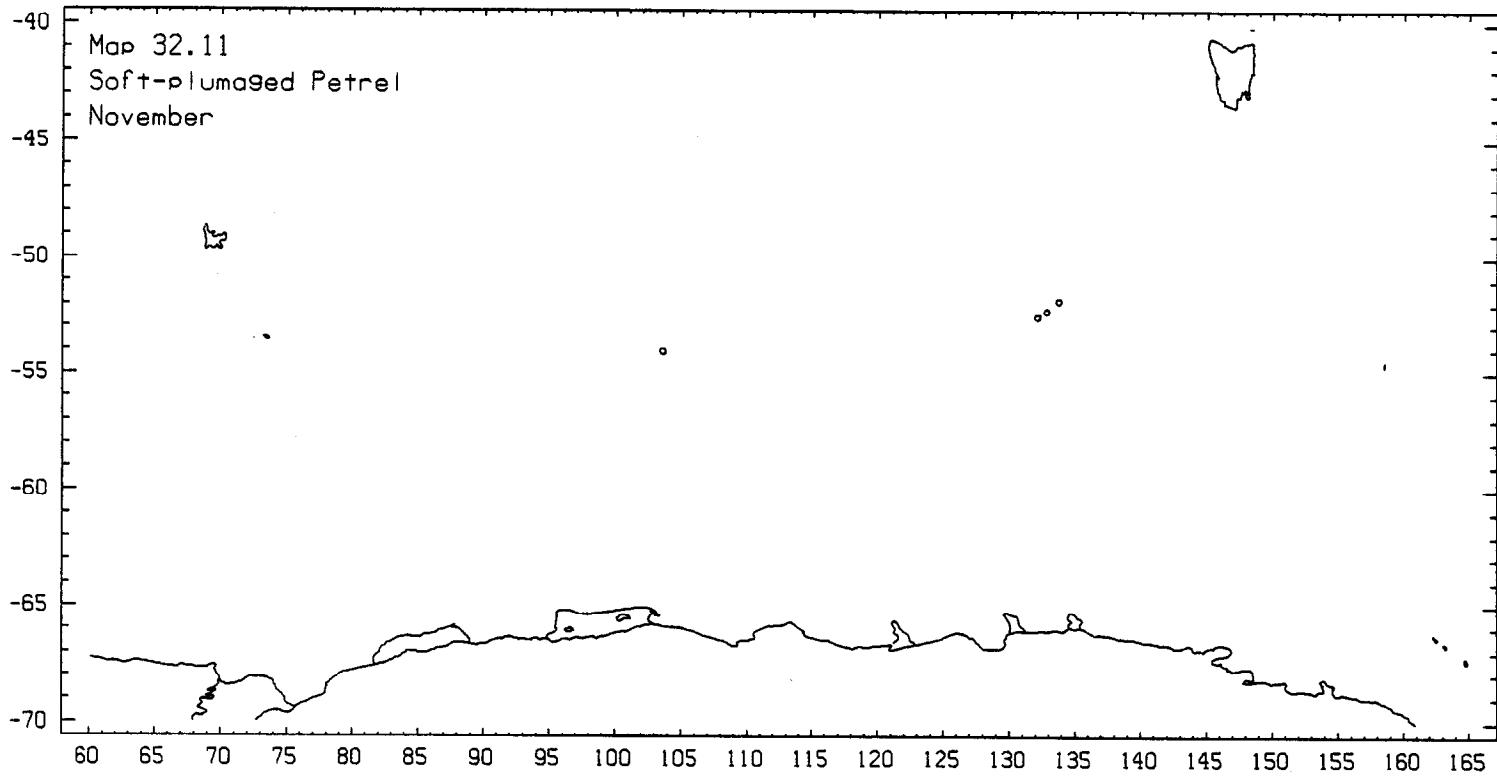




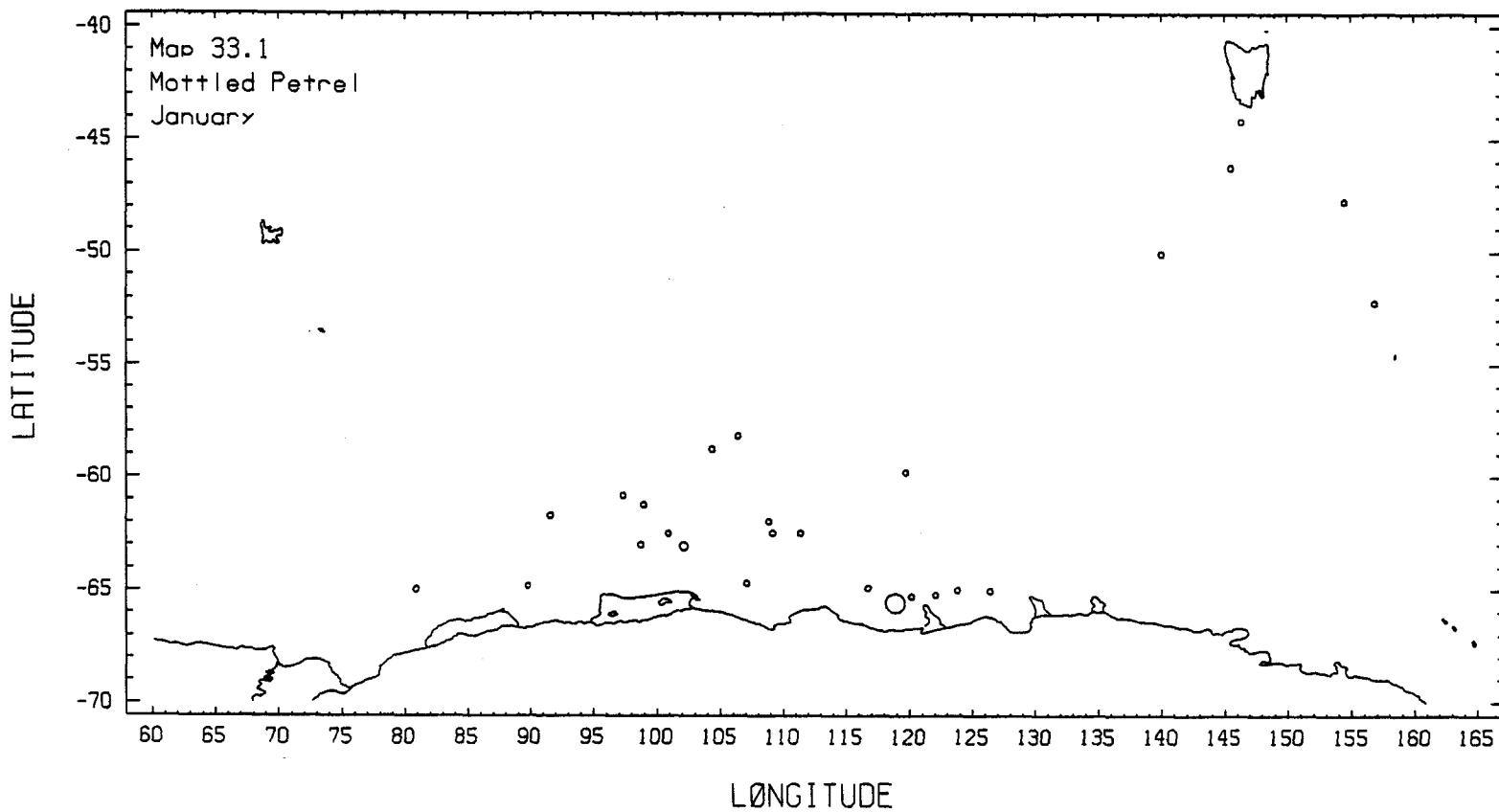
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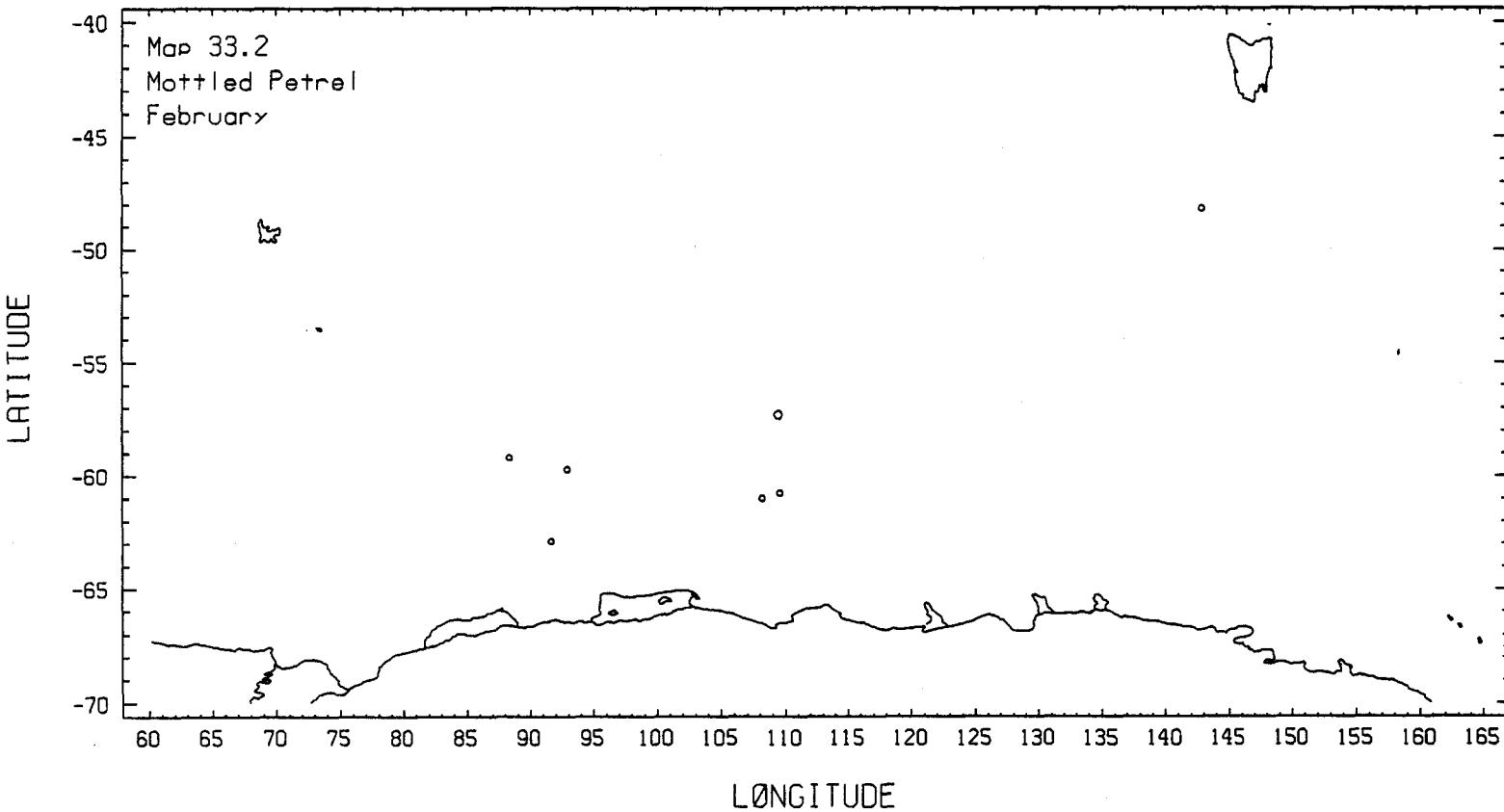


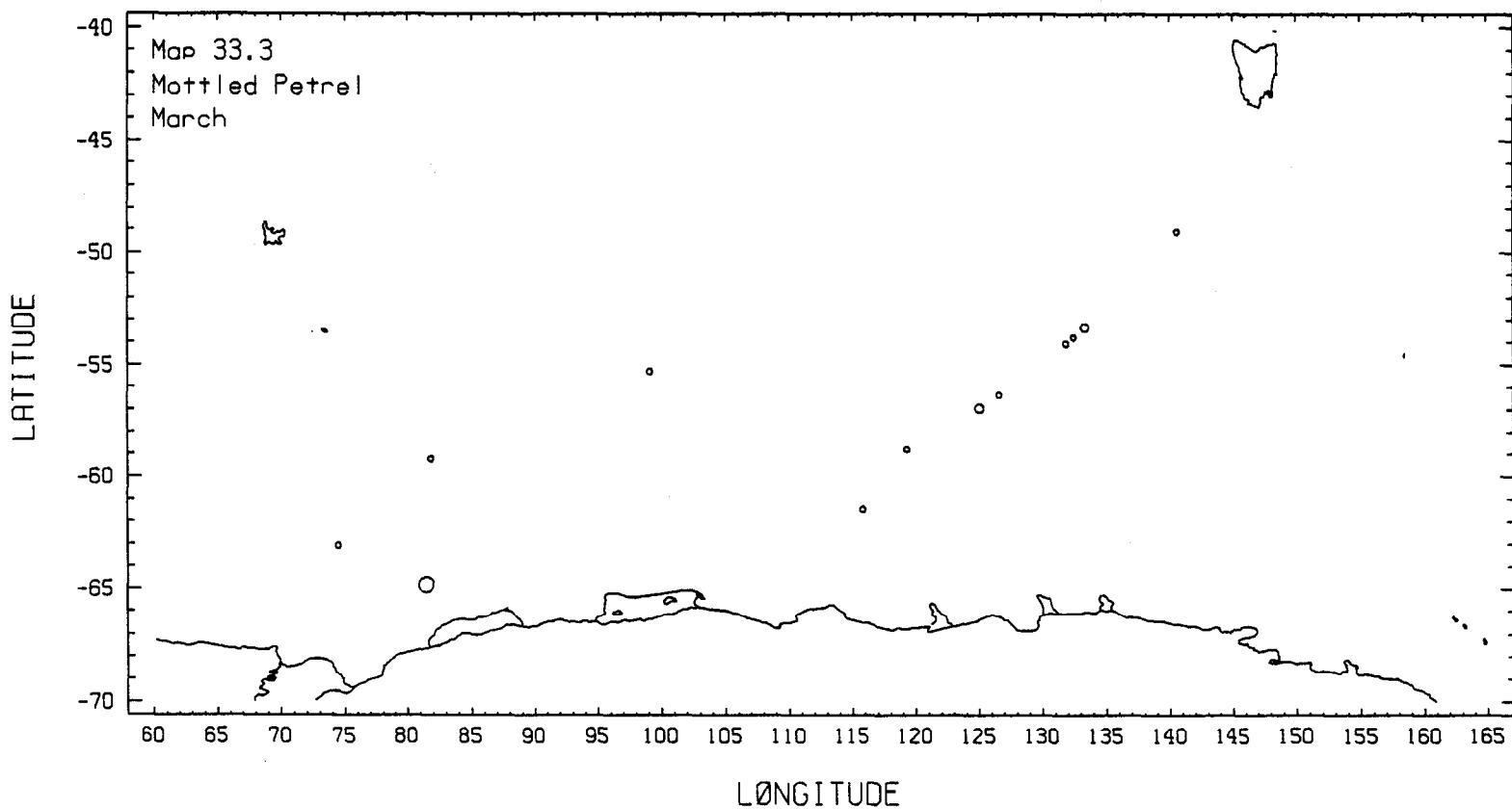
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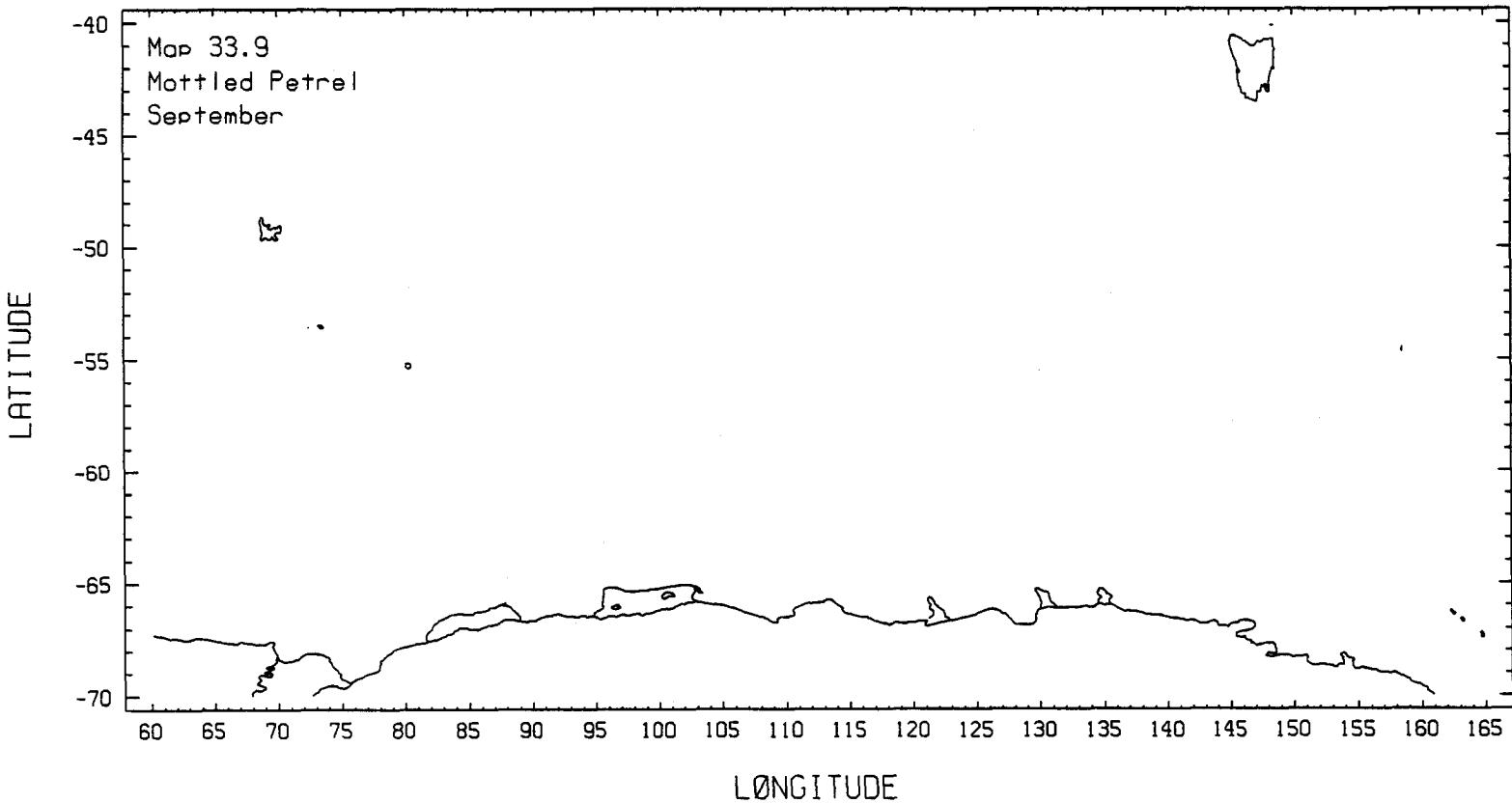


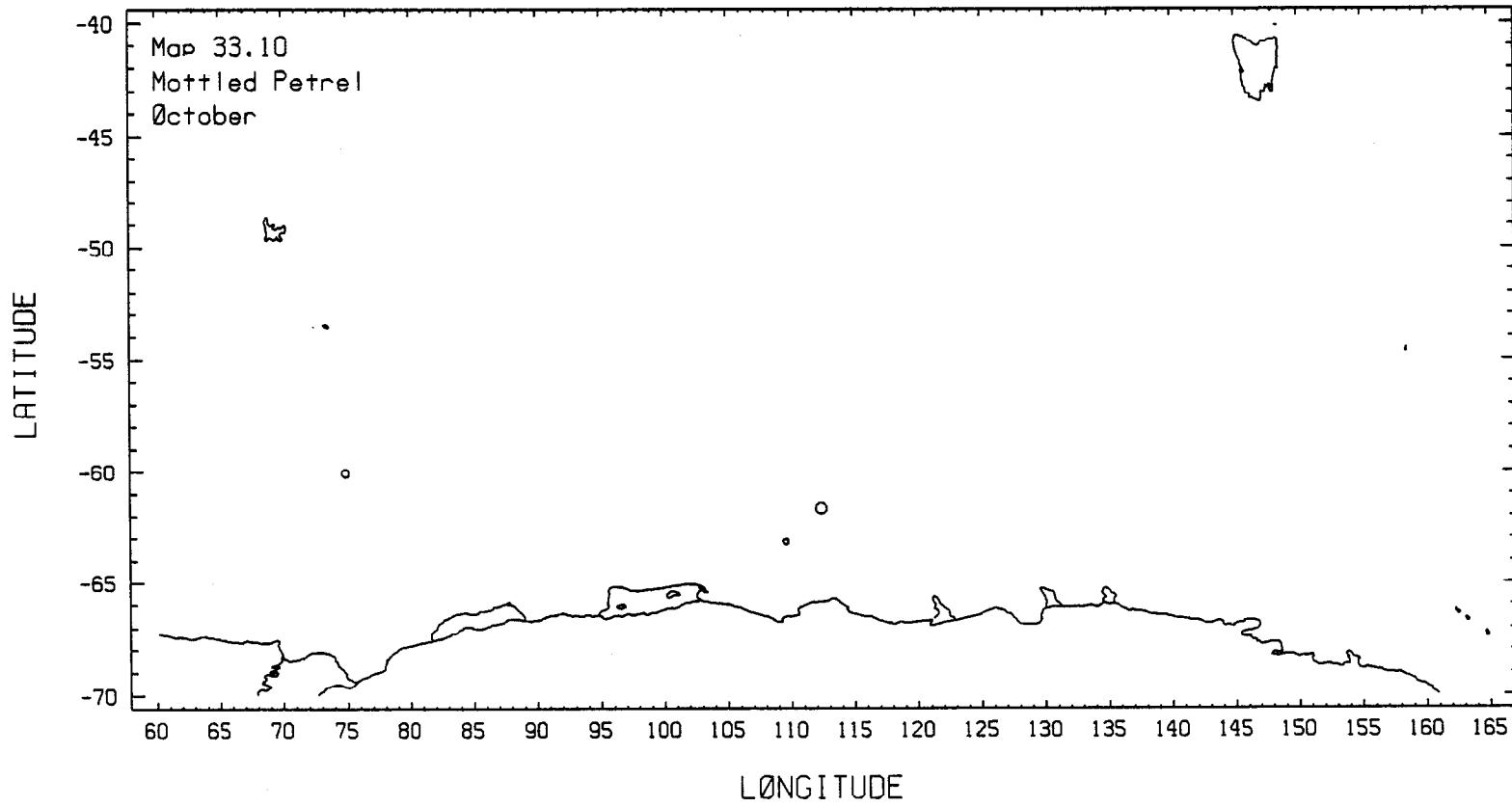
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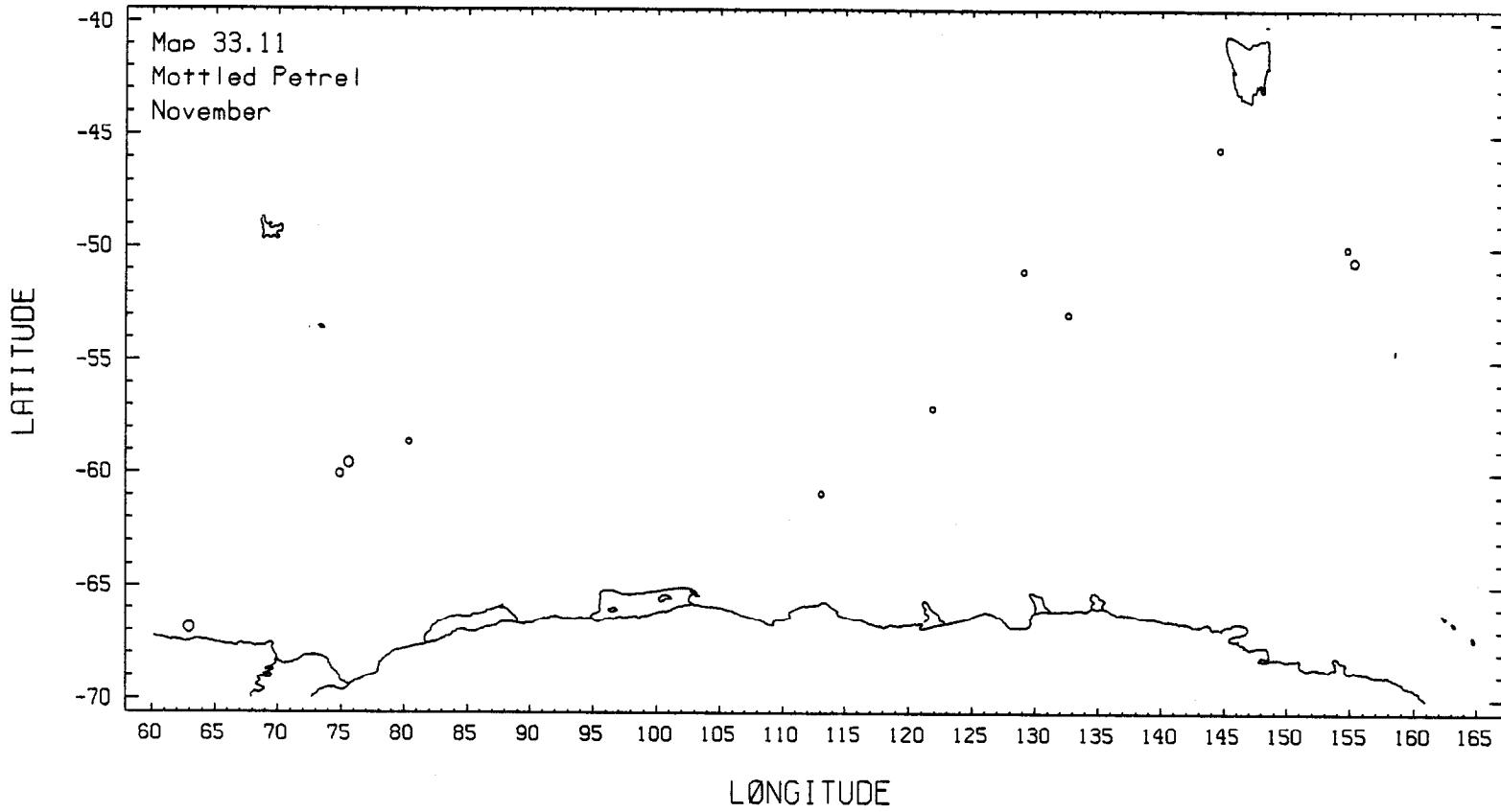


