University of Southampton

Locating the Past

Exploring the Predictive Potential of Geographic Information Systems for Enhancing the Archaeological Assessment and Management of Marine Environments using Historic Shipwreck Reports

Anthony Hugo Hanks

Doctor of Philosophy

Faculty of Arts

Archaeology

April 2002

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF ARTS

ARCHAEOLOGY

Doctor of Philosophy

Locating the Past

By Anthony Hugo Hanks

The effective management of the maritime cultural heritage is inhibited by the lack of information on the true extent and locations of the materials it comprises. In addition underwater archaeology carries a heavy organisational, equipment and financial overhead. The principal objective of this research is to develop a tool that will provide the basis for more effectual and cost-effective maritime archaeological assessment. The methodology used involved a number of steps that together form an innovative approach combining the power and clarity of quantitative and spatial analyses. These steps were:

- The creation of a database based on historic records of 1163 shipwrecks in the Solent and the waters around the Isle Of Wight for the period 1140-1909.
- The extraction and creation of analytical data from the database.
- The analysis of that data to identify the factors that influenced the occurrence and locations of the shipwrecks.
- The analysis of the spatial data provided by the records using a Geographic Information System and the development of a predictive model indicating the quantitative potential of different areas of the seabed as the locations of historic shipwrecks.
- The development of a further model predicting the potential locations of prehistoric shipwrecks.

The results provided prioritised lists, maps and models showing the quantitative potential of different locations as the sites of shipwrecks. The methodology and the resulting tools provide the basis for new procedures that will satisfy the principle objective and provide a major contribution to maritime archaeological assessment and management.

Table of Contents

		Page
List of Figures		(vi)
List of Tables		(xiv)
Preface		(xvii)
Acknowledgements		(xx)
Chapter 1 - Introduction		1-1
Chapter 2 - Maritime Records		
2.1	Introduction	2-1
2.2	Trade	2-4
2.3	Meteorology	2-8
Chapter 3 - The Shipwreck Database		
3.1	Introduction	3-1
3.2	Structure of Database	3-1
3.3	Assumptions Made	3-4
Chapter 4 - Analysis of Shipwreck Database		
4.1	Frequency of Shipwrecks	4-1
4.2	Locations of Shipwrecks	4-12
4.3	How Wrecked	4-29
4.4	Nationality of Shipwrecks	4-37
4.5	Ports of Departure and Destination	4-47
4.6	Cargoes Carried	4-54
4.7	Age of Vessels	4-56
4.8	Size of Vessels	4-62
4.9	Types of Vessel	4-68
4.10	Weather	4-68
4.11	Occurrence of Shipwrecks Relative to Tide Cycle	4-74

Chapter 5 - Trade Routes and Volumes

5.1	Introduction	5-1
5.2	Overseas Trade	5-1
5.3	London's Overseas Trade	5-10
5.4	Southampton's Overseas Trade	5-12
5.5	England's Coastal Trade	5-13
5.6	London's Coastal Trade	5-16
5.7	Southampton's Coastal Trade	5-18
5.8	South Coast Outport's Coastal Trade	5-20
5.9	Shipping Volumes in Study Area	5-25
5.10	Size of Ships	5-28
5.11	Trade Seasonality	5-31

Chapter 6 – Navigation

6.1	Introduction	6-1
6.2	Non-Instrumental Navigation	6-1
6.3	Quantitative Navigation	6-4
6.3.1	The Magnetic Compass	6-4
6.3.2	Charts and Sailing Directions	6-5
6.3.3	Tides	6-9
6.3.4	The Log-ship	6-10
6.3.5	Measurement of Distance	6-11
6.3.6	Other Causes of Navigational Errors	6-12
6.3.7	Lighthouses and Sea-marks	6-13

Chapter 7 – Maritime Hazards

7.1	Introduction	7-1
7.2	Maritime Hazards of the Study Area	7-1

Chapter 8 – Meteorology

8.1	Introduction	8-1
8.2	British Isles Meteorology	8-2
8.3	English Channel Meteorology	8-3
8.4	Solent Meteorology	8-5

Chapter 9 – Effects of Topography

9.1	Introduction	9-1
9.2	Effects of Topography on the Wind	9-1

Chapter 10 – Conclusions
10.1 Introduction 10-1
10.2 Volume of Shipping 10-3
10.3 Peak Annual Totals 10-19
10.4 Peak Monthly Totals 10-27
10.5 Peak Daily Totals 10-41
10.6 Wind Conditions 10-42
10.7 Poor Visibility 10-55
10.8 Tides 10-60
10.9 Cargoes Carried 10-61
10.10 Coastal/Overseas Traders 10-76
10.11 Age of Vessels 10-77
10.12 Sizes of Vessels 10-82
10.13 Conclusions 10-87
10.14 The Model 10-100
Chapter 11 – Extrapolation
11.1 Introduction 11-1
11.2 Time Period 11-2
11.3 Geomorphology 11-2
11.4 Maritime Activity 11-6
11.5 Weather Patterns 11-12
11.6 Application of Model 11-13
Bibliography B-1

List of Figures

		Page
1.1	Map of the location of the study area	1-2
1.2	Map of the study area	1-3
4.1	Map of locations of shipwrecks	4-2
4.2	Map of regions	4-3
4.3	Thematic map of the density of shipwrecks by region	4-4
4.4	Number of Wrecks by decade 1140 – 1909	4-5
4.5	Annual number of shipwrecks 1740 - 1909	4-6
4.6	Map of the locations of shipwrecks in the Coastal subgroup	4-7
4.7	Map of the locations of shipwrecks in the Overseas subgroup	4-8
4.8	Percentage number of shipwrecks each month 1140 – 1909	4-11
4.9	Percentage number of shipwrecks each month 1140 – 1739	4-11
4.10	Percentage number of shipwrecks each month 1740 – 1909	4-12
4.11	Map of the locations of vessels wrecked in January	4-13
4.12	Map of the locations of vessels wrecked in February	4-14
4.13	Map of the locations of vessels wrecked in March	4-15
4.14	Map of the locations of vessels wrecked in April	4-16
4.15	Map of the locations of vessels wrecked in May	4-17
4.16	Map of the locations of vessels wrecked in June	4-18
4.17	Map of the locations of vessels wrecked in July	4-19
4.18	Map of the locations of vessels wrecked in August	4-20
4.19	Map of the locations of vessels wrecked in September	4-21
4.20	Map of the locations of vessels wrecked in October	4-22
4.21	Map of the locations of vessels wrecked in November	4-23
4.22	Map of the locations of vessels wrecked in December	4-24
4.23	Vessels wrecked by stranding by decade 1140 – 1909	4-30
4.24	Vessels wrecked by foundering by decade 1140 – 1909	4-31
4.25	Vessels wrecked by burning or explosion by decade 1140 – 1909	4-31
4.26	Vessels wrecked following collisions by decade 1140 – 1909	4-32
4.27	Map of the locations of vessels wrecked by stranding	4-33
4.28	Map of the locations of vessels wrecked by foundering	4-34
4.29	Map of the locations of vessels wrecked by burning/explosion	4-35
4.30	Map of the locations of vessels wrecked following collision	4-36

4.31	Cumulative numbers of shipwrecks by decade for the six most frequent nationalities excluding British	4-39
4.32	Map of the locations of French vessels wrecked	4-41
4.33	Map of the locations of Dutch vessels wrecked	4-42
4.34	Map of the locations of Spanish vessels wrecked	4-43
4.35	Map of the locations of German vessels wrecked	4-44
4.36	Map of the locations of Swedish vessels wrecked	4-45
4.37	Map of the locations of Norwegian vessels wrecked	4-46
4.38	Map of the locations of shipwrecks in the Local subgroup	4-48
4.39	Numbers of shipwrecks in the Up Channel subgroup by decade	4-49
4.40	Numbers of shipwrecks in the Down Channel subgroup by decade	4-49
4.41	Numbers of shipwrecks in the Local subgroup by decade	4-50
4.42	Numbers of vessels wrecked while at anchor or moored	4-50
4.43	Map of the locations of vessels wrecked sailing up the English Channel	4-51
4.44	Map of the locations of vessels wrecked sailing down the English Channel	4-52
4.45	Map of the locations of vessels wrecked when coming to anchor, at anchor or moored	4-53
4.46	Age profile of vessels wrecked	4-56
4.47	Age profile of vessels wrecked prior to 1850	4-57
4.48	Age profile of vessels wrecked 1851 to 1909	4-57
4.49	Map of the locations of wrecked vessels up to and including 5 years old	4-58
4.50	Map of the locations of wrecked vessels 6 – 15 years old	4-59
4.51	Map of the locations of wrecked vessels 16 – 30 years old	4-60
4.52	Map of the locations of wrecked vessels over 30 years old	4-61
4.53	Size of Vessels	4-63
4.54	Map of the locations of wrecked vessels up to 100 tons	4-64
4.55	Map of the locations of wrecked vessels 101 – 300 tons	4-65
4.56	Map of the locations of wrecked vessels 301 - 600 tons	4-66
4.57	Map of the locations of wrecked vessels over 600 tons	4-67

4.58	Frequency of wind direction from shipwreck reports	4-73
4.59	Percentage of shipwrecks occurring each day of the tidal cycle	4-75
4.60	Map of the locations of vessels wrecked six days before spring tides	4-76
4.61	Map of the locations of vessels wrecked five days before spring tides	4-77
4.62	Map of the locations of vessels wrecked four days before spring tides	4-78
4.63	Map of the locations of vessels wrecked three days before spring tides	4-79
4.64	Map of the locations of vessels wrecked two days before spring tides	4-80
4.65	Map of the locations of vessels wrecked one day before spring tides	4-81
4.66	Map of the locations of vessels wrecked at spring tides	4-82
4.67	Map of the locations of vessels wrecked one day after spring tides	4-83
4.68	Map of the locations of vessels wrecked two days after spring tides	4-84
4.69	Map of the locations of vessels wrecked three days after spring tides	4-85
4.70	Map of the locations of vessels wrecked four days after spring tides	4-86
4.71	Map of the locations of vessels wrecked five days after spring tides	4-87
4.72	Map of the locations of vessels wrecked six days after spring tides	4-88
4.73	Map of the locations of vessels wrecked at neap tides	4-89
5.1	English (later British) imports and exports and the tonnage of shipping cleared outwards 1696 - 1822	5-9
6.1	The hand as a yardstick for distance off	6-3
7.1	Map of the maritime hazards	7-2
8.1	Comparison of wind direction frequency at Calshot, 0700 GMT and 1300 GMT	8-8

8.2	Number of gales per year for the Northern British Isles	8-9
8.3	A Daytime Wind Trace (Anemogram)	8-10
9.1	Recorded Winds at 9am, 24th October 1859	9-1
9.2	Possible sea breeze airflow across the Isle of Wight and the Solent	9-2
9.3	Wind flow over solid barrier	9-3
10.1	UK imports and exports 1740-1909	10-4
10.2	Annual/cumulative numbers of shipwrecks 1740-1909	10-4
10.3	Comparison of the annual volume of trade and number of vessels wrecked 1740-1820	10-5
10.4	Comparison of the annual and cumulative numbers of shipwrecks for the Overseas subgroup 1740-1909	10-9
10.5	Comparison of the annual and cumulative numbers of vessels wrecked for the Coastal Subgroup 1740-1909	10-10
10.6	Comparison of the annual and cumulative numbers of shipwrecks in the Local subgroup	10-10
10.7	Thematic map of the density of shipwrecks in the Coastal subgroup by region	10-13
10.8	Thematic map of the density of shipwrecks in the Overseas subgroup by region	10-14
10.9	Thematic map of the density of shipwrecks in the Local subgroup by region	10-15
10.10	Map of the locations of vessels wrecked in 1881	10-20
10.11	Map of the locations of vessels wrecked in 1753	10-22
10.12	Map of the locations of vessels wrecked in 1795	10-24
10.13	Map of the locations of vessels wrecked in 1809	10-26
10.14	Thematic map of the density of vessels wrecked in January by region	10-28
10.15	Thematic map of the density of vessels wrecked in February by region	10-29
10.16	Thematic map of the density of vessels wrecked in March by region	10-30
10.17	Thematic map of the density of vessels wrecked in April by region	10-31

10.18 Thematic map of the density of vessels wrecked in May by region 10-32
10.19 Thematic map of the density of vessels wrecked in June by region 10-33
10.20 Thematic map of the density of vessels wrecked in July by region 10-34
10.21 Thematic map of the density of vessels wrecked in August by region 10-35
10.22 Thematic map of the density of vessels wrecked in September by region 10-36
10.23 Thematic map of the density of vessels wrecked in October by region 10-37
10.24 Thematic map of the density of vessels wrecked in November by region 10-38
10.25 Thematic map of the density of vessels wrecked in December by region 10-39
10.26 Number (%) of shipwrecks per month compared with the average number (%) of gales per month on the central part of the south coast of England 1876-1915 10-44
10.27 Scatter plot of number of shipwrecks each month against the frequency of gales on the south coast of England 10-45
10.28 Number of shipwrecks by reported wind direction 10-46
10.29 Comparison of the recorded wind direction for shipwrecks and for Calshot 1300 GMT 10-47
10.30 Polar diagram comparing the frequency of winds from eight compass directions for vessels wrecked and Calshot 1300 GMT 10-48
10.31 Map of the locations of vessels wrecked in winds from South to West 10-49
10.32 Thematic map of the density of vessels wrecked in winds from South to West by region 10-50
10.33 Map of the locations of vessels wrecked in winds from Northeast to Southeast 10-51
10.34 Thematic map of the density of vessels wrecked in winds from Northeast to Southeast by region 10-52

10.35 Map of the locations of vessels wrecked in winds from East to South 10-53
10.36 Thematic map of the density of vessels wrecked in winds from East to South by region 10-54
10.37 Average number of days with visibility of less than 3.7 km at Calshot 1927-36 10-56
10.38 Comparison of numbers of vessels wrecked and days of poor visibility at Calshot per month 10-56
10.39 Monthly distribution of numbers of vessels wrecked in impaired visibility 10-57
10.40 Map of the locations of vessels wrecked in impaired visibility 10-58
10.41 Thematic map of the density of vessels wrecked in impaired visibility by region 10-59
10.42 Numbers (%) of ships wrecked, sailing to or from the study area, on the different days of the tidal springs/neaps cycle 10-60
10.43 Thematic map of the density of vessels wrecked six days before spring tides by region 10-62
10.44 Thematic map of the density of vessels wrecked five days before spring tides by region 10-63
10.45 Thematic map of the density of vessels wrecked four days before spring tides by region 10-64
10.46 Thematic map of the density of vessels wrecked three days before spring tides by region 10-65
10.47 Thematic map of the density of vessels wrecked two days before spring tides by region 10-66
10.48 Thematic map of the density of vessels wrecked one day before spring tides by region 10-67
10.49 Thematic map of the density of vessels wrecked at spring tides by region 10-68
10.50 Thematic map of the density of vessels wrecked one day after spring tides by region 10-69
10.51 Thematic map of the density of vessels wrecked two days after spring tides by region 10-70
10.52 Thematic map of the density of vessels wrecked three days after

spring tides by region 10-71
10.53 Thematic map of the density of vessels wrecked four days after spring tides by region 10-72
10.54 Thematic map of the density of vessels wrecked five days after spring tides by region 10-73
10.55 Thematic map of the density of vessels wrecked six days after spring tides by region 10-74
10.56 Thematic map of the density of vessels wrecked at neap tides by region 10-75
10.57 Comparison of the cumulative numbers of Coastal and Overseas subgroup vessels shipwrecked from 1740 to 1909 10-76
10.58 Thematic map of the density of wrecked vessels up to and including 5 years old by region 10-78
10.59 Thematic map of the density of wrecked vessels 6-15 years old by region 10-79
10.60 Thematic map of the density of wrecked vessels 16-30 years old by region 10-80
10.61 Thematic map of the density of wrecked vessels over 30 years old by region 10-81
10.62 Revised size of vessels 10-82
10.63 Thematic map of the density of wrecked vessels up to and including 100 tons by region 10-83
10.64 Thematic map of the density of wrecked vessels 101-300 tons by region 10-84
10.65 Thematic map of the density of wrecked vessels 301-600 tons by region 10-85
10.66 Thematic map of the density of wrecked vessels over 600 tons by region 10-86
10.67 Comparison of the numbers of vessels wrecked sailing up and down the English Channel by decade 1740-1909 10-91
10.68 Thematic map of the density of wrecked vessels in the Up Channel subgroup by region 10-92
10.69 Thematic map of the density of wrecked vessels in the Down Channel subgroup by region 10-93

10.70 Thematic map of the density of vessels wrecked by stranding by region 10-95
10.71 Thematic map of the density of vessels wrecked by foundering by region 10-96
10.72 Thematic map of the density of vessels wrecked following collision by region 10-97
10.73 Thematic map of the density of shipwrecks per sq. km. by region 10-98
10.74 Thematic map of regions by hazard type 10-99
11.1 Map of the study area *c*5000 BP 11-3
11.2 Suggested relative distribution of wrecked craft 1st Century B.C. 11-14

List of Tables

		Page
4.1	Numbers and Percentages of Shipwrecks by Month	4-9
4.2	Number of Shipwrecks Each Month by Decade 1230 to 1909	4-10
4.3	Locations of Shipwrecks	4-25
4.4	Location Types	4-28
4.5	Locations within Location Types	4-28
4.6	Numbers (%) of Shipwrecks by Location Type in each Subgroup	4-29
4.7	How Vessels were Wrecked	4-29
4.8	Numbers (%) of Shipwrecks by Wrecking Type for each Subgroup	4-30
4.9	Nationality of Shipwrecks	4-37
4.10	Nationality of Vessels Wrecked by Decade	4-38
4.11	Mean Period (years) between Shipwrecks	4-40
4.12	Nationality of Shipwrecks pre-1740	4-40
4.13	Numbers of Wrecks from Ports of Departure and/or to Destination Outside the English Channel	4-47
4.14	Average Frequency per year (%) of Shipwrecks for the Subgroups plus Anchored or Moored Within the Study Area	4-54
4.15	Cargoes Most Frequently Carried	4-55
4.16	Number of Vessels (%) Wrecked in each Subgroup by Age Group	4-62
4.17	Size of Vessels by Decade	4-69
4.18	Types of Vessel by Decade	4-70
4.19	Types of Vessel Function by Decade	4-71
4.20	Numbers of Vessels Wrecked in Reported Beaufort Scale Winds	4-72
4.21	Numbers (%) of Shipwrecks that Occurred at each Beaufort Scale by Subgroup	4-72
4.22	Number (%) of Shipwrecks that Occurred in each Subgroup by Wind Direction	4-74
4.23	Numbers (%) of Shipwrecks each day of Tidal Cycle by Subgroup	4-75

5.1 Customs Revenues at Chief English Ports (£000) 5-5
5.2 English Overseas Trade 1700-1775 (annual averages £ *million*) 5-6
5.3 Comparison of Tonnage (000 tons) of English and Foreign Ships Engaged in English Overseas Trade during Peace and War 5-6
5.4 Tonnage (000 tons) of Overseas Trade Entries and Clearances, 1686-1779 5-7
5.5 Tonnage (000 tons) of Overseas Trade Entries and Clearances 5-8
5.6 Numbers of Ships Involved in London's Overseas Trade, 1686 5-11
5.7 London's Percentage Share of Overseas Trade, 1700-1770 5-11
5.8 Distribution of English shipping by tonnage, 1582-1702 5-14
5.9 Volume of Coal (%) Shipped from Newcastle, 1683 that Would have Passed Through or Near the Study Area 5-15
5.10 Volume of Coal (%) Shipped from Newcastle, 1731 that Would have Passed Through or Near the Study Area 5-15
5.11 London's Coastal Shipments, 1628 that Would have Passed Through or Near the Study Area 5-16
5.12 London's Coastal Shipments, 1683 that Would have Passed Through or Near the Study Area 5-17
5.13 London's Inward Coastal Shipments, 1683 that Would have Passed Through or Near the Study Area 5-18
5.14 Shipping Arrivals & Departures, English Ports 1465-1520 5-26
5.15 Numbers of Ship Likely to Sail through Study Area 5-26
5.16 Coastal Shipments Likely to Sail through Study Area 5-27
5.17 English Merchant Shipping 1561-1629 5-29
5.18 Average Tonnage of English Ships 5-30
5.19 Size of Cargoes Cleared (tons) 1715-17 5-31
5.20 Ships Entering England with Wine, 1664 5-32
5.21 Number of Ships Entering London from Spain & Portugal 5-33
5.22 Arrivals at London from West Indies 5-33

5.23	Arrivals at London from Virginia & Maryland	5-34
8.1	Frequency (%) of Fog and Mist in the Central English Channel	8-3
8.2	Monthly Frequency (%) of Wind Direction in the Western and Central English Channel	8-4
8.3	Frequency (%) of Force 8-12 Winds in the Western and Central English Channel	8-5
8.4	Average Number of Gales on or near the Central Part of the South Coast of England	8-5
8.5	Average Number of Days of Visibility Less than 3.7 km	8-6
8.6	Frequency (%) of Visibility of less than 1.85 km at Calshot Under Different Wind Conditions	8-7
8.7	Frequency (%) of Wind Direction at Calshot	8-7
8.8	Frequency (%) of Wind Direction at Portsmouth	8-8
8.9	Average Number of Days on which Gales Occur at Calshot and Portsmouth	8-9
8.10	Wind Gust Speeds	8-11
10.1	Numbers (%) of Shipwrecks in the 'Back of Wight' and the 'Vicinity of Portsmouth' for the Five Subgroups	10-18
10.2	Numbers (%) of Vessels Wrecked Each Month at 'Back of Wight' and 'Vicinity of Portsmouth' Areas	10-40
10.3	Monthly Totals, 1140 – 1909, Adjusted for January & September High Daily Totals	10-40
10.4	Numbers (%) of vessels wrecked in different Beaufort Force winds and the frequency (%) of those winds in the Western and Central English Channel and at Calshot	10-43
10.5	Frequency of Winds (%) from the Sea (SE-SW) and the Land (NW-NE) at Calshot, August, 1932	10-46
10.6	Rate of Growth of British Overseas Trade (%), 1800-1900	10-91

Preface

The original objectives of this research were centred on the building of a Solent wreck database and the development of a Geographic Information System (GIS) to facilitate its analysis. It was hoped this would enable the construction of a predictive model to identify those locations where wrecks might have occurred most frequently, particularly in prehistory. This may appear to be an exercise that is tantamount to stating the obvious. Everyone knows that wrecks happen in storms and on lee shores or reefs, etc. However, if it were this simple we would have discovered all the wrecks that have ever occurred. Yet vast numbers of wrecks in the historical record remain undiscovered, while conversely, discoveries are often made of wrecks that were never documented or for which records have long been lost. This research takes as a premise that the analysis of the wreck events we do know about may reveal hitherto unsuspected aspects of, and relationships between, the factors that caused them and thus shed light on those we have yet to discover.

The reasons for doing this broadly fall into two categories. Firstly, if it were accepted that shipwrecks constitute archaeological source material of the highest quality, any means of improving the discovery rate would be welcomed. Currently, discoveries of prehistoric boats are entirely fortuitous and to date there have been no research designs that systematically set out to make such discoveries. A current initiative at the *Centre for Maritime Archaeology* in Southampton is probably the first to do so and to which this research aims to contribute. Secondly, this country is alas, woefully backward in its management and protection of the underwater archaeological resource in general as indicated by the procedures currently in place (Frith, 1993:Ch. 7). Any enhancement of our ability to predict the 'hot-spots' would have utility for all those involved in heritage management, whether protection, assessment, research, interpretation or public access. As Hildred (1997:iv) stated 'The targeting of areas of archaeological sensitivity is vital to future initiatives for the protection, development and exploitation of the seabed. It is axiomatic that successful management of the archaeological resource must stem from quantification and assessment of that resource. Among recent welcome developments in the way we treat our maritime sites, following the recommendations set out in 'Heritage at Sea' (JNAPC 1989), was the creation of a National Record of Maritime Sites now based at Swindon. The development of a means of predicting where shipwrecks of archaeological interest would be most likely to be located would provide a powerful tool, not so much so they can be excavated to reveal their secrets, but to enhance their management and preservation. A tool that would provide a major step forward in the methods of assessing the archaeological potential of an area of seabed. Improved predictive ability would mesh well with the way this national record is intended to operate, i.e., as an active management tool. Such a capability would form the basis for and assist in the establishment of new procedures for the protection and preservation of our historic and archaeological underwater cultural heritage equivalent to those provided for terrestrial archaeological sites by PPG16.

Even so, ships have, in some instances, provided some of the most detailed archaeological data available. For earlier periods and prehistory in particular, where other sources of archaeological material may be dispersed and fragmentary, it is possible that a well preserved shipwreck site could provide data that are not available elsewhere. The further back in time the more important it would tend to become. Such sites are hard to find and will become increasingly so in areas of heavy sedimentation and with the ravages of site destruction processes. The ability to predict 'most likely locations' would greatly assist in the management of the archaeological resources that are allocated to the improvement of our knowledge of the past.

The developed model provides a baseline indicator of the likely concentrations of shipwrecks of the historical period. However, the cautionary message for heritage managers and developers alike is that the human factor governing all past sailings means that while it may be possible to predict where wrecks are likely to be, it is not possible to predict where they will not be. The myriad of reasons why wrecks occurred throughout history mean that a vessel could come to grief almost anywhere there is water. The analysis that forms the basis of this study shows that the actual pattern of the occurrence of shipwrecks is complicated by the human factor in a way that is entirely unpredictable, (it cannot be predicted when a tired watch keeper will fall asleep resulting in a vessel being wrecked or colliding with another), although it can be predicted that such an event will happen because humans are fallible.

An unexpected spin-off from the analysis is the new perspective it has provided on the hazards that faced seafarers in the past as well as the socio-political pressures for improvements in navigation aids and ship safety. These improvements in themselves are of interest because the trajectory of improvement is not matched, in the research area at least, by a similar reduction in the occurrence of shipwrecks.

Acknowledgements

I would like to thank all the people who have helped me in the writing of this thesis. The completion of the research detailed could only be achieved on a full time basis due to the backing of the L.A. Burgess Scholarship. To those who thought me worthy of that award I offer my heart felt thanks.

Many people were of great help to me in carrying out my research. I would like to mention, the staff of the Meteorological Office Library and Archive for their help in identifying appropriate books and documents to assist my research, the staff of the maritime section of the Royal Commission on the Historical Monuments of England for data on historic wrecks, the staff of the Admiralty Hydrographic Office for their assistance in obtaining information on particular shipwrecks and tide publications, and the provision of copies of historic charts. In particular I thank Jon Adams, my tutor, for his advice and guidance and many valuable comments. In addition Justin Dix, my Advisor, together with David Hinton and John Robb for reading my very rough draft and providing valuable comments and guidance. Dominic Fontana deserves a special mention for providing digitised and scanned copies of maps of the study area and tips on the use of 'Mapinfo' and also Rory Quinn for providing bathometry data. My long-term friends John Hunter and Cmdr. Griff Watkins RN retd. both provided me with invaluable help. John, being my man on the Isle of Wight, put in considerable effort scouring the bookshops for books and maps to help my research and Griff who took on the onerous task of proof reading my final draft and provided so many valuable comment and suggestions. Last but not least my wife Pat for without her forbearance as the list of jobs around the house and garden needing to be addressed grew longer and longer and also her help with the typing when I acquired RSI.

Chapter 1 - Introduction

The sea has and is used widely for the movement of goods. As Willan (1938:xii) explains, 'the main reason for the important part played by water transport was its superiority over other forms, a superiority it retained until the coming of the railways'. Carriage by land was often difficult and always expensive. In the time of the Romans it has been estimated that carriage by land was about 60 times more expensive than by sea (Hopkins, 1983:xx). In the seventeenth century Sir Robert Southwell calculated that sea carriage was twenty times as cheap as wheeled carriage although Willan (1938:xiii) suggests that this is an exaggeration. Apart from the fact that all imports and exports, to and from the British Isles, necessarily have to go by sea Willan (1938:xiii) suggests that, but for sea transport, the English coal industry would never have developed as it did during the seventeenth century. For the carriage of such a bulky commodity sea transport was essential. As Willan (1938:190) suggests, a boat of 30 tons carried as much as 100 horses. In fact movement of goods by sea was vital to the economic life of England (Willan, 1938:xiv). We would therefore expect high levels of shipping, which would increase as the population and prosperity, increased.

The sea is also a hostile environment, any sea voyage involves risk and throughout the long history of water transport there have been steady losses (Adams, 2001:293). Bascom (1976:72) states that 'statistics from the eighteenth and nineteenth centuries indicate that approximately 40 per cent of all wooden sailing ships ended their careers by running onto reefs, rocks, or beaches' and a further 10-20 per cent 'sank well offshore'. Recent fieldwork (Ballard, *et al.*, 2000:1591) would seem to confirm that a significant number of wrecked vessels lie in deep waters. The series of disasters these statistics represent have furnished us with archaeological source material of unparalleled potential and on which we are really only just beginning to capitalise (Adams, 2001:307). It is source material that forms a significant proportion of our cultural heritage and one that must be managed and protected with all available resources.

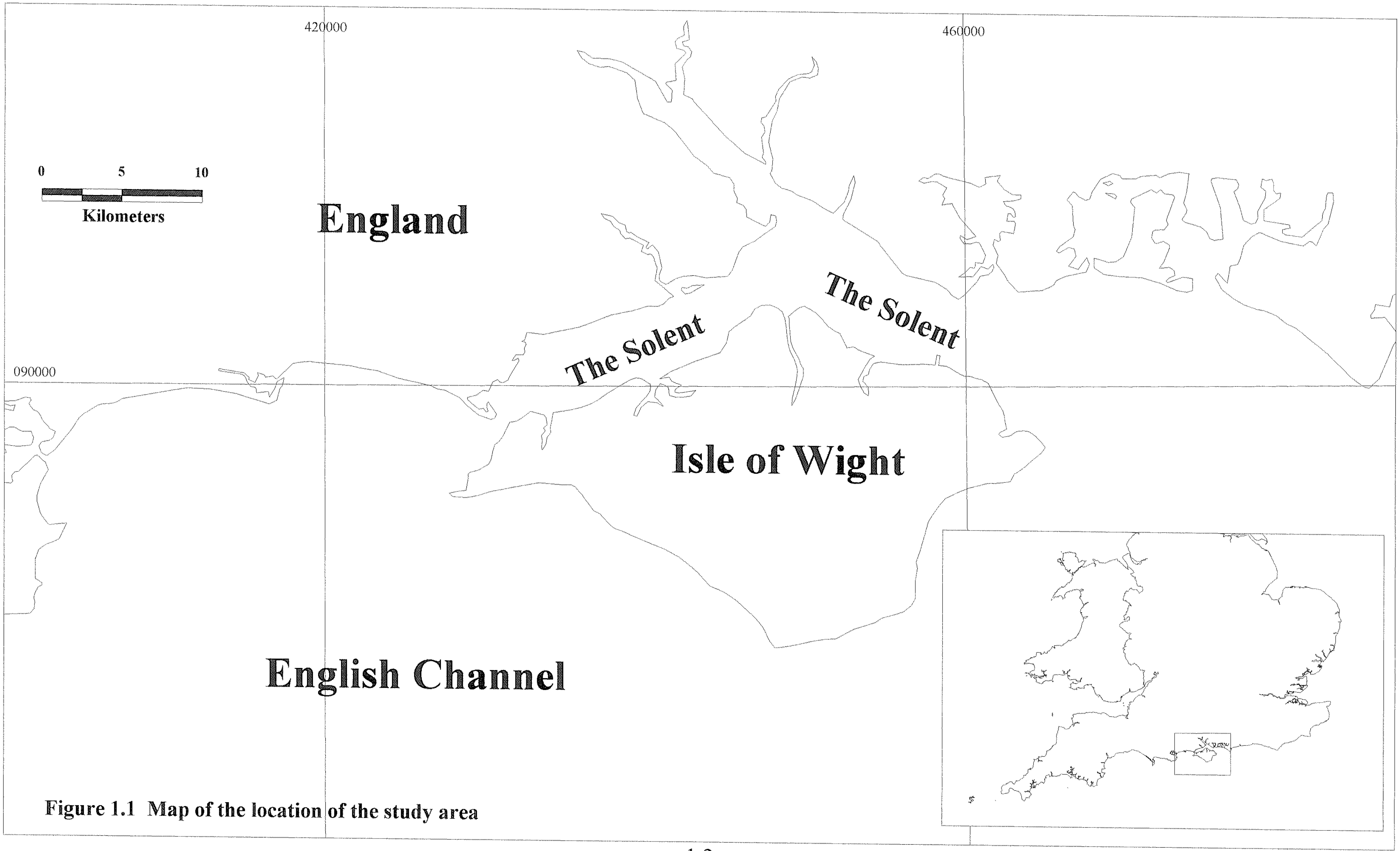


Figure 1.1 Map of the location of the study area

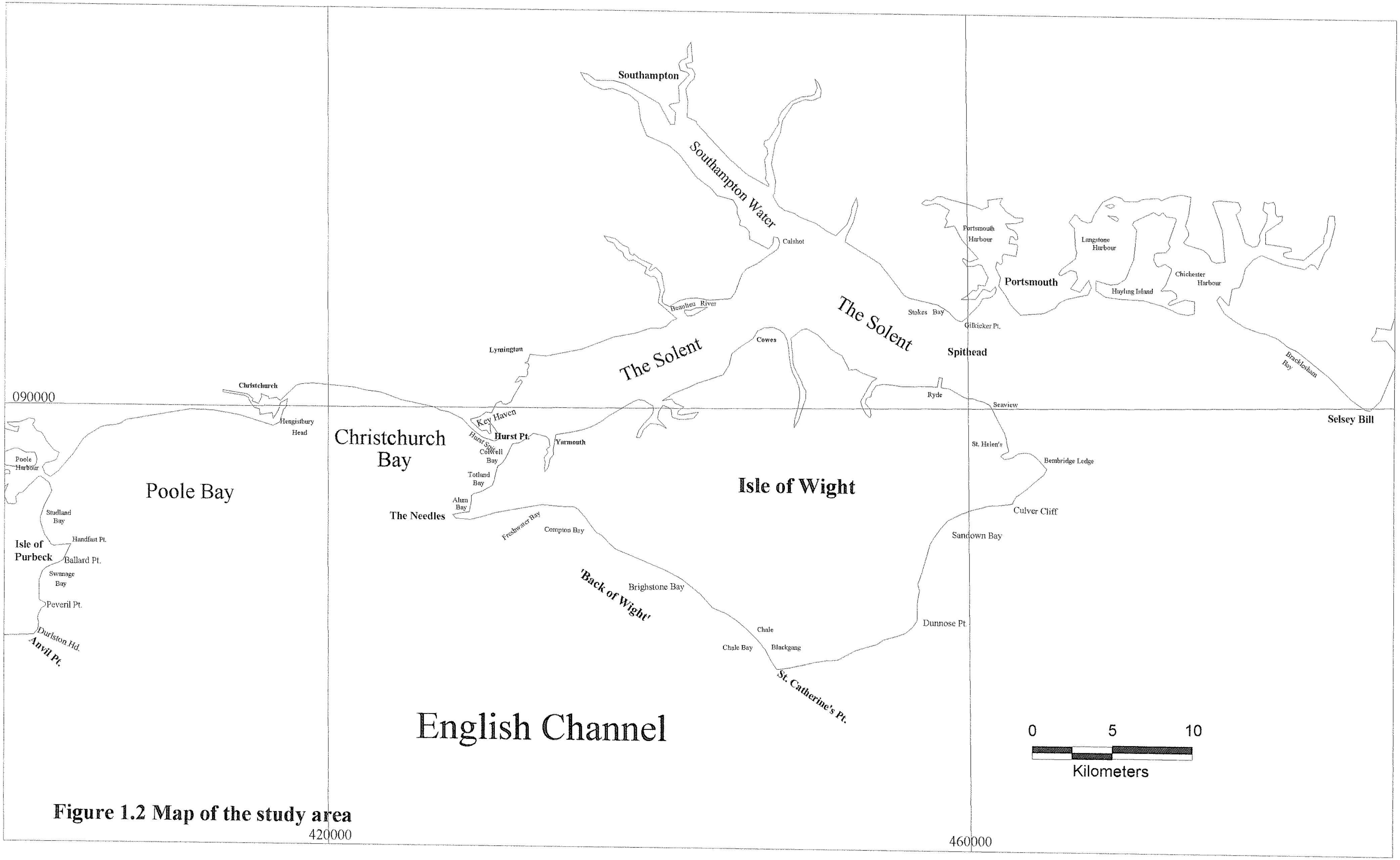


Figure 1.2 Map of the study area

The aim of this research project is to provide a means by which the level of management and protection of the maritime cultural heritage can be improved. This will be achieved by producing a tool that can be used by those responsible for those activities to assess, for different time periods, the probability of shipwrecks being located in designated areas of the seabed. It will assist both in the archaeological assessment aspect of the planning procedures for marine environments and in the deployment of archaeological resources in wide area surveys.

The methodology used a number of steps that together form an innovative approach not previously applied in maritime archaeology combining the power and clarity of quantitative and spatial analyses. These steps were:

- The creation of a database of shipwrecks based on historic records.
- The extraction and creation of analytical data from the database.
- The analysis of that data to identify the factors that influenced the occurrence and locations of the shipwrecks.
- The analysis of the spatial data provided by the records using a Geographic Information System and the development of a predictive model indicating the quantitative potential of different areas of the seabed as the locations of historic shipwrecks.
- The development of a further model predicting the potential locations of prehistoric shipwrecks.

To gather and analyse data on wrecks for the whole of the UK would be an impossible task within the time span of this study. As Larn & Larn (1995:xvi) state, 'it would be impossible in the lifetime of any person to research in great depth the details of all the shipwrecks' recorded in their shipwreck index. It is therefore necessary to select an area or region for which this can be achieved. The area chosen for this study is the Solent and the waters surrounding the Isle of Wight, off the south coast of England (see Figure 1.1). This is one of the most intensively used waterways of the last several Millennia and also one of the most treacherous. McKee (1968:25) describes the area as possibly the largest graveyard of battleships in the world and the south-west coast of the Isle of Wight, the dreaded 'Back of Wight', as an accident 'black spot' which must have taken many Roman vessels and still takes a fair quota of modern ships. The study area stretches from Anvil Point, on the Isle of Purbeck, in the west, to Selsey Bill, in the east and from the small port of Eling to the north of Southampton to approximately 16 km south of St. Catherine's Point. The area has a number of advantages, which make it well suited to the study of shipwrecks:

- It provides an easily delimited geographic area.
- It is a major area for shipping and trade both in the present day and historically, containing the important ports of Portsmouth, Southampton and Poole as well as a number of smaller ports and the ancient trading centre of Hengistbury.
- The coastline of the Isle of Wight and that of the Dorset, Hampshire and Sussex mainland provide many different types of environment both friendly and hostile to shipping. Medland (1995:5) describes the Isle of Wight's 100 km coastline as being "unevenly scattered with a succession of appalling marine hazards which leave little room for luck and good seamanship in adverse conditions".
- The records of shipwrecks, particularly for the Isle of Wight, are perhaps more comprehensive than for most areas of the UK due to the writings of islanders and in particular, the log kept by James Wheeler, a longshoreman at Blackgang from 1746 to 1808. Also the book *Back of Wight*, by Fred Mew, who was a coastguard at St Catherine's Point, first published in 1934, includes, as well as his own experiences, lists of wrecks passed down from generation to generation and extracts from the records of St. Andrews Church at Chale.

Only vessels wrecked during their active working life are considered and not those abandoned to decay in creeks, rivers and mud berths.

Development over time of many of the aspects effecting ship safety have an influence on the potential risk of ships being wrecked. The introduction of better navigation equipment and techniques, the building and improvement of navigation marks such as lighthouses, improvements in ship design, sailing rigs and equipment will all have had an effect that should have registered in the statistics of the vessels wrecked. This puts a limit on the value of modern shipwreck statistics and therefore a cut-off date for the collection of those statistics is necessary if they are to be extrapolated to predict the likely sites of earlier shipwrecks. The choice of this cut-off date has been influenced by a number of factors. The first was the collation of sufficient records of shipwrecks to provide a suitably sized statistical sample. The next was major changes to shipping which would have affected those statistics. The results of the Select Committee established by the Government in 1836 (see page 2-2) led to the introduction of the Merchant Shipping Act (Larn & Larn, 1995:viii) that set standards for merchant ships with the aim of reducing the losses. For example in 1876 the Merchant Shipping Act made the Plimsoll Mark and the Load Line compulsory, factors which obviously affect the risk of a ship being wrecked. The development of steamships in the nineteenth century changed the dependence on sail, but as Greenhill (2000:47) states 'even in 1906 the steamship had still not come of age'. Nevertheless in 1890 the 8 million tons of United Kingdom registered shipping consisted of approximately 3 million tons sail and 5 million tons steam (Greenhill, 1993:101). By 1910 the figures were 1 million tons of sail to 10.5 million tons of steam vessels (Greenhill, 1993:98). One effect of the First World War was the reversal of the decline of the numbers of sailing vessels with huge numbers being built between 1916 and 1921 (Greenhill, 1993:102-103). The sailing merchant vessel survived well into the twentieth century. Even so the losses during the First World War to enemy action and the increase in leisure yachting about the middle of the 19th century must also influence the statistics. A cut-off date of the end of 1909 was therefore selected which would also allow the possibility of time analysis in decades.

The approach taken has been to build a database from the details provided by the historical reports of 1163 shipwrecks that occurred within the study area. The statistical analysis of the causal factors identified from these wreck reports allowed:

- The identification of the factors that led to wrecking (which in many cases are shown to be counter-intuitive, e.g. that so many happened in winds of Beaufort Force 6 or less).
- Quantification of the relative magnitude of these factors (again, often counter intuitive or revealing commonly held beliefs to be invalid).

While it was not possible, from the wreck reports, to identify with pinpoint precision where the vast majority of the shipwrecks occurred it was possible for clear trends to be categorised. The GIS was used to highlight and present these factors in spatial form providing the basis for the predictive model.