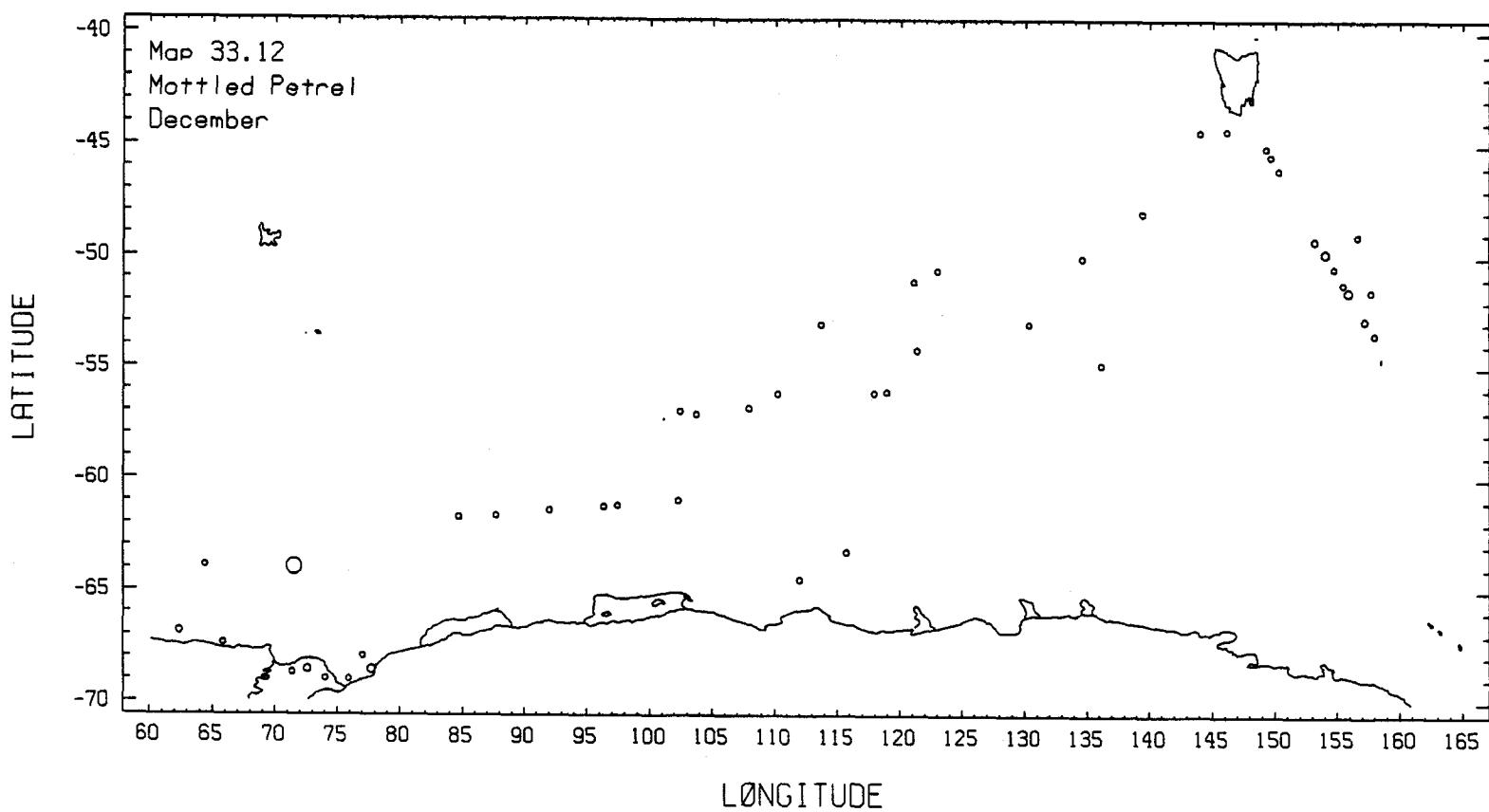


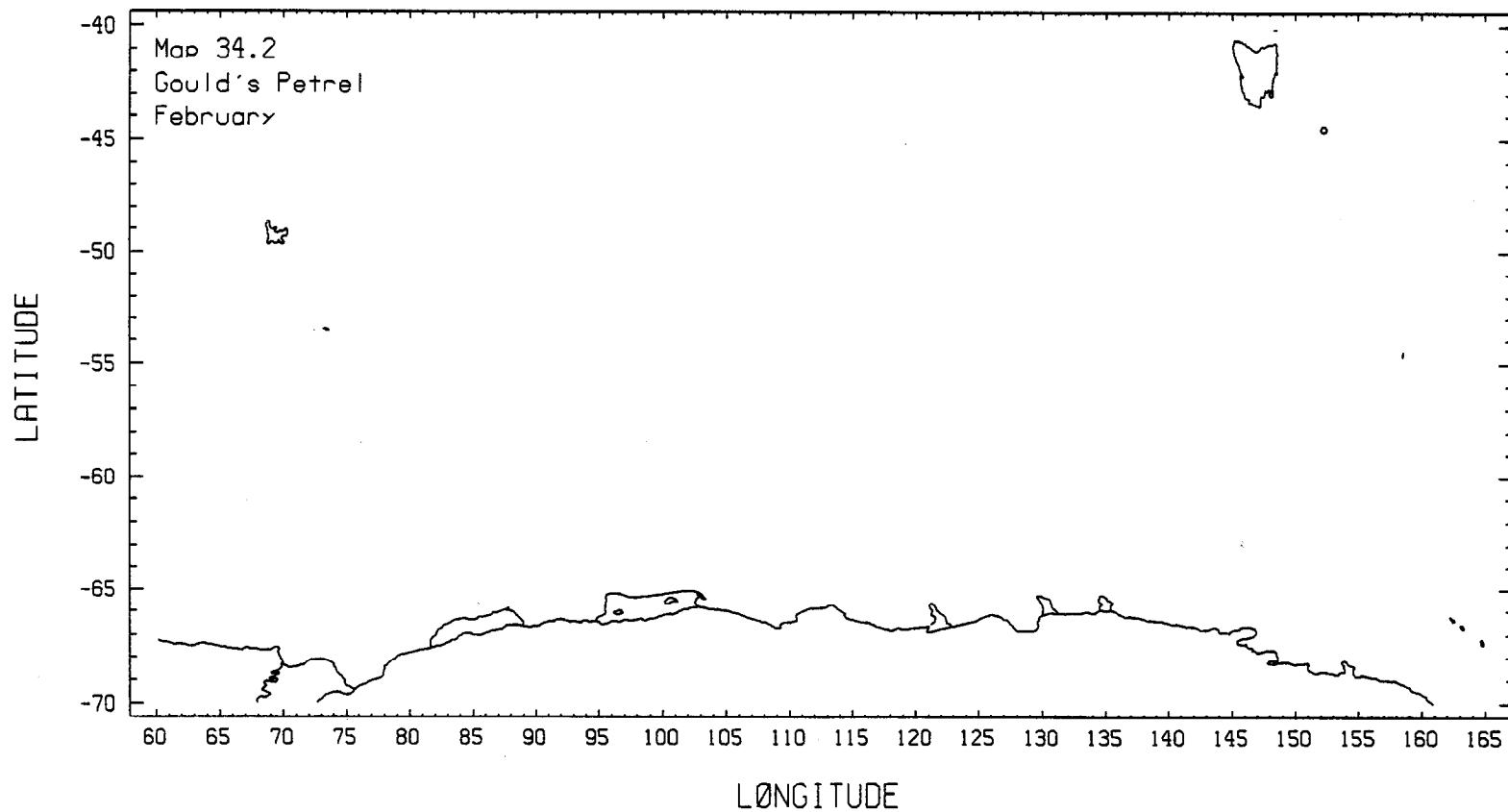


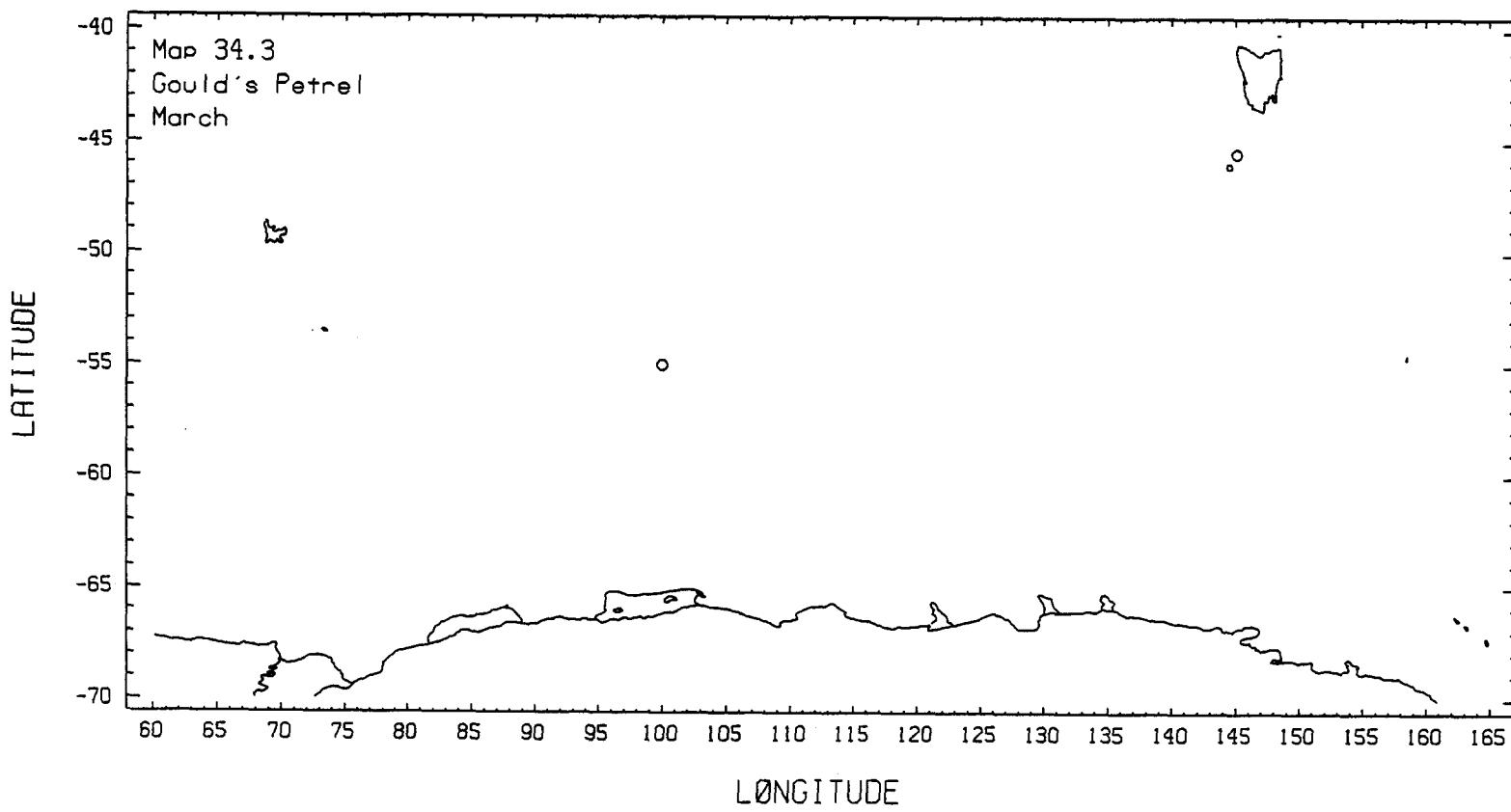


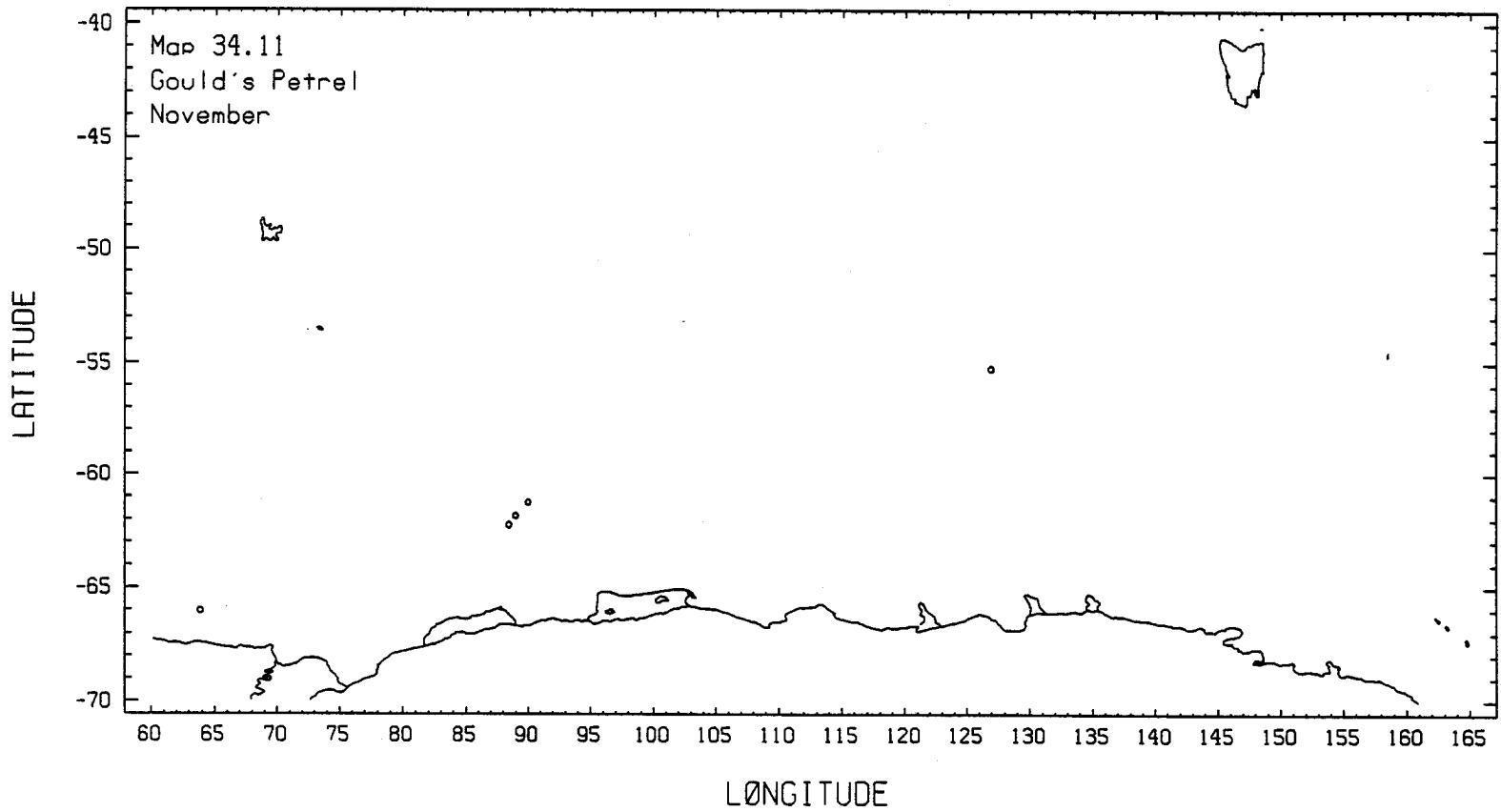


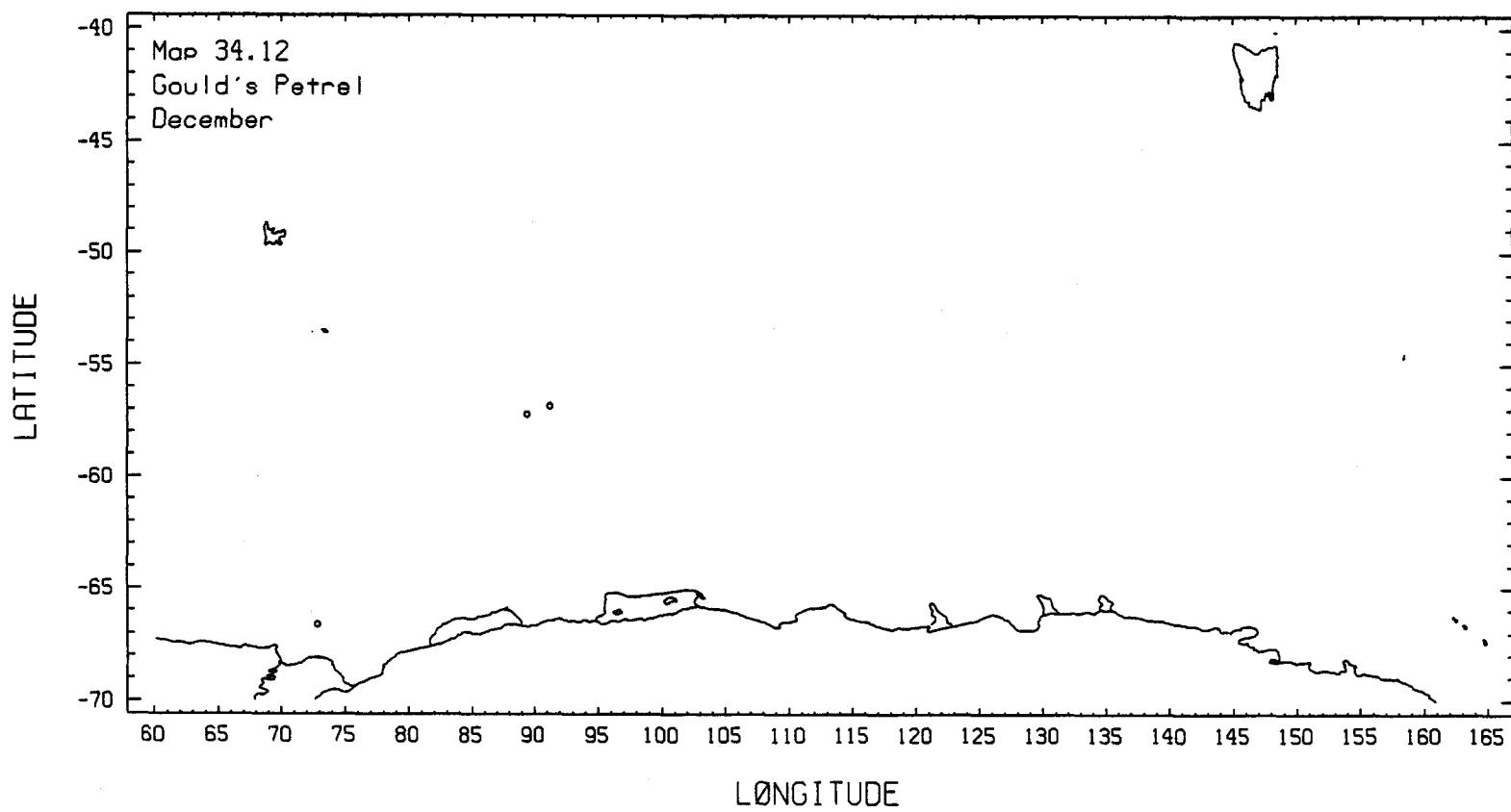


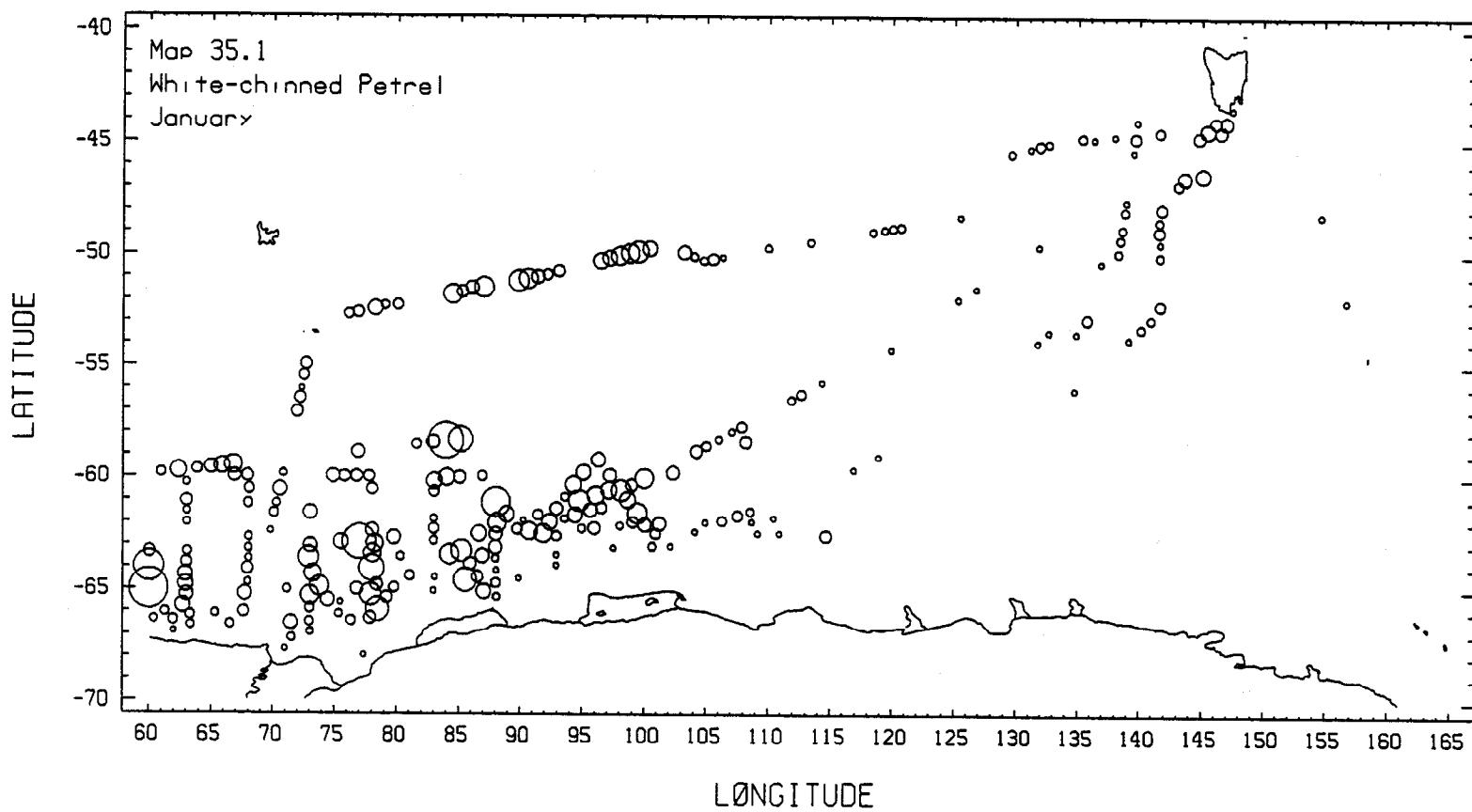


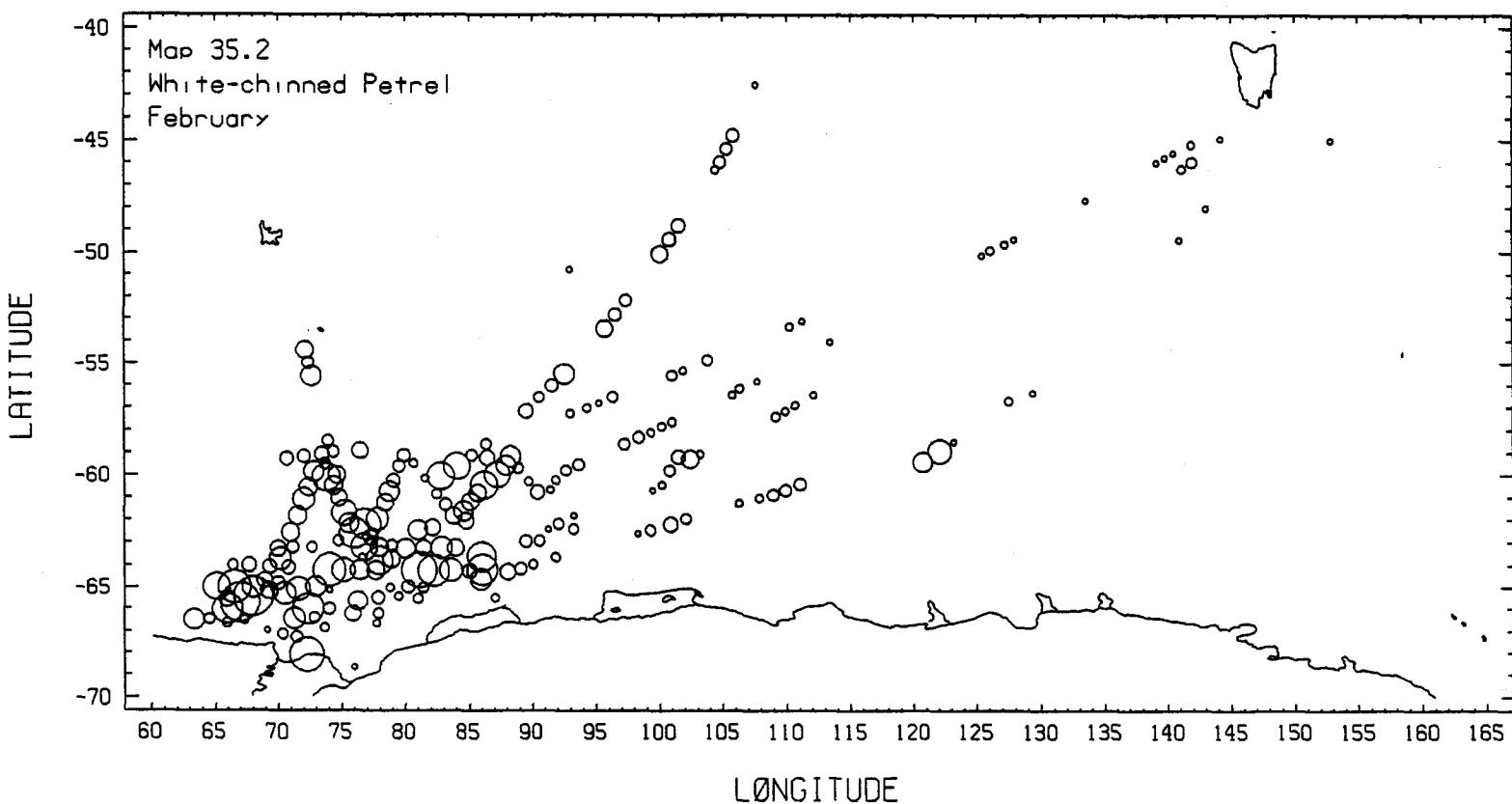


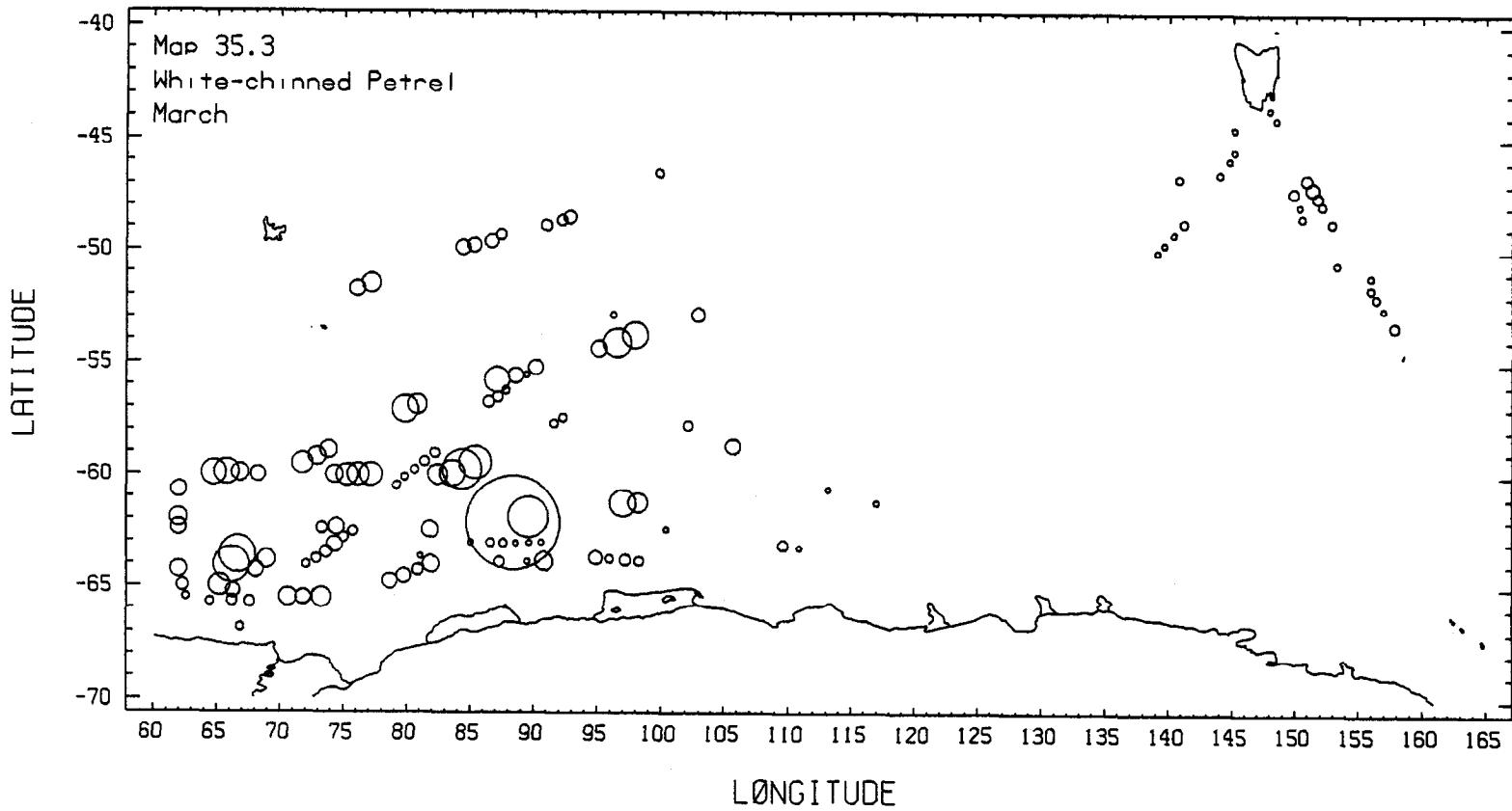


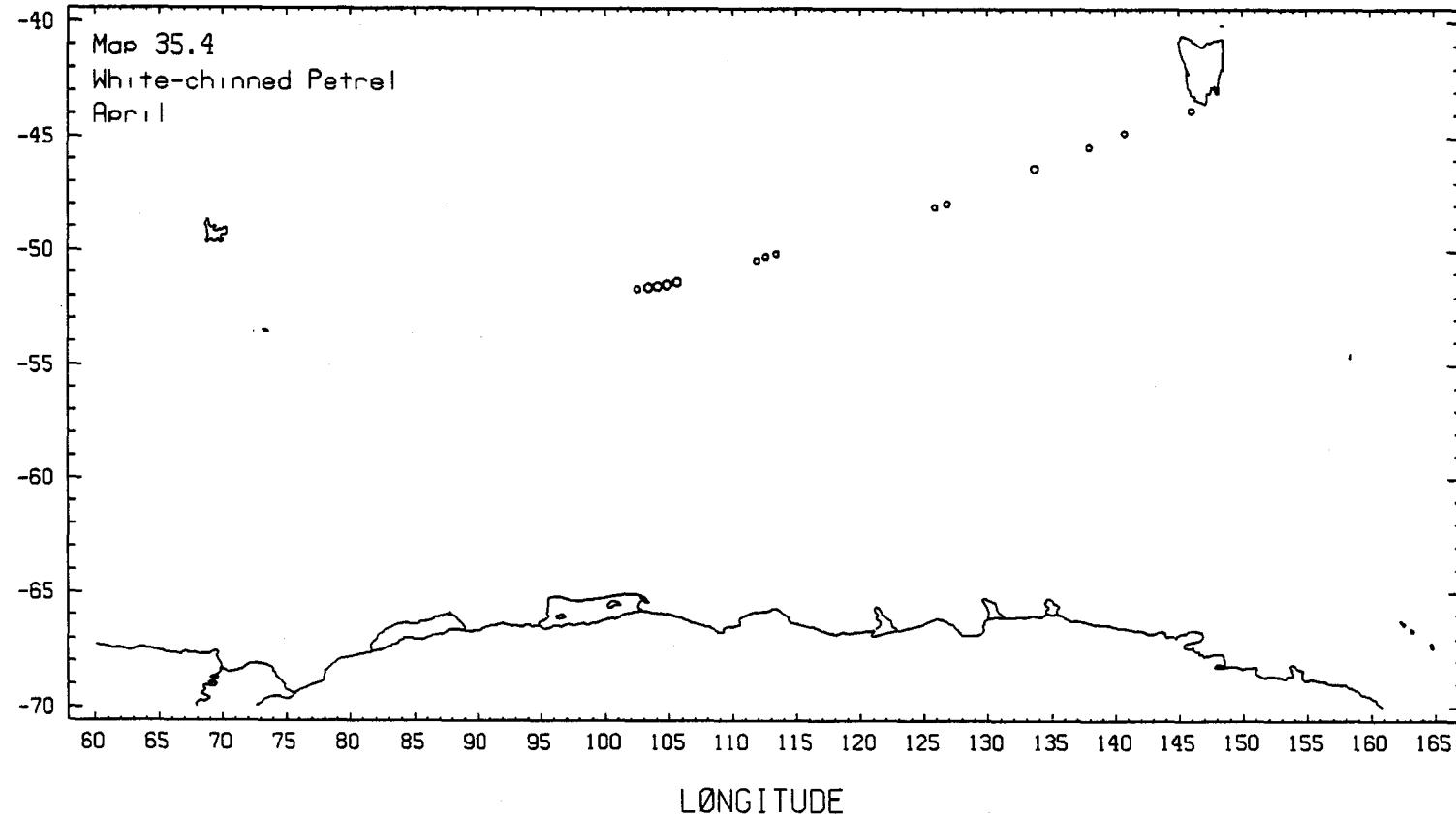


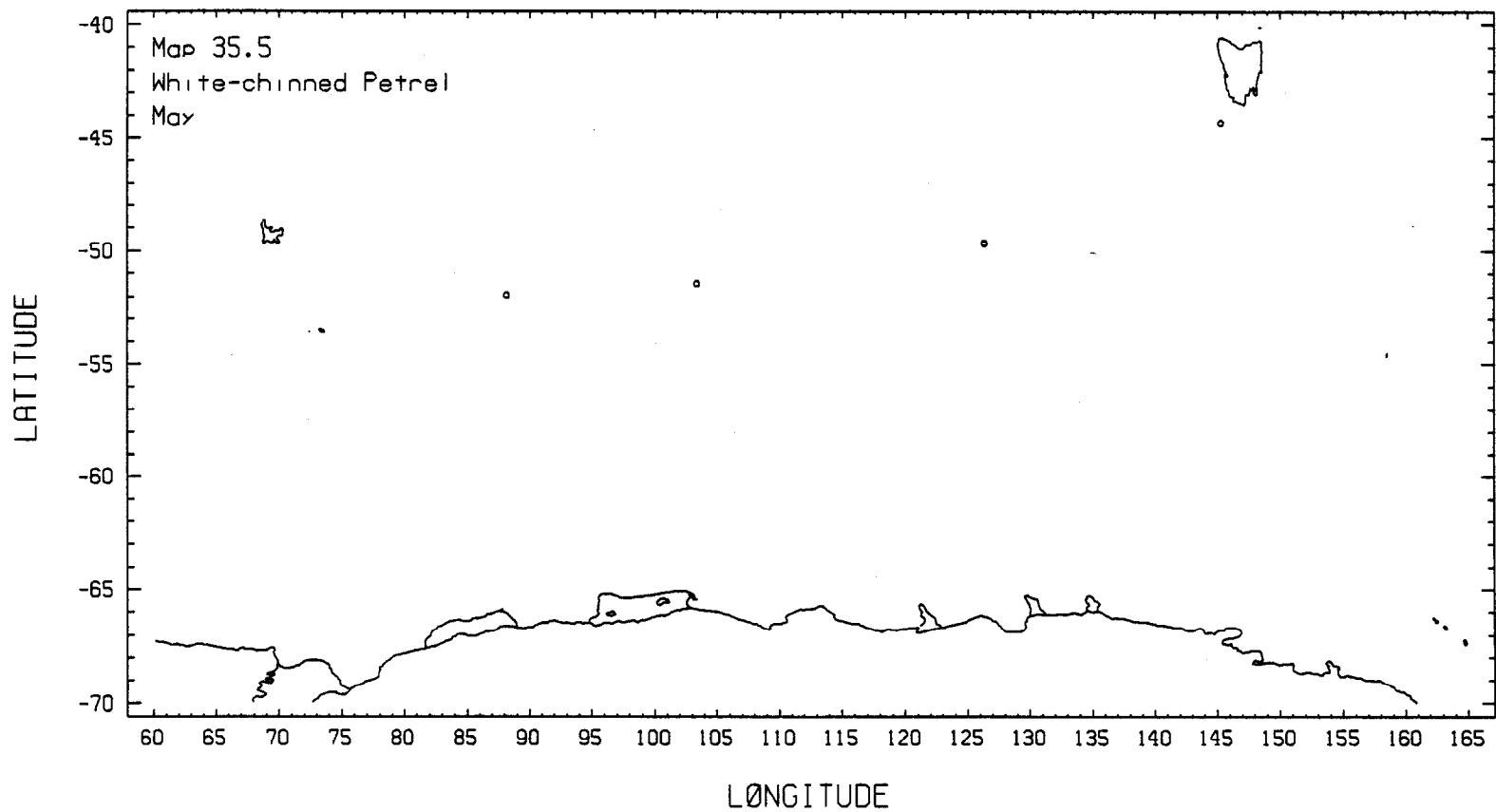


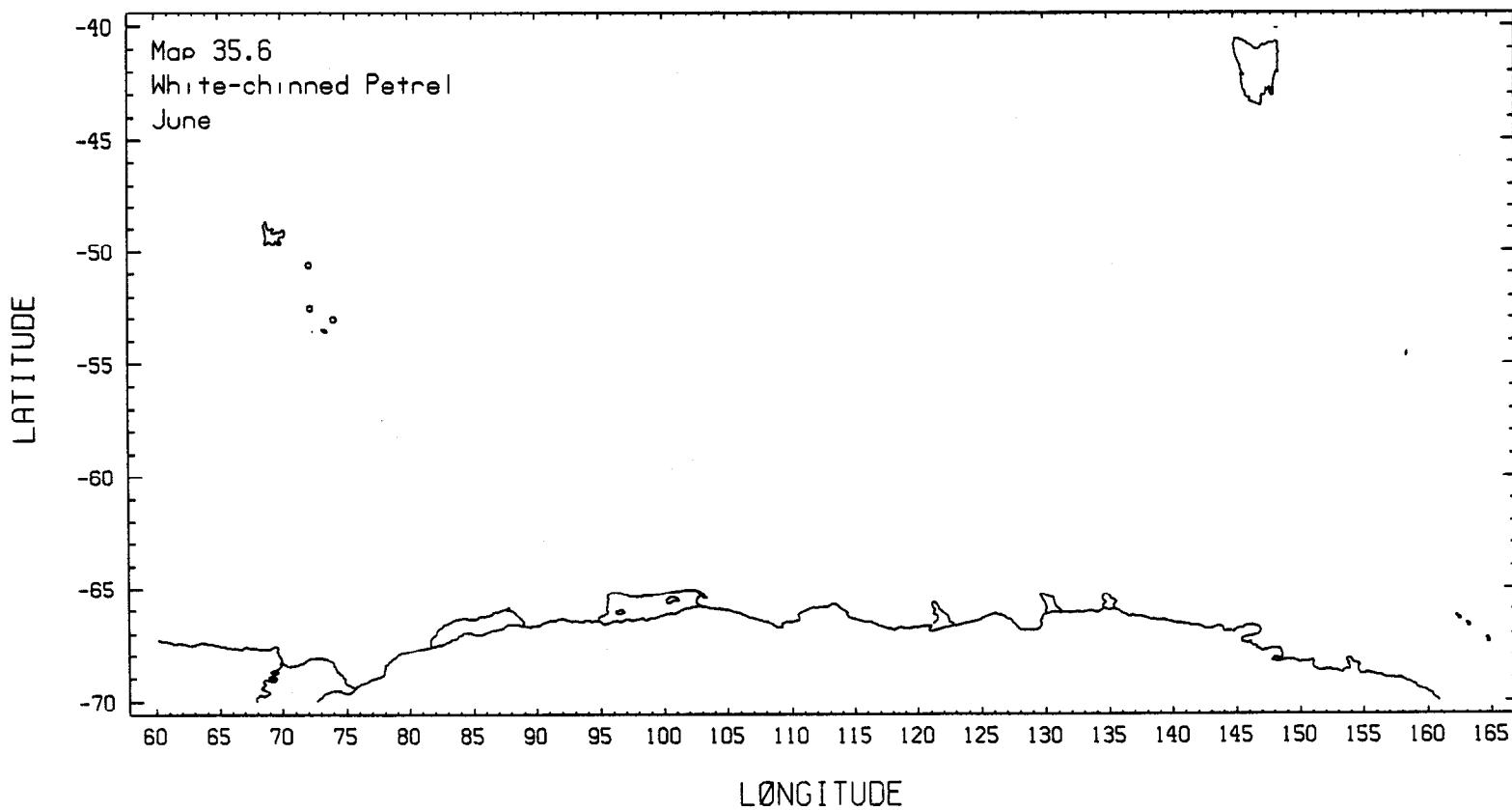




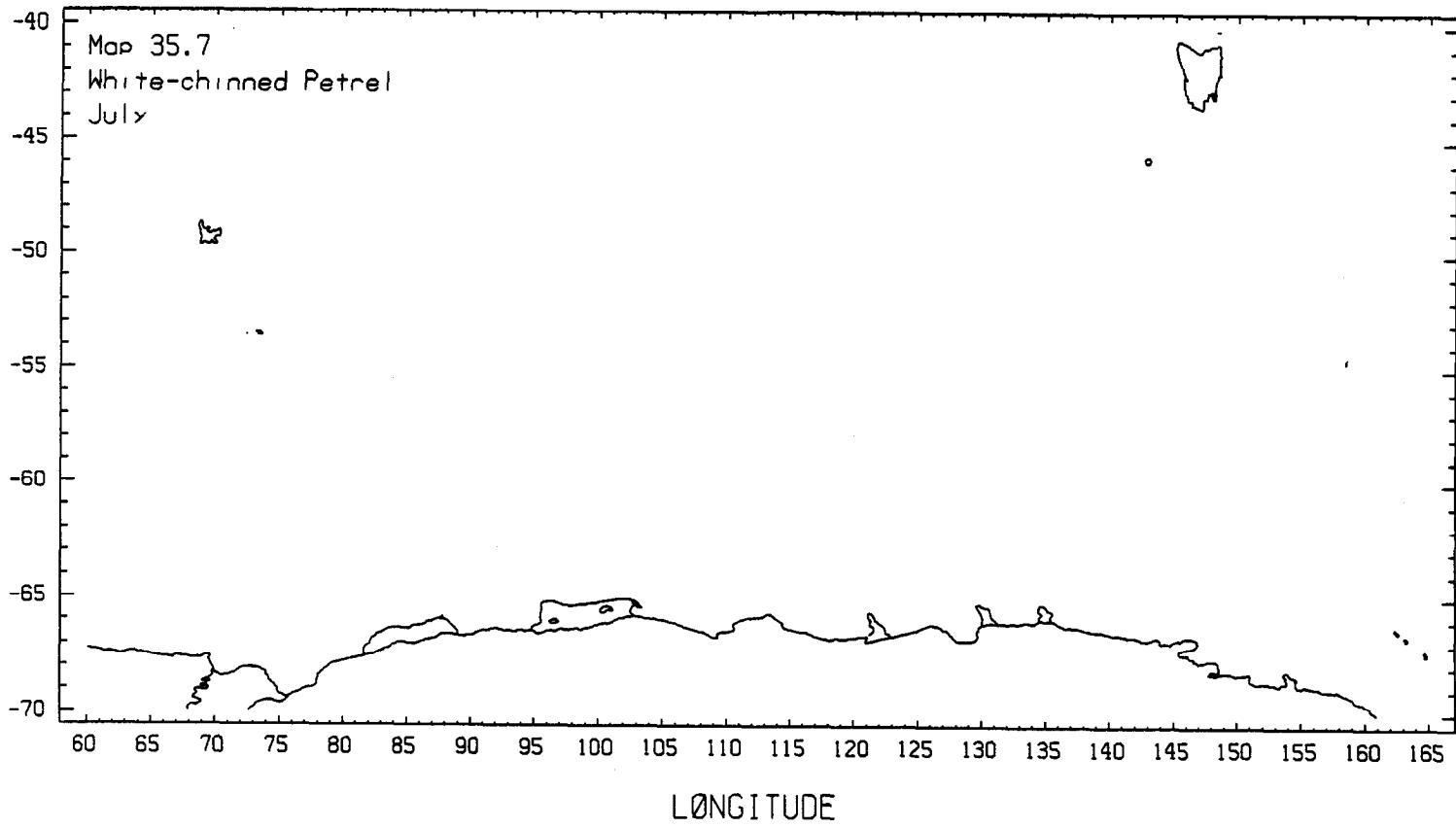


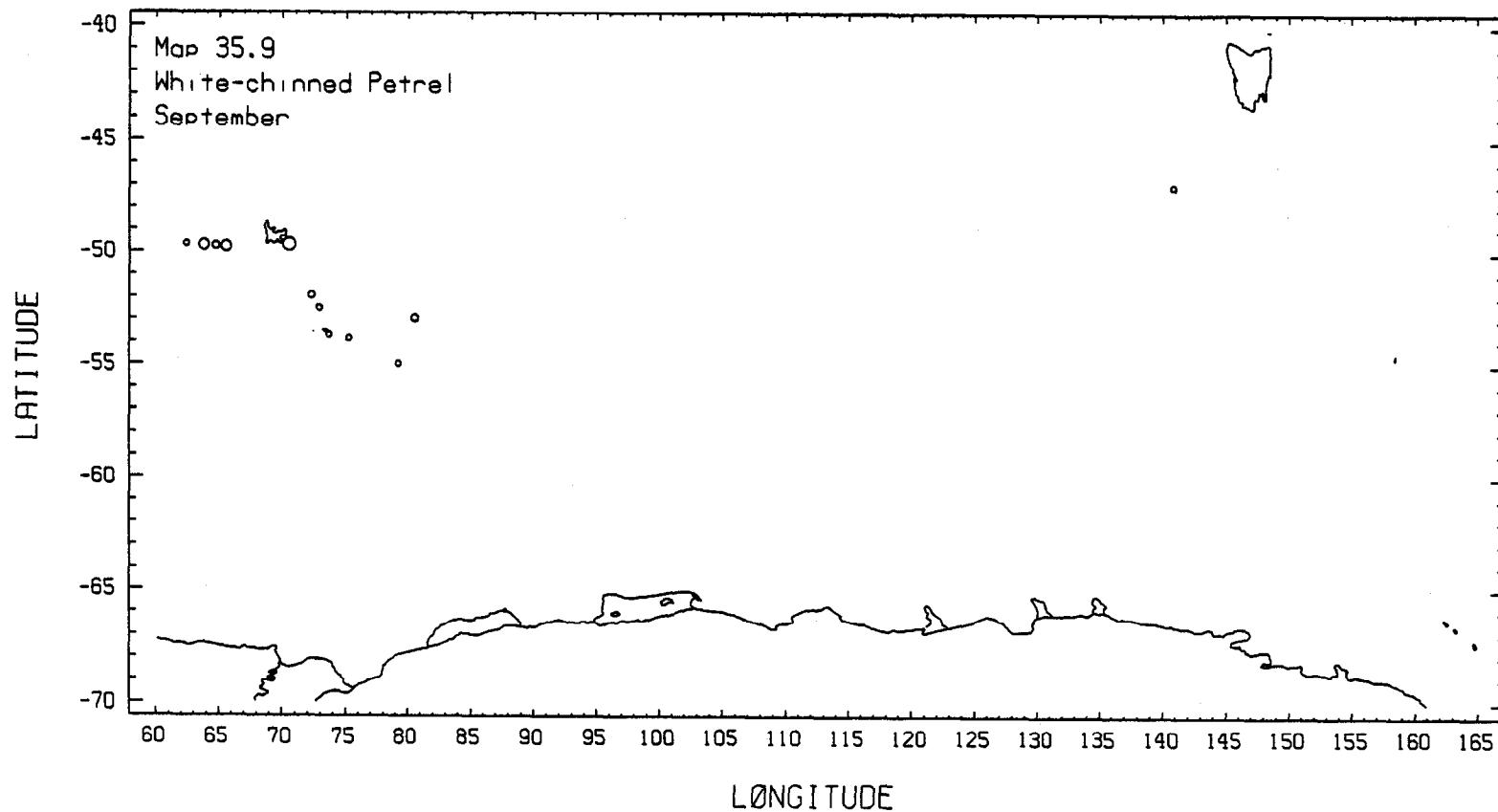


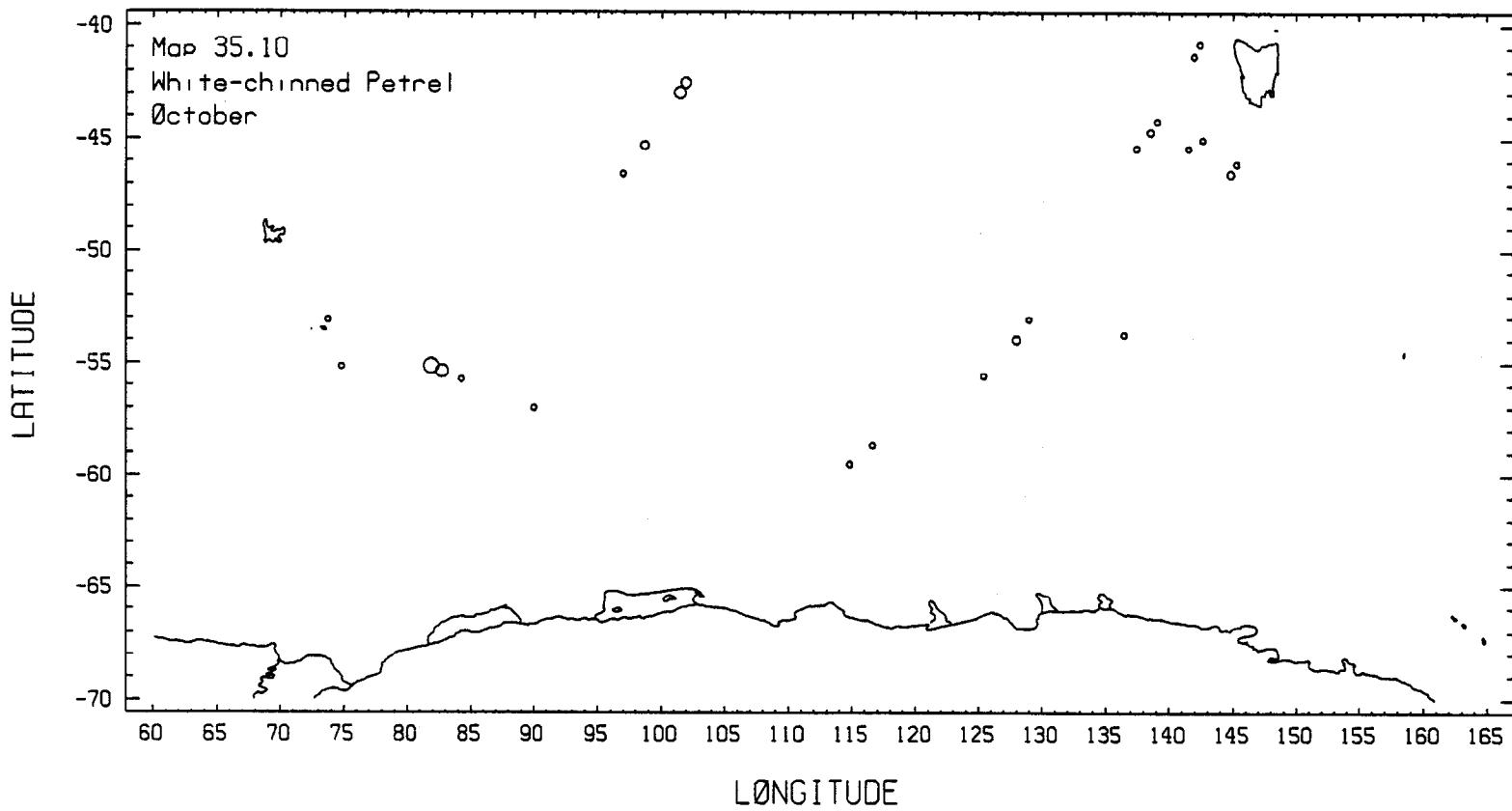


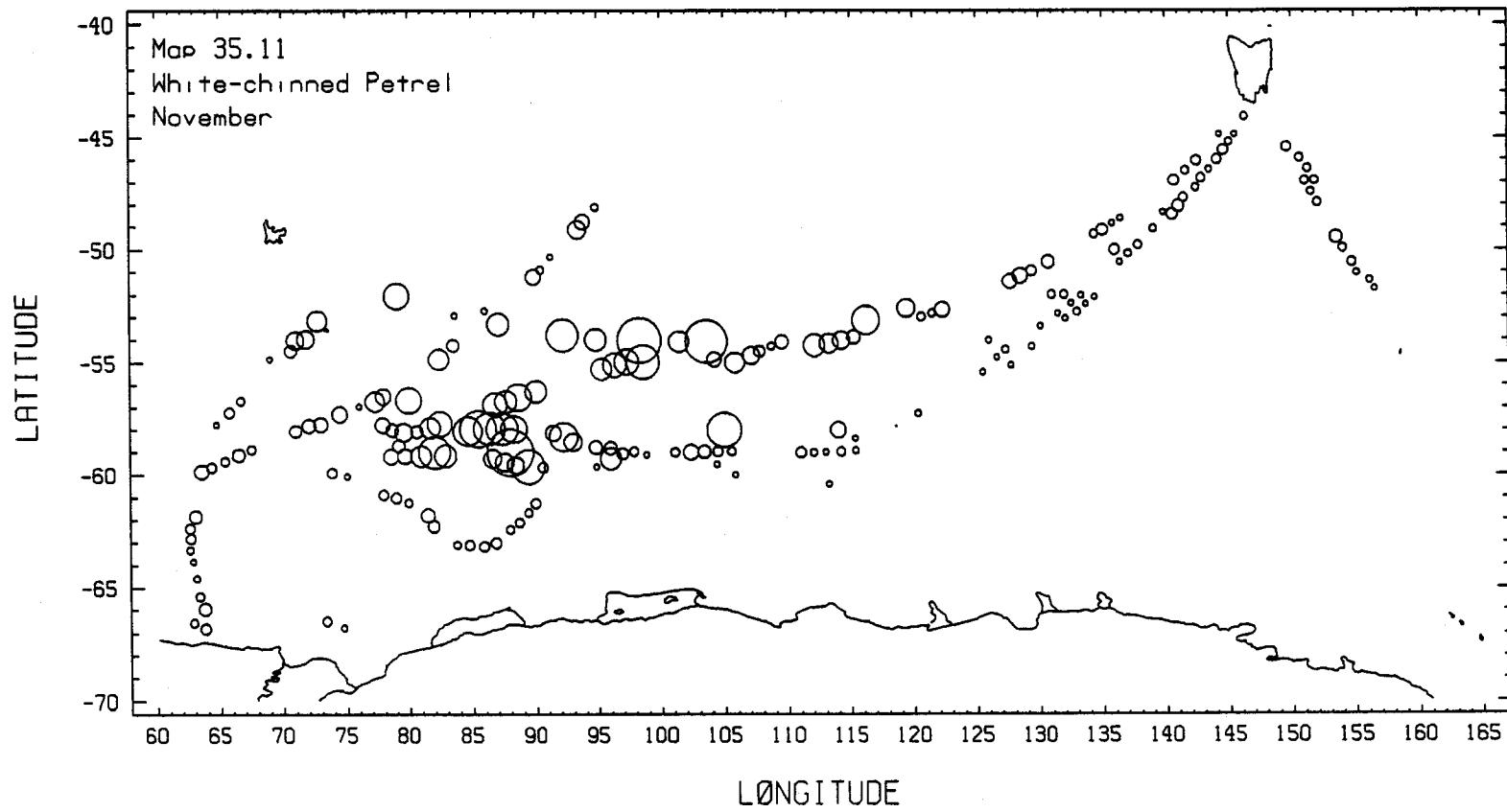


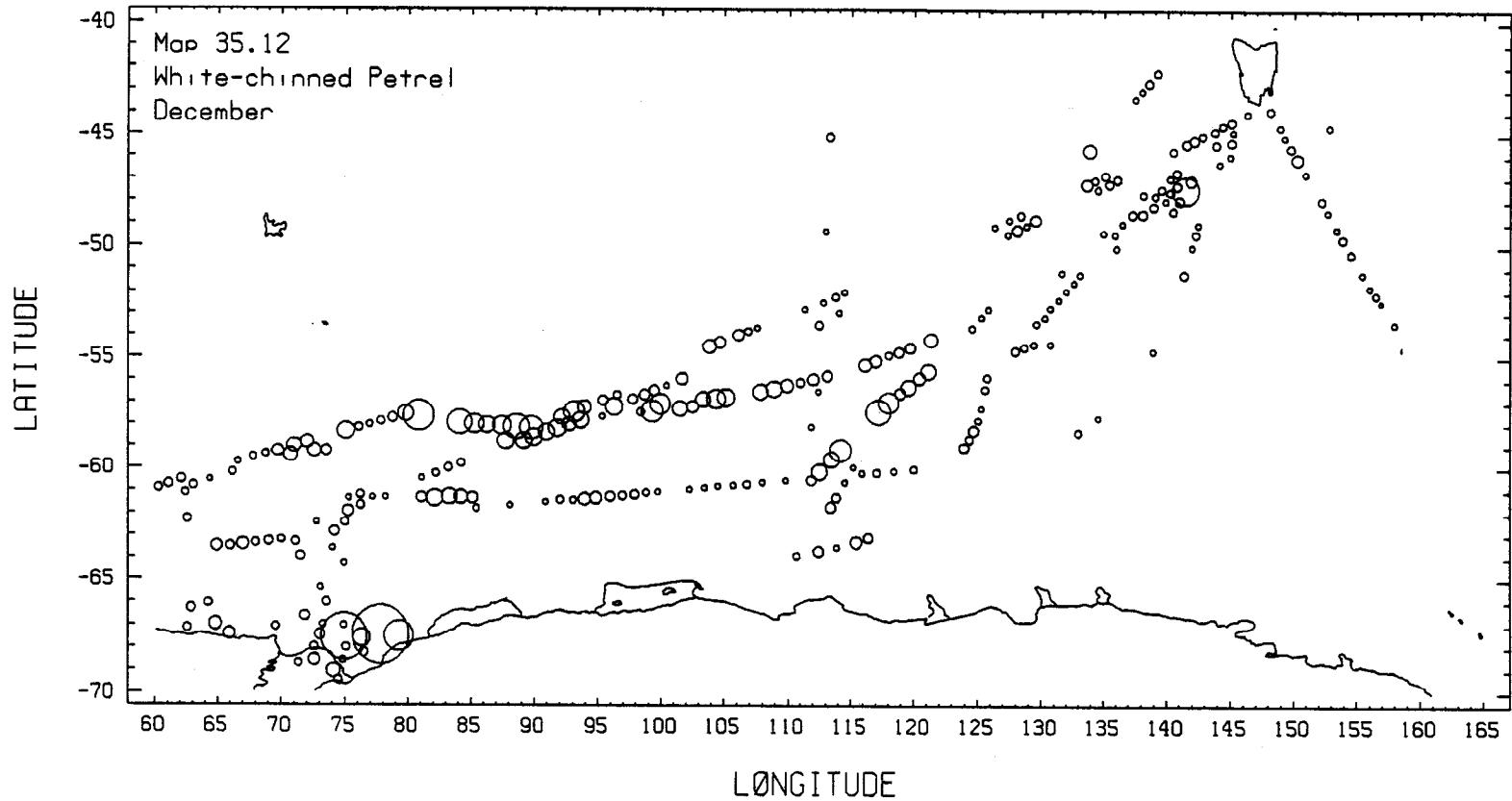
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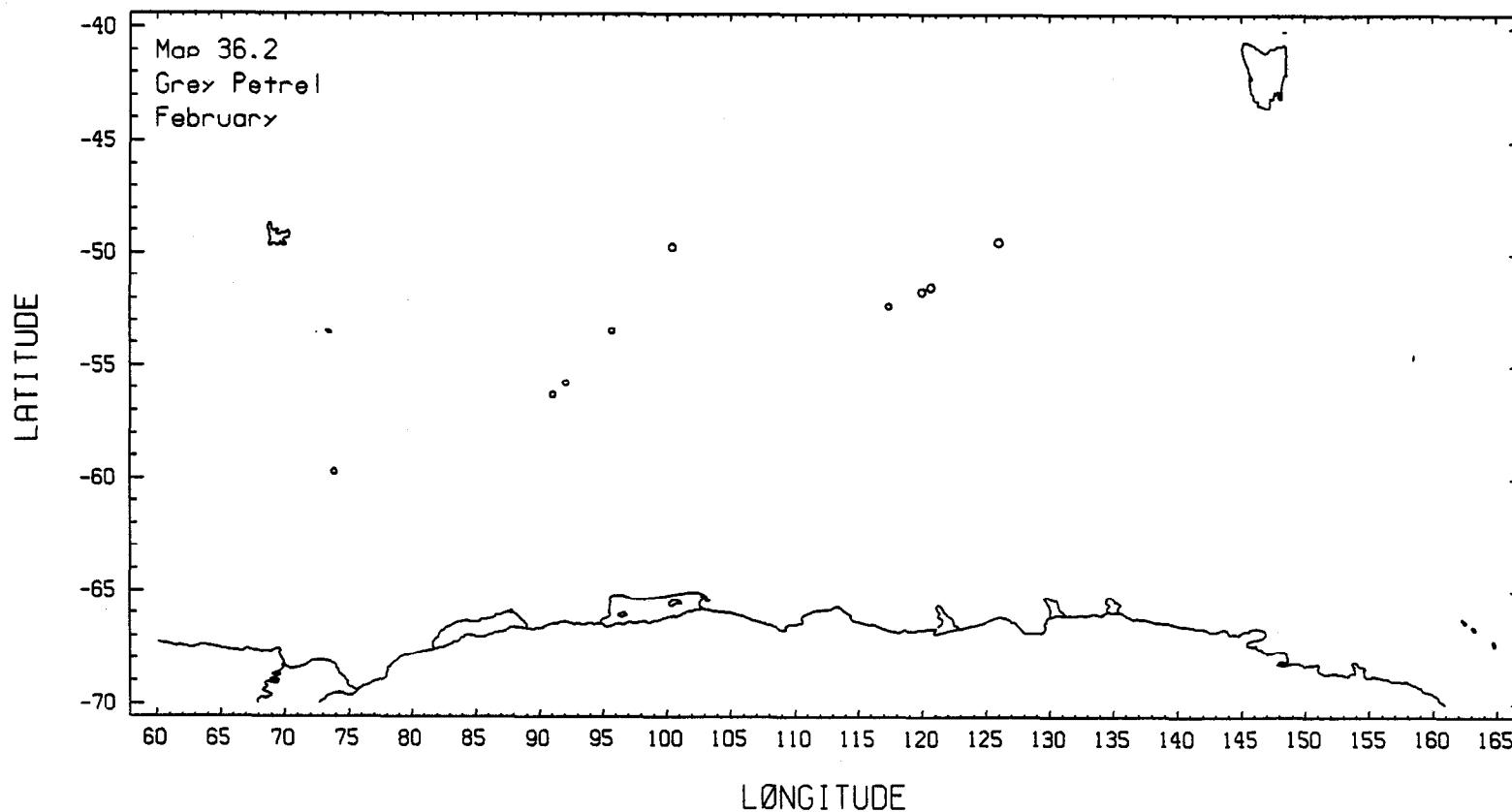


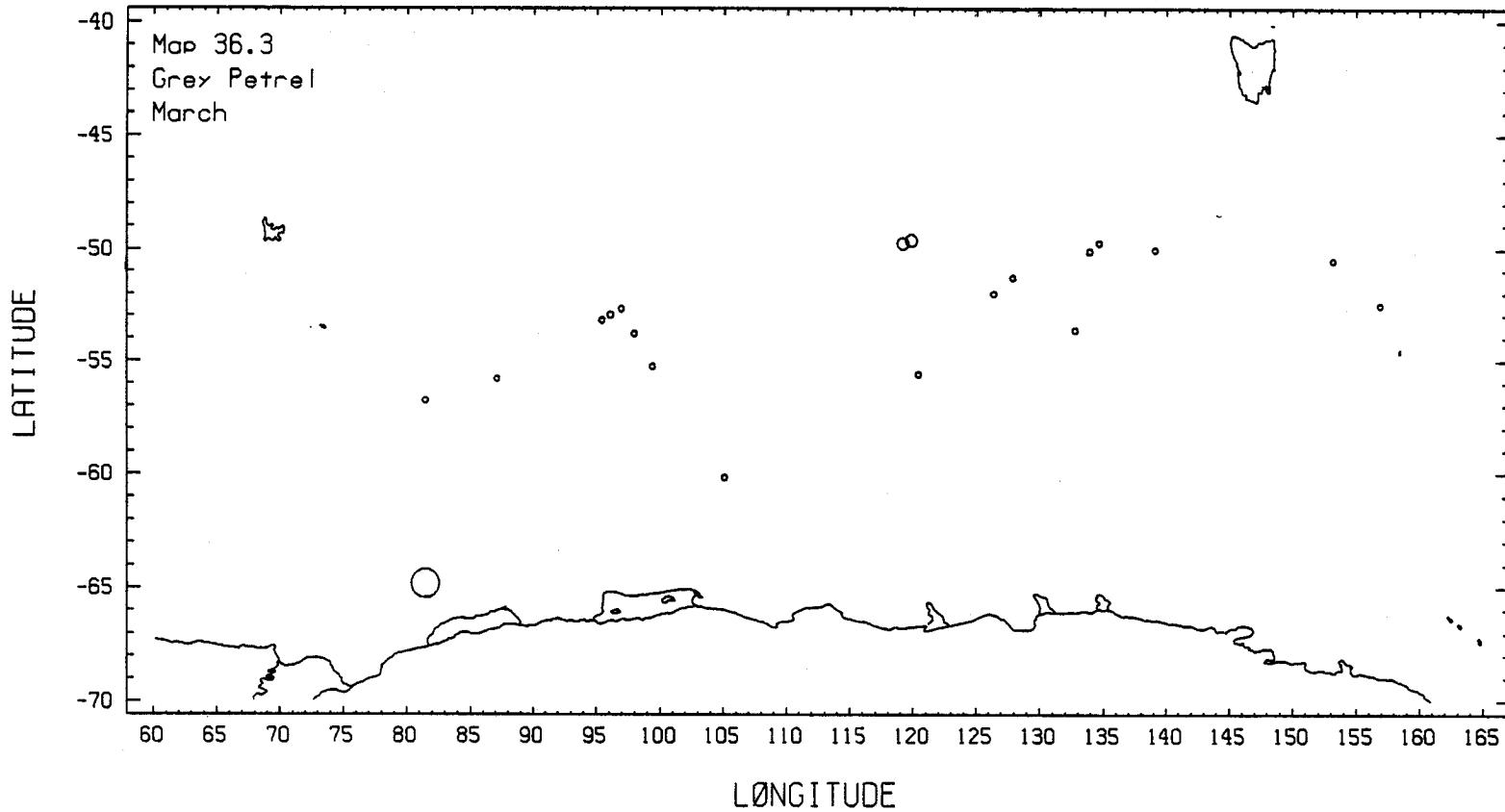


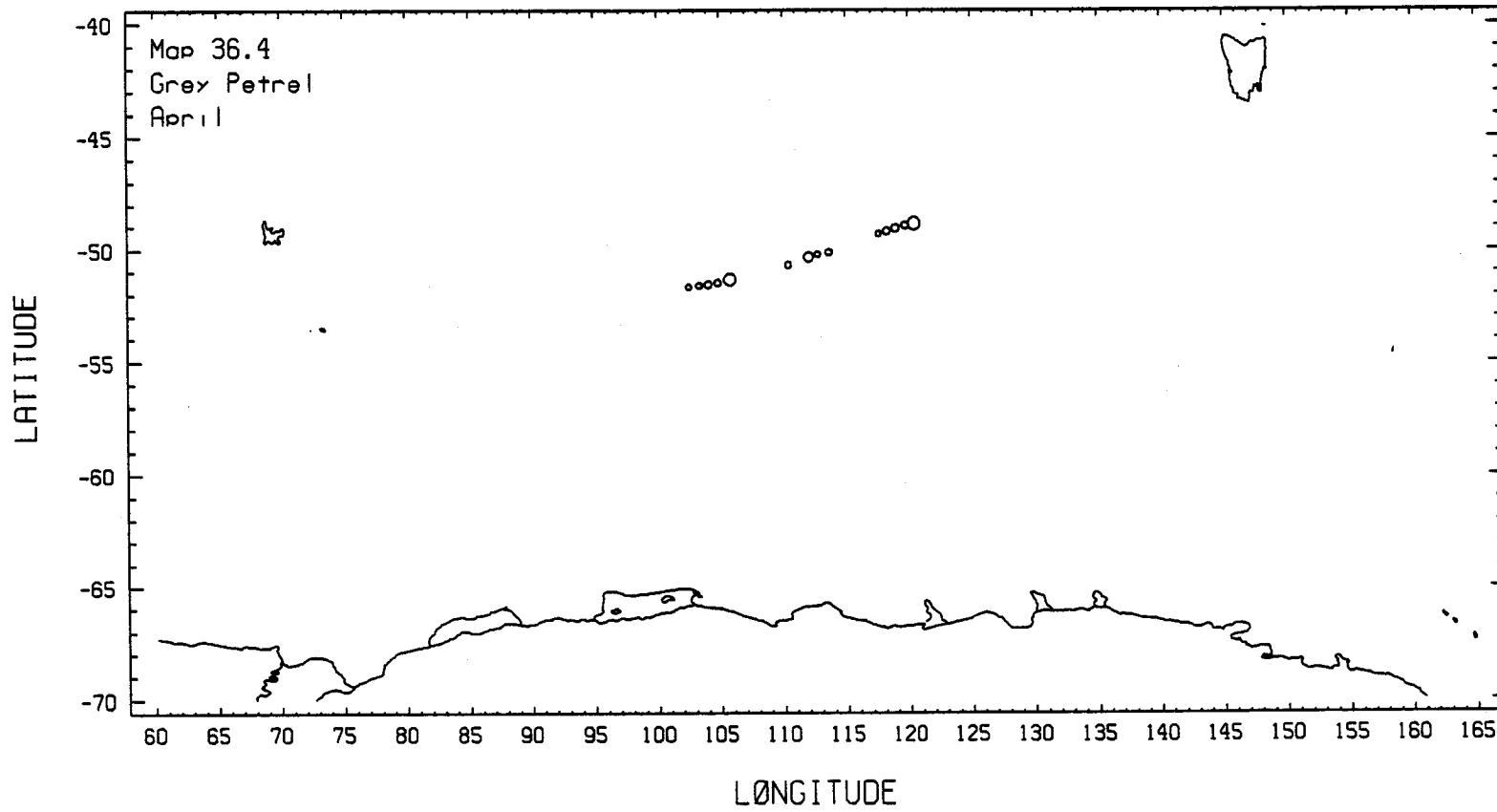


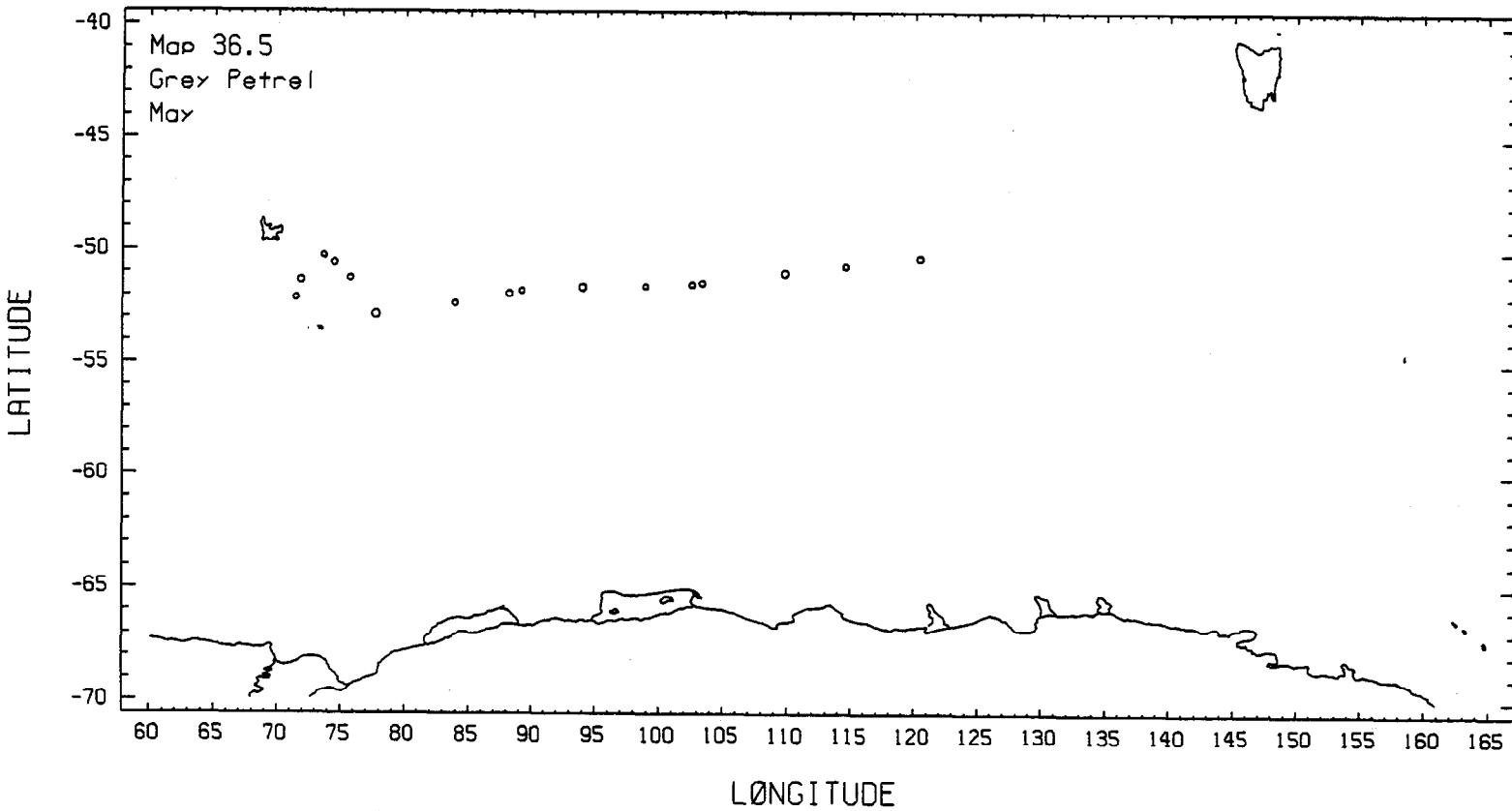


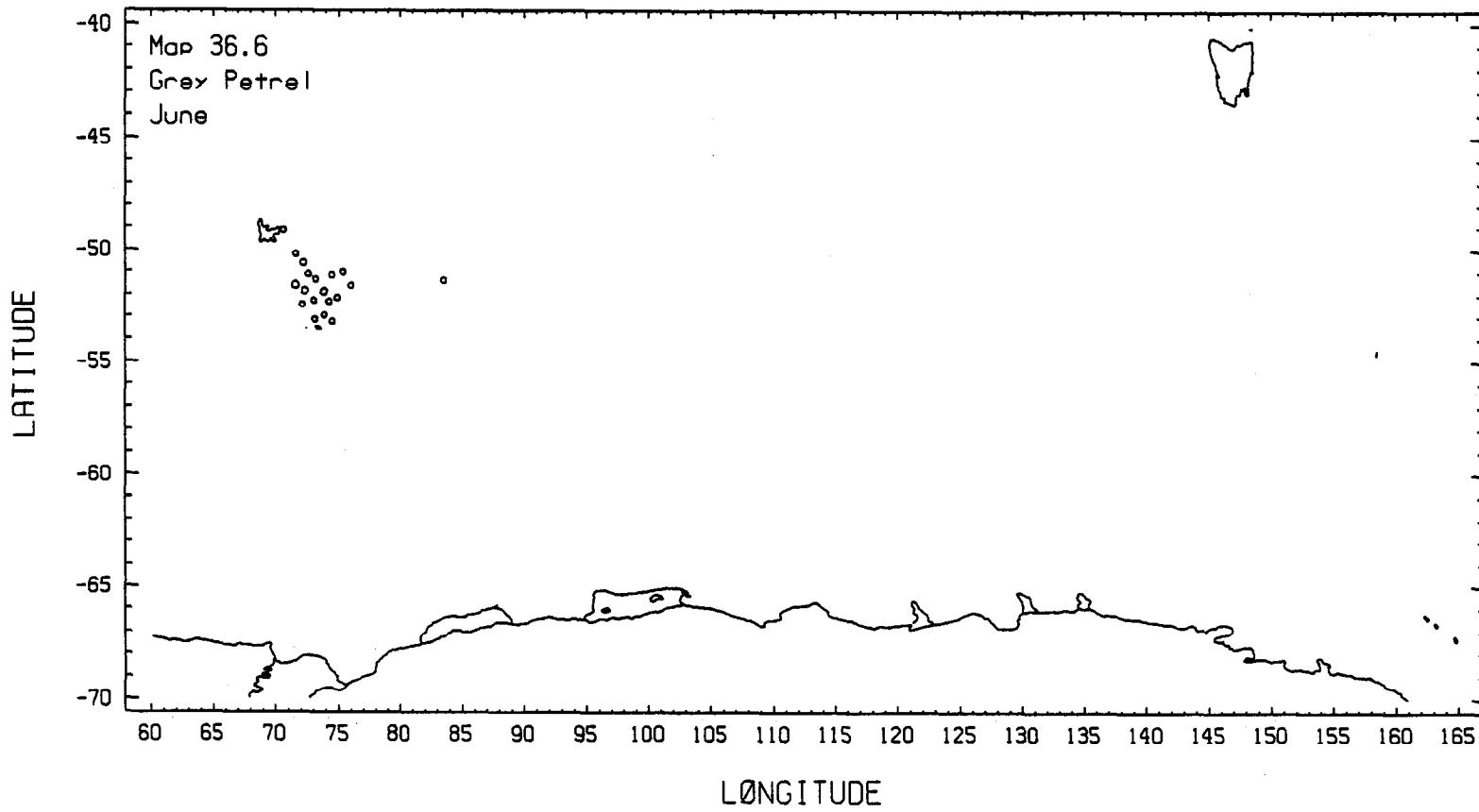


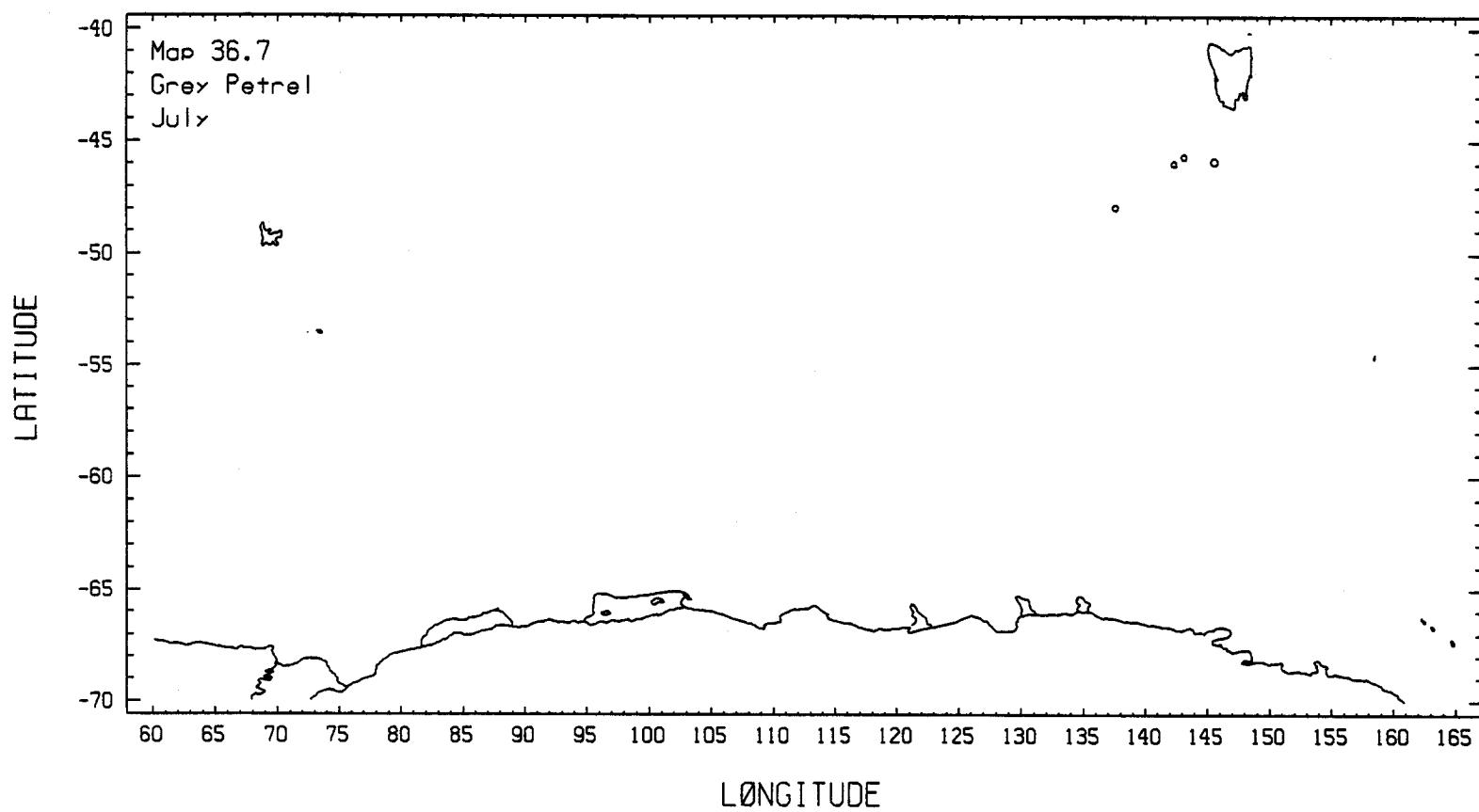


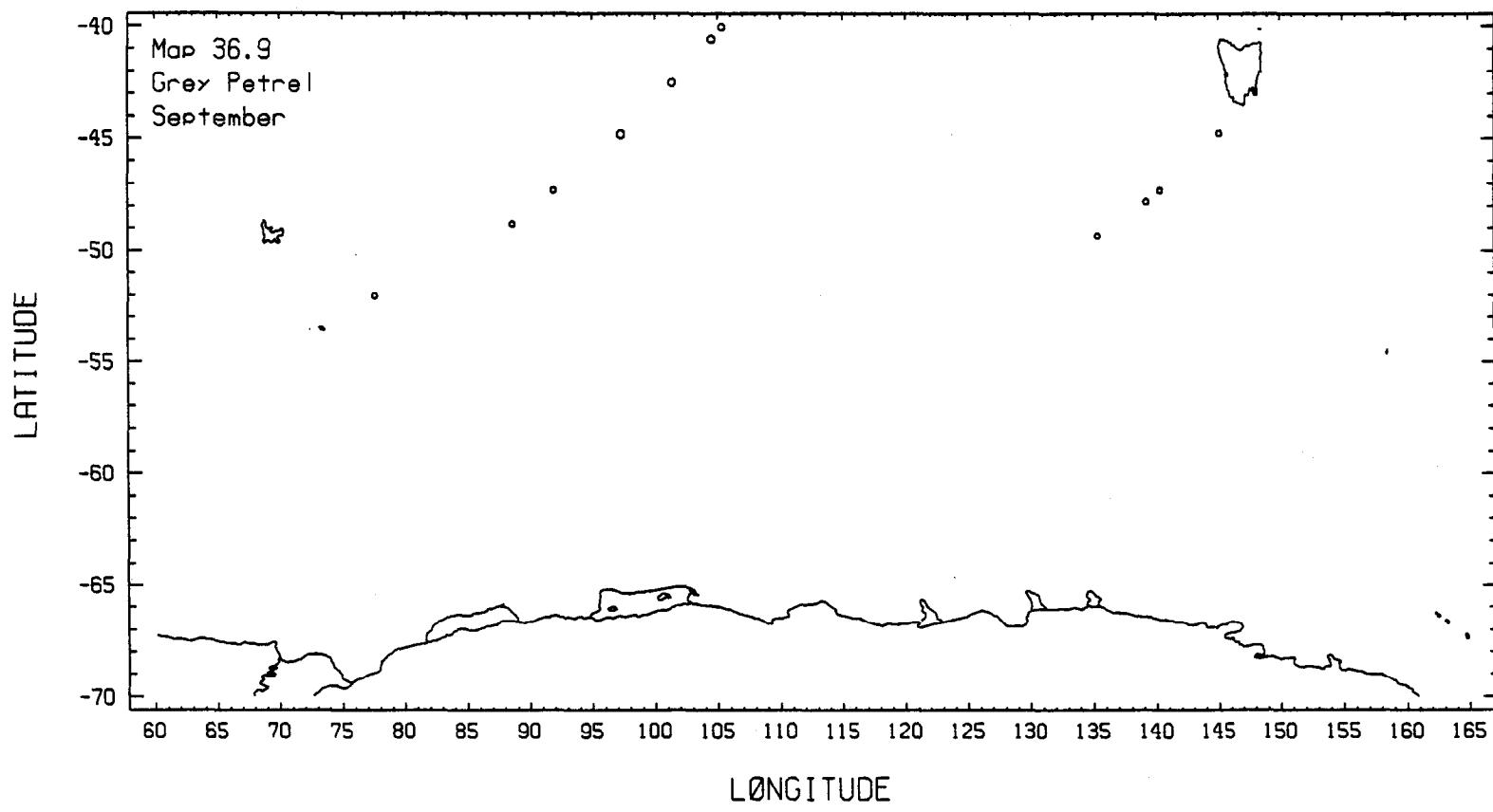


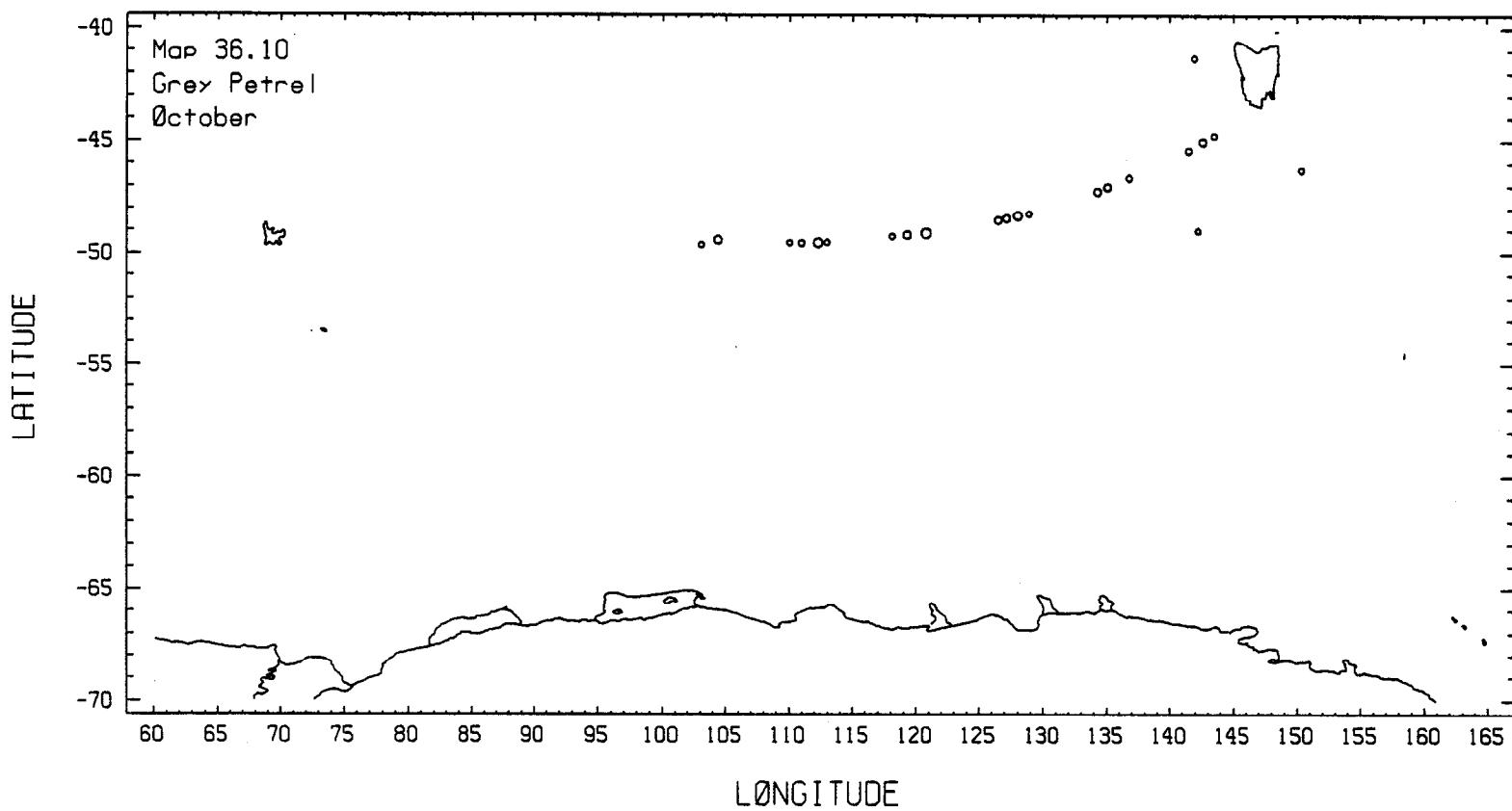


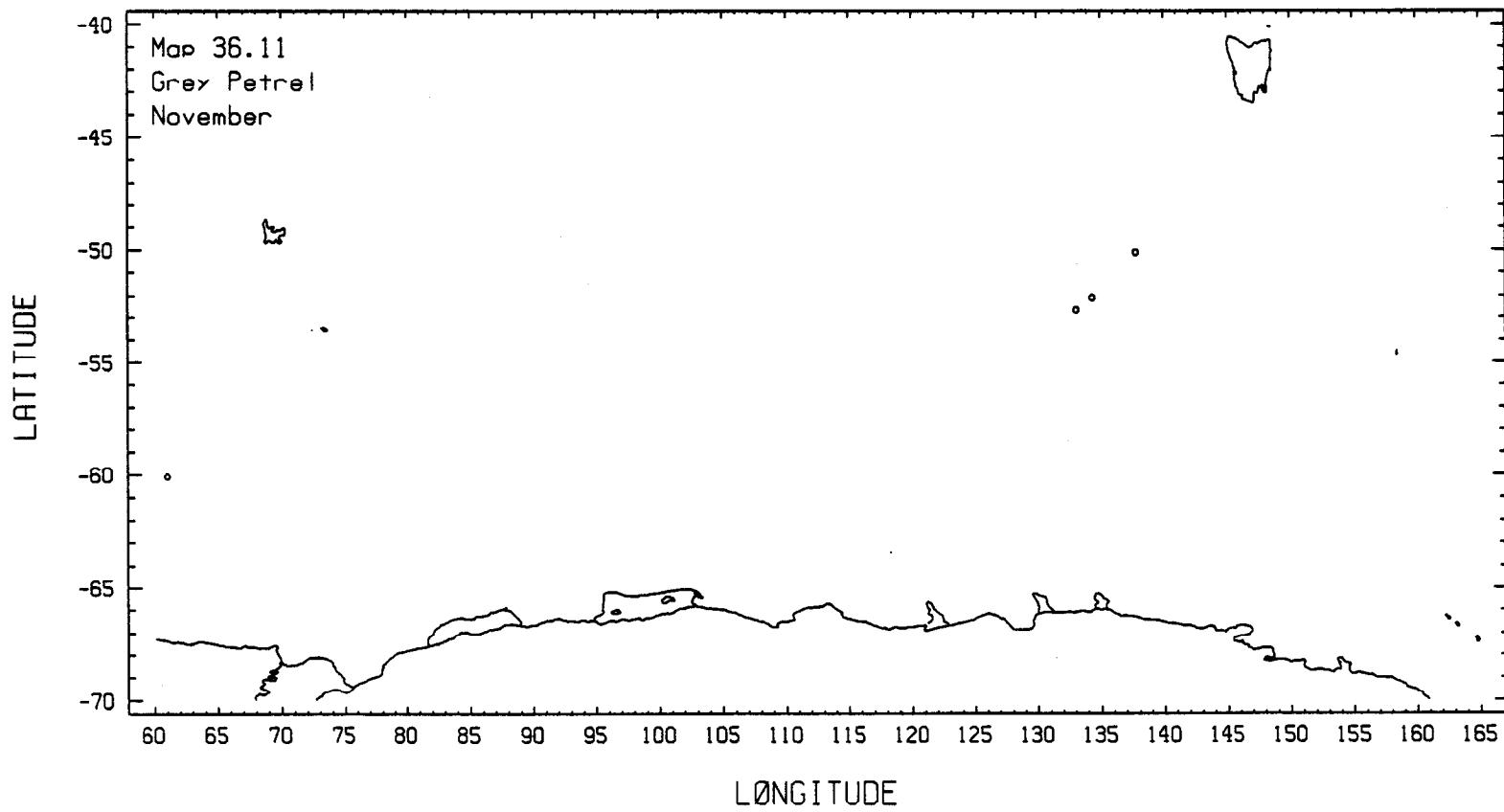


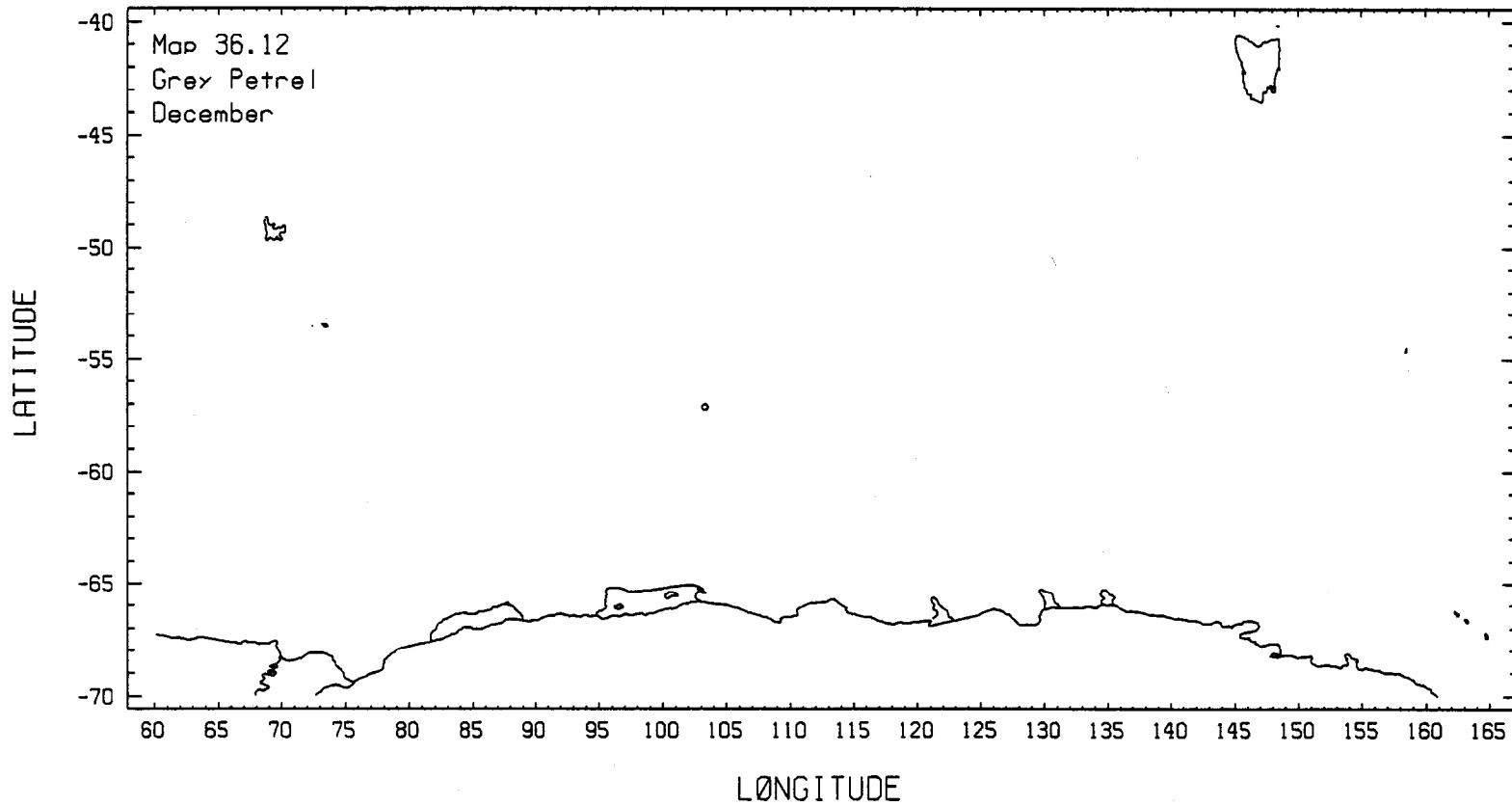


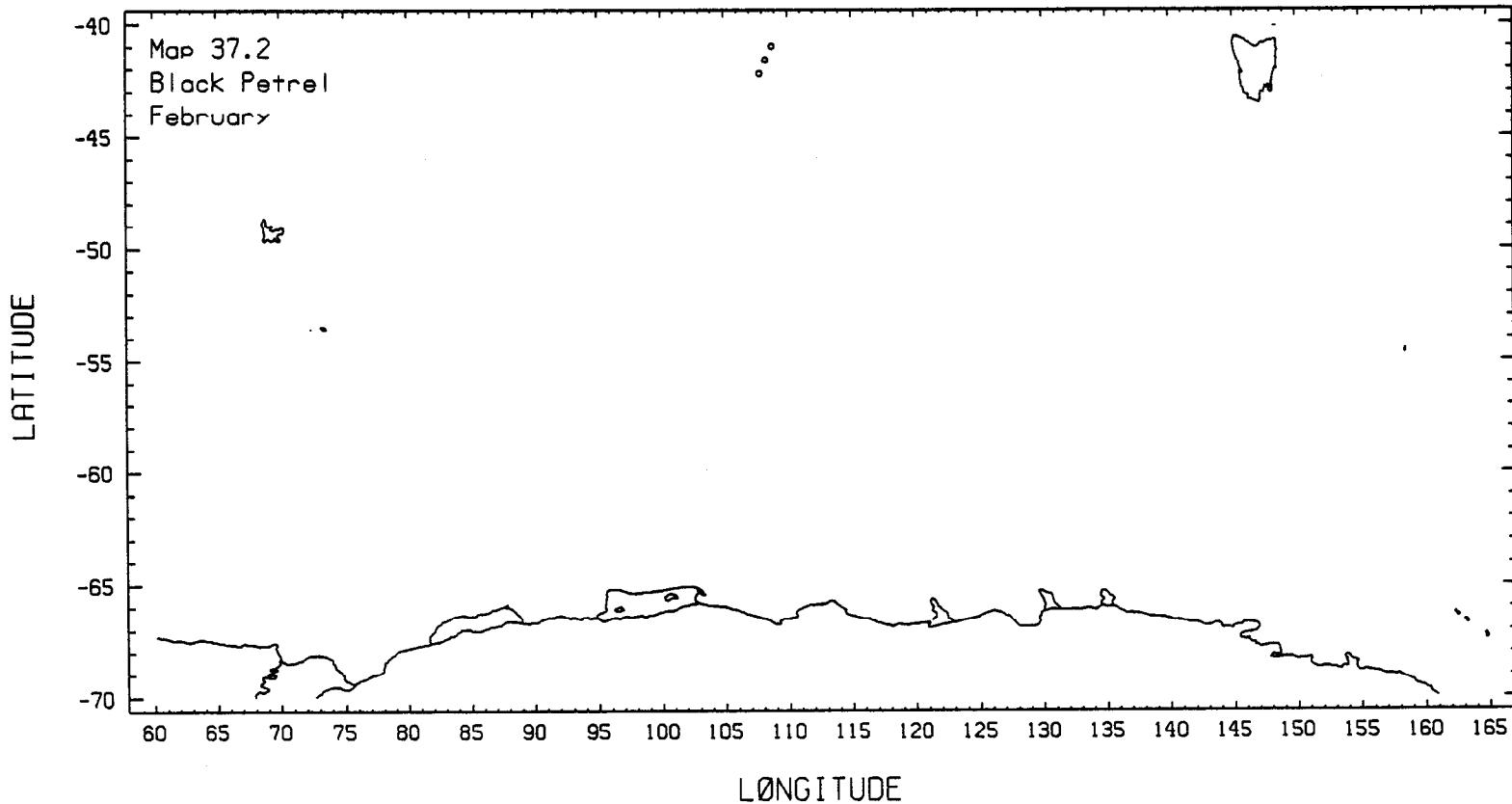


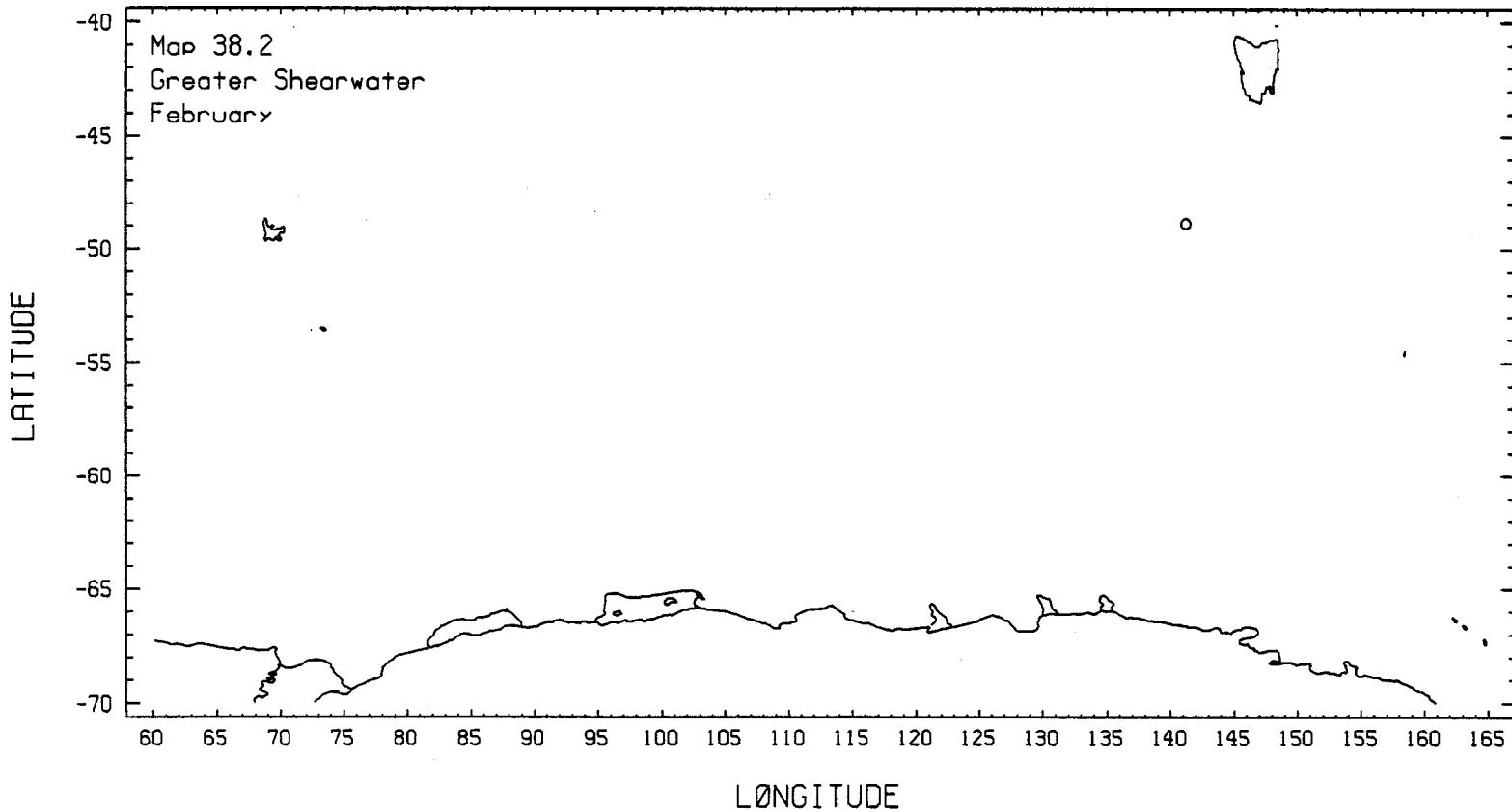


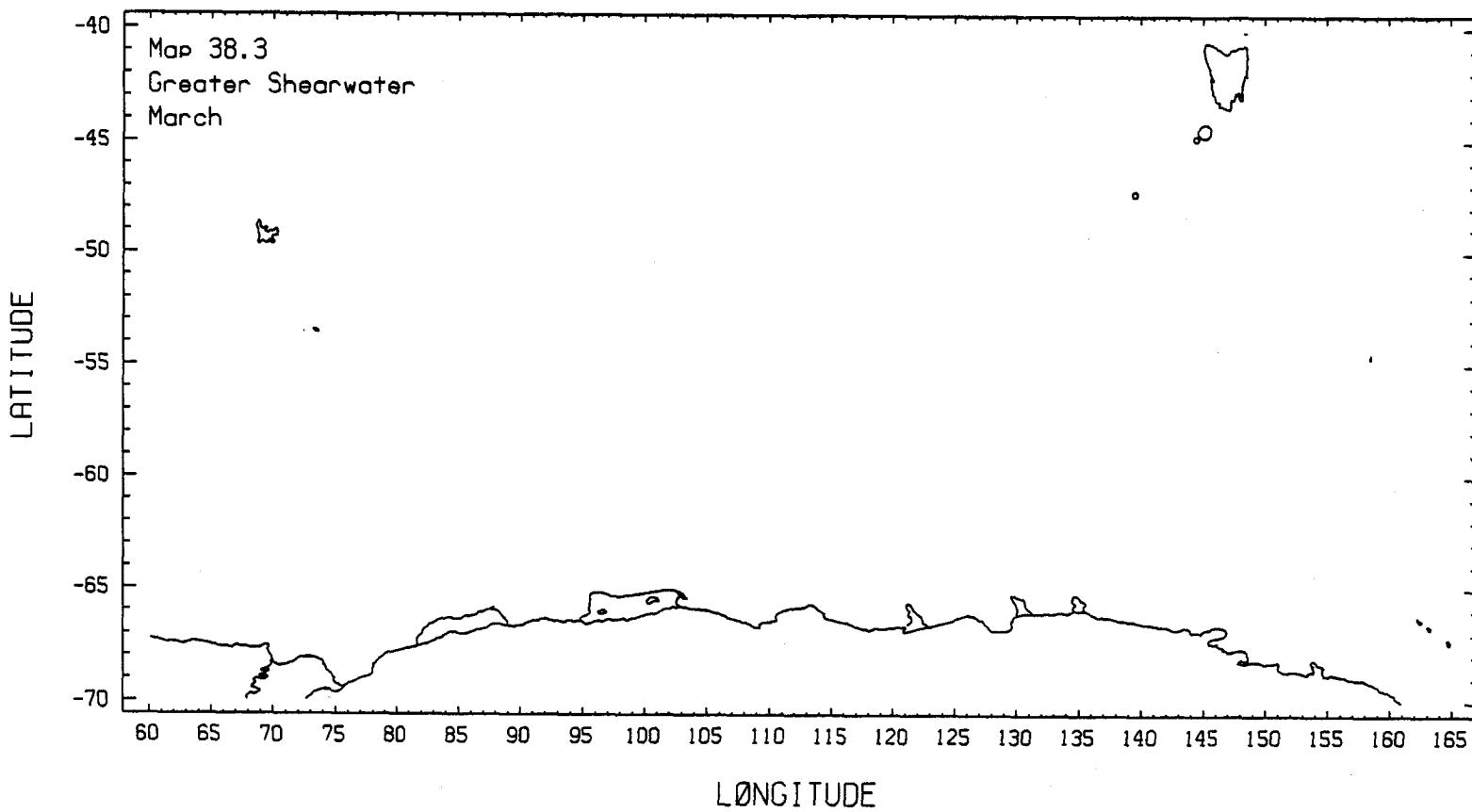


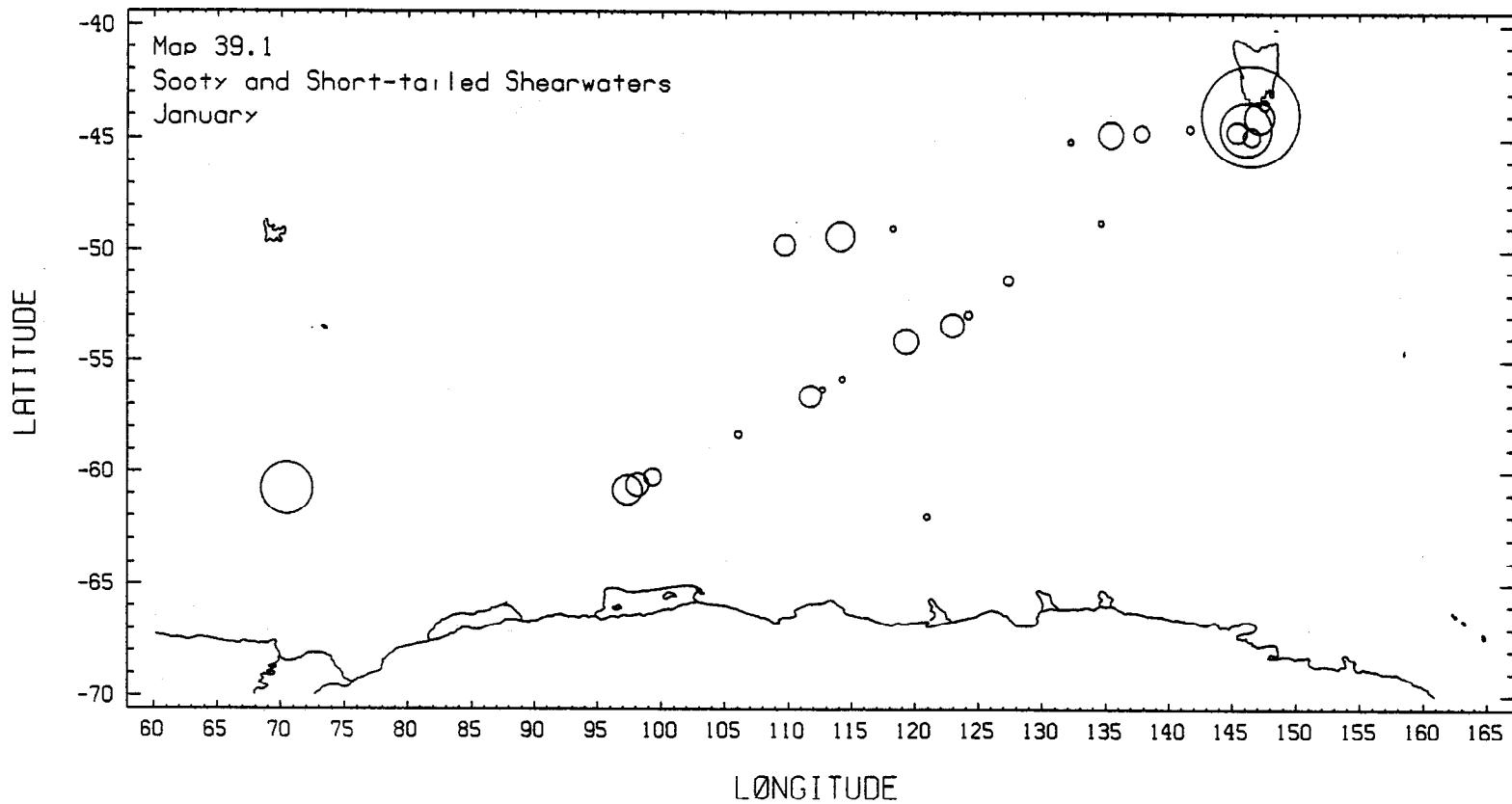


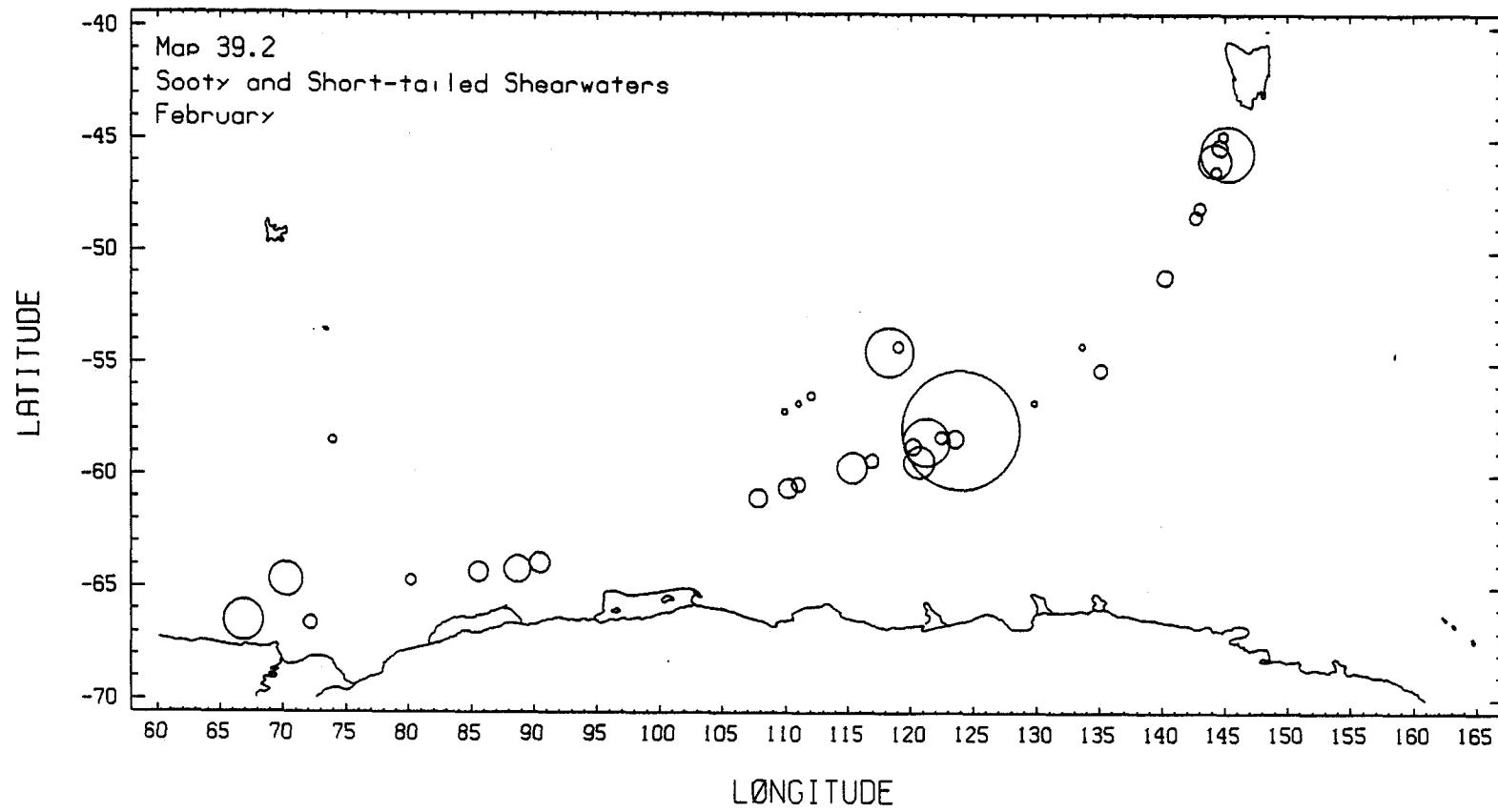


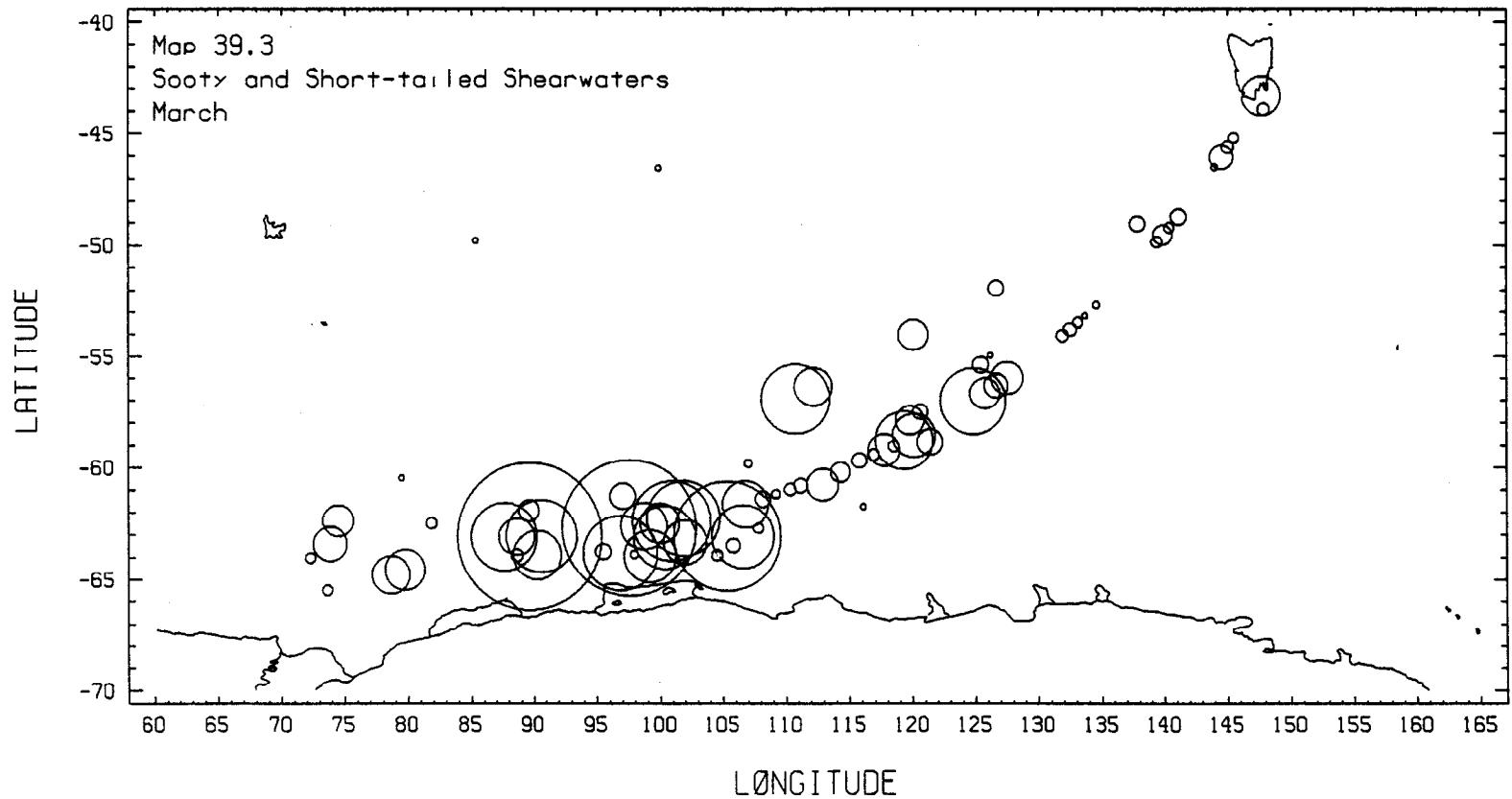


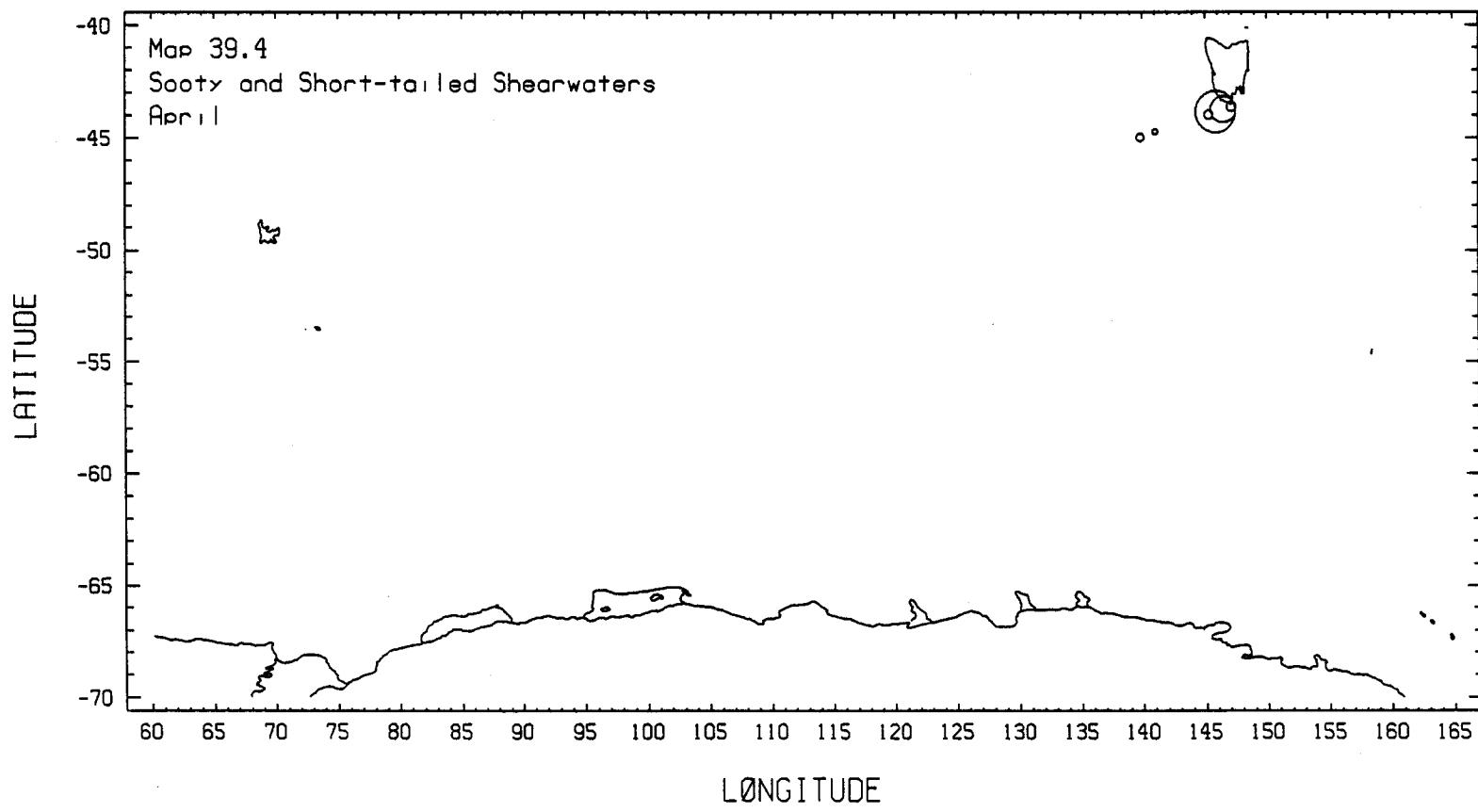


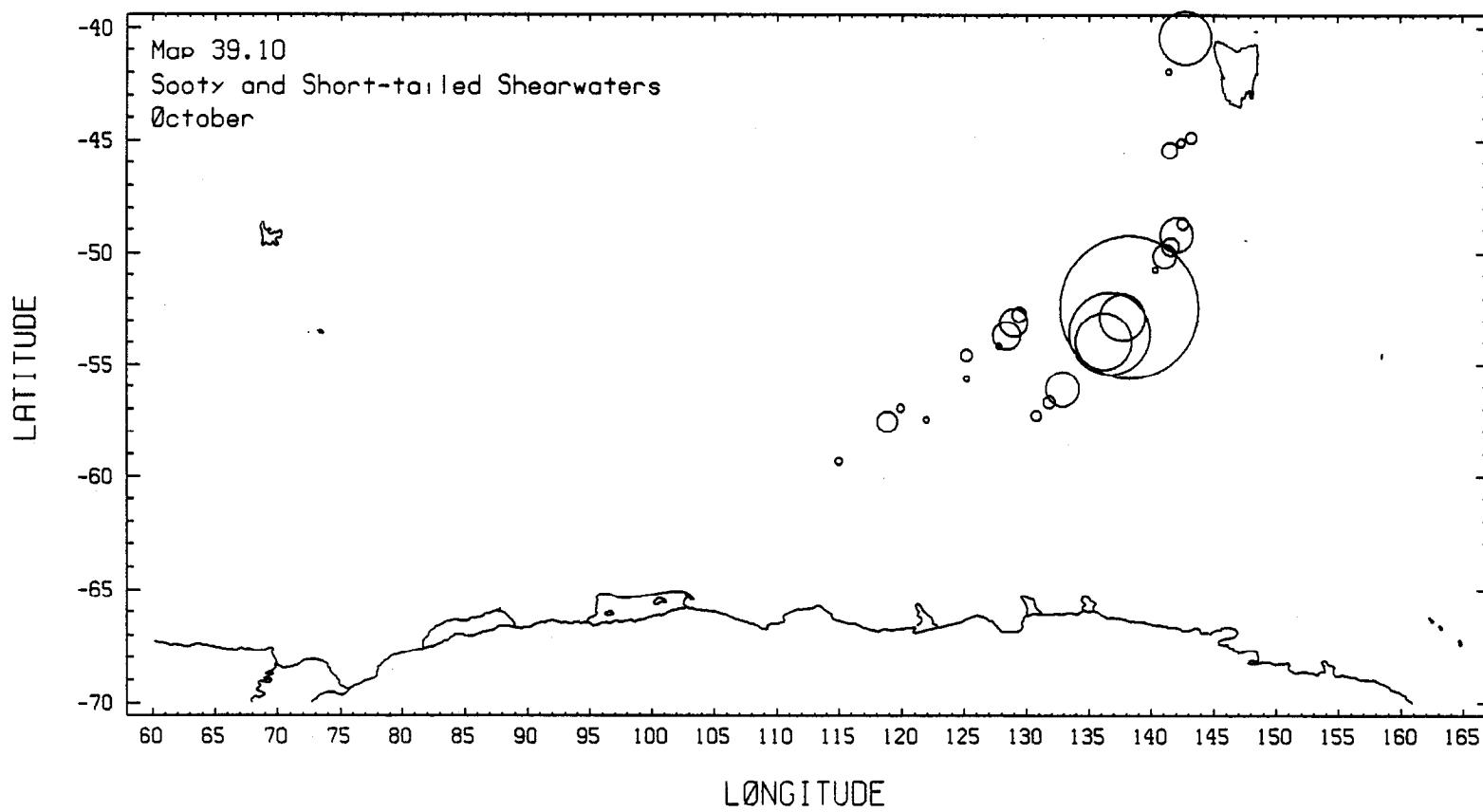


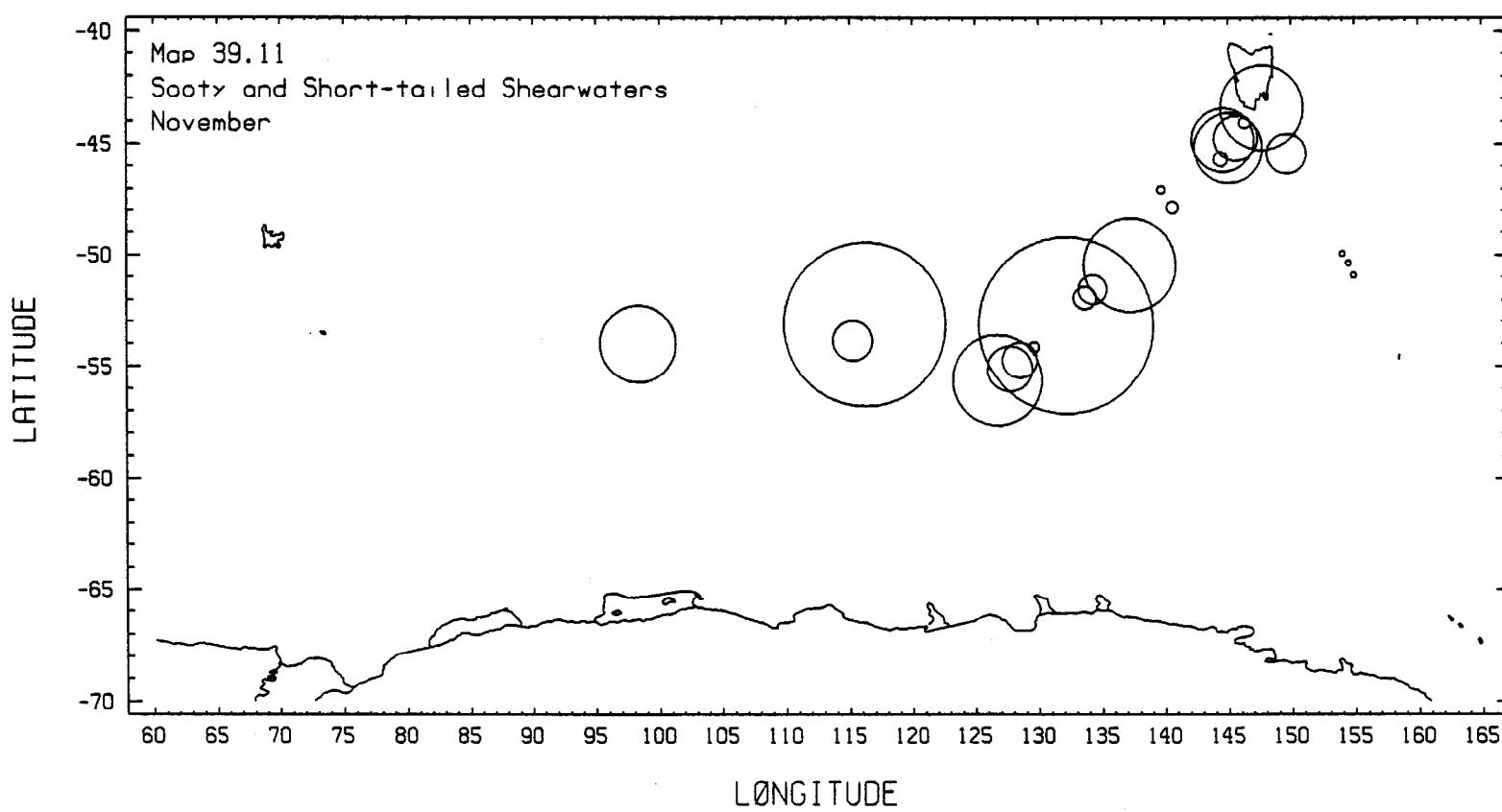


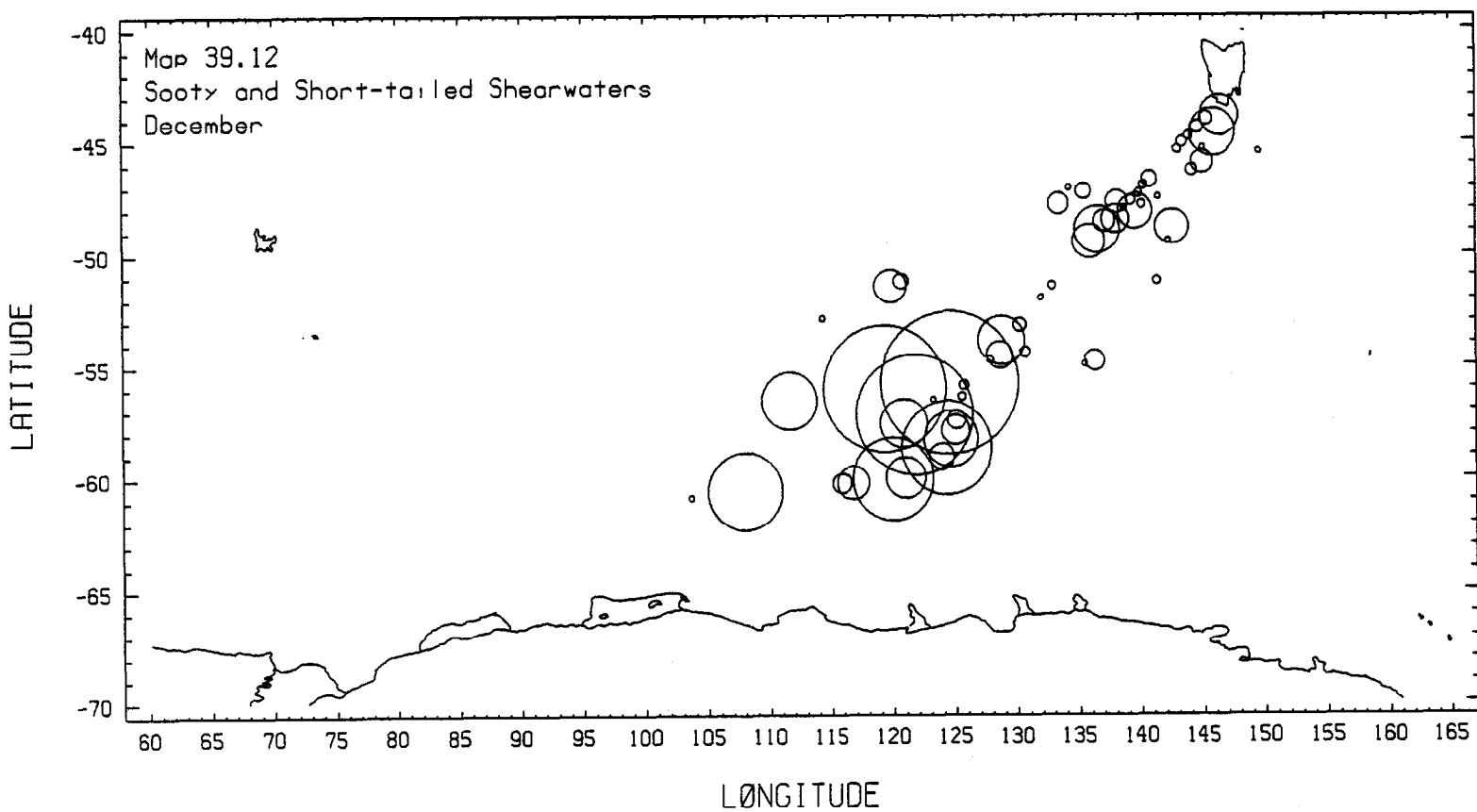


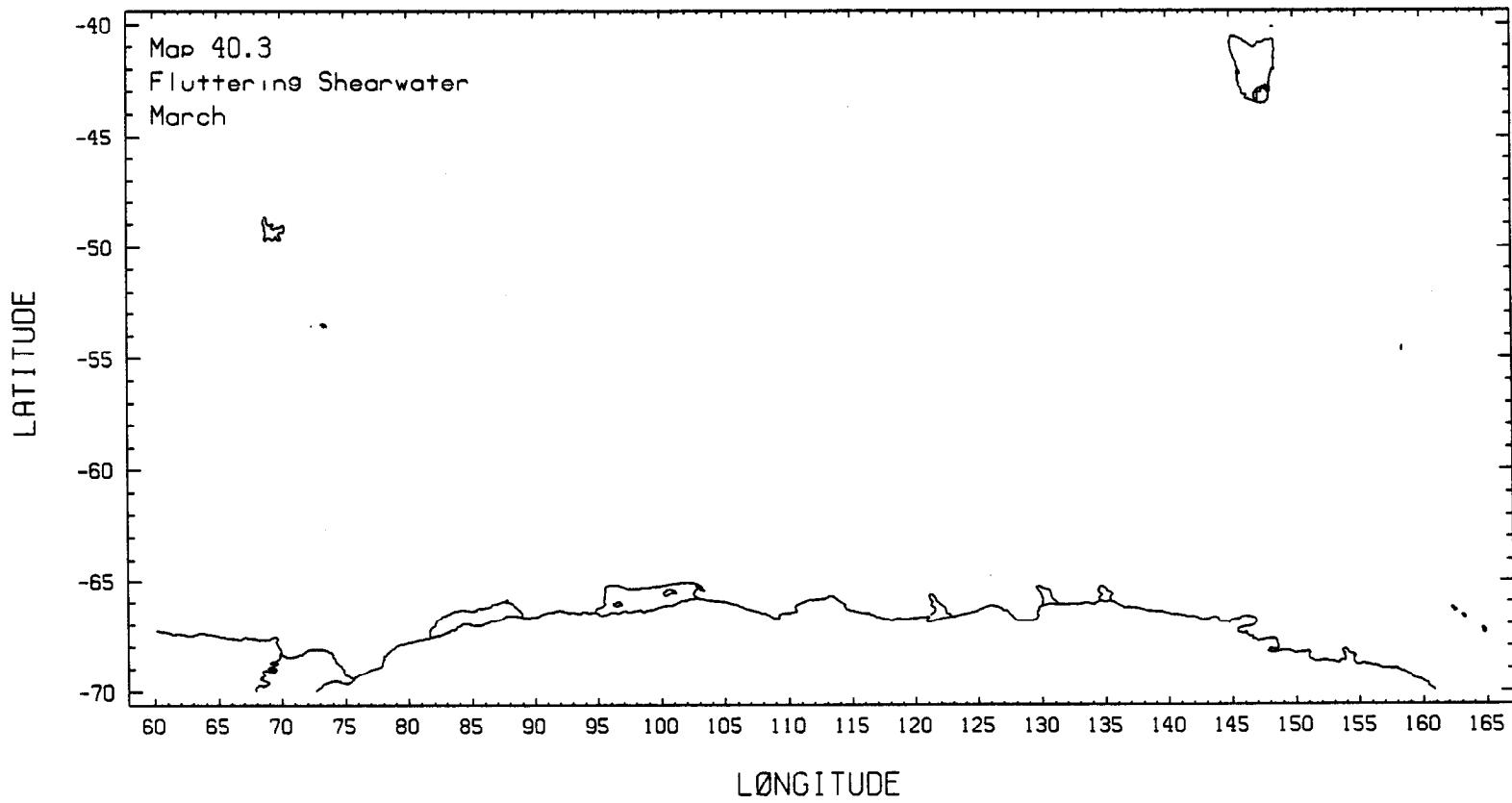




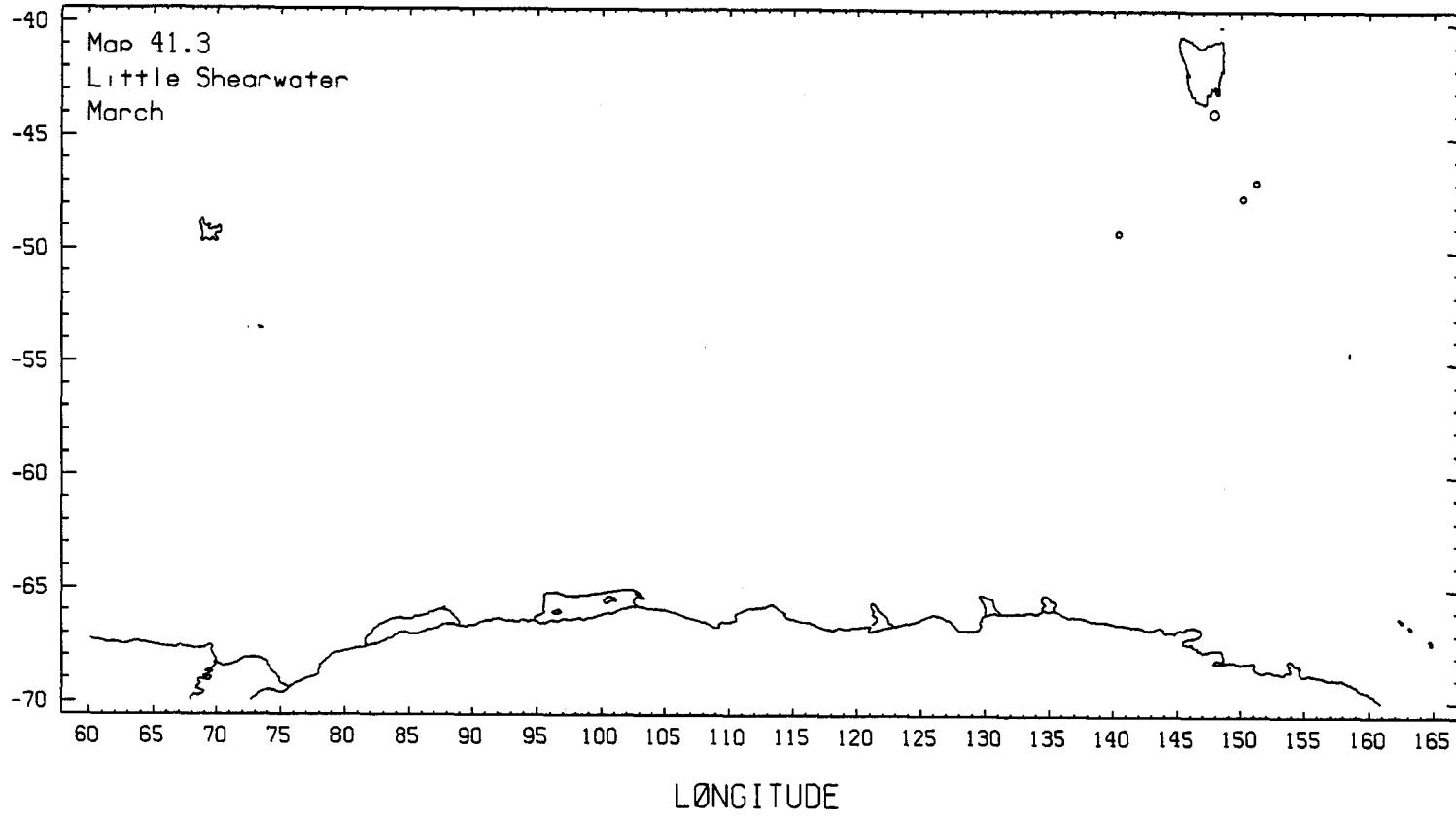


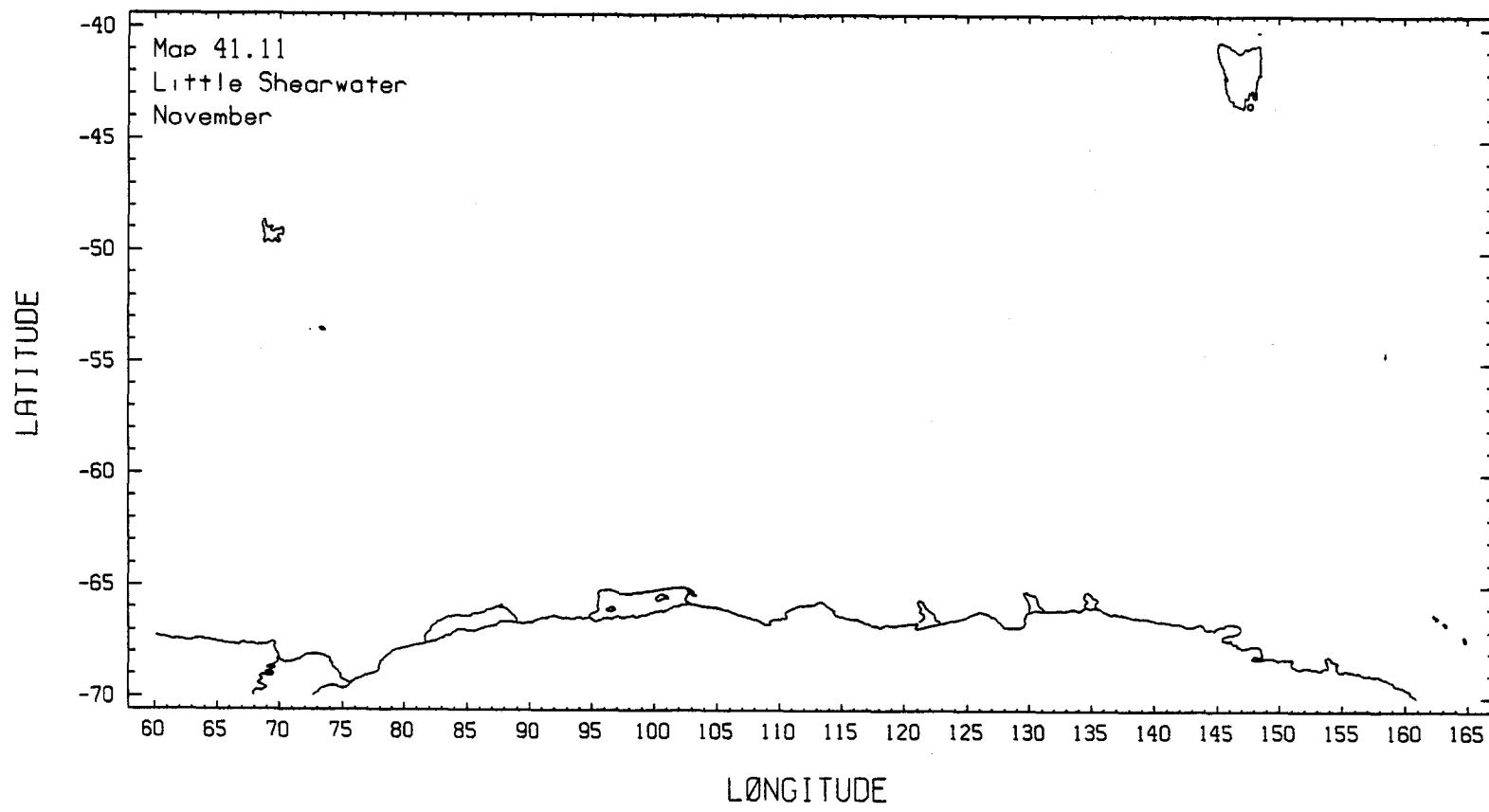




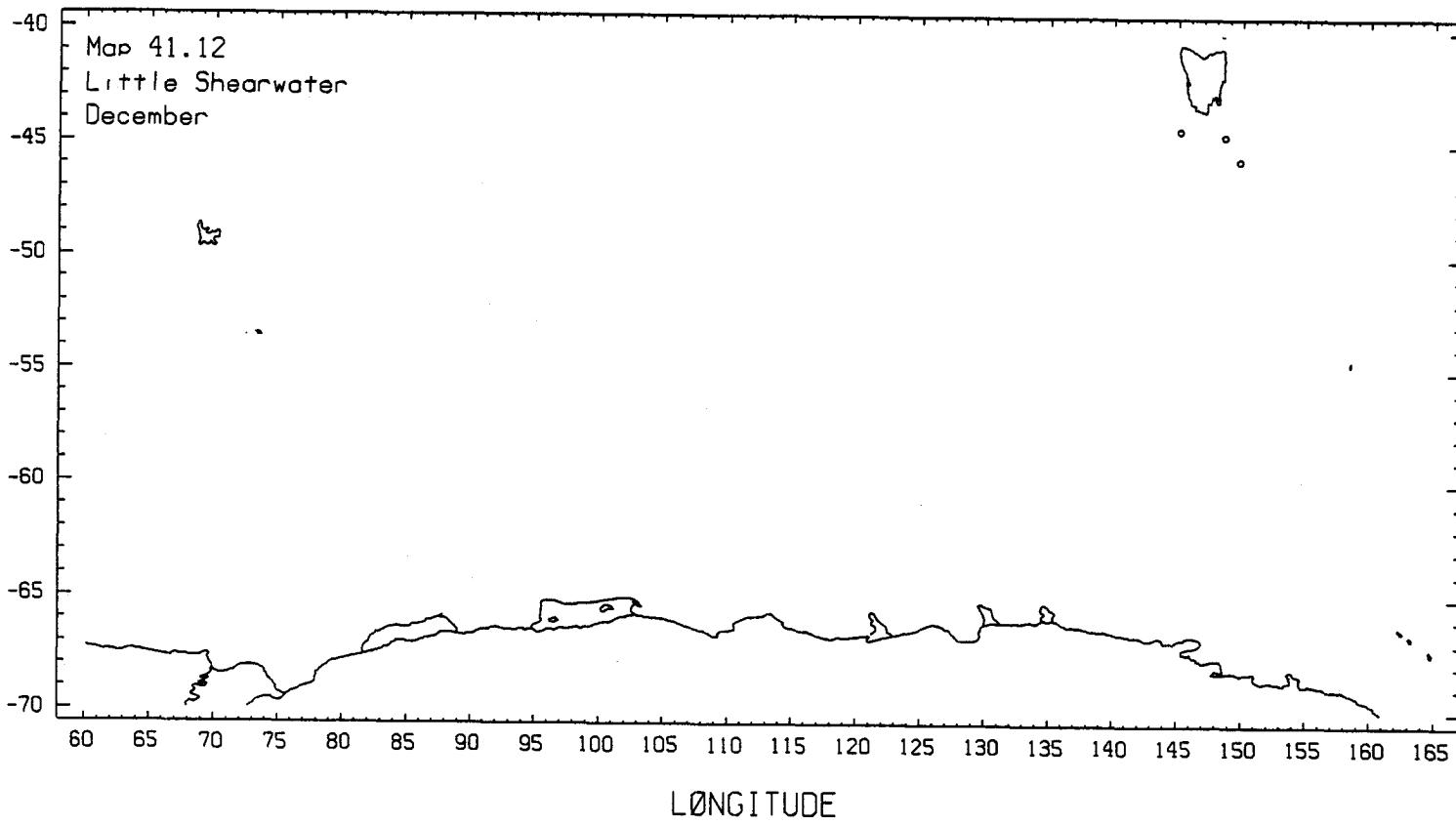


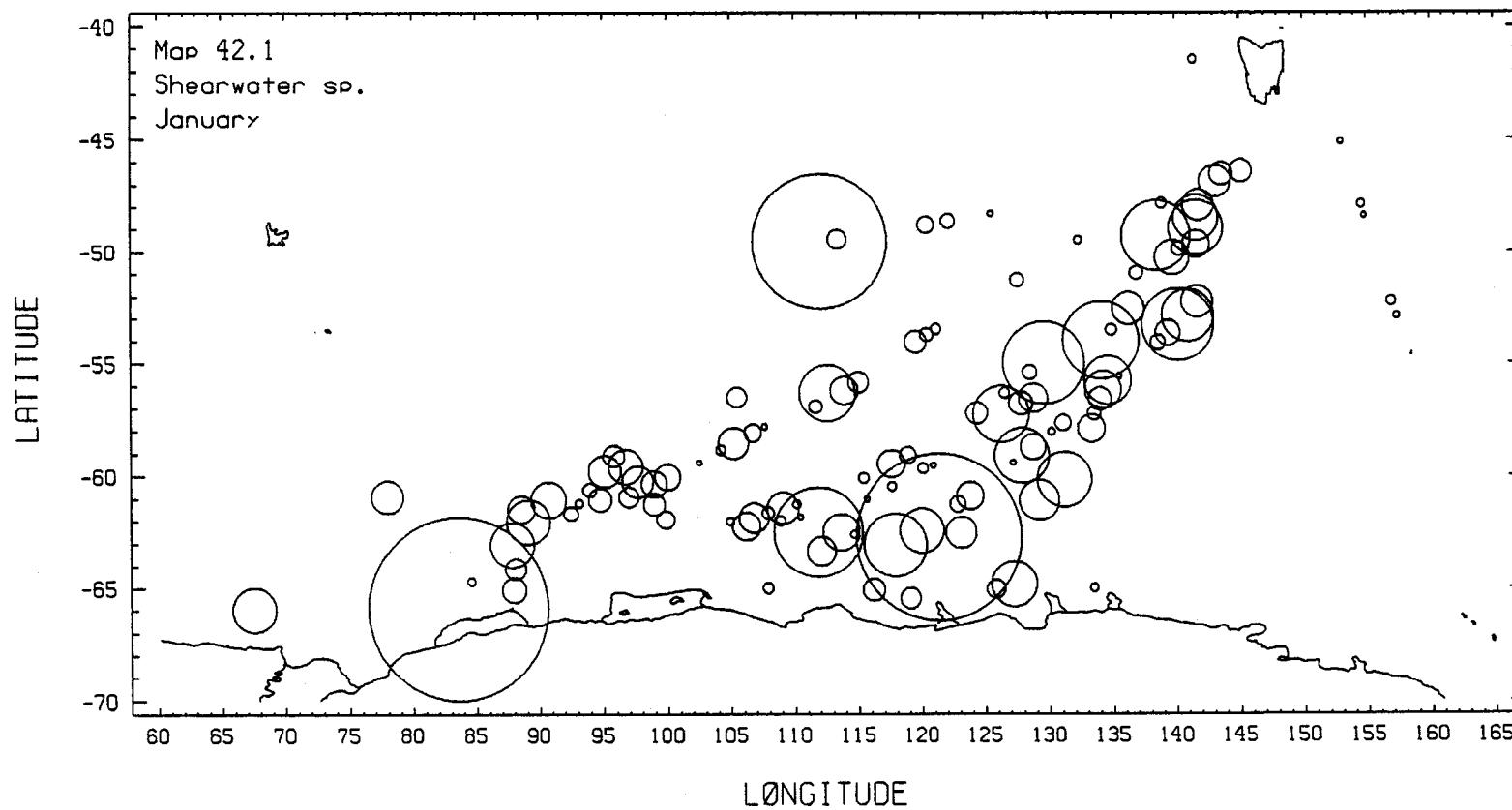
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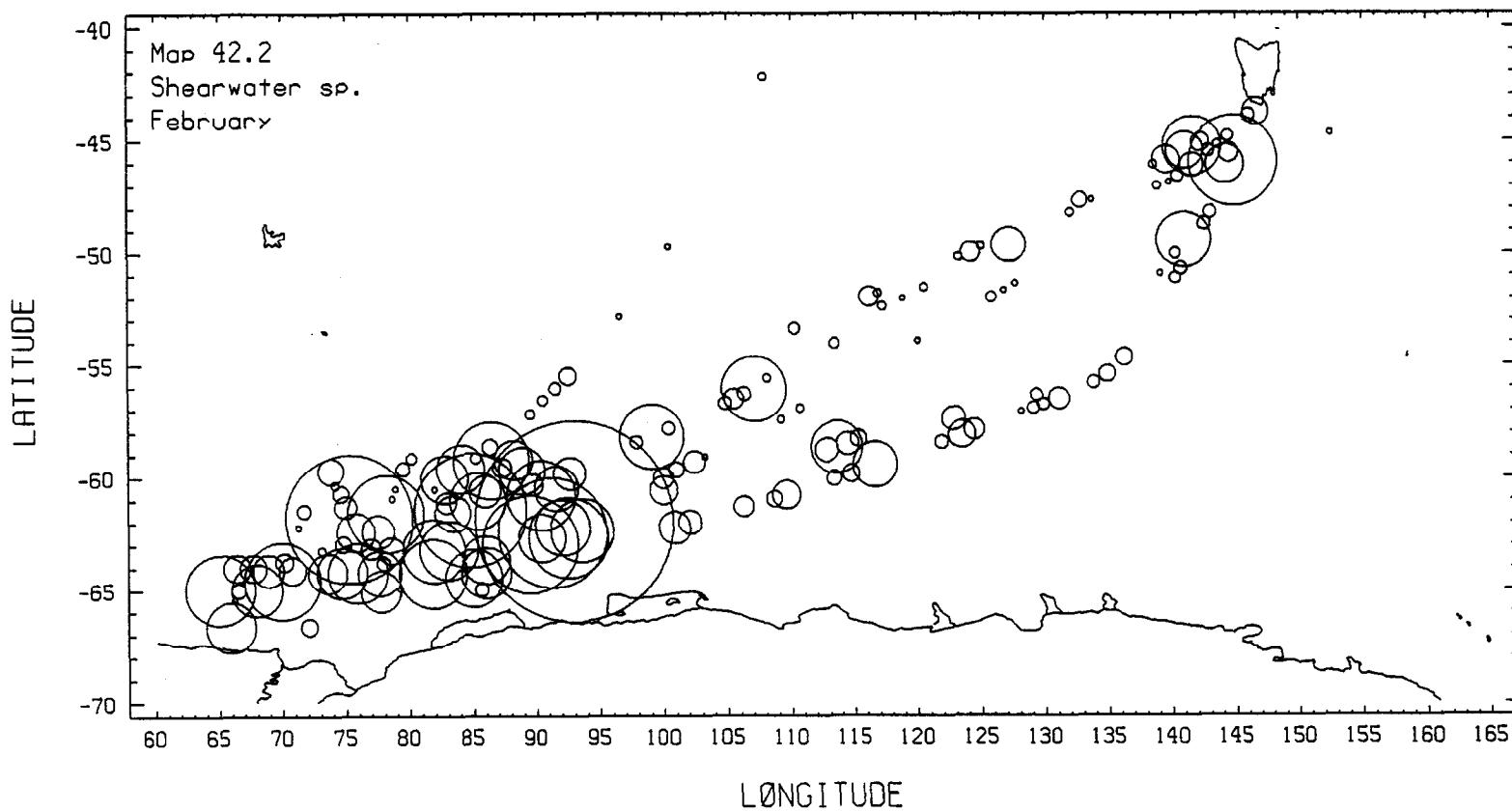


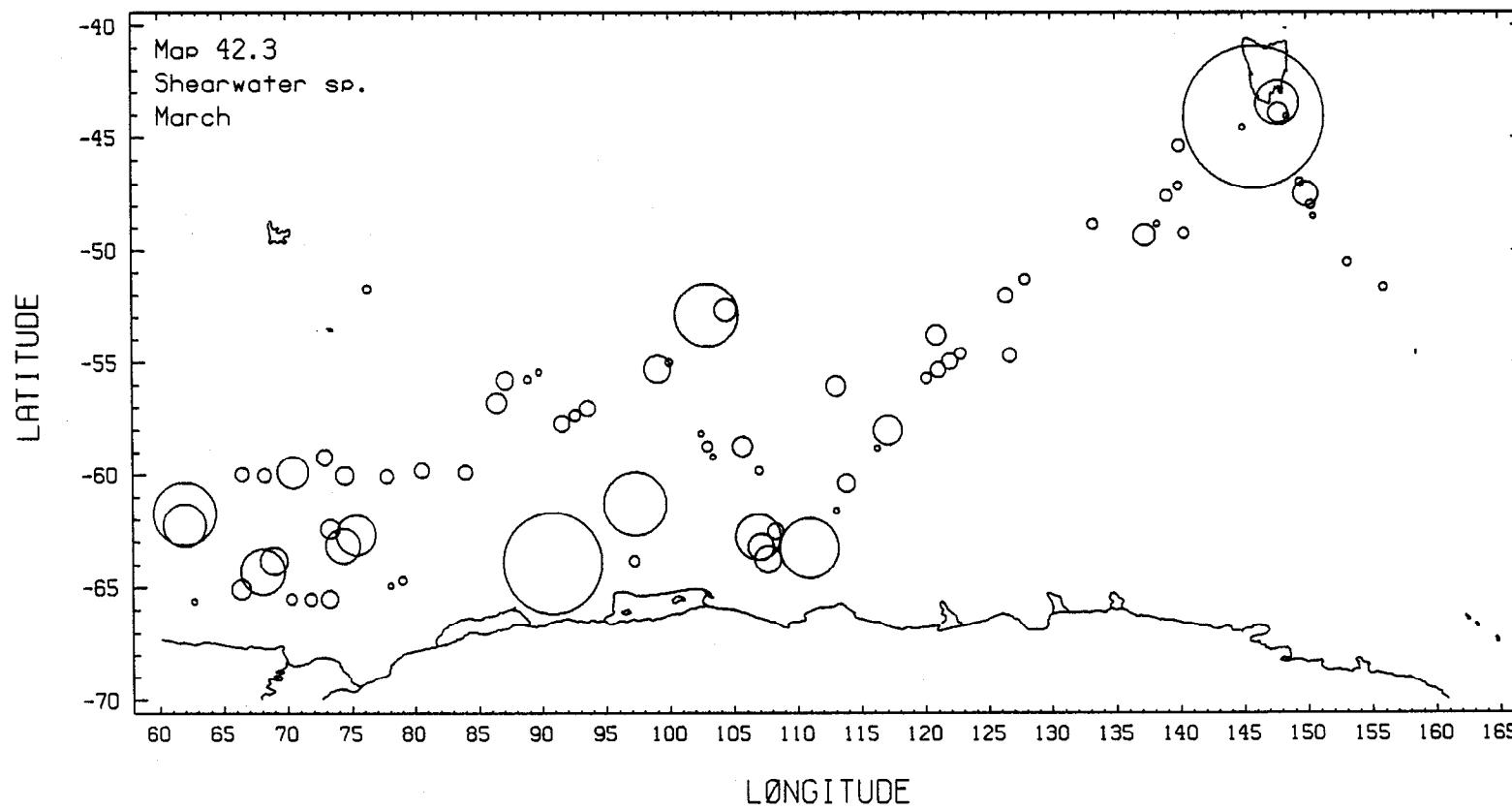


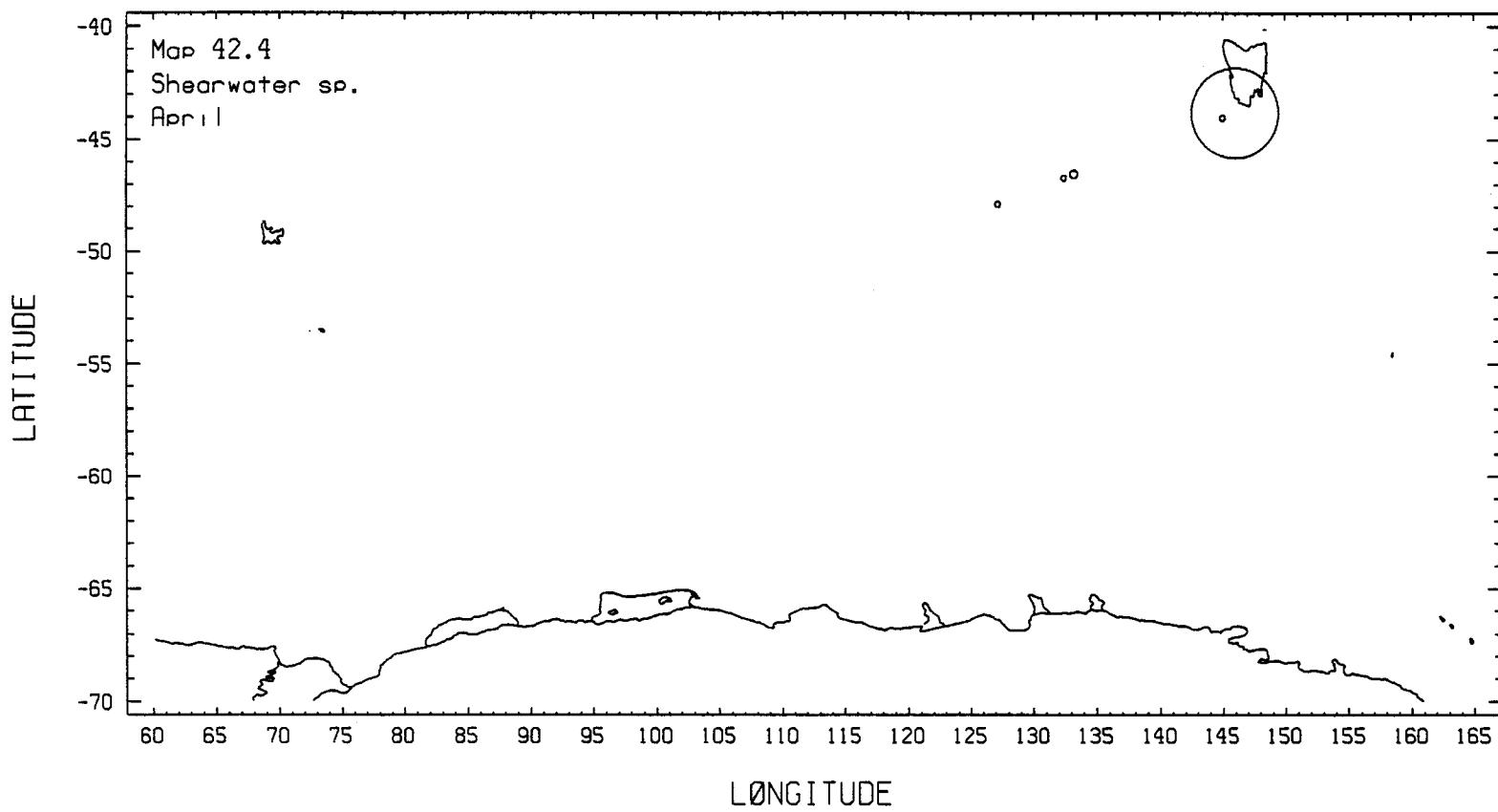
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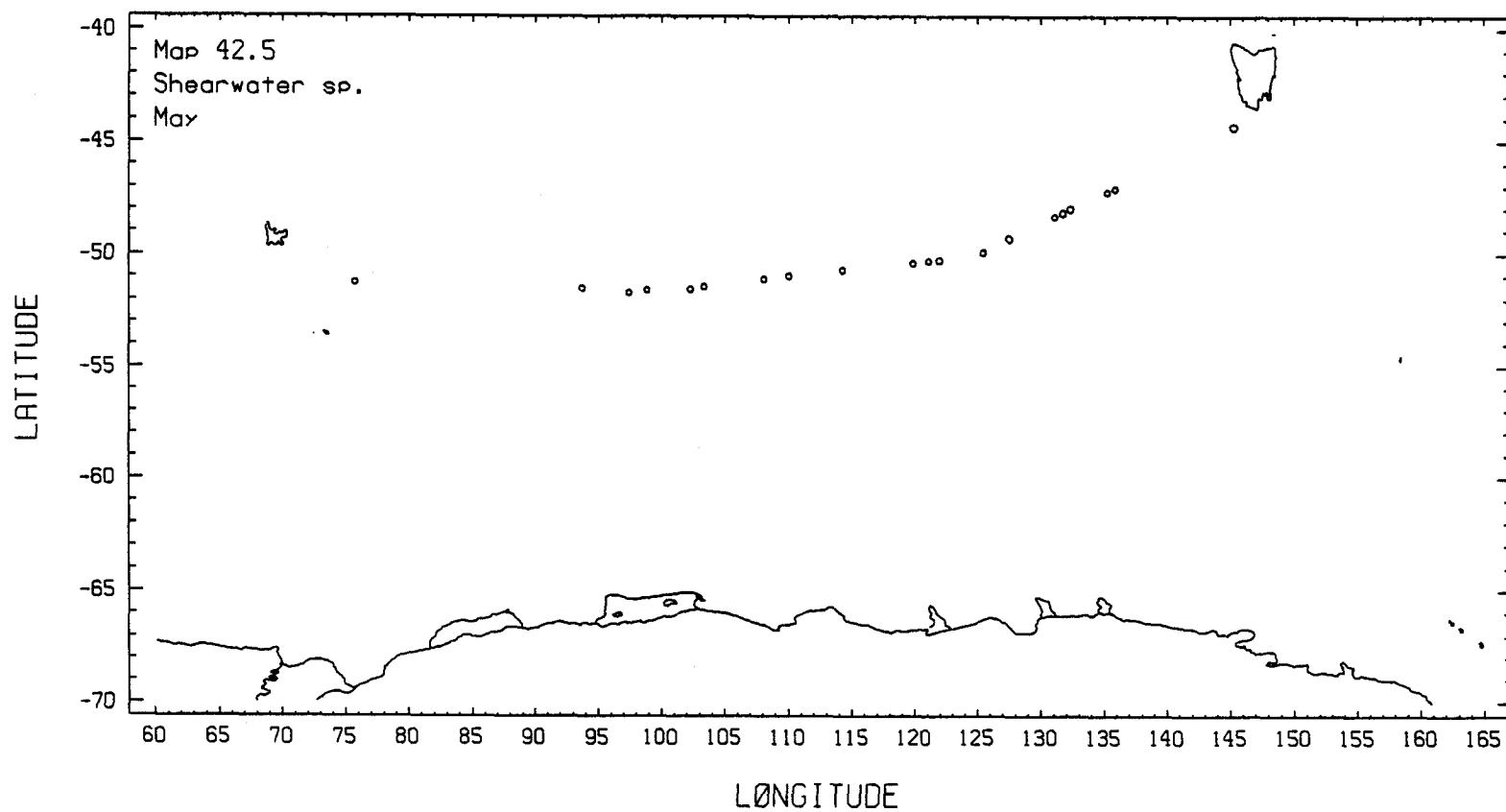