This thesis is structured with each chapter presenting details of a single aspect of the research completed. It therefore presents a complete description of the methodology used. The first four chapters constitute of an introduction. Chapter 2 describes the historical records used to derive the base data on the shipwrecks and the type and extent of the information they contain. Chapter 3 details the structure of the database of the information derived from the historical records and assumptions made. Chapter 4 presents the raw statistical data derived from the database and forms the first part of the analysis of that data. The appropriateness or benefits of those statistics in deducing the causes of vessels being wrecked or their effectiveness as parameters to develop a predictive model are not discussed. As well as introducing the breadth and detail of the data the records hold they also provide thought provoking background to main objective of this thesis.

Chapters 5 to 9 outline the data and factors that appear to have the strongest influence on vessels being wrecked and, where appropriate, how they changed or developed over time. They cover:

- Trade routes and volumes, leading to an estimate of the possible volumes of maritime traffic in the study area.
- Advances in navigation al instruments and techniques, particularly those that would have been used by mariners in the English Channel. It also covers the introduction and improvements to lighthouses and seamarks.
- The maritime hazards of the study area.
- The climate and weather conditions of the English Channel focusing on the study area.
- The effects of the topography of the study area.

The last two chapters expound the results of the research. Chapter 10 details the analysis of the statistics and the influencing factors. It details the results in quantitative lists, spatial maps and diagrams and presents the first predictive model. Chapter 11 extrapolates the results from Chapter 10 to identify the potential locations of early historic and prehistoric vessels using the study area as an example. This extrapolation is combined with an evaluation of the probable geomorphic structure of the study area *c*5000 BP to present the second predictive model.

Chapter 2 - Maritime Records

2.1 Introduction

To develop the GIS model it is necessary to identify the profiles of shipwrecks and the correlation between the various factors that contributed to the wrecking of the ships. A major problem to address in this regard is that from earliest times and throughout the Middle Ages until the late 17th century, shipwrecks and the fate of the sailors on them, were considered unimportant and seldom recorded (Larn & Larn, 1995:ix; Friel, 1983:56-59). We really only learn of them from records such as those of disputes over the Right of Wreck, court cases of people charged with theft from wrecks, wars, or particularly momentous shipwreck singularities.

An example of this lack of definitive information comes from reports on the Great Storm that struck Britain on the 26/27th November 1703. Reports state (Lamb & Frydendahl, 1991:59:McEwen, 1991:116-125) that 160 to 200 naval warships, victuallers and supply ships anchored in the Downs off the East Coast of Kent were scattered. Twelve warships were wrecked on the Goodwins with the loss of 1500 lives, but we only have the names of four of them, *Mary, Northumberland, Restoration* and *Stirling Castle*. In addition three fleets of ships, with troops from Ireland, were anchored off Portsmouth and Cowes with storeships and merchantmen awaiting a convoy. England was at war with France in the War of the Spanish Succession. Of the ships in the Downs, some sank at their anchors while others were blown on to the Goodwin Sands and yet others, such as the *Association*, were driven to the shores of Holland. The records also show that one man o'war, the *Newcastle*, sank at Spithead, and two on the coast of Sussex, the *Eagle* at Selsey Bill and the *Resolution* near Pevensey, both of which had been at anchor in St. Helen's Road, off the eastern end of the Isle of Wight. There is no mention of merchant ships, but hundreds were sunk and as many as 8000 lives lost. Thirteen navy ships from Portsmouth were scattered and destroyed. The only other shipwreck reported in the Solent area for that day is the fireship *Vesuvius*, which sank at Spithead. Considering the ferocity of the storm, the number of casualties and the number of vessels that must have been in the Solent, it is very surprising more are not recorded as having sunk. Lamb and Frydendahl (1991), provide details of other major storms which affected the English Channel, but for which there are no reports of ships being wrecked in the Solent region. Examples are; 12th September 1695 (Lamb & Frydendahl, 1991:55), a violent storm sprang up, at night, and many ships were torn from their anchors and driven west. Presumably it was an easterly wind, which is particularly dangerous for vessels at anchor off Portsmouth, in St. Helen's Road and the East Solent; 8th January 1735, SSW gale affecting Southeast England (Lamb & Frydendahl, 1991:79), the associated depression tracked across England. A report at the time described it as 'the most violent storm since the great storm of November 1703'; 3rd August 1737, violent easterly gale affecting Southeast England, the associated depression tracked up the Channel and across Kent (Lamb & Frydendahl, 1991:81). Ships were sunk in the Thames; 31st December 1739, easterly gale which probably affected the Channel (Lamb & Frydendahl, 1991:82). Several vessels laden with corn and with coals sunk in and off the Thames.

It was not until 1836 that definitive information on shipping losses became readily available (Larn & Larn, 1995:vi). Concern over the loss of British registered ships and, probably, the consequential financial loss to the merchants and traders, caused the Government of the time to appoint a Select Committee to inquire into the 'Causes of Shipwreck'. The Minutes of Evidence from that select committee, using the reports of ship losses from Lloyd's Books, showed the true extent of the problem, which was revealed to be far worse than anybody had imagined (Larn & Larn, 1995:vii). For example between the years 1816 and 1818, 1,203 ships were lost, and between 1833 and 1835, 1,702. This equalled 1.3 ships lost every day. Another entry showed that for the sixteen-month period January 1833 to May 1834, ninety-five British registered ships were lost without trace, presumably as Bascom (1976:72) describes, 'sank well offshore'. Not withstanding the enormity of these figures, the report admitted that they did not show the full extent of the situation, they were just an indication, as the losses recorded in the Lloyd's Books were only of the ships insured by the 'Lloyds syndicates' (Larn & Larn, 1995:viii). It stated 'whereas it is well known that many vessels and lives are lost by wreck or foundering at sea, of which no entry is made in Lloyd's books, and of which, as no record is kept, no Returns can be produced'.

The findings of the Select Committee led to the production of an annual report of shipwreck statistics. The first report in 1851 showed losses of 692 ships on the coasts of the UK, in 1852 it increased to 1,115. In 1856 the report listed 546 sailing ships lost in deep water, 432 lost in coastal waters, 141 sailing colliers lost and 34 steamships. Between 1864 and 1869, the number of sailing ships lost world wide, which were insured in England, was ten thousand (Bascom, 1976:84). These bare figures alone provide a measure of the immensity of the problem and also of the number of shipwrecks that litter the seas.

From the individual reports on many of these wrecks it may be possible to derive statistics that will point to the known and unknown locations of their remains. Friel (1983:56) when writing about medieval wreck records states 'there is no hope of using the extant material as a statististical source for the nature and frequency of ship losses'. My approach therefore is to create a database of known shipwrecks using more modern records, analyse the reasons why the ships were wrecked and extrapolate backwards in time based on the results of that analysis. This together with available data on the changes of circumstances between periods of time should enable a statistical model of the most likely locations for wrecks to be developed. These changes include:

- The improvements in sailing capabilities and increase in size of ships over time (Burwash, 1947:82: Harland, 1984:Ch. 3: Unger, 1994:7-10: Hutchinson, 1994:27-64; Bosscher, 1995a:7-8; Bosscher, 1995b:24-27).
- The establishment of lighthouses and navigation marks (Hutchinson, 1994:170-175; Bosscher, 1995a:9); the improvement of navigation equipment and techniques (Hutchinson 1994:164-182; Bosscher, 1995a:9).
- Changes in trade routes and volumes (Bosscher, 1995b: 10-11).
- The effects of war (Bosscher, 1995b:11 & 15-16).

The 1836 Minutes of the Select Committee gave a number of reasons for the scale of the loss of ships. Of the crews they listed; incompetence of Masters and Officers in seamanship and navigation; drunkenness of Masters, Officers and men 'leading to improper or contradictory orders; and sleeping on the lookout or at the helm'. To these were added 'imperfections of charts' and the lack of 'Harbours of Refuge' on many stretches of the coast of the British Isles. The 'defective construction of ships' was identified as a cause which had been 'encouraged' by the Lloyd's system of classification between 1798 to 1834 and also the inappropriateness of form in British merchant vessels, which often incapacitates them from beating off a lee shore (Larn & Larn, 1995:vi-vii). Retired sea Captains who may not have been expert, or even trained, in ship surveying carried out the classification of ships. There were no standards or rules for them to work to; they were free to set their own which led to large variances. Pressure from the Lloyds Underwriters led to a system where ships built on the Thames, for example, would be given a higher class than one built on the Clyde and remain in that class for longer. This led to the Select Committee's comment that it was 'the age of a vessel and her port of build which were the chief tests of her strength and safety, and by which all new vessels were registered as First Class for a given number of years, from six to twelve, after which the strongest ships were placed on a level with the weakest….having some gone to pieces on their first voyage' (Larn & Larn, 1995:viii-ix). Bascom (1976:73-76) provides detailed descriptions of how ships may have sunk in open water and also states (1976:71) that their worst hazards were running aground at night or being blown on shore by a storm. In the ten years 1859 to 1868 the Board of Trade recorded 5,075 ships wrecked, other than by collision, in the waters close to the United Kingdom (Bascom, 1976:77 & Table 4), half of which were in coastal waters. Of the total, 55 per cent were due to 'stress of weather', 18 per cent due to inattention, carelessness or neglect, 9.5 per cent due to defects in the ship or equipment and a further 17.5 per cent classified as various or unknown causes. These statistics may be suspect depending on who made the reports to the Board of Trade and their motives. The owners would wish to hide any occurrences that would be detrimental to them. Whether the statistics derived from the database of wrecks support these contentions or not, they are not the type of information that can readily be presented in a GIS. The analysis in this thesis is therefore targeted at providing the type of data from which a GIS predictive model can be developed.

2.2 Trade

The primary sources for information on shipping movements are the records of custom duties paid. Records of the national custom duties levied on overseas trade cargoes are available from the late thirteenth century (Carus-Wilson & Coleman, 1963:1-2), when Edward I set duties on wool and hides. The records are in two parts; the Particular Accounts that were kept by the royal officials at each port and the Enrolled Customs Accounts that were an annual account prepared by the Royal Exchequer. The Enrolled Accounts were compiled from summaries submitted by the local officials (Carus-Wilson & Coleman, 1963:3). It was the duty of the local officials to tabulate daily details of ships arriving from or departing for foreign ports. These details were to include, the name of the ship, its homeport, the masters name, and against each item of cargo the name of the merchant responsible and the duty payable. Only a small proportion of these records are still available, but the Enrolled Accounts survive almost completely intact. For the period up to the beginning of the fourteenth century the details of shipping movements is dependent upon the records of local customs (Salzman, 1931:352-353). The charges were payable by merchants importing or exporting goods, unless they were exempted, and recorded in Port Books. Those exempt were freemen of the port and others specifically granted the privilege by charter, for example at Southampton those exempt were burgesses of the town, burgesses of other towns, such as London, which provided a reciprocal privilege and tenants of the bishop of Winchester (Lewis, 1993:vii). The value of these early records is questionable, as Salzman (1931:357) states they 'vary in minuteness of detail according to the idiosyncrasies of the individual collectors' and Hatcher (1973:6) writes of their 'scarcity and intractability before the later fifteenth century'. Carus-Wilson and Coleman (1963:2) pronounce that 'local customs, whether English or foreign.....are so riddled with exemptions that no overall trade figures can be derived from their accounts and the interpretation of these is a matter of extreme difficulty'.

The records for overseas trade cargoes entering and clearing English ports (Davis, 1962:396 & 411) from the late sixteenth century to the end of the seventeenth century are partial and fragmentary. Separate Port Books were kept for coastal trade, but a high proportion of these have been lost, for example the Port Books for London from 1696 onwards have been destroyed. These Port Books usually recorded the names, destinations and cargoes of the ships, but unfortunately ships without cargoes, that is either entered or left a port in ballast, were not recorded, therefore not all shipping movements are detailed. Customs Ledgers contain the value and volume of trade in each commodity with each country for every year from 1696 onward. The two volumes (British Library Add. MSS. 11255-11256) contain statistics of the tonnage of entries and clearances at English ports. Board of Trade papers (PRO. BT6-185) contain the tonnage of entries and clearances for 1771-3 (Davis, 1962:412). Schlote (1938:3) states that accurate statistics of English overseas trade exist from 1696 and then goes on to describe the 'serious practical difficulties' involved in analysing them (Schlote, 1938:3-10). Even so he produced a graph (see Figure 5.1) of English, later British (the statistics refer to England and Wales until 1754 and from then on also include Scotland), imports and exports and the tonnage of shipping cleared outward from 1696 to 1822. The tonnage of shipping cleared outwards relates only to exports and does not include coastal shipments. The tonnage of arrivals is not so well recorded, as can be identified from the table in Davis (1962:26), and therefore is not shown, but what information is available indicates that they followed the same basic upward trend. Even so the graph only provides detail for total English overseas trade and not that for individual ports.

The Port Books for Southampton, recording the custom and harbour dues paid, give the numbers of vessels that took on or discharged cargo and of vessels anchoring in the area controlled by the port, but not the total number of vessel movements. For example, large ships, such as the Genoese carracks, anchored off the port and their cargoes were taken to and from the shore in their own *barca* or local boats. Each individual boatload is recorded in the Port Book. The movement of the boats to and from the carracks when empty going to pick up goods or returning after having taken goods out is not recorded. This presumably also applies to local vessels that enter the port without either off loading or picking up cargo. In addition the date against an entry in the Port Book is not necessarily the date of a vessel entering or leaving the port, but the movement of cargo on or off the shore. To complicate the interpretation of the port books further it appears the same local boats, or boats owned by the same people, took short trips out of Southampton, out one day, back the next, presumably trans-shipping goods locally with only the movement of dutiable goods being recorded. Also ships anchoring within the area of the port, such as at Calshot or Cowes Roads, were charged anchorage even when not shipping cargoes to or from Southampton. The Port Books, therefore, do not detail all the shipping movements in and out of the port and further, would not provide a true indication of the sea traffic in the Solent. Any perceived direct correlation between the shipping movements in the Southampton Port Books and the number of shipwrecks in the Solent is therefore likely to be false.

The shipwreck reports show clearly that it was not only vessels that were voyaging to or from the Solent that became casualties within the study area. Large numbers were sailing the main traffic route of the English Channel and may not even have been touching port in England at all. To identify all the ships that would have passed or entered the Solent in the years covered by this research is clearly impractical, a deduction supported by Ian Friel (pers. comm.). It is possible that the trends in the volumes of ship movements may be deduced from a study of the figures in the customs records and other historical documents together with an understanding of social, economic and political influences. For example, the volume of cross-Channel trade would have been severely affected by the varying political situation between England and France, such as the One Hundred Years War. The customs records were designed to account for customs charges and concentrate on volumes and values of commodities and do not always provide data on ships. To provide an indication as to the numbers of ships these trade volumes would have to be converted to 'virtual' ships, if that is at all possible.

The customs accounts for the ports of Southampton, Poole and Chichester provide details of the number of ship arrivals and departures, but administratively, these main ports also included other ports in their vicinity as members. Customs officials grouped together the records for the ports of the whole area of coast they were responsible for under the main, or 'head port' of the area (Carus-Wilson & Coleman, 1963:8). The ports covered by the Southampton account, for the period 1275 to 1401, (Carus-Wilson & Coleman, 1963:183-185) changed frequently and at times includes other ports in the Solent area such as Portsmouth and those on the Isle of Wight and also ports as far west as Exeter. Burwash (1947:190) gives details for periods in the fifteenth and sixteenth centuries when Chichester included; Arundel, Shoreham, Seaford, Pevensey, Hastings, Rye, Winchelsea, Lydd, Romney, Hythe and Folkestone; Poole included; Lulworth, Lyme Regis, Weymouth, and Seaton. The accounts for Southampton, Chichester and Poole do not necessarily provide a true indication of the sea traffic through the area covered by this study. For example, the information that the number of entries to Chichester increased from 191 to 527, between the years 1464-1519 (Burwash, 1947:159), does not provide specific enough detail to be able to say that the number of ship entering the study area increased by that amount. It may, though, provide an indicator as to the likely increasing trend. When writing on the coasting trade during the seventeenth and eighteenth century, Willan (1938:13) states it is easier to obtain figures on the size of ships than to find accurate statistics of the total number of ships employed. This may be because he was referencing shipment sizes which may, or may not, be full shiploads.

Burwash (1947:201, 207 & 217-222) gives details of some of the ships that would have sailed in the study area during the period 1460-1540. Unfortunately this does not provide a complete picture as the custom records were only meant for the recording of shipments of commodities that attracted duty. Principally they do not include coasting trade, but also some goods, such as fresh fish, corn, flour and 'bestial' (cattle) did not attract any duty and in addition the king had the power to exempt people from paying duties. Although these were frequently recorded, it was not done consistently.

There are no continuous records for the period 1600-1775. From 1601 the annual customs accounts ceased to be enrolled in the office of the King's Remembrancer and a new series of centrally compiled accounts of imports and exports does not start until near the end of the century (Minchinton, 1969:53). There is also a question over the accuracy of the records that are available. Because of fraud by merchants and customs officials it is likely the official records understate the volume of imports and may also overstate the volume of exports (Minchinton, 1969:57). Large-scale smuggling took place from the late sixteenth century, when customs duties and trade regulations increased, until the advent of free trade in the nineteenth century (Minchinton, 1969:55). For these reasons the volume of trade indicated by the customs records for the seventeenth and eighteenth century cannot be taken as definitive of the true extent of English overseas trade (Minchinton, 1969:57).

2.3 Meteorology

The Board of Trade statistics for 1871, quoted by Bascom (1976:77), contrary to what would be intuitively expected, indicate that more than half of the ships lost by 'stress of weather' were in wind strengths of Beaufort Force 6 and below. Only 30 per cent were lost in strong gales and hurricanes. Weather is one of the factors that must be taken in to account in this analysis, but perhaps the perception that only very rough weather was a major danger to sailing ships will need to be revised. Unfortunately, here again, detailed information is only available for relatively recent times with the daily Meteorological Office records commencing in 1861. Prior to that, information is only available from personal diaries, records and reports on particularly noteworthy weather. There may also be some doubt as to the accuracy of these latter records as many are third party reports or drawn up by amateur meteorologists. This particularly applies to wind speed records (Palutikof *et al.*, 1997:225).

Chapter 3 - The Shipwreck Database

3.1 Introduction

A database of shipwrecks was constructed from the historic records of wrecks for Dorset, Hampshire, Sussex and the Isle of Wight extracted from a number of books, the Maritime NMR and numerous other documents and manuscripts. The principal books used are Larn & Larn, 1995 and 1997, Mew, 1974, Medland, 1995, and Phillips, 1995. The database covers wrecks in the area delineated by the Admiralty chart number 5600.1:1997, *Outer Approaches to the Solent*, which extends from Anvil Point in the west to Selsey Bill in the east. The results of the research described in this thesis are based on the detailed analysis of the data contained in that database.

3.2 Structure of Database

The fields in the database are:

year	Four digit year vessel was wrecked.
date	Numeric day alpha month.
weekday	Alpha day of the week.
report	'R' indicates date is that of the report of the wreck not the date of wrecking.
time	24 hour clock time of wrecking or alpha part of the day, e.g. morning.
ship name	Name of vessel.
ship type	Type of vessel.
size	Dimensions of vessel, length, breadth, draft and tonnage and for men o'war the number of guns.
built	Date and location built.
position	The latitude and longitude of single point for each location.
location	Name or description of place where wrecking occurred.
from/via	Names of places vessel was sailing from and via.

destination	Name of place vessel was sailing to.
nationality	Vessel's country of registration.
cargo	Cargo carried.
how wrecked	Brief description of the final act of wrecking e.g. stranded.
why wrecked	Description of what led to the vessel being wrecked.
weather	Eye witness description of weather at the time of wrecking.
comments	Any other useful information.
reference	Source of information on wreck.

The database contains 1163 entries, the criteria for which are that they are sailing vessels with the minimum of a known year of wrecking and a location where wrecked. The location is not always specific enough to be quoted as a latitude and longitude position, but sufficient to identify that it lies within the area covered. To make analysis by location easier all the wrecks within a given location have been given the same latitude and longitude position.

During analysis of the database other data, which is detailed in Chapters 4 and 10, was derived that enabled additional analyses. For example:

- If the date of the shipwreck was known, the date within the tidal cycle relative to spring or neap tides was derived.
- If the time of day was known the state of the tide relative to high or low water was identified as was the tidal stream at any given location.
- The ports of departure and destination enabled the identification of whether vessels were sailing up or down the English Channel, sailing to or from British ports or sailing locally within the study area.

The wrecks date from 1140-1909 with 88.65 per cent of the entries in the period 1740-1909, 1740 being the date from which the annual number of wrecks begins to become more consistent. This date coincides with that of the earliest known copy of the current Lloyds List (Larn & Larn, 1995:vii) and is close to 1746 when James Wheeler commenced his log of ships wrecked on the Isle of Wight (Mew, 1974:51-62). The cut off point of 1909 has been applied (see Chapter 1) principally because

WWI started during the next decade when large numbers of vessels were sunk by the action of warships. Many merchant ships were sunk indiscriminately whereas in earlier centuries the trend was for them to be captured and either ransomed or assimilated into a country's merchant or naval fleets. For example, estimates of the number of prizes taken by England in the seventeenth and eighteenth centuries are as follows (Davis, 1962:51 & 68):

First Dutch War, 1652-4.	1,000-1,700
War with Spain, 1655-60.	400
Second Dutch War, 1664-7.	522
Third Dutch War, 1672-4.	500
League of Augsburg War, 1689-97.	1,279
War of Spanish Succession, 1701-13.	2,203
Wars of Jenkin's Ear and	
Austrian Succession, 1739-48.	1,499
Seven Years War, 1756-63.	1,855

Conversely English losses in the war with Spain, 1655-60 were 1,000 and 1,800, during the three Dutch wars approximately 500 and during the War of the League of Augsburg, 1689-97 the estimates are as high as 4,000 (Davis, 1962:315-316). In wars later than those quoted above, although French privateers took large numbers of English ships they were frequently ransomed (Davis, 1962:69).

Two other factors considered are that at the beginning of the twentieth century steam ships were becoming more common and yachting, under royal patronage, was expanding as a popular pastime in the Solent (Rance, 1982:34-35). Steam ships do not rely on, or react to, the wind in the same way sailing ships have to and therefore will present a different wreck profile from sailing ships and distort the model. No steamships have been included in the database. Pleasure yachts have been included in the database, firstly because it is not always possible to distinguish them from small working craft and secondly, their wreck profile is probably similar to the small working craft. Another reason for choosing 1909 is that it is at the end of a decade and enables date-based analysis to be carried out by decade.

Not all of the vessels recorded became total wrecks; some were refloated. These are included as their position is one where other wrecks could be located. The numbers of shipwrecks recorded for each year reflects the reporting problems mentioned in the introduction with very low numbers before the eighteenth century and then a significant increase.

The detailed information available for each wreck varies and is by no means complete in the majority of cases. The analyses have therefore been carried out on the data that are available using different groupings, or samples, of data as appropriate. For example of the 1163 shipwrecks 1107 have a location sufficiently accurate to enable a position to be quoted in latitude and longitude. Although for a number where the location is given such as 'Back of Wight' or near Portsmouth the accuracy of that position is limited. Regions have been established for each of these locations on the GIS and they are considered as separate groups. The latitude and longitude positions on the database are either taken directly from the referenced documents or derived from Admiralty chart number 5600.1:1997.

All the maps have been derived from the Ordnance Survey maps covering the study area and down loaded from EDINA (http://edina.ac.uk). The maps are therefore based on the British National Grid.

3.3 Assumptions Made.

In formulating the data certain assumptions have been made, particularly with regard to the positions of the wrecks. The position provided in the books referenced is not always used. For example (Larn & Larn, 1995), where wrecks described as having wrecked off the Isle of Wight have been given a latitude and longitude position in the middle of the island these have not been given a position on the database. For others personal maritime experience has been applied to modify the provided position if considered justifiable from the description of the wrecking. In addition, single locations described both similarly and in different ways are grouped together in a single position, for example: (see Figure 7.1 for locations of places mentioned)

The locations 'off Portsmouth' and 'near Portsmouth' have been given the same position on the western edge of Horse and Dean Sand near the entrance to the main channel into Portsmouth. The location Portsmouth has been given the same position.

The locations 'off' or 'near Selsey' have been given the same position off the tip of Selsey Bill.

The location 'near Chichester' has been assumed to be near the entrance to Chichester Harbour and given a position off the southern edge of the East Pole Sands.

The location 'Back of Wight' has been given a position approximately mid-way between the Needles and St. Catherine's Point at the eastern end of the Brook Ledges.

The location 'near Swanage' has been given the same position as 'Peveril Ledge' off Peveril Point.

The location 'near Poole' and 'near Poole Harbour' has been given a position off Studland Bay.

Four locations given as (Larn & Larn, 1995:Section 1); Portsmouth, Woolfeners; Spithead, Woolstoners; Hayling Island, Woolsteners; Hayling Island, Woolsonors, have been assumed to be the sand bank to the east of the entrance to Langstone Harbour which today is called the East Winner. This is based on the evidence of the Trinity House chart of Spithead, dated 1797, where the sandbank appears to be called 'Wolfiner' or 'Woltiner', and the report on the wreck of the merchantman *Baillies*, 11 January, 1797, (Grocott, 1997:46) which says 'she ran on the Woolsners, or Chichester shoals, at the entrance to Langstone Harbour'.

Two locations given as Bullplace Ledge and Bullplace, Brook (Larn & Larn, 1995, Section 2) have also been identified on the same chart as the modern Hanover Point and the part of Brook Ledges off that point.

In addition three wrecks; the *Mary Anne*, July, 1841, sailing from Saundersfoot to Drogheda; the *Dover*, 13th September, 1841, sailing from Saundersfoot to Wicklow; the *Hero*, 28th August, 1861, sailing from Par to Milford and identified (Larn & Larn, 1995:Section 2) as being wrecked at Freshwater, Isle of Wight, have been assumed to have wrecked at Freshwater East or Freshwater West in Wales and are therefore not included in the wrecks database. The *Hornet*, wrecked on the 17th September 1794, at 'Portsmouth, near, on the Oars(*sic*)' has also not been included as this has been assumed to be The Owers, off Selsey Bill and outside the study area. Their exclusion has had minimal effect on the results of the analysis of the database as they added little or nothing more than increasing the total count of shipwrecks.

Where the name of a location that a ship was sailing from or to could apply to a number of places, assumptions have been made as to which is the most likely, for example:

St Croix is assumed to be the Island in the West Indies.

Santa Cruz is assumed to be in South America.

Santo Domingo is assumed to be in the Dominican Republic.

Charleston is assumed to be in Cornwall primarily because of the cargo carried by the ships from that location, namely china clay.

Charlestown has been assumed to be in the USA.

The historic records provide fifty different descriptions of how the ships were wrecked. This has been rationalised as detailed in Chapter 4, table 4.3 and in addition vessels which were wrecked in off shore locations have been considered to have 'foundered' and those on shore or on banks of rocks to have been 'stranded'.

Chapter 4 - Analysis of Shipwreck Database

4.1 Frequency of Shipwrecks

The purpose of this chapter is to present the raw statistics derived from the shipwreck database. There is no discussion as to the appropriateness or benefit of these statistics in deducing the causes of vessels being wrecked or as parameters for the predictive model. That is carried out in Chapter 10, which draws together all the data presented in Chapters 4 to 9.

The distribution of the shipwrecks over the study area is not uniform. Figure 4.1 shows the locations where ships have been wrecked. The locations are either exact positions of known wrecks or positions derived from the accounts of wrecking given in the historic documents. Shipwrecks with the same location description have been given the same position and therefore each wreck symbol may represent one or more ships that were wrecked at a particular location. Hence Figure 4.1 does not represent the quantitative distribution of shipwrecks in the study area. As the accuracy of the position given for the majority of the wrecks is not known it is not feasible to use the method of dividing the study area into a grid for GIS analysis. The approach of dividing the area into "regions" has therefore been used as shown in Figure 4.2. The regions delineate locations mentioned in the historic records. These are principally the main geographic features such as the bays, banks, headlands, harbour entrances, and anchorages and consequently, with the exclusion of the deep-water regions, they delineate naturally the shallow areas that form such a threat to shipping. The density of distribution of the shipwrecks within these regions is shown in Figure 4.3. The map shows that the distribution of shipwrecks is also not uniform with densities varying from region to region. This variable distribution must be caused by factors that contribute to the causes of ships being wrecked. Also the regions where there are clusters of shipwrecks may be associated with particular causes of shipwreck. The statistics that can be derived from the data extracted from the historic accounts of the shipwrecks should provide indicators as to those causes. The indicators can then be used to formulate the hypotheses that will enable a GIS predictive model to be created.

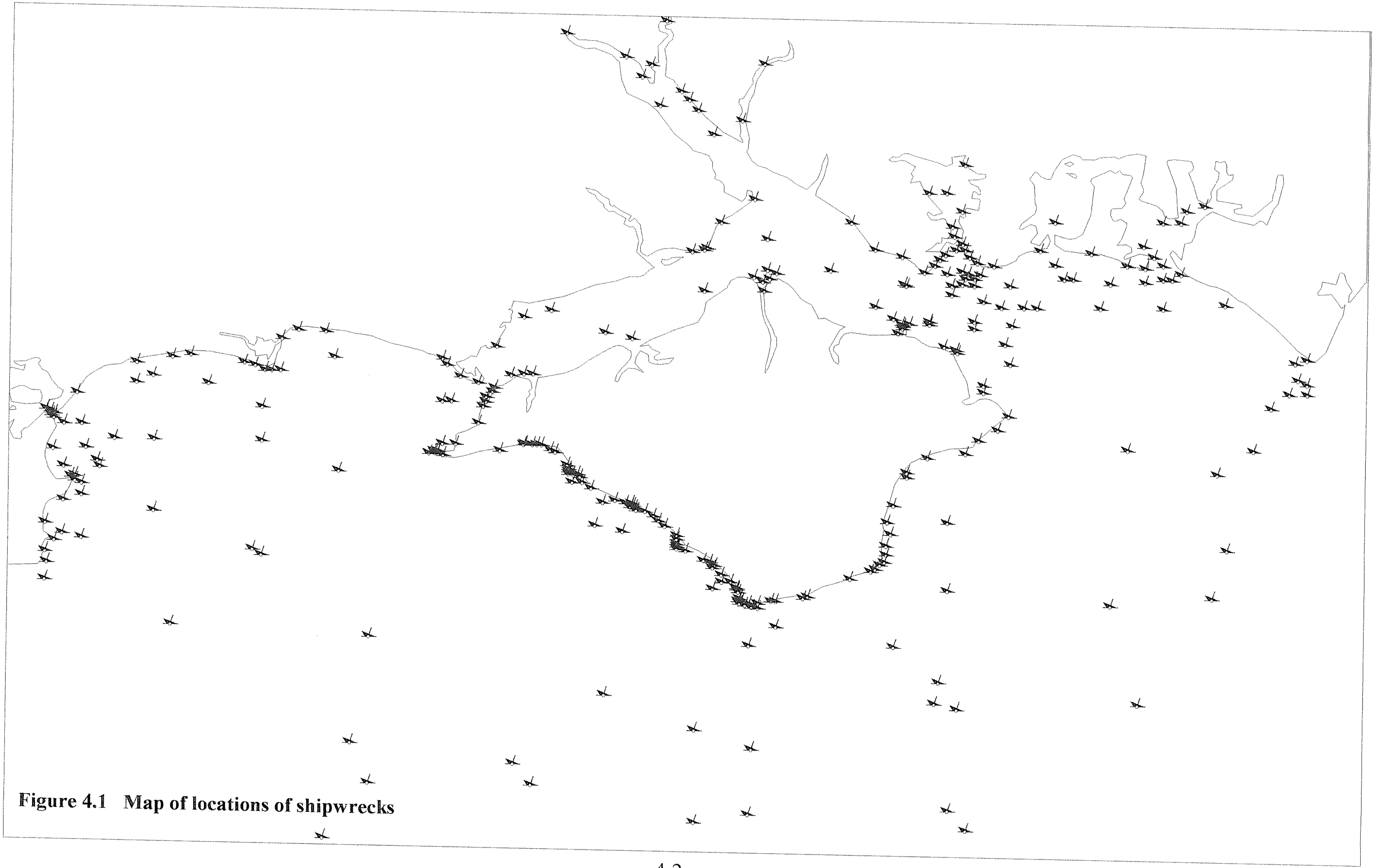


Figure 4.1 Map of locations of shipwrecks

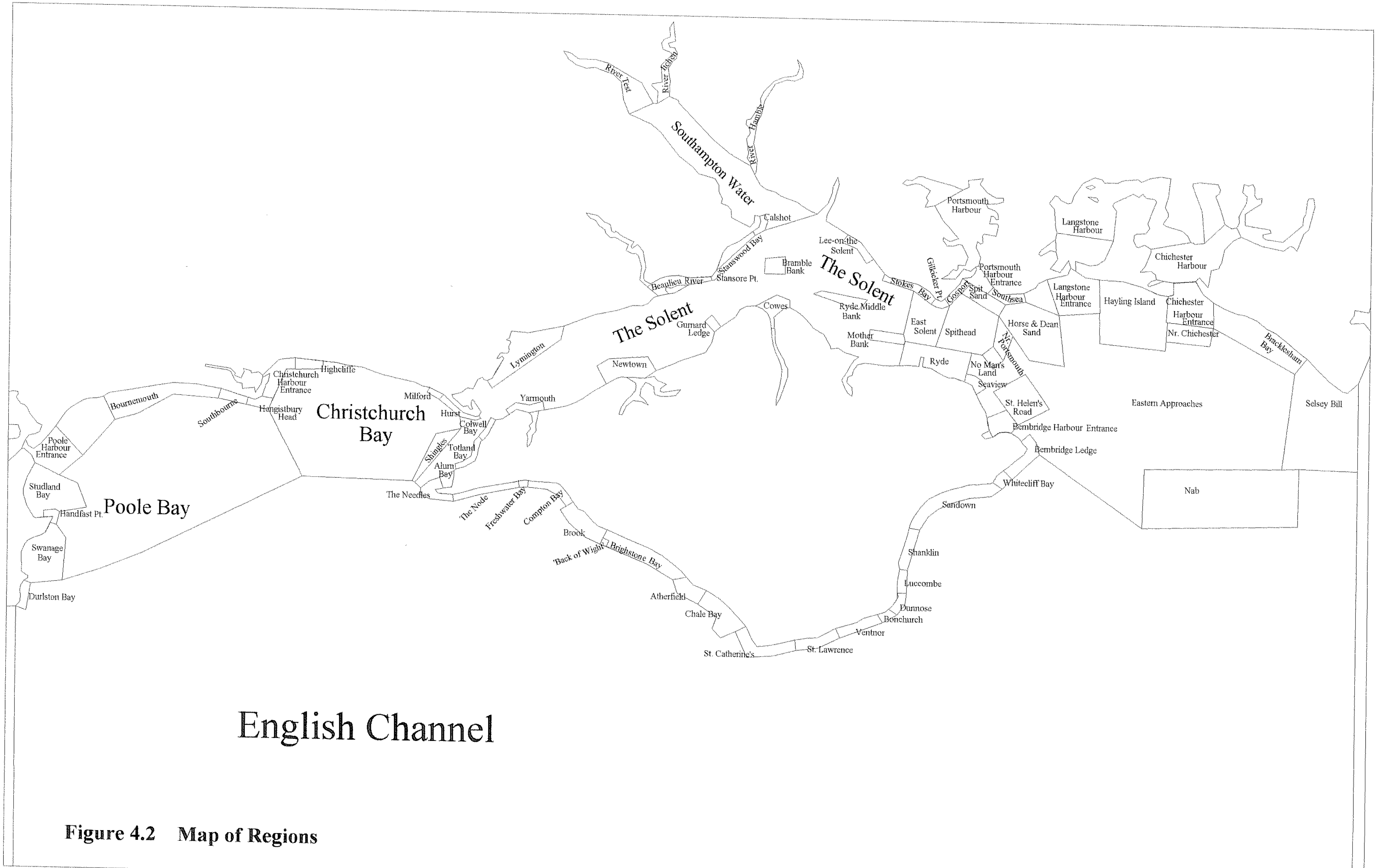


Figure 4.2 Map of Regions

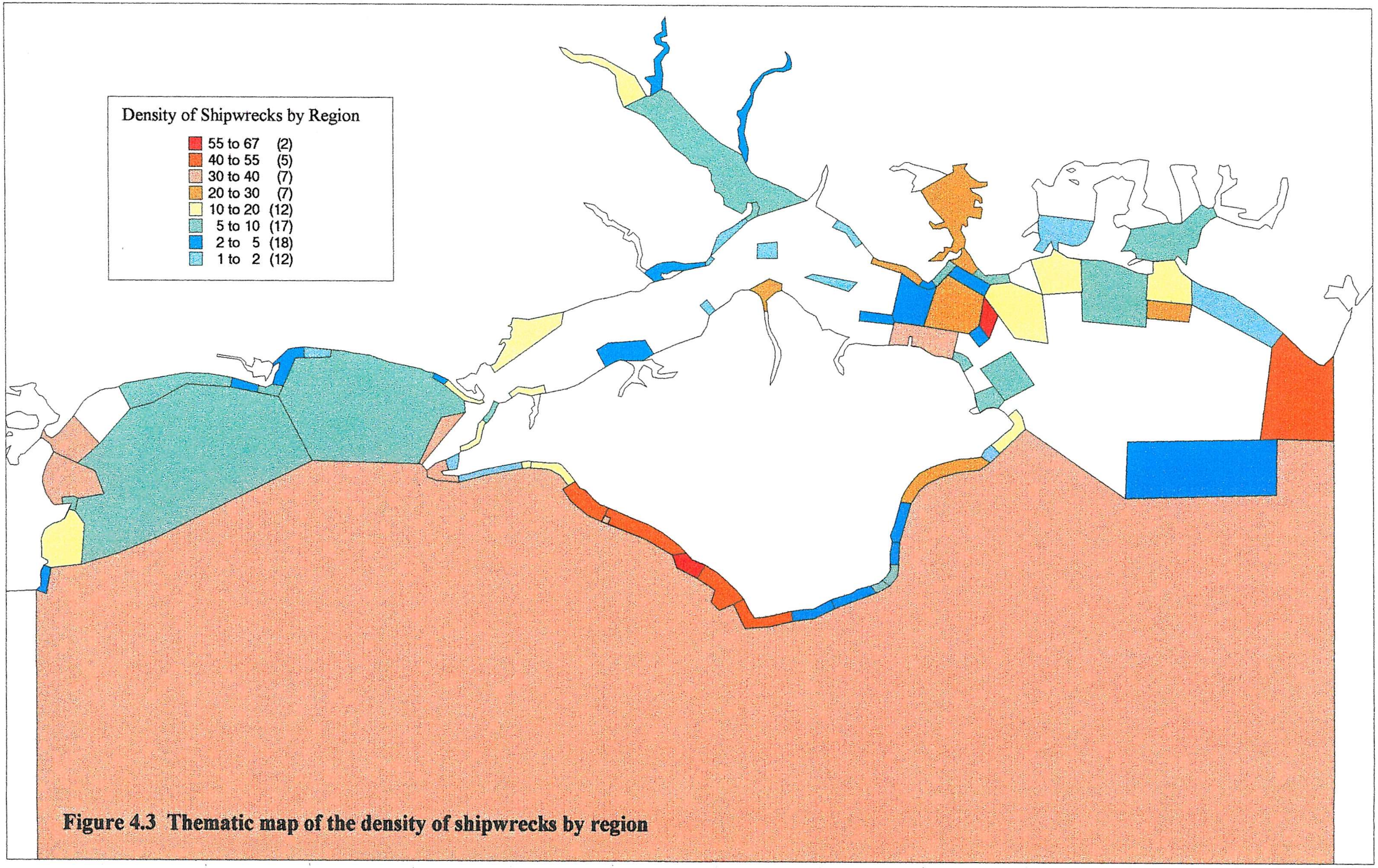


Figure 4.3 Thematic map of the density of shipwrecks by region

The spread of the number of wrecks over the full period of 1140 - 1909 is leptokurtic, skewed towards the later dates, 1031 of the total of 1163 wrecks, 88.6%, occurred post 1739. The distribution is also multi-modal. The number of wrecks identified for each year over the full period varying from 0 to 34 with a mean of 1.51. The graph below (Figure 4.4) shows the totals for each decade.

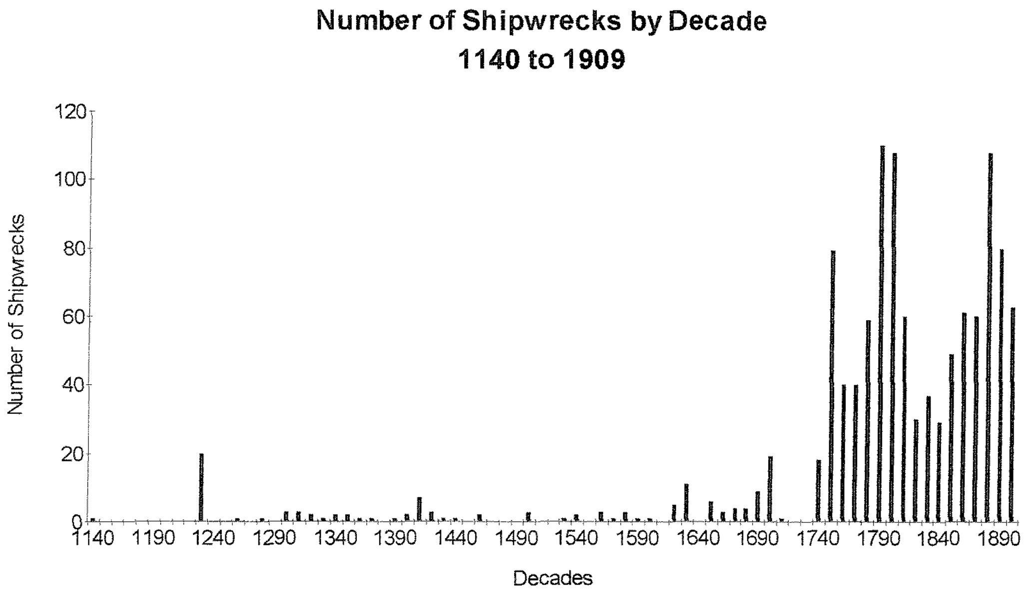


Figure 4.4 Number of Wrecks by decade 1140 - 1909

As already stated in Chapter 3, and clearly identifiable from Figure 4.4, the number of wrecks becomes more consistent from 1740. Even so there is still a considerable annual and decade variation. For the period from 1740 the distribution is still multi-modal with a main mode of 3. The mean is 5.96. The annual maximum of 34 occurred in 1881. This number includes 12 fishing boats wrecked on Selsey Bill Beach in a gale on the same day. Other high annual totals are 25 in 1753, 25 in 1795, 23 in 1809 and 20 in 1238 (see Figure 4.5). The variations in the number of wrecks each year may be as a result of the irregularity in their being reported as identified in Chapter 1. The diligence of James Wheeler and Fred Mew on the Isle of Wight in documenting wrecks on the south of the island and the Admiralty's presence at Portsmouth possibly mean the records from the middle of the eighteenth century are more complete than they might have been otherwise. Hence they may also be quite reliable.