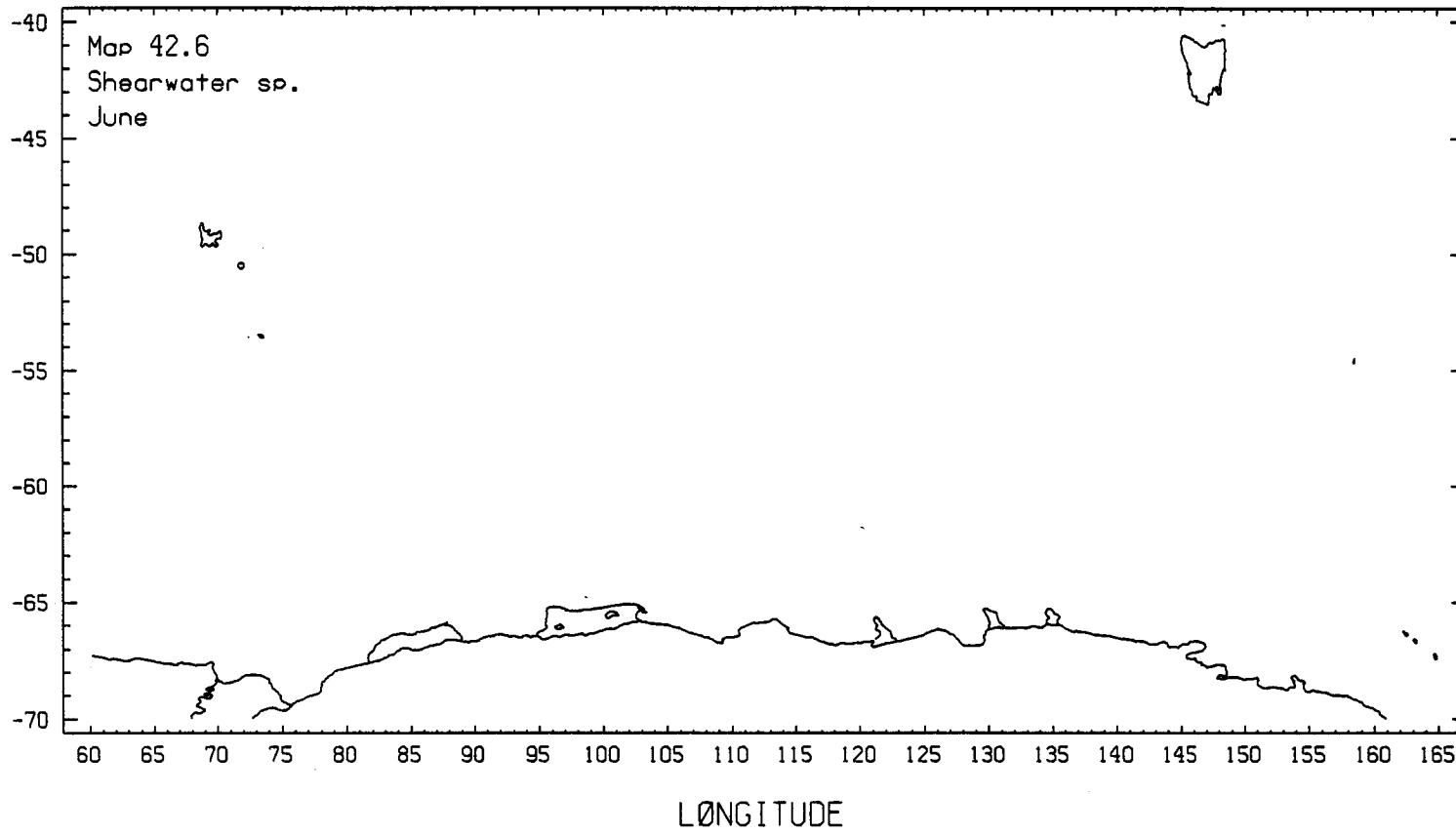


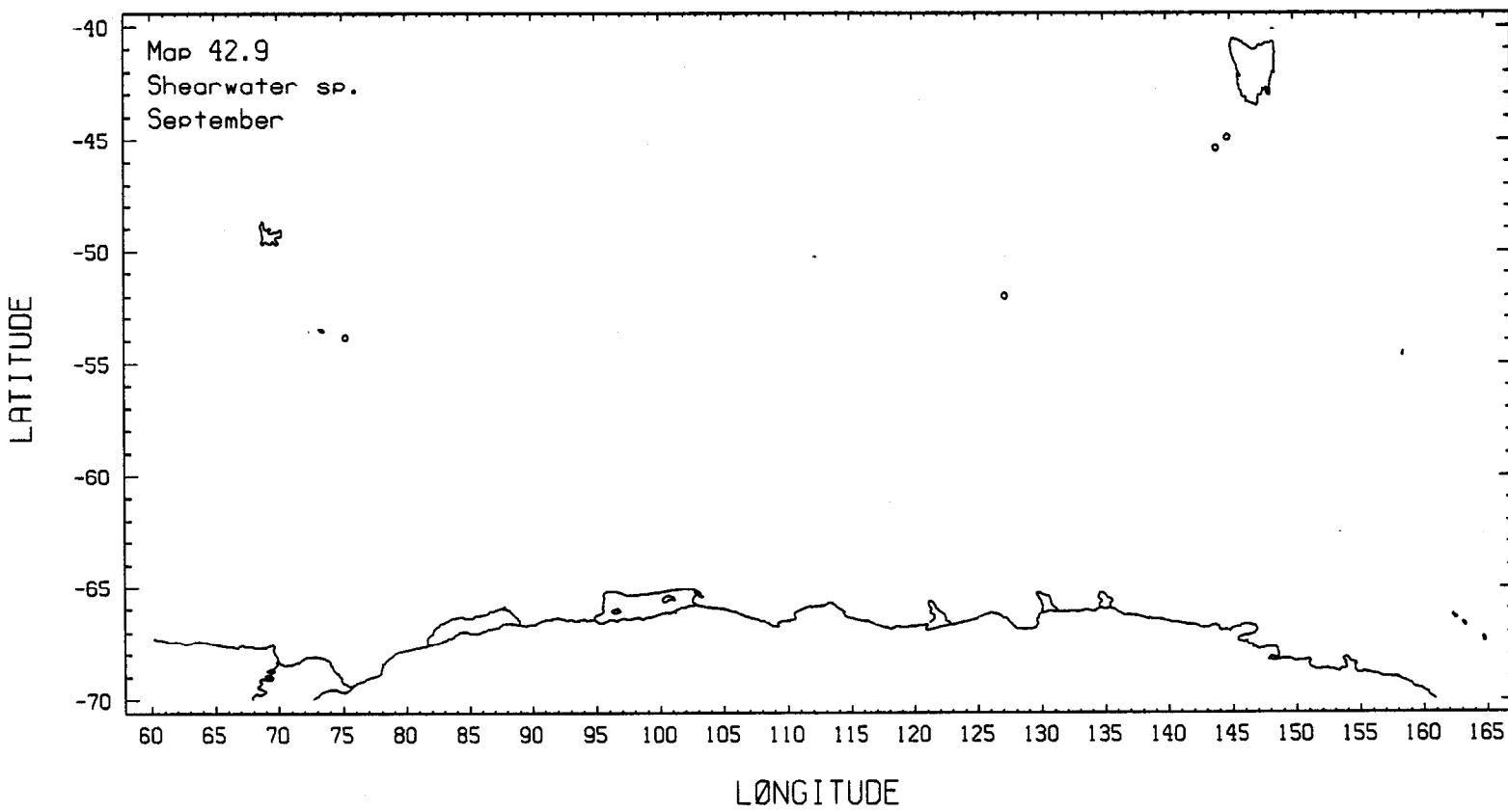


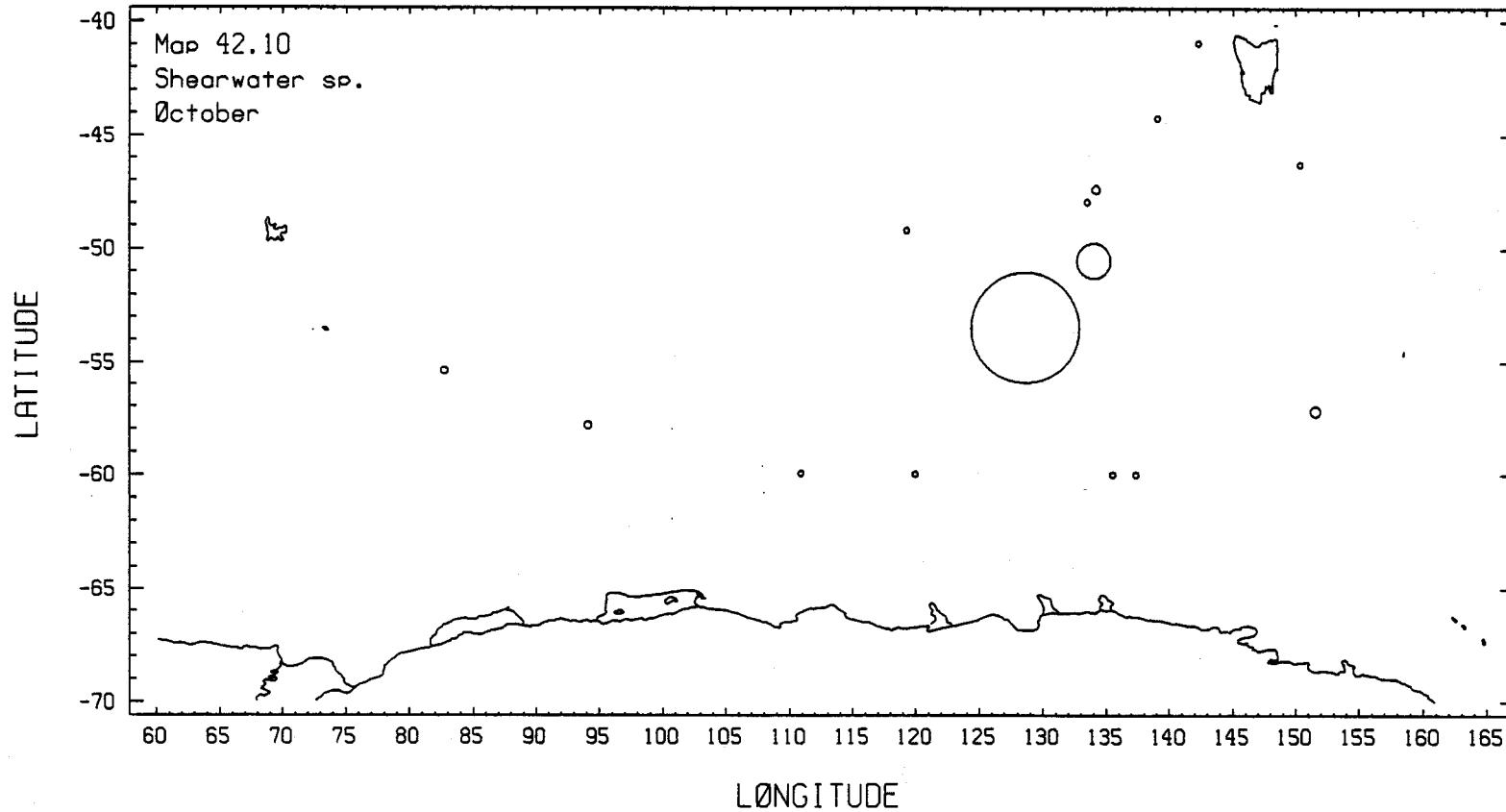


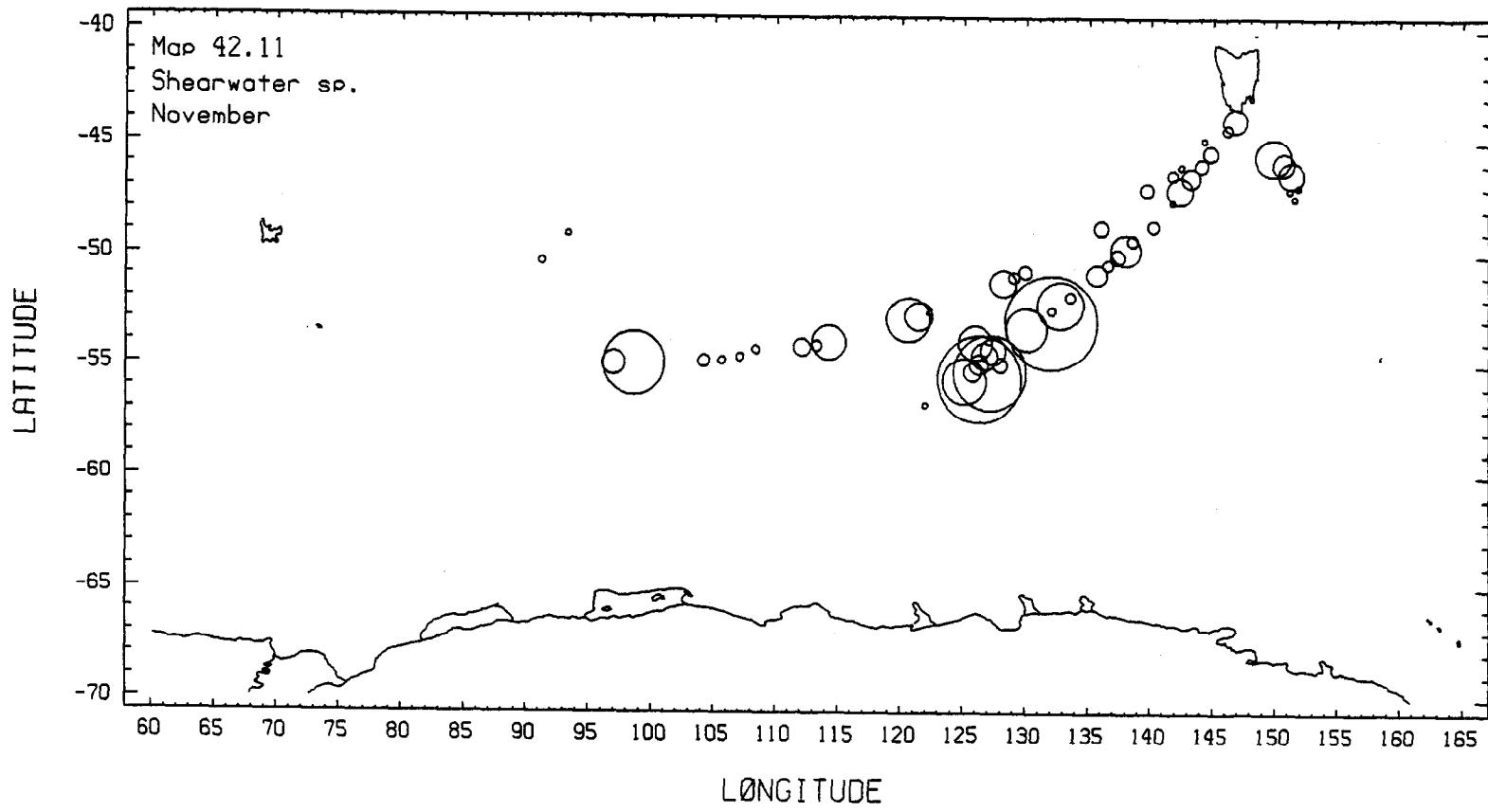


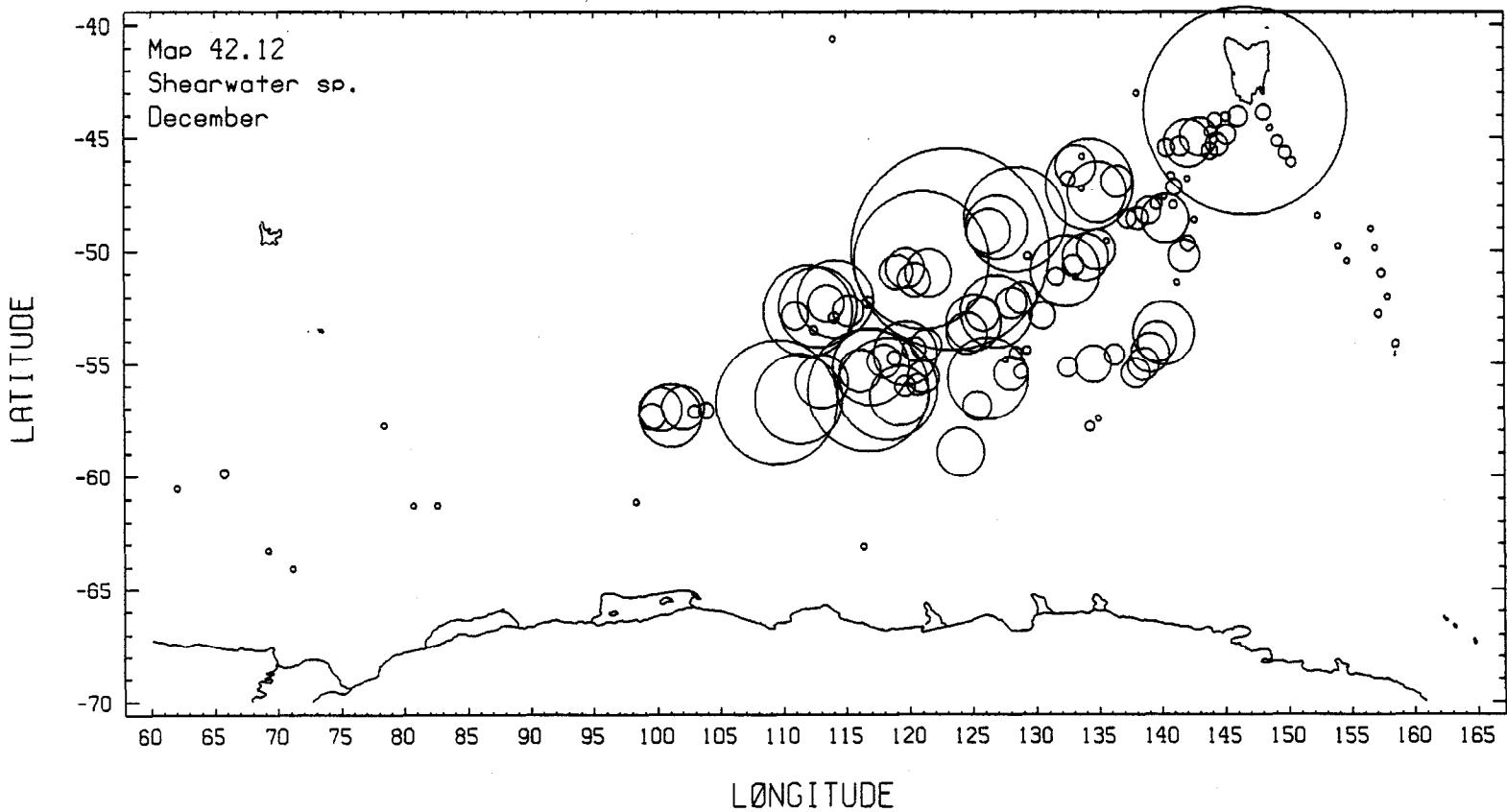
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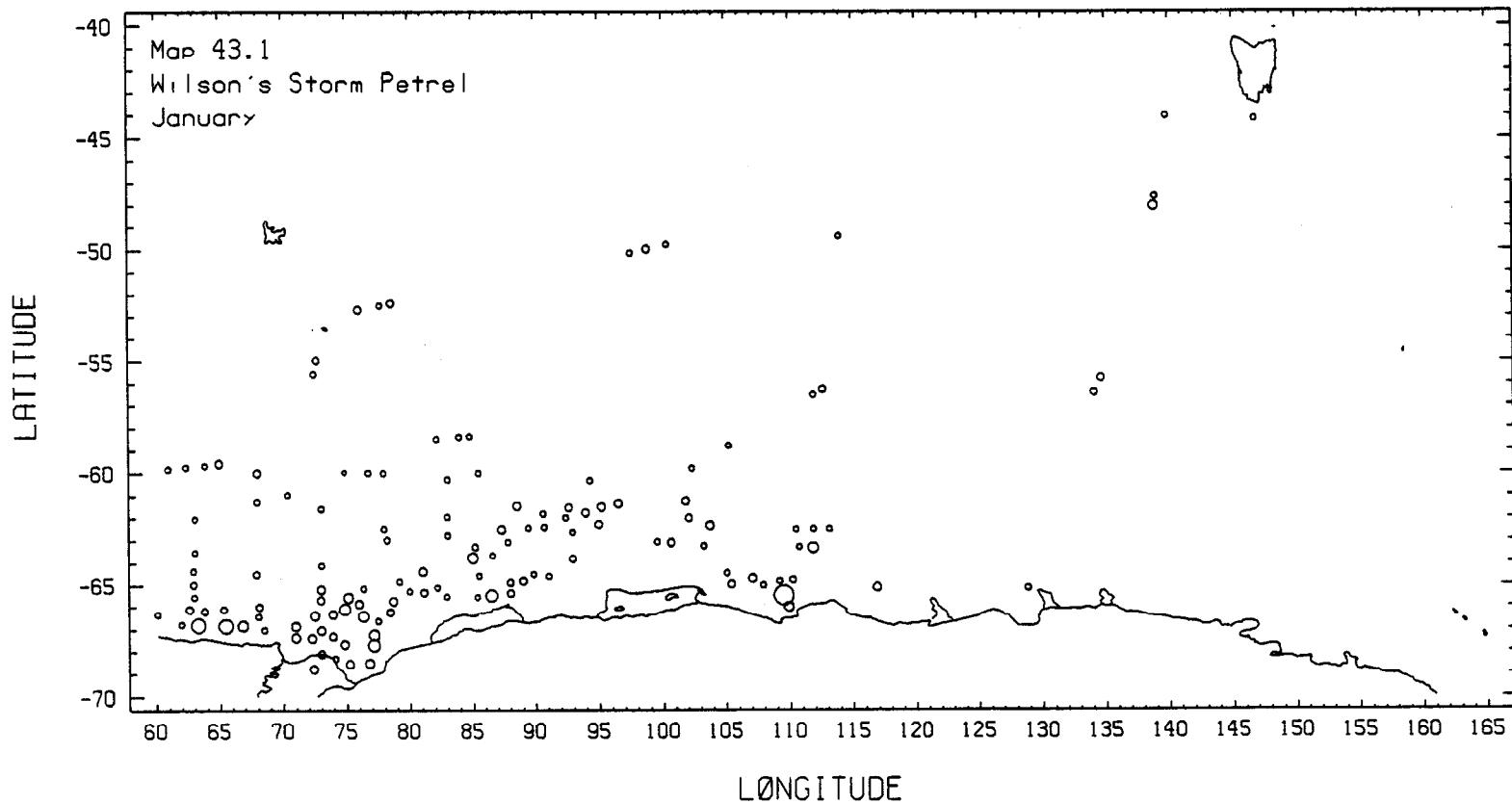


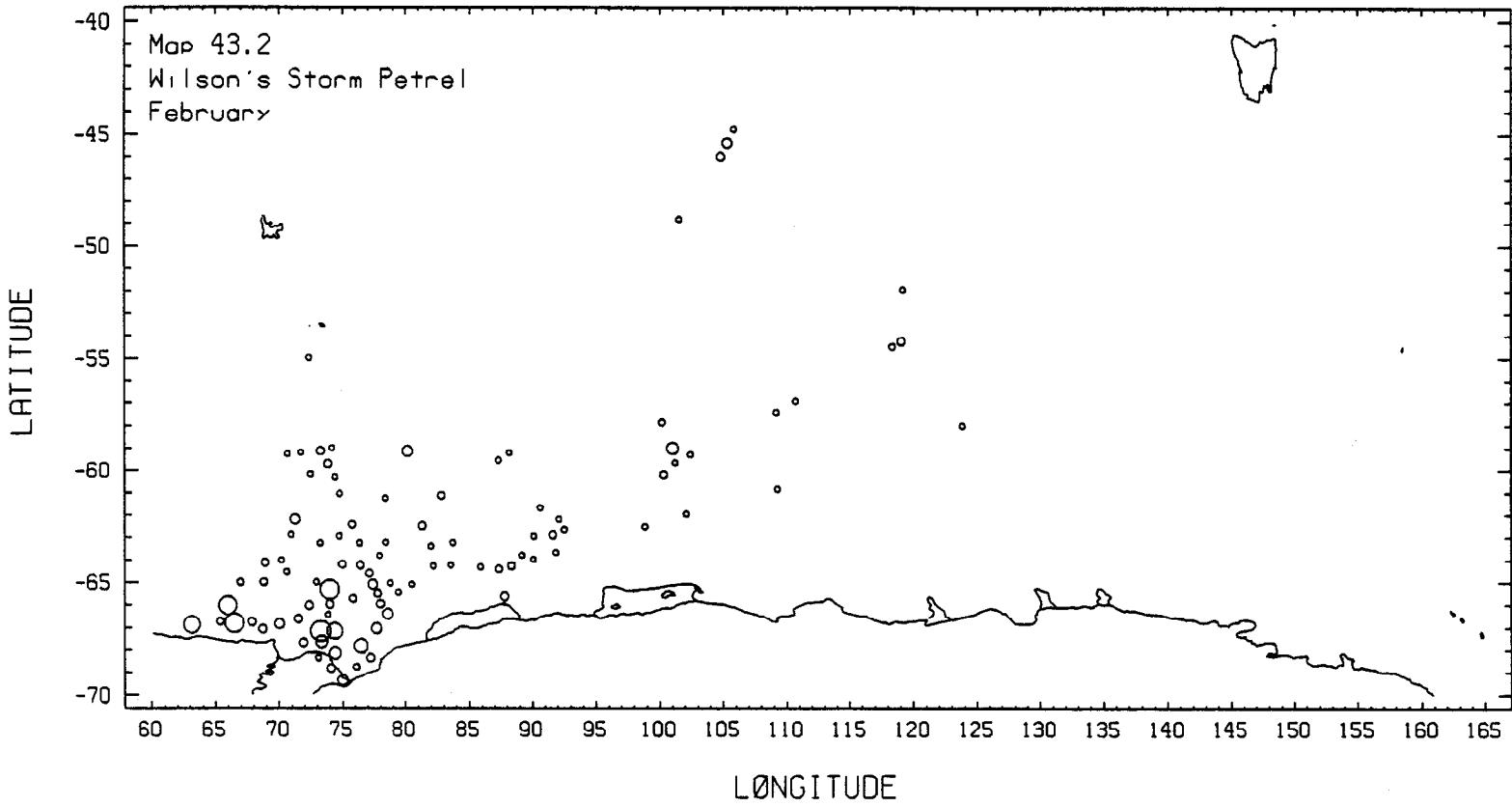


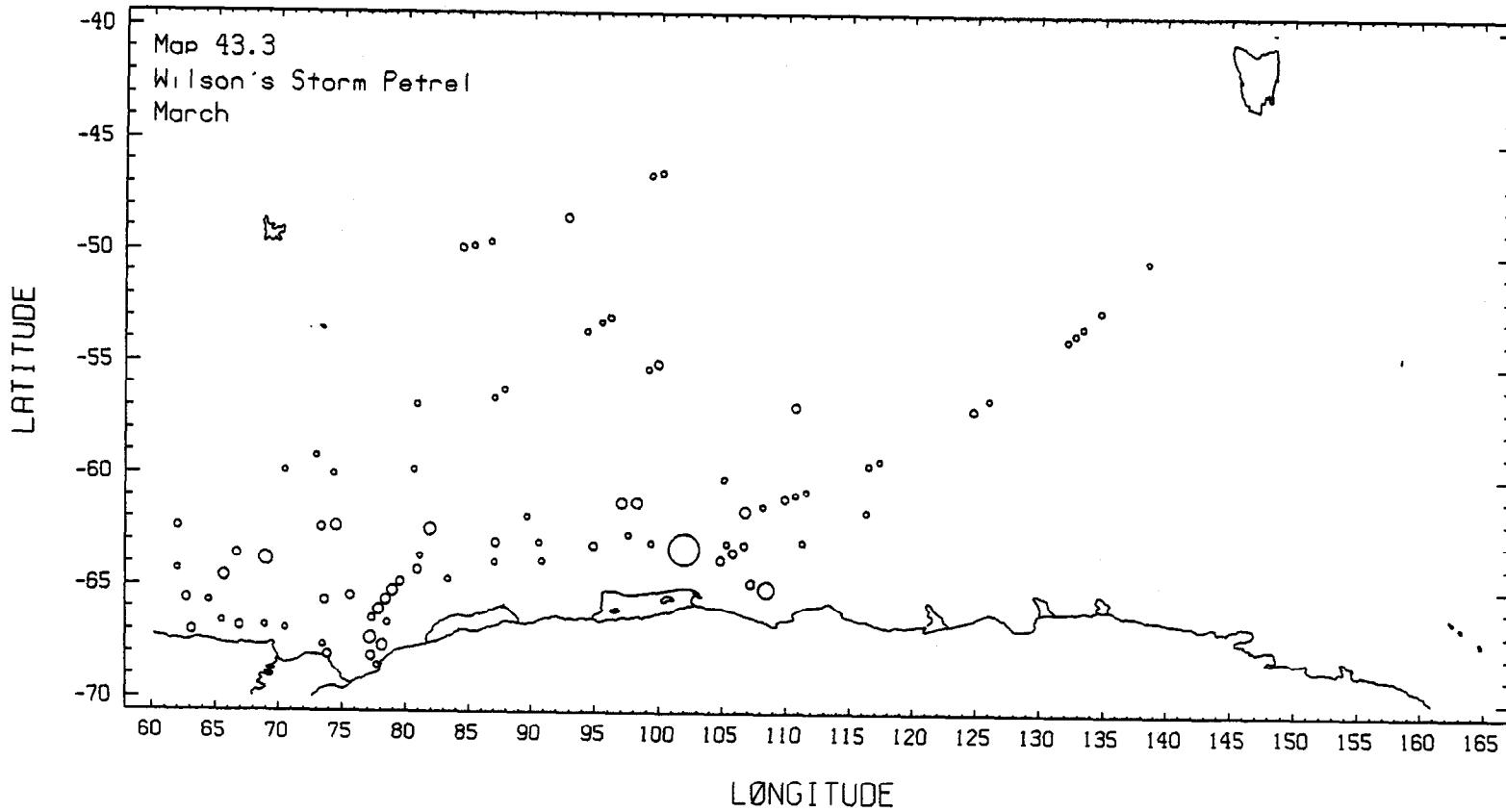


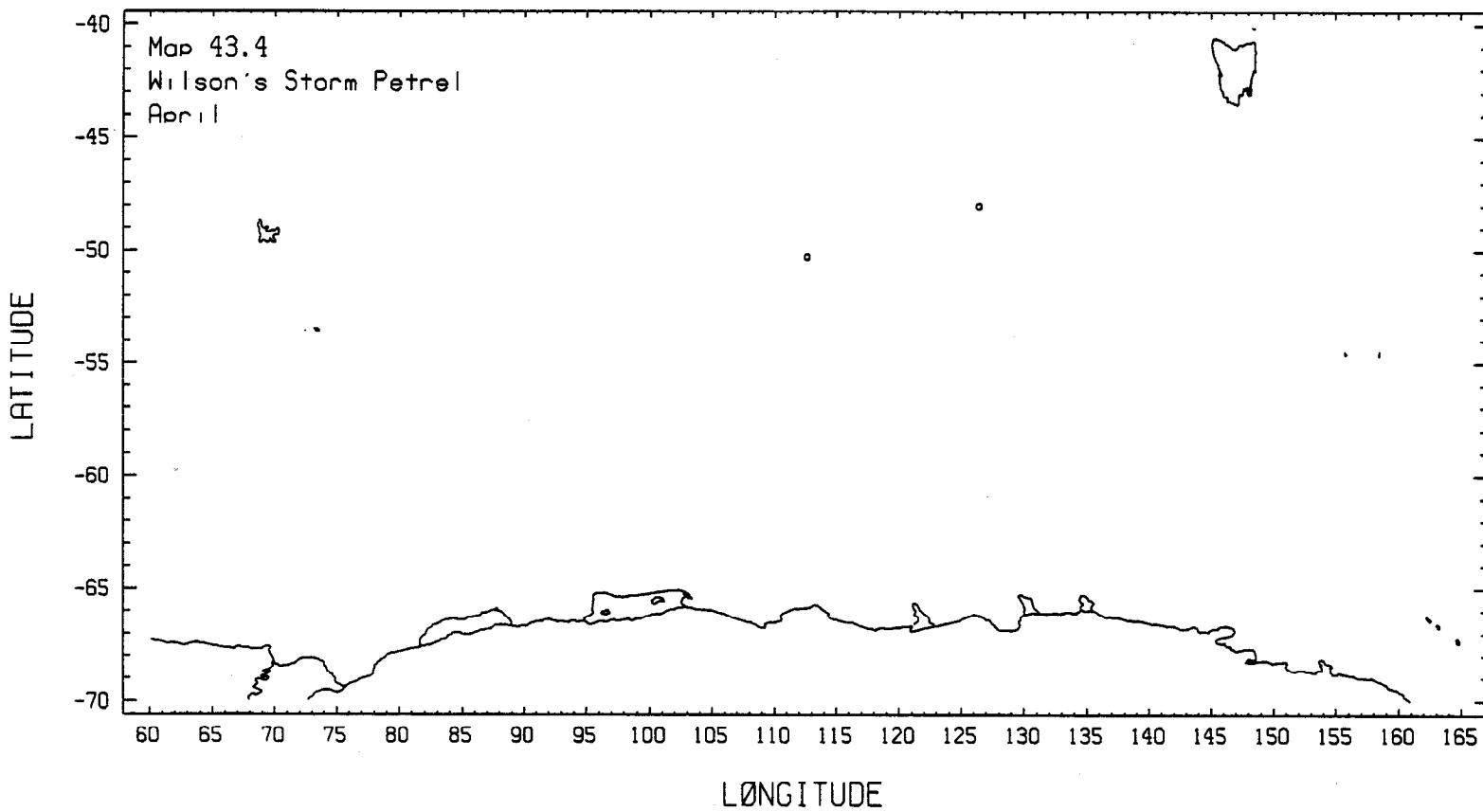


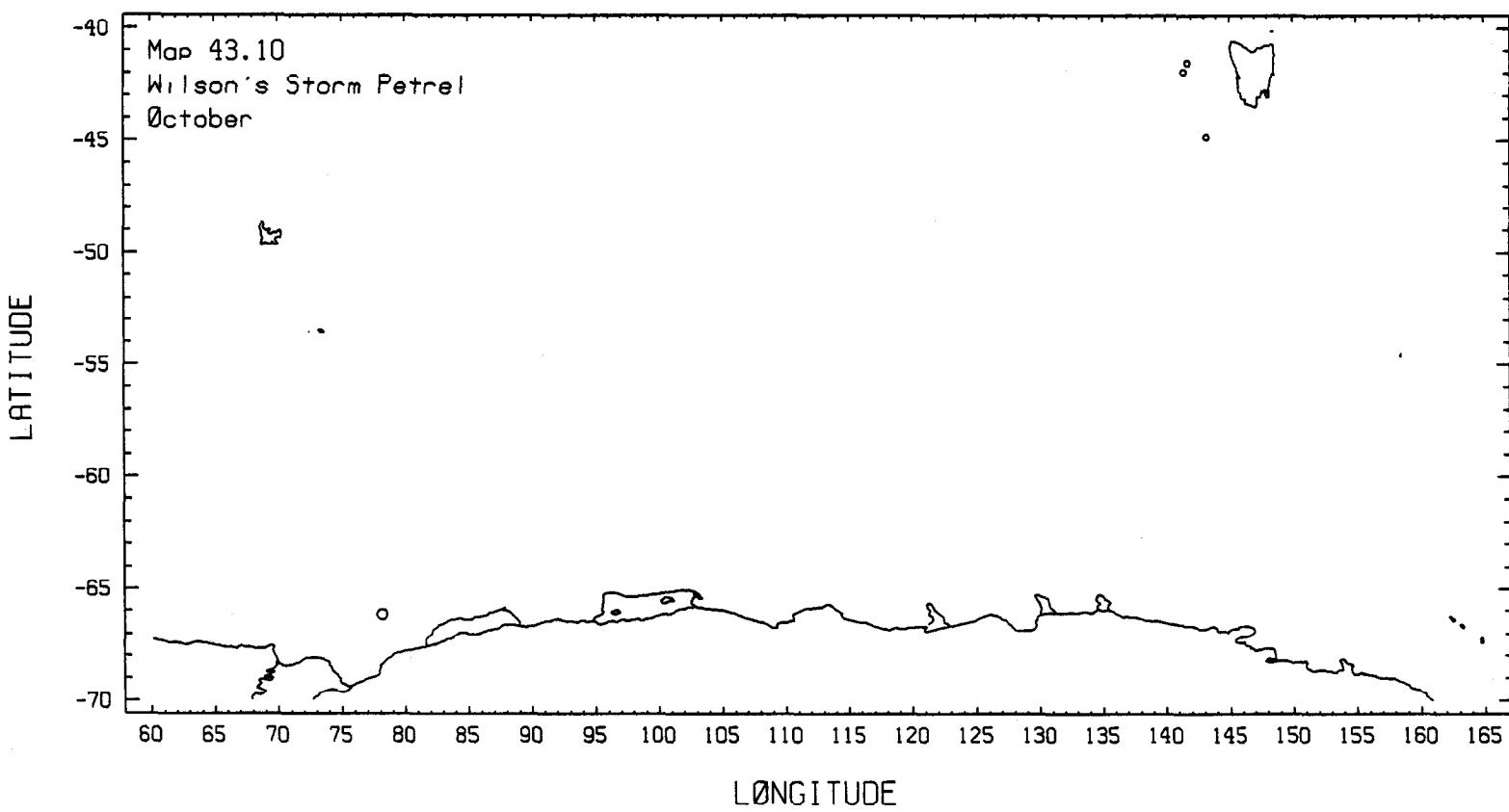




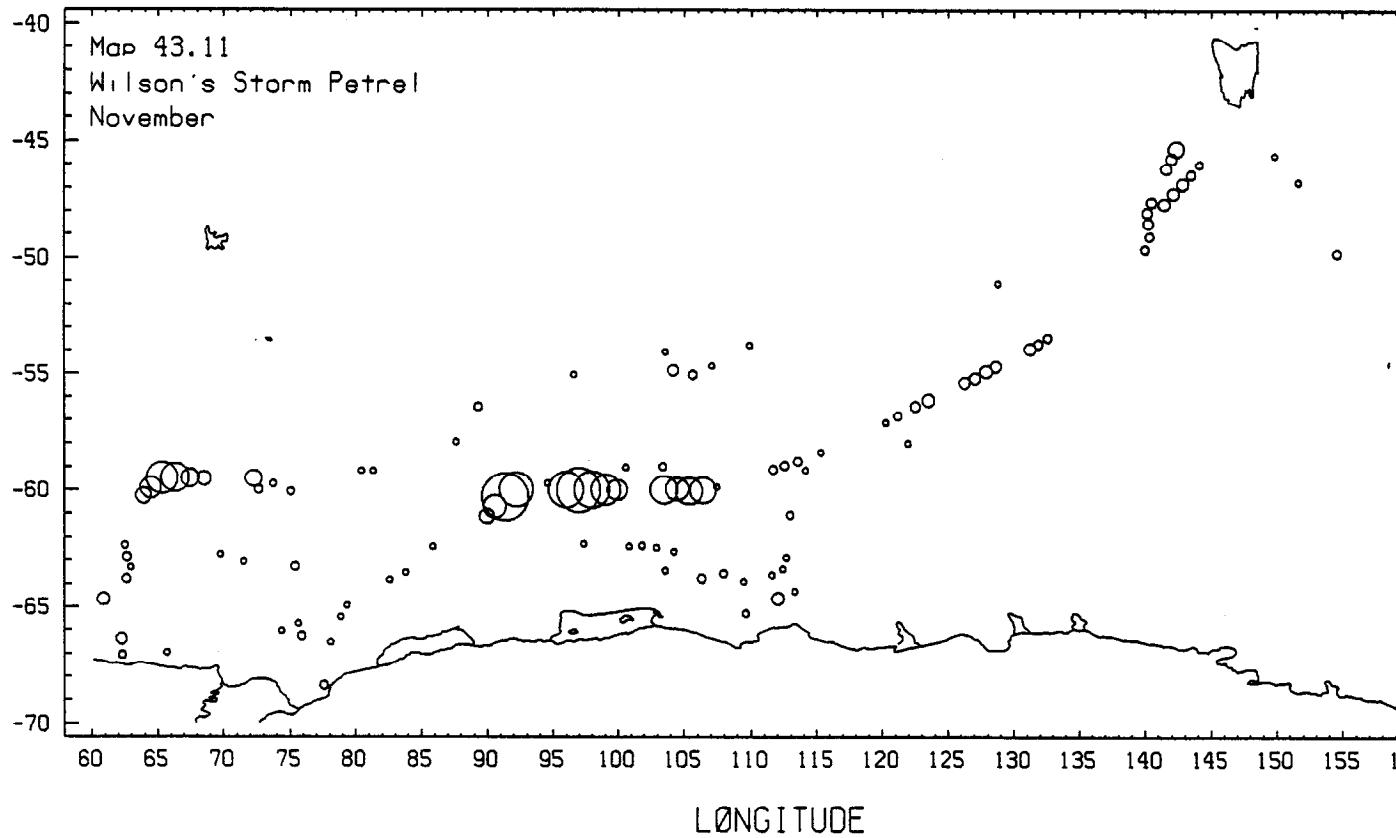


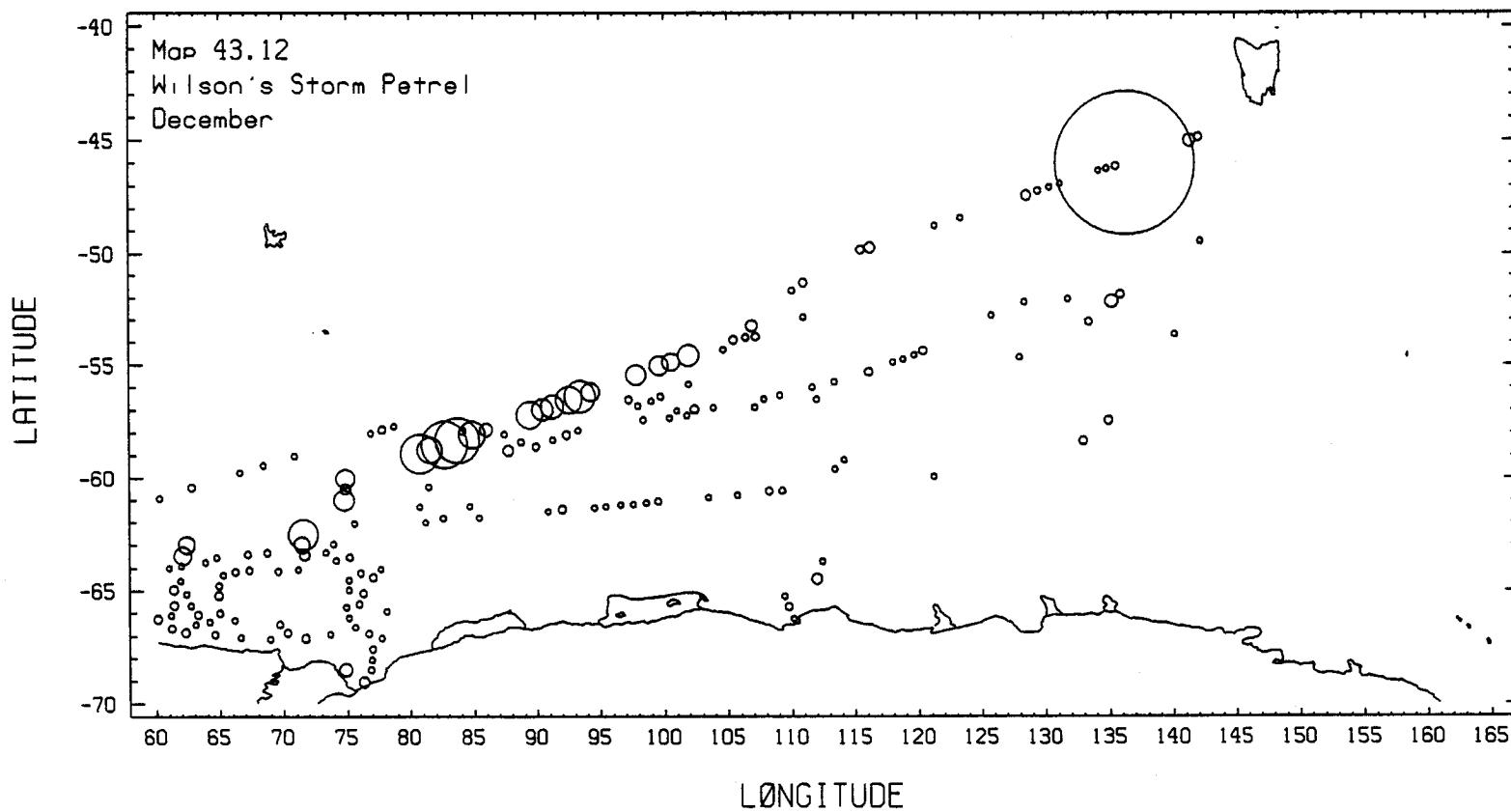




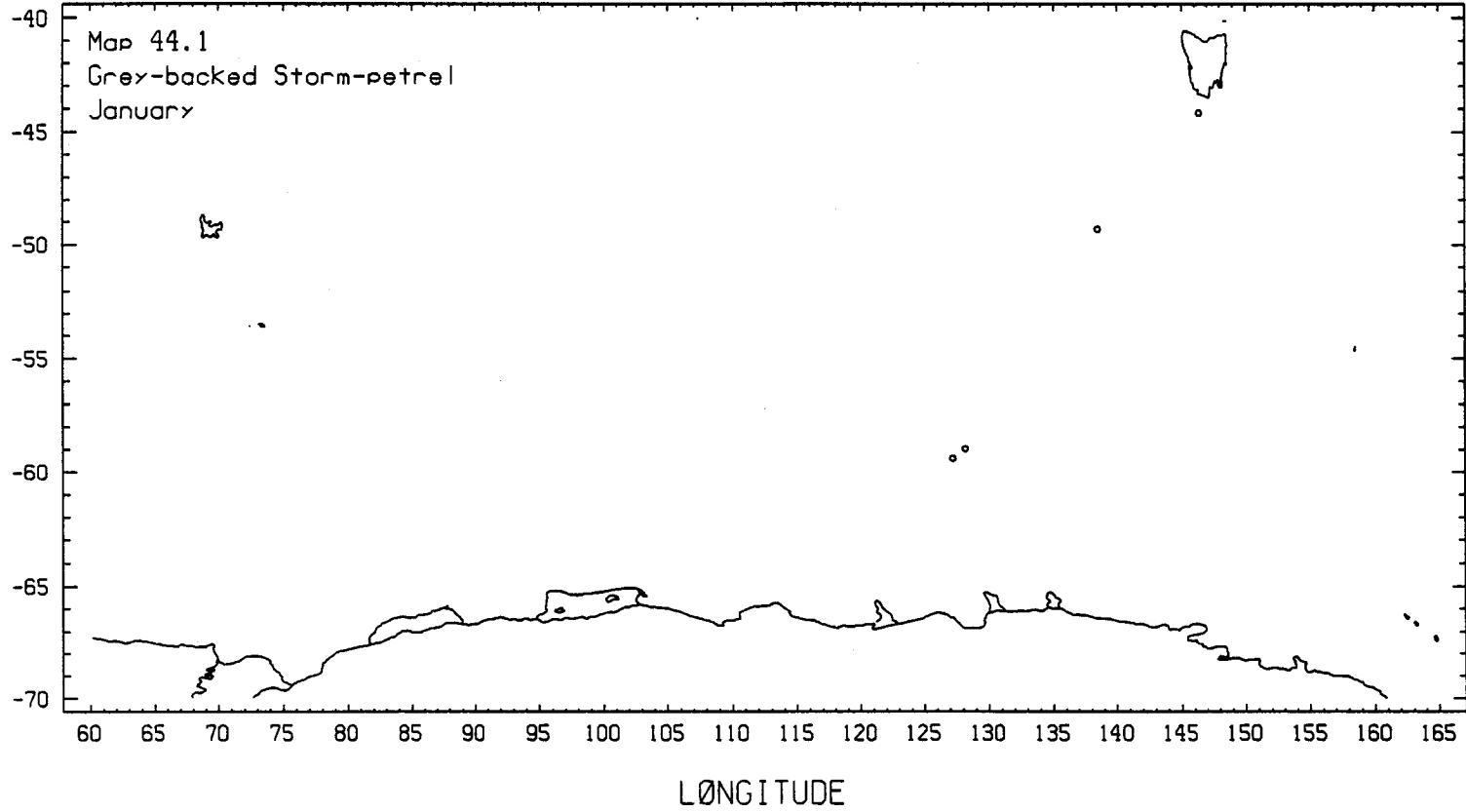


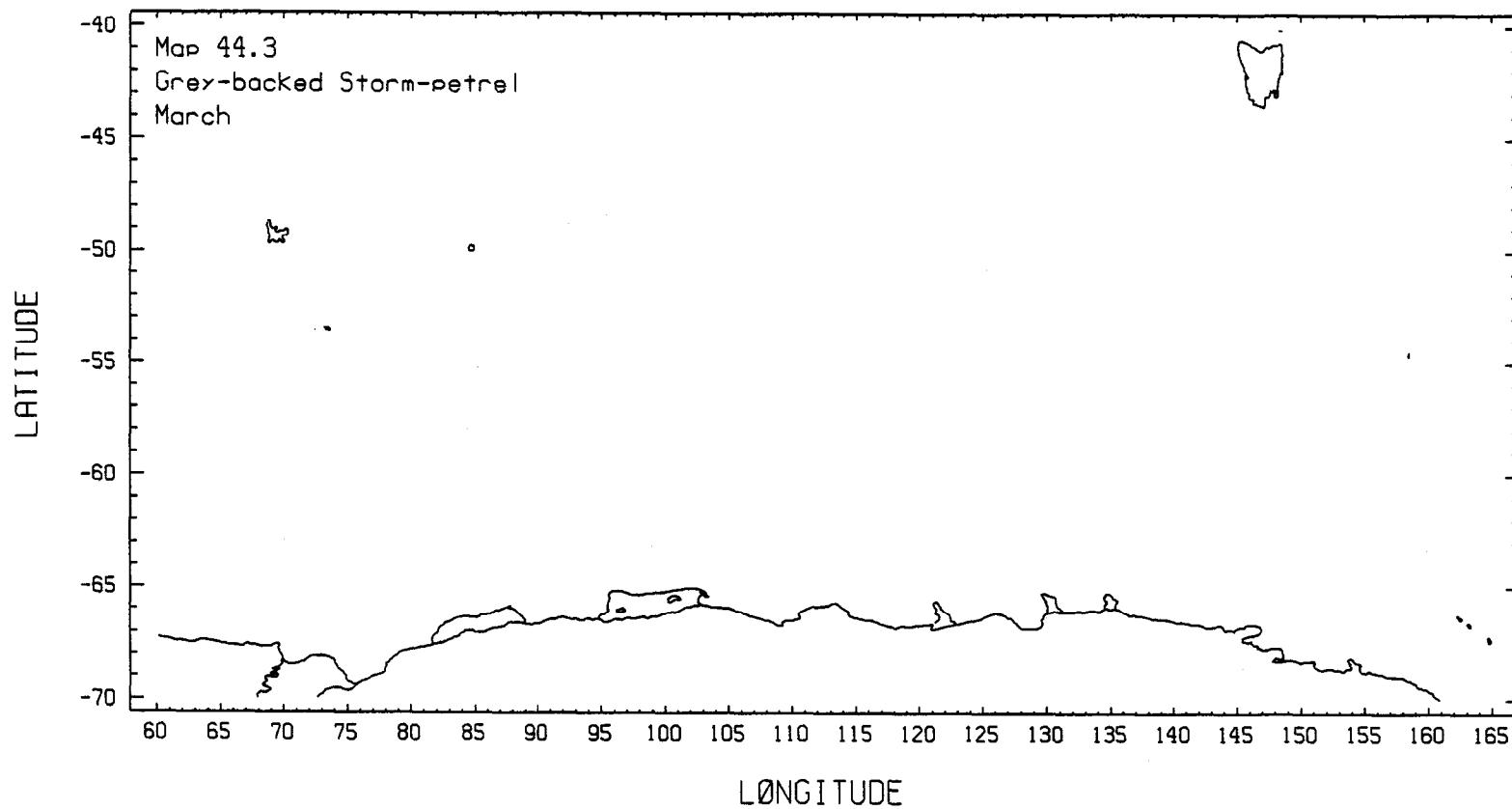
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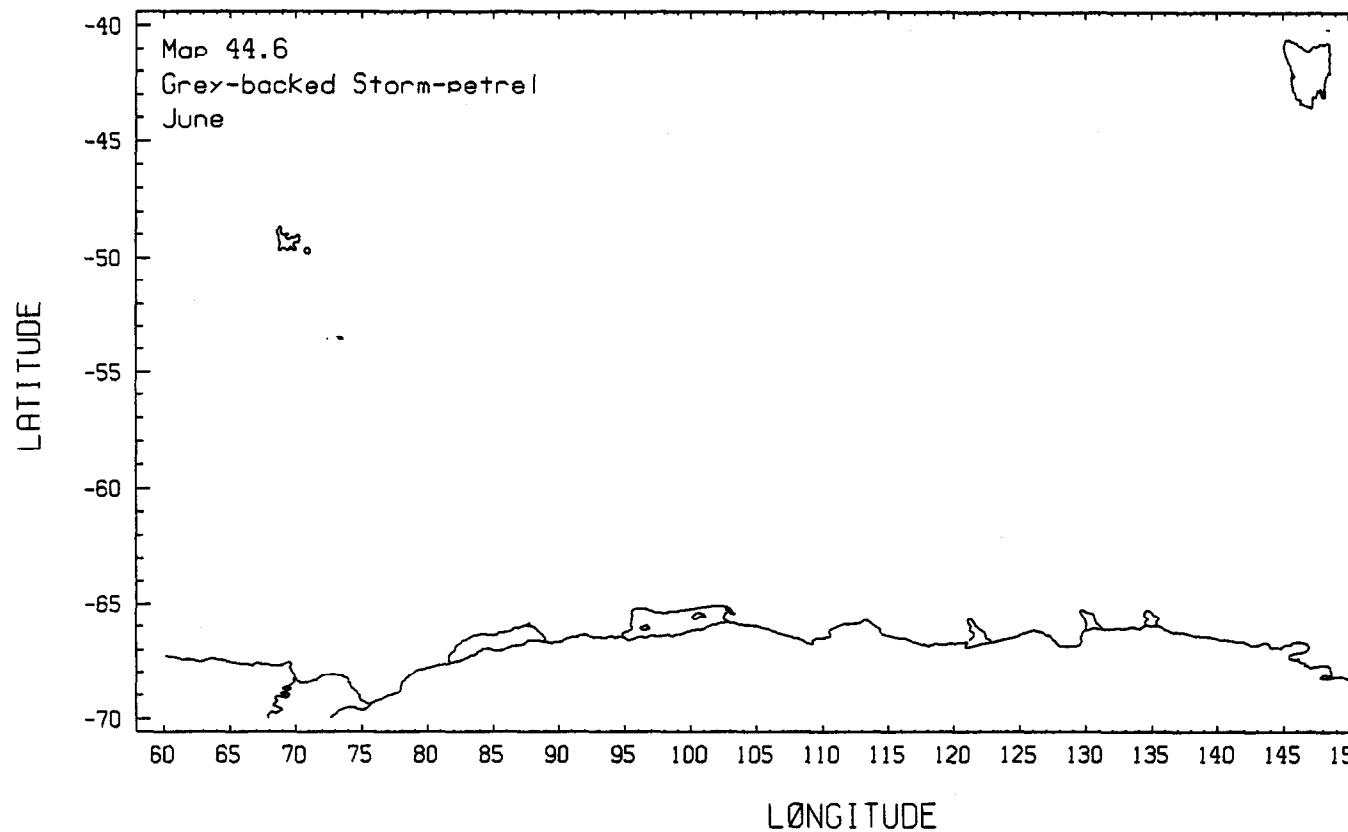


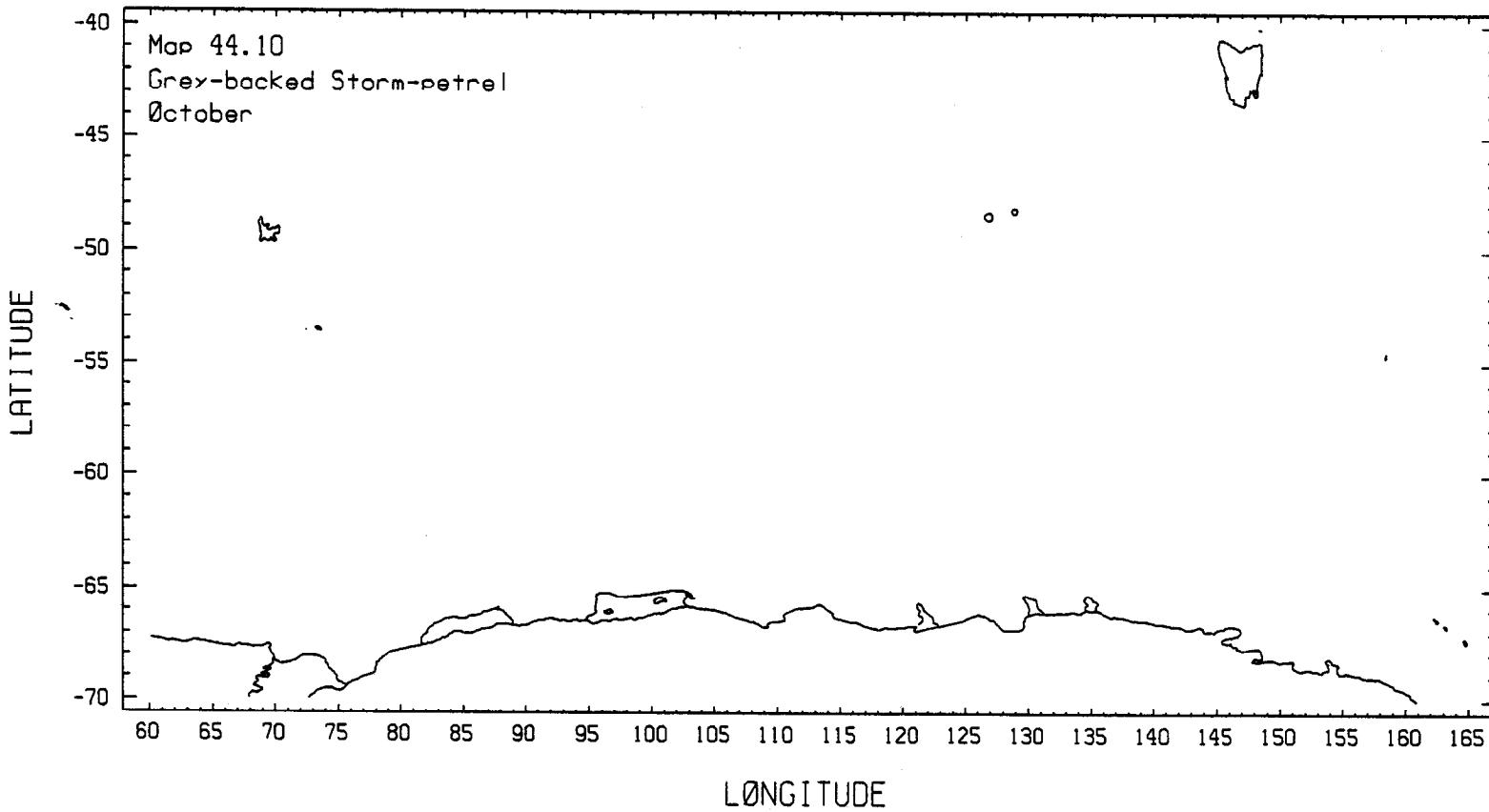


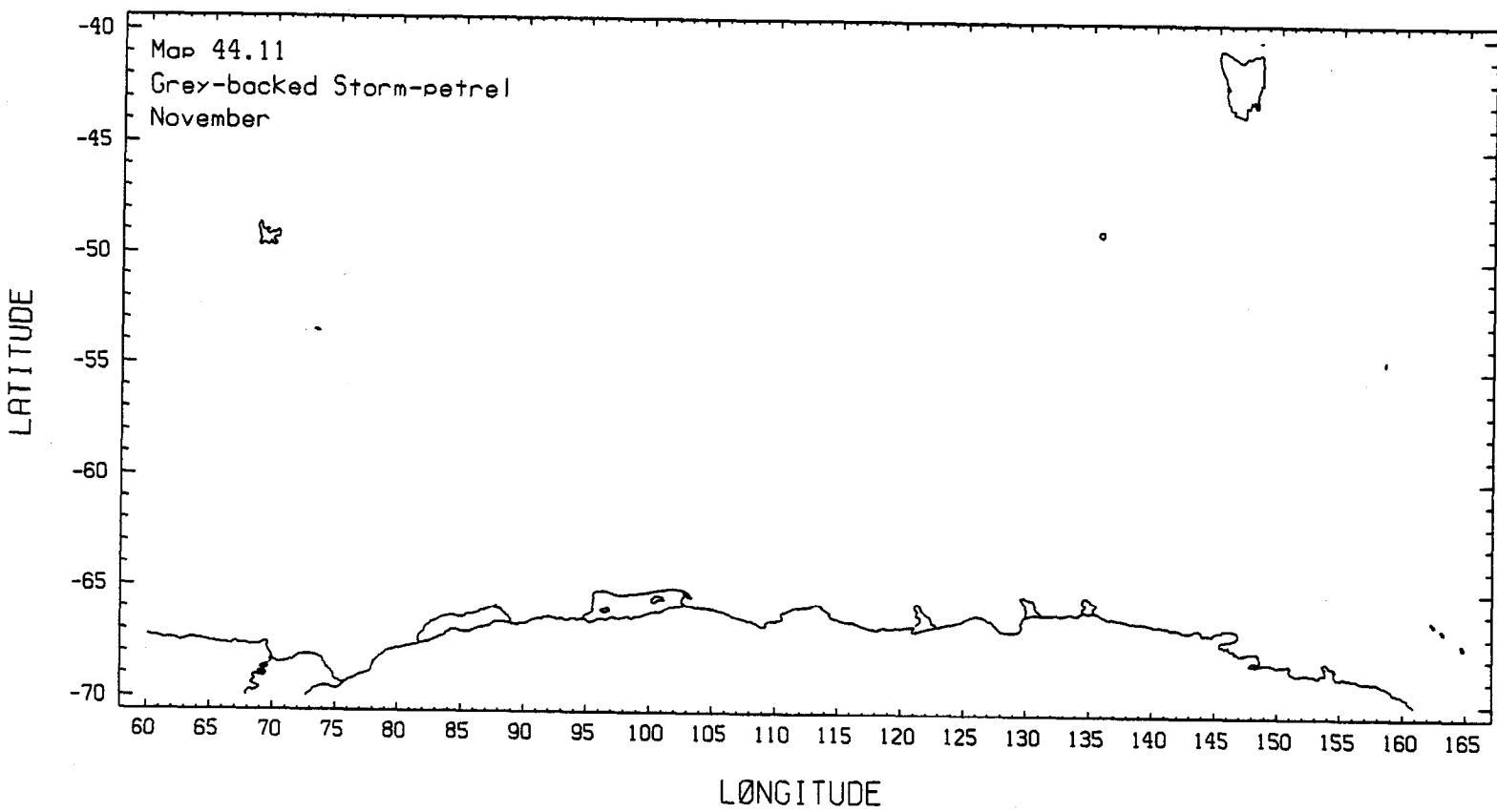
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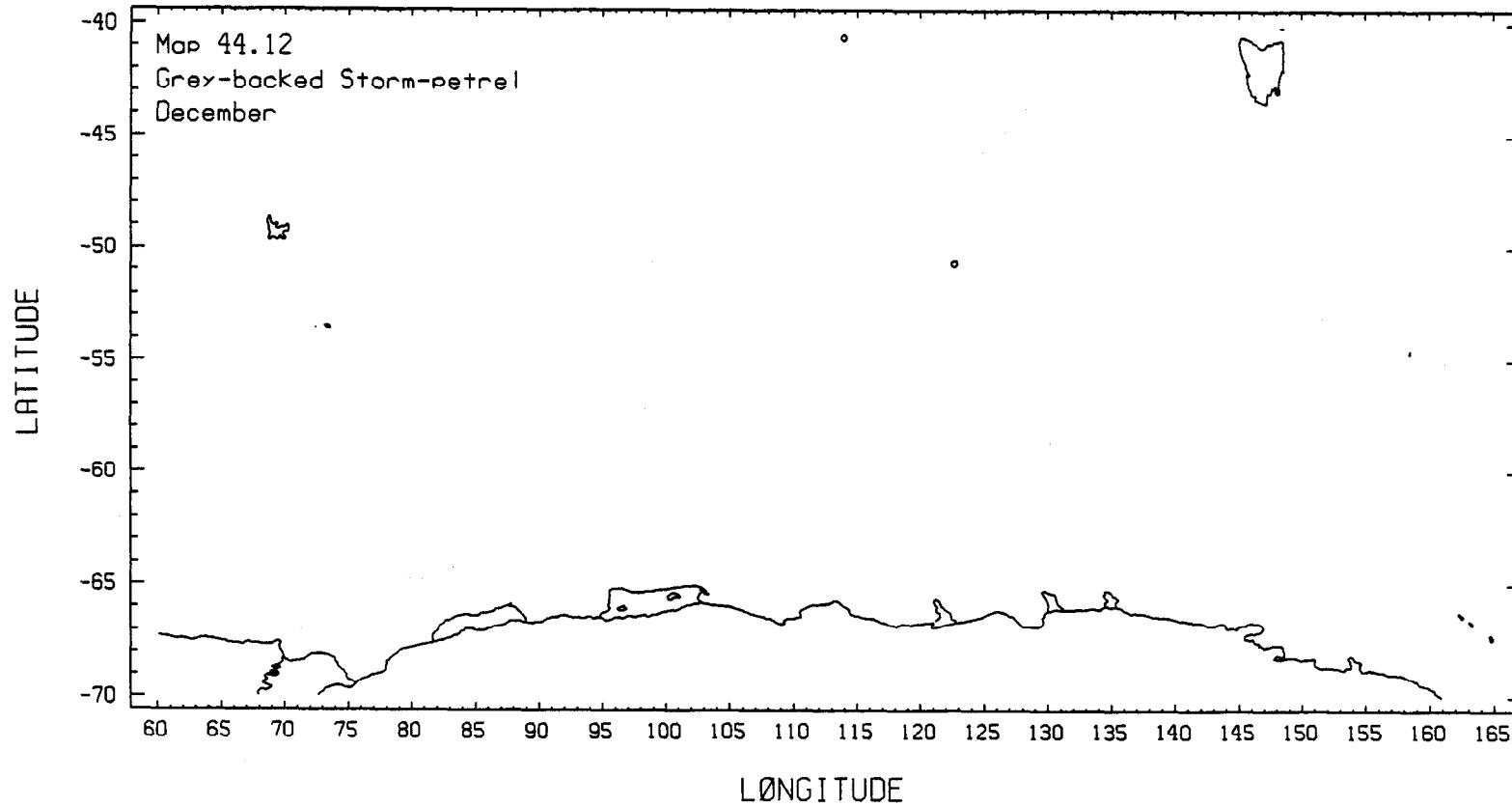


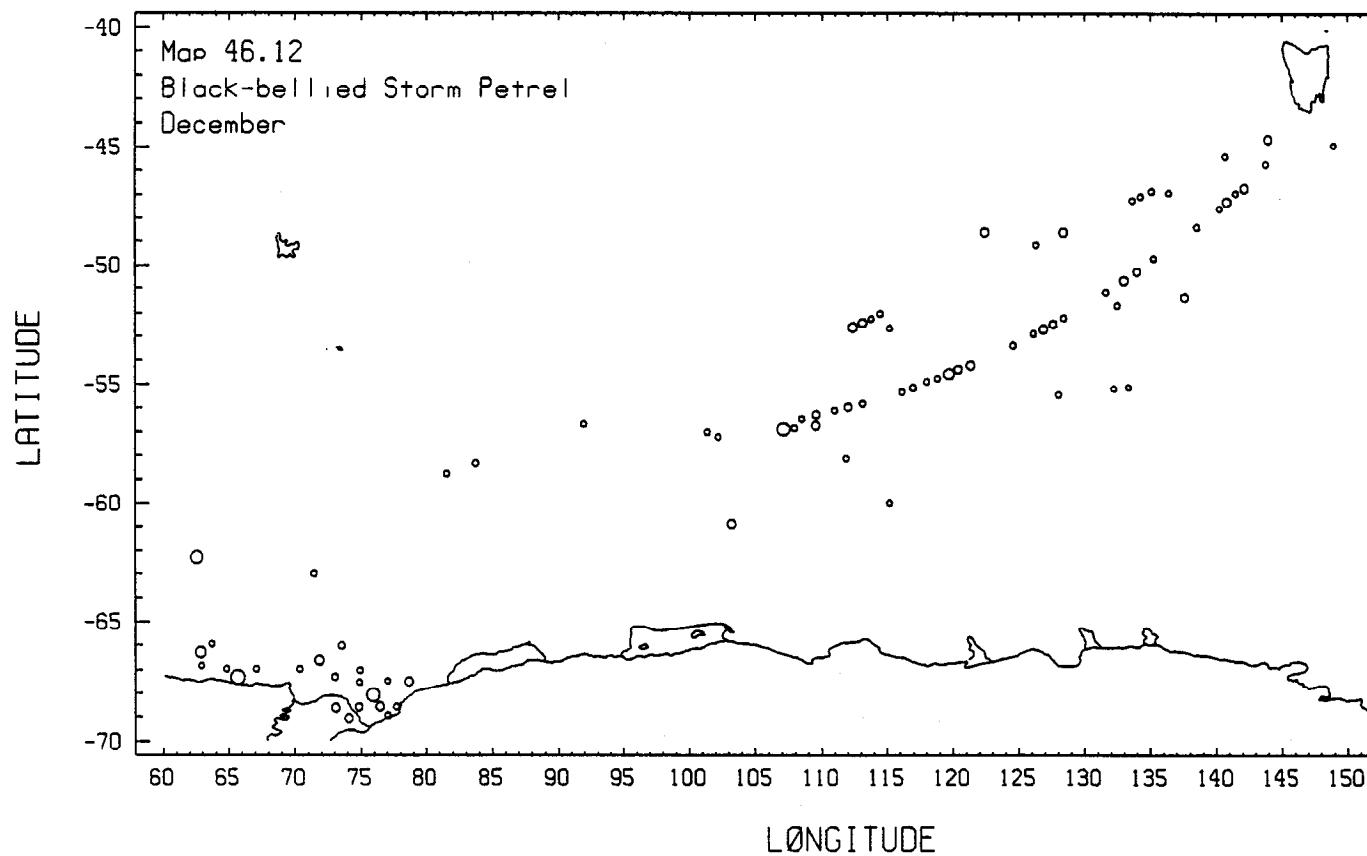


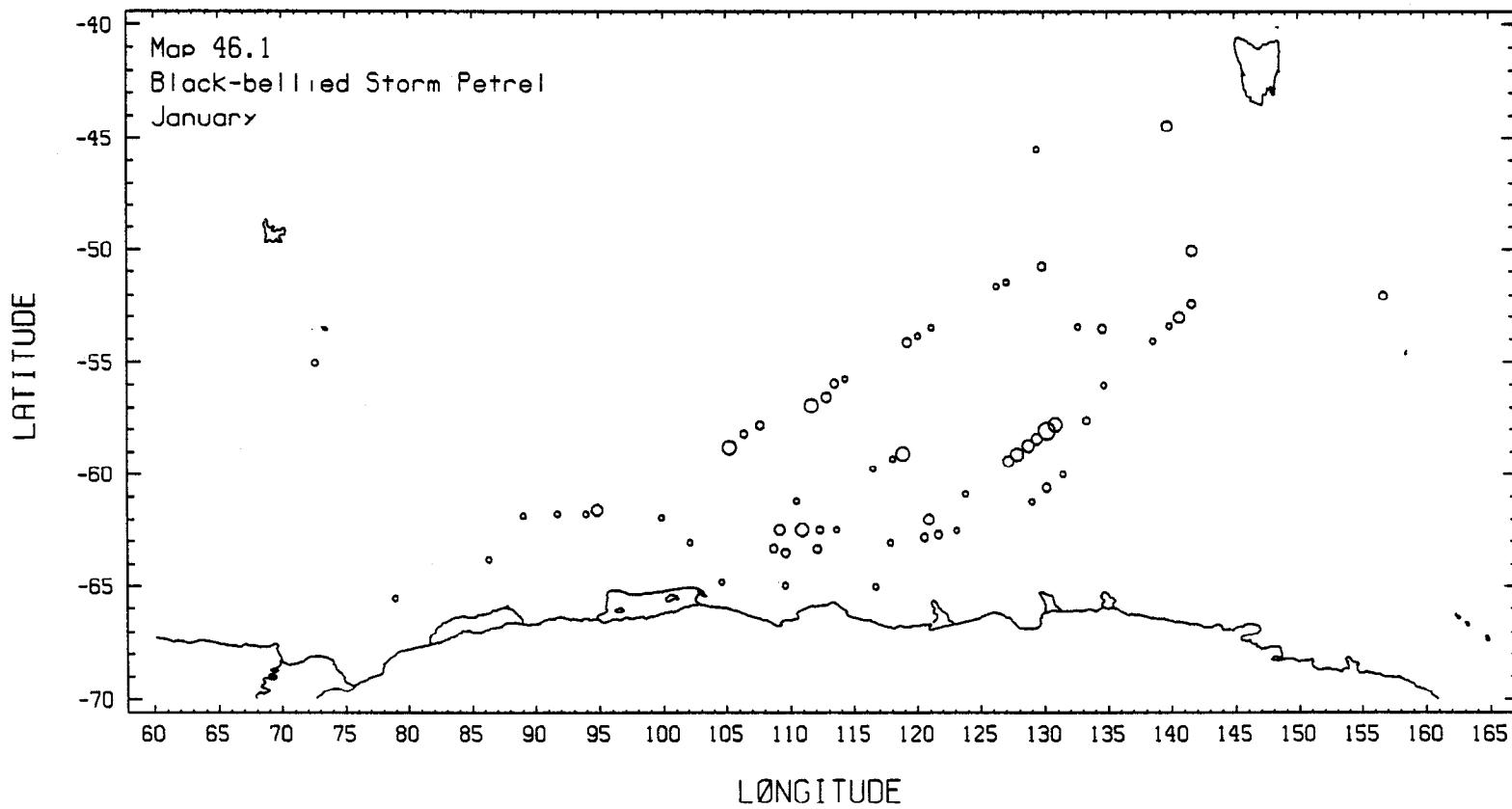


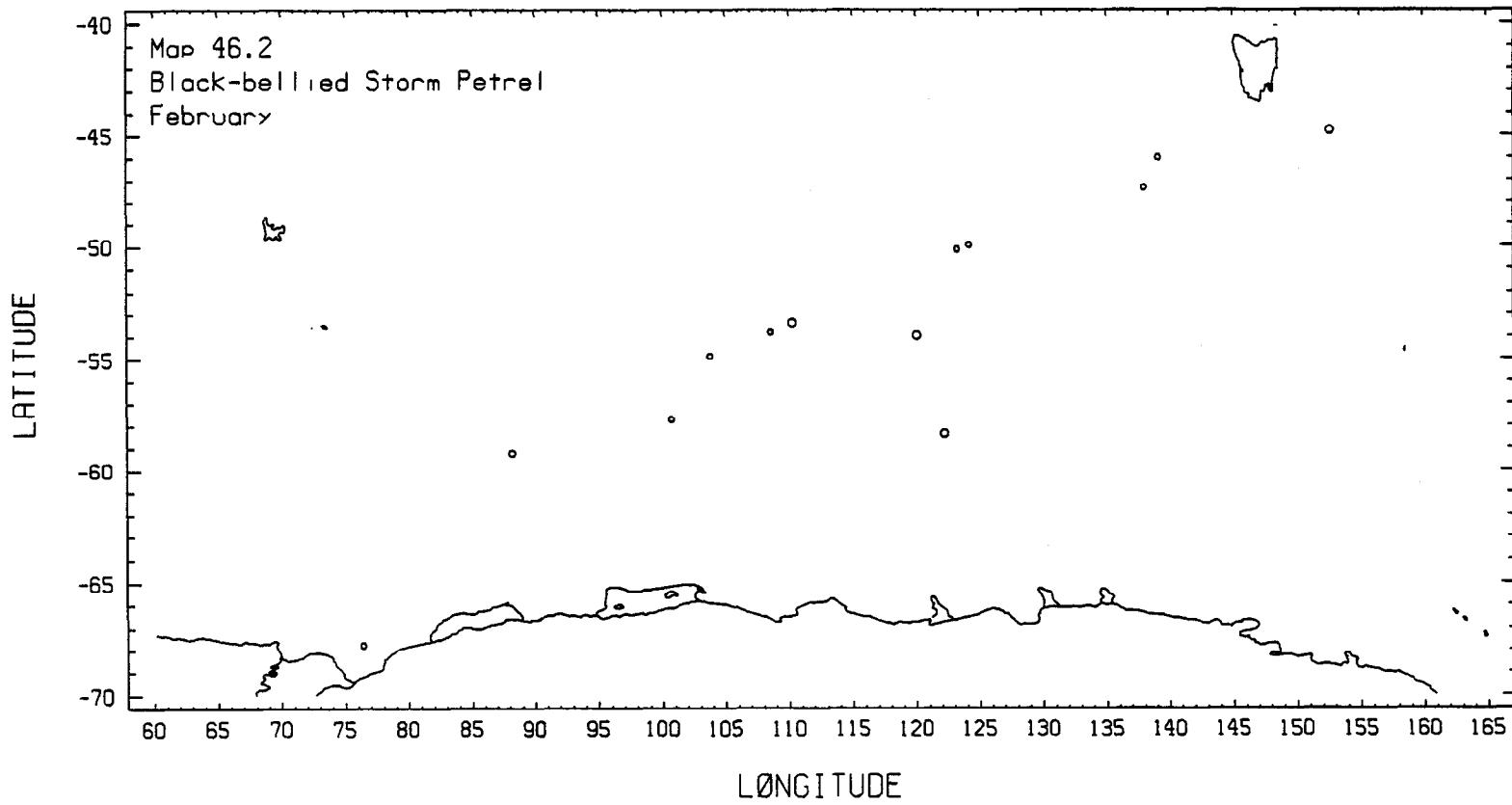


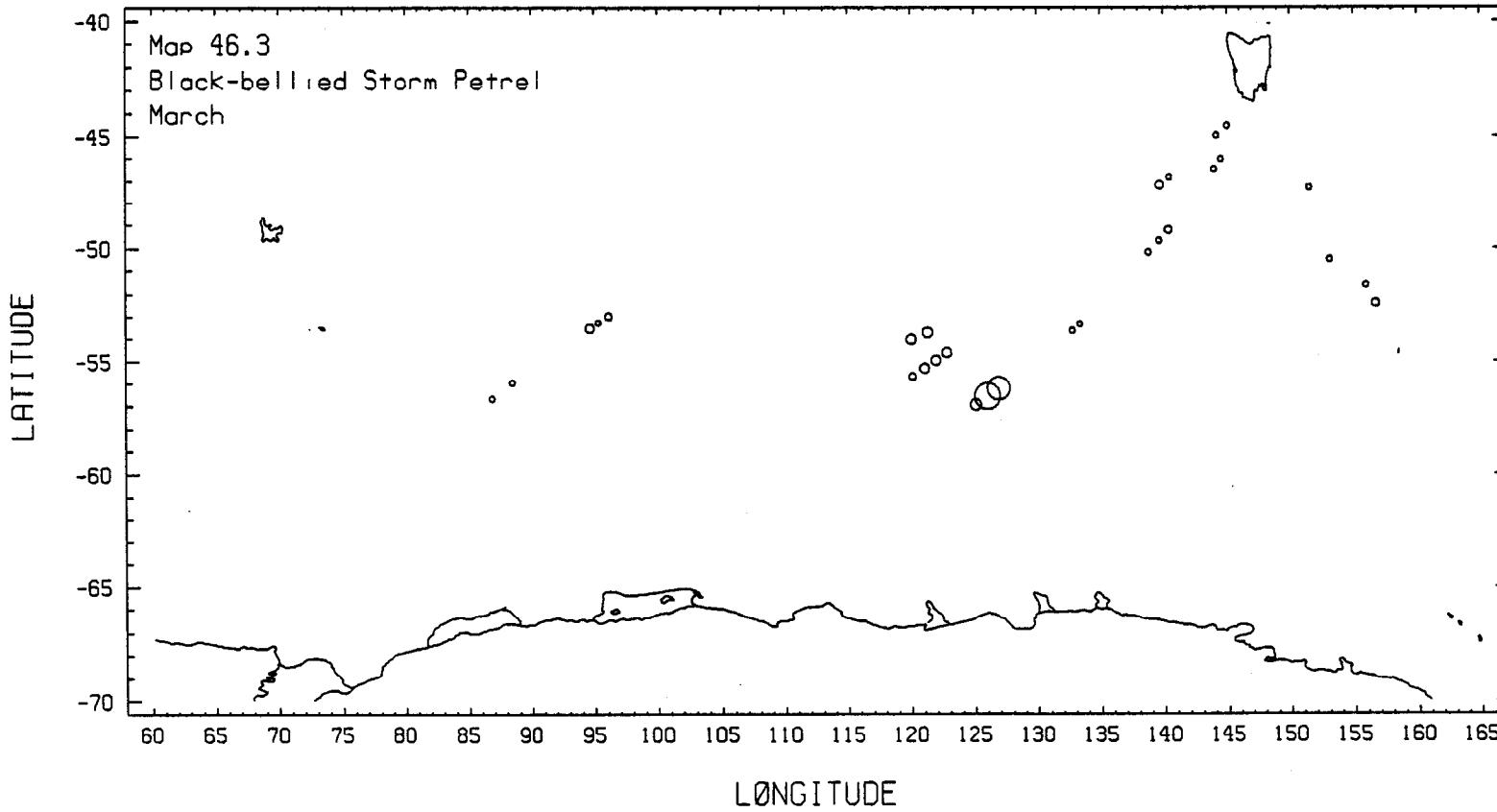


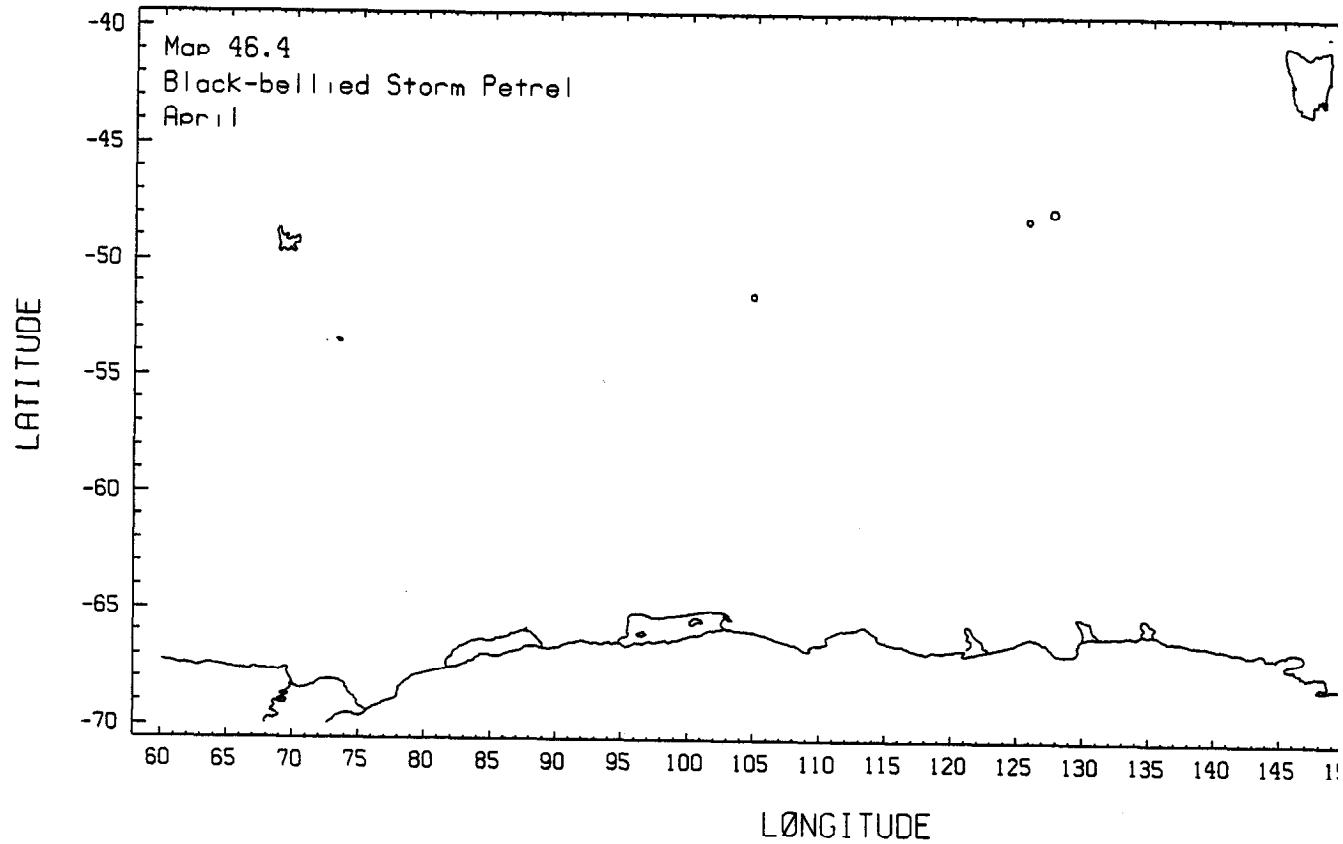


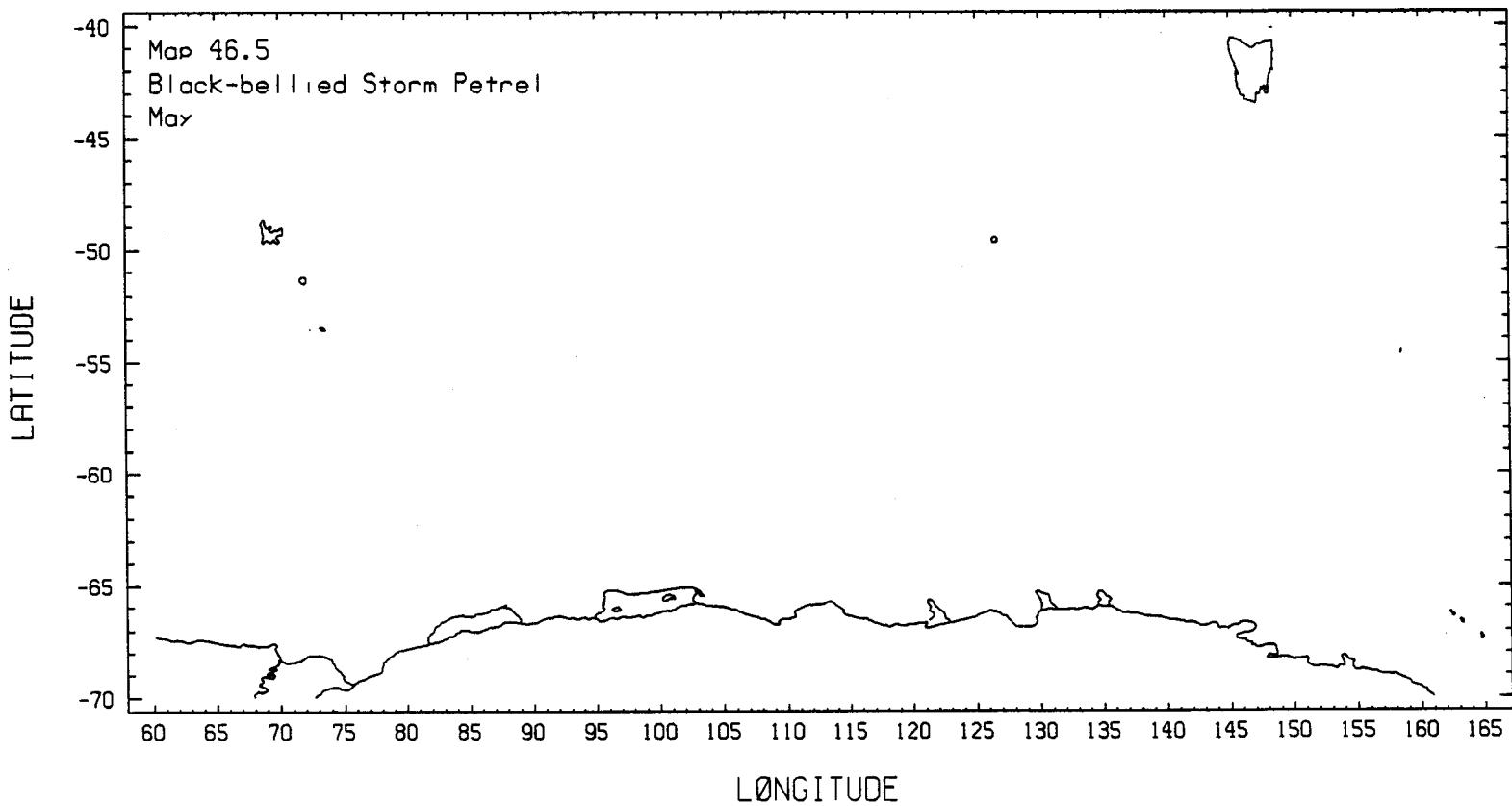


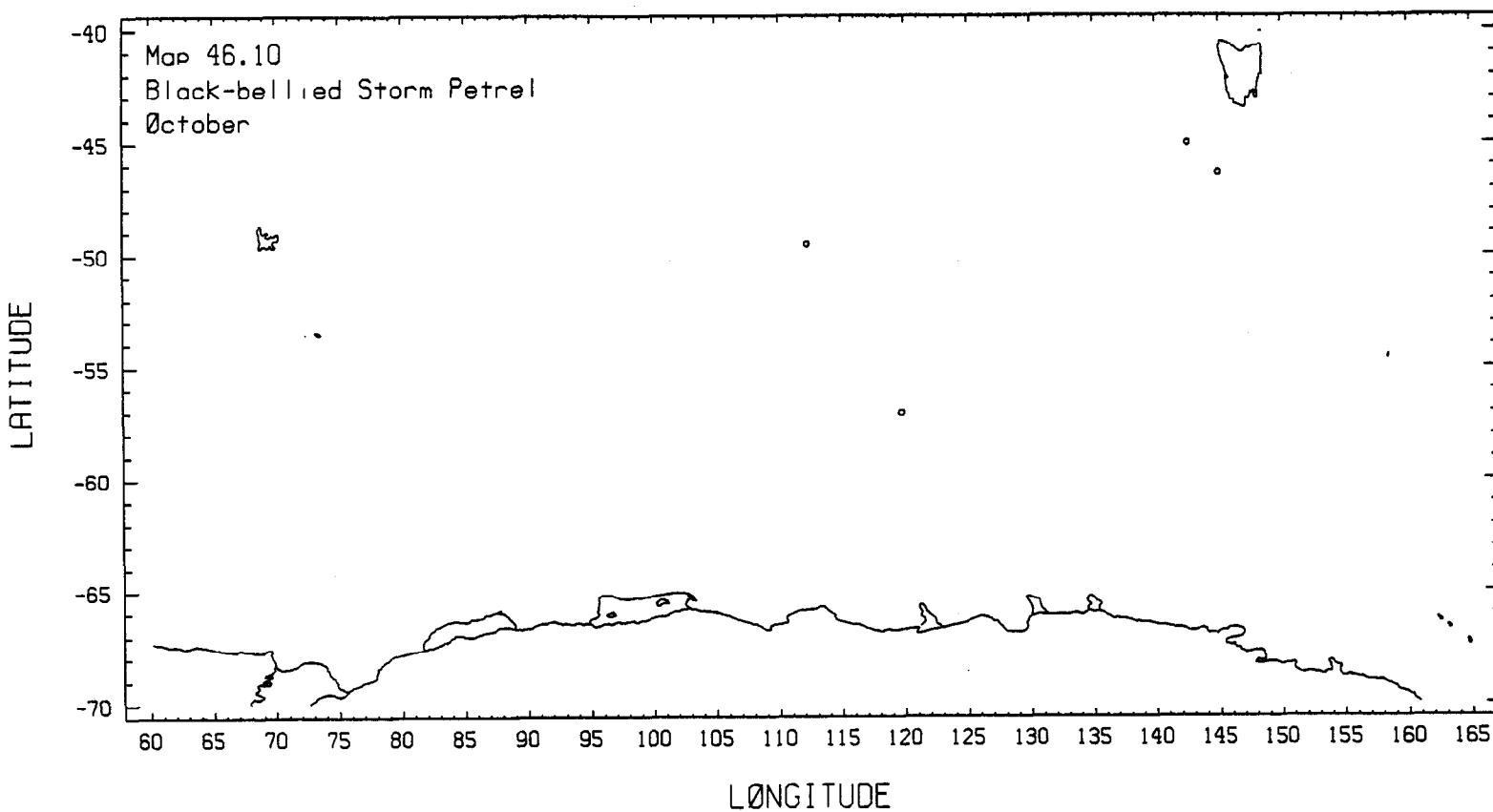


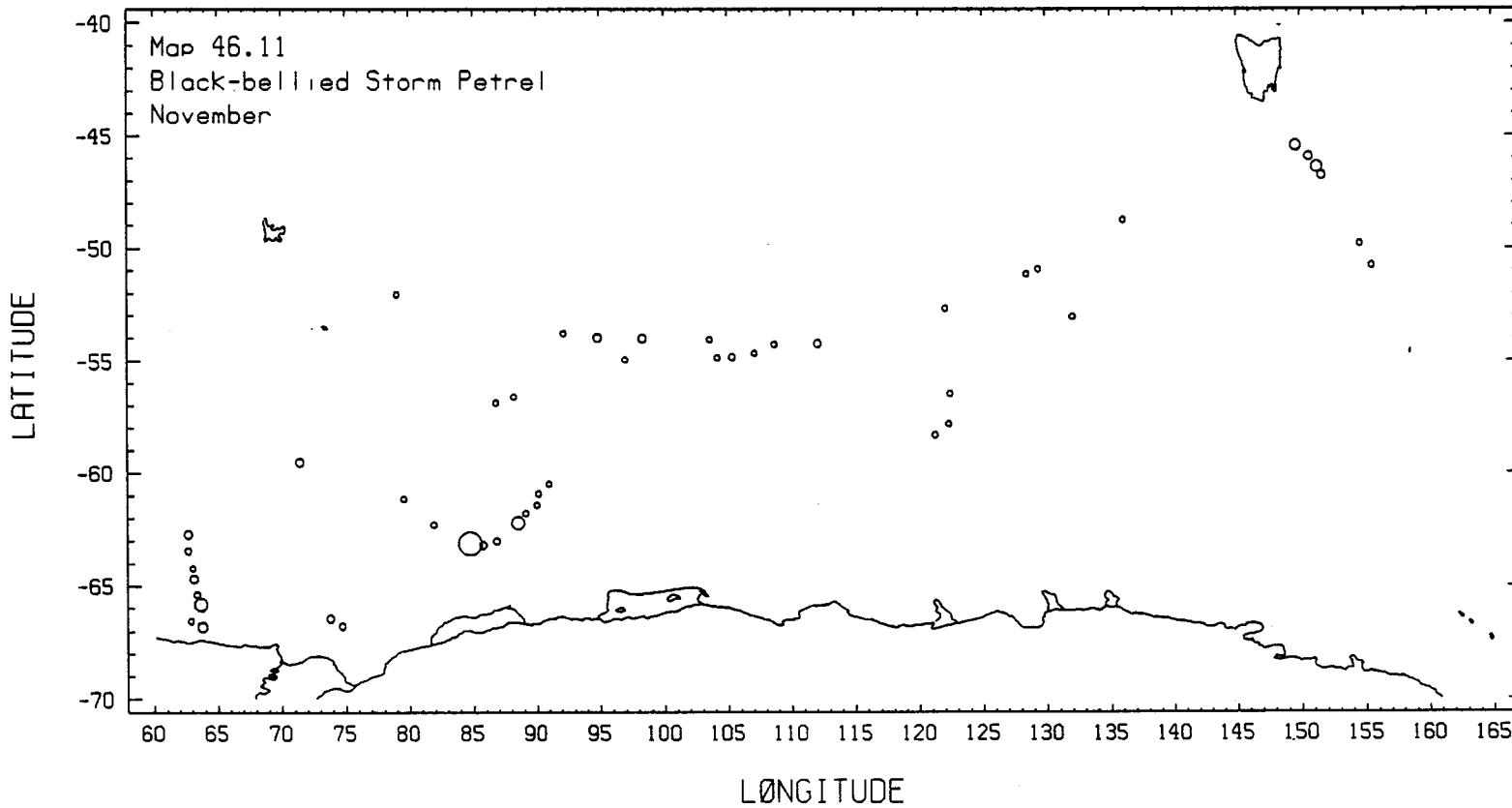


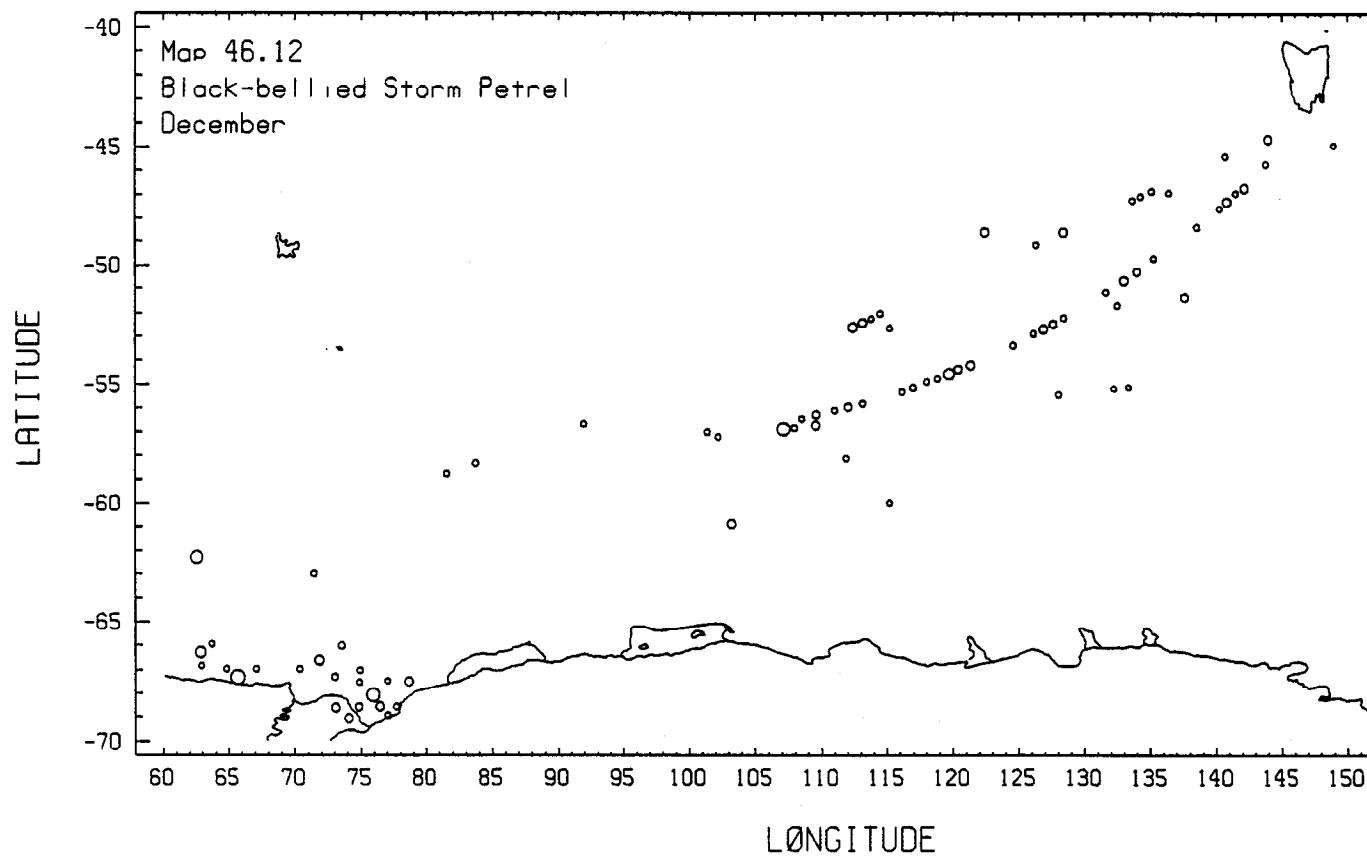


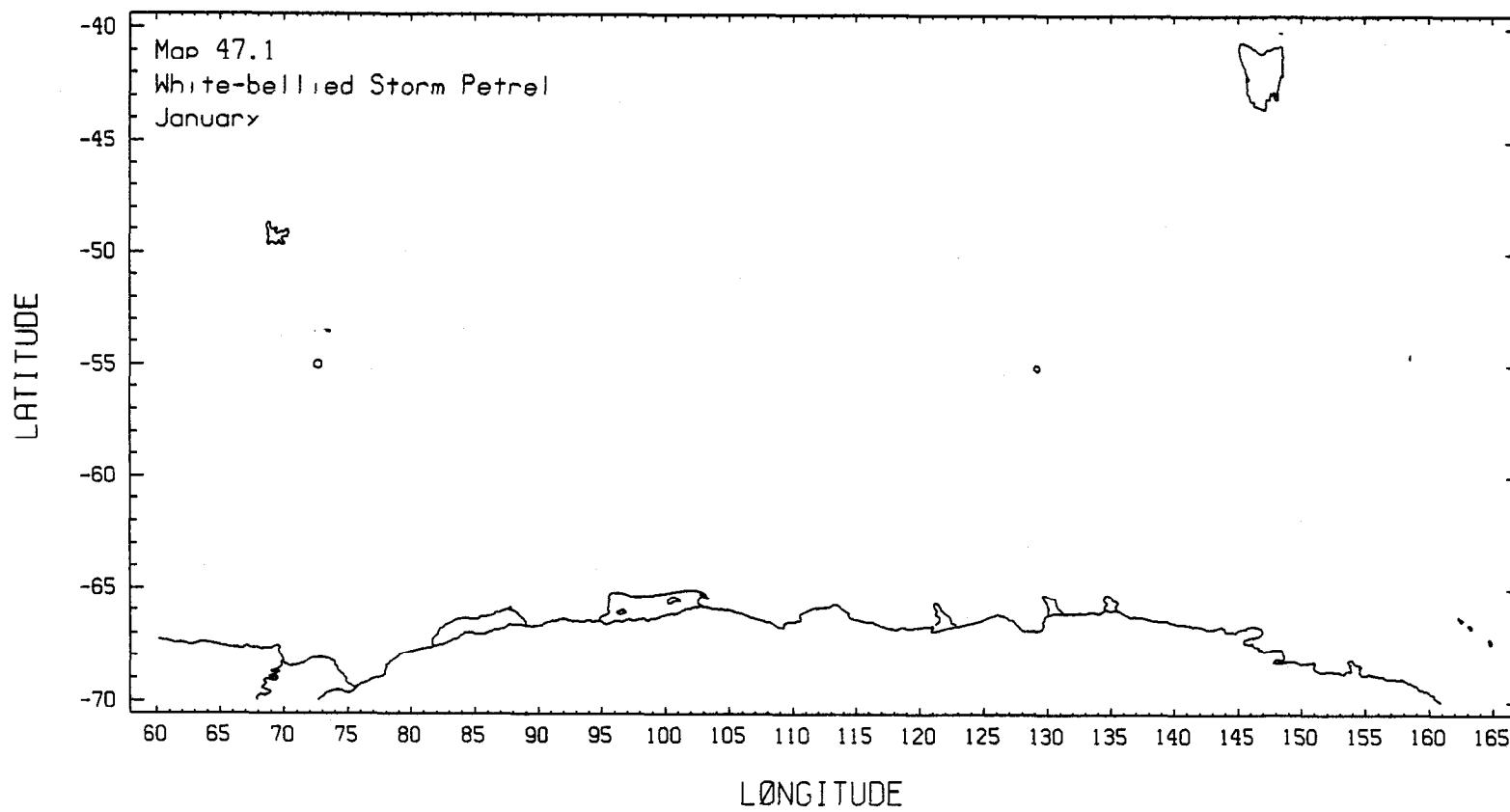


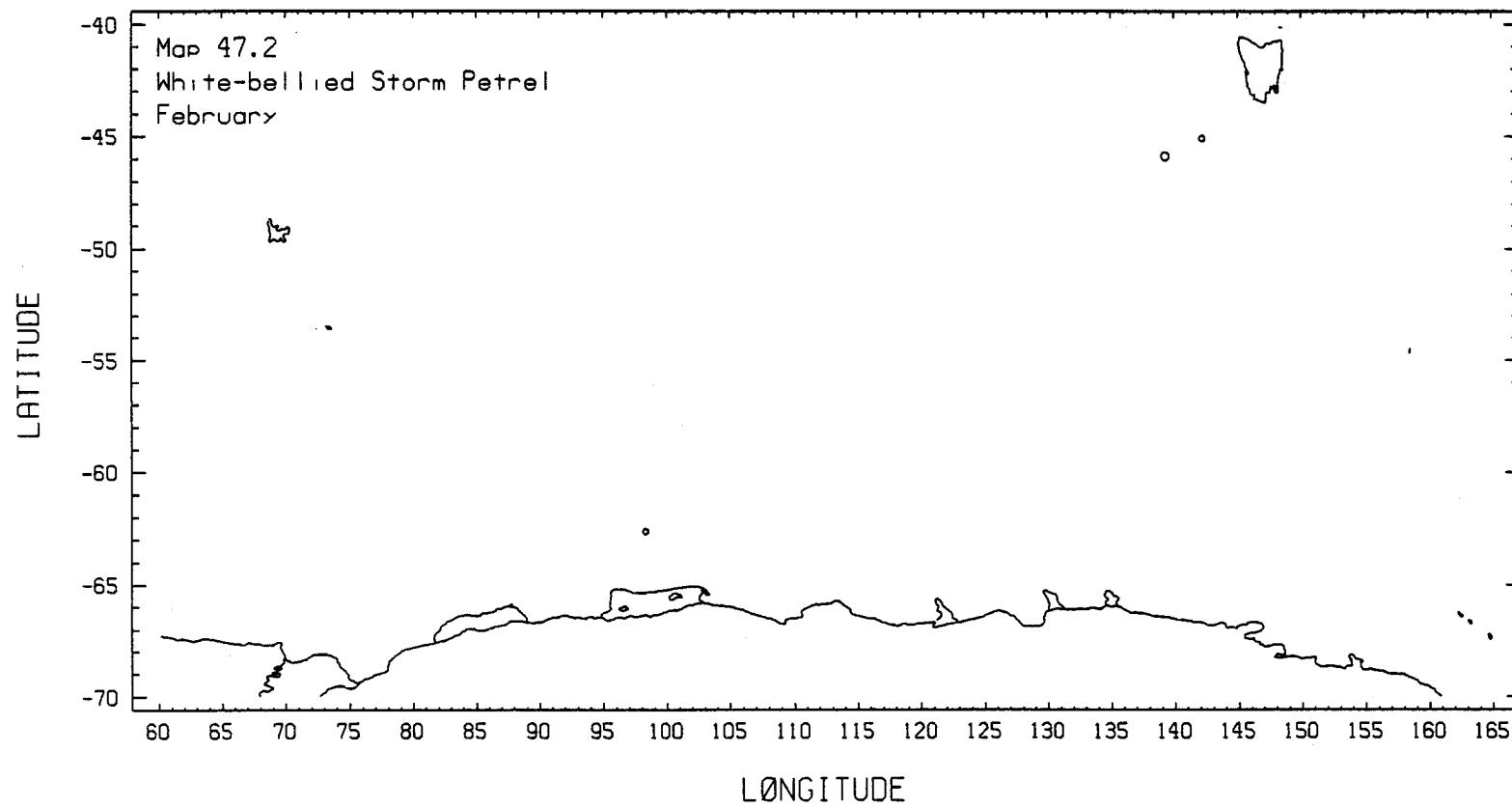


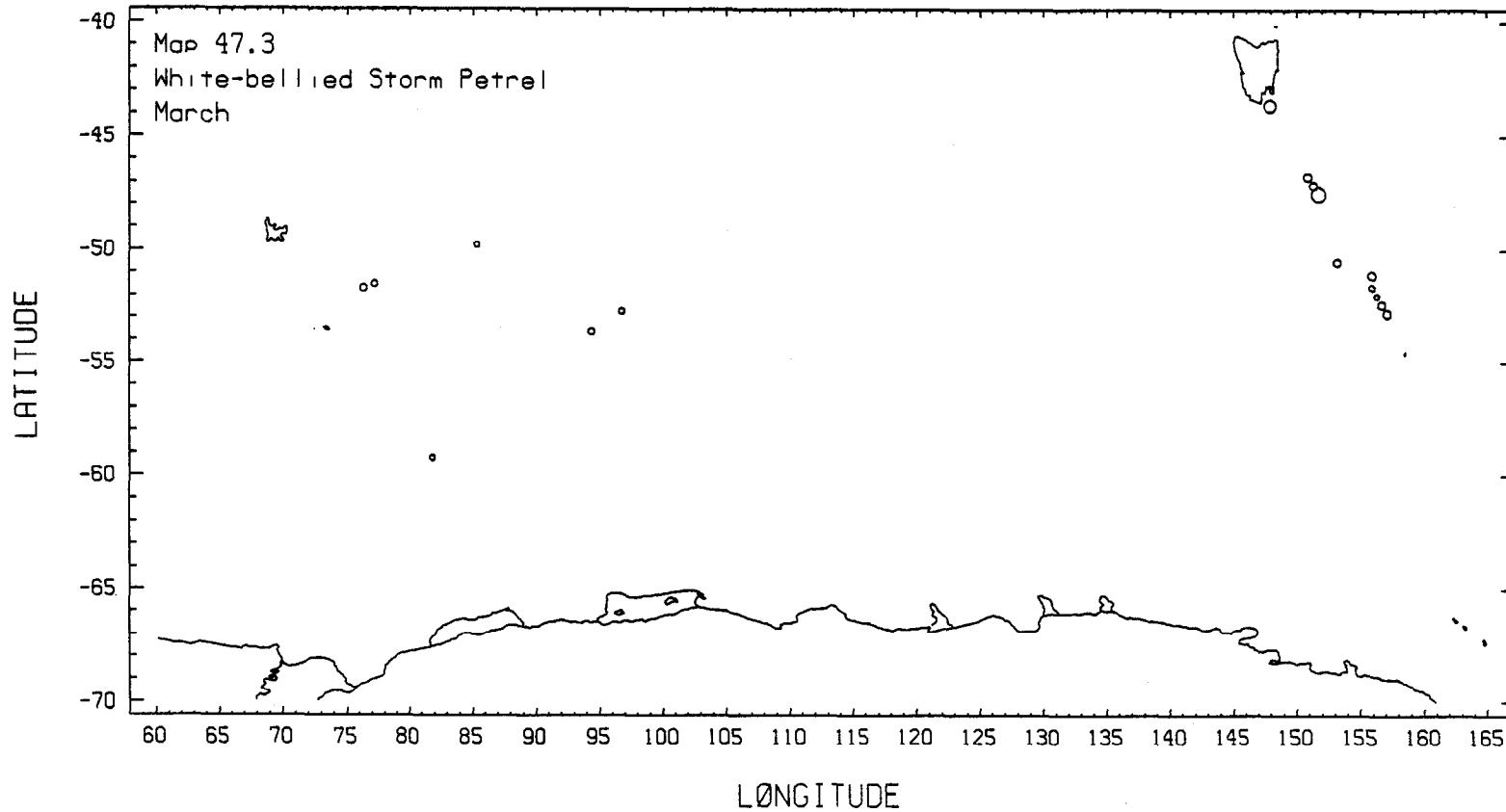


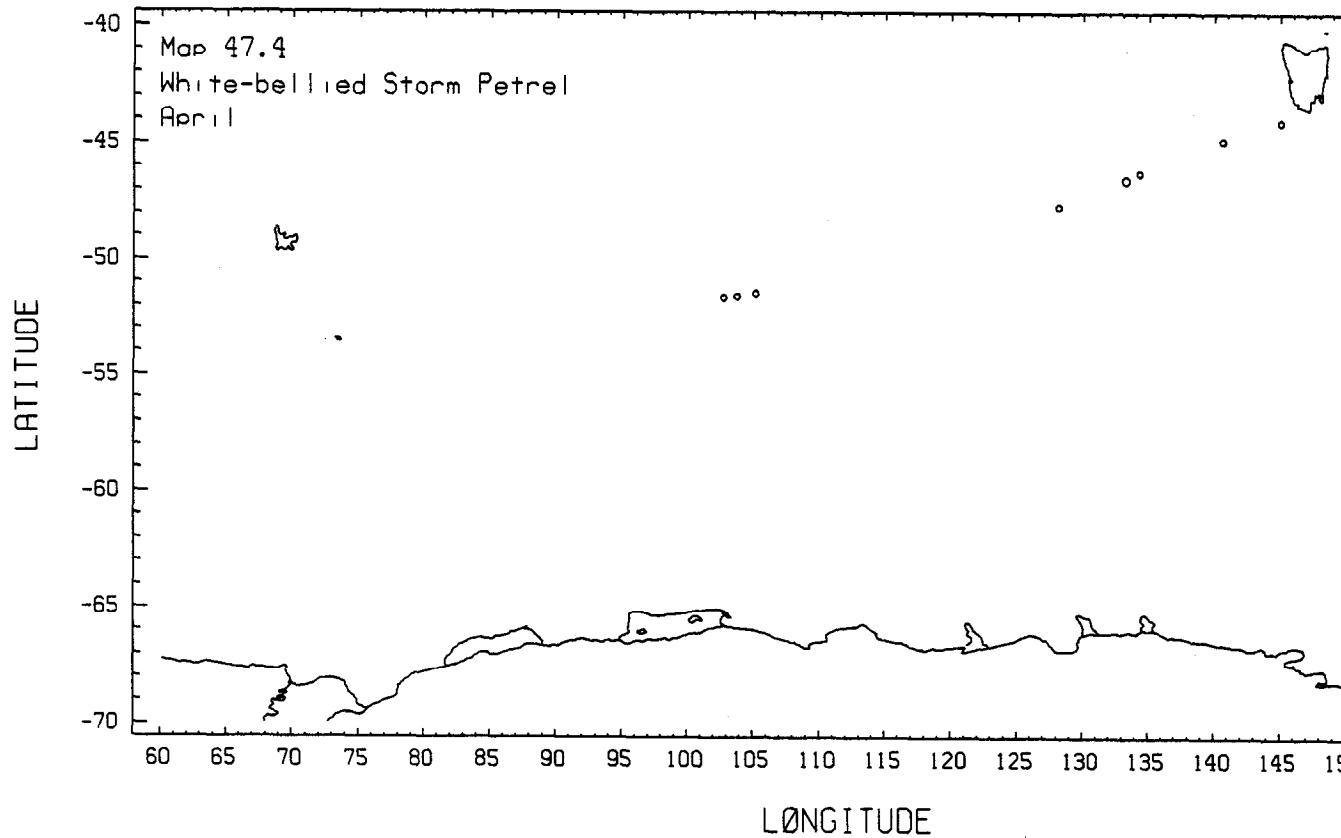


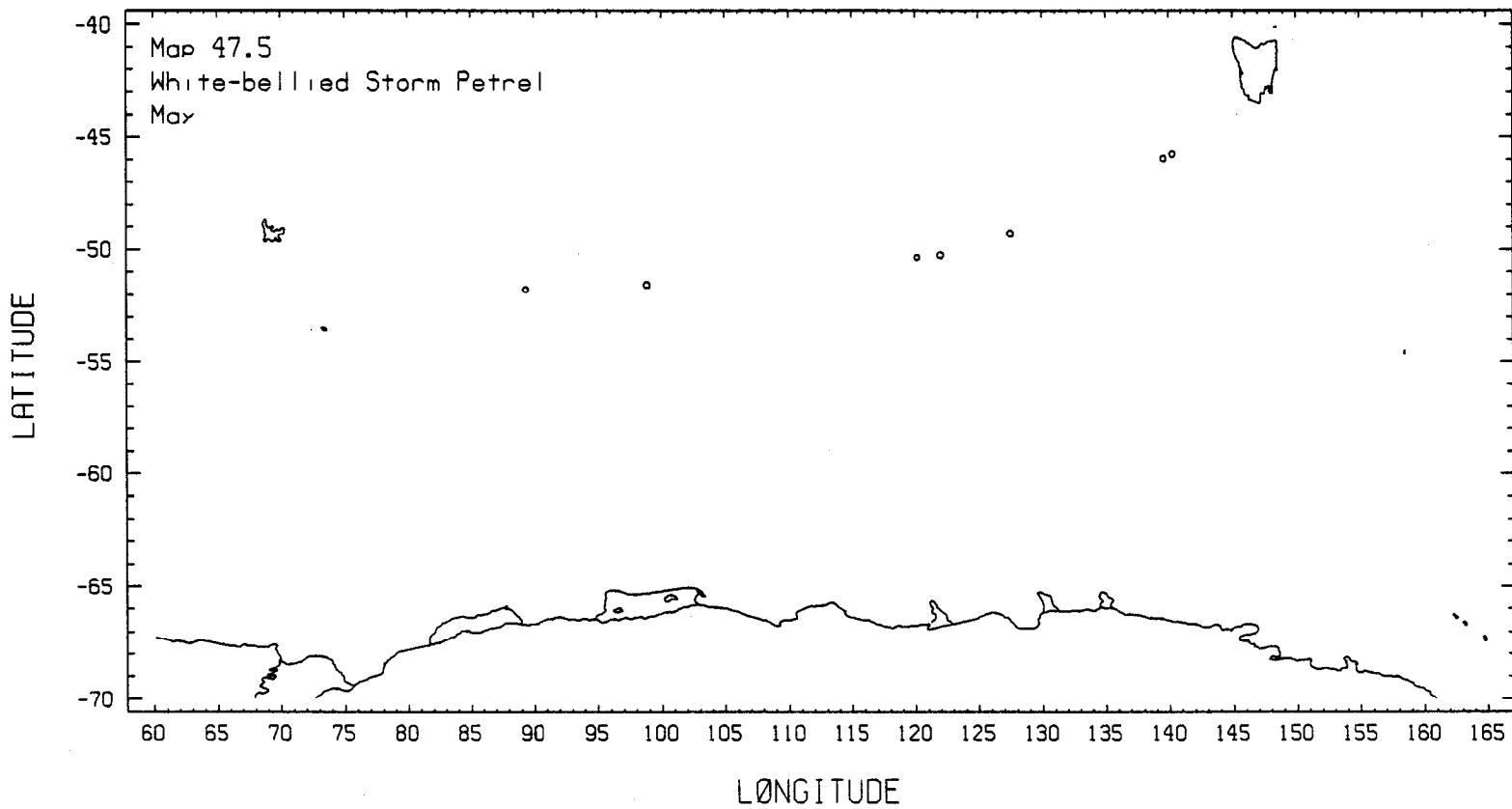


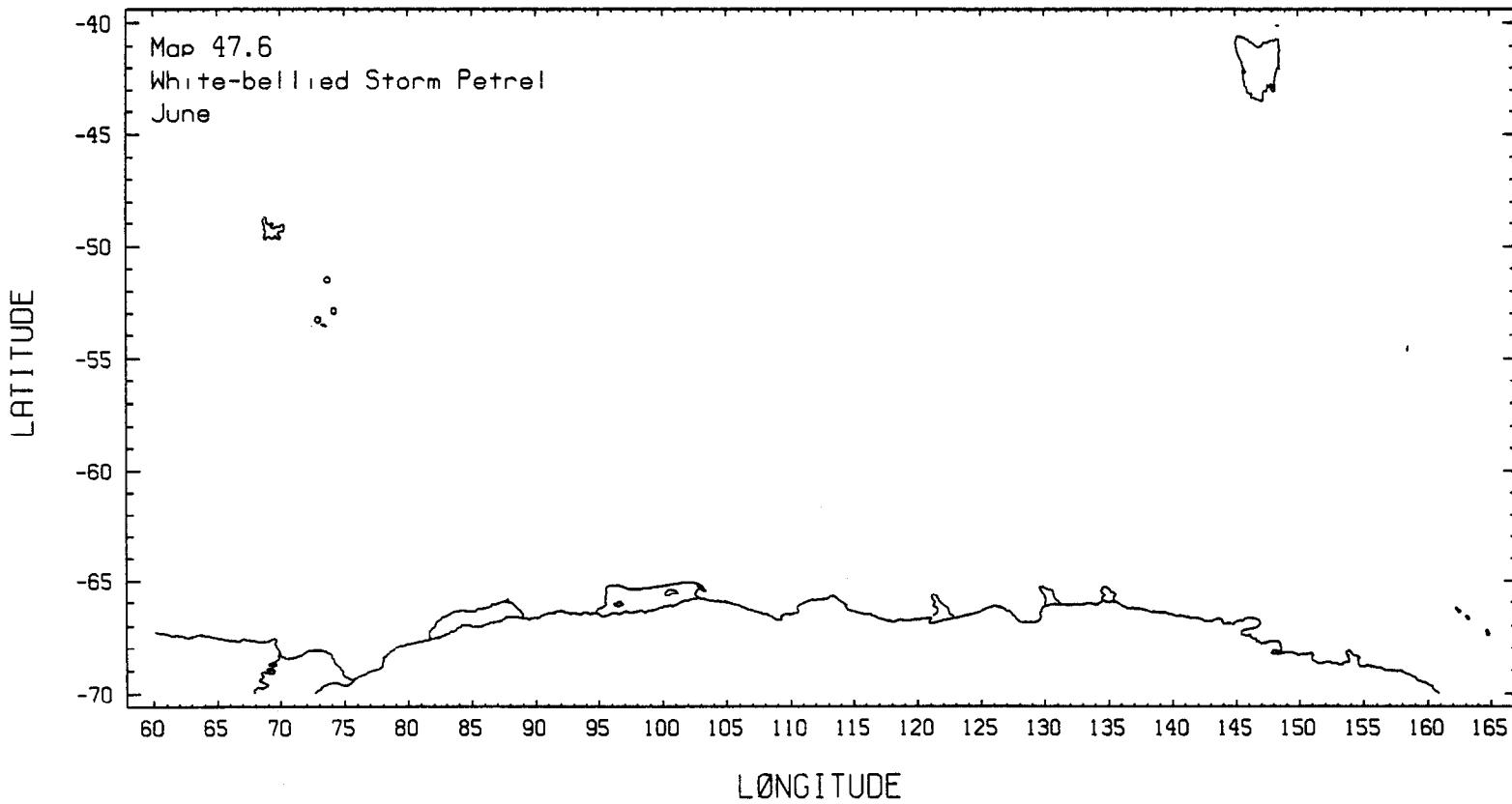




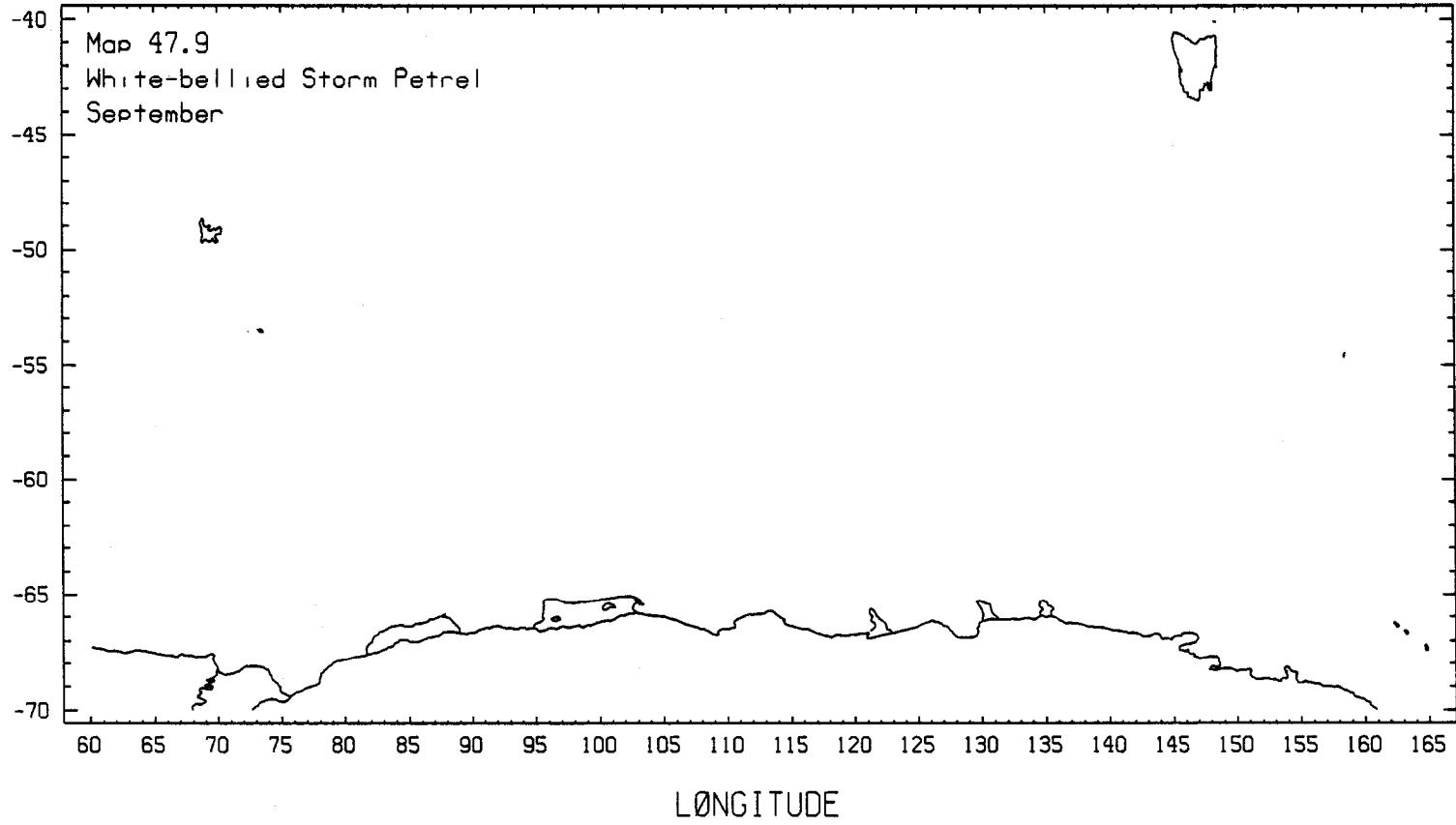


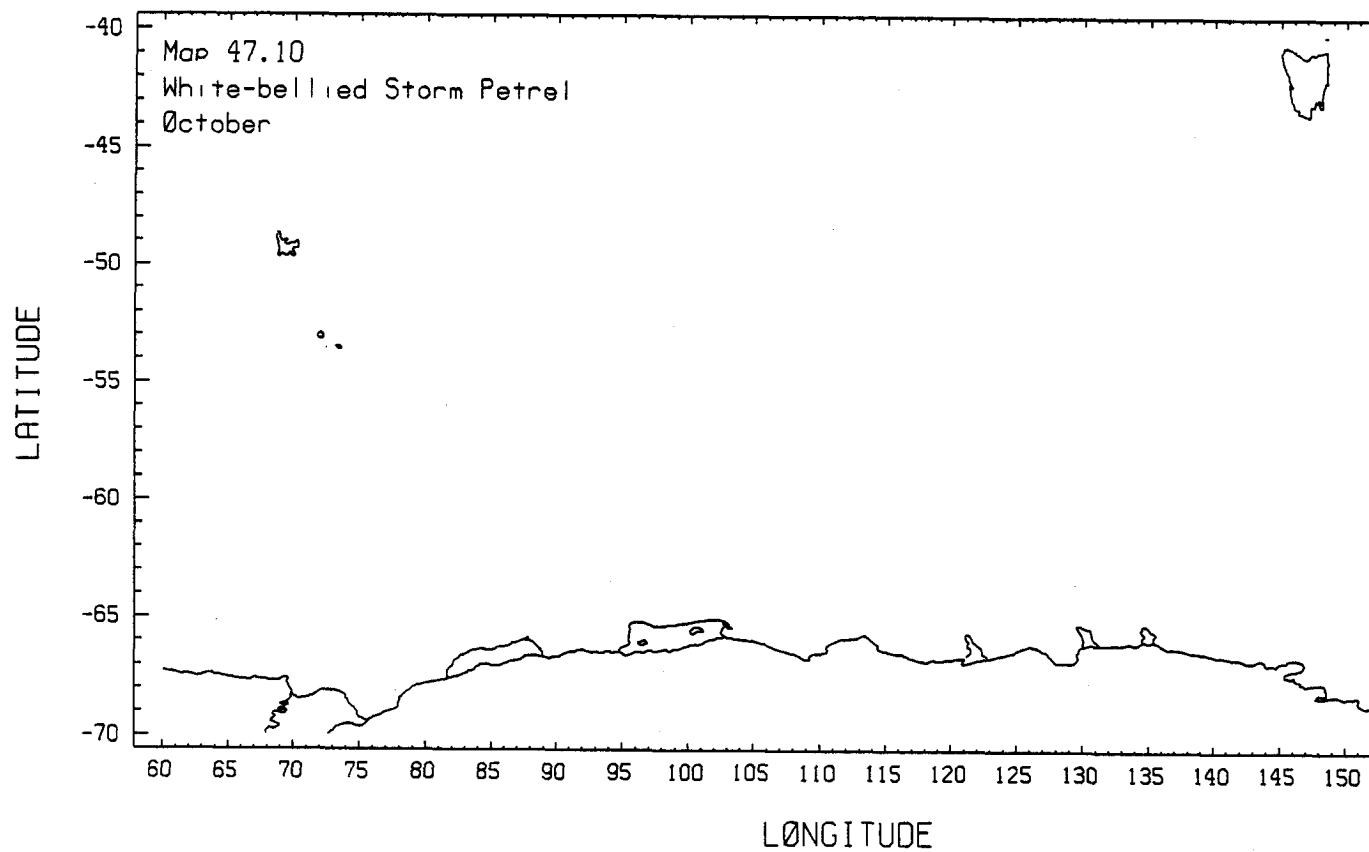


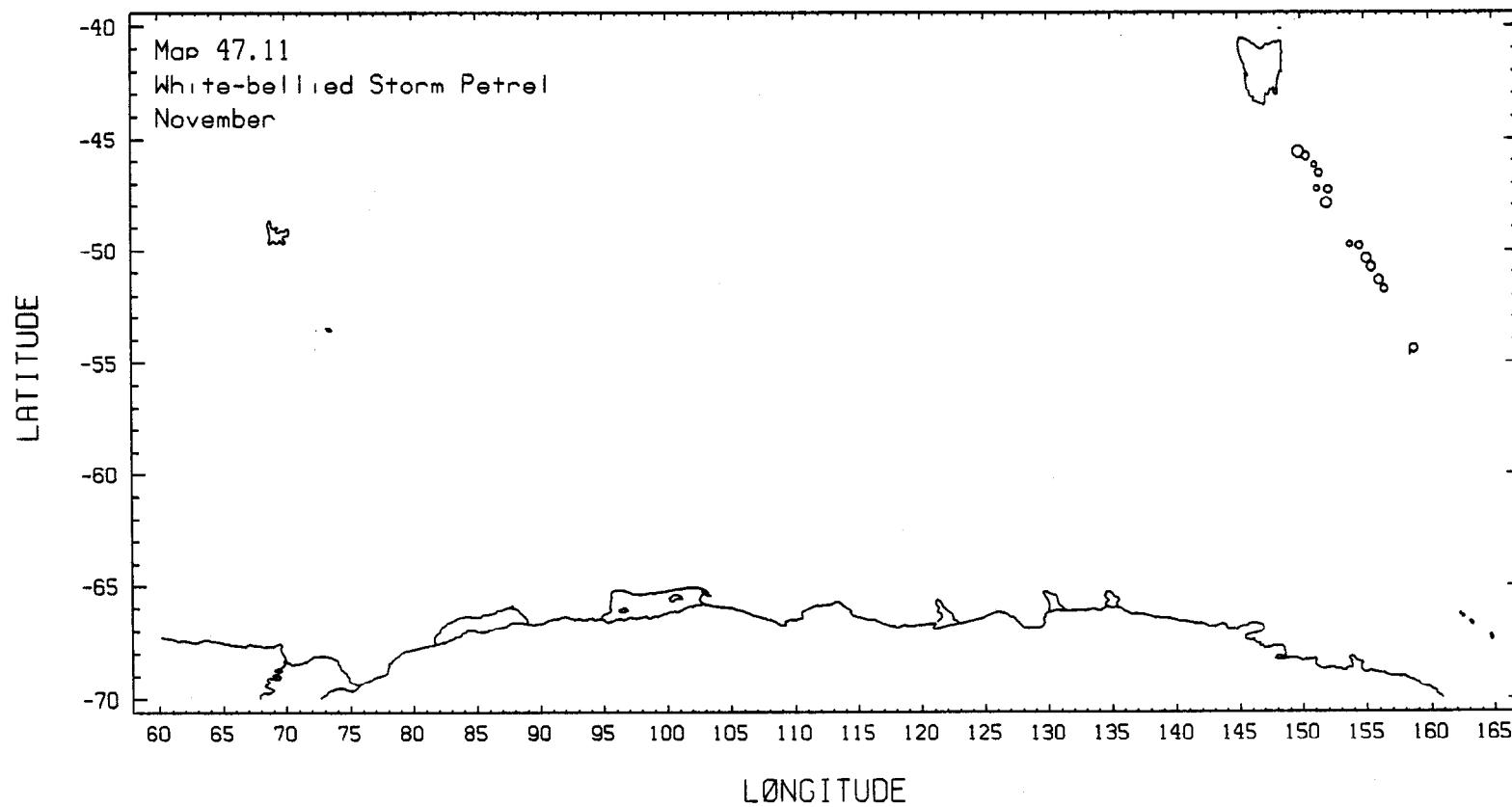




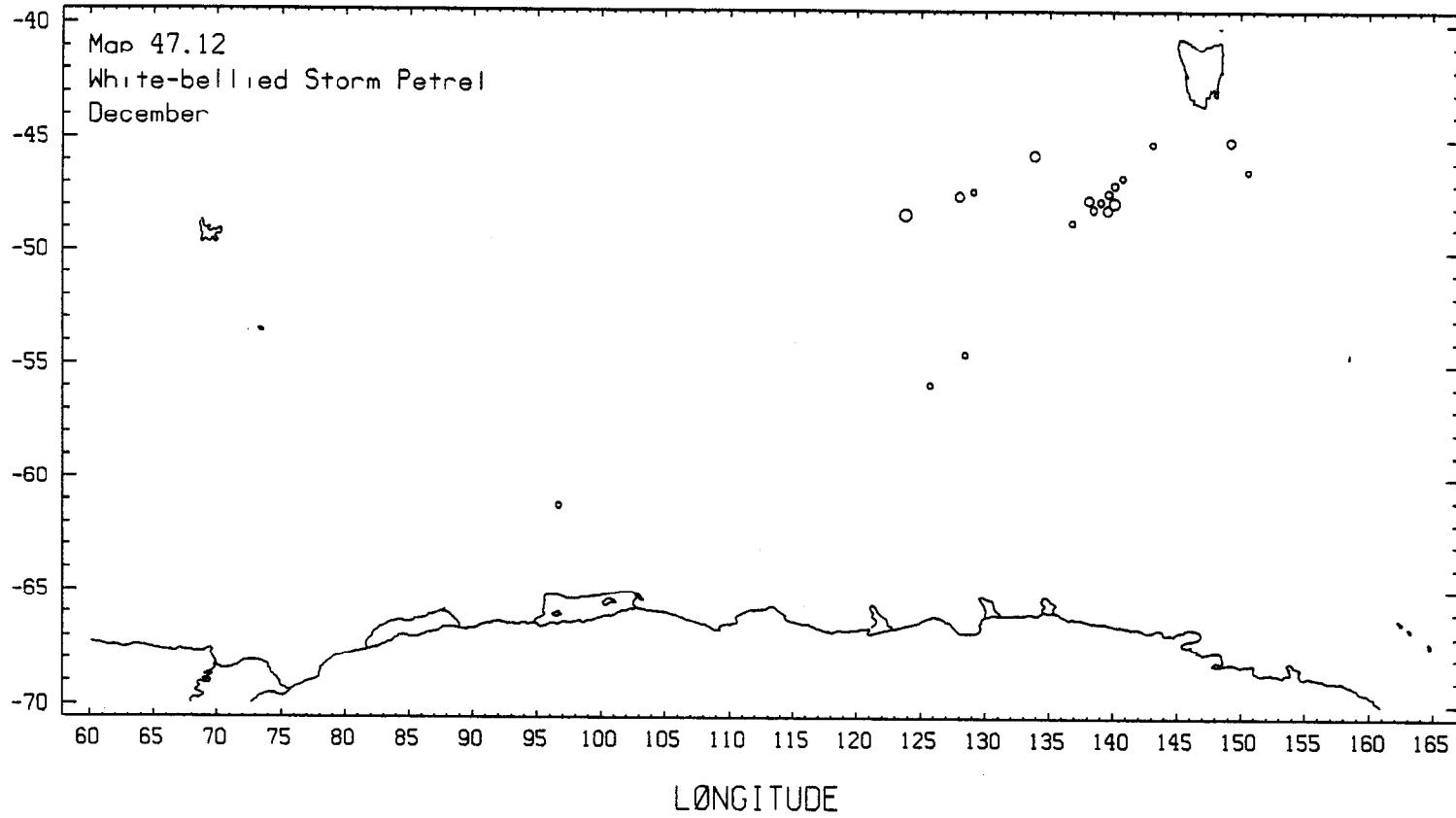
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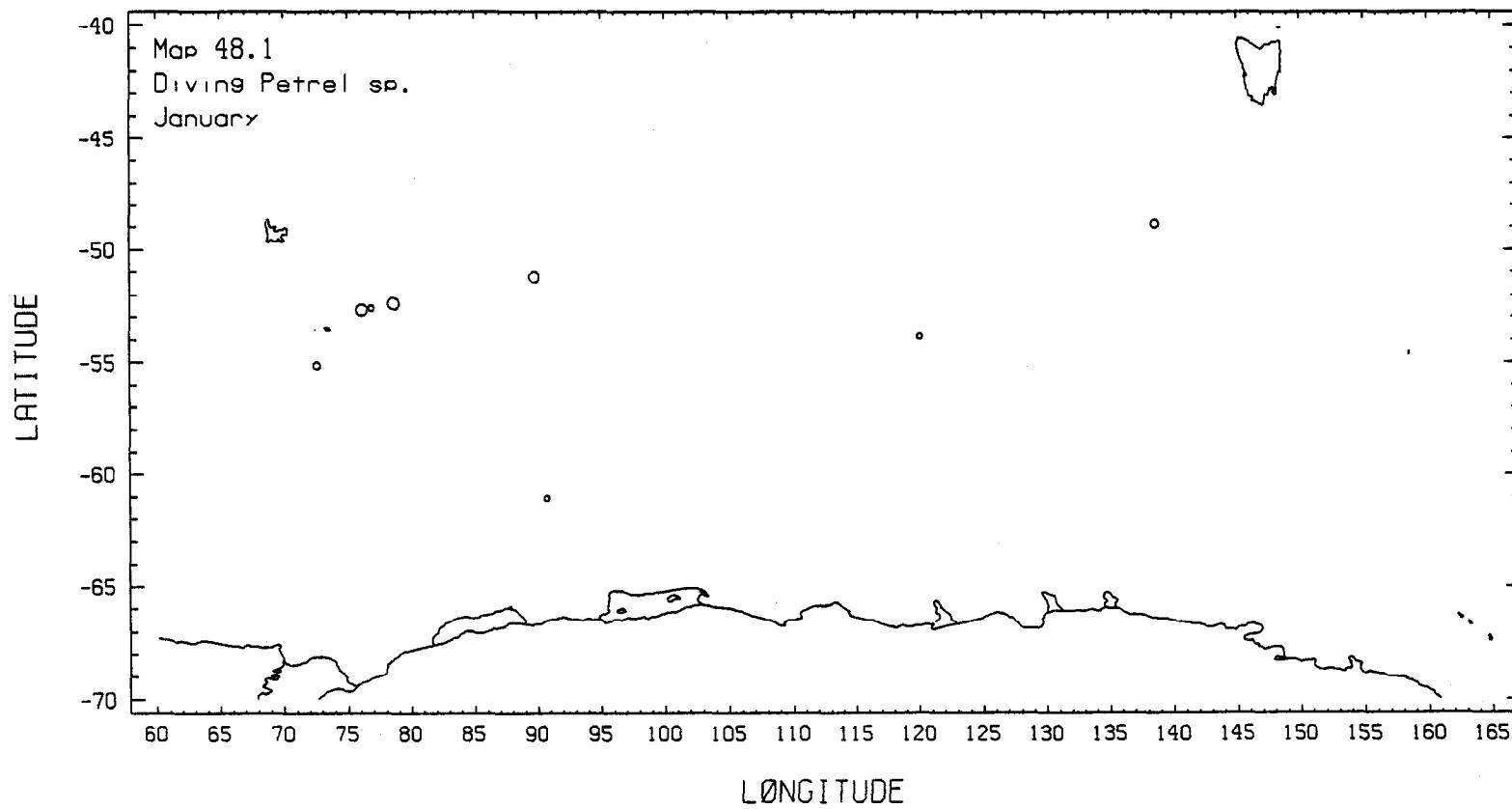


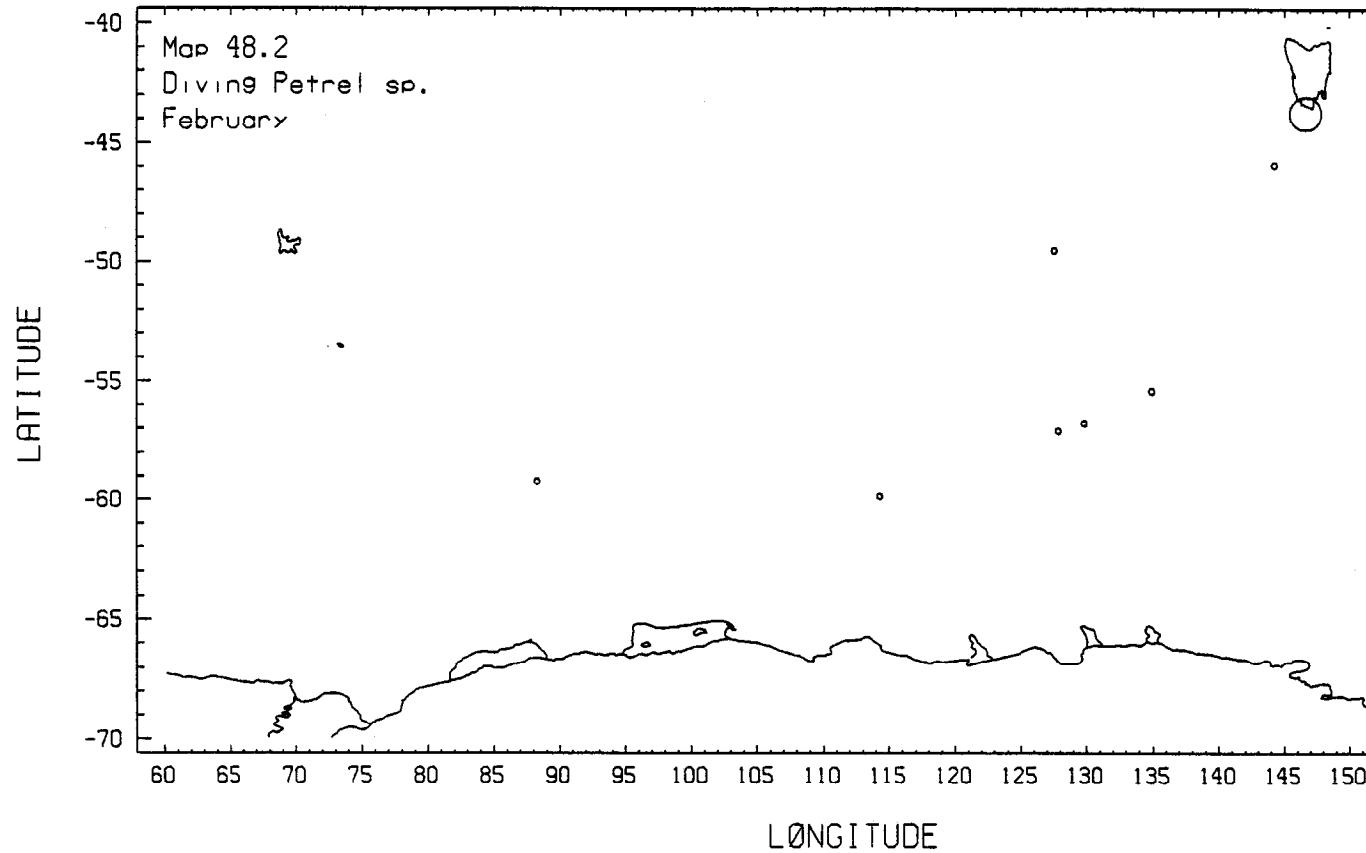


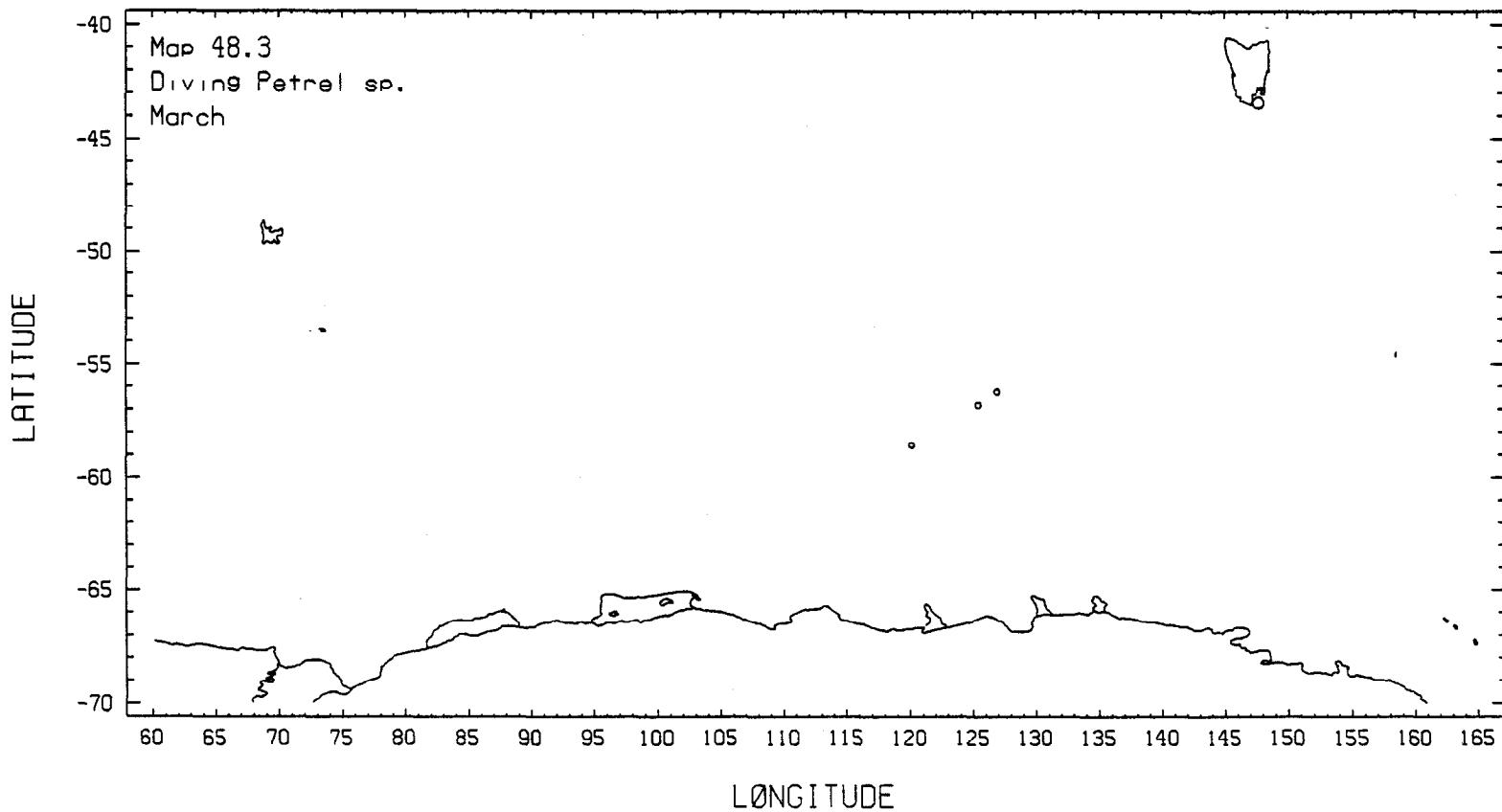


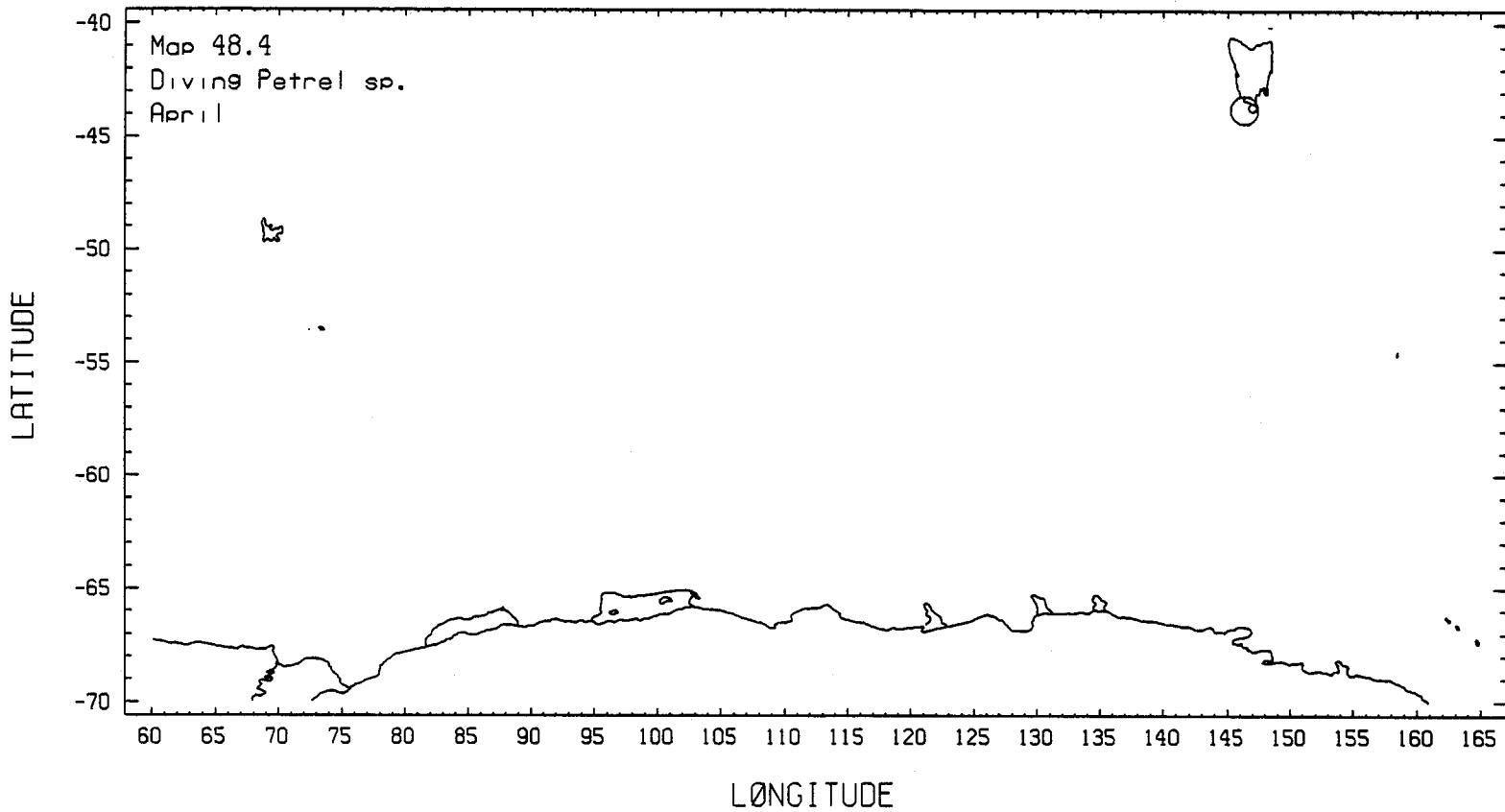
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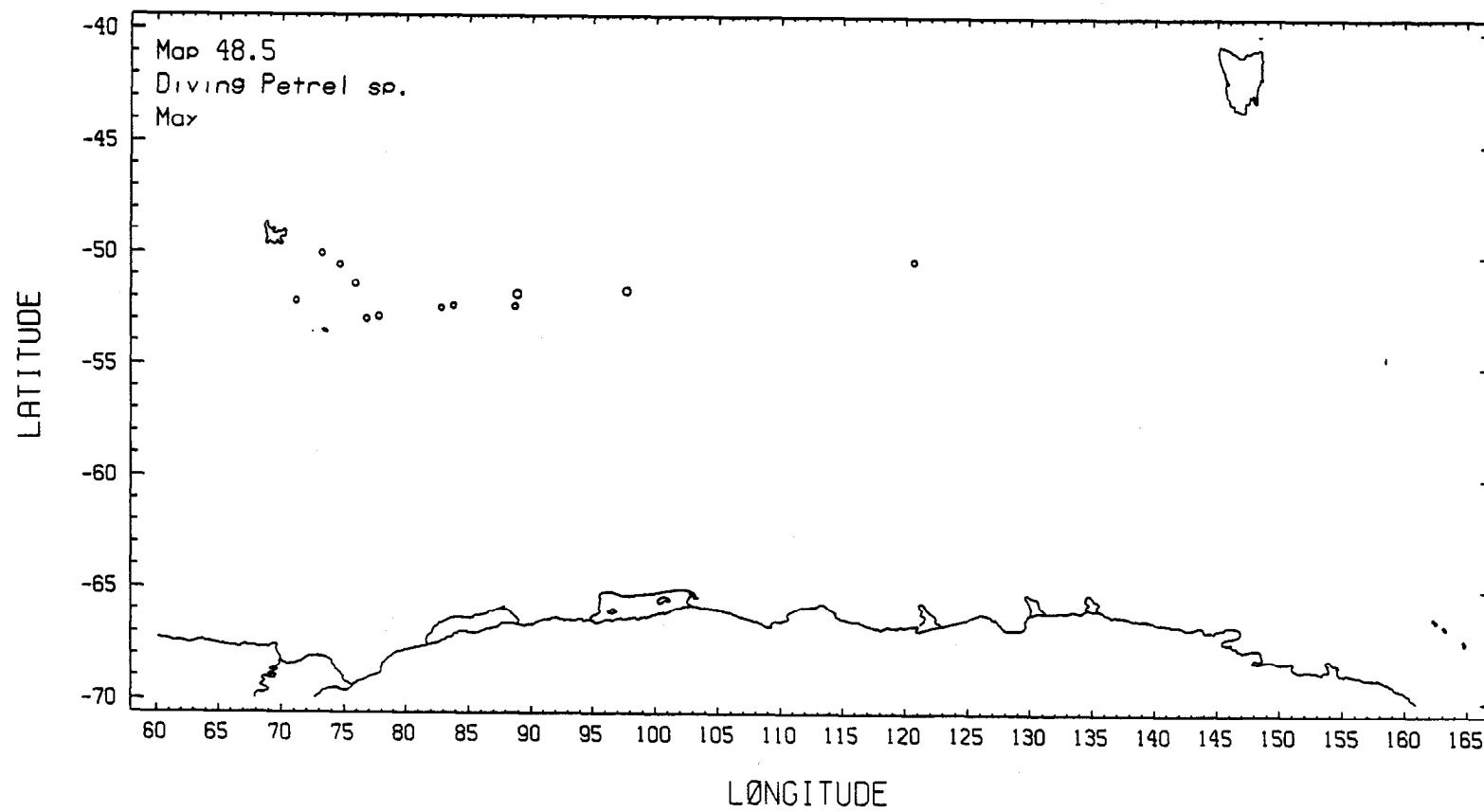