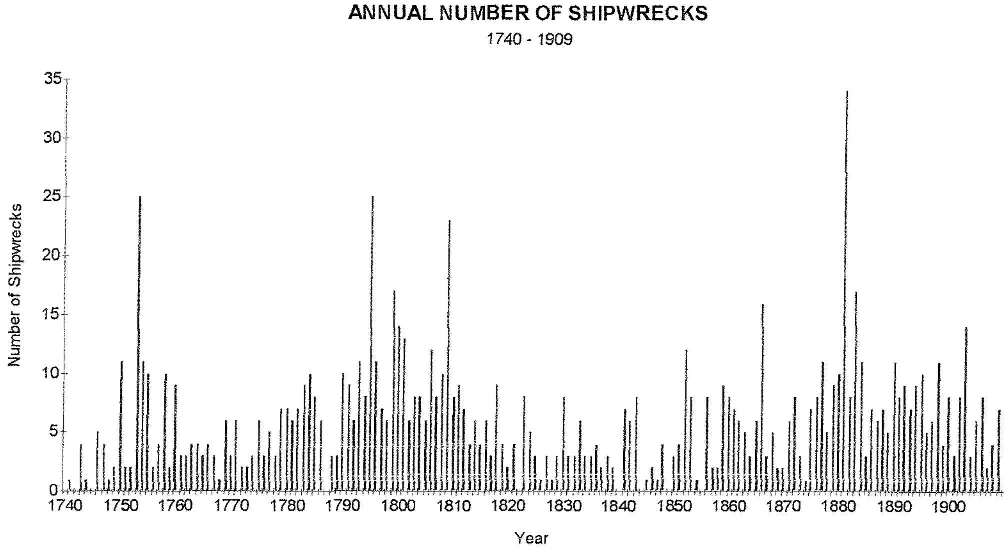


Figure 4.5 Annual number of shipwrecks 1740 - 1909

The shipwrecks on the database have been divided into five subgroups to provide comparisons for the different factors identified as possible causes of shipwreck. The subgroups are:

Coastal - Vessels wrecked sailing from one UK port to another, including Eire (see Figure 4.6).

Overseas - Vessels wrecked sailing from UK ports to overseas ports, overseas ports to UK ports and from one overseas port to another (see Figure 4.7).

Up Channel – Vessels wrecked sailing up the English Channel (see Figure 4.43).

Down Channel – Vessels wrecked sailing down the English Channel (see Figure 4.44).

Local – Vessels sailing from one location to another within the study area (see Figure 4.38).

These subgroups are not mutually exclusive and overlap with some of the shipwrecks included in more than one group, for example shipwrecks in the Coastal and Overseas

Figure 4.6 Map of the locations of shipwrecks in the Coastal subgroup

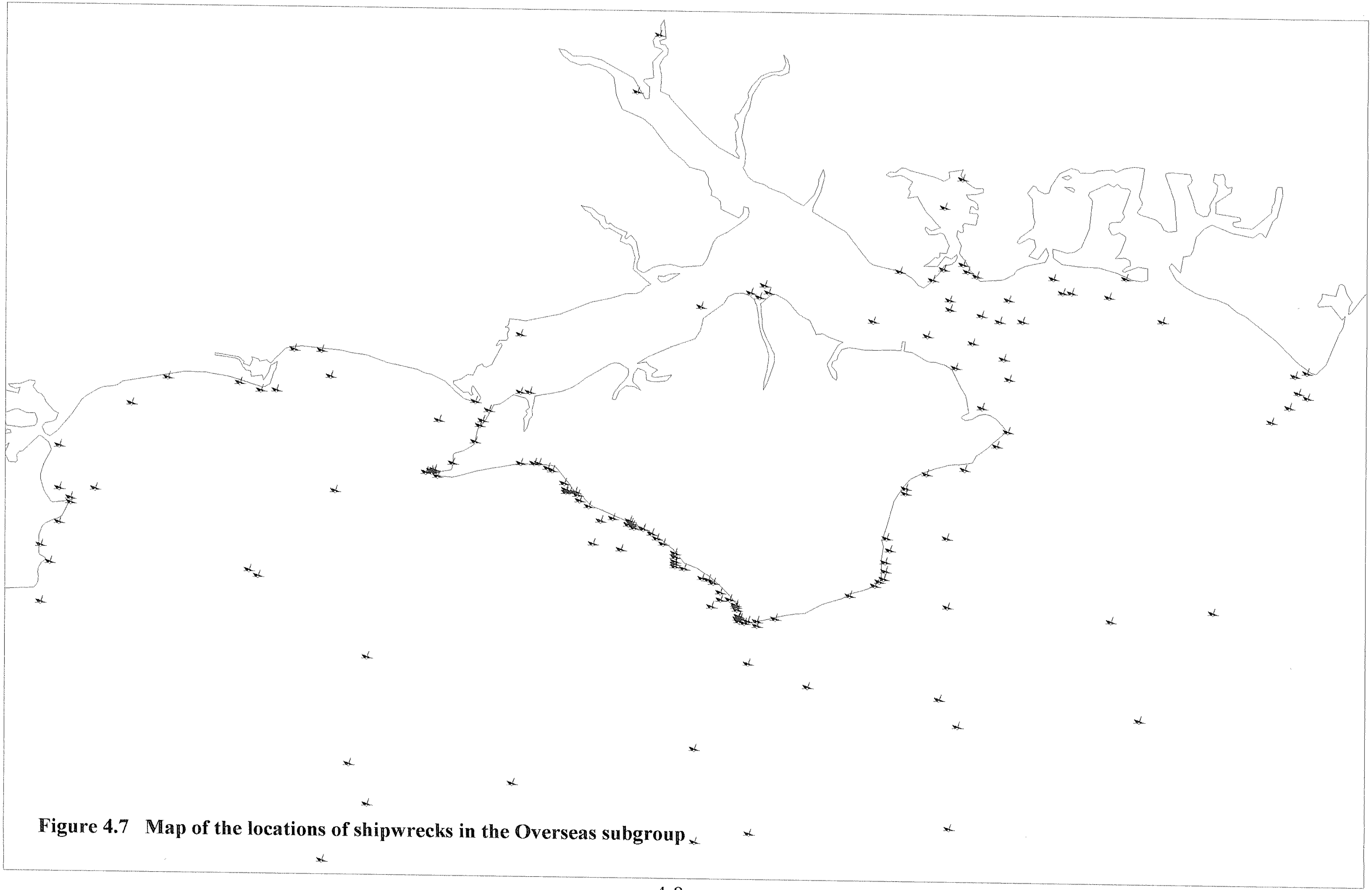


Figure 4.7 Map of the locations of shipwrecks in the Overseas subgroup

subgroups will also be included in the Up Channel and Down Channel subgroups. The size of each subgroup varies as does the number of shipwrecks, or sample, for which the reports provide information on the factors identified and there must be some judgement as to whether they make a large enough sample for effective statistical analysis. Even so all five subgroups are included in each analysis for completeness.

The number of wrecks that occurred in each month is also variable, both for the periods up to and from 1740 (see Table 4.1. and Figures 4.8, 4.9. & 4.10. below).

Table 4.1 - Numbers and Percentages of Shipwrecks by Month

	1140 - 1909		1140 - 1739		1740 - 1909	
Month	**No. Wrecks**	**%**	**No. Wrecks**	**%**	**No. Wrecks**	**%**
January	204	19.50	19	17.76	185	19.70
February	111	10.61	10	9.35	101	10.76
March	99	9.46	7	6.54	92	9.80
April	54	5.16	7	6.54	47	5.01
May	42	4.02	2	1.87	40	4.26
June	26	2.49	1	0.93	25	2.66
July	30	2.87	6	5.61	24	2.56
August	48	4.59	2	1.87	46	4.90
September	80	7.65	21	19.63	59	6.28
October	94	8.99	10	9.35	84	8.95
November	128	12.24	14	13.08	114	12.14
December	130	12.43	8	7.48	122	12.99

The close similarity in the distribution of shipwrecks each month for the overall time span 1140 to 1909 and for 1740 to 1909 is due to the high percentage of the shipwrecks being recorded in that later period. The high number for September for the period 1140 to 1739 is due to a single event in 1238 when 20+ ships were sunk in a storm at Portsmouth.

The overall distribution of shipwrecks each month is also very variable as indicated in Table 4.2. The first shipwrecks for which the month is recorded are in 1238.

Table 4.2 - Number of Shipwrecks Each Month by Decade 1230 to 1909

Month	Total																																	
Jan	3													1								1												
Feb	2																			1					1									
Mar	3																															1	1	
Apr	7								1	1					1					4														
May	1									1																								
Jun	1																												1					
Jul	3											1								1													1	
Aug	0																																	
Sep	20	20																																
Oct	2													1				1																
Nov	2								1				1																					
Dec	1																		1															
Year		1230		1250					1300					1350					1400					1450					1500					1550

Month	Total																																			
Jan	201	1			1						1		1		1	12				1	31	8	4	13	19	27	4	4	3	9	5	9	7	27	9	5
Feb	109								3		2				3					4	8	4	3	8	8	11	4	2	4	5	1	13	6	7	9	4
Mar	96	1							1				2	1						4	5	5	5	7	5	3	15	4	1	2		4	6	11	10	5
Apr	47																				4	1	6	2	4	3	1		5	1	3	2		4	8	3
May	41																			1		1	3	1	5	5	4	1	1		1	1	2	4	6	4
Jun	25																				2	1	2	1	4	1	1		1		2	4	1	3		2
Jul	27			1							1				1									1	2	6		1	1		3		1	6		3
Aug	48														2						5	3		4	6	1		1	2		3	2	1	1	1	6
Sep	60															1				1	4	2	2	5	7	1	4	2			1	2	3	9	2	14
Oct	92							2	1		1	1		1		1	1			2	5	3	5	4	5	5	7	3	4		3	8	4	15	4	7
Nov	126							1	4			1		1	1	4				1	5	4	3	5	17	16	10	3	2		5	5	10	9	14	5
Dec	129							1	2		1	1			1	1				1	4	8	6	6	21	15	8	6	2	1	13	2	9	8	7	5
Year		1560				1600					1650					1700					1750					1800					1850					1900

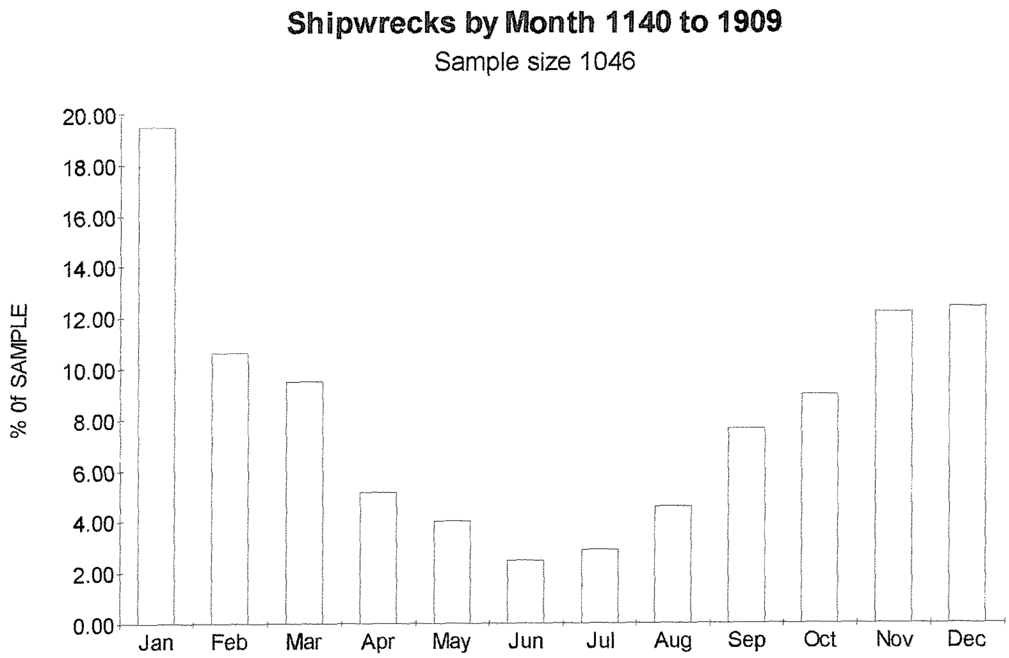


Figure 4.8 **Percentage number of shipwrecks each month 1140 – 1909**

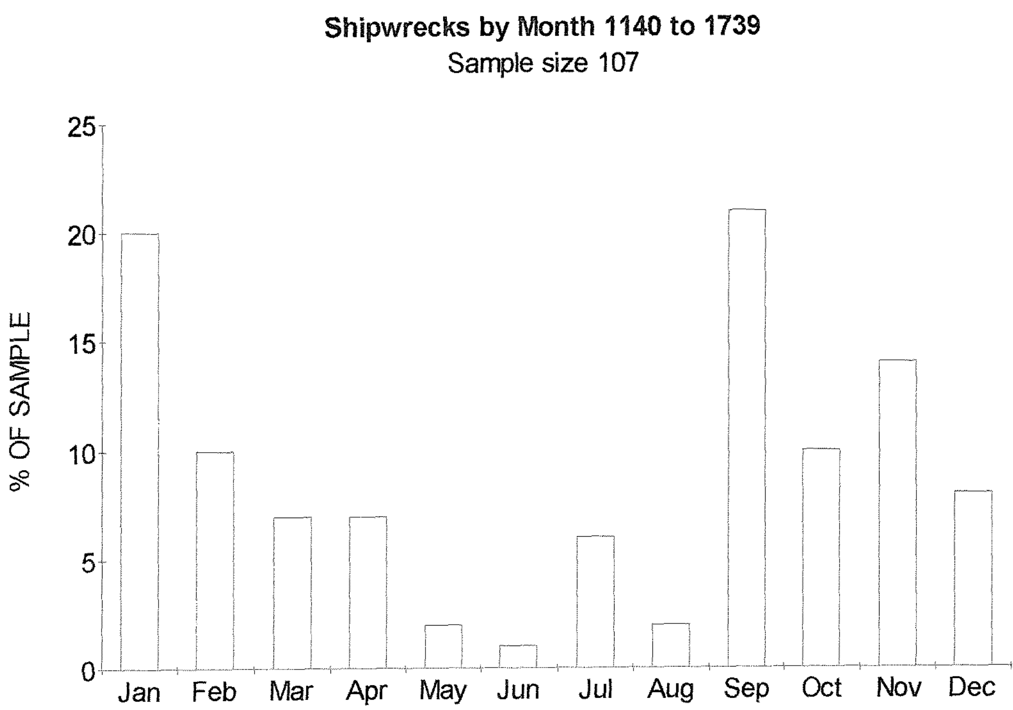


Figure 4.9 **Percentage number of shipwrecks each month 1140 - 1739**

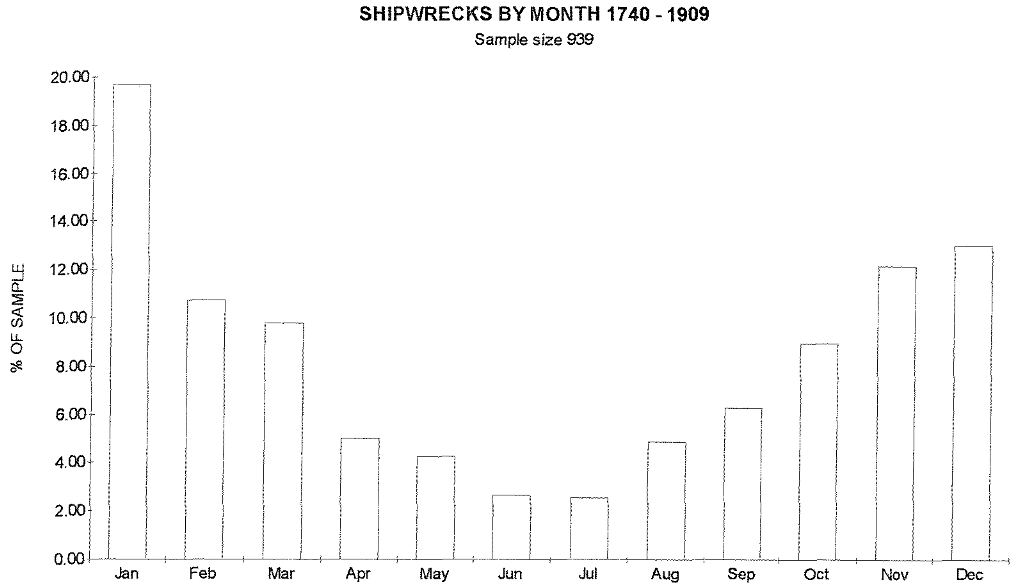


Figure 4.10 Percentage number of shipwrecks each month 1740 - 1909

The distributions of the shipwrecks in the study area for each month of the year are shown in Figures 4.11 to 4.22.

4.2 Locations of Shipwrecks

The information available on 1107 shipwrecks is sufficient to provide an identifiable location. Table 4.3 provides the detail of the number of shipwrecks in each region (see Figures 4.1 to 4.3.) grouping the wrecks into six areas:

Southwest of the Isle of Wight, from the Needles to, and including, St Catherine's Point ('Back of Wight').
Southeast of the Isle of Wight, from St. Catherine's Point to Bembridge Ledge.
Northeast of the Isle of Wight from Bembridge to Cowes.
Northwest of the Isle of Wight, from Cowes to the Needles.
The Dorset coast from Anvil Point to Christchurch Bay
The Hampshire coast from Christchurch Bay to Selsey Bill.
The West and East Solent.
The English Channel.

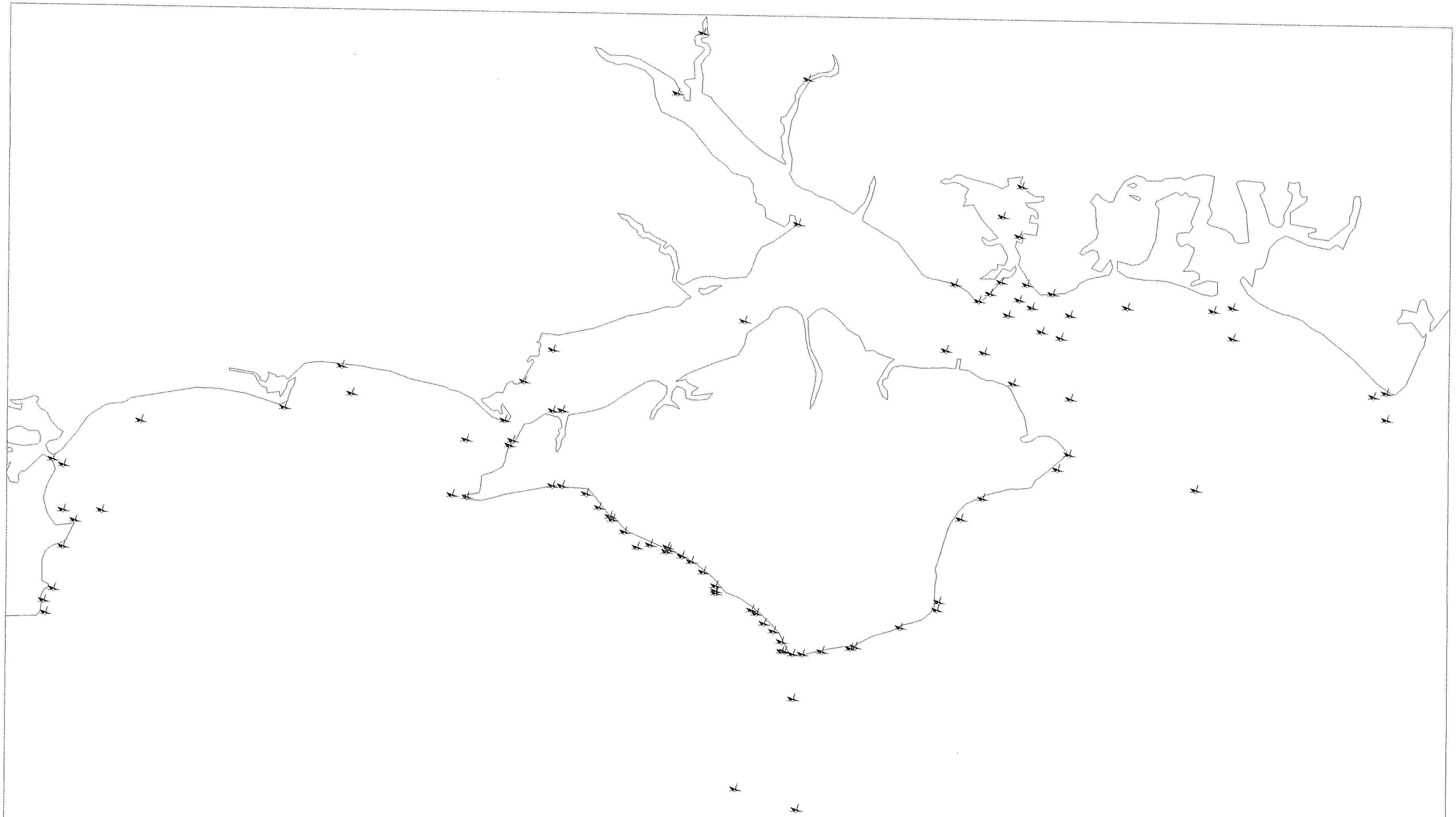


Figure 4.11 Map of the locations of vessels wrecked in January

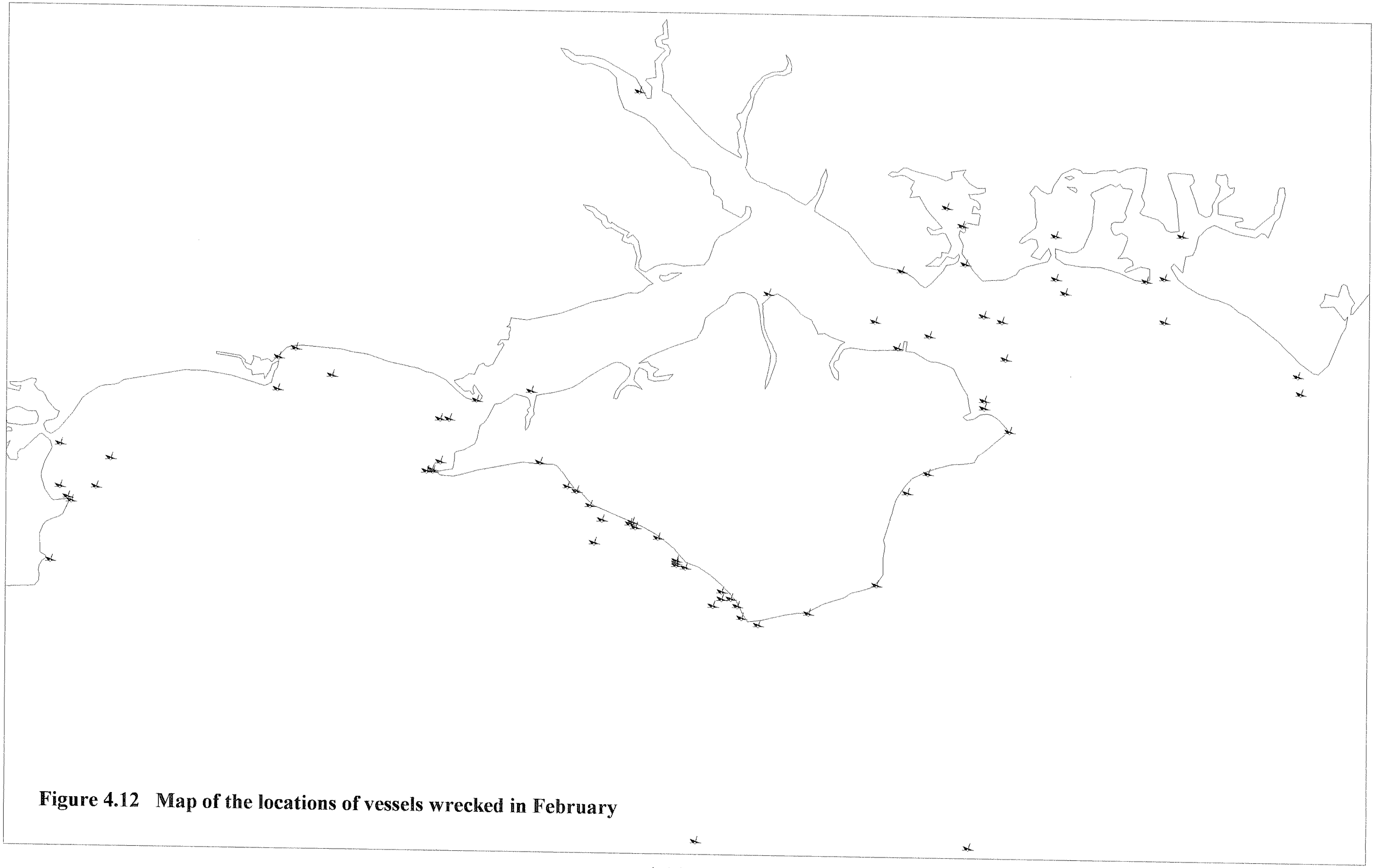


Figure 4.12 Map of the locations of vessels wrecked in February

Figure 4.13 Map of the locations of vessels wrecked in March

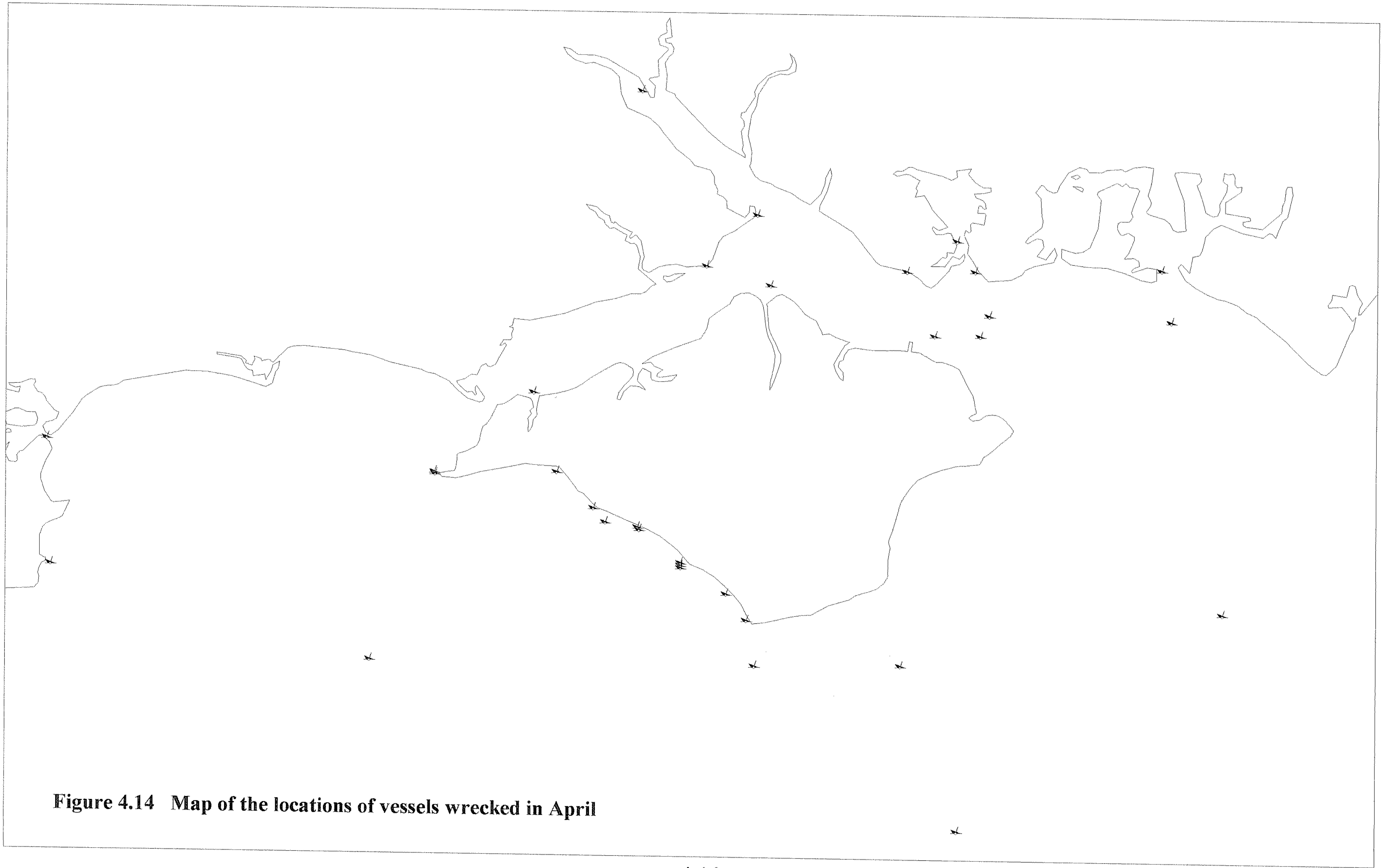


Figure 4.14 Map of the locations of vessels wrecked in April

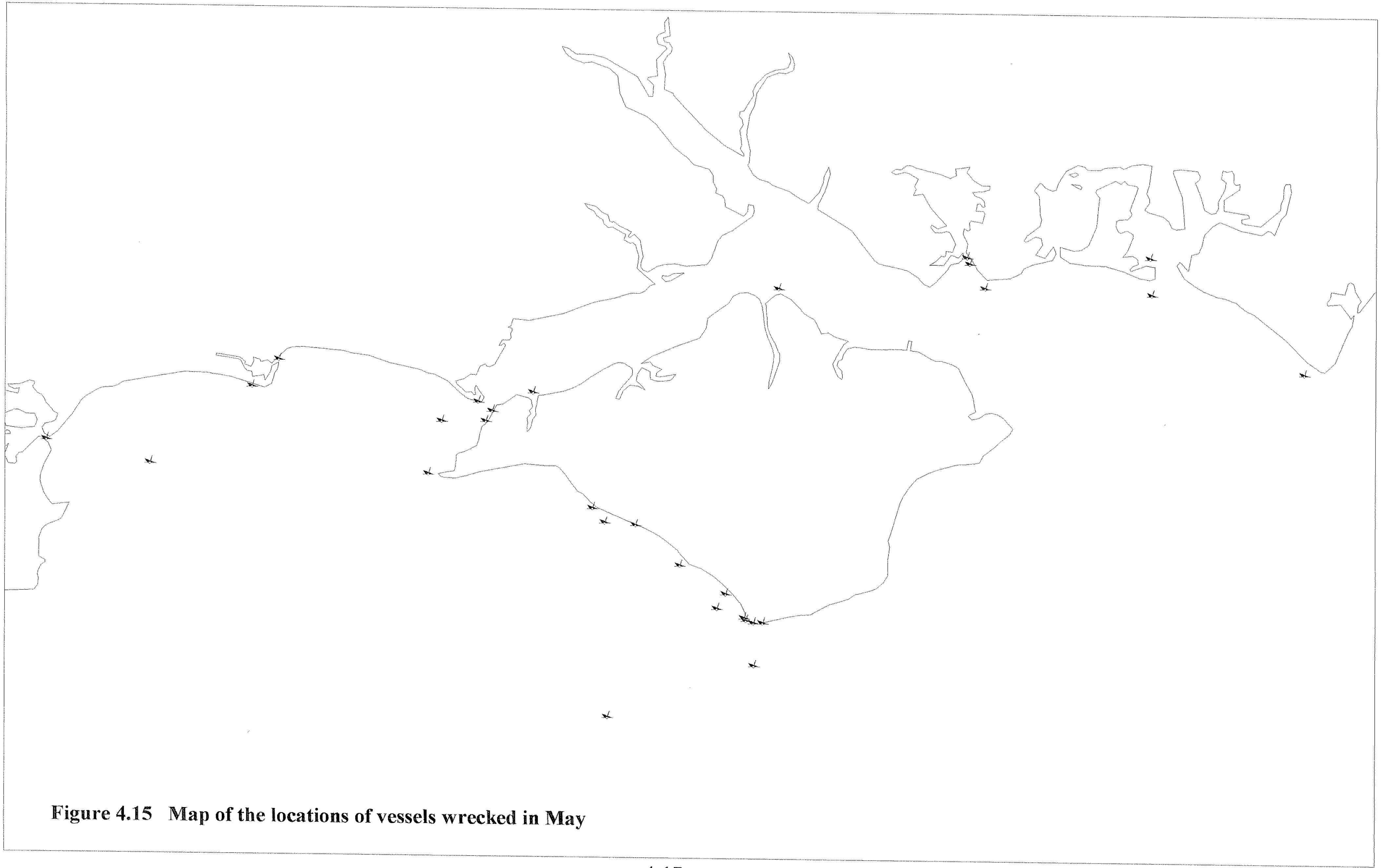


Figure 4.15 Map of the locations of vessels wrecked in May

Figure 4.16 Map of the locations of vessels wrecked in June

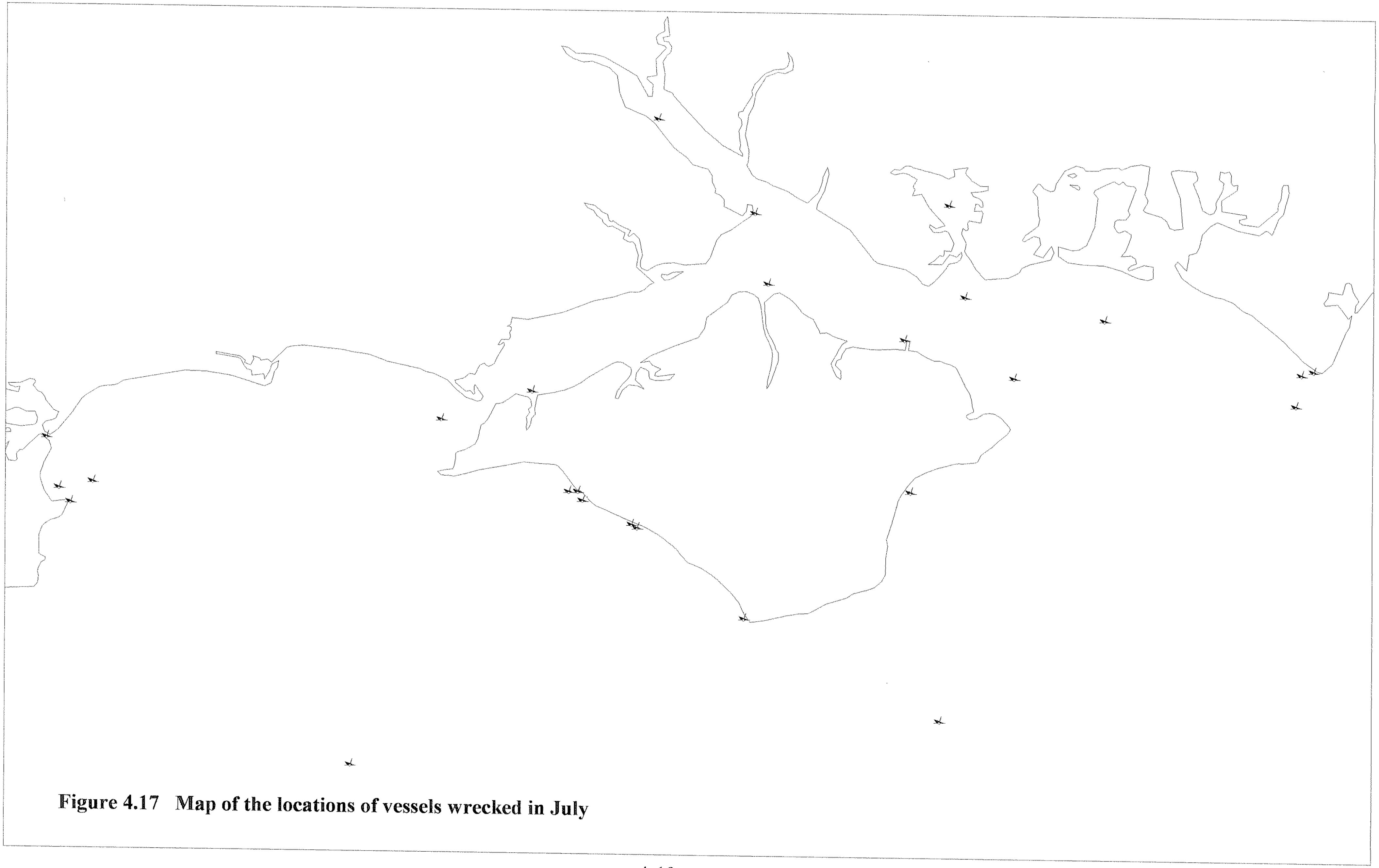


Figure 4.17 Map of the locations of vessels wrecked in July

Figure 4.18 Map of the locations of vessels wrecked in August

Figure 4.19 Map of the locations of vessels wrecked in September

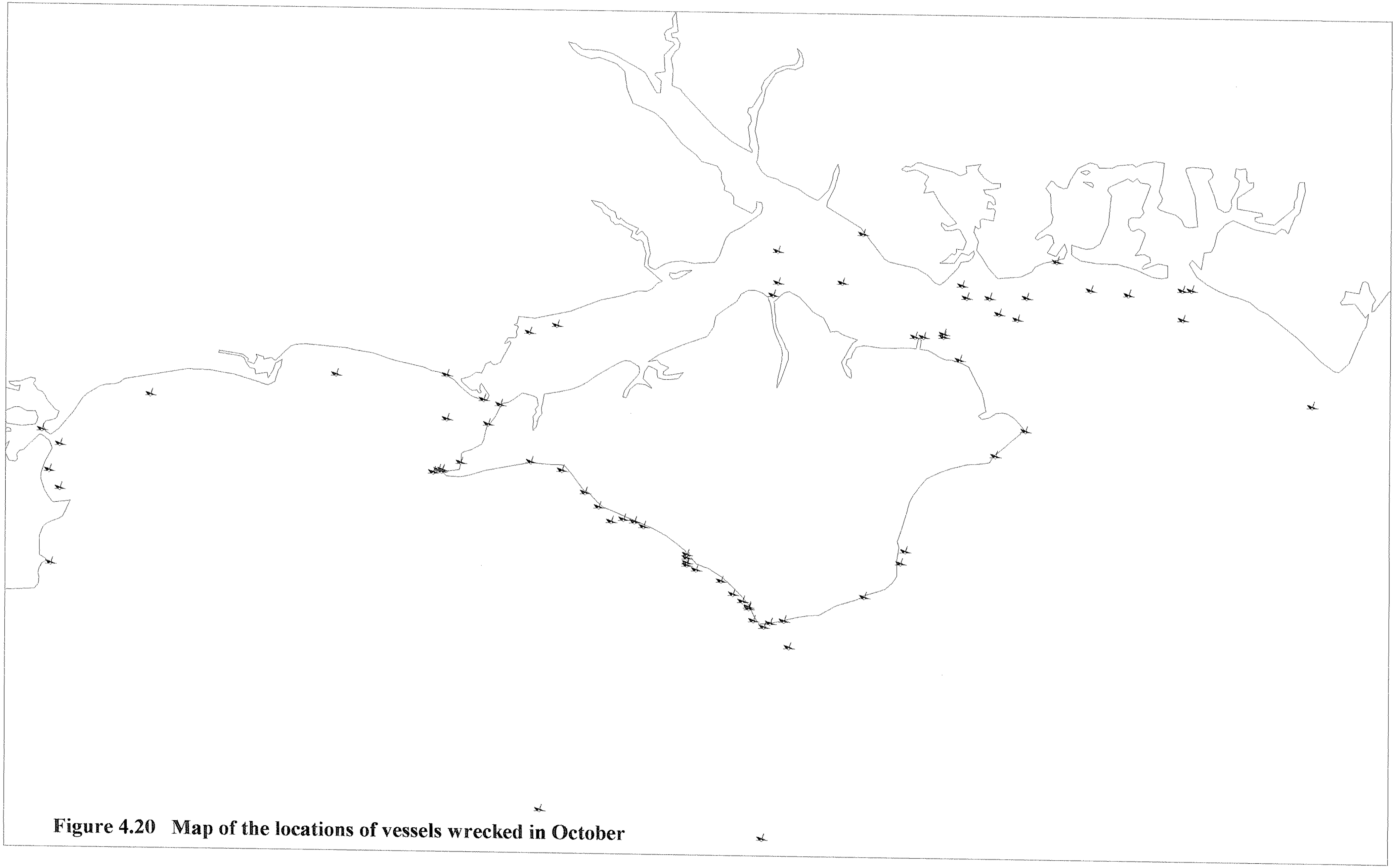


Figure 4.20 Map of the locations of vessels wrecked in October

Figure 4.21 Map of the locations of vessels wrecked in November

Figure 4.22 Map of the locations of vessels wrecked in December

The locations listed in the table below are the nearest prominent topographical coastal feature, port or town.