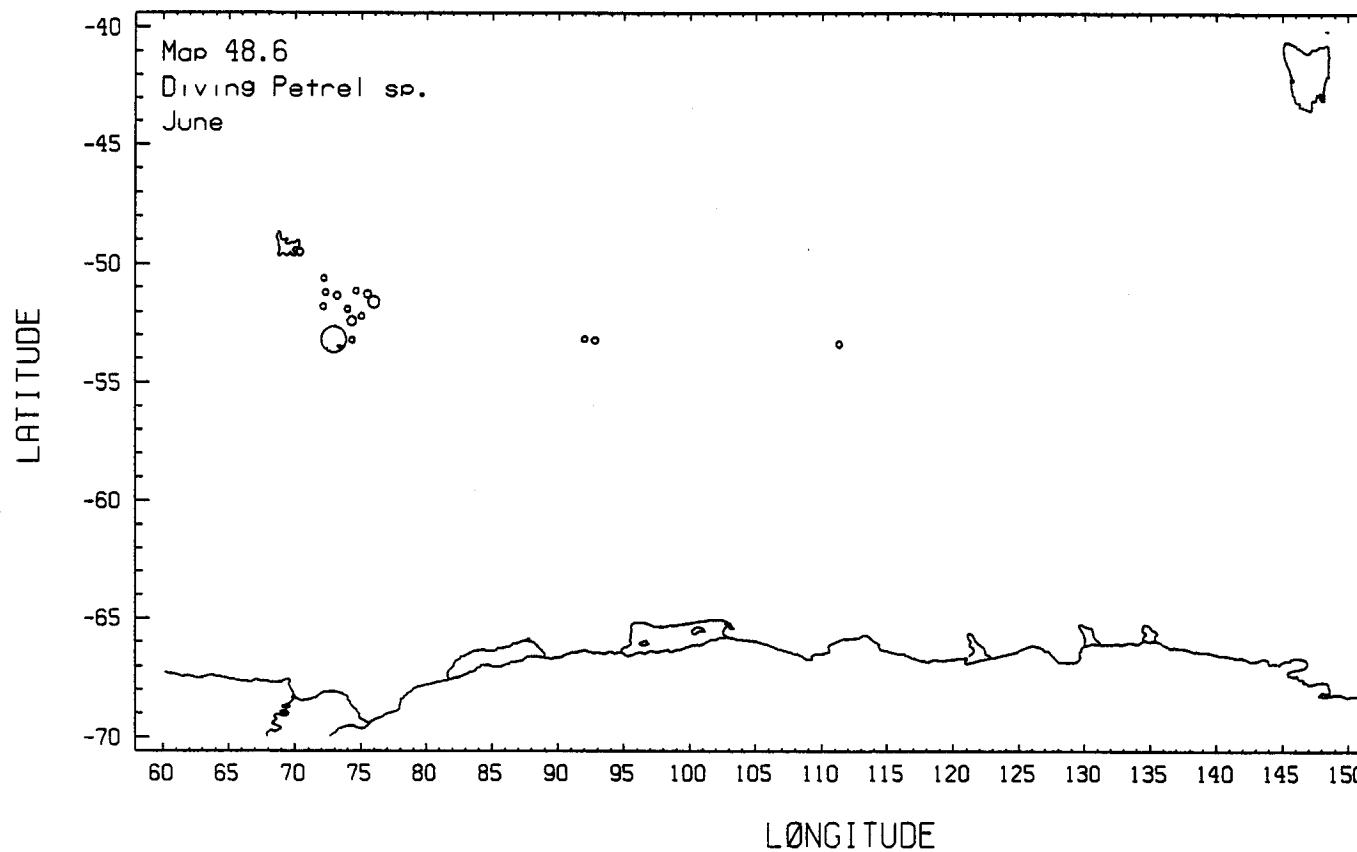


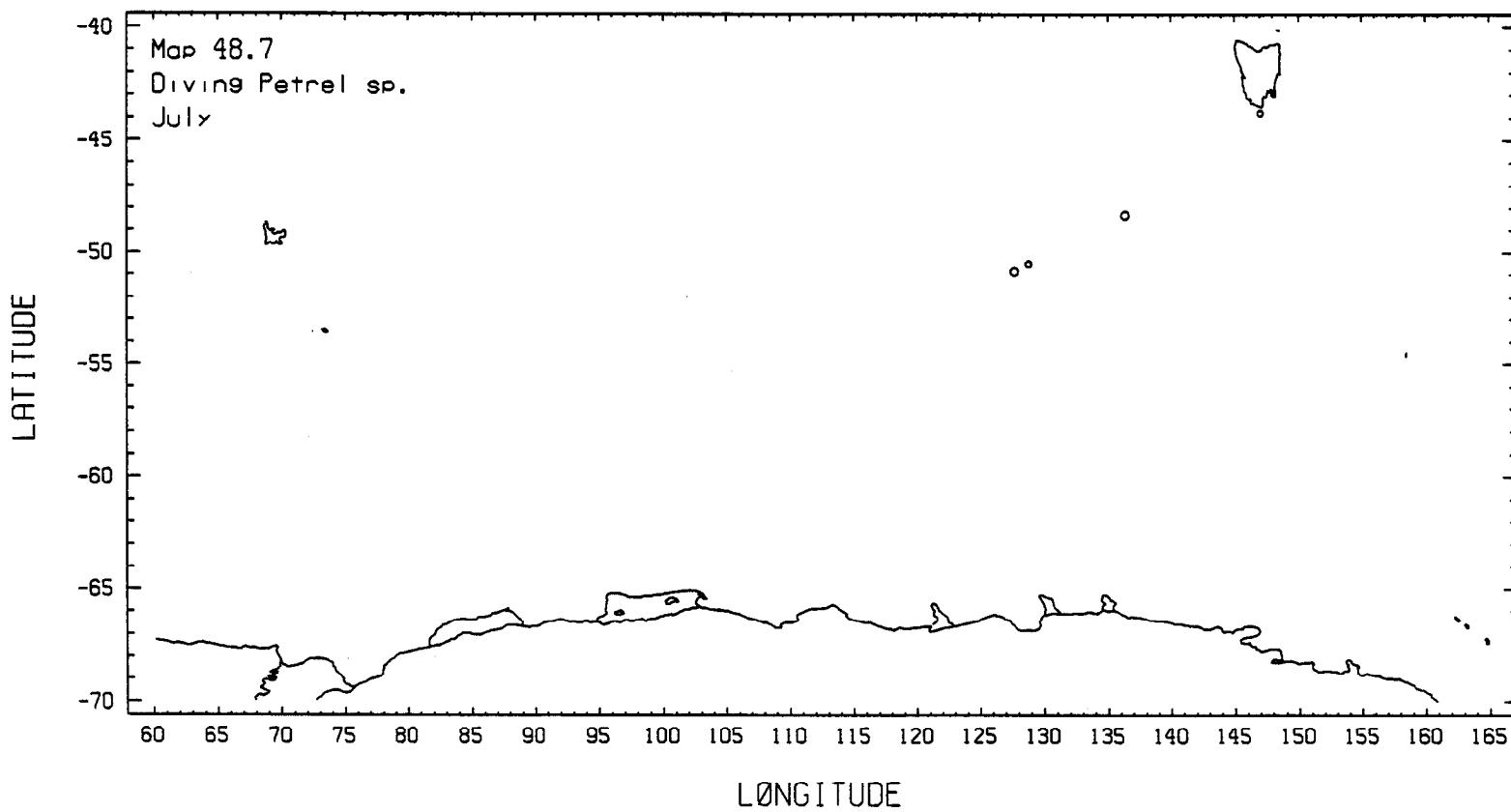


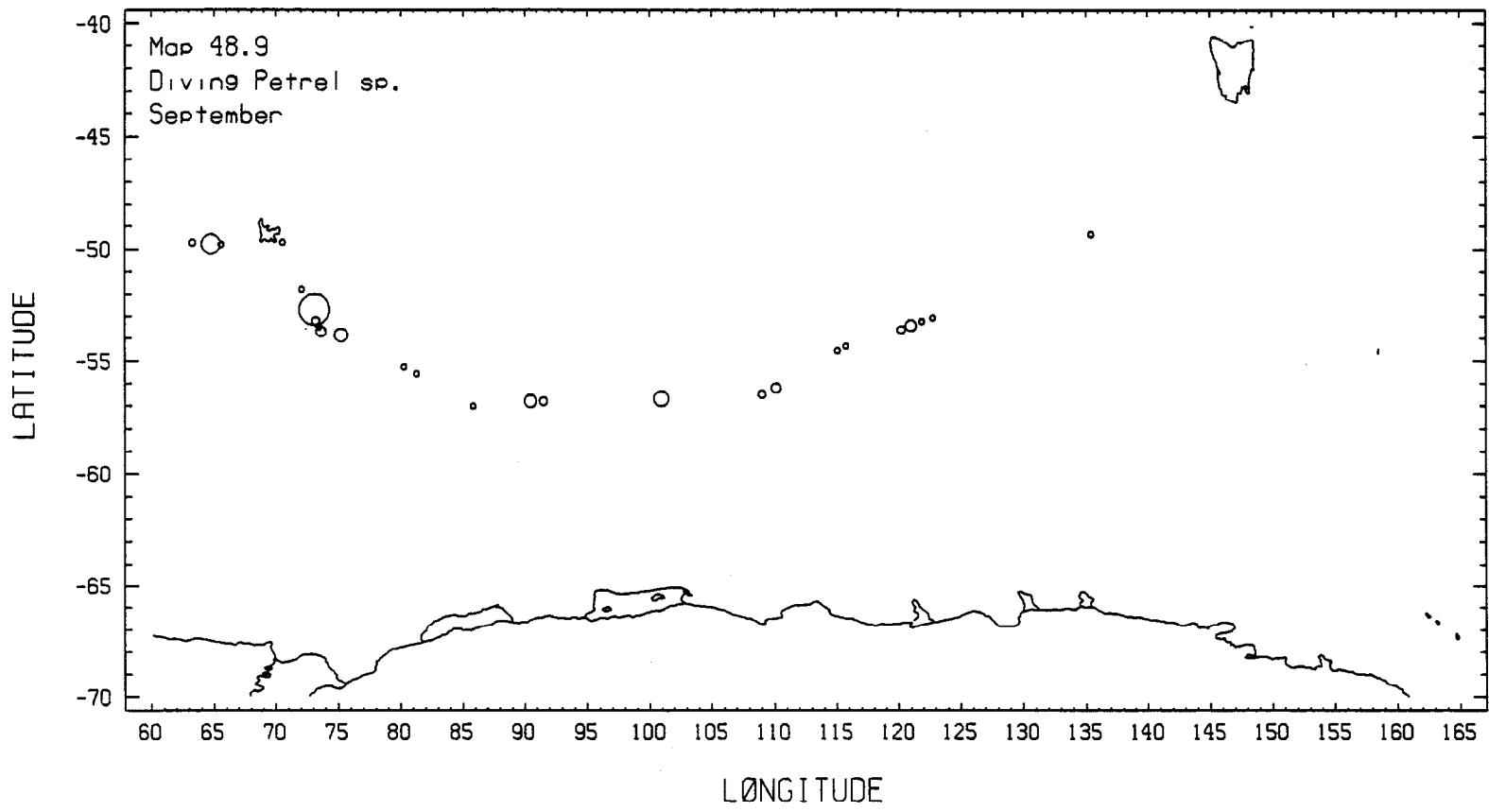


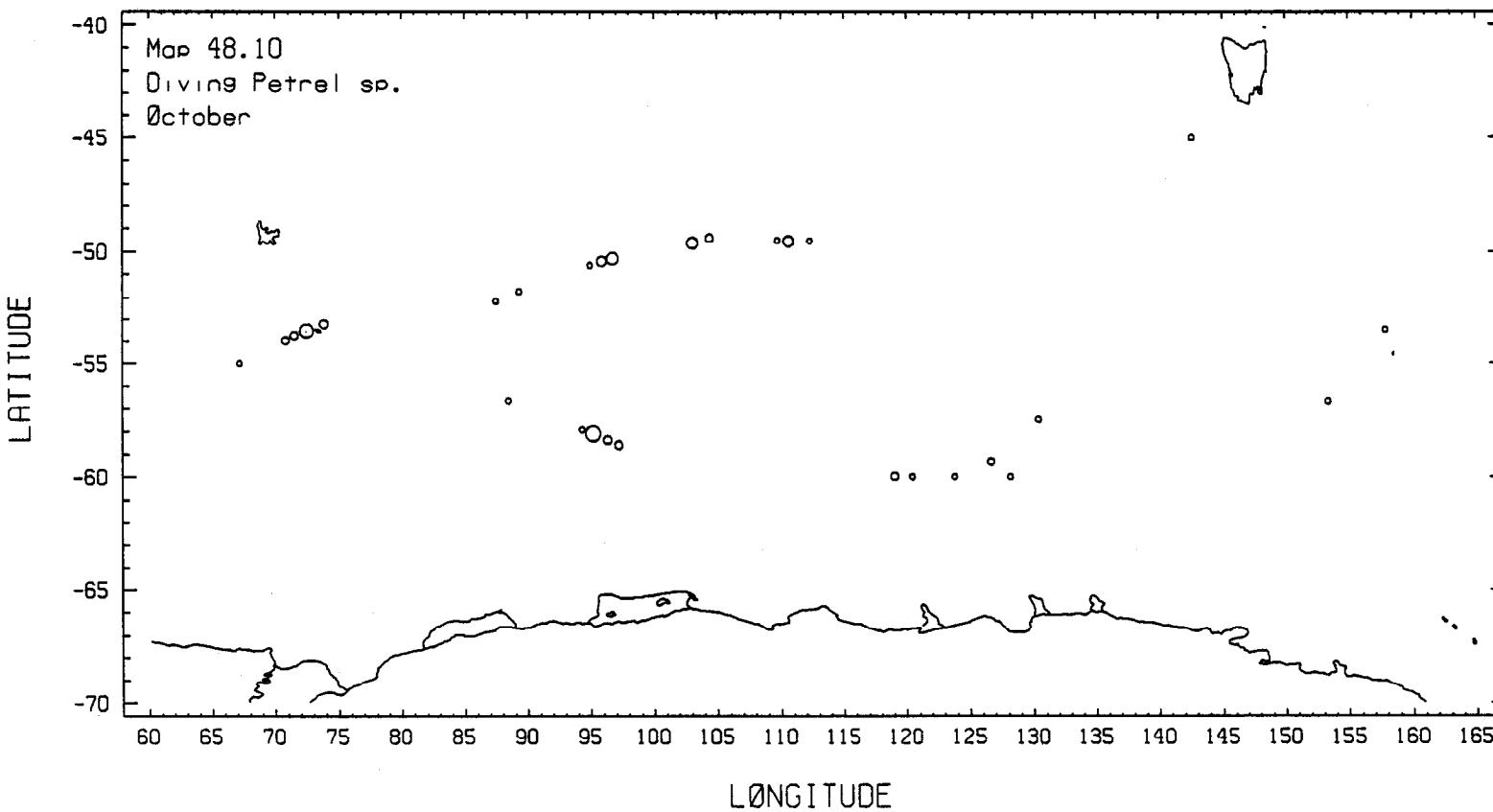


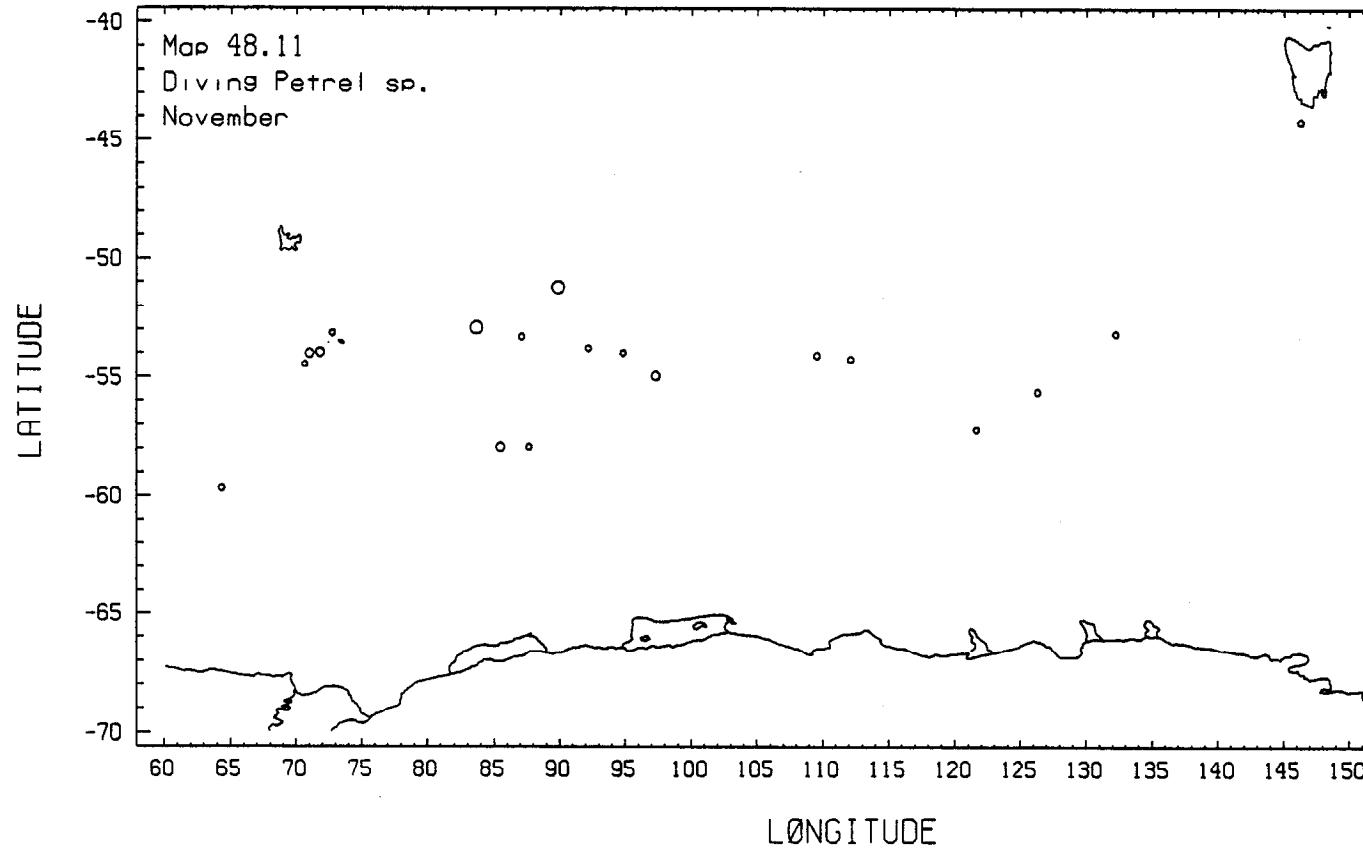


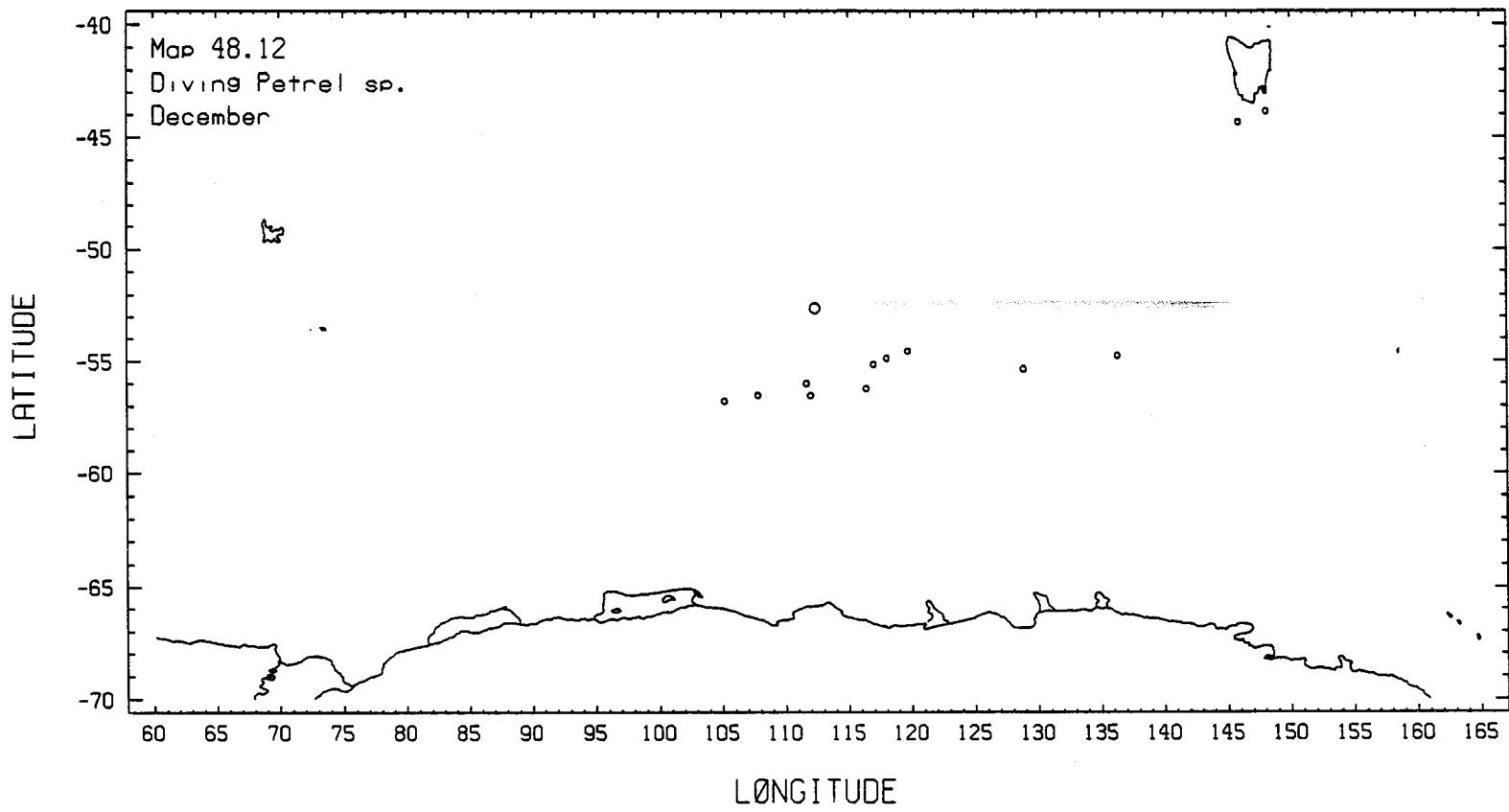


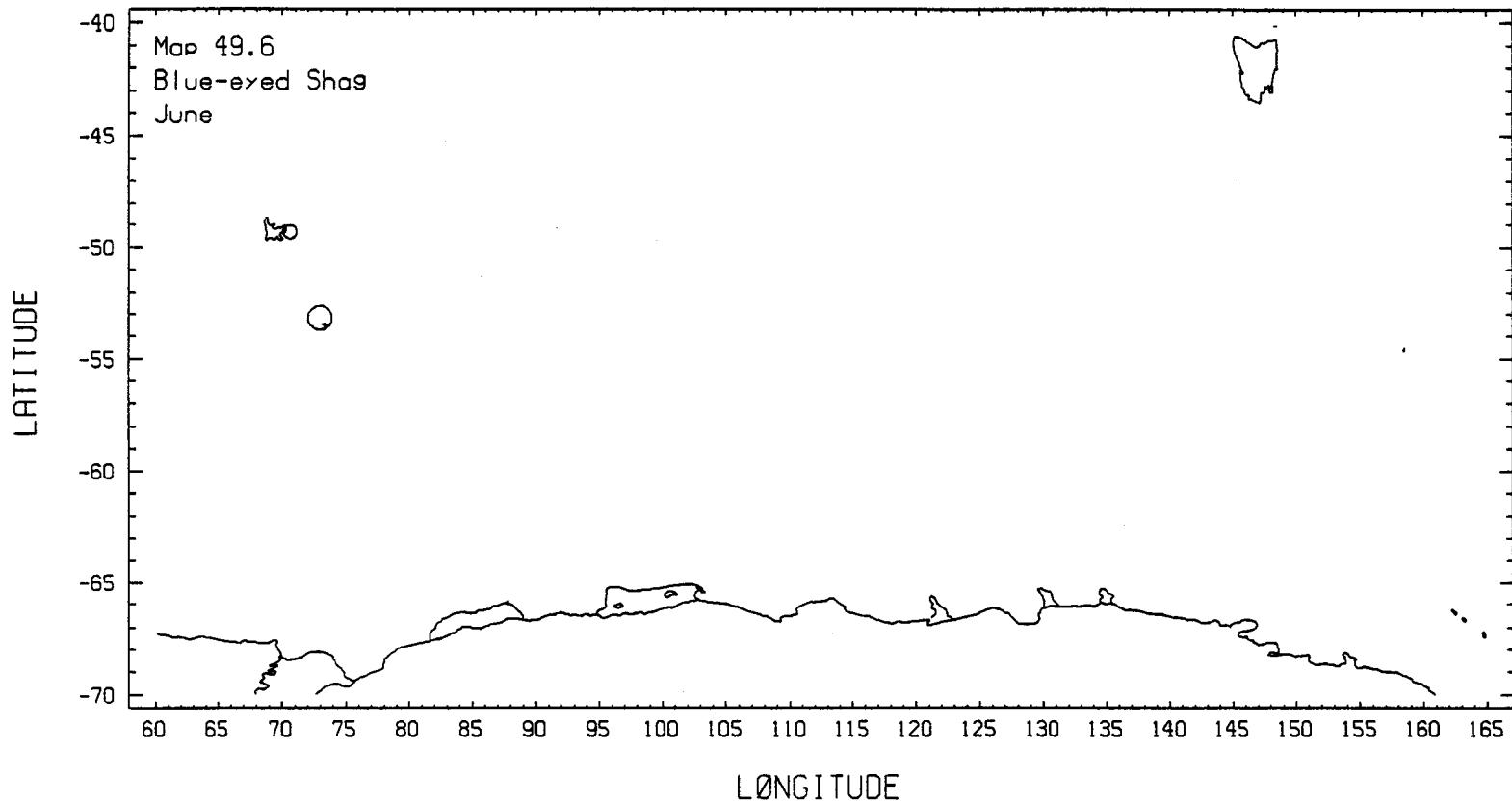


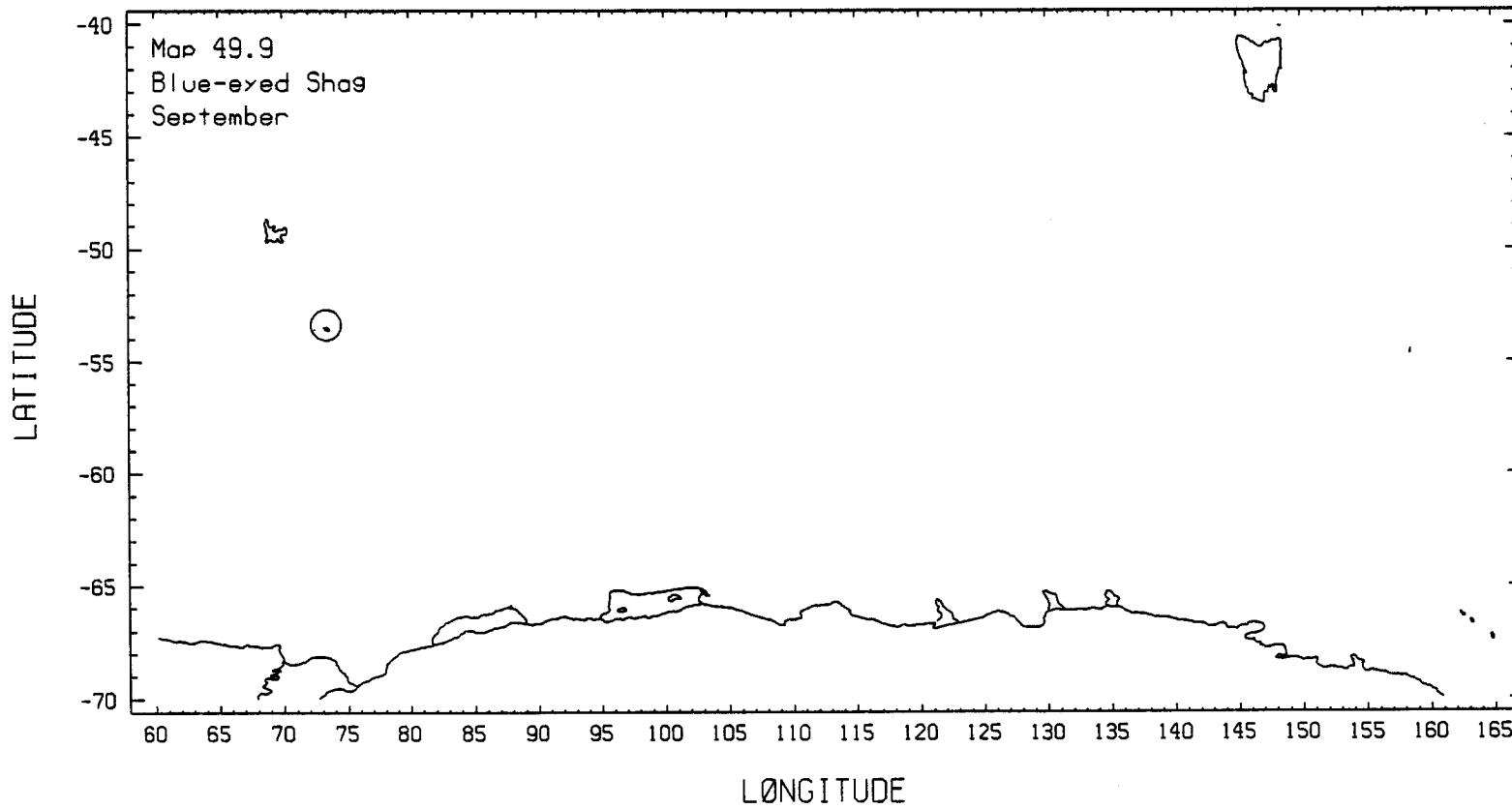


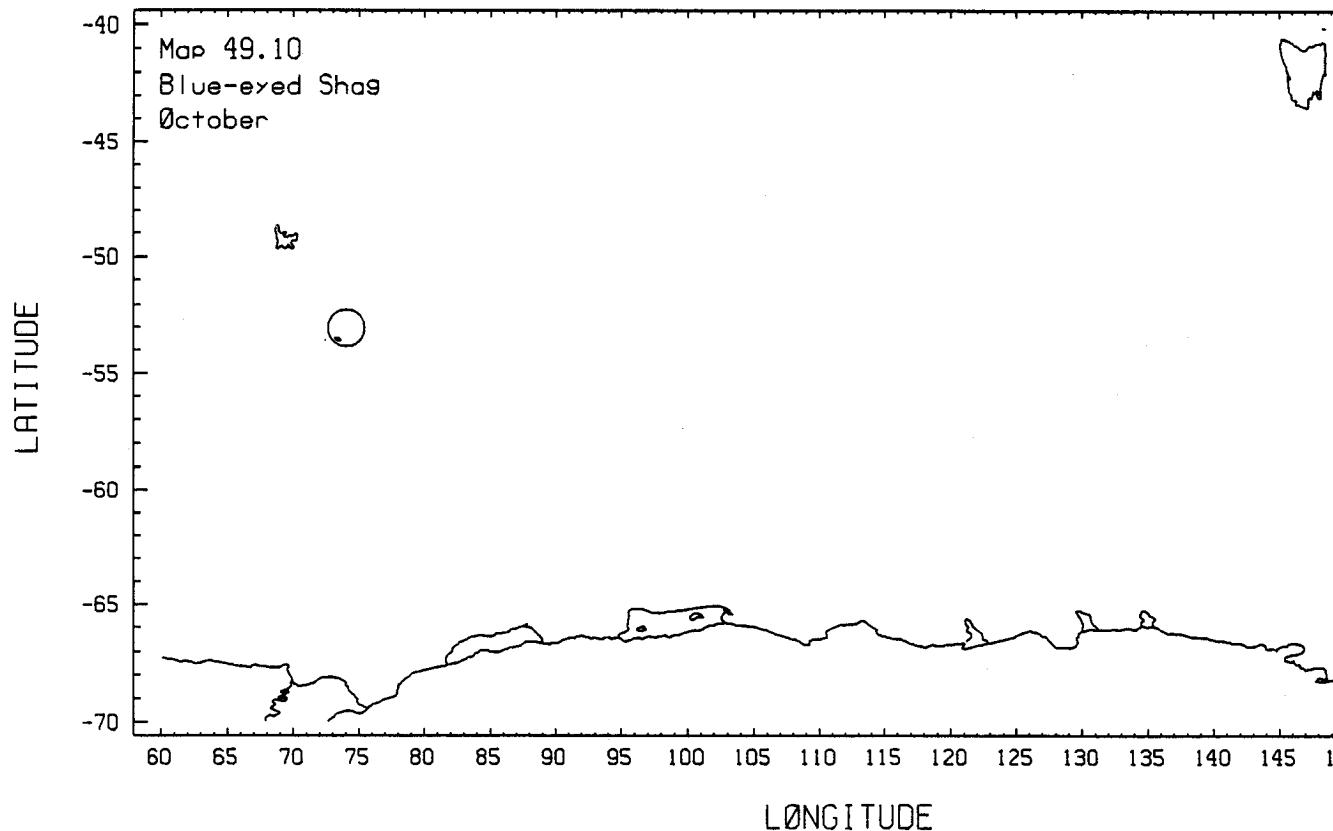




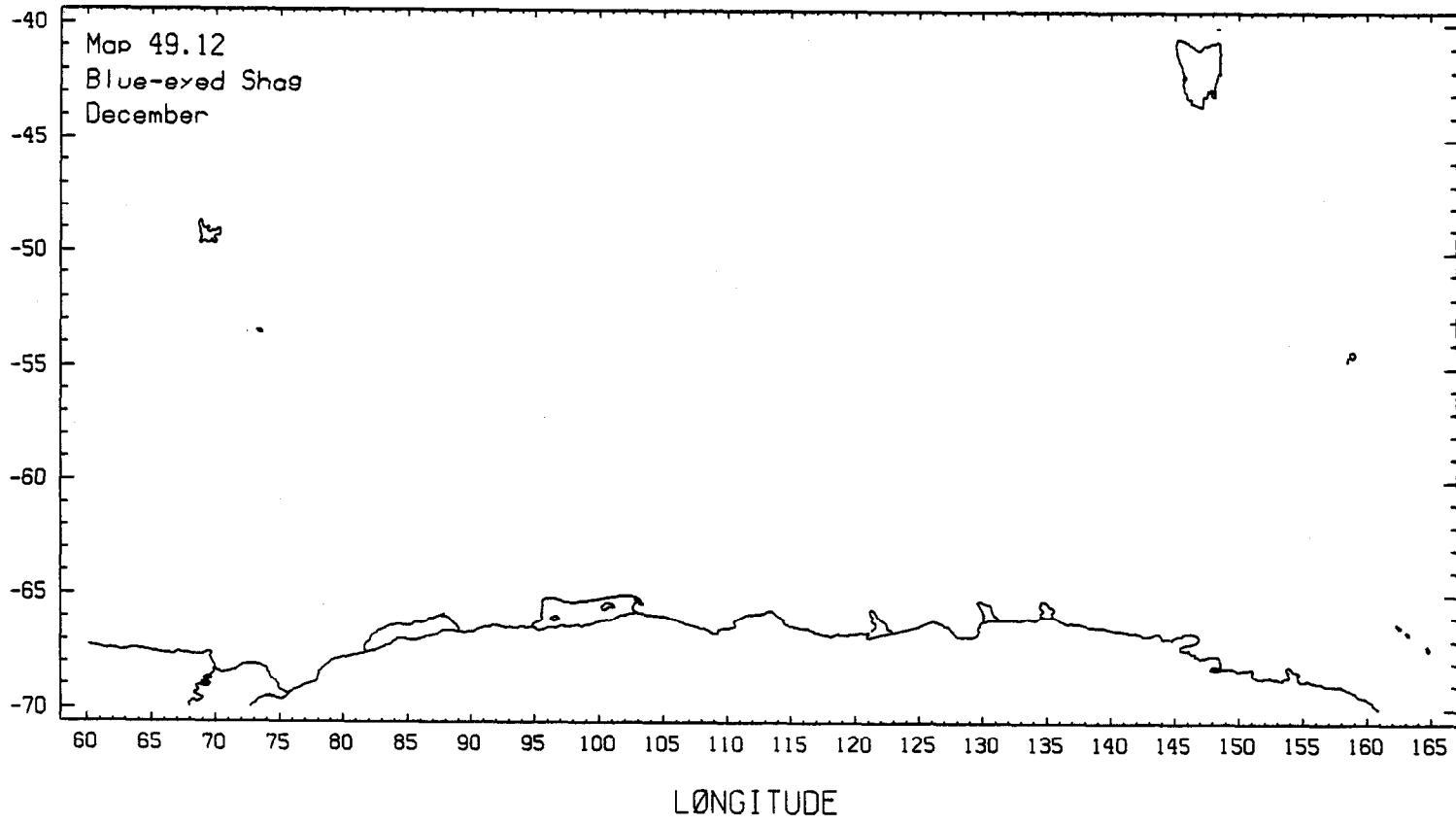


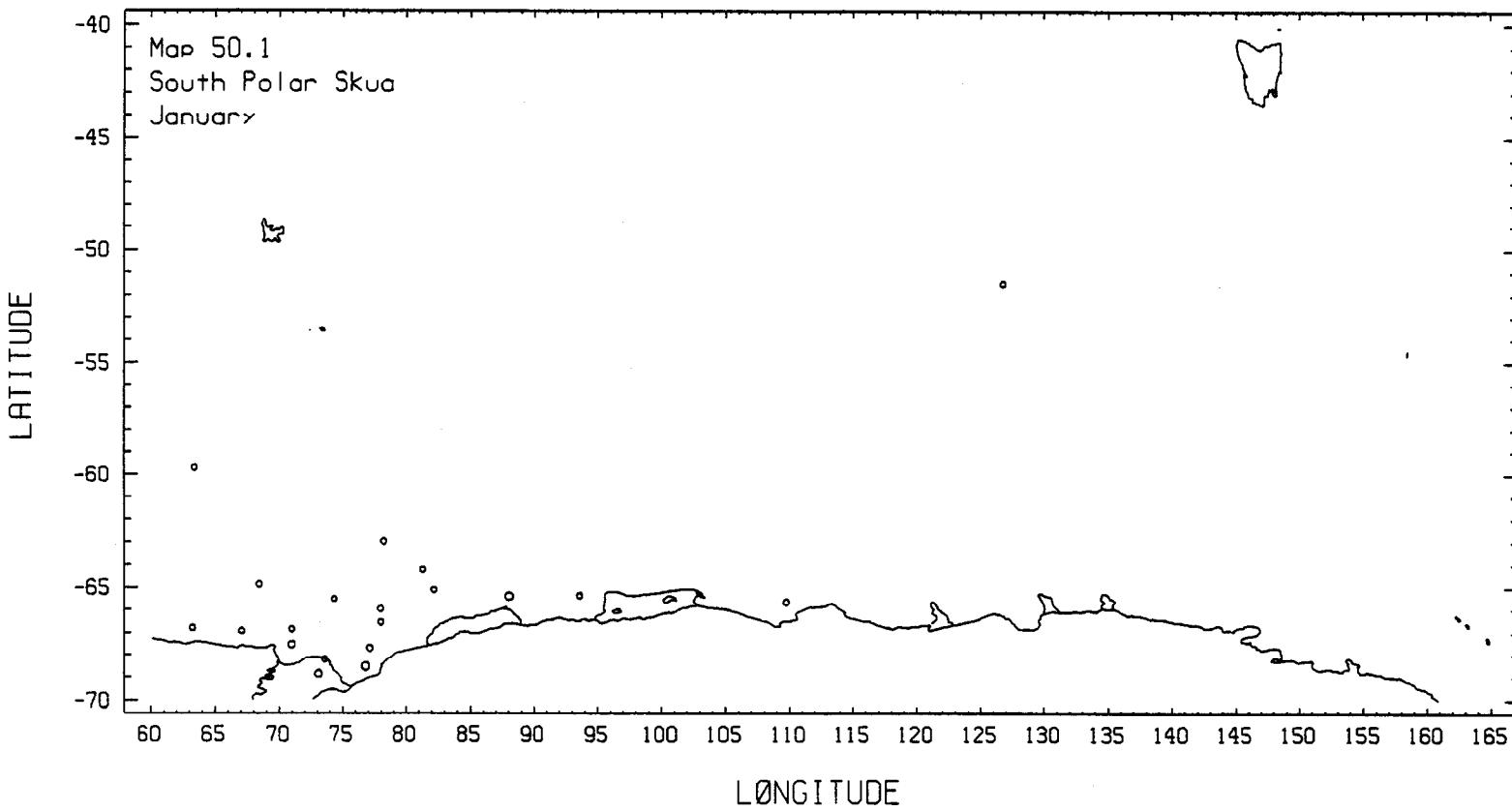


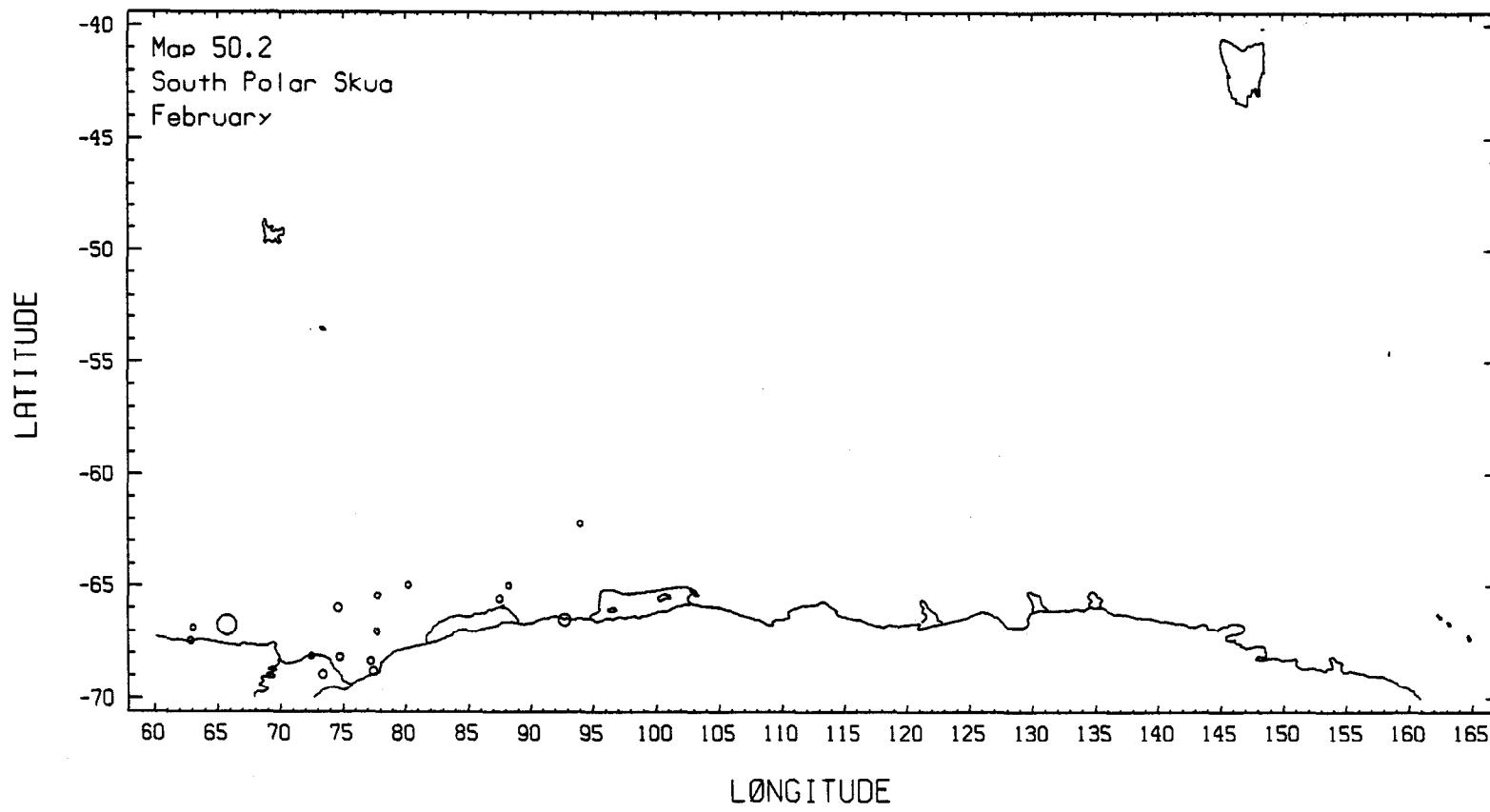


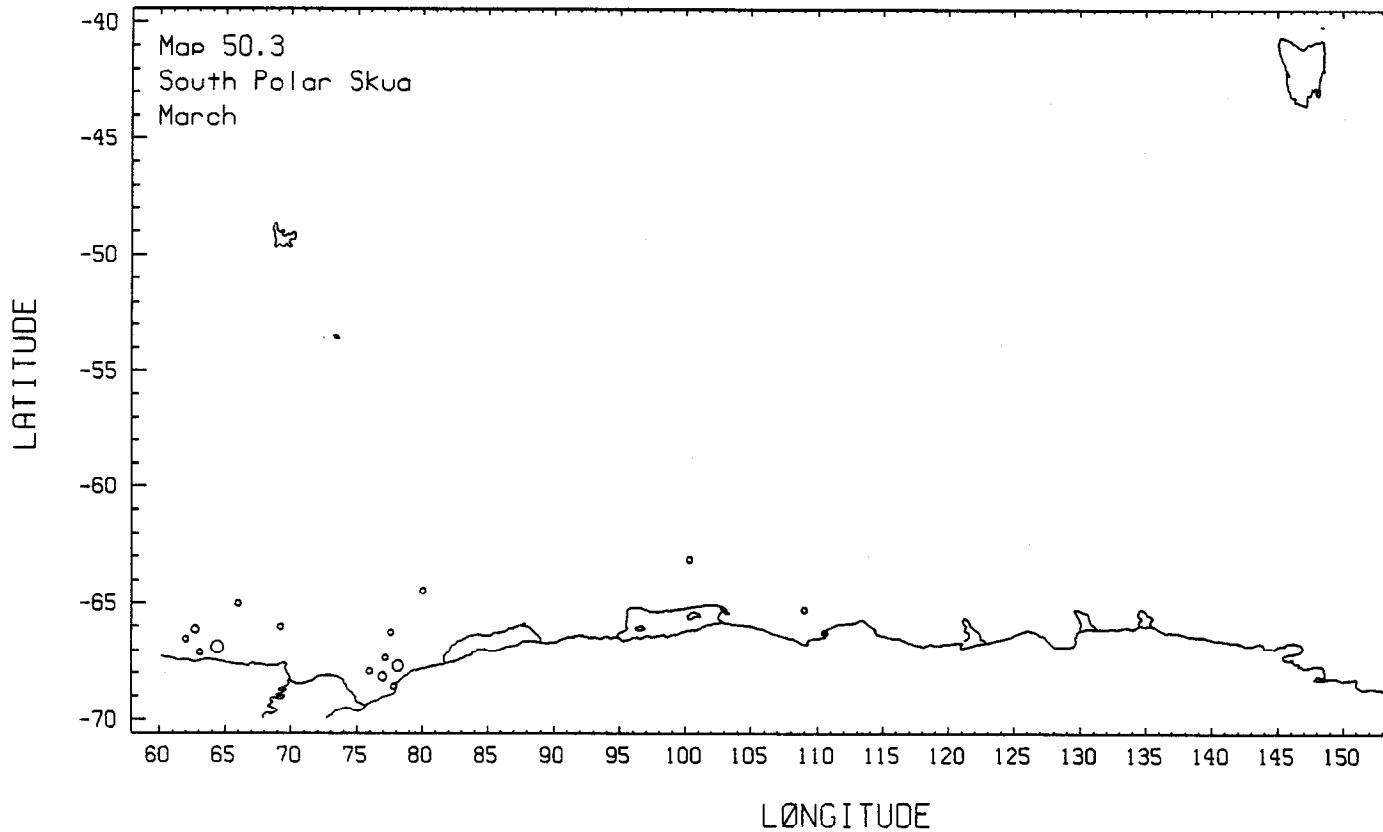


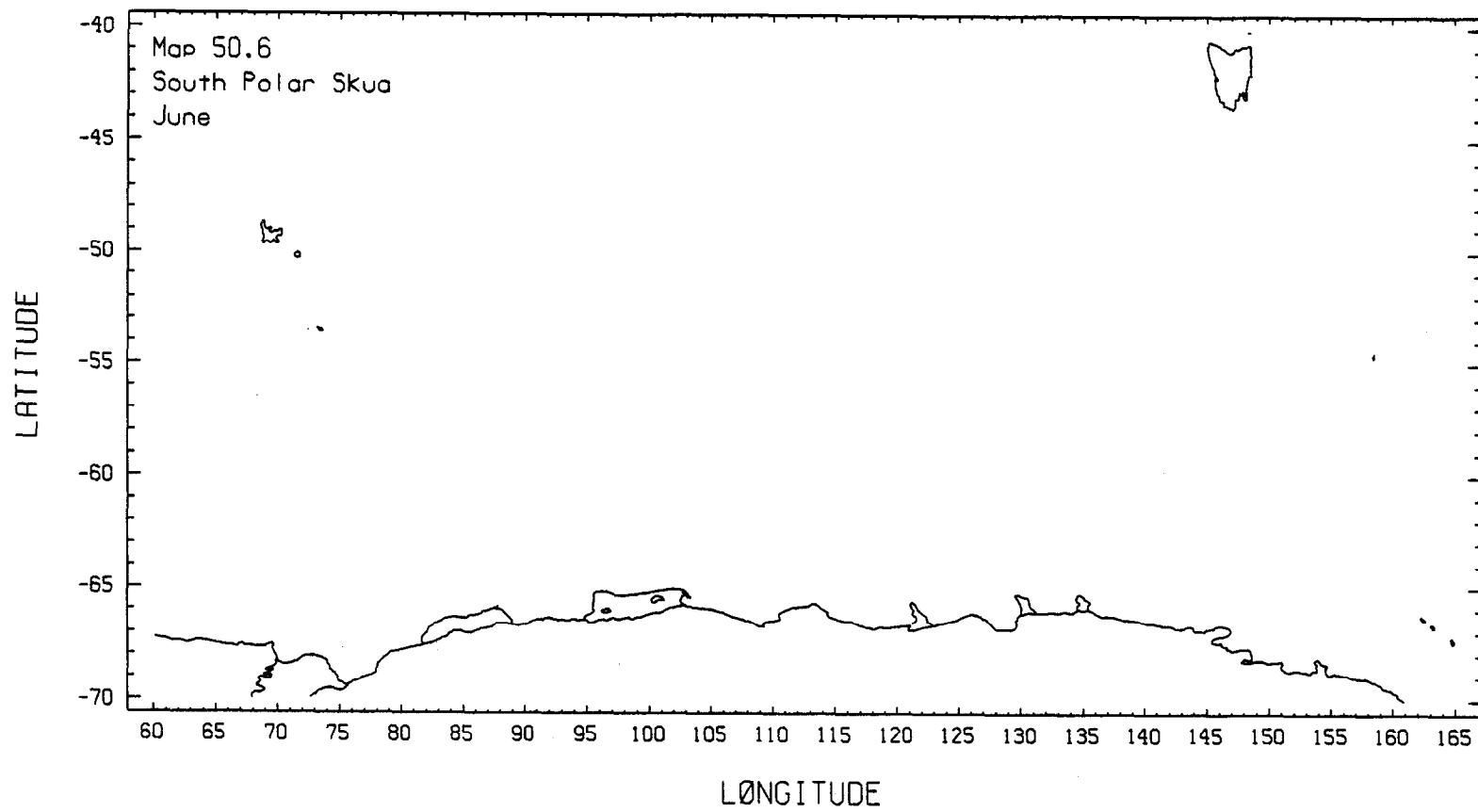
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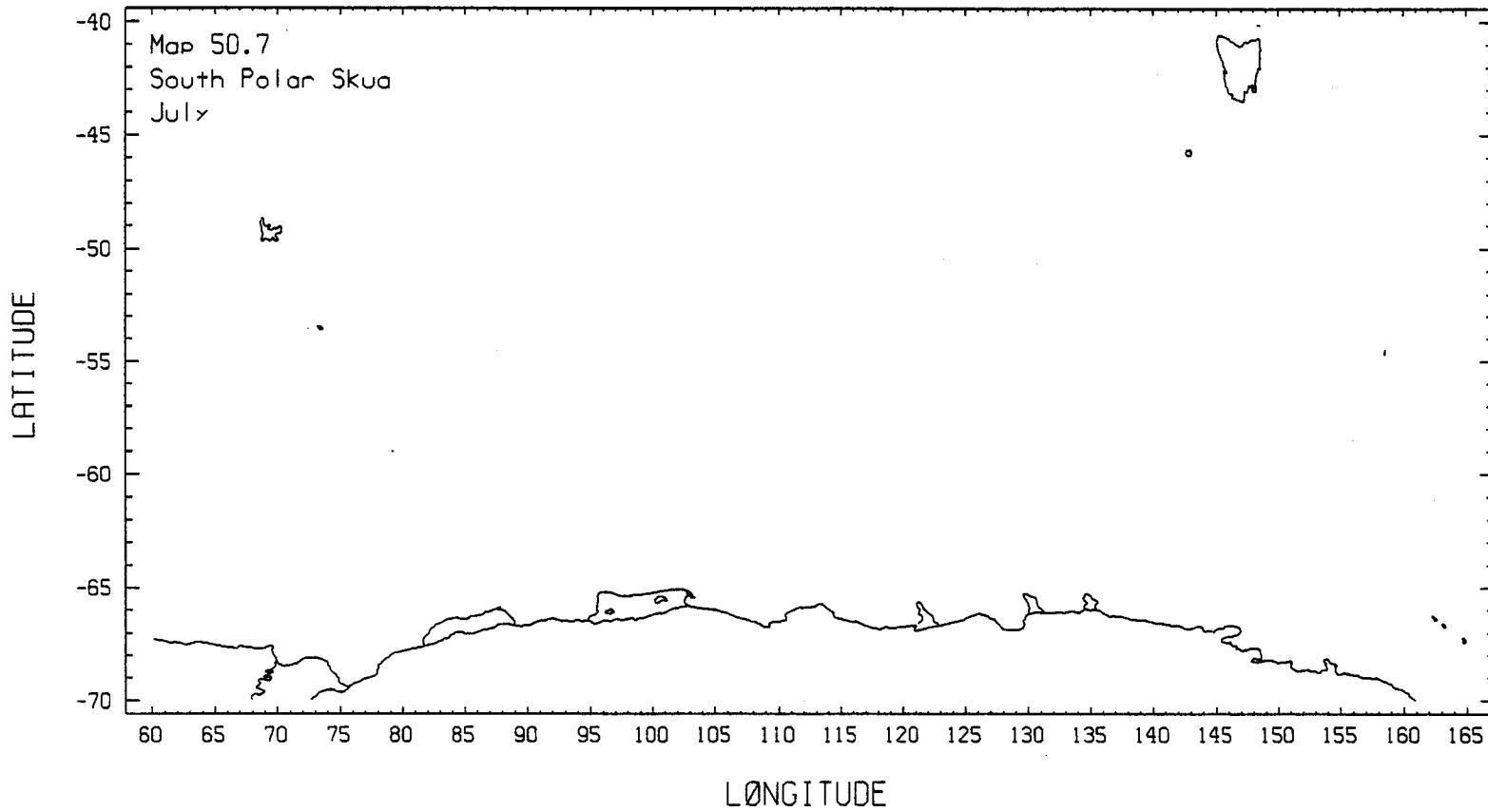


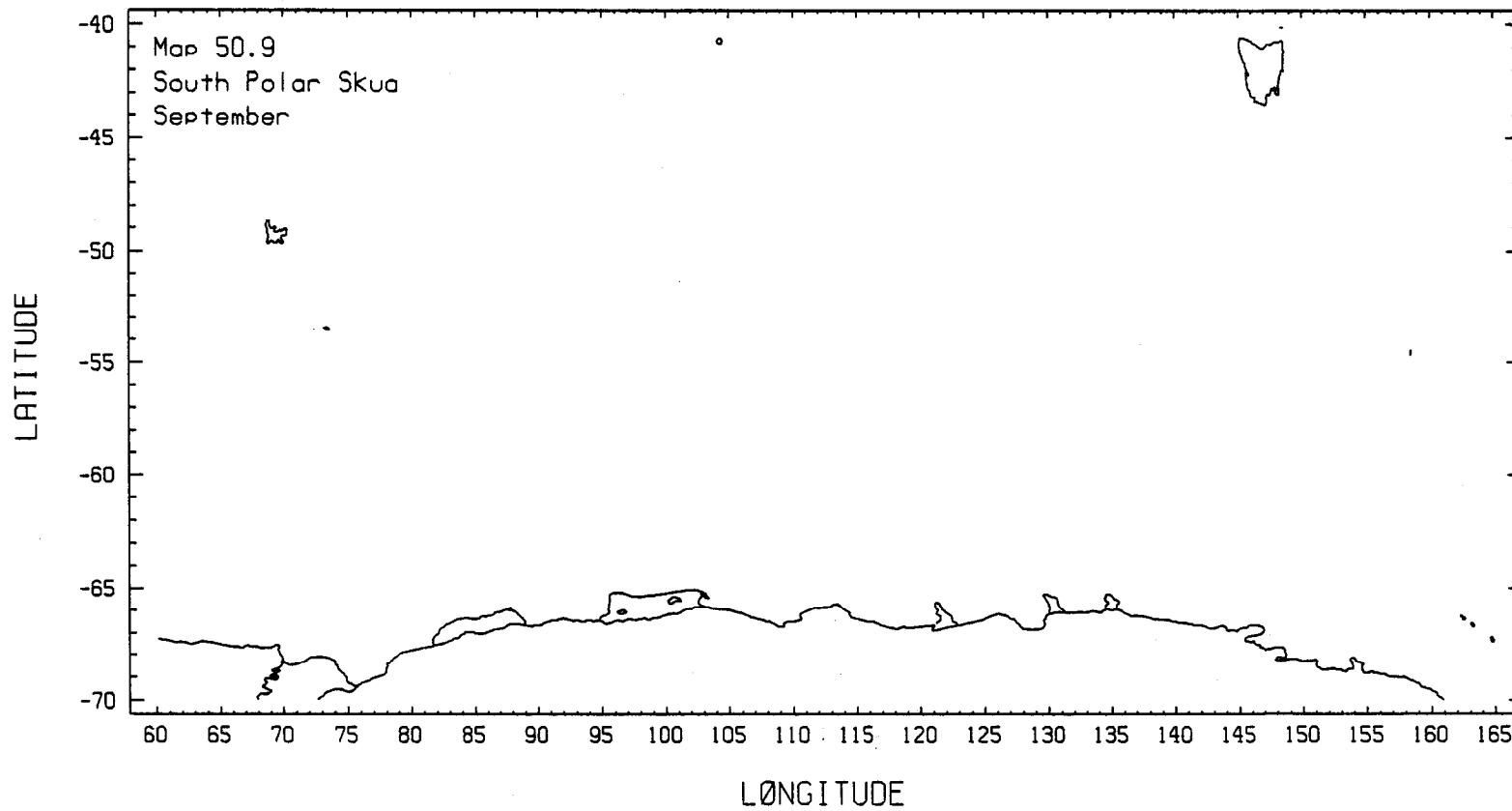


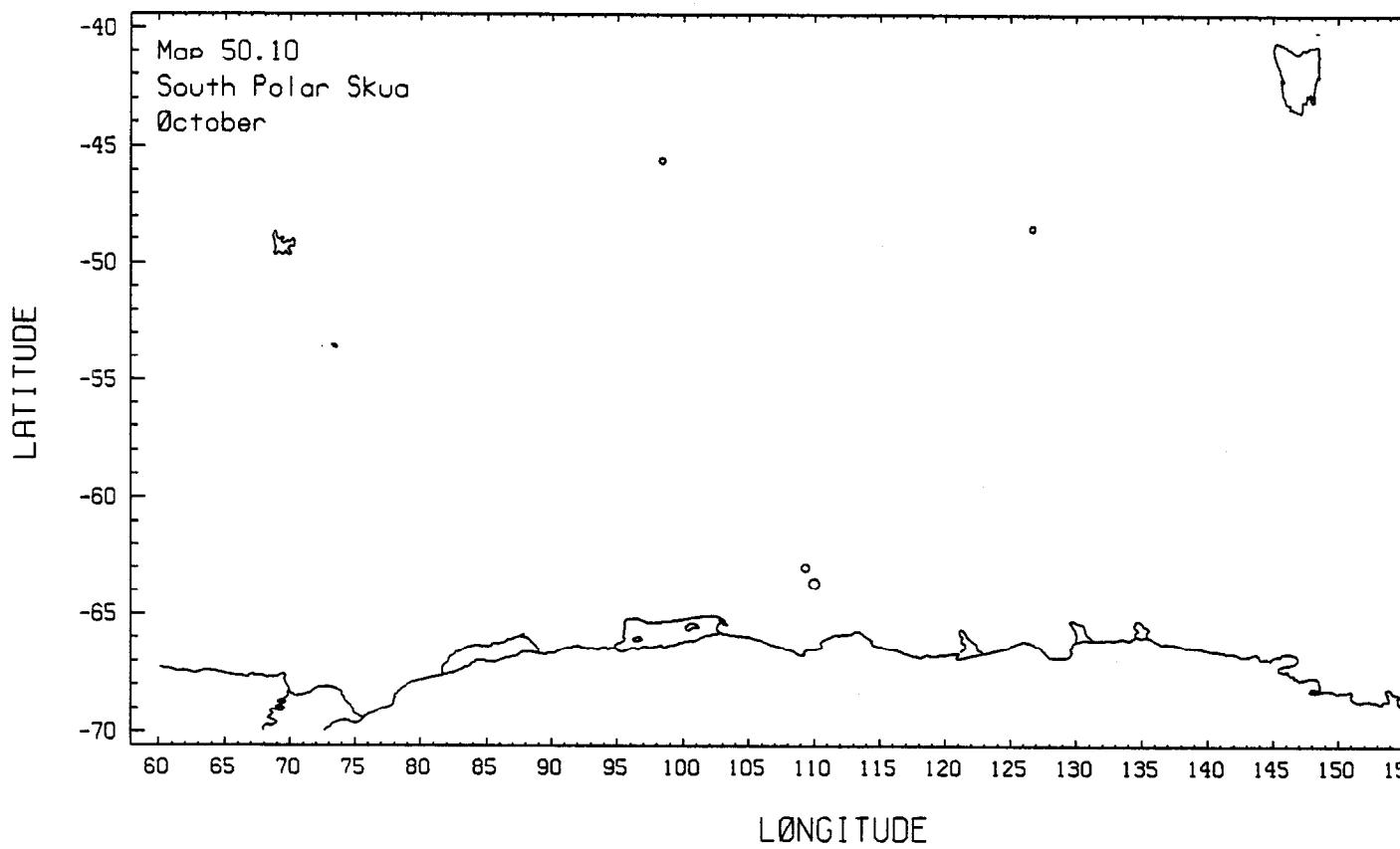


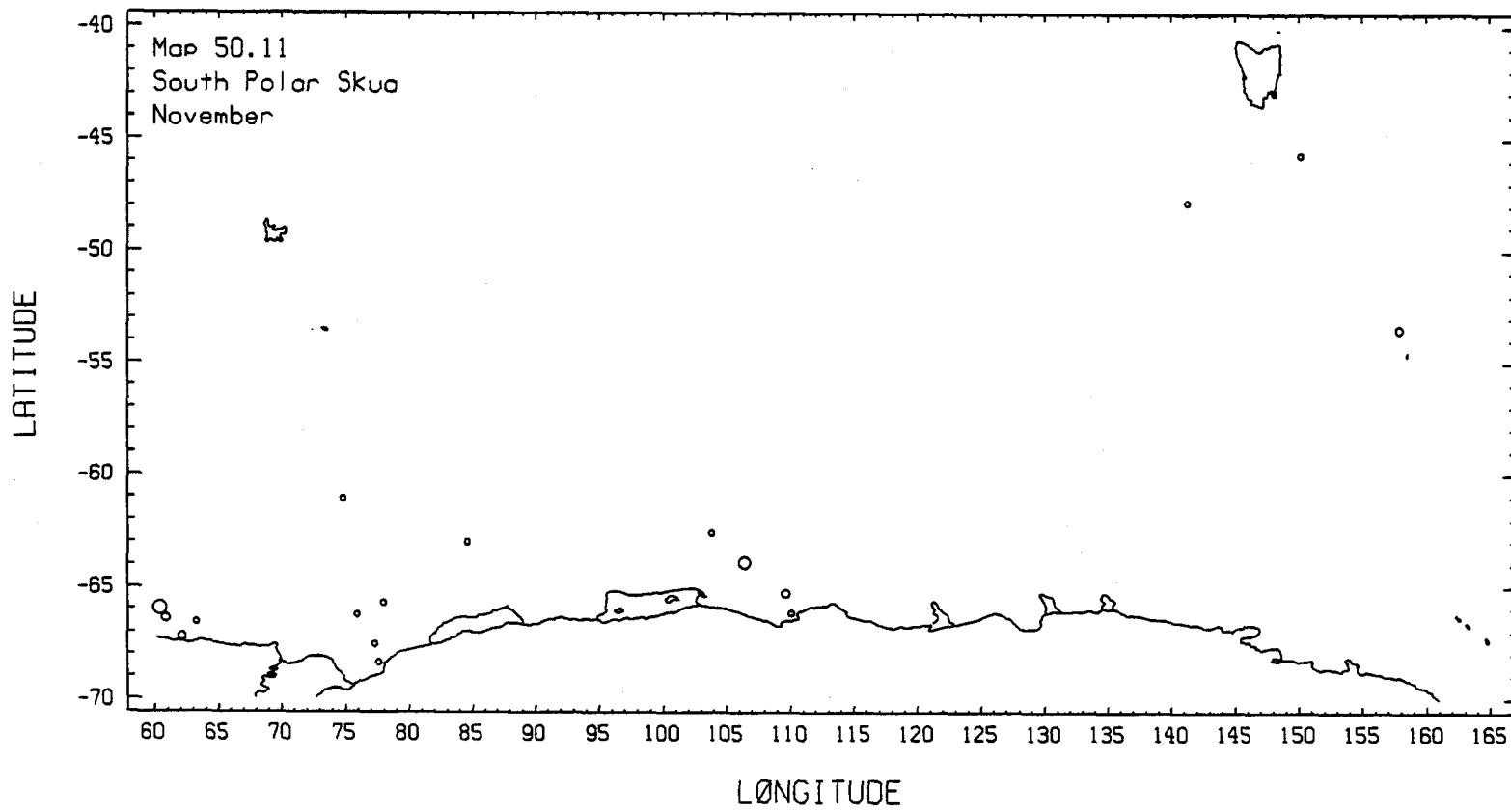


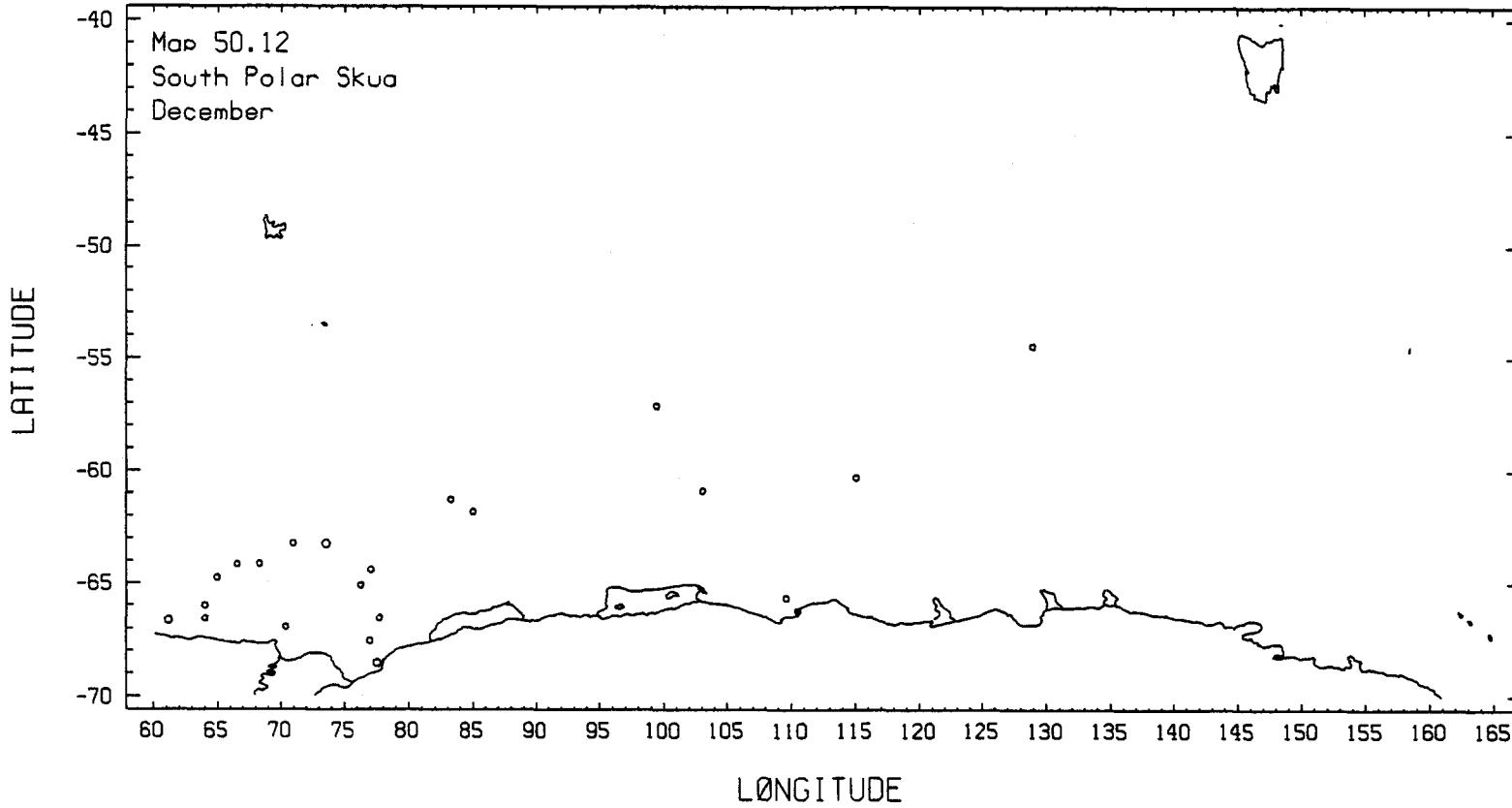


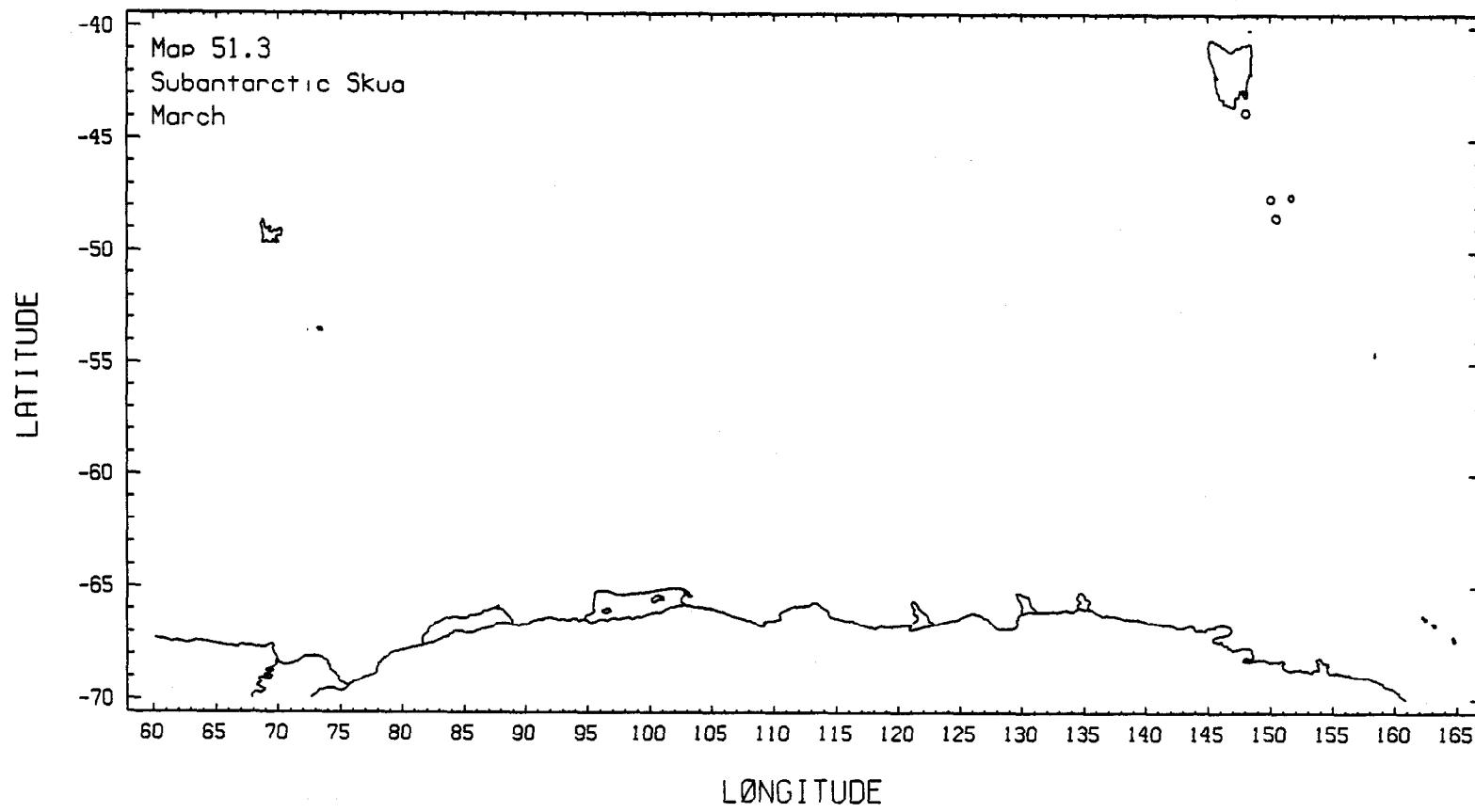


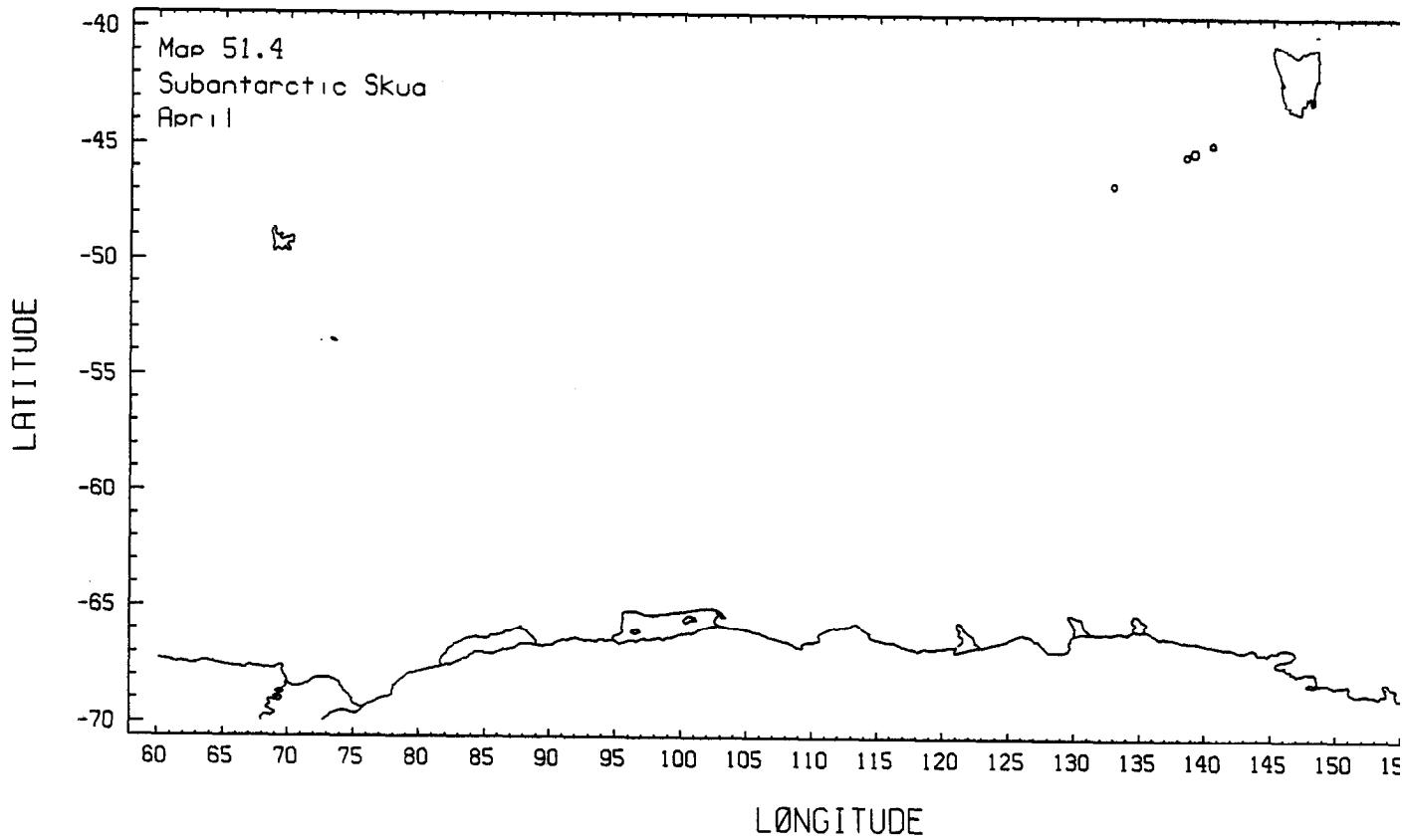


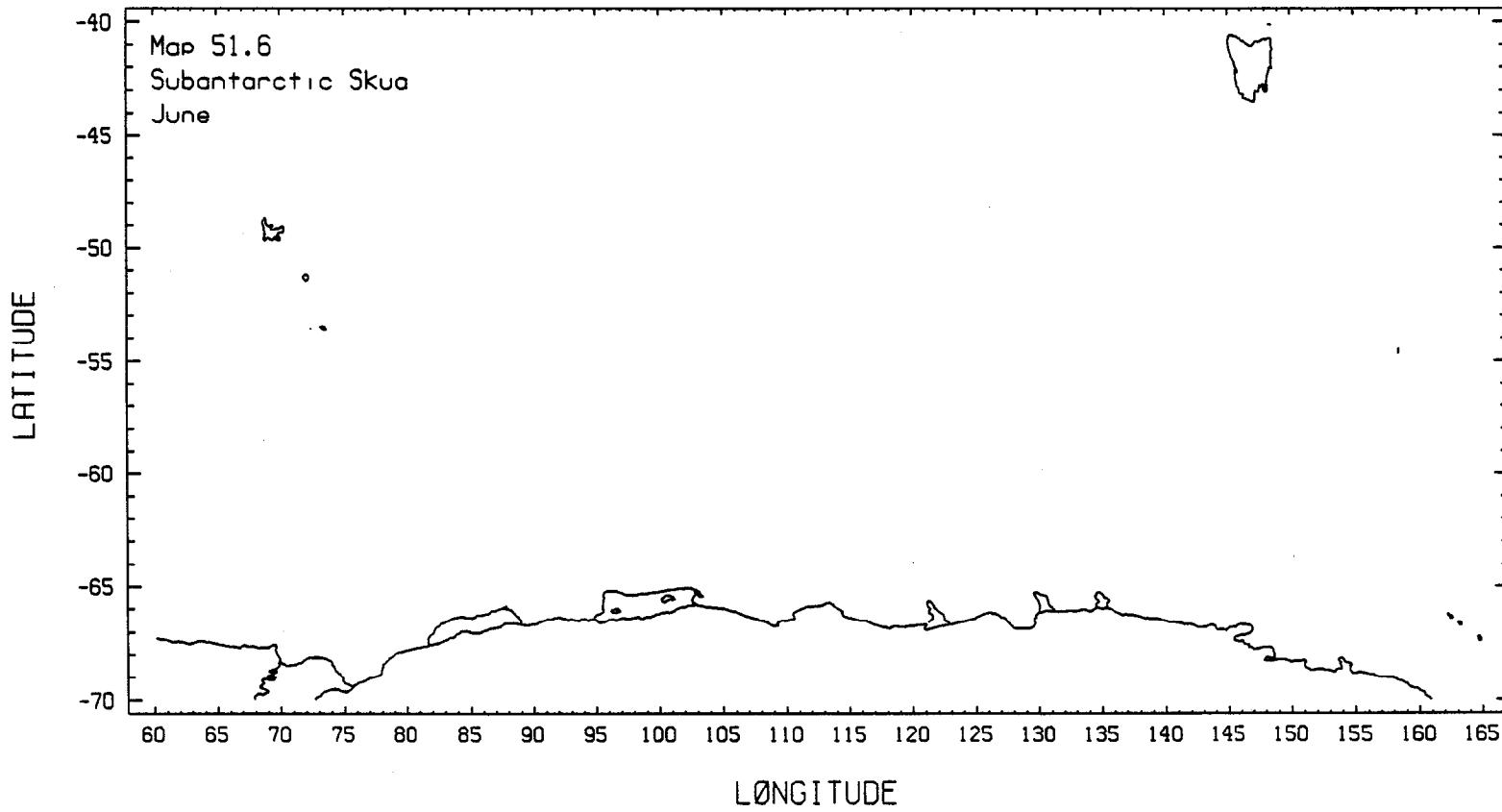


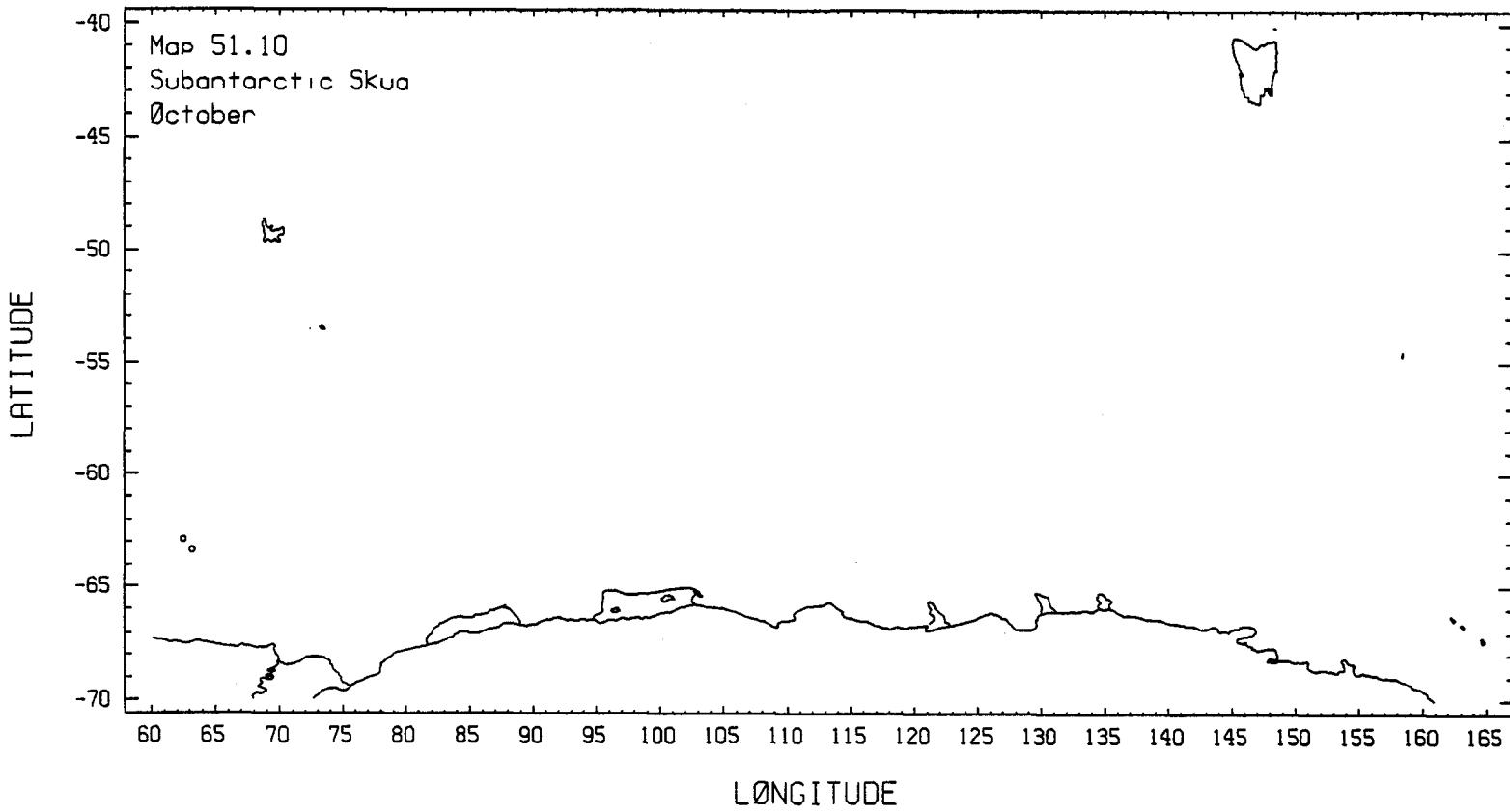


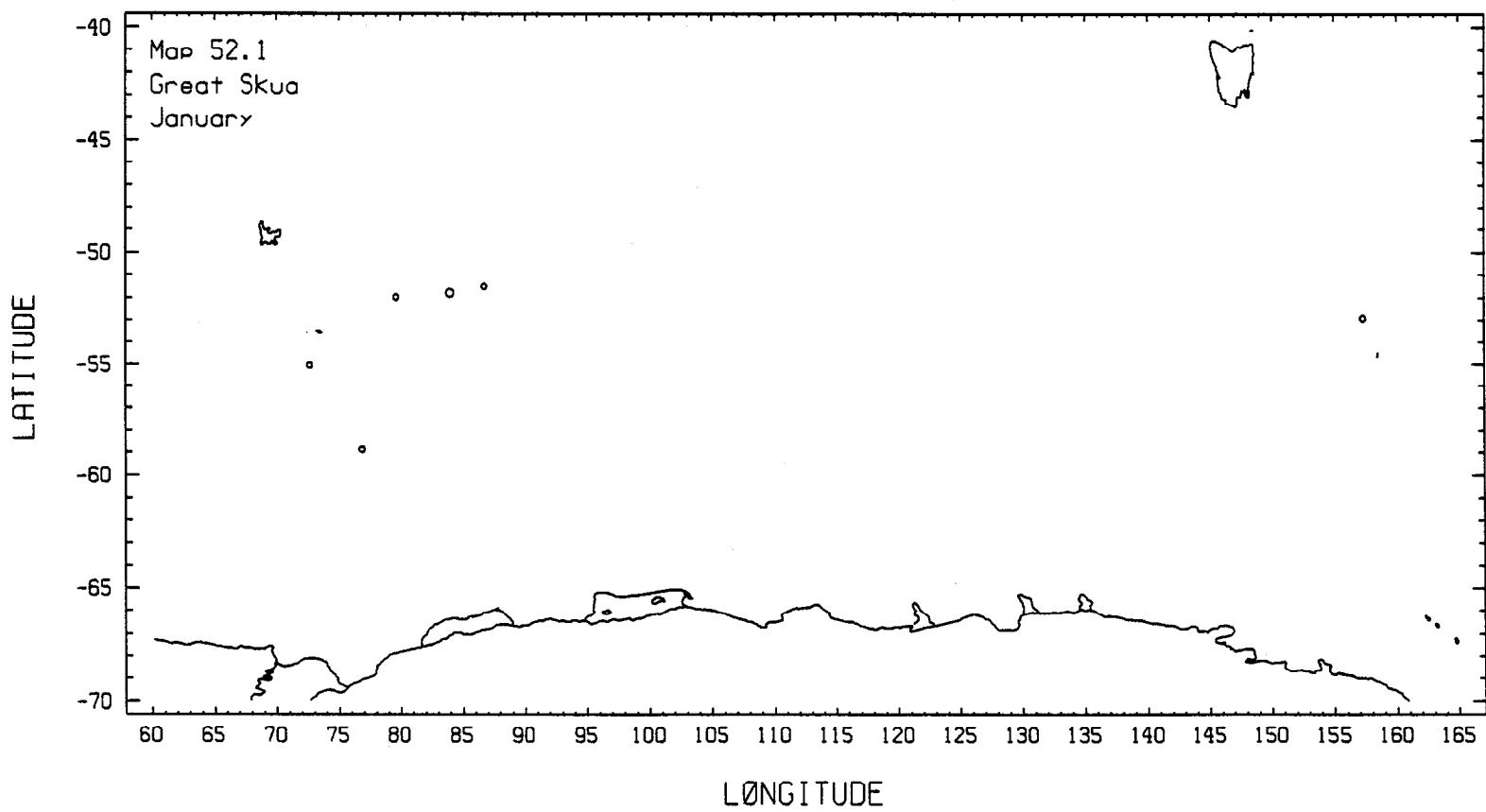


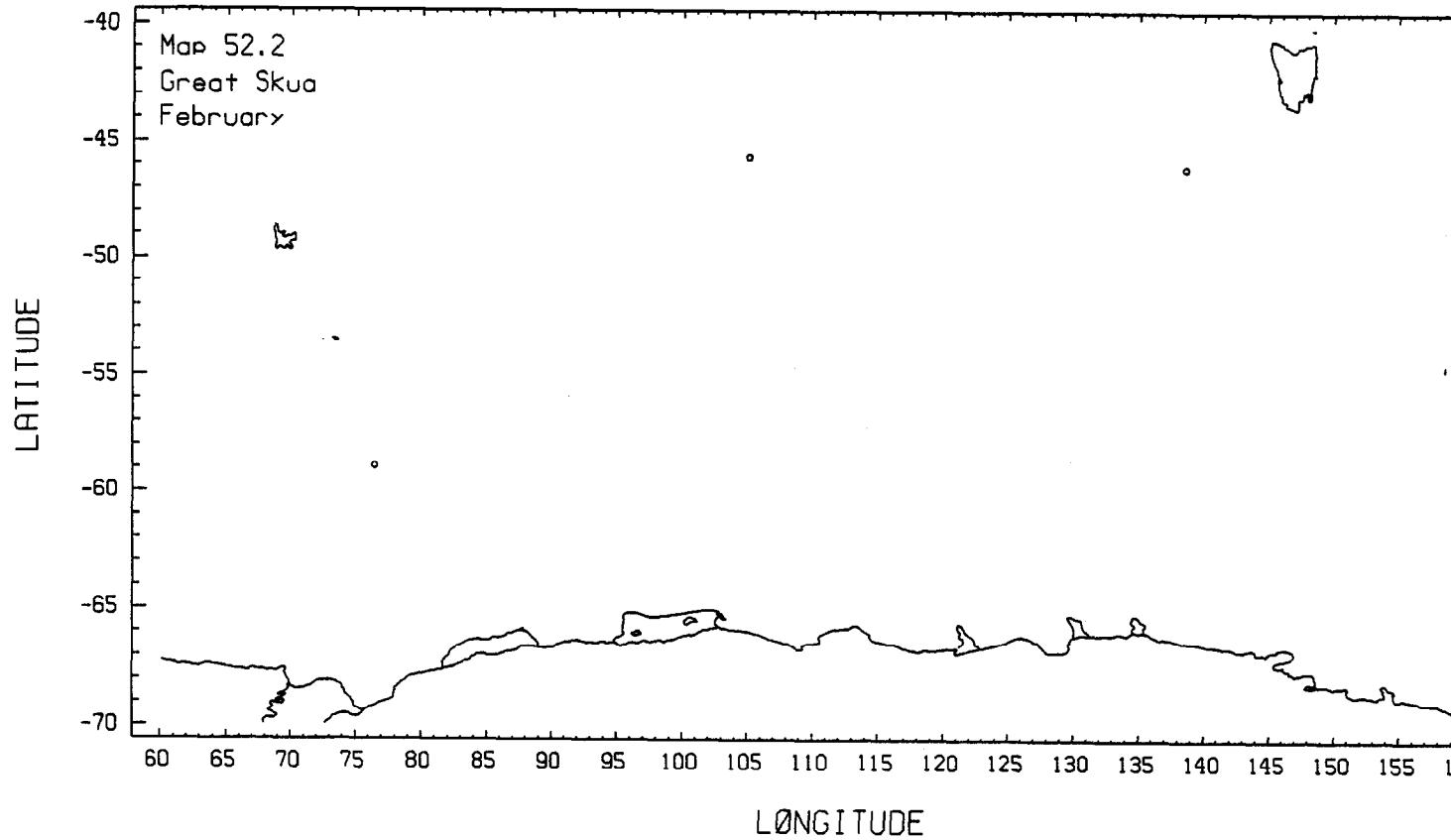


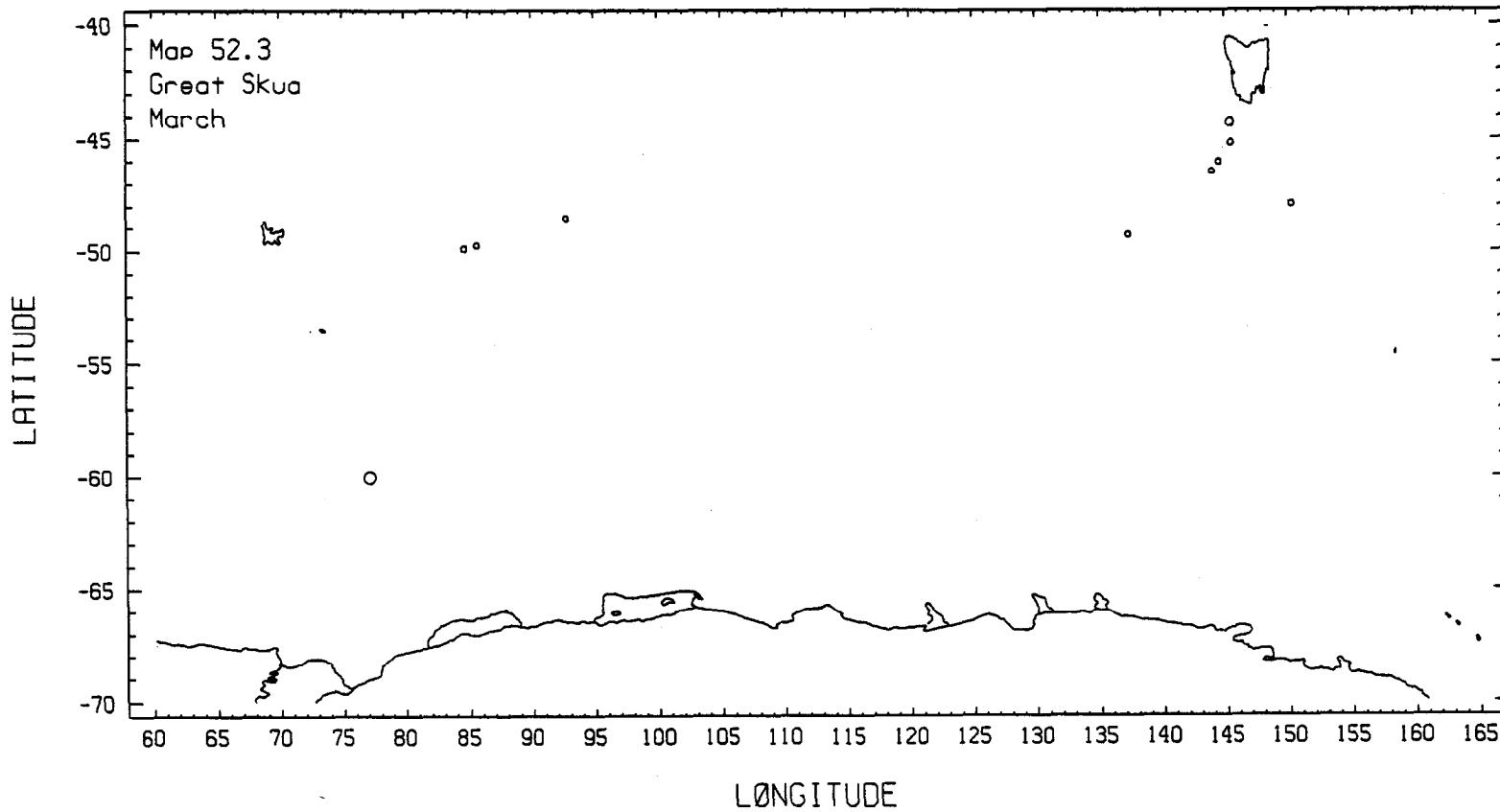


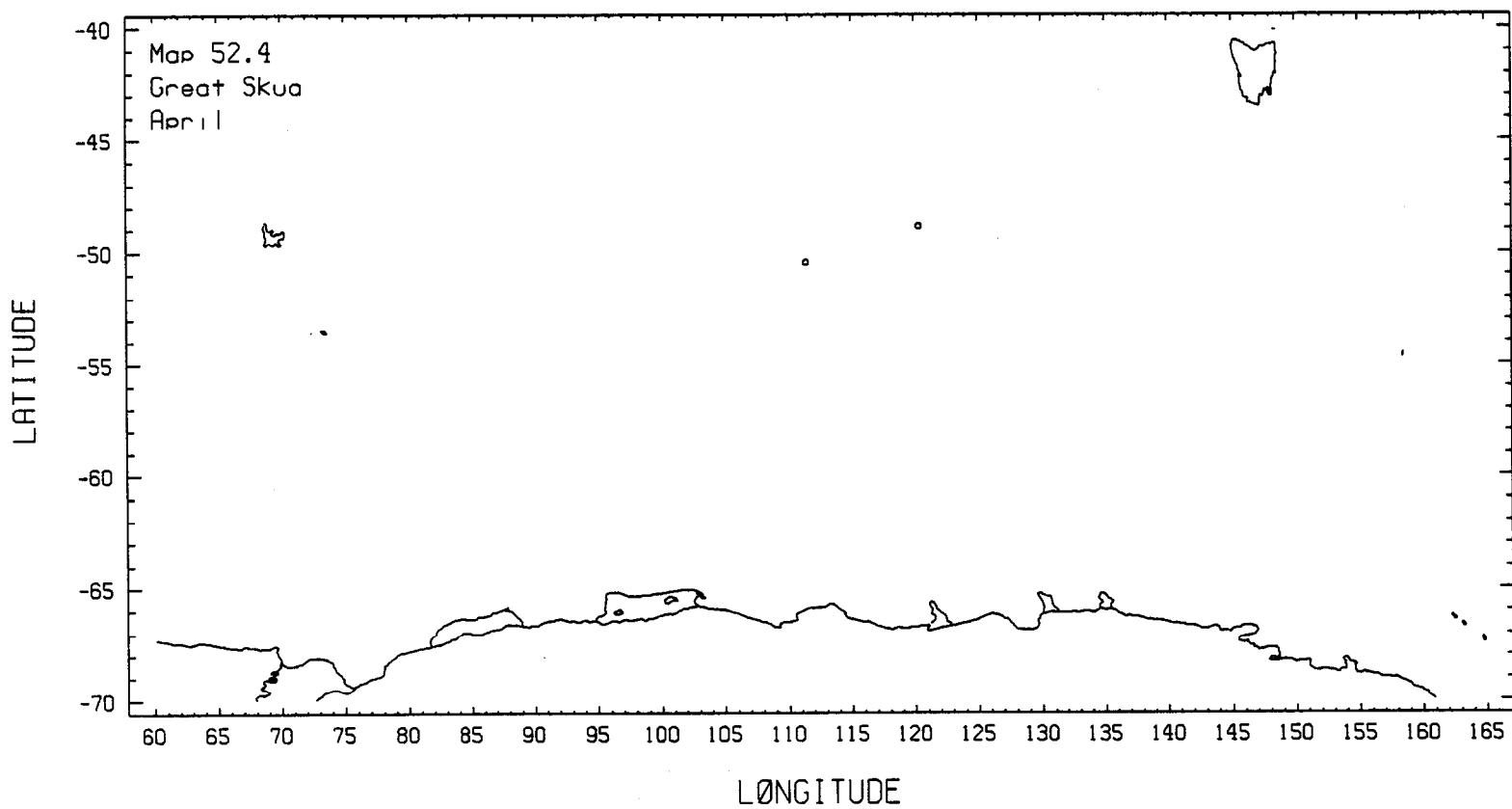


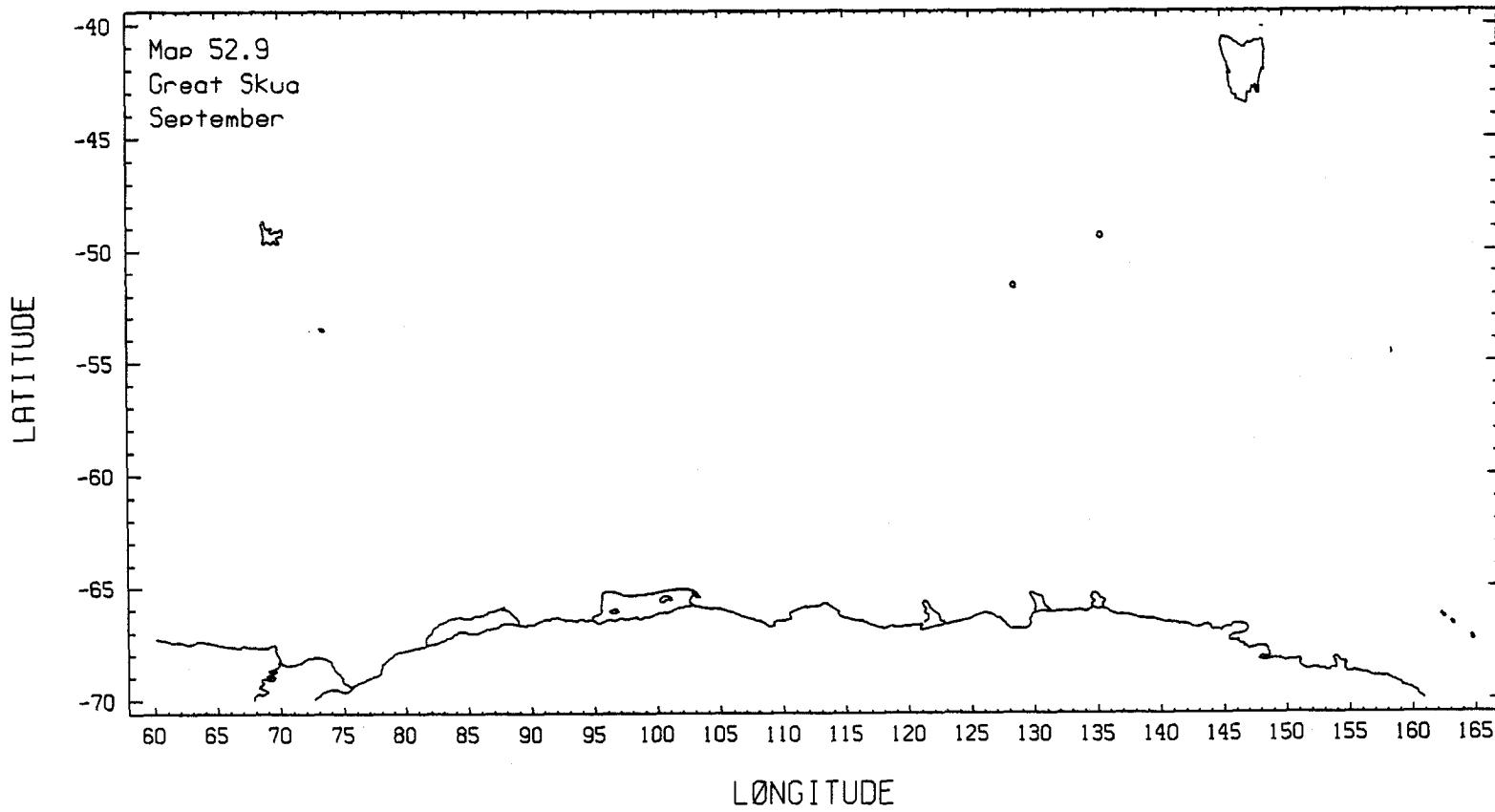


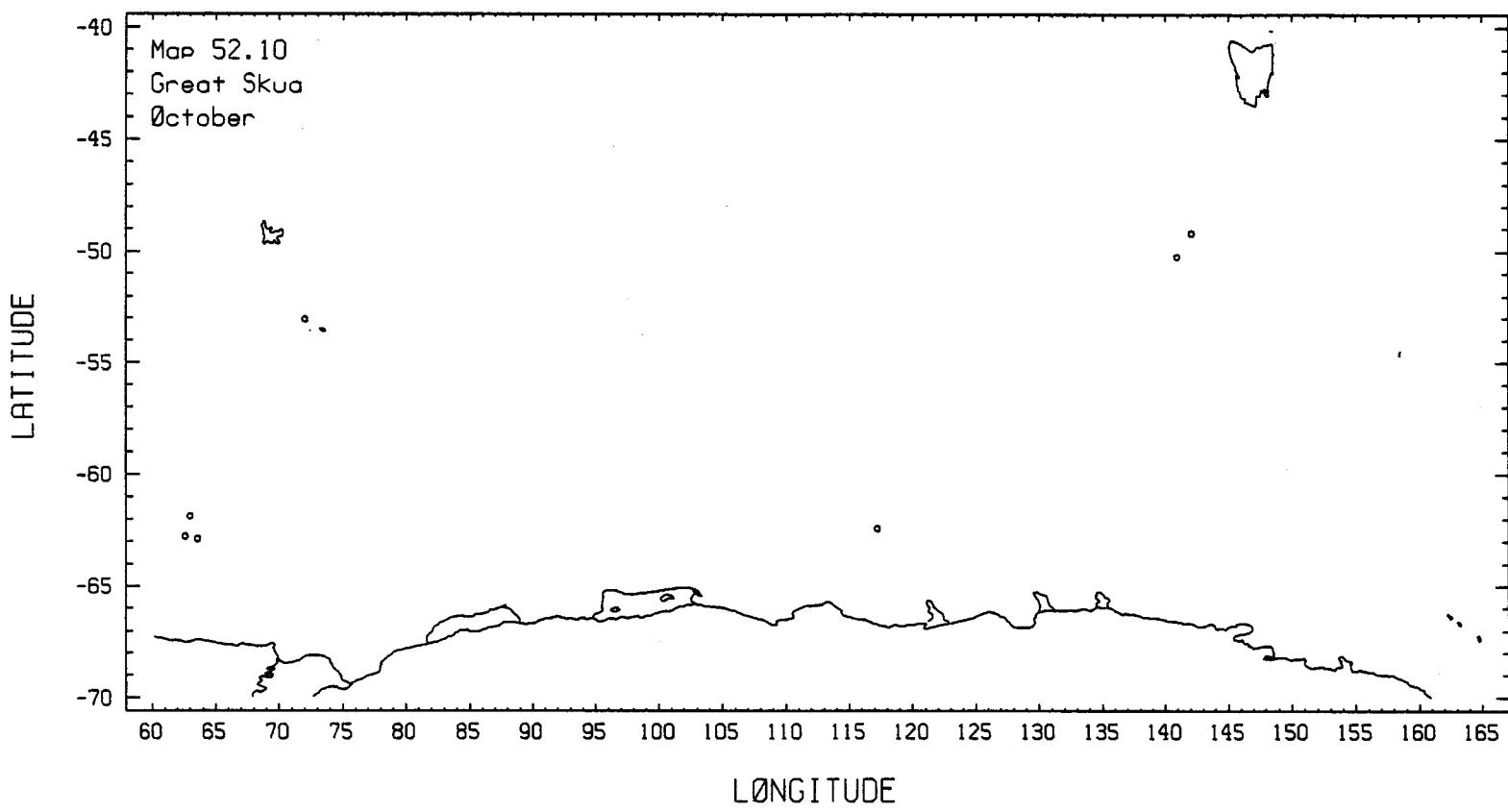


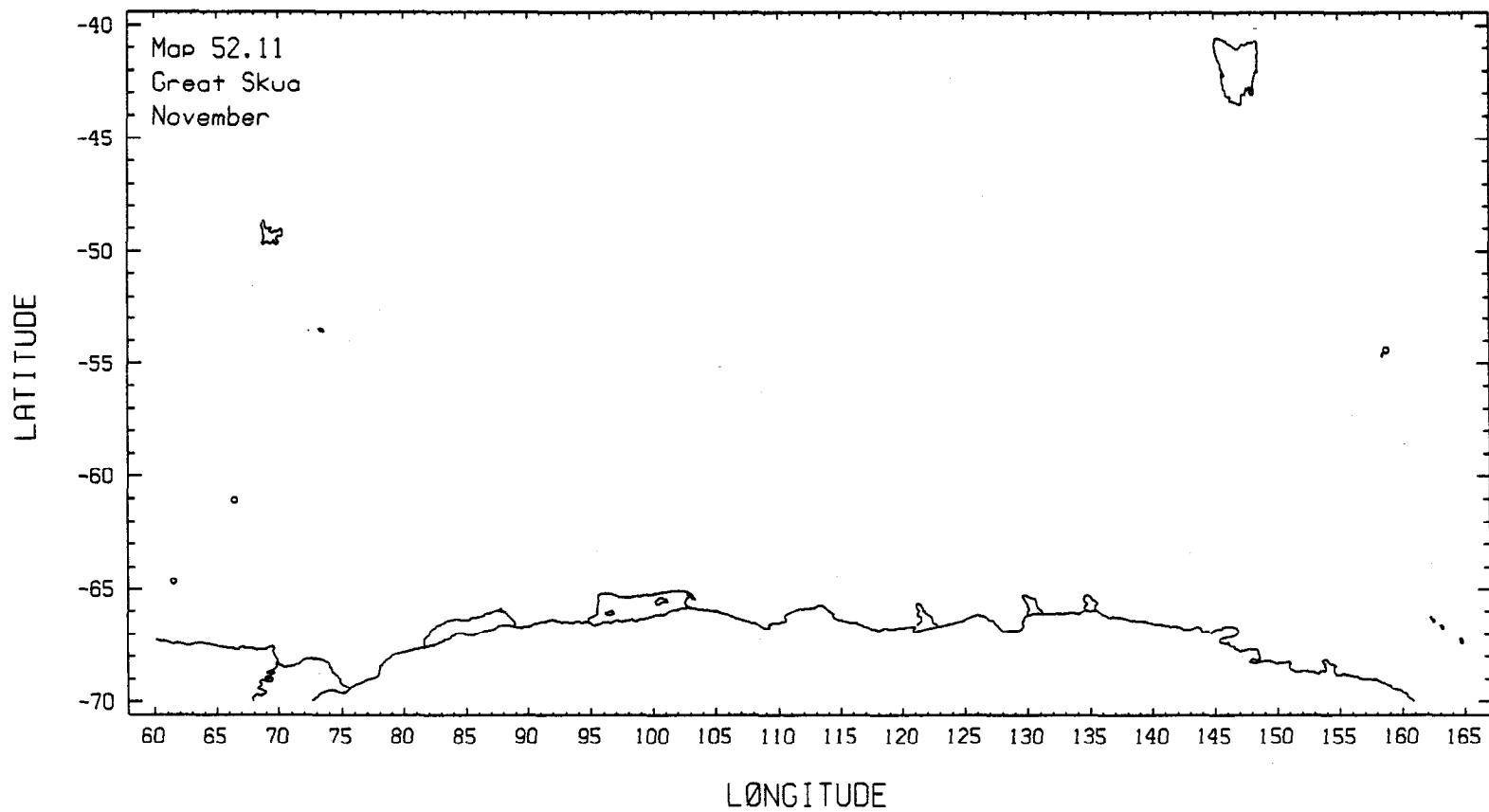


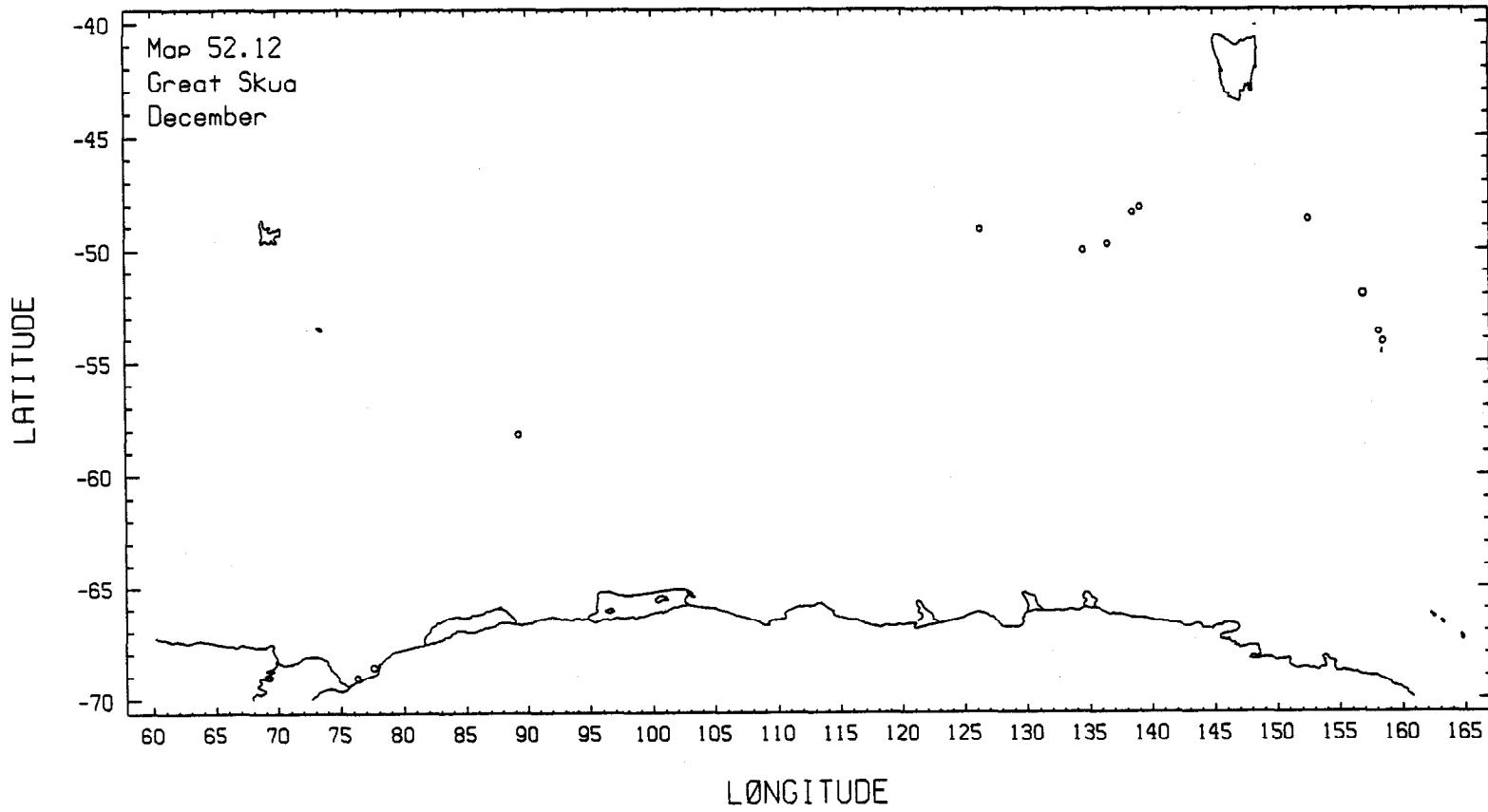


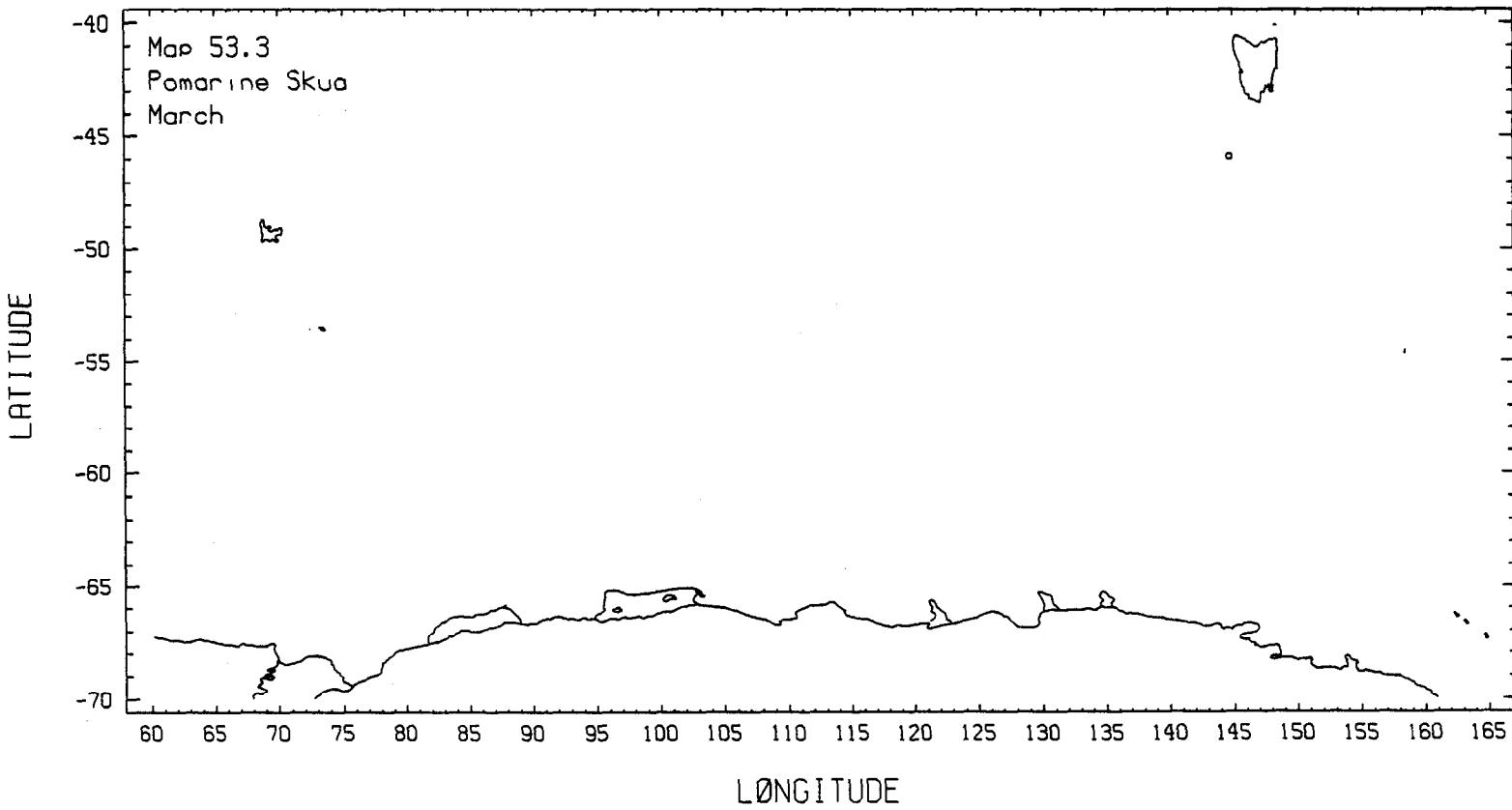


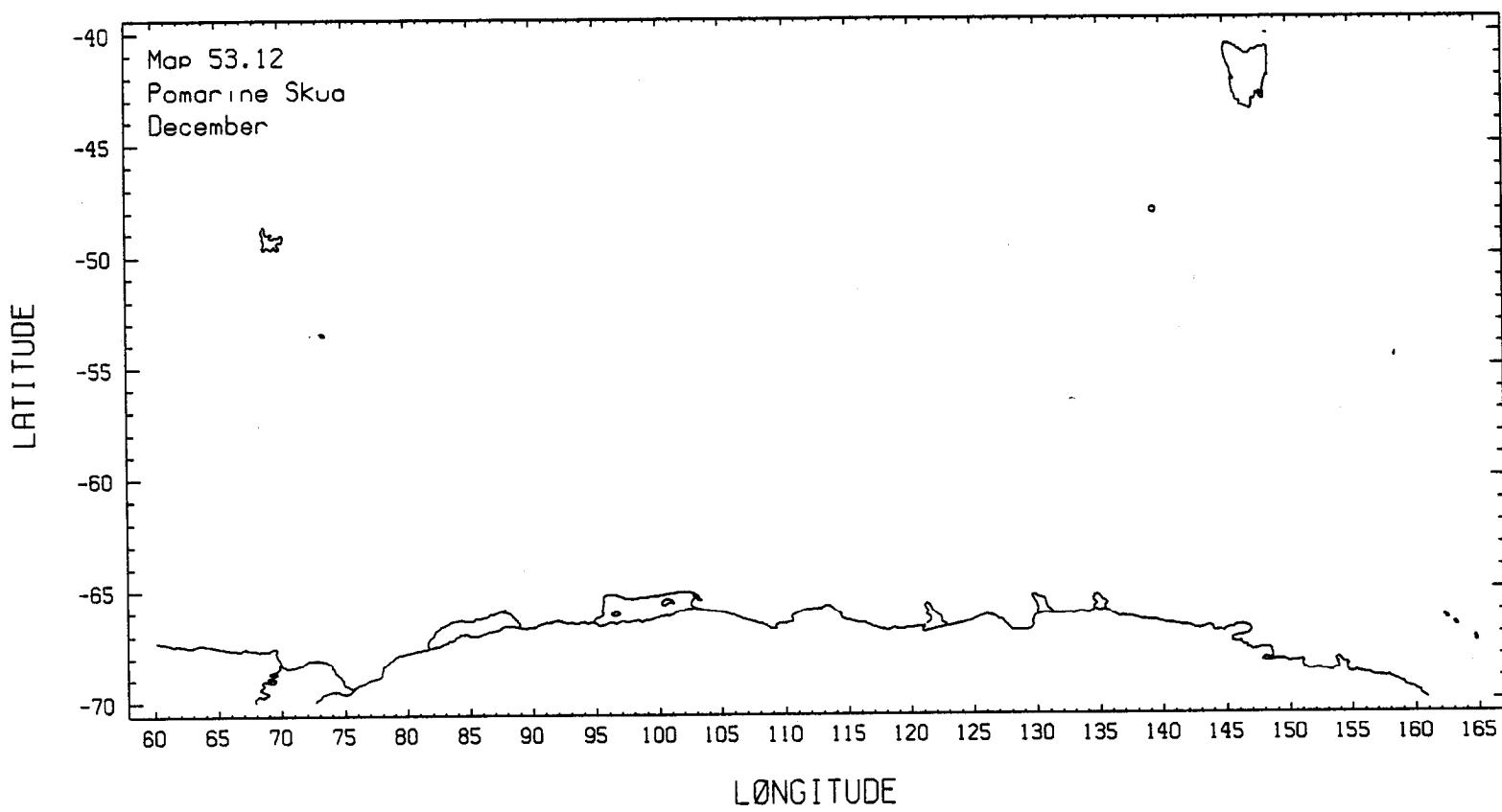


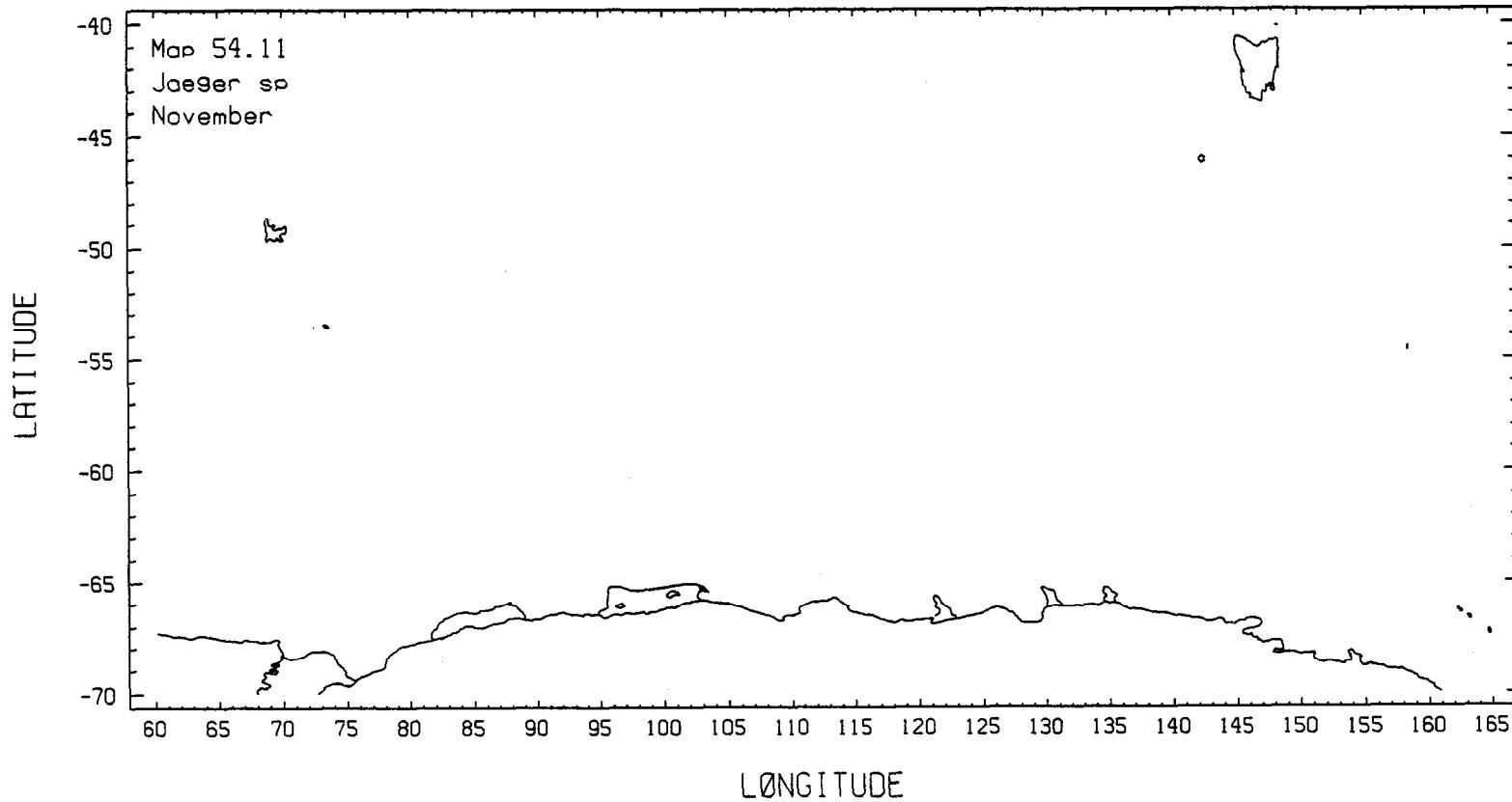




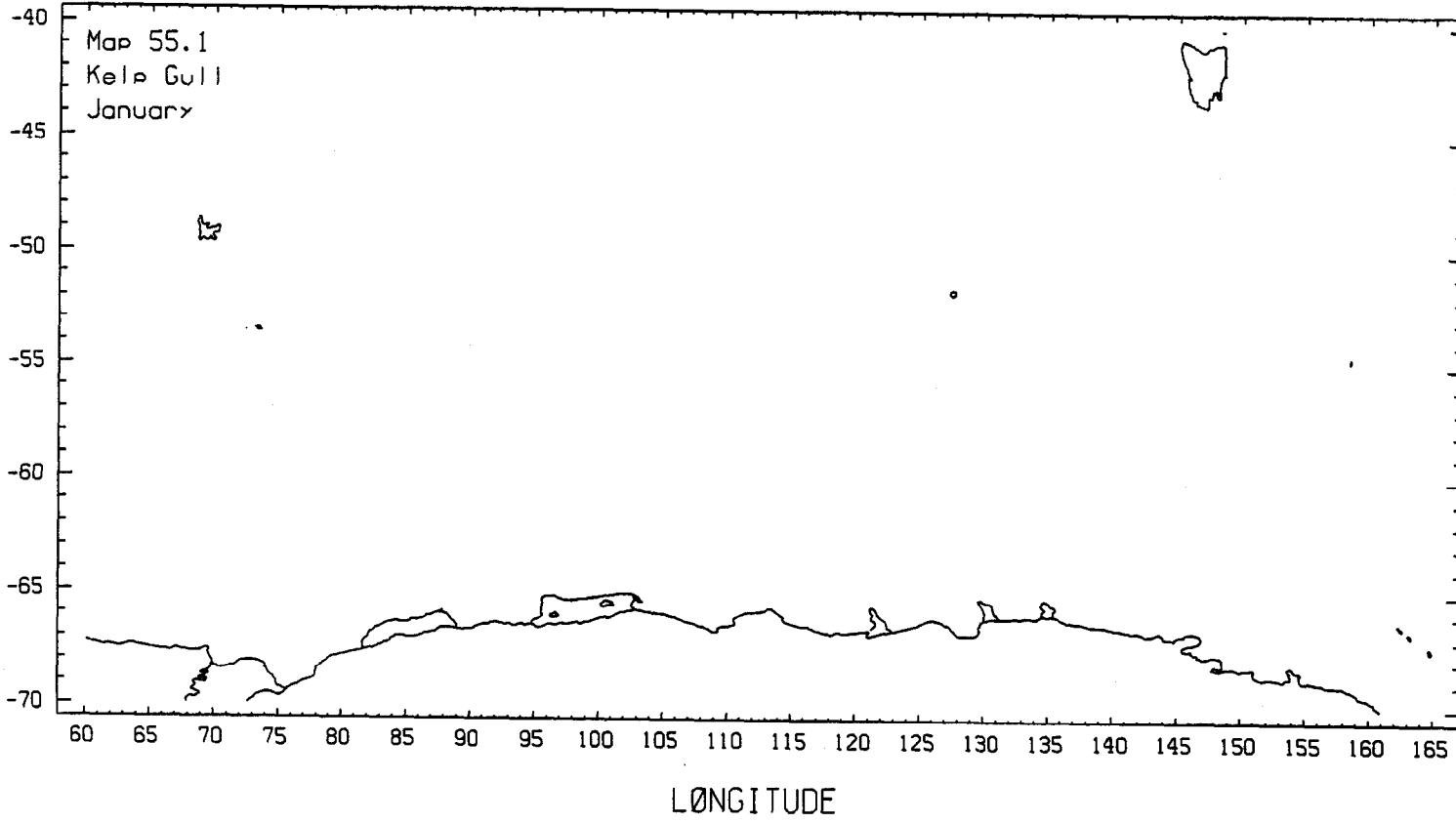


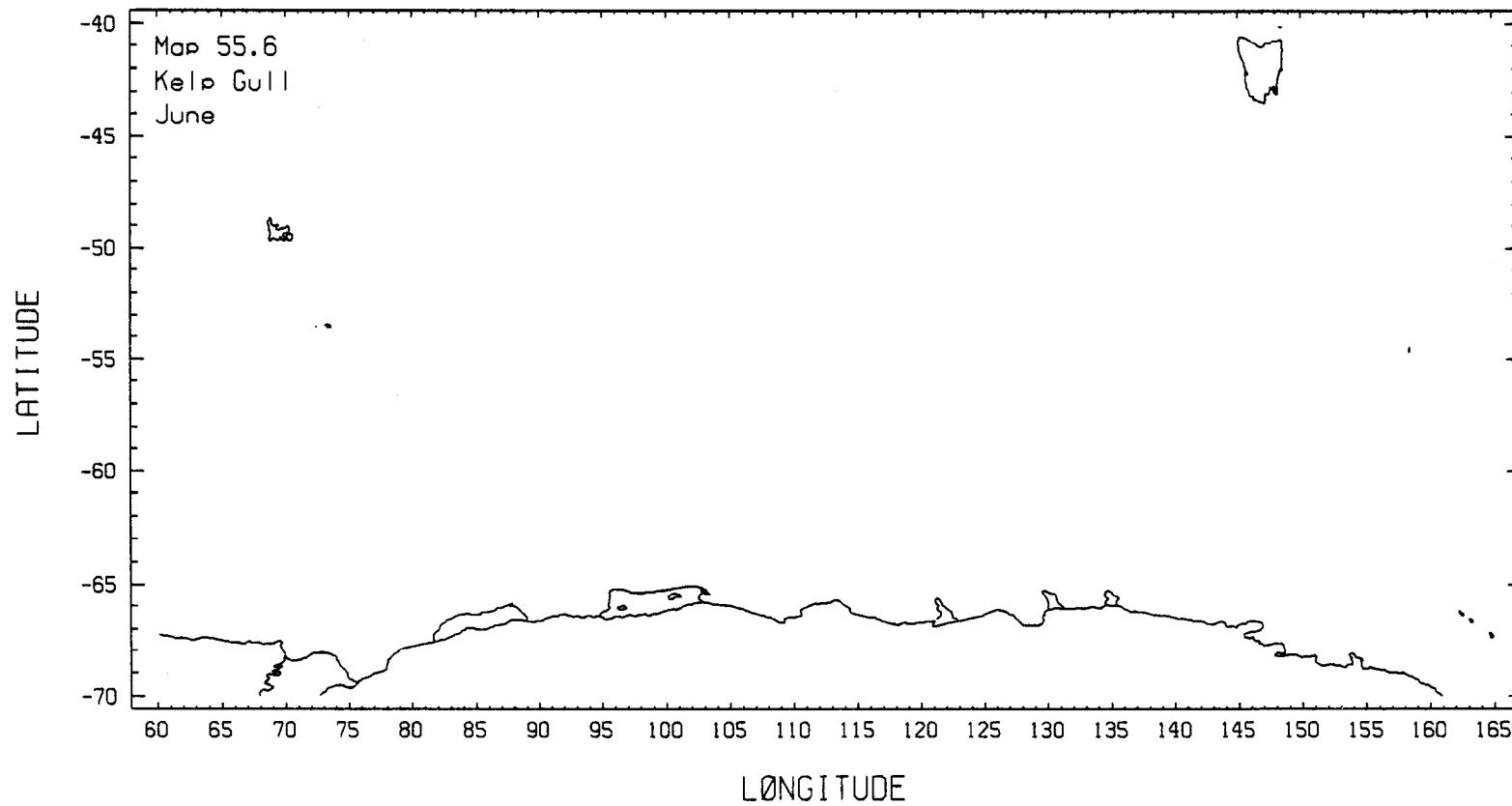




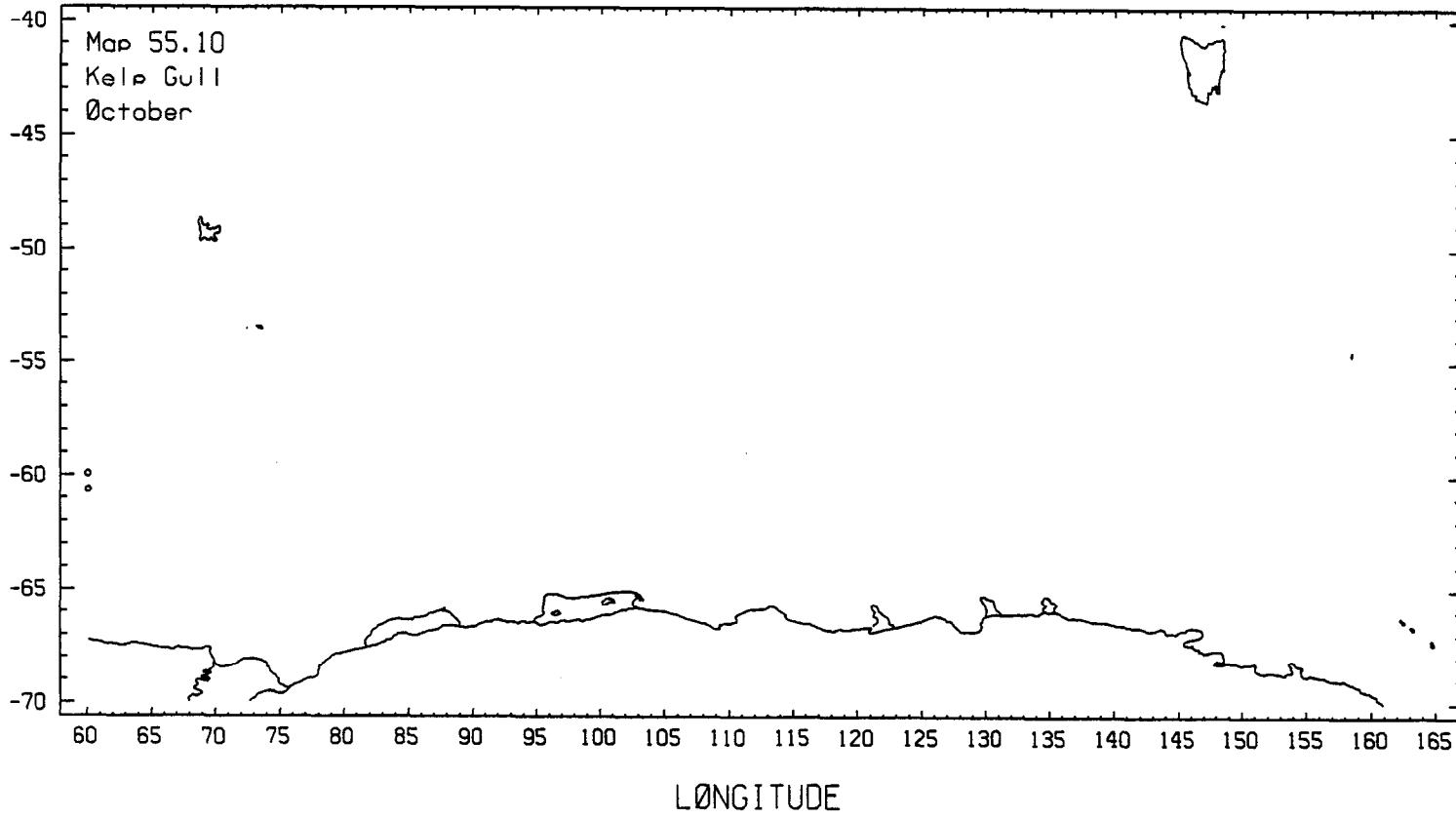


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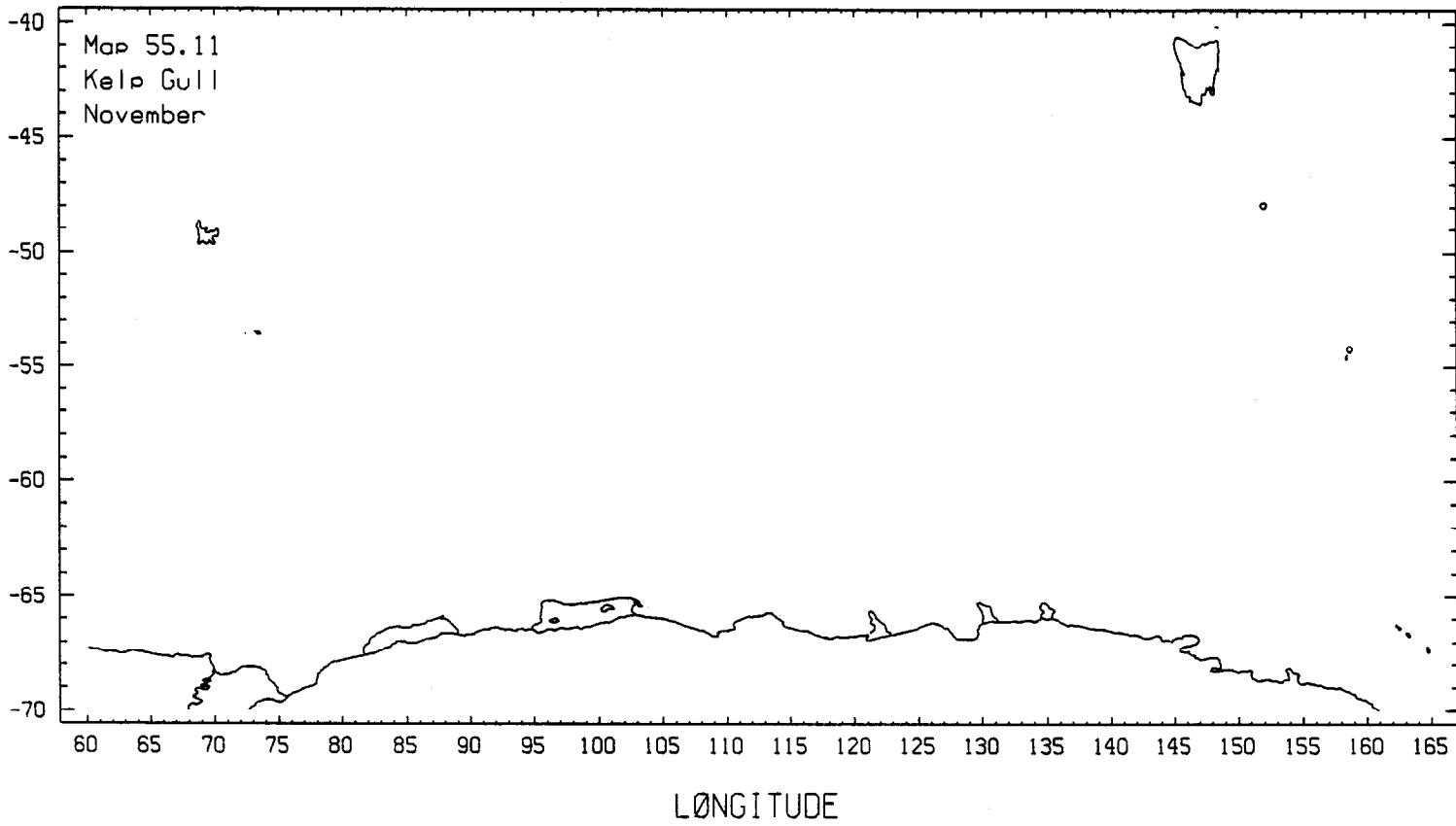


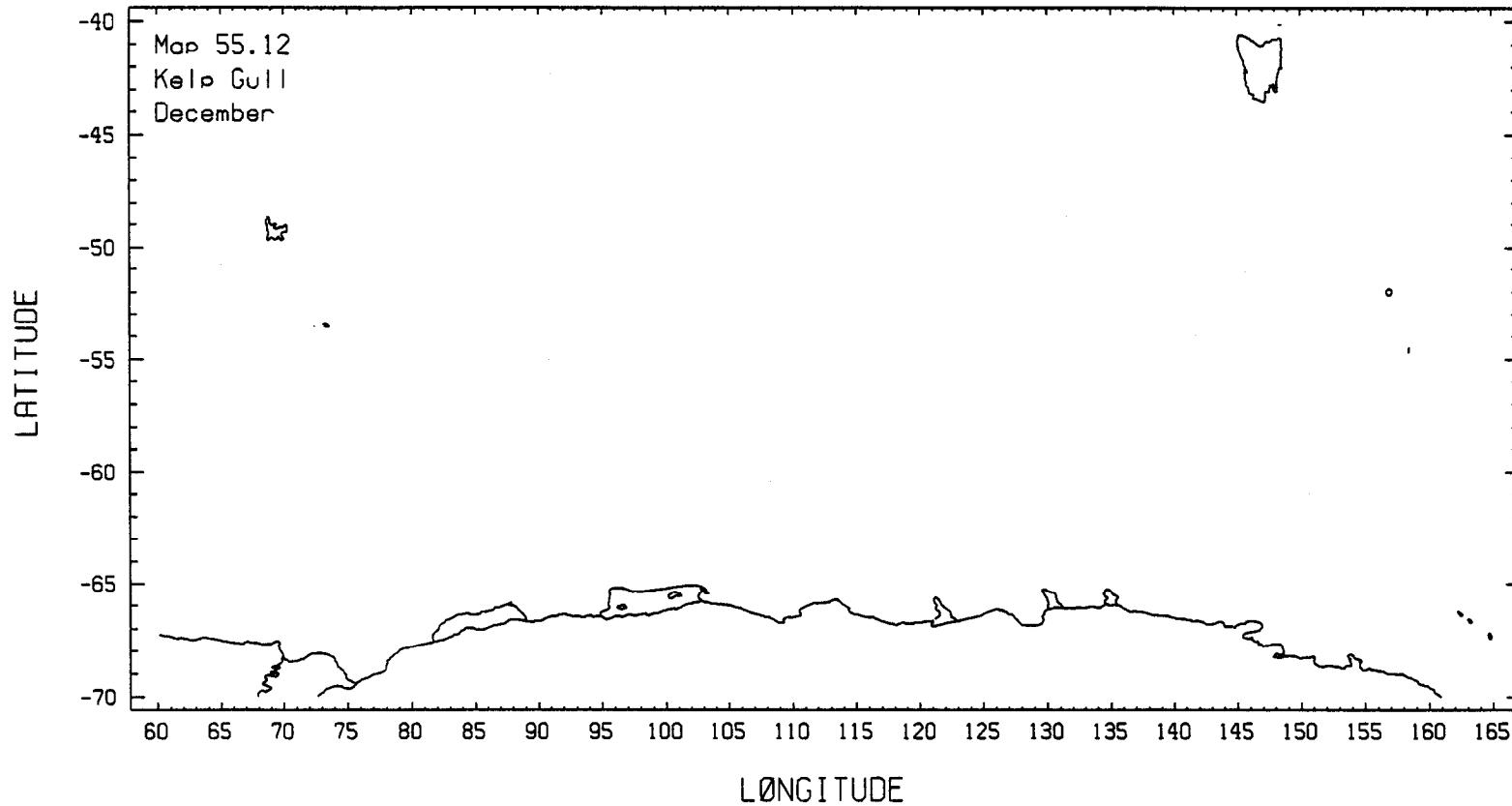


LATITUDE



LATITUDE





LATITUDE

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Map 56.10
Antarctic Tern
October

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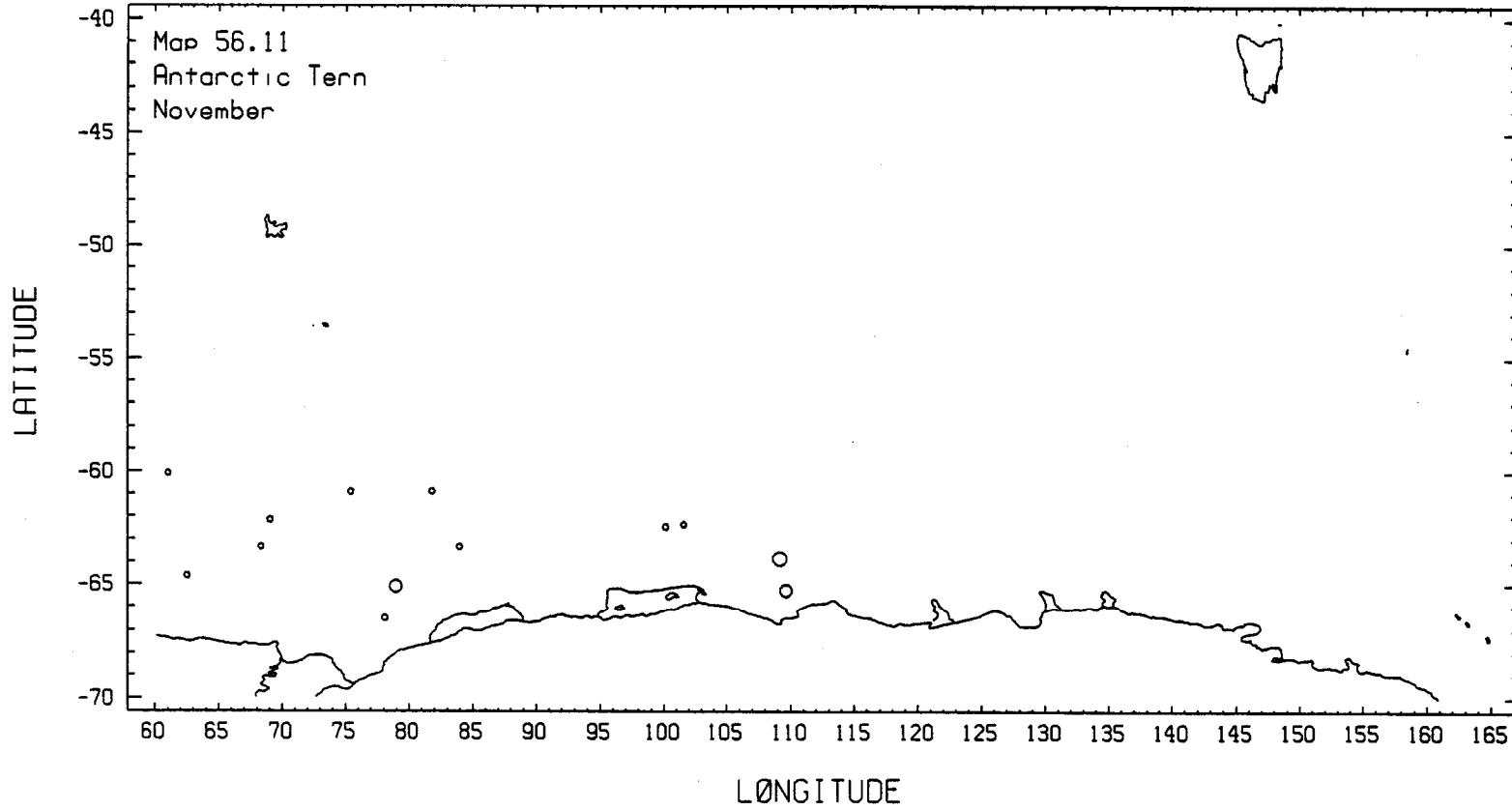
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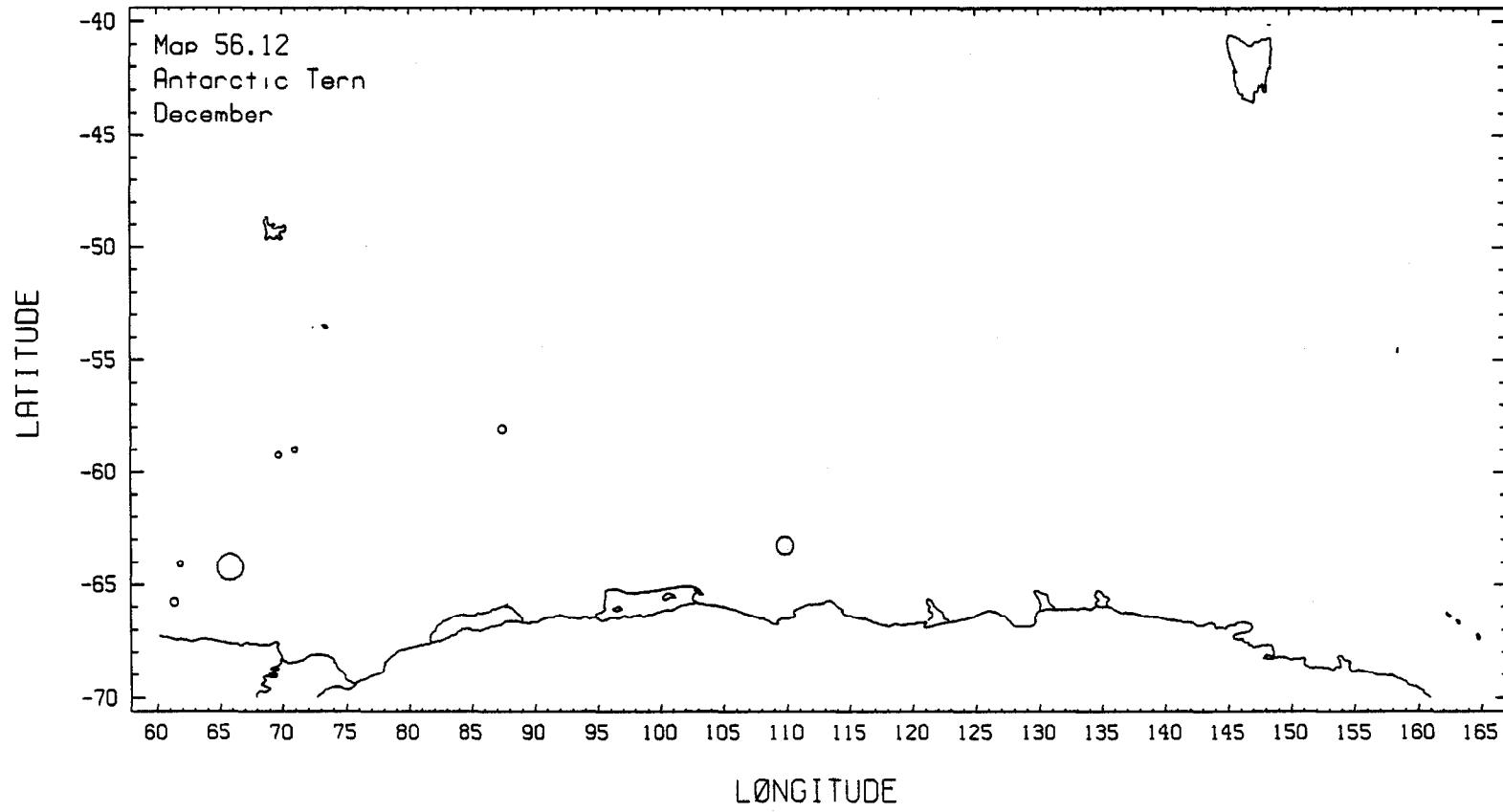
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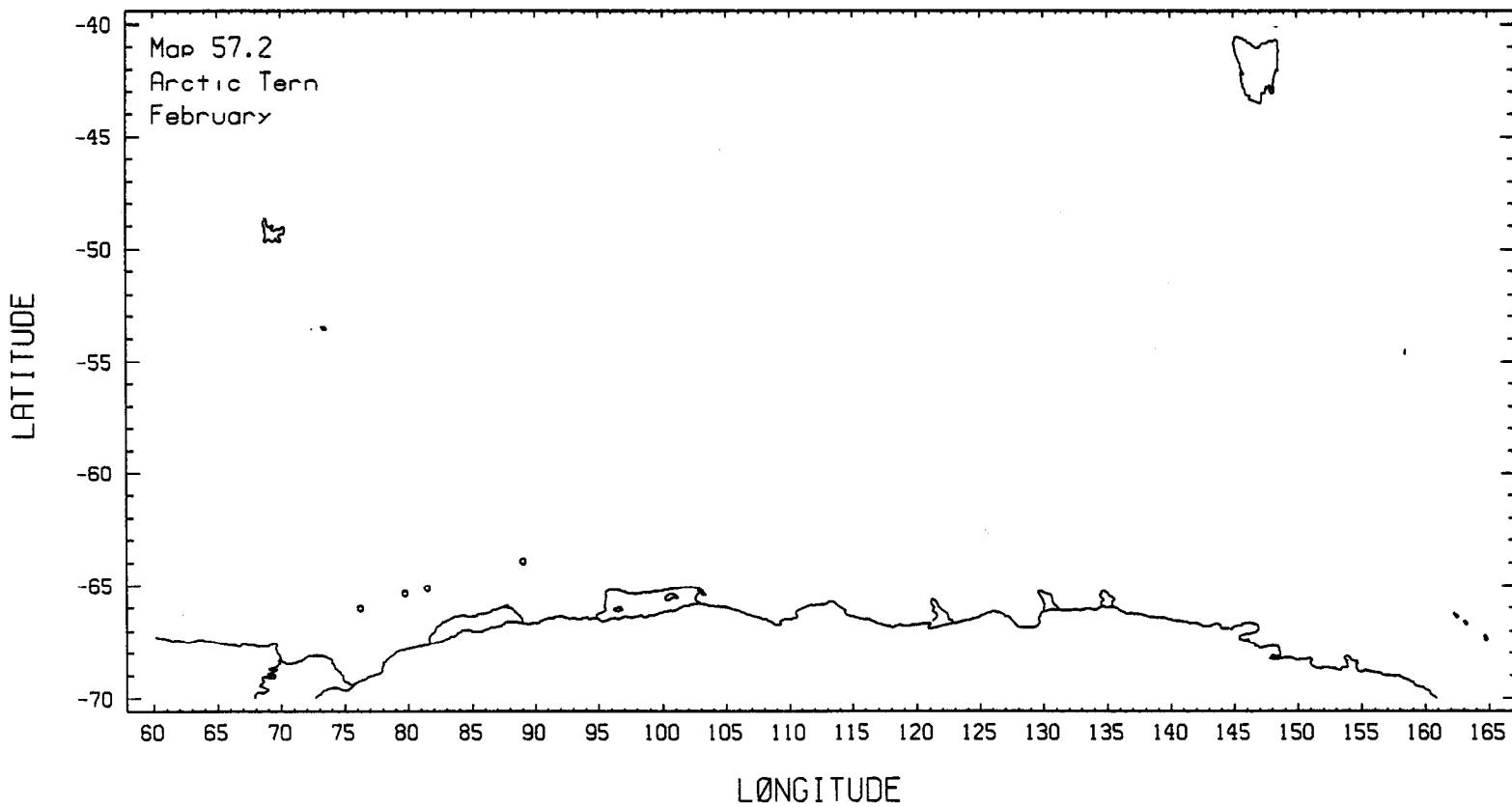
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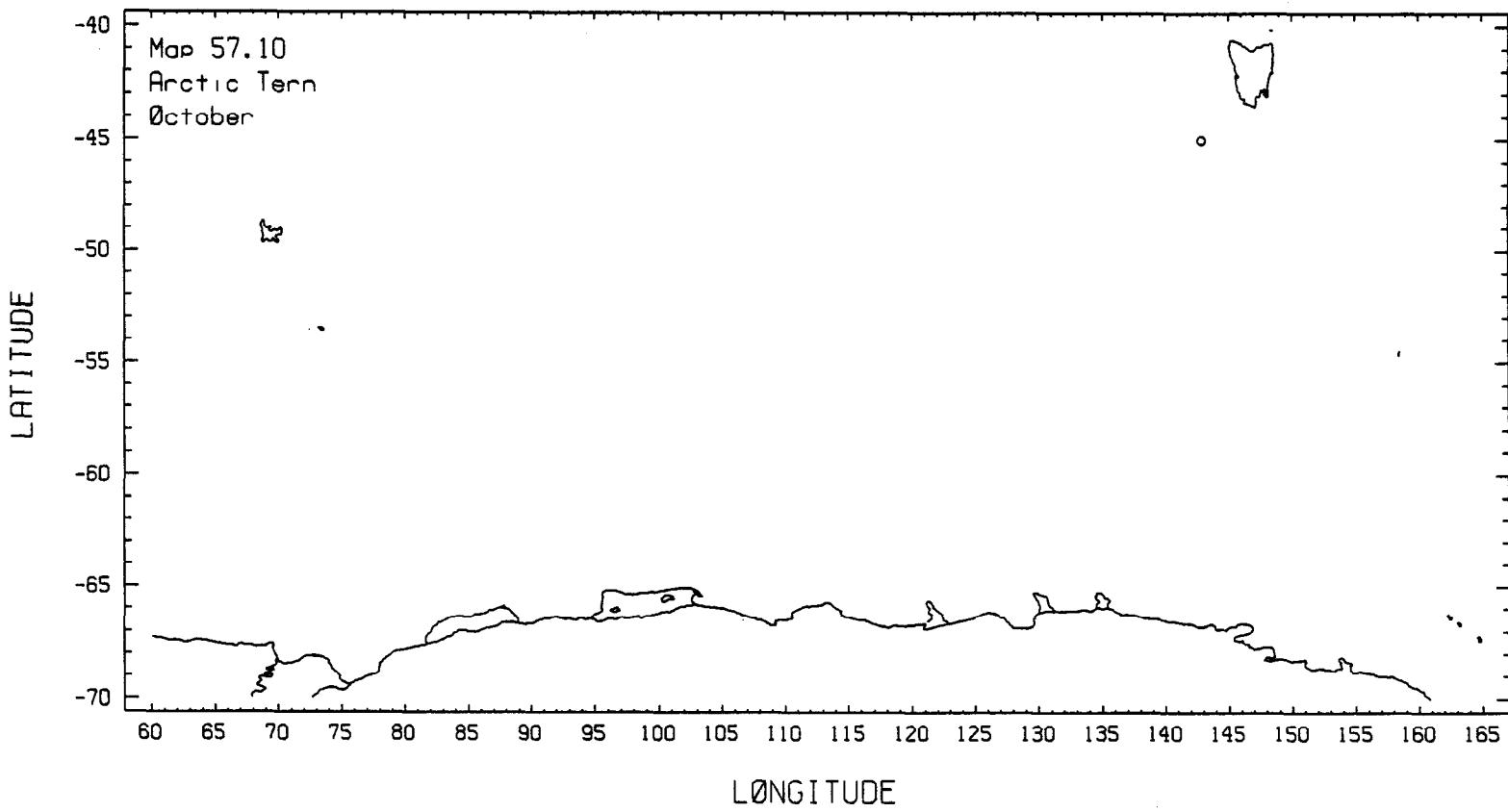
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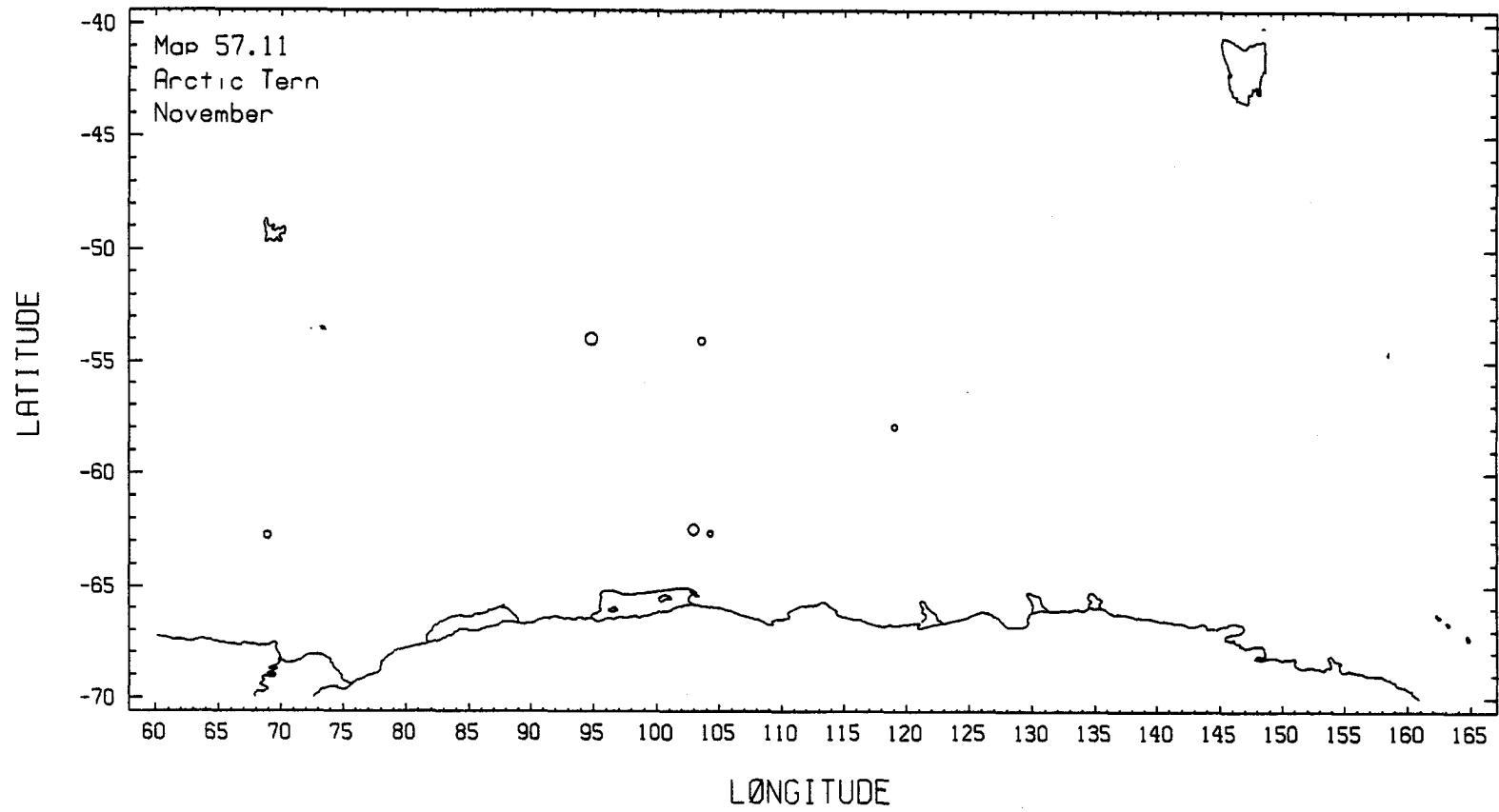