Table 4.3 - Locations of Shipwrecks

Location		No. of Wrecks
South West I.O.W.	**Total:**	**349**
'Back of Wight'		38
The Needles		30
The Node		1
Freshwater Bay		10
Compton Bay		14
Brook		51
Brighstone Bay		44
Atherfield		67
Chale Bay		45
St. Catherine's Point		49
South East I.O.W.	**Total:**	**72**
St. Lawrence		4
Ventnor		4
Bonchurch		5
Dunnose Point		9
Luccombe Bay		3
Shanklin		2
Sandown		26
Whitecliff Bay		1
Bembridge Ledge		18
North East I.O.W.	**Total:**	**72**
Bembridge Harbour Entrance		5
St. Helen's Road		5
Nettlestone Point/Seaview		7
Ryde		35
Cowes		20

North West I.O.W.	**Total:**	**40**
Gurnard Head		1
Between Cowes & Yarmouth		2
Newtown River		1
Yarmouth		19
Colwell Bay		5
Totland Bay		11
Alum Bay		1
Dorset	**Total:**	**129**
Durleston Head/Bay		3
Swanage Bay		19
Handfast Point		7
Studland Bay		36
Poole Harbour Entrance		32
Poole Bay		8
Bournemouth		5
Southbourne		2
Hengistbury Head		6
Christchurch Harbour Entrance		3
Christchurch Bay		7
Highcliffe		1
Hampshire	**Total:**	**236**
Milford-on-Sea		3
Hurst Point		14
Lymington		14
Beaulieu River		2
Stansore Point		1
Stanswood Bay		1
Calshot		6
Southampton Water		7
River Test		15
River Itchen		2

Hamble River	3
Lee-on Solent	1
Stokes Bay	29
Gilkicker Point	3
Gosport	6
Portsmouth Harbour	20
Portsmouth Harbour Entrance	20
Southsea	6
Langstone Harbour	1
Langstone Harbour Entrance	13
Hayling Island	7
Chichester Harbour	5
Chichester Harbour Entrance	15
Bracklesham Bay	1
Selsey Bill	41

Solent	**Total:**	**169**
Shingles Bank		37
Bramble Bank		1
Ryde Middle Bank		1
Mother Bank		2
East Solent		2
Spithead		22
Spit Sand		4
Horse & Dean Sand		11
Near Portsmouth		61
Near Chichester		23
No Man's Land		2
Nab Tower		3

English Channel	**Total:**	**40**

Each of these locations can be rationalised by type; headland, bay, harbour entrance, open water, anchorage, rocks, and banks.

Table 4.4 - Location Types

Type	No. Wrecks
Headland	311
Bay	283
Harbour Entrance	255
Open Water	73
Bank	69
Anchorage	56
Harbour	47
River Mouth	1
Total	1095

The discrepancy in the totals for Tables 4.3 and 4.4 is due to shipwrecks where the location type cannot be identified from the location or other information in the reports, many of which have been allocated to the 'Open Water' location type. The location types can be further rationalised to cover such locations as anchorages off harbour entrances or in bays and banks or rocks off harbour entrances, in bays or off headlands.

Table 4.5 - Locations within Location Types

Type		No. Wrecks
Harbour Entrance:		
	Bank	47
	Anchorage	11
	Rocks	2
Bay:		
	Anchorage	22
	Rocks	22
Headland:		
	Rocks	152

The breakdown of the location types for the five subgroups of shipwrecks is detailed in Table 4.6:

Table 4.6 – Numbers (%) of Shipwrecks by Location Type in each Subgroup

Subgroup	Sample Size	Bay	Headland	Harbour Entrance	Open Water	Anchorage
Coastal	287	17.42	22.30	34.49	7.31	10.10
Overseas	425	30.35	35.06	17.41	8.94	3.76
Up Channel	377	31.83	35.54	17.77	6.63	3.45
Down Channel	225	19.11	24.89	31.11	11.56	6.22
Local	70	12.86	18.57	38.57	10.00	18.57

4.3 How Wrecked

For 911 of the shipwrecks on the database the reports provided a description as to how the wreck occurred. Fifty different descriptions have been identified, including such as 'Beat to pieces', 'Torne & shattered on the sea', 'Bulged' and 'Fell over'. Some 56 were simply described as 'sank' and a further 30 as 'lost'. These descriptions have been rationalised with many such as driven ashore, cast ashore, went ashore grouped together to provide three basic ways in which ships can wreck. For the purposes of analysis the method of being wrecked for a further 195 shipwrecks has been assumed based primarily on location. The table below (4.7) provides a list of the three basic ways of wrecking and the number of wrecks on the database for which each was applicable.

Table 4.7 - How Vessels were Wrecked

How Wrecked	No. of Wrecks	%
Stranded	841 vessels	76.14%
Foundered	245 vessels	22.15%
Burnt	20 vessels	2.0%(includes 1 blew up)

The vessels that wrecked following a collision are not shown separately in Table 4.7, but are included in the other groupings dependent upon the ultimate manner of loss.

Within the groupings further subdivisions provide:

Stranded:

On rocks	135 vessels.
On bank	88 vessels.
Following act of war	5 vessels.
Following collision	1 vessel.

Foundered:

Following collision	49 vessels.
Following capsize	11 vessels.
After hitting rocks	9 vessels.
After hitting bank	7 vessels.
Following act of war	4 vessels.

From the figures above it can be determined that 5.49% of vessels were wrecked as a result of collisions.

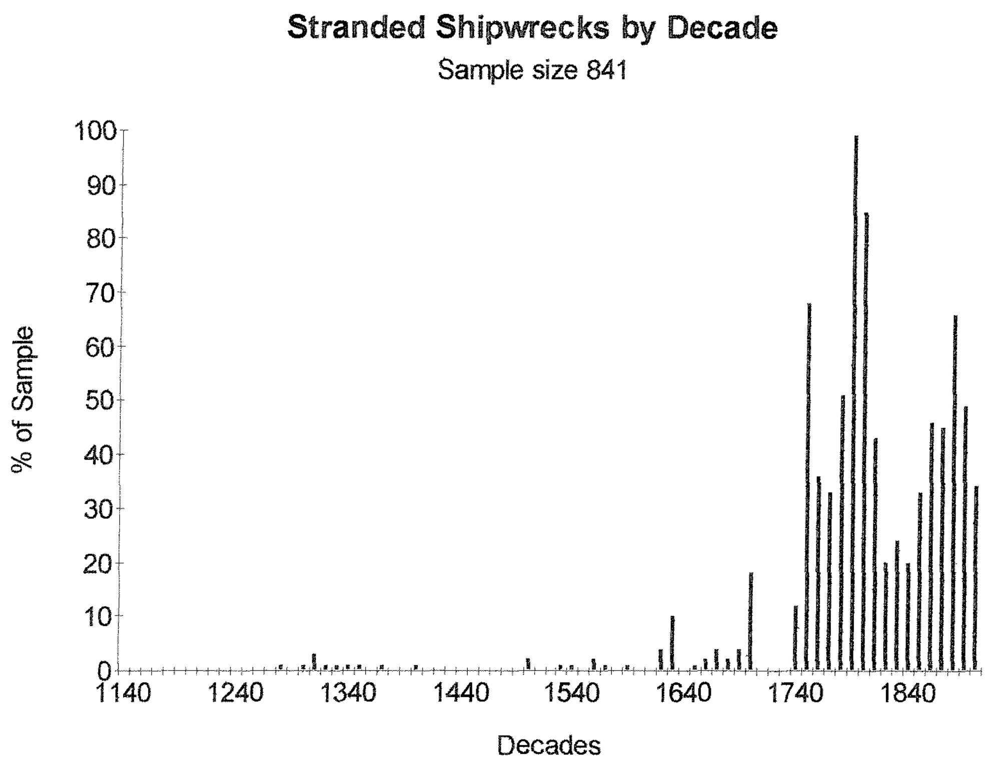


Figure 4.23 Vessels wrecked by stranding by decade 1140 – 1909

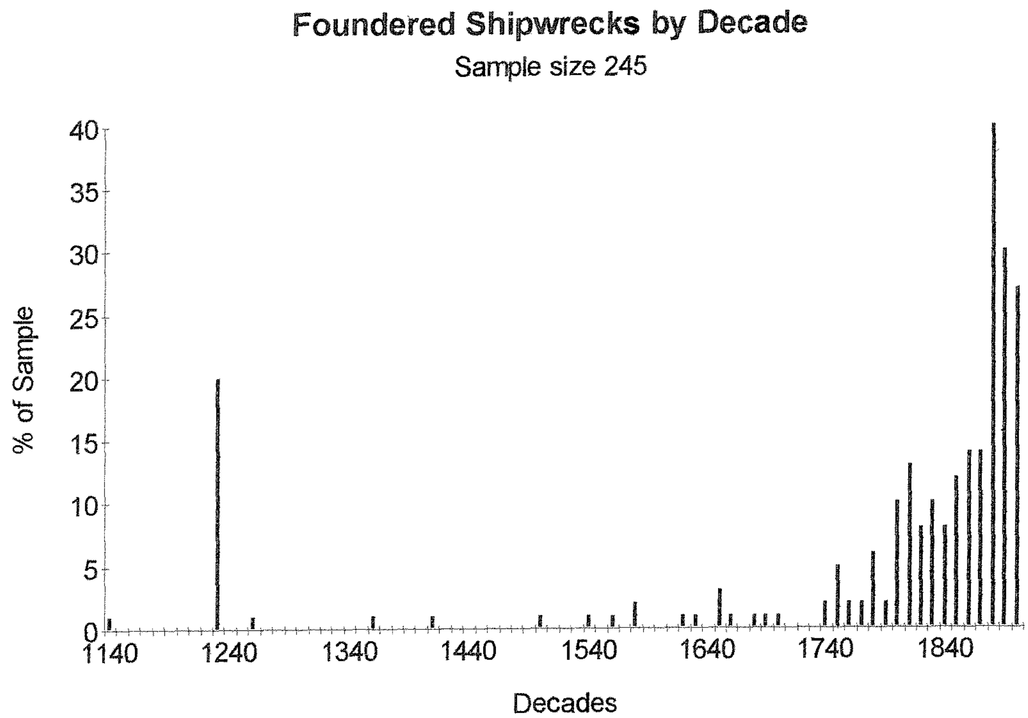


Figure 4.24 **Vessels wrecked by foundering by decade 1140 – 1909**

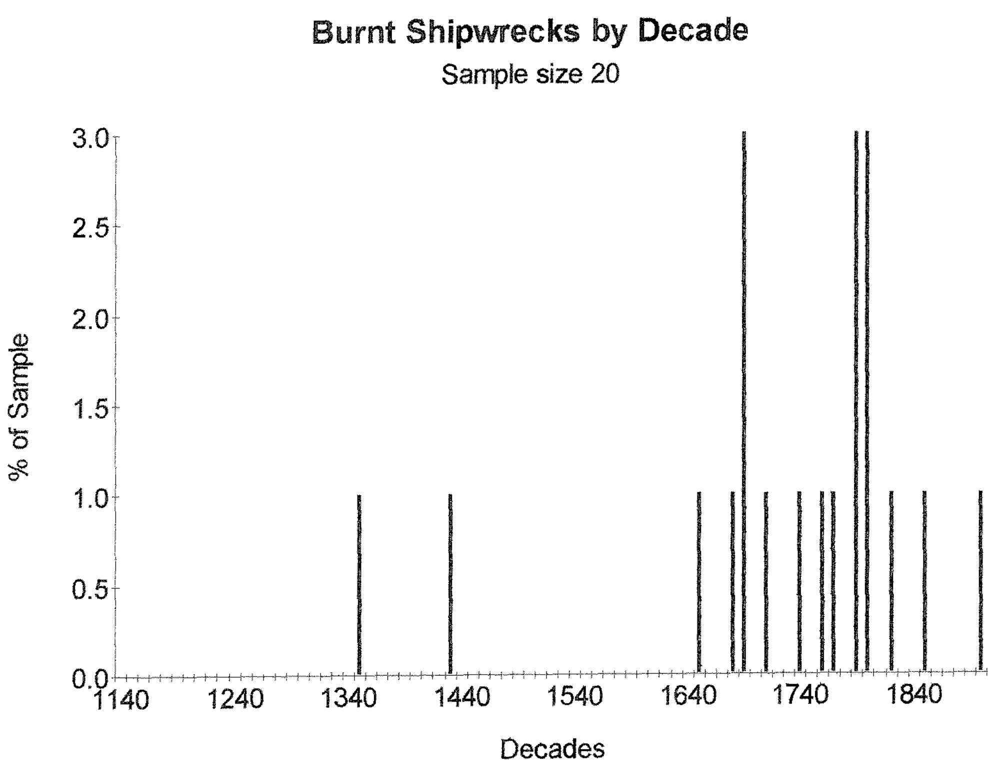


Figure 4.25 **Vessels wrecked by burning or explosion by decade 1140-1909**

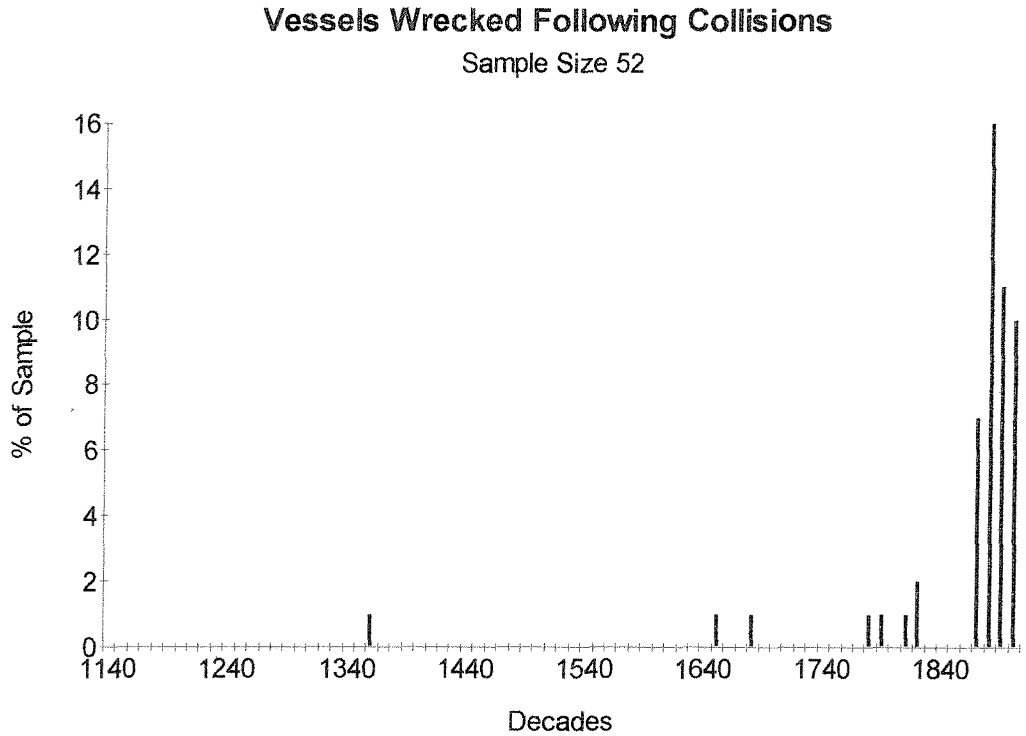


Figure 4.26 Vessels wrecked following collisions by decade 1140 - 1909

The number of vessels for each of the five subgroups by way of being wrecked is detailed in Table 4.8.

Table 4.8 – Numbers (%) of Shipwrecks by Wrecking Type for each Subgroup

Subgroup	Sample Size	Stranded	Foundered	Collision	Burnt
Coastal	289	67.13	31.83	7.96	1.04
Overseas	441	83.22	15.87	5.22	0.91
Up Channel	392	83.93	15.31	2.81	0.77
Down Channel	231	77.06	21.65	8.23	1.30
Local	69	40.58	59.42	20.29	0.00

The records identify a total of 84 vessels that were wrecked while at anchor or moored. This group also includes one vessel that was coming to anchor and two that were in the dockyard at Portsmouth (see Figure 4.42 & 4.45). A number of other vessels could have been considered as having been at anchor, such as the transports wrecked in Stokes Bay on 30th January 1890, but are not included in this total.

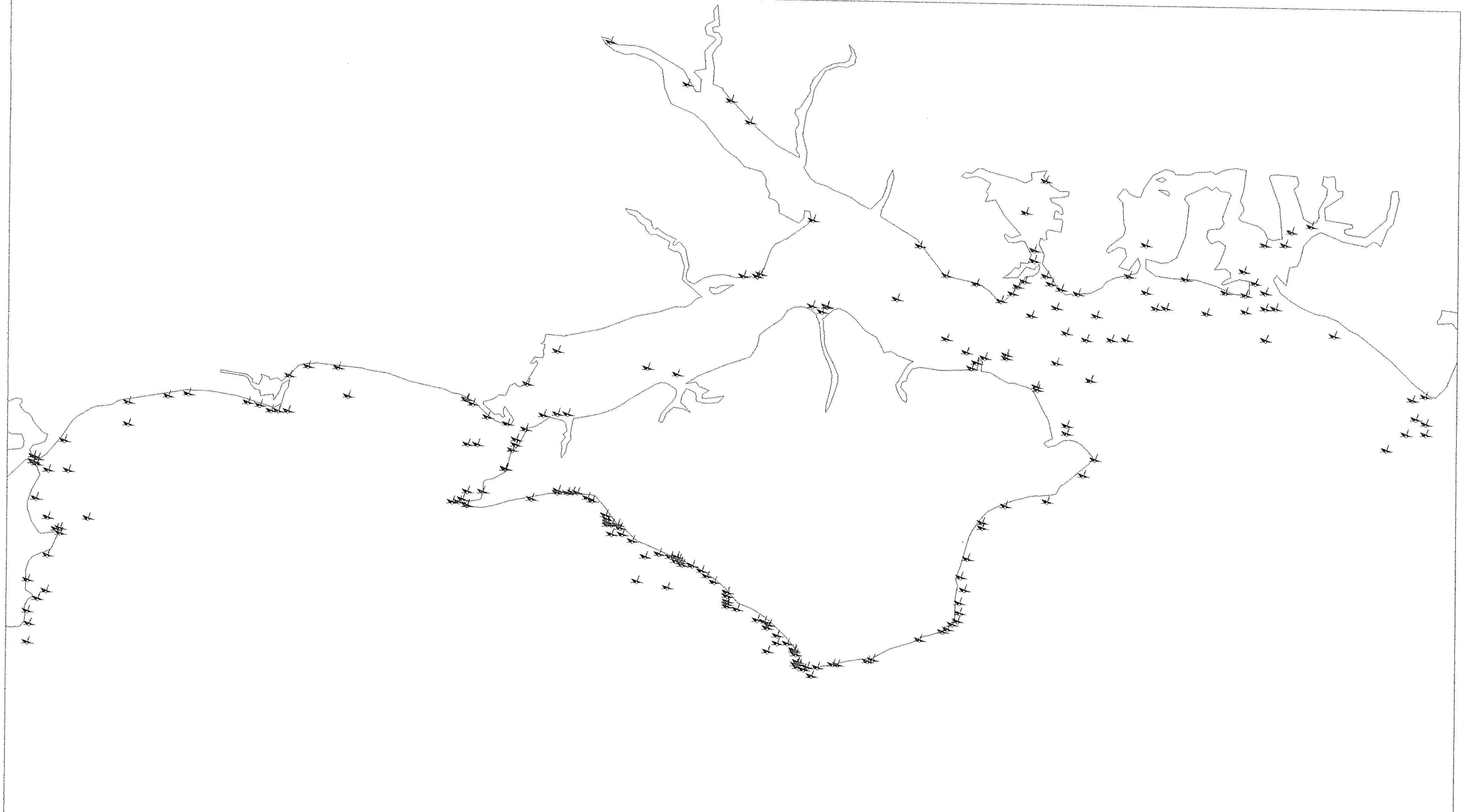


Figure 4.27 Map of the locations of vessels wrecked by stranding

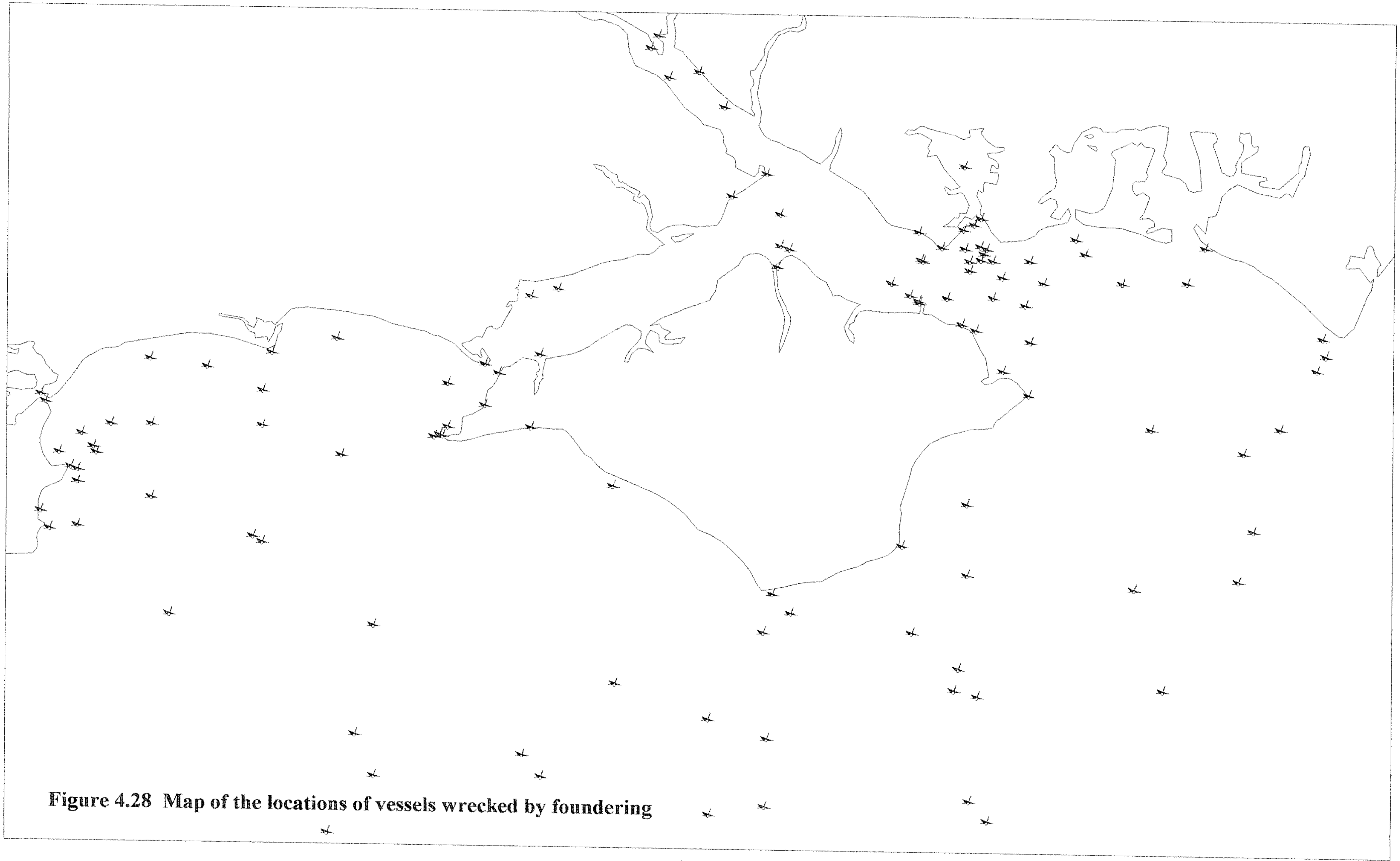


Figure 4.28 Map of the locations of vessels wrecked by foundering

Figure 4.29 Map of the locations of vessels wrecked by burning/explosion

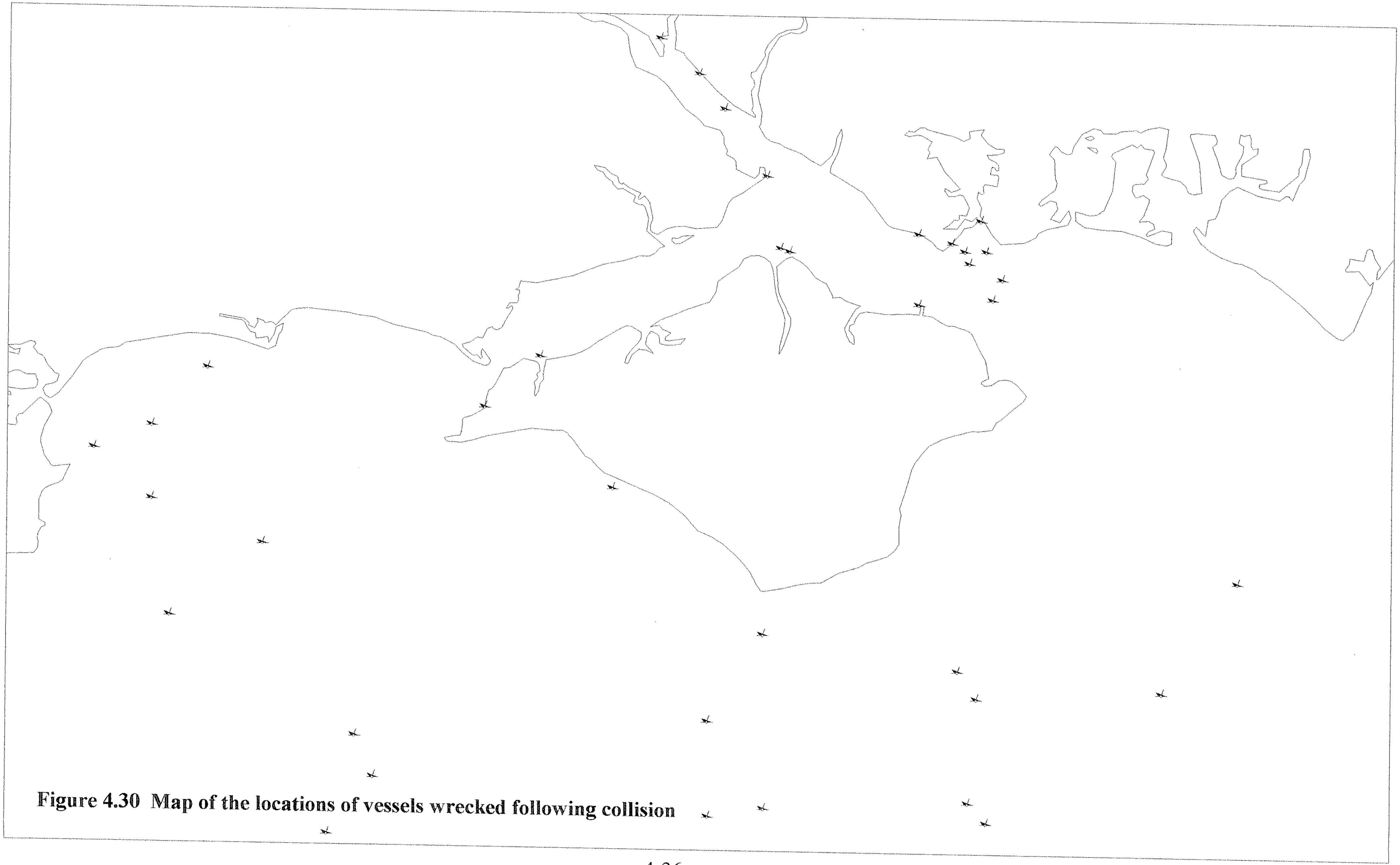


Figure 4.30 Map of the locations of vessels wrecked following collision

4.4. Nationality of Wrecks

The political map of the world has changed many times during the timescale spanned by the wreck database. Where the information was available the nationality of a wreck is given as recorded in the source documentation. If only the port of registry was given the nationality is the country the port lies in today. All ships from England, Scotland, Ireland and Wales are identified as British (see Table 4.9).

Table 4.9 - Nationality of Wrecks

Nationality	No.
British	632
French	65
Dutch	40
Spanish	21
Swedish	17
Norwegian	16
German	12
Prussian	6
Danish	4
Russian	4
Italian	3
USA	3
Canadian	2
Portuguese	2
Venetian	2
Austrian	1
Belgian	1
Genoese	1
Greek	1
Hanoverian	1
Maltese	1
Polish	1
South African	1
Total	837

Table 4.10 – Nationality of Vessels Wrecked by Decade

Nationality	Total																																																													
British	632	1				1								2	1											1									1		2	2	1	2	5	7	1			5	24	10	21	26	61	58	44	20	19	16	27	41	34	89	59	51
French	64		2								1		1																	1				1	2						2					4	8	2		6	1		1	2	1		6	4	3	5	8	3
Dutch	40																																	2			2		2	1		3				1	7	8	3	4	1		1				1		1	1	2	
Spanish	21	1		1		1	1				1		1					1				1				1		1		1											1						1	1	2	2	1	1							1			
Norwegian	16																																																								1		1	6	4	4
Swedish	14																																							1							2	1	1	1	1	1			1		1	1	1	1		1
German	12																																		3														1			2						1	1	1	1	2
Danish	4																																														1			2	1											
Prussian	4																																															1		1	1		1									
Russian	4																																																					1		1					1	1
Italian	3											1																																															1	1		
USA	3																																																			1					1		1			
Canadian	2																																																										2			
Portuguese	2			1																																																1										
Venetian	2																													1																					1											
Austrian	1																																																											1		
Belgian	1																																																										1			
Genoese	1												1																																																	
Greek	1																																																										1			
Hanoverian	1																																																					1								
Maltese	1																																																								1					
Polish	1																																																	1												
South African	1																																																								1					
Total	831	2	2	2	0	2	1	0	0	0	2	1	3	2	1	0	0	1	0	0	0	1	0	0	0	2	0	1	0	3	0	0	0	3	6	0	4	2	3	4	8	10	1	0	0	10	43	23	28	43	68	64	47	24	21	17	39	47	48	105	75	62
		1300					1350					1400					1450					1500					1550					1660					1650					1700					1750					1800					1850					1900

The distribution of the British vessels shipwrecked spans the whole period covered by this study, but this does not apply to the vessels of other nationalities. Figure 4.31 shows the cumulative numbers by decade for the countries with the six highest totals of shipwrecks. The locations of these shipwrecks are shown in Figures 4-32 to 4-37. It is interesting to note the concentration of Dutch, Spanish, Swedish and Prussian vessels wrecked during the decades 1750 to 1800 that span a period of significant British naval activity and the frequency of Spanish vessels prior to the seventeenth century.

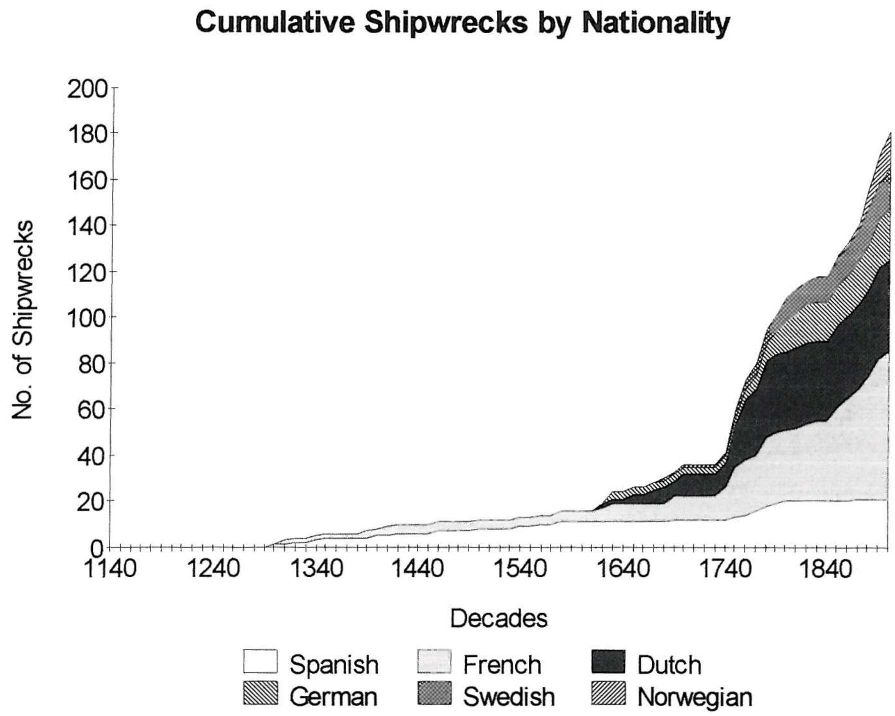


Figure 4.31 Cumulative numbers of shipwrecks by decade for the six most frequent nationalities excluding British

The earliest "foreign" ship recorded as being wrecked within the study area was Spanish, in 1309. The total number of Spanish vessels is relatively small and there is a gap of over one hundred years between shipwrecks from 1588, the year of the Spanish Armada, to 1697. The second earliest "foreign" vessel wrecked was French. The wrecking of French ships occurs on a fairly regular basis, but there are gaps that coincide, to a degree, with periods of war or political differences; 1399 to 1416, 1692 to 1741 and 1798 to 1819. The first Dutch vessel wrecked is not until 1627. The total of 19 German shipwrecks used in Figure 4.31 and Table 4.9 includes the one Hanoverian and six Prussian vessels. The earliest two German vessels wrecked are recorded for 1634 with another in 1635, but then there is a gap until 1769. The first Swedish shipwreck recorded is in 1683. The next is not until 1750. The first Norwegian vessel is not wrecked until 1851. Table 4.11 lists the mean period between shipwrecks for the overall time scale of 1140 to 1909 and the mean for the time span between the first and last occurrences of shipwrecks for the countries shown in Figure 4.31. Figures 4.32 to 4.44 show the locations of the shipwrecks of these nationalities.

Table 4.11 - Mean Period (years) between Shipwrecks

Nationality	Overall Mean	Time span Mean
French	11.77	9.17
Dutch	19.23	7.05
Spanish	36.61	28.57
German	40.47	15.88
Swedish	45.24	13.29
Norwegian	48.06	3.63

Table 4.12 – Nationality of Shipwrecks pre-1740

Nationality	No. Wrecks
British	27
French	10
Dutch	10
Spanish	12
Italian	3
German	3
Portuguese	1
Swedish	1

Note:

The total of Italian shipwrecks includes one Venetian and one Genoese vessel.

The number of different nationalities recorded for the period up to 1740 is much smaller than for the post 1740 period and there is also a much smaller ratio of British.

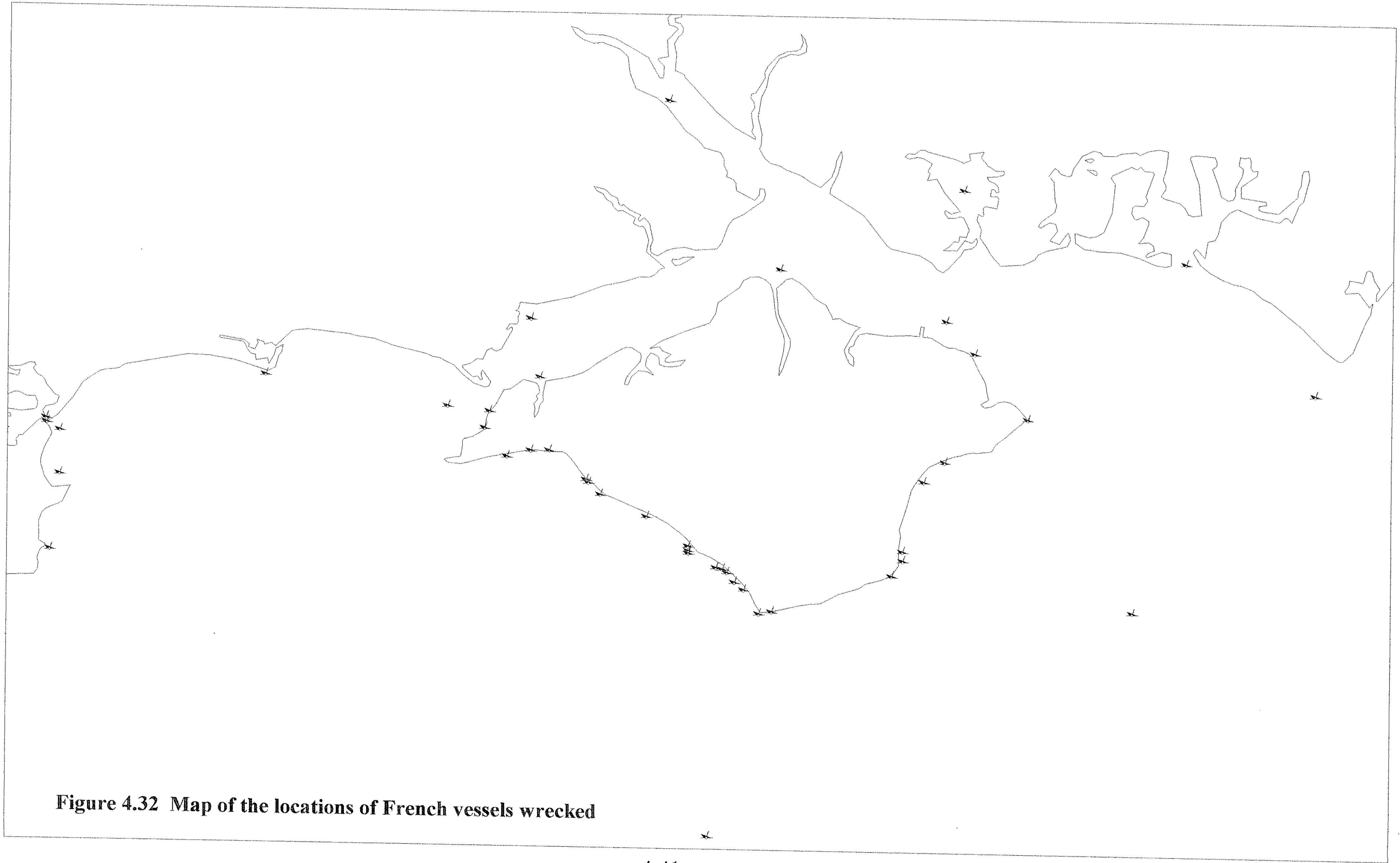


Figure 4.32 Map of the locations of French vessels wrecked

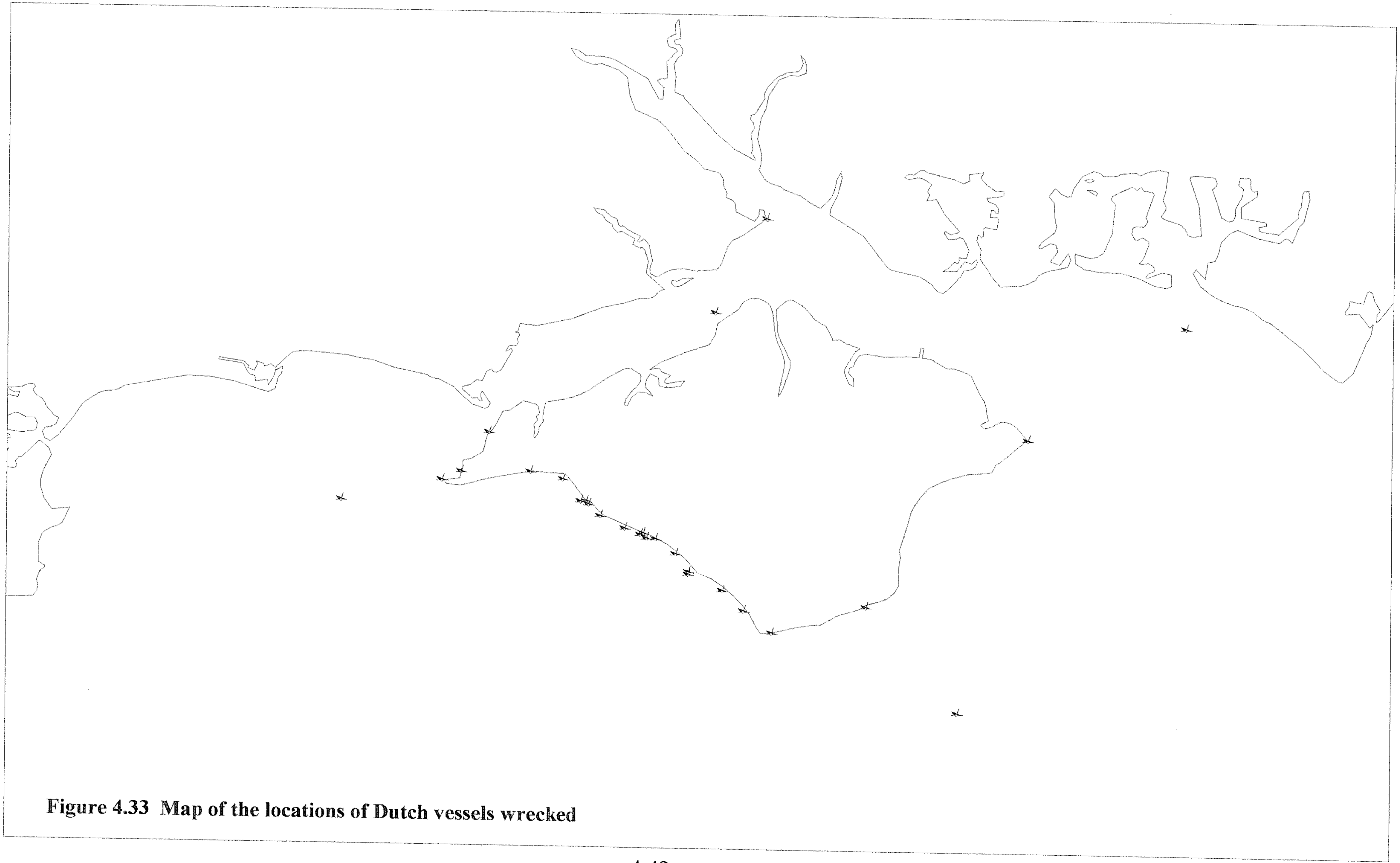


Figure 4.33 Map of the locations of Dutch vessels wrecked

Figure 4.34 Map of the locations of Spanish vessels wrecked

Figure 4.35 Map of the locations of German vessels wrecked

Figure 4.36 Map of the locations of Swedish vessels wrecked

Figure 4.37 Map of the locations of Norwegian vessels wrecked

vessels. Of 132 shipwrecks the nationality of 63 is known. The first nationality of a shipwreck is not recorded until 1304 and there is a gap between 1711 and 1740 even though there is a reasonably regular recording of shipwrecks from about the end of the of sixteenth century. The numbers of shipwrecks for each of the nationalities recorded for the pre 1740 period are detailed in table 4.12 above.