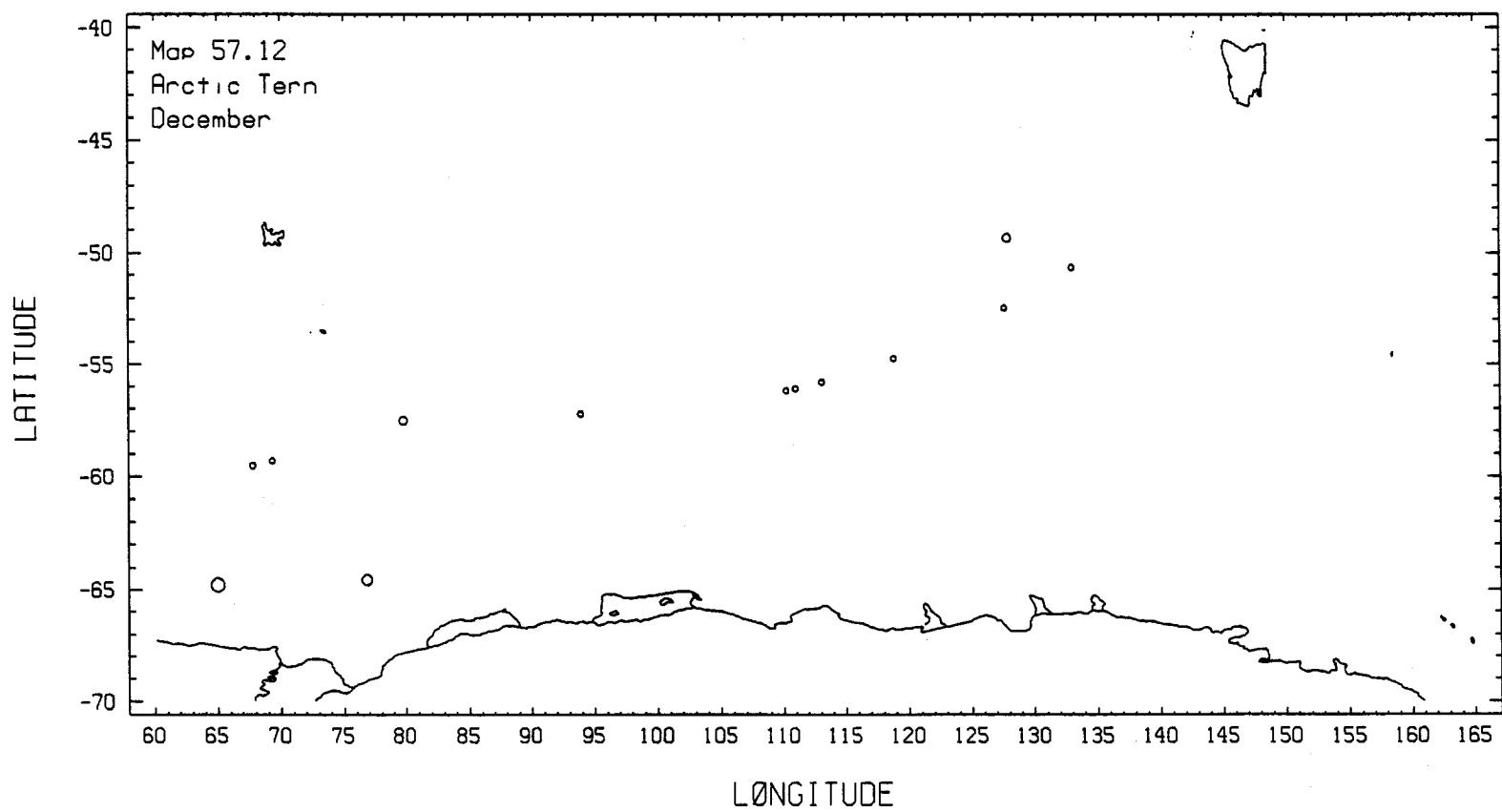












4. DISCUSSION

Although it is clear that the pattern for many species is largely an artefact of the sampling methodology, some preliminary trends can be determined.

The pelagic records of penguins indicate the extensive dispersal of these species during the non-breeding season. Breeding season foraging trips of light-mantled sooty albatrosses and white-chinned petrels reach Antarctic waters from their subantarctic breeding localities. Winter records of southern fulmars and Antarctic petrels indicate the movement well north into subantarctic waters. Snow petrels do not range far from their breeding colonies during the breeding season.

Records of sooty and short-tailed shearwaters over Antarctic waters, at the time of the breeding season in Tasmania and New Zealand, suggest that a re-appraisal of the pelagic range of these species may be warranted.

This publication is intended to be only a preliminary examination of the pelagic distributions and relative abundances of the species and species groups mapped. The next stages of analyses, examining spatial and temporal patterns, and oceanographic determinants of the distributions observed are presently underway. Following these studies, the relationships between seabird distributions, and those of prey species (e.g. krill and fish), will be examined. These studies will ultimately contribute to a more detailed understanding of the role of seabirds as predators of marine resources in the southern Indian Ocean.

ACKNOWLEDGMENTS

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