4.5 Ports of Departure and Destination

The details on a total sample of 762 of the vessels wrecked provide the ports of departure and/or destination. For 174 only one of these is named. Of the sample, 564 (74%) of the vessels were sailing either to or from, or via, a British Isles port and of these 259 (45.9%, 34% of total sample) were sailing to or from ports in the study area. 243 of the vessels, (43.1%, 31.9% of the total sample), were making coastal voyages around the British Isles (not including the Channel Islands), 63 (25.9%) of which were sailing either to or from London. Another 82 (33.7%) of that total, (10.8% of the total sample), were sailing locally to and from ports entirely within the study area. A total of 30 of the vessels (3.9% of the total sample) were sailing to or from the Channel Islands, 10 (33.3%) of which, to or from ports in the study area and 12 (40.0%) to or from London. In total 141 (18.5%) of the wrecked vessels had been sailing to London, 102 (72.3%) of which were from overseas ports. Another 69 (9.1% of the total sample) were sailing from London, 45 (65.2%) of which were to overseas destinations.

Table 4.13 - Numbers of Wrecks from Ports of Departure and/or to Destination Outside the English Channel

Area of the World	Total	To	From
European Atlantic	137	41	96
Mediterranean	50	10	40
Caribbean	56	23	33
USA	43	12	31
South/Central America	21	9	12
Africa, Far East, Australasia	25	14	11
Canada	11	3	8
Totals	343	112	231

Figure 4.38 Map of the locations of shipwrecks in the Local subgroup

The numbers of the vessels wrecked which had been sailing to or from ports outside the English Channel are shown in Table 4.13 above.

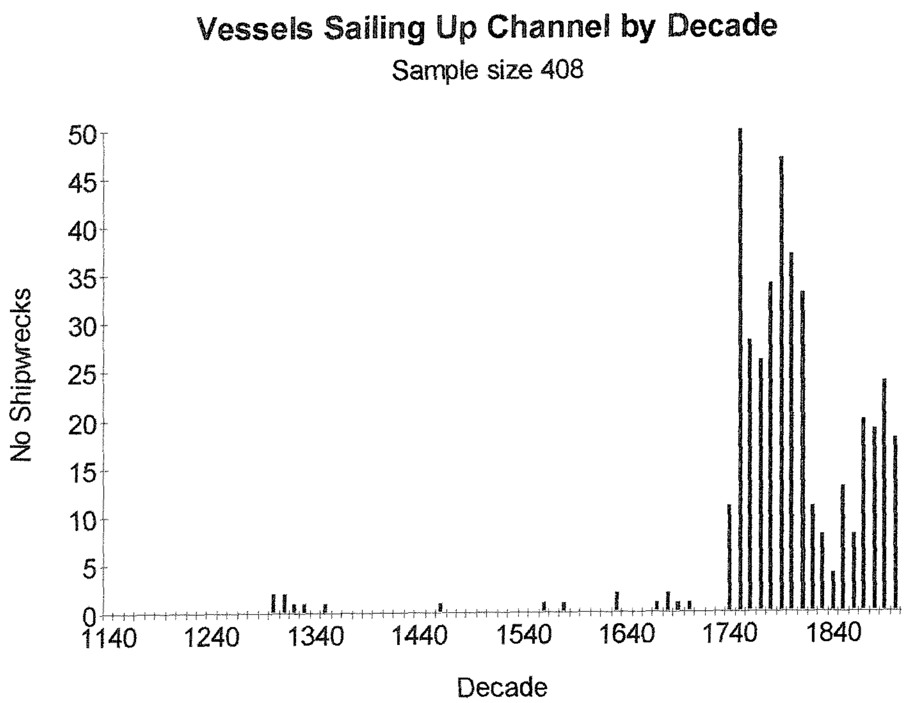


Figure 4.39 Numbers of shipwrecks in the Up Channel subgroup by decade

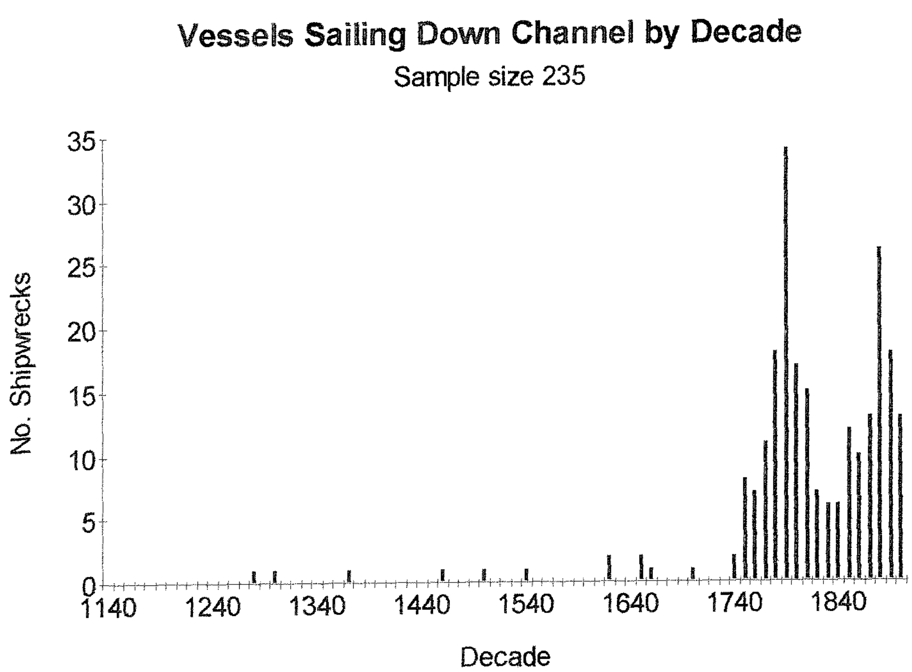


Figure 4.40 Numbers of shipwrecks in the Down Channel subgroup by decade

A further 34 of the vessels were sailing to or from ports across the North Sea, 13 to and 17 from ports in the British Isles. In total 408 of the vessels were sailing up the English Channel and 235 sailing down the English Channel.

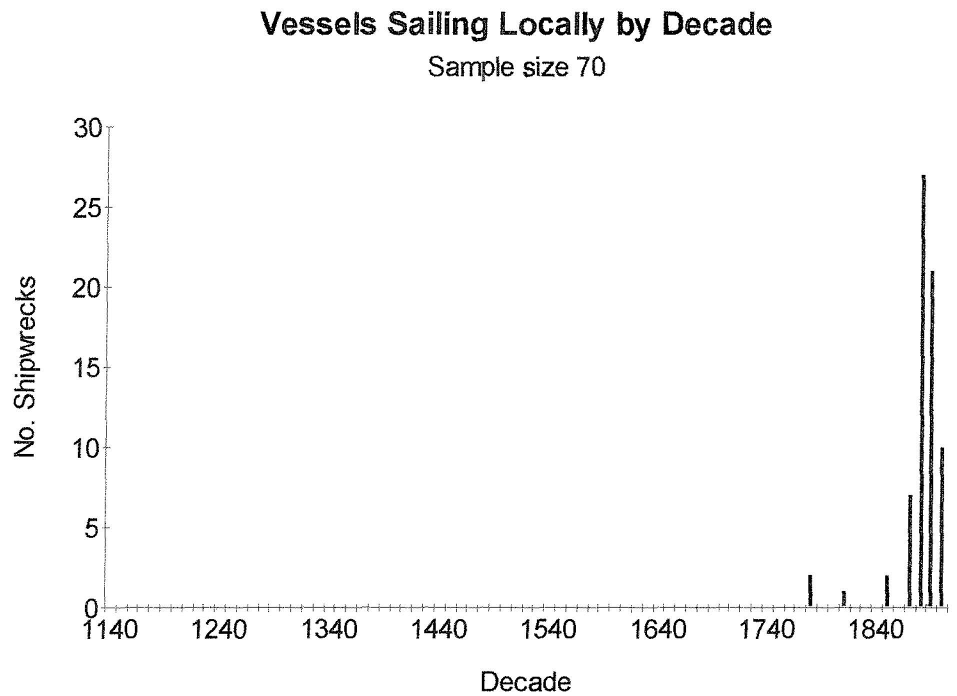


Figure 4.41 Numbers of shipwrecks in the Local subgroup by decade

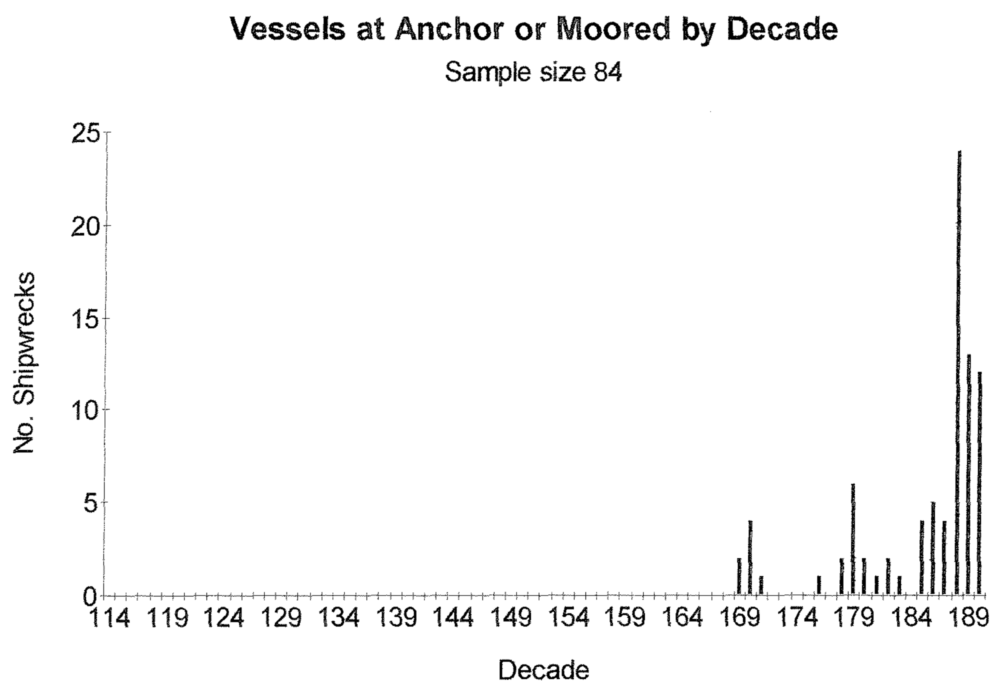


Figure 4.42 Numbers of vessels wrecked while at anchor or moored

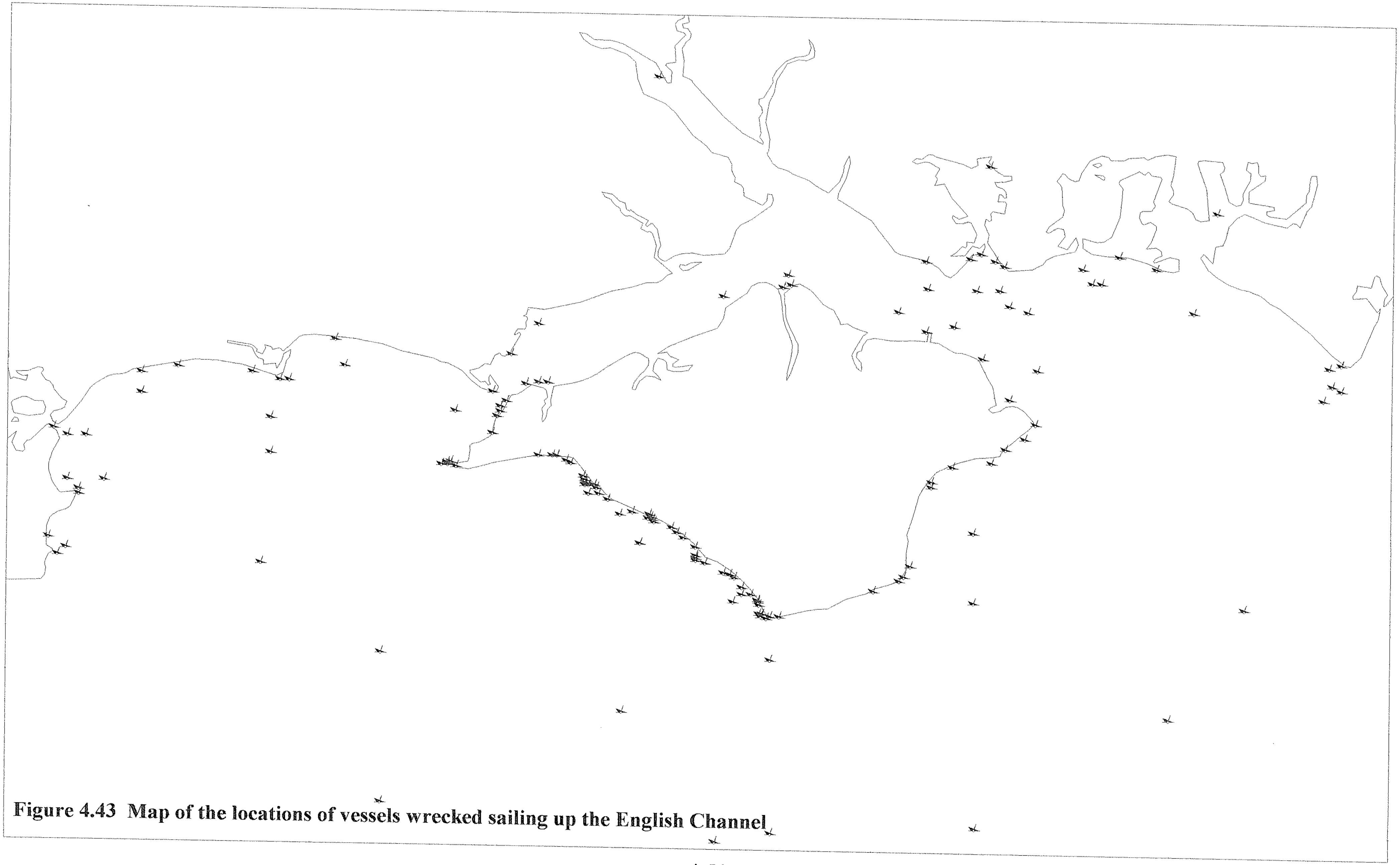


Figure 4.43 Map of the locations of vessels wrecked sailing up the English Channel

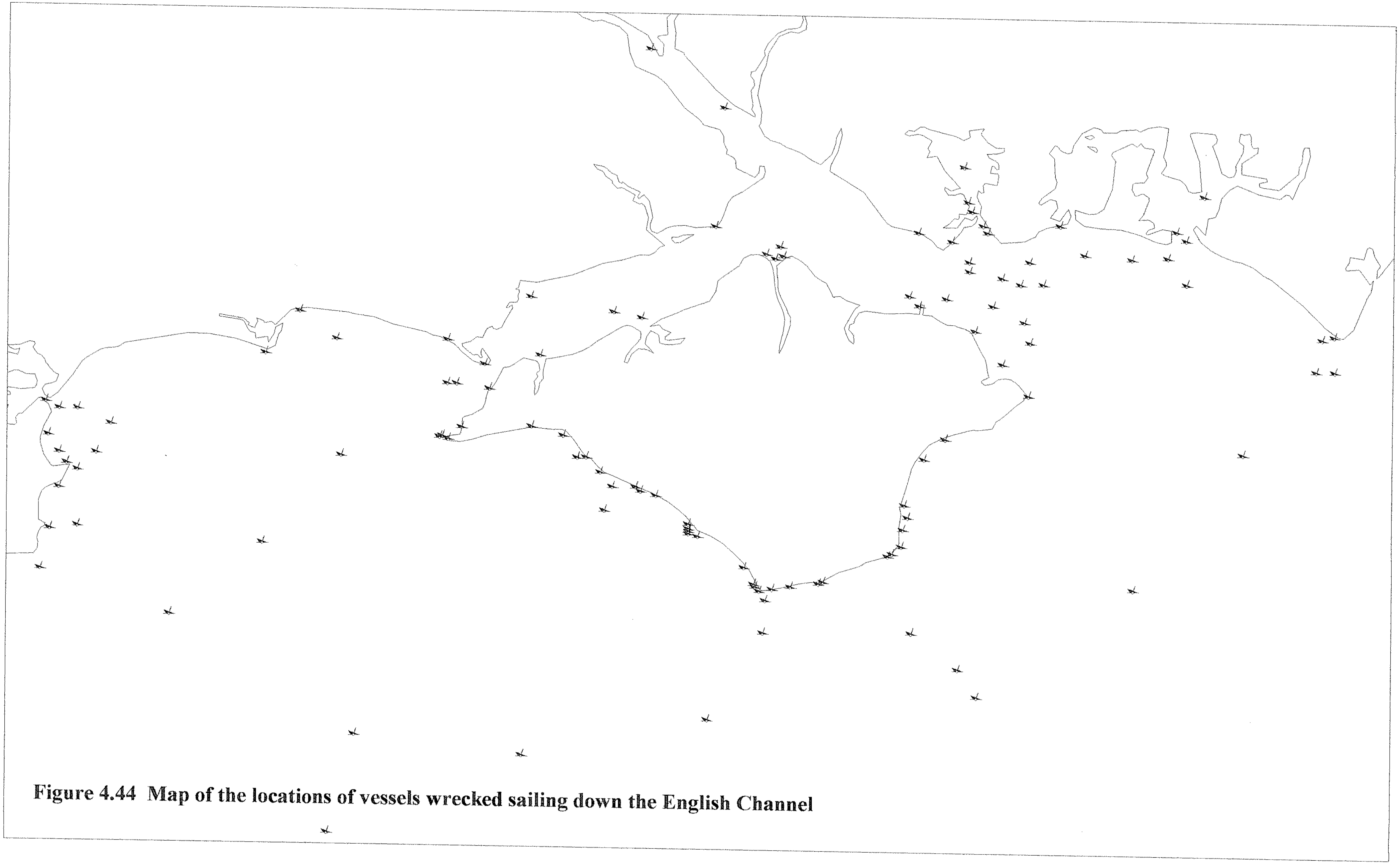


Figure 4.44 Map of the locations of vessels wrecked sailing down the English Channel

Figure 4.45 Map of the locations of vessels wrecked when coming to anchor, at anchor or moored

Table 4.14 - Average Frequency per year (%) of Shipwrecks for the Subgroups plus Anchored or Moored Within the Study Area

Movement	Overall Average	Post 1740 Average	1st Mention Average
Coastal	0.39	1.77	0.49
Overseas	0.59	2.70	0.73
Up Channel	0.53	2.30	0.67
Down Channel	0.30	1.31	0.37
Local	0.09	0.41	0.55
Anchored/Moored	0.07	0.26	0.24

The comparison of the average frequency of vessels being wrecked sailing up or down the English Channel, sailing to and from ports within the study area and while at anchor or moored within the study area is shown in Table 4.14. It also shows the comparison between the average for the overall time scale for the study, the average for 1740 onwards and the average from the first date of reference to vessels in each category. The distributions of all four of the categories are skewed towards the later dates and multi-modal. The mode for all categories is zero.

4.6 Cargoes Carried

The wreck reports provide details of the cargoes carried by 600 of the wrecks. The most frequently mentioned commodities are listed in Table 4.15. These figures cannot be taken as an indication of the relative importance in British trade of the commodities listed, but they may indicate the structure of trade that used the English Channel trade route. The date divisions are arbitrary, but have been chosen to try to provide an indication of changing trade patterns post 1739. Up to and including 1739 the cargoes of 27 shipwrecks were recorded. From 1740 to 1800 the number was 176, from 1801 to 1850 the number was 49 and from 1851 to 1909 the number was 333. Chapter 2 discusses the problems with the availability of information on shipwrecks, but the variance in the numbers of vessels for which details of their cargo are available, perhaps, reinforces this assertion. The relatively high number for the period 1740 to 1800, compared with the preceding and following periods is most likely a result of the recording of 130 shipwrecks on the 'Back of Wight' between 1746 and 1808 by James Wheeler (Mew, 1974:51-62).

Table 4.15 - Cargoes Most Frequently Carried

Commodity	No. of Wrecks				
	Total	1140-1739	1740-1800	1801-1850	1851-1909
Coal	67	-	8	11	48
Wine	56	12	38	6	-
Timber	45	1	20	6	18
Stone/Slate/Bricks	43	-	6	5	32
Fruit & Nuts	36	1	24	6	5
Salt	36	-	20	4	12
Grain/Flour	35	3	7	3	22
Metal/Manuf. Goods	32	4	7	6	15
Bale Goods/Wool/ Cotton/Cloth/Silk	30	4	20	2	4
Alcoholic Spirits	29	2	18	7	2
Clay/Chalk	27	-	2	-	25
General	24	5	5	-	12
Sand/Shingle/Cement	21	-	-	-	21
Meat/Fish/Vegetables	22	-	9	4	9
Oil/Petrol	20	1	11	1	7
Sugar	17	-	12	3	2
Silver/Gold/Money/ Species	13	7	5	-	1
Troops/Weapons/ Explosives/Gvmt. & Naval Stores	13	2	6	1	4
Tobacco	13	-	11	1	1
Hides/Skins/Leather	12	2	7	2	1
Butter	7	-	4	3	-
Spices	9	-	4	2	2

4.7 Age of Vessels

The records of a sample of 295 of the vessels wrecked provide the date they were built. The age profile of this sample is as shown in Figure 4.46 below. The span of the age range is considerable with the youngest being wrecked in the same year as being built and the oldest after 94 years of service. The distribution is skewed towards the youngest ages. The distribution is multi-modal with the main mode of 14 at 3 years old. There are 12 shipwrecks for both 2 and 12 years old and 10 for the ages of less than 1 and 14 years. The mean is 22.13 years, the median 21 years.

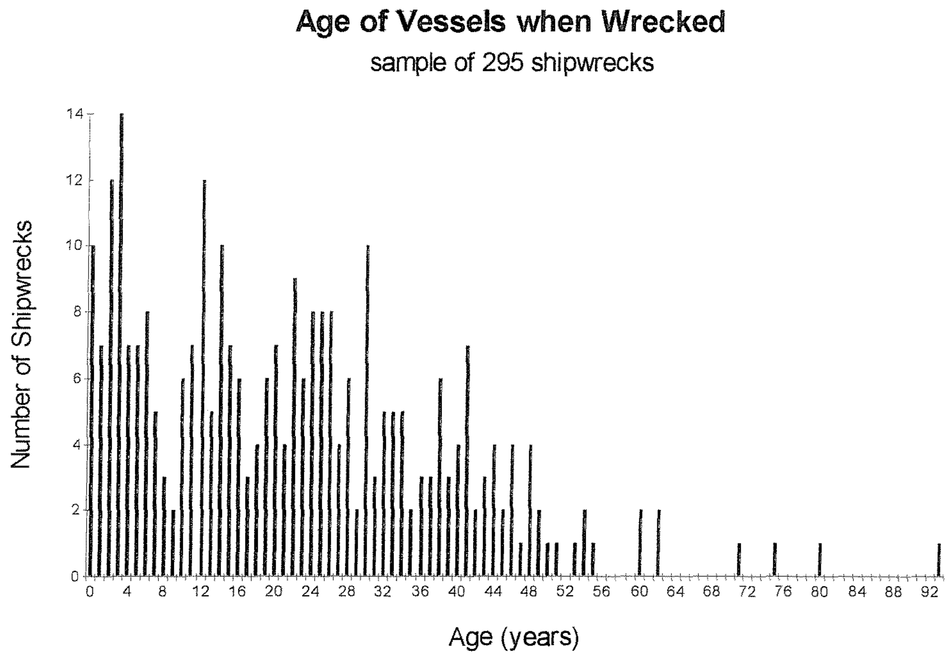


Figure 4.46 Age profile of vessels wrecked

The sample was analysed by dividing it over the same time periods as those used in section 4.6 above. The distribution of the sample over time is very much skewed to the later dates. The sample has therefore been analysed over two time periods, up to 1850 (Figure 4.47) and 1851 to 1909 (Figure 4.48). Even so the number of shipwrecks in each time period is still very unbalanced with 44 in the first period and 249 in the later period. The results of this analysis should therefore be treated with caution.

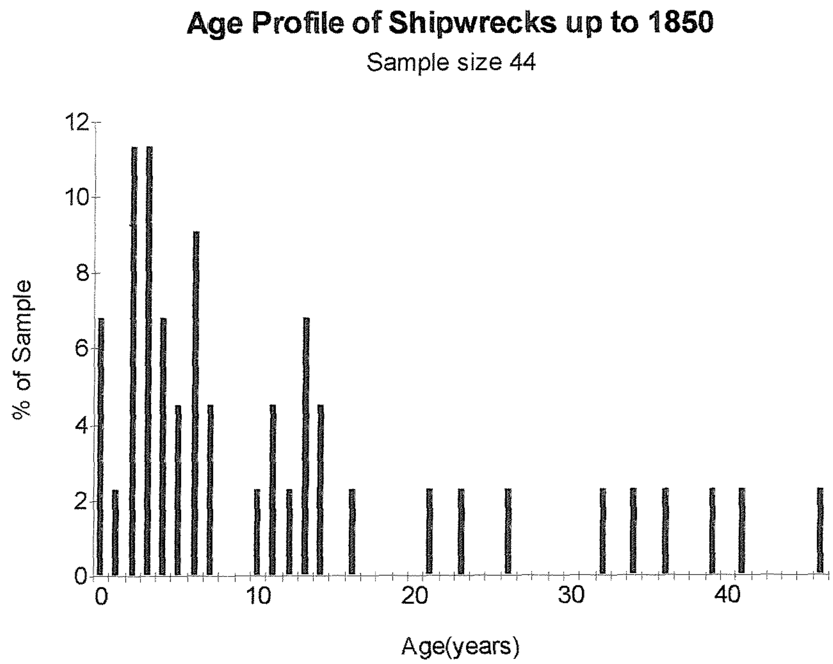


Figure 4.47 Age profile of vessels wrecked prior to 1850

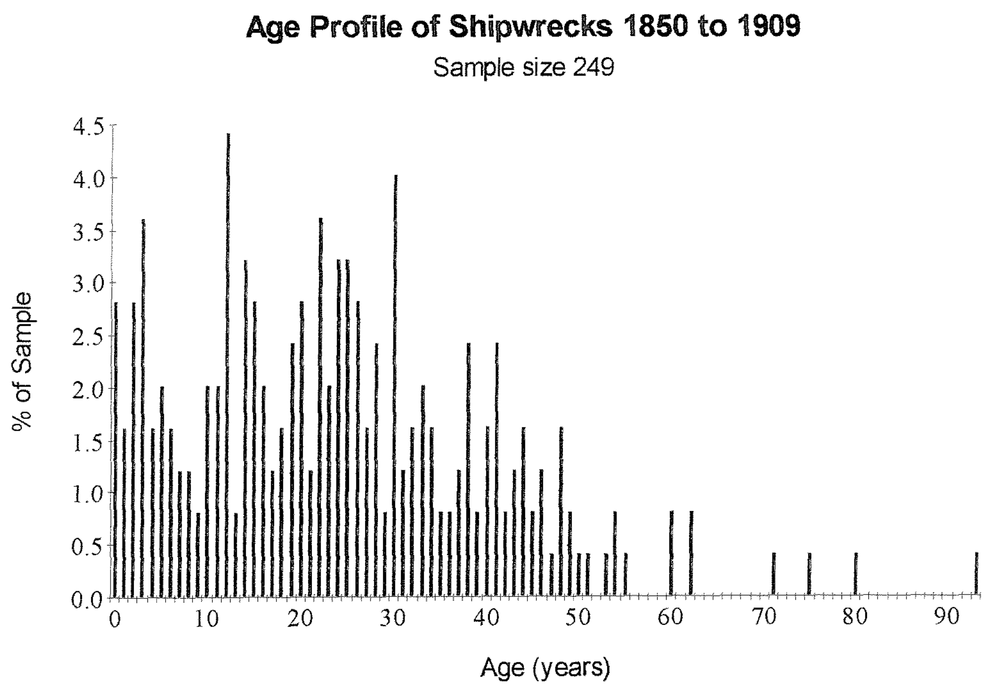


Figure 4.48 Age profile of vessels wrecked 1851 to 1909

Figure 4.49 Map of the locations of wrecked vessels up to and including 5 years old

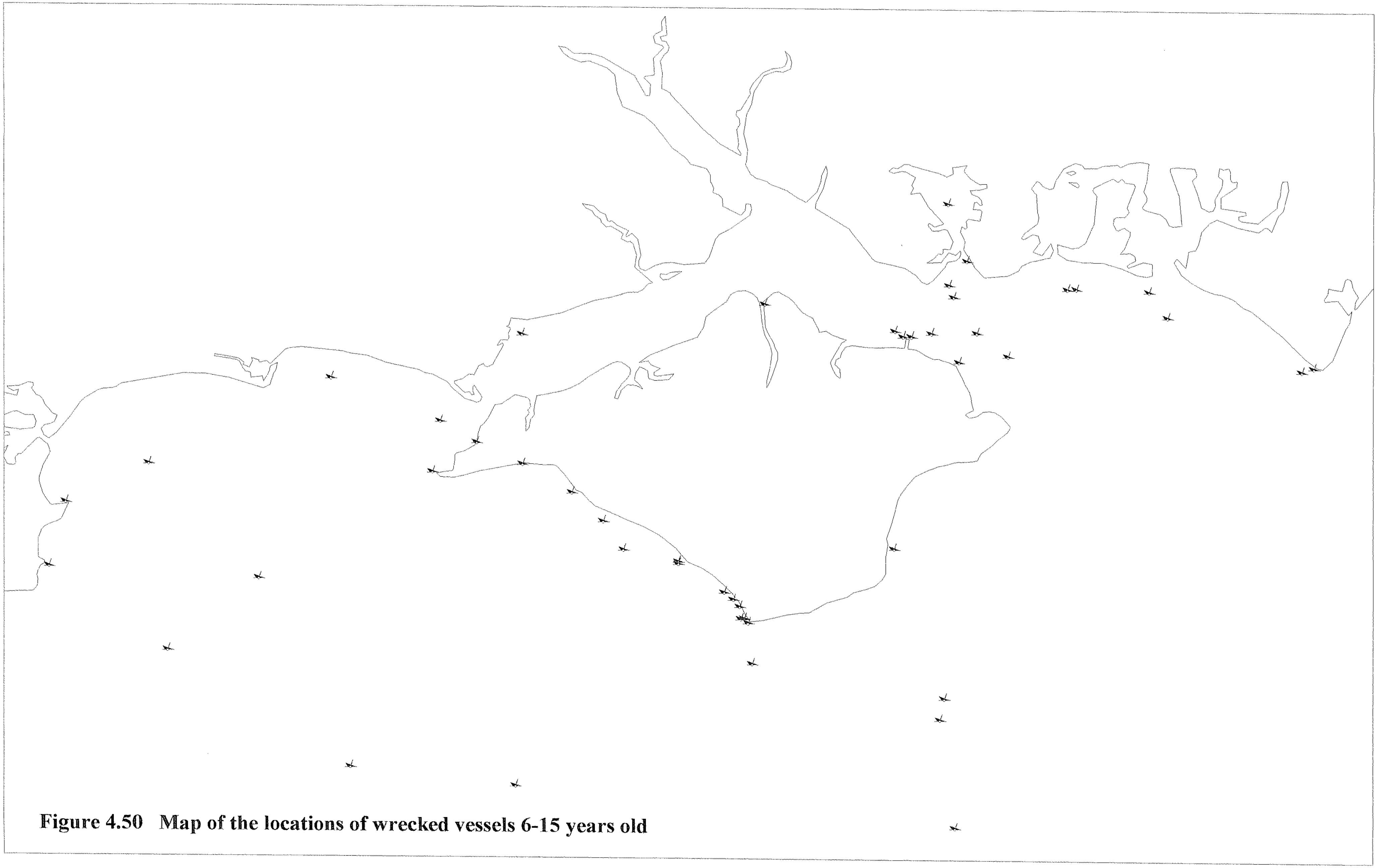


Figure 4.50 Map of the locations of wrecked vessels 6-15 years old

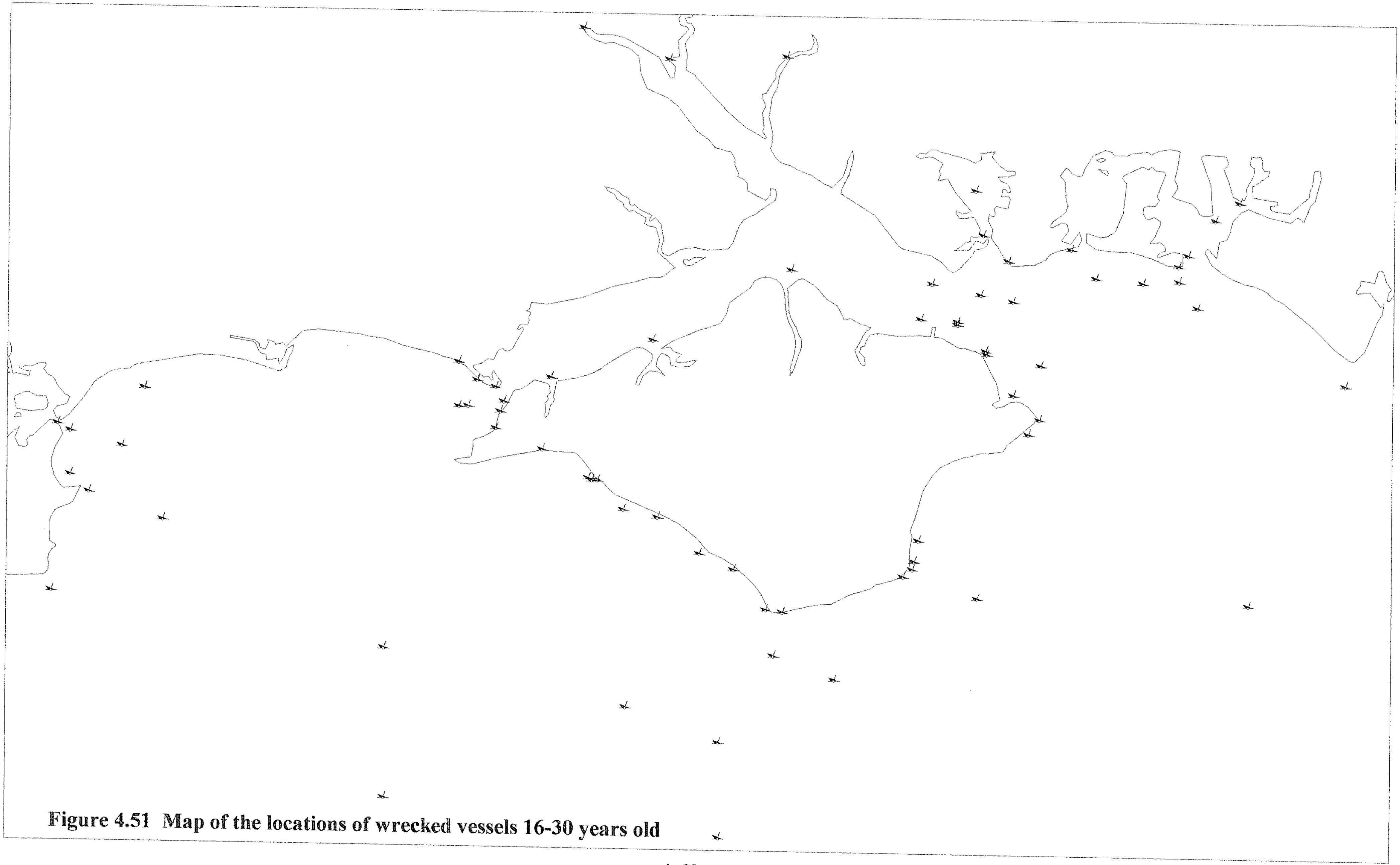


Figure 4.51 Map of the locations of wrecked vessels 16-30 years old

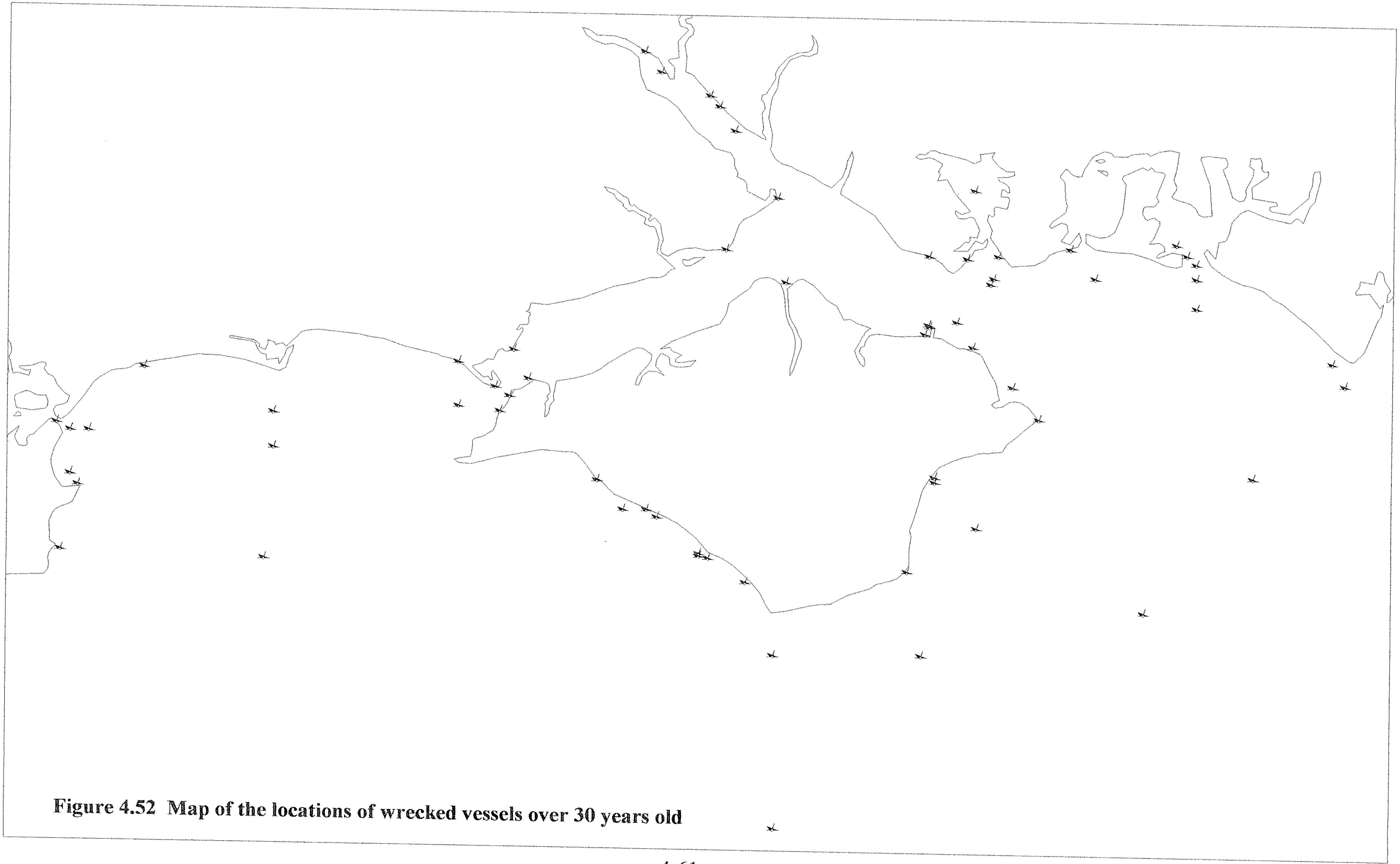


Figure 4.52 Map of the locations of wrecked vessels over 30 years old

The two distributions are skewed towards the younger ages. While the age profile for the period 1851 to 1909 is very similar to that for the whole sample. The earlier period shows a much younger profile. The mean age of the vessels wrecked in the earlier time period is 11.61 years, the median is between 5 and 6 years and there are dual modes at 2 and 3 years. The mean for the later period is 24.16 years, with a median of 23 years and a mode of 11 years. To emphasise the difference the mean for the period 1801 to 1850 is 14.09 years and the median 10 years.

The maps of the locations of the vessels wrecked in the different age groups (Figures 4.49 to 4.52) show very little difference in the distributions of those shipwrecks. The only noticeable difference being the lower proportions of vessels up to 5 years old which foundered in open water. The percentage of vessels for each of the subgroups by age groups is detailed in Table 4.16. This analysis shows a trend for younger vessels in overseas trade and older vessels in coastal trade.

Table 4.16 – Number of Vessels (%) Wrecked in each Subgroup by Age Group

	0-5 Years	6-15 Years	16-30 Years	30+ Years
Coastal	10.17	16.10	33.05	40.68
Overseas	21.93	23.68	32.46	21.93
Up Channel	14.13	25.00	27.17	33.70
Down Channel	20.24	17.86	34.52	27.38
Local	10.00	20.00	40.00	30.00

4.8 Size of Vessels

The reports on a sample of 189 of the vessels wrecked provide the tonnage of those vessels. The details shown below use the reported tonnage and no attempt has been made to standardise the measurements. They are therefore, probably, a mixture of the various measurements used during the time period covered by this study, from the original tuns of wine to the modern registered tonnage. In addition the tonnage normally quoted for merchant vessels is a measurement of the weight of cargo they can carry while for warships it is the displacement tonnage (Kemp, 1976:876). Yachts may be quoted in Thames Measurement tonnage that was introduced in 1855.

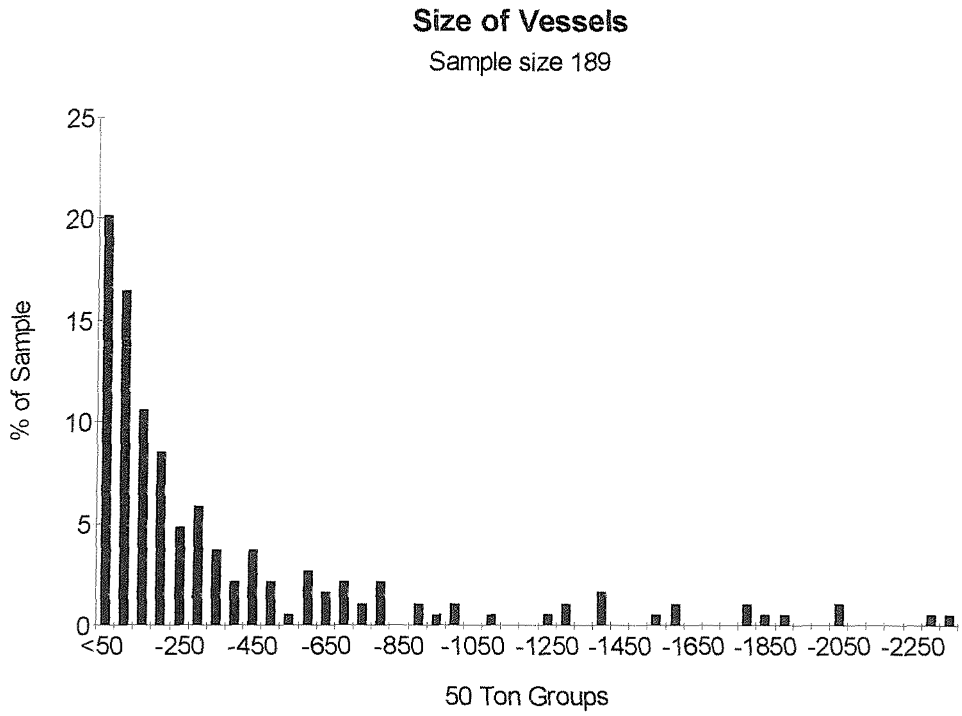


Figure 4.53 Size of Vessels

The graph above (Figure 4.53), shows the distribution of the wrecks by tonnage in bands of 50 ton increments from > 50 tons up to 2350 tons. The range is 1 - 2347 tons and the mean 367.47 tons. The distribution is skewed towards the lower tonnage with a median is only 170 tons. This distribution may possibly be specific to the study area. The high percentage of vessels under 50 tons is probably accounted for by the single event in 1881 when twelve 3-4 ton fishing vessels were wrecked on Selsey Bill beach and the presence of large numbers of small yachts in the Solent area, of which at least nine were wrecked. In addition the location of Portsmouth, a major naval base and collection point for convoys, possibly accounts for the long tail towards the higher tonnages. Of the fifty-three vessels over 650 tons eleven are warships. Prior to 1858 all six vessels over 1,000 tons are warships. From 1858, there are eight full-rigged ships, two barques, one schooner and one bulk ore carrier, but no warships, which may be due to the rapid introduction of steam from about the middle of the nineteenth century (Archibald, 1987:75-76, 82-83,90-91). The long tail towards the high tonnage is an indication of the introduction of larger iron and steel constructed vessels and the large fully rigged ships.

Figure 4.54 Map of the locations of wrecked vessels up to 100 tons

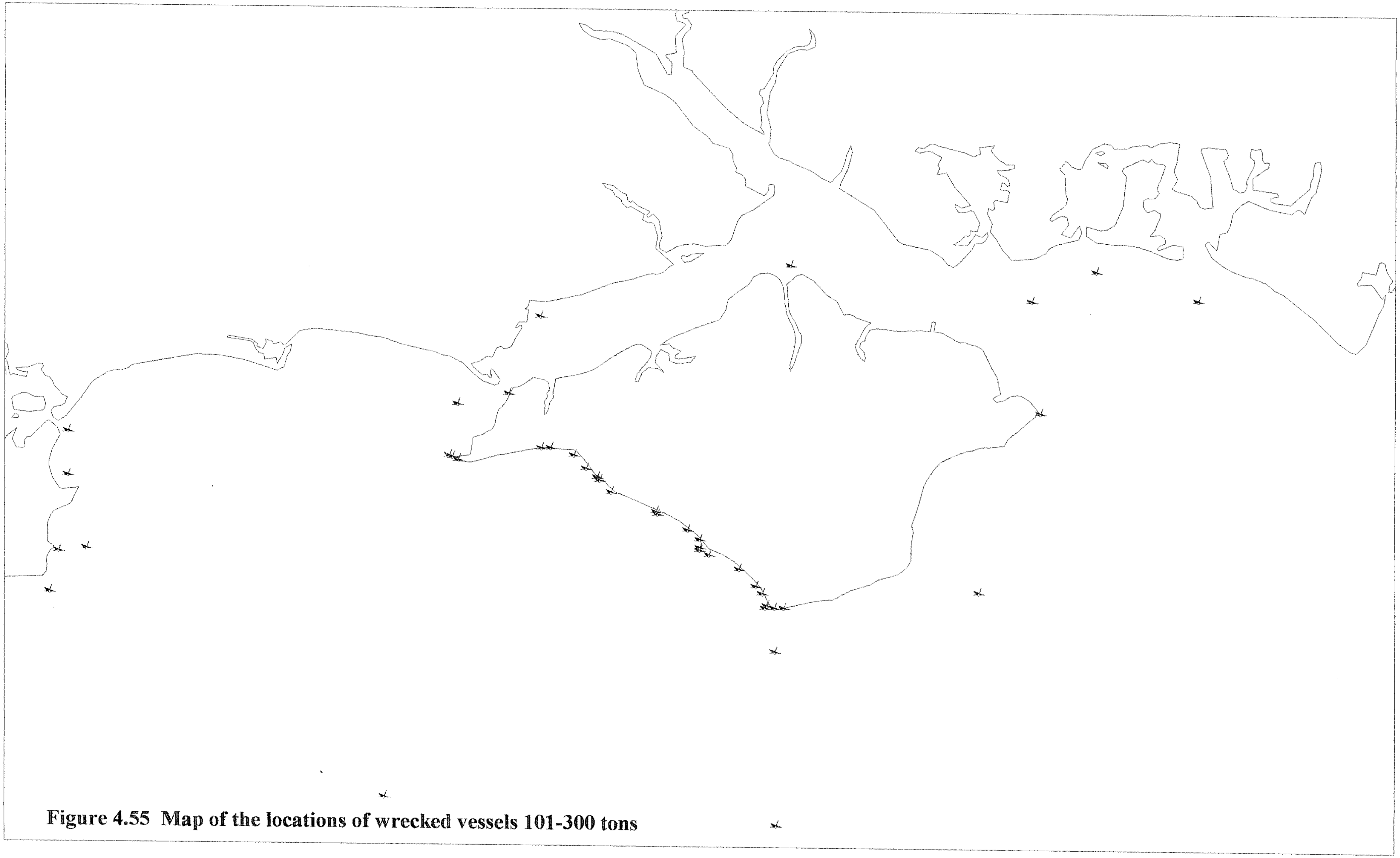


Figure 4.55 Map of the locations of wrecked vessels 101-300 tons

Figure 4.56 Map of the locations of wrecked vessels 301-600 tons

Figure 4.57 Map of the locations of wrecked vessels over 600 tons

The numbers in each of the size groups are too small for reliable statistical analysis. The maps, Figures 4.54 to 4.57, show similar distributions of location for the four size groups. There is a concentration of vessels up to 100 tons in Poole Bay, at the entrance to Poole Harbour, in Studland Bay and off Handfast Point all but two vessels were coastal, the vast majority sailing to or from ports in the study area. About a third were sailing to or from Poole. The over 600 tons group has a small concentration of shipwrecks off Portsmouth which are all warships.

The size profile of the vessels wrecked over time is shown in Table 4.17 below. The first vessel for which the tonnage is recorded was wrecked in 1420. This table shows the increase in the size of vessels over time and possibly also the change in the recording of maritime disasters to include the smaller vessels.

4.9 Types of Vessel

The records of 633 of the vessels wrecked identified them by type and/or by function. The tables below, 4.18 and 4.19 use the descriptions from the historic records and do not take account of the changes that occurred to vessels of a given name type. For example the term 'Brig' was originally used as an abbreviation for Brigantine, but later became a particular type of vessel. The date of the earliest of these records is 1407.

4.10 Weather

Reports on 417 of the shipwrecks on the database provided data on the weather conditions at the time of the wrecking. Of these, 388 gave details of the strength of the wind and 276 the wind direction. Details on visibility or precipitation were given for 47 of the shipwrecks. The first report using the Beaufort Scale was for a vessel wrecked on the 8th January 1851. Before that date, and for the reports after that date which do not use the Beaufort Scale, the strength of the wind is usually described in similar terminology to that used in the Beaufort Scale definitions for these the Beaufort Scale wind strength numbers have been interpreted. Table 4.20 details the number of shipwrecks for each Beaufort Scale wind strength.

Table 4.17 – Size of Vessels by Decade

Tonnage	Total																																																			
0-49	38																																					2		1	1					1		1	3	21	7	1
50-99	24																																				1	1	3		4			2		1	1	1	2	4	1	3
100-149	25																																				1	3		2					2	1	1	3	1	2	5	4
150-199	12																																				2	2	1		2				2			1			1	1
200-249	14																																				1	2	3								1			3	2	2
250-299	7																																						3									2			2	
300-349	11																							2															2	1						1	1	1		1	1	1
350-399	2																																							1										1		
400-449	9			1																																				1		1			1					1	3	1
450-499	1																																												1							
500-549	4			1																																	1											1	1			
550-599	4																																								1			1						2		
600-649	5																																								1	1					1	1	1			
650-699	3																														1																	1	1			
700-749	2															1																																1			
750-799	3																																							1										1		1
800-849	2																																							1								1				
850-899	1																															1																				
900-949	2																																							1									1			
950-999	1																			1																																
1000-1049	1																																								1											
1050-1099	1																																										1									
1100-1149	0																																																			
1150-1199	0																																																			
1200-1249	1																																																1			
1250-1299	2																																																1		1	
1300-1349	0																																																			
1350-1399	2																																																			2
1400-1449	1				1																																															
1450-1449	0																																																			
1500-1549	1																																																	1		
1550-1599	2																																																	1	1	
1600-1649	0																																																			
1650-1699	0																																																			
1700-1749	0																																																			
1750-1799	1																																				1															
1800-1849	2																																														2					
1850-1899	1																																								1											
1900-1949	0																																																			
1950-1990	0																																																			
2000-2049	2																																							1	1											
2050-2099	0																																																			
2100-2149	0																																																			
2150-2199	0																																																			
2200-2249	0																																																			
2250-2299	1																																																	1		
2300-2349	1																																																		1	
Years	1400					1450					1500					1550					1600					1650					1700					1750					1800					1850					1900	

Table 4.18 – Types of Vessel by Decade

Vessel Type	Total																																																			
Schooner	78																												1										1		1	2	2		1	1	12	13	6	15	12	11
Brig	76																																				6	2	1	10	13	7	2	1	4	2	3	9	8	4	3	1
Ketch	47																																				1										1		3	11	22	9
Sloop	46																																			1	10	2	1	6	5	6	1	3	1	2	2	1	3		1	1
Cutter	43																																					2	1	3	3			1			1	1	1	9	6	15
Barque	43																	1																												2	7	7	9	9	4	4
Smack	29																																									1		1		2		2	5	10	5	3
Brigantine	29																														1						2		1	1							2	4	3	5	8	2
Snow	26																																				14	2	2		1					3	1	1	2			
Barge	18																																													1		1		1	7	2	6
Galliot	15																																				3	5	1	2		1	2		1							
Yawl	12																																																	7	2	3
Carrack	13	2	4	2				1								1		1		2																																
Lugger	10																																						1			1						1	2	2	1	2
Full-Rigged Ship	11																																													1		3		1	5	1	
Yacht	9																																																1		4	3	1
Hoy	6																																								4	2										
Dandy	4																																																			2	2
Dogger	3																																				3															
Balinger	2		2																																																	
Shallop	2																																				2															
Galliot-Hoy	2																																				1		1													
Chasse-Maree	2																																															2					
Billyboy	1																																															1					
Fly Boat	1																															1																				
Gallyeasse	1																																			1																
Frigate	2																																							1			1									
Wherry	1																																																	1		
Years		'1400					'1450					'1500					'1550					'1600					'1650					'1700					'1750					'1800					'1850				'1900	

Table 4.19 - Types of Vessel Function by Decade

Vessel Function	Total																																																				
Man o'War	37				1											1											2	1		2	4	7	1				2			3	5	2	2	2	1				1			
Transport	28																																							1	4	6	15	2									
Fishing	28																																														1		3	17	3	4
East Indiaman	7																							2												1				1	2			1								
Collier	7																																				1				2	2						1		1		
West Indiaman	5																																						1		2	1	1									
Liquified Gas Carrier	4																																																	4		
Pilot	3																																															1		1	1	
Bulk Ore Carrier	2																																																1		1	
Privateer	2																																			1		1														
Troopship	1																																										1									
Packet	1																																									1										
Fleet Messenger Vessel	1																																														1					
Revenue Cutter	1																																							1												
Prison Hulk	1																																									1										
Coaster	1																																						1													
Kings Cutter	1																																							1												
Gunboat	1																																								1											
Years		'1400					'1450					'1500					'1550					'1600					'1650					'1700					'1750					'1800					'1850					'19

The numbers (%) of vessels wrecked in the different Beaufort Scale winds are detailed for the five subgroups in Table 4.21 below.

Table 4.20 – Numbers of Vessels Wrecked in Reported Beaufort Scale Winds

Description	Beaufort Scale	No. of Wrecks
Hurricane	12	11
Violent Storm	11	16
Storm	10	82
Severe Gale	9	58
Gale	8	89
Near Gale	7	27
Strong Breeze	6	36
Fresh Breeze	5	26
Moderate Breeze	4	21
Gentle Breeze	3	5
Light Breeze	2	10
Light Air	1	4
Calm	0	3

The high proportion of Beaufort Scale 10 and 8, storm and gale force, winds may be due to the colloquial use of those words to describe strong wind situations.

Table 4.21 – Numbers (%) of Shipwrecks that Occurred at each Beaufort Scale by Subgroup

	Subgroup:	Coastal	Overseas	Up Chan.	Down Chan.	Local
Beaufort Scale	Sample Size:	129	126	101	85	46
12		0.00	3.97	4.95	0.00	0.00
11		3.10	3.17	1.98	7.06	0.00
10		10.85	12.70	8.91	15.29	8.70
9		12.40	17.46	13.86	22.35	4.35
8		13.95	28.57	30.69	20.00	6.52

7	10.08	8.73	5.94	10.59	13.04
6	17.05	9.52	13.86	5.88	21.74
5	12.40	5.56	6.93	9.41	15.22
4	10.85	5.56	7.92	5.88	15.22
3	1.55	2.38	1.98	1.18	4.35
2	3.88	1.59	2.97	1.18	2.17
1	1.55	0.79	0.00	1.18	4.35
0	2.33	0.00	0.00	0.00	4.35

The reports of the wind direction at the time of the vessels being wrecked provide a wind rose of 32 point of the compass. Table 4.22 details the percentage of shipwrecks for each of those compass points for the total of the 276 reports and also the five subgroups.

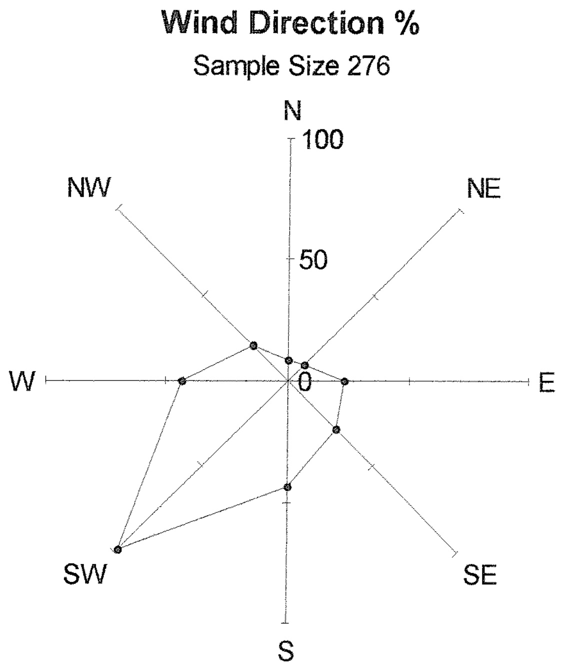


Figure 4.58 Frequency of wind direction from shipwreck reports

The 32-point wind rose is a little cumbersome, therefore to provide the more normally used 8 point wind rose in Figure 4.58 the wind directions were divided into 45° segments. The number of reports for directions on the 45° dividing lines have been divided equally between the segments on either side e.g. the number for NNE has been divided equally between north and north-east.

Table 4.22 – Number (%) of Shipwrecks that Occurred in each Subgroup by Wind Direction

Direction	Coastal	Overseas	Up Channel	Down Channel	Local	Total Database
N	0.88	0.00	0.00	0.00	2.50	0.72
N by E	0.00	1.01	0.00	1.41	0.00	0.36
NNE	1.75	2.02	1.22	1.41	2.50	1.45
NE by N	0.001	0.00	0.00	0.00	0.00	0.00
NE	4.39	0.00	2.44	2.82	2.50	2.17
NE by E	0.00	0.00	0.00	0.00	0.00	0.00
ENE	1.75	0.00	0.00	2.82	2.50	0.72
E by N	0.00	0.00	0.00	0.00	0.00	0.00
E	6.14	8.08	7.32	5.63	10.00	6.52
E by S	0.88	0.00	1.22	0.00	0.00	1.09
ESE	0.00	3.03	3.66	0.00	0.00	1.09
SE by E	0.00	1.01	1.22	0.00	0.00	0.36
SE	7.89	4.04	1.22	7.04	12.50	6.88
SE by S	0.00	1.01	1.22	0.00	0.00	0.36
SSE	3.51	4.04	4.88	1.41	7.50	4.35
S by E	0.88	1.01	1.22	1.41	0.00	0.72
S	6.14	12.12	10.98	9.86	2.50	9.78
S by W	0.00	0.00	0.00	0.00	0.00	0.00
SSW	9.65	6.06	7.32	11.27	5.00	6.16
SW by S	0.88	1.01	1.22	0.00	2.50	0.72
SW	21.05	32.32	31.71	23.94	20.00	24.64
SW by W	0.00	0.00	0.00	0.00	2.50	0.00
WSW	12.28	11.11	10.98	14.08	5.00	14.49
W by S	0.00	1.01	1.22	0.00	0.00	0.36
W	7.89	4.04	3.66	4.23	10.00	5.80
W by N	0.88	0.00	0.00	1.41	0.00	0.36
WNW	4.39	4.04	4.88	2.82	5.00	3.99
NW by W	0.00	0.00	0.00	0.00	0.00	0.00
NW	6.14	1.01	1.22	4.23	10.00	4.71
NW by N	0.00	0.00	0.00	0.00	0.00	0.00
NNW	2.63	1.01	1.22	4.23	0.00	1.81
N by W	0.00	1.01	0.00	1.41	0.00	0.36
Sample Size	**114**	**99**	**82**	**71**	**40**	**276**

4.11 Occurrence of Shipwrecks Relative to Tide Cycle

The number of wrecks that occurred on each day of the tide cycle varied (see Figure 4-59). The sample of 826 shipwrecks for which the date of wrecking was known provided a multi-modal distribution. The mean is 59.0 with a minimum of 45 one day before neaps and the maximum of 100 at springs.

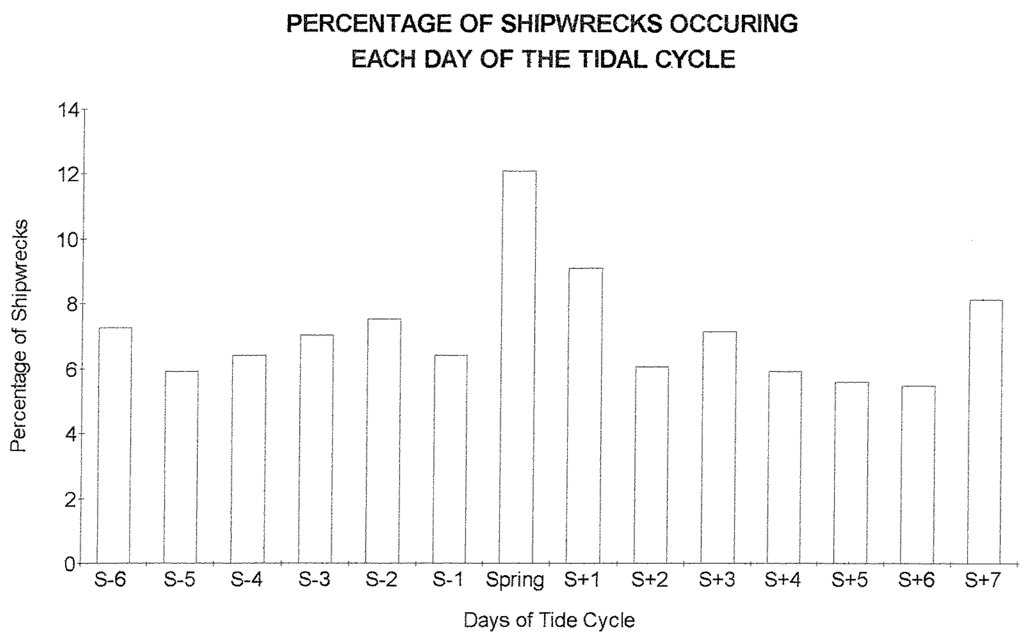


Figure 4.59 Percentage of shipwrecks occurring each day of the tidal cycle

The breakdown of the number of shipwrecks that occurred each day of the tidal cycle for the five subgroups is detailed in Table 4.23.

Table 4.23 – Numbers (%) of Shipwrecks each day of Tidal Cycle by Subgroup

Subgroups	Sample	S-6	S-5	S-4	S-3	S-2	S-1	S	S+1	S+2	S+3	S+4	S+5	S+6	S+7
Local Coastal	241	5.81	4.56	6.22	8.30	8.71	7.05	9.54	9.96	2.90	6.64	5.39	6.64	8.71	9.54
Overseas	346	7.51	7.51	6.65	7.23	5.49	5.78	15.03	5.49	4.34	10.12	6.94	4.62	3.76	9.54
Up Chan.	308	7.14	5.84	5.52	8.12	6.49	4.87	13.31	7.47	4.55	9.74	6.49	4.87	5.52	10.06
Down Chan.	176	8.52	6.82	5.68	7.39	7.95	6.25	14.20	5.11	2.84	7.39	8.52	4.55	5.11	9.66
Local	67	2.99	8.96	8.96	5.97	7.46	10.45	10.45	8.96	1.49	8.96	2.99	8.96	7.46	5.97
All Wrecks	826	7.26	5.93	6.41	7.02	7.51	6.42	12.1	9.07	6.05	7.14	5.93	5.56	5.45	8.11

The maps below show the locations of the vessels wrecked on each of the days of the tidal cycle.

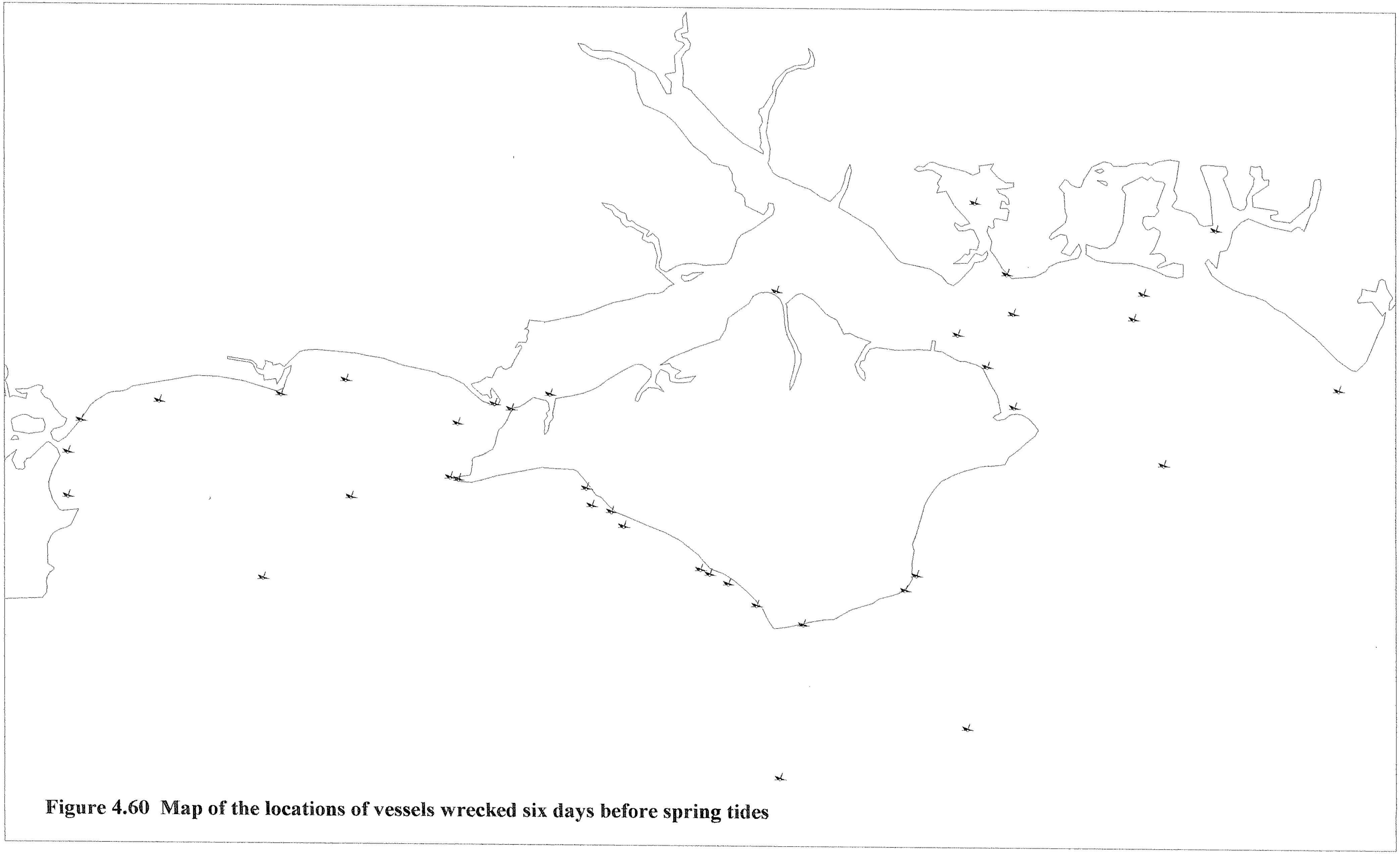


Figure 4.60 Map of the locations of vessels wrecked six days before spring tides

Figure 4.61 Map of the locations of vessels wrecked five days before spring tides

Figure 4.62 Map of the locations of vessels wrecked four days before spring tides

Figure 4.63 Map of the locations of vessels wrecked three days before spring tides

Figure 4.64 Map of the locations of vessels wrecked two days before spring tides

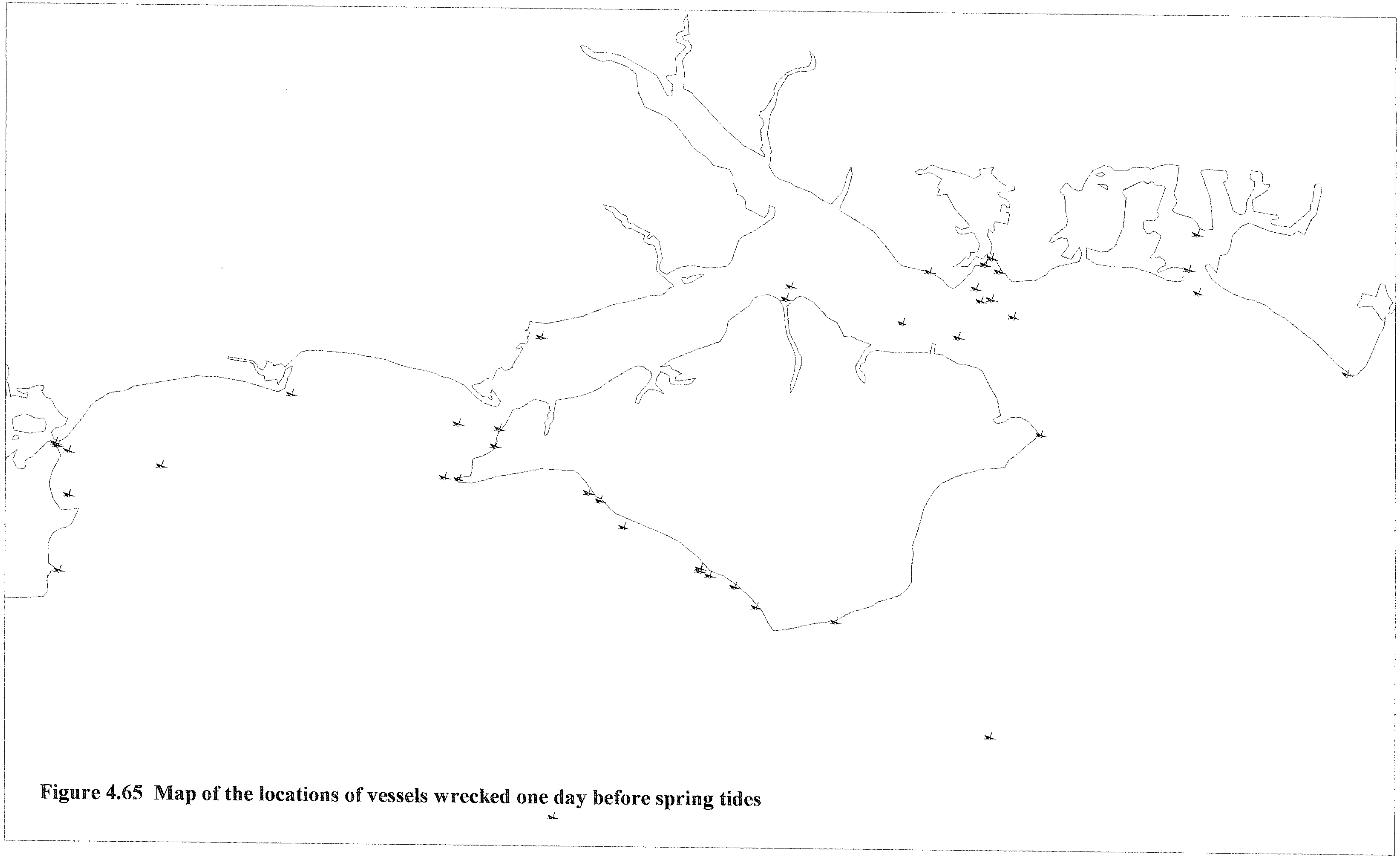


Figure 4.65 Map of the locations of vessels wrecked one day before spring tides

Figure 4.66 Map of the locations of vessels wrecked at spring tides

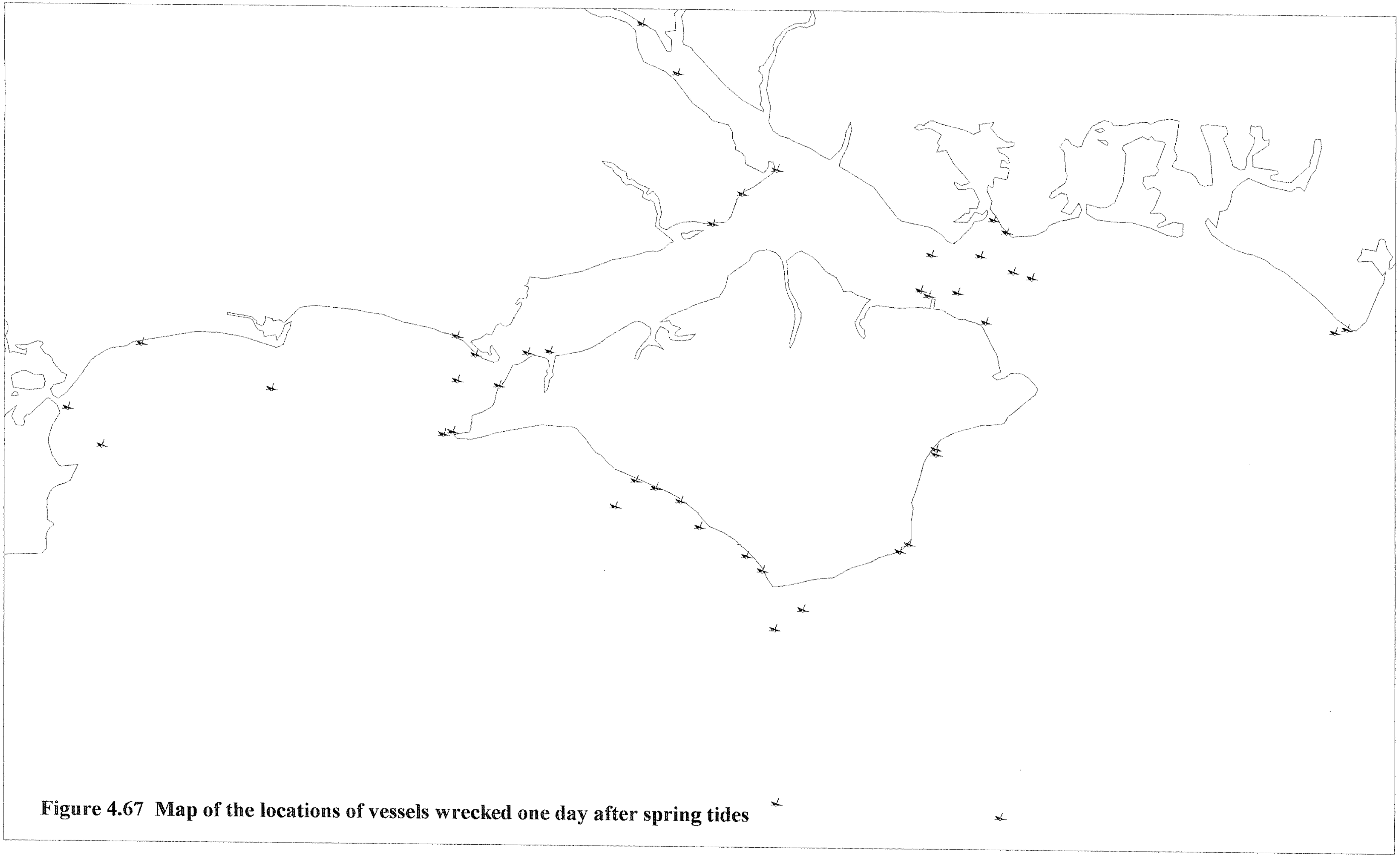


Figure 4.67 Map of the locations of vessels wrecked one day after spring tides

Figure 4.68 Map of the locations of vessels wrecked two days after spring tides

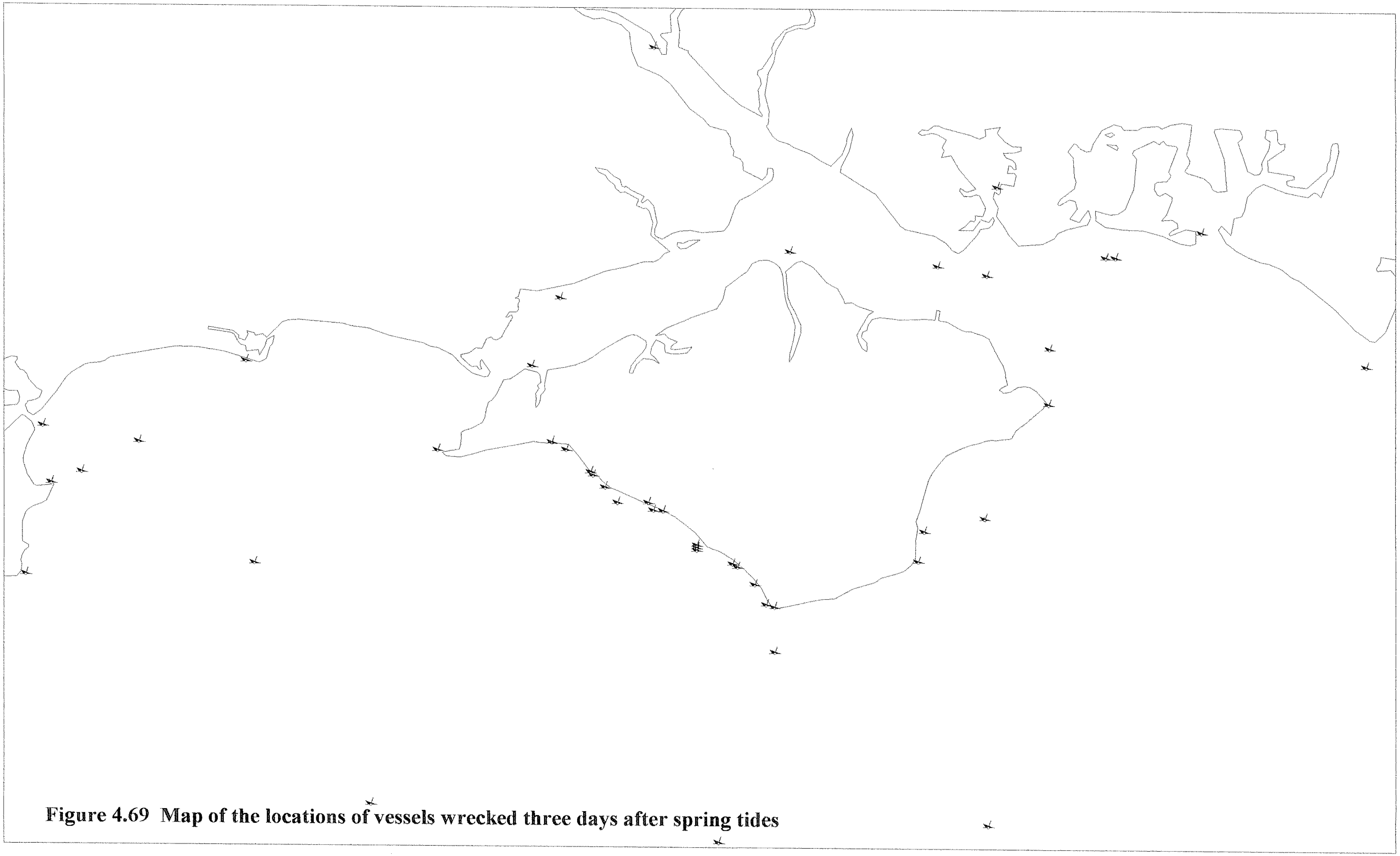


Figure 4.69 Map of the locations of vessels wrecked three days after spring tides

Figure 4.70 Map of the locations of vessels wrecked four days after spring tides

Figure 4.71 Map of the locations of vessels wrecked five days after spring tides

Figure 4.72 Map of the locations of vessels wrecked six days after spring tides

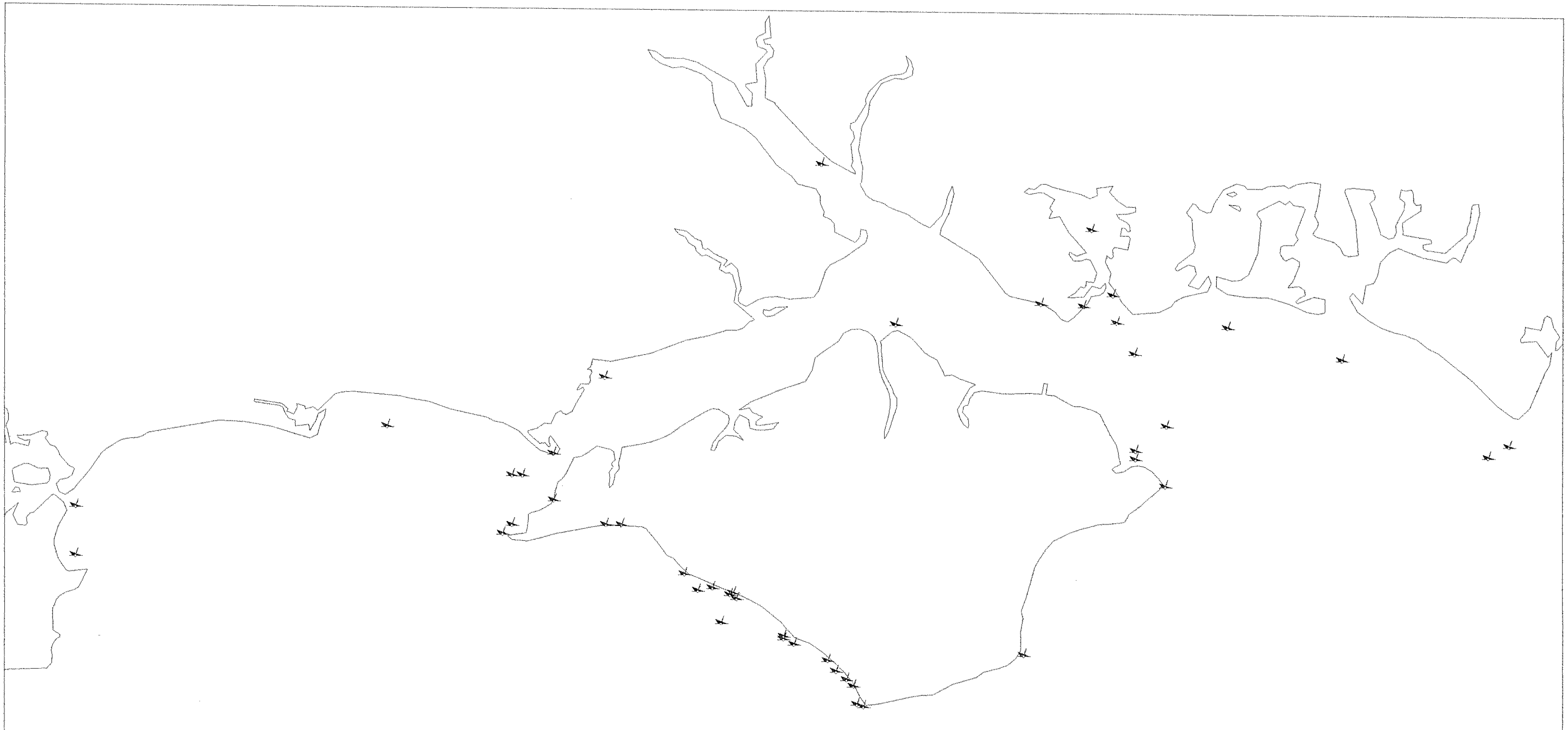


Figure 4.73 Map of the locations of vessels wrecked at neap tides

Chapter 5 - Trade Routes and Volumes

5.1 Introduction

The English Channel has long been a highway for traders ferrying goods along the coast, to and from the continent, and to and from the Mediterranean. McGrail (1987:fig 13.7) shows likely early trade routes with Hengistbury as a focus for the Solent area. These routes are similar to those that were still being used by the English and Hanseatic traders in the fourteenth and fifteenth centuries (Power & Postan, 1933:92). In the last 500 years the Channel has been a focus of trade to and from every corner of the world. The information from the shipwrecks themselves provides much of the detail. Maritime trade, operating the Solent and adjacent stretches of the English Channel, is the source of the vast majority of the shipwrecks lying in the Solent and around the Isle of Wight. Chapter 2 has discussed the difficulty in obtaining records of shipping and shipwrecks. It is therefore not feasible to accurately identify the number of ships sailing in the English Channel in historic times and another approach must be taken. This chapter investigates English maritime trade over the major part of the time scale covered by the shipwrecks identified on the database with the objective of providing a understanding of the volumes of shipping that would have sailed in and through the study area over time.

5.2 Overseas Trade

The mid-tenth century to the fourteenth century was a period of demographic and economic growth in northern Europe with increased trade and the need for larger ships (Unger, 1994:7). The political change caused by the Norman Conquest had tended to shift English trade in the direction of France with the focus of that trade moving down the English Channel (Steane, 1985:131). In the twelfth century the population was predominantly rural, but enough surpluses were being created to support the small urban population (Bolton, 1980:12 & 13). Cereals and wool were major commodity being produced. Southampton had become a major port with imports included wine, exotic foods, building materials and lead. Raw wool and cloth were the main exports, but other included ale, livestock and salted venison. By the late thirteenth century wool from about eight million sheep was being exported to the Flemish and Italian cloth industries. Tables of Southampton customs dues for *c* 1300 and for 1329 list a wide range of goods. They included wine, cider, beer, fish, animal skins, hides and furs, wool, wood, manufactured hardwares, cloth, minerals and metals, agricultural produce, spices and stone (Fulford, 1978:67). England was not a leading player in European trade, being more in the position of a source of raw materials for the more advance mainland centres (Minchinton, 1969:5).

The thirteenth century saw England become over populated causing a reduction in pasture for livestock as the use of land for arable farming expanded. This together with the unusual climatic instability that brought droughts, floods, storms and severe winters caused a decline in agricultural productivity (Platt, 1978:91-94). The reduction of the population caused by the series of plagues in the fourteenth century only caused to exacerbate the situation. The whole period was one of turmoil that must have affected trade adversely. There then followed a period of recovery and a renewed economic expansion led to increased trade and a greater importance for shipping and shipbuilding (Unger, 1994:7). Davis (1973:7) identifies the period 1475 to 1550 as one when England's sales of woollen cloth to established markets in Europe grew rapidly as prosperity increased. The Port Books of Southampton provide a detailed picture of the maritime trade in and out of Southampton in the late Middle Ages. At this time Southampton was the hub of a network to and from the Mediterranean and many parts of the British Isles. The Port Book for 1435-36 (Foster, 1963) in particular gives the names of the ports from which vessels entering Southampton came, while in addition those of 1439-40 (Cobb, 1961) and 1509-10 (James, 1990) provide details of the cargoes carried in and out of the port.

By the late Middle Ages England had become one of the foci of European trade (Bolton, 1980:289). Even though the English Channel was one of the primary sea routes not all of this trade would have passed through or near the study area. England's trading ranged from Iceland to the Mediterranean. The main market was the sale of wool and cloth to Flanders and the Low Countries for bullion or in exchange for raw materials, foodstuffs, manufactured goods, haberdashery and high quality cloths. There was significant trade with the Atlantic coast of Europe, cloth and grain were exchanged for wine with the English possessions in South-West France and with Spain and Portugal which provided iron ore, wool oil, soap, dyestuffs and citrus fruit. Florentine and Venetian galleys and Genoese carracks shipped wode, alum, dyestuffs, spices, high quality cloth and sweet wine to trade for English cloth, wool, tin and pewter (Bolton, 1980:287:289). Iceland was a source of fish, which was traded for foodstuffs, manufactured goods and cloth. The Hanse traders brought naval stores, hemp, pitch, tar, furs, flax, linen, mineral ores, potash and fish in exchange for cloth. English cloth was traded in the Rhineland for steel, metalware, manufactured goods and cheap fabrics. Finally there was more local trade across the Channel with Brittany and Normandy and between the West Coast ports and Ireland. Most of this trade was carried in foreign ships (Friel, 1995:131). English ships, mostly under 100 tons (Waters, 1958:7;Friel, 1995:181 & 183), were predominantly engaged in the home coastal trade, rarely entered the Baltic, or sailed as far as Madeira, the Canaries or the Azores, or into the Mediterranean.

As well as the decline in trade due to the effects of plague and climate there were period of expansion and contraction due mainly to politics and war (Bolton, 1980:289-292). Between 1460 and 1520 the majority of English ports handled an increasing volume of trade (Burwash, 1947:163) and in the 15th century London and Southampton handled considerably more of that trade than any of the other ports (Burwash, 1947:147). The trade handled by ports was very compartmentalised. The London customs accounts for that period show a majority of the foreign shipping coming from the Low Countries and the Hanse cities with some also from south-western Europe (Burwash, 1947:148). Southampton was a major link with the Mediterranean with the Venetian galleys and Genoese carracks calling at the port (Burwash, 1947:149). The East Coast ports traded principally with the countries bordering the North Sea (Burwash, 1947:151-152). The Cinque Ports by this time were too shallow to take the larger ships, but they were still active with smaller vessels. Sandwich had an active coastal trade with London and the Mediterranean galleys called there until 1456 and later sometimes anchored in the Downs (Burwash, 1947:157). The Sussex ports carried on brisk trade with the Low Countries and Flanders and also traded with Brittany and the French Atlantic coast (Burwash, 1947:158). The ports of Dorset traded chiefly with Normandy, the northern ports of Brittany and those of the Bay of Biscay (Burwash, 1947:159). The Channel Islands traded between these same areas of France and those of the English south coast. The larger West Country ports traded principally with Portugal, Spain, Brittany, France, Normandy, Iceland and Ireland, but ships from other places such as the Mediterranean and the Baltic also visited both for trade and victualling (Burwash, 1947:160). Ships from the south and west coasts of England were comparatively rare in the east-coast ports (Burwash, 1947:152).

Minchinton (1969:2) identifies the end of the sixteenth century/beginning of seventeenth century as an important period for English trade. England in the sixteenth century was still a rural country with its people predominantly engaged in agriculture (Davis, 1962:388). Apart from London there were no towns of any size and England's merchant fleet was very small compared with those of the major European traders (Minchinton, 1969:7). With the eviction of the Hanse merchants in 1598 and the creation of the English East India Company in 1601, the large portion of English trade that had been controlled by foreign merchants was being taken into English hands. Michinton (1969:3) describes it as 'a sign that England was moving from the periphery towards the centre of a new trading system'; a European trading system that would be looking well beyond its own frontiers. The growth of the English shipping industry in the seventeenth century was based principally on the need to transport basic goods such as coal and timber, the Newfoundland and Greenland fisheries and the expansion of the Mediterranean and African trades (Minchinton, 1969:7). In those two centuries it developed to become one of the fastest growing English industries with the tonnage of shipping increasing nearly seven fold, in a period when the population probably only doubled (Davis, 1962:389).

At the beginning of the seventeenth century the major English export was still cloth (Minchinton, 1969:7-8;Davis, 1962:8). Davis (1973:7) describes the period 1630 to 1689 as one where trade grew 'exceptionally rapidly'. Trade with Spain and Portugal was growing and the decline of the Spanish and Italian textile industries provided an opening which the English and the Dutch exploited (Davis, 1973:21). 'The Mediterranean was full of English ships' (Davis, 1962:8). The English East India Company was developing trade, as were the French and the Dutch, with India and the East Indies. Four English East Indian fleets were dispatched between 1600-1607. Over 200 English ships were occupied in the Newfoundland fishery. The English, French, Dutch, and Swedish were establishing settlements in North America and the West Indies. Although the series of wars with the Dutch, the English Civil War and the war with Spain, 1655-60, caused some disruption English trade continued to expand, especially with the colonies.

The detailed trade statistics for individual ports are not readily available for the seventeenth century (Minchinton, 1969:33), but the following table (5.1) based on customs revenues gives an indication of the growth in trade and the changes in the relative importance of various ports.

Table 5.1 - Customs Revenues at Chief English Ports (£000)

Port	1614	1617	1672	1676
London	105.1	121.9	502.3	569.5
Hull	7.7	5.9	22.5	20.2
Exeter	4.1	4.4	15.7	17.0
Bristol	3.6	3.6	56.9	65.9
Newcastle	3.8	3.0	8.9	9.4
Plymouth	2.3	3.5	14.1	16.6
Lyme Regis	3.0	2.9	6.5	4.4
Southampton	2.3	3.2	9.8	6.6
Dartmouth	2.3	3.5	2.2	1.3

From Table 5.1 it can be seen that by this time Southampton was no longer second to London. Bristol gained that position due to a growing involvement in the trans-Atlantic trade after 1660. In 1700, of the ships entering Bristol, 49.5% were from the American colonies and the West Indies, 20.5% from Spain and Portugal and 11 % from Ireland (Minchinton, 1969:33). The growth in trade led to an expansion of the English merchant navy (Minchinton, 1969:10).

The rate of increase of trade was not consistent, for example it was slower during periods of conflict, 1640-60 and 1689-1713, than in periods of peace, 1660-89 (Davis, 1962,20). English exports increased by about 75% between 1600-1640 and, 37-64% between 1640-1660 and approximately 58% from the early 1660s to the mid 1680s after which the growth halted for both political and commercial reasons (Minchinton, 1969:10-14). Between 1688-1738 it probably only grew by about a half. In addition the change of 'enemy' from the Dutch to the French had a significant effect on the trade coming into and going out of the English Channel and there were considerable losses to French privateers. In the 1730s the rate of increase in overseas trade speeded up, slowed down again during the war years of 1739-48 and then speeded up again rapidly after the end of the war (Davis, 1962:23). There was also a similar increase in imports during the period. The following table (5.2) shows the increase in trade during the first three quarters of the eighteenth century (Minchinton, 1969:15 & 16;Schumpeter, 1960:Tables II-IV):

Table 5.2 - English Overseas Trade 1700-1775
(annual averages £ *million*)

	1700-9	1710-19	1720-9	1730-9	1740-9	1750-9	1760-9	1770-5
Imports:	4.7	5.5	6.8	7.5	7.3	8.4	10.8	12.8
Exports:	4.5	4.8	4.9	5.8	6.5	8.7	10.0	10.0
Re-exports:	1.7	2.1	2.8	3.2	3.6	3.5	4.4	5.6

War not only had an effect on the development of trade, but also on the ratio of English and foreign ships engaged in the English overseas trade. There was an increased reliance on foreign shipping in times of war. Available records of entries and clearances show this clearly, see Table 5.3 (Davis, 1962:334).

Table 5.3 - Comparison of Tonnage (000 tons) of English and Foreign Ships Engaged in English Overseas Trade during Peace and War

Period	**Entries**		**Clearances**	
	English	**Foreign**	**English**	**Foreign**
WAR 1692-4	82	106	82	81
Peace 1699-1701			294	44
WAR 1710-11			255	63
Peace 1713-15			421	27
Peace 1751	421	59	648	46
WAR 1758	283	130	427	99
Peace 1772	652	128	815	73
WAR 1779	482	228	581	139

Table 5.4 - Tonnage (000 tons) of Overseas Trade Entries and Clearances, 1686-1779

	Entries			Clearances		
	English	Foreign	Total	English	Foreign	Total
1686	399	67	466	331	30	361
1692-3	70	107	177	89	92	181
1696	95	106	201	74	69	143
1696				92	83	175
1697				144	101	245
1699-1701				294	44	338
1700-2				274	44	318
1709				244	46	290
1710				244	67	311
1711				266	58	324
1712				327	29	356
1713				412	26	438
1714				445	34	479
1715				406	20	426
1716			349	439	17	456
1717			347	414	15	429
1718	354	15	369	428	17	445
1723			393	393	27	420
1726-8			421	433	24	457
1730	422					
1737	404					
1744	269					
1751	421	59	480	648	46	694
1758	283	130	413	427	90	526
1765	568	125	693	690	68	758
1772	652	128	780	815	73	888
1779	482	228	710	581	139	720

At the end of the seventeenth century statistics on the number of ships entering and leaving harbours engaged in overseas trade began to be recorded, although not consistently. Table 5.4 above details the figures from the end of the seventeenth

century to three-quarters of the way through the eighteenth (Davis, 1962:26).
Davis (1962:28) suggests the apparent decline after 1686 is the true indicator of the overseas trade. High duties imposed on French goods severely affected the legal trade with France, which was replaced by smuggling and the importation of wine and salt from Portugal. Even so the trade with Turkey and the Newfoundland fishery also declined and therefore there was an overall decline in shipping movements. Other disturbances to trade were the Jacobite Rebellion in 1715, a dispute with the Baltic powers during 1717-19, war with Spain in 1718, the effects of the South Sea Bubble of 1720, war with Spain 1739-48 which France entered in 1744 and war with France again 1756-63. During the period 1739-1815 there were hostilities on 43 of the intervening years. Even so, from 1748 until 1775, the commencement of the War of American Independence, there was almost continuous rapid expansion of English trade, apart from during the first two years of the Seven Years War. The most rapid were the American, West Indies and East Indies trades. During the years of war the expansion of trade stopped and then in the years of peace trade grew rapidly again. Stagnation followed the end of the Napoleonic wars, but when England became the workshop of the world it returned to rapid growth (Davis, 1962:43).

Table 5.5 - Tonnage (000 tons) of Overseas Trade Entries and Clearances

Geographical Area	**1686**		**1715-17**	**1771-3**	
	Entries	**Clear's**	**Clear's**	**Entries**	**Clear's**
North Europe	141.6	55.2	47.9	280.2	89.3
Nearby Europe	180.6	187.6	234.5	218.5	486.7
Spain & Portugal	33.1	24.2	44.1	53.9	29.9
Mediterranean	25.7	18.8	30.3	13.6	29.1
East Indies	5.8	8.4	4.3	14.1	13.9
West Indies	44.4	34.0	35.7	95.8	104.5
North America	35.6	33.1	40.5	96.9	99.0

Note:

The countries included in the geographical area groupings are:

'North Europe': Norway, North Russia, Denmark, Baltic.

'Nearby Europe': Holland, France, Germany, Flanders, Ireland, Isle of Man, Channel Islands.

'Spain & Portugal': Spain, Portugal, Canaries, Madeira, Azores.

'Mediterranean': Excluding Spain and France.

'East Indies': All territories east of Cape of Good Hope.

'West Indies': Includes Slave Coast of Africa.

Trade statistics from the Atlantic and Mediterranean coasts of France and the Mediterranean coast of Spain are difficult to isolate from those for the rest of the two countries (Davis, 1962:204).

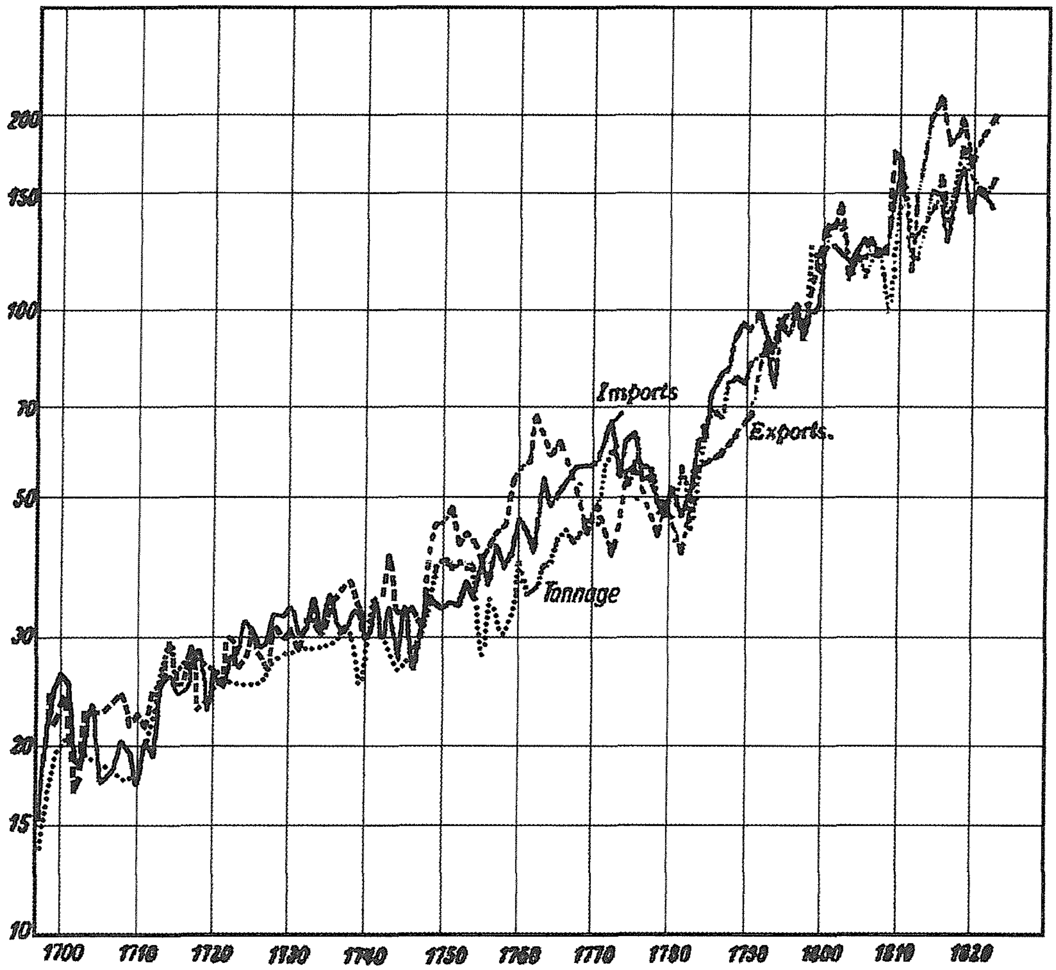


Figure 5.1 **English (later British) imports and exports and the tonnage of shipping cleared outwards 1696 to 1822** (Schlote, 1938:Diagram 1)

Note:

Up to 1754 the statistics relate to England and Wales, from 1755 they include Scotland and from 1800 Ireland.

The Y scale is relative, values for 1799-1800 = 100.

The colonial trade continued to grow (with wartime checks), but at a slower rate, into the eighteenth century (Davis, 1962:17;1973:7). The western ports provided competition for the trade with America and the West Indies, the ports of the north-east competed for the Baltic and Scandinavian trade and coal and corn was increasingly being shipped direct from the local ports. A breakdown of the Trade from different geographical areas is shown in Table 5.5 above (Davis, 1962:200). Davis (1962:210) gives further breakdowns of these figures, which help in evaluating the likely English trade traffic in the English Channel (see section 5.9. Shipping Volumes in the Study Area)

In addition to the trade and shipping statistics already presented Schlote (1938:Diagram 1) provides a graph representing the volumes of English, later British overseas trade (see Figure 5.1 above). There are a number of inconsistencies and gaps in the statistics used to derive this graph (Schlote, 1938:12-15) and therefore actual values cannot be identified, but it can be used to show trends. Through in to the twentieth century English (later British) trade continued to grow in series of peaks and troughs. Following the decline after the Napoleonic Wars trade grew at an increasing rate until 1860. The rate of increase then declined until World War I, which had a major negative effect on trade that was not recovered until the 1930s (Schlote, 1938:41-43). The annual average rate of growth of British overseas trade from 1820 to the commencement of the First World War was 3.3 per cent.

5.3 London's Overseas Trade

London was the major port of England and therefore took the vast majority of the trade (Willan, 1938:192). It was a centre of export of manufactured goods from other parts of the country, and a distribution centre for imported goods, principally to East Coast ports (Willan, 1938:143). For the major part of the seventeenth century London increased its share of the total volume of English foreign and coastal trade, and shipping. By far the largest proportion of the new colonial trade was with London. For example in the period 1634-69 London's imports doubled, within which imports from America and the West Indies quadrupled (also from Norway and the Baltic), while those from southern Europe increased by less than half (Davis, 1962:17-18). The number of ships leaving London for North America and the West Indies, during the later part of the seventeenth century, is demonstrated by the totals for 1664 and 1686 that were 88 and 247 respectfully.

The number of ships involved in the London portion of the trade during the latter part of the seventeenth century is indicated by the following table (5.6) of entries and clearances (Davis, 1962:201):

Table 5.6 - Numbers of Ships Involved in London's Overseas Trade, 1686

Geographical Area	Number of Entries	Clear's
North Europe	412	185
Nearby Europe	820	465
Ireland & Isle of Man.	41	51
Spain & Portugal	247	182
Mediterranean	118	79
East Indies	15	23
West Indies & Africa	225	161
North America	110	114
Total	1988	1260

Note:

For definition of geographical areas see note for Table 5.5.

'Nearby Europe': Holland, France, Germany, Flanders, Channel Islands.

London's proportion of English overseas trade was probably declining by the beginning of the eighteenth century. Table 5.7 below shows London's percentage share for the major part of that century (Minchinton, 1969:35; Schumpter, 1960:9).

Table 5.7 - London's Percentage Share of Overseas Trade, 1700-1770

	1700	1710	1720	1730	1740	1750	1760	1770
Exports:	69	71	66	69	65	62	73	63
Re-exports	86	80	85	83	75	70	75	69
Imports:	80	72	81	80	73	71	72	73

The percentage of the tonnage of shipping entering London from abroad was also declining from 59% in 1686, to 54% in 1718, and 49% in 1772 (Davis, 1962:35).

Even though London handled the largest proportion of England's overseas trade much of the miscellaneous trade with France and Flanders, which was substantial, was carried out in small ships from the ports of the south coast (Davis, 1962:202). Most of the ships involved in this cross-Channel trade were no more than 30 tons and records show they made frequent trips (Davis, 1962:205), for example twelve in a year between Southampton and Le Havre.

5.4 Southampton's Overseas Trade

The history of Southampton as a trading port is one of periods of considerable activity and periods of extreme recession. As mentioned in section 5.2 when England became part of the Angevin Empire the focus of trade moved down the English Channel to the benefit of Southampton when it became second to London in importance (Burwash, 1947:147;Pelham, 1964:208). The loss of Normandy changed this position and the port would have gone into significant decline had it not been for the growth of the Gascony wine trade and the wool trade with Flanders and Italy. War and the France raid of 1338 were the forerunners of a major decline. The cancelling of Calais' monopoly on the trading of wool, hides and tin was a precursor to the development of Italian trade. It was not until the fifteenth century that this trade was to revive Southampton's fortunes (Pelham, 1964:213). 1500 to 1530 was a boom period based on trade with the Mediterranean and Southern Europe. There then followed a rapid contraction when the Mediterranean trade declined and what remained went to London (Merson, 1964:218). The cloth trade, based on London, was replacing the wool trade and Southampton lost the tin trade (Merson, 1964:219). This resulted in a thirty-year degeneration in Southampton's trade, followed by a brief revival and then another decline (Merson, 1964:221).

Southampton did not share in the developing trade with the colonies or the revival of the trade with the Mediterranean and Southern Europe in the seventeenth century (Merson, 1964:223). These were taken by Exeter, Bristol and Liverpool. What overseas trade there was, was mainly with France and the Channel Islands. In the early eighteenth century the port rated twelfth or thirteenth in the table of trade (Temple Patterson, 1964:228). This trade was mainly local except for coal from Tyne and Wear and wine from Spain and Portugal. In addition there was continuing trade with the Channel Islands, which accounted for 60-70 % of overseas trade. There was some trade with France and occasional shipments from the Low Countries and the Baltic. Southampton was not a major player in the rapid expansion of English trade that commenced about the middle of the eighteenth century. Its main fame at that time was as a spa and fashionable seaside resort (Temple Patterson, 1964:229). Following the Napoleonic War trade increased (Temple Patterson, 1964:231), but only along the lines of the previous pattern. Passenger traffic to France, the Channel Islands and the Isle of Wight increased. In the 1820s steam packet passenger services were established to carry these passengers and the numbers carried increased to reach 100,000 in the years 1827 to 1829. The completion of the rail link from London to Southampton in 1840 (Temple Patterson, 1964:233) opened the way for Southampton to develop as a major steamship port and become the fifth busiest by 1860. In 1894 Southampton was officially designated Britain's premier military port. During the South African Wars 419 troop transports left Southampton and 476 arrived (Knowles, 1951:86).

5.5 England's Coastal Trade

For a complete picture of the volume of shipping local coasting trade statistics also need to be considered. Unfortunately these were not always recorded and a high proportion of the separate Port Books recording the statistics have been lost (Davis, 1962:396). Even so it is probably reasonable to assume that the coastal traffic also increased with the need to move goods to and from the main trade ports. The graph in Figure 5.1 can therefore, be used as an indicator of the increase of total English trade shipping over the period, but trade volumes alone do not give an understanding of the routes ships would have taken. To do this it is necessary to identify where the ships, which plied the English Channel, were going to and coming from and if possible in what numbers.

Shipments of coal far exceeded, both in weight and volume, those of any other merchandise. In the reign of James I, the rapid growth of the industry, was described as 'one of the greatest home trades in the Commonwealth of England' (Hatcher, 1993:470; Willan, 1938:55). Hatcher (1993:470) describes coal, together with fish that came a poor second, as 'the prime stimuli to the development of the English shipping industry in the later sixteenth and seventeenth centuries'. The growth in the coal trade is indicated by the following comparison:

Table 5.8 - Distribution of English shipping by tonnage, 1582-1702

Period	Total tonnage	Coal trade	% of whole	Fisheries	Other coastal trade	Foreign trade
1582	68,433	7,618	11.1	17,316	10,607	32,892
1609-15	101,566	28,223	27.8	27,721	15,743	29,897
1660	161,619	70,899	43.9	23,489	24,051	42,180
1702	267,444	78,212	29.2	24,920	42,454	122,858

(Hatcher, 1993:Table 13.1)

Hatcher (1993:471) points out that the majority of the fishing tonnage would be the fishing vessels rather than the ships transporting the fish so there can be no comparisons between the fisheries' tonnage and any other in terms of trade volumes. By the first decade of the seventeenth century a quarter of England's shipping tonnage was carrying coal, equivalent to all foreign trade (Hatcher, 1993:471). By 1660 it had increased to 40% of all trading tonnage and almost three times the size of all other coastal shipping. Even with the massive increase in English maritime trade in the late seventeenth century coal shipments still accounted for almost 30% of all trading tonnage. In 1615 it was estimated that 400 ships were engaged in the coal trade. In 1624 it was estimated that 300 ships were employed in the carriage of coal from Newcastle alone and by the end of the seventeenth century the number of ships involve in the east-coast trade was estimated at 1,400 which still leaves those from the west-coast and Scotland. Willan (1938:210-211) details for the years 1683 and 1731 the shipments of a total of 209,160 and 280,353 caldrons of coal from Newcastle to the various ports around the British Isles. In both years the vast majority, 149,681 (71.6%) and 217,102 (77.4%) caldrons were delivered to London. Tables 5.9 and 5.10 below shows the shipments that would probably have passed through or near the study area.

Table 5.9 – Volume of Coal (%) Shipped from Newcastle, 1683 that Would have Passed Through or Near the Study Area

Destinations	% Shipments	Destinations	% Shipments
Southampton	2.00	Cowes	0.18
Exeter	1.06	Plymouth	0.13
Portsmouth	0.80	Guernsey	0.05
Poole	0.33	Chichester	0.03
Dartmouth	0.23	Jersey	0.02
Weymouth	0.21	Total	5.04%

Table 5.10 – Volume of Coal (%) Shipped from Newcastle, 1731 that Would have Passed Through or Near the Study Area

Destinations	% Shipments	Destinations	% Shipments
Southampton	1.15	Weymouth	0.31
Portsmouth	1.09	Cowes	0.26
Lymington	0.39	Chichester	0.07
Exeter	0.39	Dartmouth	0.04
Poole	0.36	Fowey	0.01
Plymouth	0.33	Total	4.40%

Flinn & Stoker (1984:177) suggest the number of ships employed in the 1820s would have been about 1,750. Figures from the eighteenth century show the east-coast coal ports supplying almost every port on the east and south coasts as far as Exeter (Flinn & Stoker, 1984:220). Out of a total of 1,947 shipments, among the main recipients on the south-coast was Portsmouth with 73 and Southampton with 36. The coal ports of Wales supplied the western part of the south-coast as far east as Exeter (Flinn & Stoker, 1984:214) although Willan, (1938:156-158) identifies coal being shipped to Poole, Weymouth and Lyme Regis from South Wales in the seventeenth century. In most years during the sixteenth and seventeenth centuries the tonnage of coal shipped by the coastal trade from the northeast exceeded the volume of overseas imports (Davis, 1962:209). Flinn and Stoker (1984:172) estimate that there were about 3,000 voyages a year carrying coal from Newcastle in the early eighteenth century which had increased to over 10,000 in 1830.

5.6 London's Coastal Trade

London, with a population of more than half a million at the end of the seventeenth century, was dependent upon supply from a wide area. It was a major market for English commodities and incoming shipments were received from almost every port of any size in England and Wales, especially coal and agricultural produce (Willan, 1938:141 & 192). Cargoes were also shipped from London to places all around the coast.

Table 5.11 - London's Coastal Shipments, 1628 that Would have Passed Through or Near the Study Area

Destinations	No. Shipments	Destinations	No. Shipments
Topsham	12	Portsmouth	2
Weymouth	9	Falmouth	2
Dartmouth	6	Bristol	1
Plymouth	6	Cowes	1
Poole	3	Aberdovey	1
Southampton	2	Chichester	1
		Total	46

Willan (1938:203) gives the destinations and numbers of coastal shipments from London during the year ending Christmas, 1628. Of the 352 cargoes listed, 301 (85.5%), were to east coast ports, 79 (22.4%) to ports on the south coast and only one (0.3%) on the west coast. Only 46 (13%) would have been on ships that sailed to or through the area of the south coast which is part of this study (see Table 5.11 above). Shipments of ordnance went to the south coast ports of Cowes, Southampton, Poole, Weymouth, Topsham and Plymouth (Willan, 1938:143-144).

By 1683 London's coasting trade had increased significantly with 1,001 cargoes being shipped of which 643 (64.2%) were to east coast ports, 256 (25.6%) to ports on the south coast and 53 (5.3%) to the west coast (Willan, 1938:204). A total of 248 (24.8%) ships would have sailed to or through the study area (see table 5.12 below). A further 49 shipments were to destinations that could not be identified.

Table 5.12 - London's Coastal Shipments, 1683 that Would have Passed Through or Near the Study Area

Destinations	No. Shipments	Destinations	No. Shipments
Exeter	35	Cowes	2
Liverpool	28	Barnstable	2
Bristol	22	Carmarthen	1
Plymouth	21	Topsham	1
Poole	20	Aberdovey	1
Falmouth	16	Carnarvon	1
Weymouth	16	Padstow	1
Chester	16	Bideford	1
Portsmouth	15	Milford	1
Southampton	14	Truro	1
Lyme Regis	12	Teignmouth	1
Dartmouth	7	Workington	1
Chichester	7	Lymington	1
Lancaster	3	Lanstafe(Llanstephan)	1
		Total	248

The number of coastal shipments received in London that same year was 4,131. The ports they came from and the numbers are detailed in the Table 5.13 below (Willan, 1938:206). The numbers from the three coasts are; 3,329 (80.6%) from east-coast ports of which 1,475 were from Newcastle; 732 (17.7%) from the south-coast; and 70 (1.7%) from west-coast ports. The number of shipments that were to or would have passed through the study area is 369 (8.9%).

Unfortunately the London Port Books for 1697 to 1799 have been destroyed. Willan (1938:145) suggests that London's coasting trade in the eighteenth century was similar to that of the seventeenth century, but greater in extent. In 1727-28, there were

6,837 incoming coastal shipments that could have meant that on the basis of the 1683 figures 608 shipped to or through the study area. Until well into the 18th century the volume at least equalled that of all other ports put together (Davis, 1962:34).

Table 5.13 - London's Inward Coastal Shipments, 1683 that Would have Passed Through or Near the Study Area

Destinations	No. Shipments	Destinations	No. Shipments
Poole	51	Portsmouth	14
Liverpool	50	Whitehaven	5
Exeter	39	Chepstow	4
Bristol	35	St. Ives	4
Milford	28	Penzance	4
Truro	24	Cardigan	3
Southampton	20	Penryn	3
Chichester	19	Fowey	2
Cowes	16	Dartmouth	2
Carmarthen	15	Tenby	1
Falmouth	14	Weymouth	1
Plymouth	14	Padstow	1
		Total	369

5.7 Southampton's Coastal Trade

The early coastal trade of Southampton is not recorded (see Chapter 2 section 2.2), but it is highly likely that as the overseas trade grew so did Southampton's role as a transhipment centre and as a distribution outlet for both her own industries and those of her hinterland (Pelham, 1964:213). During the boom period of 1500 to 1530 imports such as spices, fruits, wine and alum were shipped on to London (Pelham, 1964:218). Tin, for which Southampton had been made staple in 1492, was brought from Cornwall annually by coastal fleets and some also transhipped to London. The port was also a distribution centre for the goods shipped by the Venetians and the Genoese (Willan, 1938:150). The trade was with east-coast ports, other south-coast ports, Wales and the Channel Islands (Studer, 1913:xix-xxii, 121-39). The numbers of arrivals and departures for Southampton and its member ports for those periods are; 1463-64, 100; 1489-90, 80; 1500-01, 282; 1519-20, 228 (Burwash, 1947:207).

With the decline and refocusing of the Mediterranean and Southern Europe trade to London about 1530 (Merson, 1964:219) the coastal transit trade would have also declined only to be further reduced by the cessation of the tin fleets. In 1600 Southampton is described as being a regional port handling general trade for the local area and distributing wine and wode to a wider area. Merson (1964:223) suggests that this pattern probably continued through the seventeenth century. Willan (1938:151-152) identifies that in 1628 Southampton shipped 122 'coastal' cargoes, but the majority of these were to Jersey and Guernsey, the other cargoes were to London, Plymouth, Falmouth and Barnstable. There were only 13 cargoes received from Newcastle, London, Shoreham, Arundel, Chichester, Portsmouth, Lyme Regis and Plymouth, none were from the Channel Islands. Over the next 50 years there was an expansion and refocusing of Southampton's coastal trade (Willan, 1938:152). In 1687 Southampton shipped 654 coastal cargoes, over half the number shipped by London. The Channel Islands trade was still important, but there was now a large trade with Cowes. Other shipments were made to London, Exeter, Dartmouth, Plymouth and Falmouth. The trade with the Channel Islands and other south-coast ports was more important than the trade with London. The number of coastal shipments received at Southampton were far lower with cargoes from Newcastle, Hull, London, Rye, Arundel, Portsmouth, Cowes, Poole, Dartmouth, Plymouth, Penzance and Ilfracombe. Southampton's coastal trade continued to grow and in 1717/18, 730 shipments were made. Cowes and the Channel Islands still took a large proportion with others going to Great Yarmouth, Newhaven, Chichester, Portsmouth, Poole, Weymouth, Lyme Regis, Exeter, Dartmouth, Plymouth, Falmouth, Fowey and Bristol. The number of cargoes received only amounted to 188 from Newcastle, Sunderland, London, Rye, Portsmouth, Cowes, Poole, Weymouth, Exeter, Dartmouth, Falmouth, and Neath.

In the eighteenth century Southampton was fifth in the league of south coast ports for tonnage of coastal shipments after Poole, Weymouth, Exeter and possibly Sandwich (Temple Patterson, 1964:228). Cargoes were traded with London, Exeter, Portsmouth, Cowes, Poole, Weymouth, Lyme Regis, Dartmouth and Rye. Following the Napoleonic War there was an increase in the volume of trade that followed the same general model of the past hundred years (Temple Patterson, 1964:231). The development of the steam packet services has already been covered in section 5.4 Southampton's Overseas Trade.

5.8 South Coast Outport's Coastal Trade

Along the south coast other ports such as Cowes, Poole, Exeter and Plymouth were also centres of distribution of imported goods (Willan, 1938:146). Chichester was the head port nearest to London (Willan, 1938:146-147) and a centre for the coastal shipment of corn, which formed the most important cargo. During 1464-65, there were 191 arrivals and departures; 1465-66, 245; 1499-1500, 490; and 1513-14, 519 (Burwash, 1947:217). In 1634 shipments (Willan, 1938:147) are recorded going to London, Rye, Dartmouth, Plymouth, Teignmouth and Milford. Inward cargoes amounted to 27, of which 12 were of coal from Newcastle. The others were mainly miscellaneous cargoes from Southampton and London. In 1684, 25 loads of wheat were shipped to London with a further three to Plymouth. Other cargoes were shipped to London, Portsmouth, Poole, Exeter, Topsham, Dartmouth, Plymouth and Fowey. There were 34 incoming cargoes from Newcastle, Sunderland, London, Newhaven, Portsmouth, Southampton and Dartmouth (Willan, 1938:148). By the Eighteenth century Chichester trade had changed. Mills now ground the grain and flour that was shipped in preference to wheat (Willan, 1938:148). Shipments were more concentrated on London, but cargoes still went to Newcastle, Portsmouth, Poole, Exeter, and Bristol. Cargoes were received from Newcastle, Sunderland, Portsmouth, Southampton, Cowes, Poole, Weymouth and Bristol. The other member ports of Chichester, to the east, contributed little to the shipping through the subject area of this study (Willan, 1938:149). In 1684 Rye received tobacco pipe clay from Poole and salt from Southampton. In the early eighteenth century Arundel shipped corn and hops to Plymouth.

The coastal traffic to and from Chichester and its member ports was small compared with that for Southampton and the two main member ports of Portsmouth and Cowes (Willan, 1938:150) both of which also had a sizeable coastal trade. In 1686/7 Cowes, which was much involved in the tobacco trade, shipped 401 cargoes (Willan, 1938:153-154), the majority of which were to Southampton and Portsmouth with others to Hull, London, Dartmouth, Plymouth and Fowey. Inward shipments amounted to 96, coming from Newcastle, London, Portsmouth, Southampton, Poole, Lyme Regis and Plymouth. Cowes' Port Books for the first half of the eighteenth century are lost but other evidence suggests that substantial trade was maintained.

Portsmouth was primarily a naval port (Willan, 1938:154) which could at times give rise to considerable coastal movements. In the year 1627, 17 coastal shipments were made 8 of which were to Dartmouth with others to London, Topsham, Plymouth, and Falmouth. Only 13 Cargoes were received from Newcastle, Sunderland, London, Shoreham, Chichester, Southampton and Plymouth. Similar to Southampton and Cowes, Portsmouth's coastal trade increased during the 17th century with a focus mainly to the south-coast ports rather than London (Willan, 1938:155). In the year 1690, 62 cargoes were shipped, the majority going to Southampton and Cowes with others to London. A larger number of shipments were received from, Newcastle, London, Southampton, Cowes and Poole. The coastal trade continued in the eighteenth century with additional cargoes to Hastings and Chichester and from Arundel, Chichester, Exeter and Plymouth.

Examples of the shipping arrivals and departures for Poole in the late fifteenth and early sixteenth centuries are; 1466, 125; 1467, 146; 1468, 101; 1487-88, 237; 1505-06, 327;and 1518-19, 355 (Burwash, 1947:220). Poole was important in the seventeenth century for the supply of clay to which was added stone in the eighteenth. The port dispatched 30 cargoes in the year 1633 (Willan, 1938:155), the majority of which went to London, but also to Southampton, Weymouth and Newport. About 20 cargoes were received from ports including London, Southampton and coal from South Wales. During the year 1691 'tobacco pipe clay' shipments were made to ports from Newcastle to Dartmouth and in addition manufactured clay pipes were shipped to Newcastle, Portsmouth, Cowes, Weymouth and Plymouth (Willan, 1938:156). Other cargoes went to London and Southampton. Inward cargoes were received from Newcastle, London, Dover, Southampton, Cowes and Milford. The total inward and outward shipments for the year amounted to 70. Only details for the second half of 1749 are available and they show shipments of tobacco pipe clay and stone to London and also other cargoes to Portsmouth and Weymouth. Incoming shipments were from Newcastle, London, Chichester, Portsmouth, Cowes, Lymington, Weymouth, Lyme

Regis and Bristol.

Weymouth a member port of Poole was the centre for the shipment of Portland stone, but also acted as a trans-shipment port for overseas goods (Willan, 1928:157). In the year 1627, 18 cargoes were dispatched 12 went to London and others to Southampton, Fowey and Bristol. Inward shipments were 36 and from Newcastle, Sunderland, London, Arundel, Southampton, Minehead, Bristol and South Wales. During 1691 cargoes were shipped to London, Portsmouth, Southampton, Christchurch, Poole, Plymouth and Guernsey. A similar number of shipments to those of 1627 were received including cargoes from Portsmouth, Poole, Lyme Regis, Exeter, Dartmouth and Plymouth. For the year 1738, 297 cargoes were shipped (Willan, 1938:158) of which 191 were stone and 165 of these went to London. Other cargoes went to Portsmouth, Lymington and Poole. Those received totalled 192 and came from ports including Newcastle, London, Portsmouth, Southampton, Lymington, Poole, Lyme Regis, Exeter, Dartmouth, Plymouth, Bristol and Milford.

Lyme Regis, another member port of Poole, appears to be known more for its harbour, the 'Cobb' and beautiful ladies (Willan, 1938:158; Defoe, 1991:86-88). In the year 1691, cargoes, including cider, were shipped to London, Cowes, Lymington, Weymouth, Topsham, Plymouth and Guernsey. Shipments were received from London, Southampton, Cowes, Poole, Exeter, Dartmouth, Plymouth and Swansea. In the eighteenth century beer was the main product traded (Willan, 1938:159). Cargoes were sent to London, Portsmouth, Poole, Weymouth, Exeter, Dartmouth, Plymouth, Fowey and Falmouth. Those received came from Newcastle, Sunderland, London, Cowes, Lymington, Poole, Exeter, Dartmouth, Plymouth, Fowey, Bristol and South Wales.

Exeter was the outlet for the Devonshire cloth trade (Willan, 1938:159). Until about 1724 ships docked at Topsham and cargoes were taken to and from Exeter, via a canal, by lighters. By that date the canal had been improved and ships could reach Exeter. During 1632 only 9 coastal shipments were made to London, Dartmouth, Plymouth, Fowey. No cloth was shipped, sugar being the main product. A larger number of cargoes were received from London, Rye, Newhaven, Chichester, Dartmouth, Plymouth and South Wales. By 1682 cloth was the main product shipped, especially to London (Willan, 1938:160). Cargoes were received from Newcastle, Whitby, Wells, Great Yarmouth, Chichester, Portsmouth, Southampton, Dartmouth, Plymouth, Fowey, Bristol and South Wales. In the eighteenth century coal was the main cargo received being carried by 60% of the coastal shipping arriving (Willan, 1938:160). The trade from London was the next most important being about 20% of the arrivals. Outgoing shipment in the year to Midsummer 1701 amounted to 86, two thirds of which went to London and 20 to Dartmouth and Plymouth (Willan, 1938:161). Trade with south-coast ports in Kent and Sussex as well as Portsmouth, Southampton, Poole and Bristol also increased.

Dartmouth was a member port of Exeter and a centre for Devon cider (Willan, 1938:162). There were 14 outgoing shipments in the year to Christmas 1632, although none of them were of cider. They were sent to London, Topsham, and Plymouth. Inward shipments were mainly coal from Newcastle and South Wales, malt from Chichester, Portsmouth and Newport and various products from London. Fifty years later the cider was being shipped mainly to Exeter with some going to Portsmouth and Plymouth. Cargoes received were coal from South Wales and Newcastle and other goods from London, Chichester, Exeter, Plymouth and Swansea.

In the latter part of the seventeenth century Plymouth's coastal shipments were mainly re-exports to other ports in the south-west; Exeter, Dartmouth, Looe, Fowey, Falmouth, Penzance, St Ives and Bideford, and to London (Willan, 1938:163). There was a considerable imbalance in coastal shipments with many more being received than sent. During the year to Christmas 1684 there were 260 inward cargoes to only 83 outward. Those received came from Bridlington, Hull, Wells, London, Newhaven, Shoreham, Arundel, Chichester, Portsmouth, Southampton, Cowes, Poole, Exeter, Truro, Bideford, Bristol, Carmarthen, South Wales and Chester. By the eighteenth century the coastal trade had declined. In the year ending Midsummer, 1717, only 21 cargoes were shipped and 148 received. The outgoing shipments were mainly to Bristol, Chepstow and Neath with others to London. Those received were mainly coal from South Wales and other cargoes from London, Southampton, Bristol and Liverpool.

The coasting trade of Falmouth, a member port of Plymouth, was not very large, but did receive cargoes from Hull, London, Southampton, Exeter, Plymouth, Bristol, Swansea, Milford and Whitehaven (Willan, 1938:164). Of the other member ports of Plymouth: Looe received a few cargoes during the early eighteenth century. At the end of the seventeenth century Fowey shipped tin and received cargoes from Southampton, Plymouth and South Wales, but in the year to Midsummer, 1717, only 2 cargoes were shipped and very few received. In the eighteenth century Truro shipped significant cargoes of tin and copper and received shipments from London, Southampton, Poole, Bristol and South Wales. Penryn and Helston had similar trade. St. Ives shipped tin and other commodities to London and Bristol at the end of the seventeenth century and received coal from South Wales and other cargoes from Falmouth, Barnstaple and Bristol. By the eighteenth century the trade had increased considerably. In the year ending Midsummer, 1717, 79 cargoes were shipped and 117 received, but Willan (1938:165) does not identify any which would have gone to or passed through the area covered by this study.

The coastal trade of the west coast ports was similar in structure to that of the east coast with Bristol as the major centre and South Wales supplying coal (Willan, 1938:167). By the mid-eighteenth century Bristol had become second to London in importance of trade (Willan, 1938:171). The shipments that would likely have passed along the south coast have been identified above. By the later part of the eighteenth century the coastal trade of the south coast ports was in decline as industry became more established in the north of the country (Willan, 1938:166).

This summary of the coastal trade provides a picture of the movement of shipping along the south coast. Even though south coast ports declined in importance in the nineteenth century as industrial activity moved north (Willan, 1938:166) as overseas trade increased in volume and was centralised in the larger ports there would still have been the need to distribute goods to the smaller ports. The development of the rail links to the south coast in the mid nineteenth century (Williamson, 1959:329) would have reduced that need. Even so Williamson (1959:353) describes the English Channel at the later part of the nineteenth century, as being 'lively with schooners, ketches and barges' carrying cargoes such as coal, minerals, agricultural produce, china clay, timber, or anything which could be carried at freight prices competitive with the railways, to all the 'little ports from Cornwall to Kent'.

5.9 Shipping Volumes in Study Area

The statistics presented in Figure 5.1 are for all English (later British) overseas trade, which means that not all of it would have been carried along the English Channel trade route. In addition there is no guarantee that all the English trade cargoes carried on that trade route would be destined for or pass through the study area although it is likely, especially in times of conflict with other European countries, that English trade traffic would hug the English coast. Burwash (1947:205, 207, 217, 220) provides figures for ship arrivals and departures at a number of English ports during the fifteenth and sixteenth centuries (see Table 5.14 below).

The countries with which England traded can be divided into two groups, those 'Out Channel' which include; the East Indies, the British West Indies, the Continental Colonies (United States), Canada (including Newfoundland), the Isles (which include the Channel Isles and the Isle of Man to 1772, the Channel Islands alone 1773-1800), Ireland, Africa, Portugal, Spain, the Straits, Italy, Turkey and Venice. 'In Channel' countries are Flanders, France, Germany, Holland, Denmark & Norway, Poland & Prussia, Sweden and Russia. This means that any trade to or from the Atlantic coast of France is included in the 'In Channel' figures and not the 'Out Channel' figures as it should be. Even so, as London was handling approximately 70% of the trade, Table 5.5 can be taken as an indicator of the increasing trend of English trade traffic in the Channel. Similarly statistics for the trading volumes of other European countries are not so readily available, but it can be reasonably assumed the English statistics are indicative of the increasing volumes of trade and shipping for all European countries using the trade routes of the English Channel, especially those with colonies.

As identified above London was, by far, the main port for both imports and exports, much of which would have been shipped via the trade routes of the English Channel to the countries of mainland Europe (France, Spain, Portugal), the Mediterranean, the Americas, Africa, Asia, Australia and the Pacific. The amount of overall trade with these countries is identified in Table 5.5 and the number of shipments to and from London in Table 5.6. None of the trade with the 'North Europe' group of countries is identified as being with English ports which would mean the ships were more likely to have passed through the study area. Also, unfortunately, it is not possible to isolate the English Channel traffic for the countries included in the 'Nearby Europe' group.

Table 5.14 - Shipping Arrivals & Departures, English Ports 1465-1520

	Number of Ships			
	London	Southampton	Chichester	Poole
1463-64	347	100		
1464-65			191	
1465-66			245	
1466				125
1467				146
1468				101
1487-88				237
1489-90		80		
1499-1500			490	
1500-01		282		
1505-06				327
1513-14			519	
1519-20	533	228		355

Note:

These figures include arrivals and departures at member ports.

Table 5.15 - Numbers of Ship Likely to Sail through Study Area

Trading Area	English Port	1686 Entries	1686 Clear's	1715-17 Clear's
Ireland:	London	41	51	68
Spain & Portugal:	London	247	182	244
Mediterranean:	London	118	79	95
	Yarmouth		15	35
West Indies & Africa:	London	225	161	164
North America:	London	110	114	130
East India	London	159	230	855
	Totals	741	602	736

Only the London trade with Ireland, of the 11 ports listed by Davis (1962:211) as the chief ports engaged in the trade, is identifiable as likely to pass through the study area. Of the trade with Spain, Portugal, Canaries, Madeira and the Azores only the shipments to and from London are identifiable as possibly passing through the study area (Davis, 1962:243). The majority of the Mediterranean trade was through London, but there were also significant shipments of fish from Yarmouth and some south-western ports (Davis, 1962:256). Most of the East Indian trade was through London, with occasional shipments through south-western ports (Davis, 1962:266). The number of ships engaged in overseas trade identifiable as likely to pass through the study area is detailed in Table 5.15 above.

Using the available records for coastal trade in later part of the seventeenth century, presented in sections 5.6, 5.7 and 5.8 above, an indication of the numbers for shipments being carried to or through the study area can be derived.

Table 5.16 – Coastal Shipments Likely to Sail through Study Area

Port	Date		Number
From London	1683		247
To London	1683		403
From Southampton	1687		654
From Cowes	1687		401
From Portsmouth	1690		62
		Total	1767

Except for the shipments from London the total from Table 5.16 does not include shipments to the study area this is to prevent double accounting of shipments from ports within the study area. It also particularly does not include shipments of coal from Newcastle. Adding the values for London's overseas trade for 1686 from Table 5.15 gives a total of 3,469 shipments. This total does not represent the full total of shipments that may have been carried to or through the study area as the numbers of overseas shipments to and from ports in the study area. But based on these numbers a figure of 3,500 shipments per annum for the end of the seventeenth century may not be an under estimate.

The graph (Schlote, 1938:Diagram 1) in Figure 5.1 indicates an approximate tenfold increase (from 15 to 150 on the scale used) in the volumes of trade, from 1696 to 1820. The number of ships sailing the Channel would also follow the same trend. Although over time, as the volume of trade increased and the distances traded increased, ships tended to get larger (Burwash, 1947:163) especially those on the long distance and trans-Atlantic routes and therefore the increase in the number of ships would not be so large. But on the other hand by the end of the Anglo-Dutch wars Portsmouth had become the leading rendezvous port for the English navy (Phillips-Birt, 1967:46). Assuming the ten-fold increase is representative and applying the increase to the number of shipments derived above suggests a total of 35,000 shipping movements in the 1820s, approximately 100 per day. This can be compared with the increase in the number of ships arriving at London during the eighteenth century from approximately 1200 per year at the beginning of the century to 3,663 in 1794 (Weightman, 1990:42) and also figures such as the arrival of 13,349 colliers in London during the years 1826 and 1827 (Flinn & Stoker, 1984:180).

Although the figure of 3.3 per cent average annual growth for British overseas trade from 1820 to the start of WWI is known this cannot be used directly to derive an increase in the number of sailing ship movements. The early to mid nineteenth century saw four developments that make a direct relationship between an increase in trade and an increase in the numbers of sailing vessel movements less likely. These were; an increase it the size of sailing ships (MacGregor, 1993:20-21); the use of iron and steel to construct ship (Ville, 1993:53); the introduction of steamships (French, 1995:32;Temple Patterson, 1964:233) and the development of the railways particularly to the south coast (Temple Patterson, 1964:233). The building of larger ships allowed more cargo to be carried for each ship movement, which together with the introduction of the steamship means that the increase in sailing ship numbers would no longer be so directly proportional to the increase in trade. In addition the development of the railways provided an alternative for the movement of goods around Britain having a similar effect on the link between trade and coastal ship movements.

5.10 Size of Ships

As already identified in section 5.2 Overseas Trade, during the early Tudor period

English ships engaged in overseas trade were mostly under 100 tons. Sixteenth and seventeenth century records provide the numbers of English ships over 100 tons (Davis, 1962:7 & 10) and also show the trend to larger size ships (see Table 5.17 below).

Table 5.17 - English Merchant Shipping 1561-1629

	Number of Ships	
	100-199 tons	200 tons & Over
1560	>71	6
1572	72	14
1577	120	15
1582	155	18
1629	>178	>145

The size of ships engaged in trade varied considerably. Davis (1962:211, 227, 243, 256, 266, 298, 299) provides details of the average size of English ships engaged in trade with different countries. Inconsistencies in the contemporary recording of ships tonnage (Davis, 1962:395) mean the figures cannot be considered as totally accurate. Table 5.18 below lists the average ship tonnage. During the same period covered by that table, as identified in section 5.3 London's Overseas Trade much of the cross-Channel trade with France and Flanders was carried out in ships of no more than 30 tons.

Table 5.18 below is constructed from values provided by (Davis, 1962:211, 227, 243, 256, 266, 298, 299), but inspection of his figures suggests they are in fact the average sizes of the cargoes loaded or unloaded. At one point in his book he states that with regard to the Mediterranean trade, in the eighteenth century, there was a growing number of 100-200 ton ships going out part-laded (Davis, 1962:246) as detailed in Table 5.19 below. This is demonstrated by the figures he provides for the number of clearances and tonnage of cargo for 1715-17 (Davis, 1962:201). Even so the figures can perhaps be used as a guide to the comparative difference in size of ships trading at different ports and on different trade routes. The ship registrations for 1788 totals 9,355 ships owned in English ports, of these 7,756, approximately 83% were less than 200 tons (Davis, 1962:79). From the mid-seventeenth until the mid-eighteenth century ships in the West Indies trade sailing from London were typically 150-200 tons, while those from the outports, principally Bristol, were more usually 100 tons or less (Davis, 1962:280-281).

Table 5.18 - Average Tonnage of English Ships

Country	Clear's	1686 Entries	1715-17 Entries	1726 Entries	1766
Germany:	London	136	97	117	129
	outports	90	90		
Holland:	London	80	58	91	82
	outports	70	73		
Flanders:	London	30	31	40	95
	outports	30	33		
France:	London	99	38	43	61
	outports	40	43		
Ireland:	London	60	72	63	65
	outports	44	47		
Spain:	London	126	88	83	108
	outports	68	50		
Portugal:	London	102	85	74	117
	outports	80	67		
Islands:	London	129	96	61	71
	outports	40	71		
Italy &	London	189	183	147	148
Greece:	outports	95	105		
Turkey:	London	271	282	199	165
Straits:	London	233	165		
East India:	London	365	361		
Barbados:	London	179	160	148	236
	outports	110	81		
Jamaica:	London	214	178	168	225
	outports	100	106		
Other W.I.:	London	144	132	137	170
	outports	91	69		
West Africa:	London	119	118		101
	outports		96		
New England:	London	120	102	104	133
	outports		74		
Newfoundland:	London	68	70		
Virginia etc.:	London	209	192		
	outports	116	106		

Note:

'Straits' is a general name given to the Mediterranean, not specifying any particular location.

'New England' includes New York, New Jersey and Pennsylvania.

'Virginia' also includes Maryland and Carolina.

In the early eighteenth century ships of 300-400 tons were increasingly used in trade with Jamaica. From the middle of the century 300-ton ships were used in considerable numbers for all West Indian trade. Even so ships of 30-40 tons continued to be used from English outports. After the middle of the eighteenth century there was a rapid increase in the size of ships, none more so than in the East India trade (Davis, 1962:262). The ships of the East India Company were the largest of English merchantmen (Davis, 1962:261).

Table 5.19 - Size of Cargoes Cleared (tons) 1715-17

Geographical Area	Cargo Size English Ships	Cargo Size Foreign Ships
North Europe	191.35	140.00
Nearby Europe	56.20	62.38
Ireland & I.o.M.	72.06	
Spain & Portugal	90.99	27.27
Mediterranean	170.97	100.00
East Indies	358.33	
West Indies & Africa	145.12	
North America	136.15	

5.11 Trade Seasonality

The highest proportion of storms and gales occur in the winter months (Palutikof & Skellern, 1991:102). The seasonality of trade may therefore have had a significant impact on the number of shipwrecks and when they occurred. It is generally recognised that there was an unwillingness to risk ships unnecessarily in winter months. In addition the Baltic ports were frequently closed in midwinter by ice as was the Thames in the seventeenth century. Even so there were cargoes for which merchants were willing or had to take the risk of late sailings.

Table 5.20- Ships Entering England with Wine, 1664

Month	No. Ships	(London Only)	
	France	Spain	Canary Is.
January	24	3	10
February	2	3	1
March	13	9	4
April	21	5	2
May	9	1	-
June	5	2	1
July	2	-	-
August	-	-	1
September	2	-	-
October	20	-	-
November	13	22	2
December	17	23	23

Corn was shipped in the autumn and early winter and wine, which formed a greater part of the French, Spanish and Portuguese trades, became available in the late autumn with shippers anxious to rush it to the market as soon as possible (Davis, 1962:190). Olive oil was also shipped during the winter months (Davis, 1962:231). Table 5.20 above shows the seasonality of French, Spanish, Canary Island wine shipments (Davis, 1962:209).

The figures in Table 5.20 can be compared with the seasonality of all shipments from Spain for the years 1686 and 1751, and for Portugal in 1751(Davis, 1962:231) in table 5.21 below. The difference between Spain and Portugal being due to the availability of port which was later than wine with its shipments spread more evenly over winter and spring (Davis, 1962:231).

The main cargo from the West Indies was sugar (Davis, 1962:268-269), which also imposed some restrictions on when ships could sail, as did the hurricane season. Sugar cane was cut during the summer and then processed. Shipments started early in the year and continued to July when the hurricane season started. Typically a ship would leave England in December or January to pick up a cargo and sail back when the holds were full, which could take some time depending on the reliability of the crop (Davis, 1962:280-281). Table 5.22 below showing arrivals from the West Indies illustrates this.

Table 5.21 - Number of Ships Entering London from Spain & Portugal

Month	No. Ships		
	Spain		Portugal
	1686	1751	1751
January	38	15	15
February	12	7	10
March	11	18	12
April	11	10	13
May	7	7	15
June	10	8	14
July	6	2	13
August	16	2	13
September	4	2	5
October	5	1	10
November	14	19	8
December	10	16	8

Table 5.22 - Arrivals at London from West Indies

	1686	1736	1766
January	16	13	10
February	7	8	8
March	11	4	13
April	14	2	6
May	18	3	9
June	25	16	16
July	29	26	59
August	21	38	53
September	27	29	62
October	25	28	29
November	19	10	26
December	13	18	20

Virginia and Maryland provided tobacco, which loose was ready in August and packed from October to June (Davis, 1962:285). Ships sailed from England in the autumn and sailed for home in the spring. Into the eighteenth century sailings became later with the peak in late spring/early summer. This is clearly shown in the Table 5.23 below.

Table 5.23 - Arrivals at London from Virginia & Maryland

	1686	**1736**	**1751**	**1766**
January	2	5	16	10
February	-	6	5	8
March	9	1	4	9
April	7	2	1	5
May	12	3	2	1
June	3	-	2	2
July	23	6	1	4
August	10	5	3	6
September	8	3	5	8
October	5	13	9	4
November	1	19	6	17
December	1	21	20	11

Chapter 6 - Navigation

6.1 Introduction

As the study area is located in a central position on the British side of the English Channel the type of navigation being used on the ships sailing in or passing through it would have been pilotage. The high cliffs and hills of the south of the Isle of Wight are well within the range of visibility. This chapter, therefore, only details the advances in navigation and navigational instruments that would have improved the safety of ships in coastal and inshore waters.

It is unlikely that a navigator sailing in to the English Channel from the Atlantic would have used the Isle of Wight as the first landfall. Sir William Monson (Waters, 1958:565) writing on the advantage of a lighthouse at the Lizard in 1622 stated 'that men do commonly fall with our coast about Plymouth or Dartmouth. Interestingly he also wrote 'it may be alleged that ships coming in with our Channel seek not our coast in the night but in the day'.

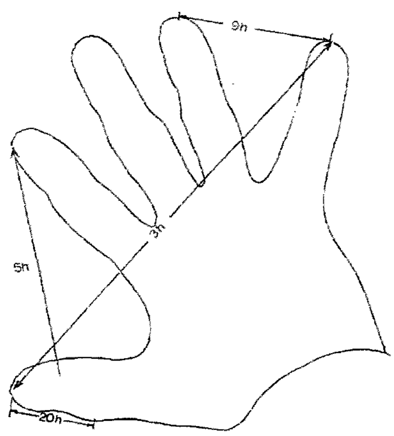
6.2 Non-instrumental Navigation

McGrail (1998:273-284) provides a detailed description of the techniques employed by navigators before the use of the magnetic compass. These techniques can be perceived in a portrayal of the *Mu'allim* or Pilot in the Arabian Sea written in AD 434 (Taylor, 1956:85), 'He knows the course of the stars and can always orient himself; he knows the value of signs, both regular, accidental and abnormal, of good and bad weather; he distinguishes the regions of the ocean by the fish, the colour of the water, the nature of the bottom, the birds, the mountains, and other indications'. The only tool he carried was the sounding line. The Norse book *Konungs Skuggsjá* (*The King's Mirror*), produced about A.D.1250 provides the details of what a skilled seaman was expected to know. Taylor (1956:81-83) suggests that as there is no mention of the loadstone it describes the skills of the seaman before the magnetic compass was available. It is written in the vein of an elderly father giving advice to his son, who wishes to become a sea-trader. The son must learn arithmetic, the movements of the stars and planets, the ocean currents, recognise the quarters of the horizon, the associated eight winds and the weather they bring at different times of the year and understand the rise and fall of the tides. Open sea sailing should not take place between the middle of October and the beginning of April. Taylor (1956:84) states the book portrays 'remarkable knowledge' of the wind, weather and tides, the movement of fish and sea mammals and the character and movements of sea-ice.

The earliest known collection of navigational information into sailing directions (*Periplus*) is from the Mediterranean and dates from the 6th century BC (McGrail, 1998:285;May & Holder, 1973:176). Navigators would compile their own, collecting any information that became available, especially from others who had sailed particular areas. In Northern Europe before literacy this type of guidance and passing on of experience would have been by word of mouth. Although writing about the English Master of the sixteenth century, Waters' (1958:495) description can be applied to the earlier navigators; 'he had learned the art of pilotage since youth by following the precepts and practice of the masters under whom he had served...The colours, contours, scent and texture of the sea-shores and the sea-bed were so impressed upon his memory that, rather like a blind man in a familiar room, he could feel his way about the coasts with confidence, here skirting a promontory, there avoiding a hidden ledge of rock, now skilfully allowing for the treacherous in-draught into some bay experienced when the flood- or maybe the ebb-stream set around a certain point, now judging by the depth of the water and nature, smell and colour of the bottom how far he was off shore'.

Apart from the shore line, to these early navigators the seabed was an important means of finding where they were (Taylor, 1956:28-31) and the sounding line was the oldest navigating 'instrument' which provided the means. The earliest mention of use of the lead and line is from the 5th century BC (Herodotus, 2.5.2) and even at that time they could be armed to pick up material from the seabed. Although from a later period the report on Frobisher's return passage from the Northwest in 1577 (Marcus, 1961:62) provides details of how the lead and line would have been used in earlier times. This part of the report describes their approach to the English Channel, 'Sonday, the fifteenth of September, about foure of the clocke, wee began to sounde with oure lead, and hadde grounde at sixty-one fadome, white small sandie grounde, and reckned us upon the backe of Sylley, and set our course easte and by north, easte north-easte, and north-east away. The sixteenth of September, about eight of the clocke in the morning sounding, we had sixty-five fadome osey sande, and thought ourselves athwert the Saint Georges Channel a little within the bankes. And bearing a small sail all nighte, we made many soundings, which were about fortie fadome, and so shallowe that we coulde not well tell where we were. The seaventeenth of September we sounded and had fortie fadome, and were not farre off the landes end, branded sande with small worms and cockle-shells". Taylor (1956:157) while writing of the 'Portuguese Pioneers' in the fourteenth century states the native Portuguese who traded to Galway and Flanders were familiar with the 'lead and line methods of the Bretons and British sailors.

When in sight of the shore another method, still in use today, could have been used to judge the distance offshore. This is using the hand as a yardstick. Watts (1987:111) provides the example, assuming a distance of 25 inches from the eye to the outstretched fingers of an outstretched arm (Figure 6.1 below):



Thumb to tip of forefinger (5 inches) = 5*h*
Knuckle to tip of thumb (1¼ inches) = 20*h*
Thumbnail (5/6 inches) = 30*h*

Figure 6.1 The hand as a yardstick for distance off (Watts, 1987:figure 4.4)

Where *h* is the height of the shore such as a headland. These measurements will obviously vary from person to person. Where the height is known a reasonably accurate distance off can be derived, but alternatively the height of the shore does not need to be known, just the yardstick to be used e.g. 'do not approach the headland closer than one hand span'.

Another similar 'guide' is the 'twelths rule' for height of tide:

Time Period (After High Water)	**Tide Height (Amount of Tidal Range)**
1 hour	minus 1/12th
2 hours	minus 3/12th
3 hours	minus 6/12th
4 hours	minus 9/12th
5 hours	minus 11/12th
6 hours	minus 12/12th

This is a very rough guide, as the change of height of the tide does not always follow a sine curve. For example in the Solent where there is a high-water stand of approximately 2 hours and the tidal curve varies considerably, from Swanage and Selsey, between springs and neaps (D'Oliveira & Lees-Spalding, 1990:233-234).

6.3 Quantitative Navigation

This is a term used to describe the second of three stages of the development of navigational techniques (McGrail, 1998:275). The term is used here to cover the advances in navigation techniques and instruments that would have been used in pilotage up to the beginning of the twentieth century.

6.3.1 The Magnetic Compass

The introduction of the magnetic compass to Northern Europe, possibly about the end of the twelfth century (McGrail, 1998:284;May & Holder, 1973:4), would have been of major benefit to the navigator, not initially to steer the ship by, but as a means of

orientation in fog and foul weather. As the magnetic compass was improved and made more reliable the compass rose replaced the wind rose for directions. It was not until the fifteenth century that Variation was first identified (Waters, 1958:24-25), its discovery probably having been hidden by the inaccuracies of the compasses.
The accuracy and quality of workmanship of compasses varied widely (Waters, 1958:28). They also seem not to have been very operational. An example is that following the disaster to Sir Clowdisley Shovel's ships off the Scilly Isles in 1707 the Royal Navy ordered compasses to be returned from the fleet for examination and of 145 only 3 were found to be serviceable (May & Holder, 1973:76).

The development of the azimuth compass was another major advance. This would have enabled navigators to fix their position by taking the bearings of terrestrial objects and also to use clearing bearing to keep clear of underwater dangers. When these navigation techniques began to be used is not known, but the first description of a compass capable of being used to take bearings is by Joao de Lisboa in *Livro de Marinharia* in 1514 (May & Holder, 1973:83). The real benefit of this capability would only be felt when accurate charts became available.

6.3.2. Charts and Sailing Directions

The first maps and charts were developed in the Mediterranean (May & Holder, 1973:176). This tradition continued with the medieval portolan maps, which were predominantly produced by cartographers from Italy and Catalan. They were drawn by hand as an adjunct to the sailing directions, but gave only rudimentary indications of the dangers likely to beset the mariner. Coastlines were shown in a generalised form with emphasis on bays and headlands, occasionally a dangerous rock or shoal bank would be marked by a '+' (Goss, 1993:41;Robinson, 1962:15-16). By the end of the fifteenth century manuscript charts of northern Europe were being drawn in the Netherlands (May & Holder, 1973:184; Robinson, 1962:16). Waters (1968:232) maintains the pre-eminence of the Netherlands in the production of North European charts and sailing directions was due to the Spanish influence and Antwerp becoming the main European entrepôt for the Spanish Empire.

Printed sailing directions covering northern and western Europe began to be published in northern Europe in the early sixteenth century (Waters, 1968:321). The Netherlands being the dominate producer for the greater part of the sixteenth and seventeenth centuries (Goss, 1993:119). France was also a major contributor and printed sailing directions for northern Europe, *Le routier de la mer*, were published in Rouen, *c*1502, with an expanded version, *Le grand routier de la mer*, in 1520. The later version was translated into English and published as *The Rutter of the Sea,* in 1528 (Waters, 1968:231-232;Robinson, 1962:17).

Henry VIII had a significant impact on improving the safety of navigation around the shores of England (Robinson, 1962:25). He encouraged chart making and put in place procedures for the training of pilots and the establishment of sea-marks along regularly used shipping lanes and port approaches. The pilots drew their own charts of the areas where they operated, but these were not made available to other mariners as the pilot's livelihood depended upon the knowledge they represented (Robinson, 1962:25). It was only in the eighteenth century that such charts and the information in them were published. The engineers building the coastal defences for Henry VIII surveyed and drew charts of the areas where these defences were located particularly along the coasts of the English Channel (Robinson, 1962:17).

None of the charts from this period, either English or from continental Europe, had soundings showing the depths at precise points (Robinson, 1962:23). A note was written on the chart giving the general depth. The least depths over dangers, such as rocks and sandbanks, were dealt with in the same manner. The charts also did not show the marks, beacons and buoys so essential to safe navigation. Even so the Elizabethan charts were considerably better at showing the coastal and inshore waters than those of earlier periods (Robinson, 1962:27).

In 1584, the first part of Lucas Janszoon Waghenaer's combined sailing directions and chart atlas of Europe, *Spieghel der Zeevaerdt*, was published in the Netherlands, followed by the second part the following year (May & Holder, 1973:185). The charts covered the shores of north and west Europe, from Norway to Spain, including the British Isles. It was translated into English and published as *The Mariner's Mirrour* in 1588, but was commonly known as the *Waggoner*, a term which became generic for chart atlases in England. It was the commencement of the production of cheap plentiful engraved charts, which marked a great technological advance in the practice of navigation (Waters, 1968:232). That said, the standard of accuracy was low with a tendency to exaggerate the more important parts of the coast (Robinson, 1962:35). Robinson (1962:34-35) suggests the charts were largely constructed using compass bearing from seaward and much of the coastline was sketched in by eye. In 1608 the Dutch firm of Blaeu published charts that were truer plans with much less exaggeration of the important parts of the coast. The coastal elevations drawn on the coastline were removed and placed in the text (Robinson, 1962:36). The Dutch monopoly of the English chart trade continued with English versions of charts being published by the Dutch cartographic firms. An attempt to break that monopoly resulted in the publishing of *The English Pilot* by John Seller, of Wapping, in two parts in 1671 and 1672. Past II included the coverage of the south coast of England. Seller had used second-hand Dutch plates for some of the charts and they were still not completely accurate (May & Holder, 1973:187). Even so, the English navigators bought them and further editions were issued during the seventeenth century (Robinson, 1962:39). By the middle of the eighteenth century the French admiralty and English private cartographic firms (Goss, 1993:290) had replaced the Netherlands' pre-eminence.

The charts being produced in the sixteenth century were all plane charts, drawn as if the earth was flat and not a sphere (May & Holder, 1973:182-184). Meridians were shown as being parallel and not converging towards the poles. Pedro Ninez, in 1537, was possibly the first to document the problems associated with this. Although the problems are not so acute with charts that cover a very small range of latitude such as might be used for pilotage. In 1569 Mercator devised a projection which corrected these problems. Charts using his projection were being published by 1599. Even so at the beginning of the eighteenth century about half the contents of chart atlases were still plane charts. In 1599, Edward Wright in his book *Certaine Errors of Navigation*, showed that for Mercator charts one minute of latitude should equal one minute of longitude multiplied by the secant of the latitude. The advantage of the Mercator projection is that all angles are correct and a compass course (rhumb line) drawn on the chart is a straight line.

Although primarily referring to ocean navigation May & Holder (1973:26) states that navigation until well into the eighteenth century consisted of sailing from one port to another or one landfall to another, the position of neither being known with any great accuracy. The lack of accurate charts for Britain was recognised during the reign of Charles II and in 1683 Captain Greenville Collins was appointed by the Admiralty to carry out a survey of the British coasts (May & Holder, 1973:187). This was completed in 1688 and the results published in 1693 as *Great Britain's Coasting Pilot.*

Scientific advances in the eighteenth century, especially those that led to the development of precision instruments, enabled cartographers to carry out accurate surveys. In 1774 Murdoch Mackenzie, who had been employed by the Admiralty between 1741 and 1770 to survey the Orkneys and the West Coast of Scotland and England, developed a survey technique using horizontal reflecting octant or sextant angles and a station pointer (Robinson, 1962:64-76;May & Holder, 1973:188). This enabled a positional fix to be taken and plotted quickly and accurately. John Hadley had perfected a reflecting octant by 1731 that was proved to be reliable and accurate at sea and together with the station pointer, invented by Murdoch Mackenzie, enabled this survey technique to be developed. It was a major advance over the compass-bearing methods used before, especially for the plotting of soundings, enabling much more detail to be shown on charts. The next major survey of the south coast of Britain was conducted by Murdoch Mackenzie, the nephew of first Murdoch Mackenzie mentioned above, from 1777-1788, followed by Graeme Spence until 1803 (May & Holder 1973:189). Both used the technique. The station pointer became an indispensable part of the marine surveyor's equipment.

At the end of the eighteenth century the Ordnance and the Hydrographic Offices were founded, in 1791 and 1795 respectively (Robinson, 1962:97). While Thomas Hurd was Hydrographer to the Board of Admiralty, 1808 - 1823, the results of Colonel Mudge's Military Survey of England were incorporated in the coastline of charts (Robinson, 1962:127). He was also responsible for Admiralty charts becoming available commercially in 1823 (May & Holder 1973:192). Until this time private publishing companies produced and sold charts to the merchant marine. Neither the Admiralty nor the private companies yet issued corrections to their charts. To get the latest information a new chart had to be purchased. In 1832 the Admiralty commenced issuing the *Nautical Magazine* which contained the latest chart information and from which chart holders could up date their charts. In 1834 the issuing of *Notices to Mariners,* which contained update information for charts commenced and has continued to this day. Francis Beaufort, who became Hydrographer in 1829, was responsible for the organising and completion of 'The Grand Survey of the British Isles' and the number of charts of the British Isles being increased from 45 to 255 (Robinson, 1962:131-132). Beaufort was responsible for the Hydrographic Office becoming the foremost institution of its kind and a model for others to follow (Robinson, 1962:141).

6.3.3. Tides

As has already been described knowledge of tides has been a requisite of northern mariners for a very long time. A thirteenth-century manuscript from St. Albans, possibly by Matthew Paris, contains a tide table for London Bridge (Taylor, 1956:136). It gives the calculated time of high water for each day of the lunar cycle based on the astronomical timing of the passage of the moon around the earth. At new moon high tide was 3 hrs 48 mins after the passage of the moon across the meridian, each day following it was 48 minutes later. In 1676 John Flamsteed drew up tide tables for London Bridge based on observations. He found that the new moon high tide was only 2 hours, or less after the passage of the moon and the daily change was sometimes less than 30 minutes. In 1683 he made the comment that' hitherto our tide tables have only shown the time of one high water'. May & Holder (1973:214) presumes this was the high water that occurred during daylight which gives some insight into the movement of shipping in the Thames and perhaps other harbours.

Published tidal information was usually related to the moon's cycle with the compass bearing of the moon at high water or 'full water' at new and full moon being provided in tide tables (Waters, 1958:31). This became known as 'the establishment of the port'. For practical purposes mariners used 45 minutes as the daily correction. The oldest surviving English sailing directions, which may well date from the 14th century, covers the English coast from Berwick to Lands End and the Scilly Isles, including the principal Channel crossings. It includes the statement 'a south moon maketh high water within Wight (Taylor, 1956:131-132). The relating of times of high water to the bearing of the moon was still in use as late as the beginning of the seventeenth century, but was being replaced by the relating of tides to time (May & Holder, 1973:215). By the first quarter of the eighteenth century tide tables were still only giving the times of high water at a port at full or new moon.

May & Holder (1973,217) chronicles the development of tidal data provided by the Admiralty. In 1833, the Admiralty issued a pamphlet giving the times of high water at London Bridge and three other ports in the UK, one of which was Portsmouth. In 1835, the *Admiralty Tide Tables* were expanded giving the times and heights of high water at nine ports in Britain and at Brest, plus the tidal differences for 33 other ports. In 1897, the tables included the times and heights of high water for a total of 24 major ports, even so Portsmouth was the only one included lying between Selsey Bill and Anvil Point (letter, 11 Feb 1999, Commander J. Page, Hydrographic Office, Taunton). Over the years the number of ports for which tidal data was provided increased.

It was not until the latter part of the 18th century that sailing directions included data on the strength of tidal streams (Waters, 1958:34). In 1835 the *Admiralty Tide Tables* began to include a few notes on the direction of tidal streams adjacent to ports. The amount of information provided increased over the years and in 1909 a new publication *Tides and Tidal Streams* was issued (May & Holder, 1973:217).

6.3.4. The Log-ship

The speed a ship was travelling through the water and the distance travelled was a matter of judgement until the late 16th century. In 1574 William Bourne mentions the use of the log-ship, an English invention (May & Holder, 1973:10-11). Initially speed was calculated by measuring the amount of line attached to the log-ship that had run out, timed by a sandglass. The accuracy of the calculation depended upon the accuracy of the sandglass, the capability of those using it to turn it over at the right moment, allowing the line to run out smoothly and stopping at the right moment. Also eddies in the wake of the ship could cause the line to run out slower than the speed of the ship (May & Holder, 1973:109-110). A major improvement was the marking of the line with knots a distance apart which equalled the amount of line that would be drawn out by the ship travelling at one nautical mile per hour. The number of knots counted out in one minute was equal to the speed of the ship in nautical miles per hour. This is the derivation of the measuring of speed at sea in knots. The first mention of knots to mark the log line is in 1632. The half-minute sandglass had also been introduced by that date in conjunction with marking the log line every 42 feet (the significance of this is identified in section 6.3.5 Measurement of Distance).

The Dutchman's Log, so called because of its popularity in the Netherlands (May & Holder, 1973:108-109) is not mentioned in documents until 1623. It was a variation of the age-old method of judging the speed of a ship by the movement of froth, seaweed, or chips thrown over the side etc. along the side of the ship. Its accuracy suffered from the problem of measuring arbitrary lengths of time accurately with a sandglass as the ship passed the chips, seaweed or froth..

Various attempts were made to develop towed logs and paddle-wheel logs, but it was not until 1802 that Edward Massey developed a towed log that was to become the most extensively used in the nineteenth century (May & Holder, 1973:115-116). Thomas Walker, a nephew of Massey, improved this in the late nineteenth century. His 'Cherub' log was to be used into the twentieth century.

6.3.5. Measurement of Distance

The English used the measurement of 5,000 feet to the mile, three miles to the league and 20 leagues to the degree (300,000 feet). The Spanish and Portuguese also used 5,000 feet to the mile, but 4 miles to the league and 17½ leagues to the degree (350,000 feet) (May & Holder, 1973:17;Waters, 1958:64).

Between 1633 and 1635 Richard Norwood calculated the length of a degree as 367,200 feet which would make the mile 6120 feet (May & Holder, 1973:17). In his book *Sea-man's Practice* he drew attention to the large errors resulting from the use of the log line marked using the 5,000 foot mile. He recommended the log line be marked at 50 feet intervals not the customary 42 feet (7 fathoms) which was the equivalent of a 6,000 feet mile (Taylor, 1956:230). The modern estimate of the nautical mile is 6080 feet made by French astronomers in 1756. Despite Norwood's work, in 1727 the French naval captain Radouay complained that the log line marked at 42 feet instead of 47½ feet based on Picard's measurement of the earth made in 1672, was still being used (Taylor, 1956:231). It was subsequently laid down by the French Government that the marks should be at 47ft 7ins. There were still complaints in 1781 of the continued use of the old 42 feet marking.

6.3.6. Other Causes of Navigational Errors

No matter how accurate navigational instruments, charts or steering compasses may be bad helmsmanship and lack of diligence by the Officer of the Watch in not assuring the steering is accurate can cause a vessel to deviate from the allotted course. This is particularly the case when sailing with a following sea in rough weather which can cause the stern of a vessel to be swung sideways, or broach, and can make it very difficult to follow an accurate course.

The incorrect or non-allowance for leeway caused by the windage of the vessels hull rigging, mast and sails or that caused by tidal streams may mean that a vessel although being steered on the correct course will not follow the intended course. The amount of leeway at any moment is dependent upon the amount of windage a vessel has and also the angle and strength of the wind. Knowledge of how much leeway to allow for with any given vessel is only gained through experience and practice.

Another factor for which the effect on a vessel is difficult to predict is surface drift. In the English Channel when the affects of the tidal streams have been eliminated there is still an underlying easterly set (Admiralty, 1971:40). It varies in strength along the Channel being at its maximum near the Dover Straits. It is caused by the action of the wind on the surface of the sea and its affect can only be estimated with experience and knowledge of the weather conditions during the last 48 hours (Admiralty, 1959:73). The rate of the surface drift approximates to one fiftieth of the wind speed and has the same affect as leeway.

All these factors mean that it is essential that the accurate position of a vessel be found frequently so that any necessary adjustments to the course can be made. Failure to do this by inattentiveness on the part of the navigator or inability due to poor weather may result in a vessel following a dangerous course and being wrecked.

6.3.7. Lighthouses and Sea-marks

The first lighthouse to be established in the study area was at St. Catherine's Down, Isle of Wight. Walter de Godeton, Lord of Chale, built it as a penance as the result of being found guilty of 'sacrilege' for buying 52 barrels of wine from the wreck of the *Mary*, which wrecked in Chale Bay on 22nd April 1313 (Medland, 1995:9). The wine belonged to the monastery of Livers, which demanded justice from Edward II. The lighthouse was completed in 1328 and was maintained by a priest endowed by Walter. The fire in the lighthouse, fuelled by faggots, was kept burning for 212 years until the dissolution of the monasteries. The effectiveness of this lighthouse must be in question due to the power of the light it would have produced especially at times of fog, mist and low clouds which are the times it would most be needed (see below).

Some of Henry VIII's actions to improve safety at sea have already been mentioned. In 1514 he set up the Corporation of Trinity House for the advancement and benefit of navigation and commerce. In 1565 Elizabeth I introduced an Act which extended the authority of Trinity House to set up and maintain beacons, marks and signs on the sea-shores and heights, as well as the approaches to ports of England and Wales as seem necessary. It also became an offence to destroy steeples or conspicuous trees used as recognised beacons (Waters, 1958:10).

In 1785 Trinity House began to construct three lighthouses, at Hurst Castle, the Needles and on St Catherine's Down (Medland, 1995:14). The Hurst light was completed in September 1786, but was not effective and was replaced in 1811 after the loss of *H.M.S. Pomone* on Goose Rock. The Needles lighthouse was being built on the top of the 500-foot cliffs above Scratchells Bay, a site that was found to be frequently shrouded in fog or mist. The St Catherine's Down light site was similarly found to be often buried in cloud. Both buildings were abandoned. It was not until 1840 that another lighthouse was built at St. Catherine's on the Point. It was found to be too high because of the prevalent fog and mist and in 1875 it was shortened by 20 feet (Beaver, 1971:59; Medland, 1995:22). A new lighthouse built on the outermost point of the Needles was completed in 1859.

Chapter 7 - Maritime Hazards

7.1 Introduction

The waters and coastline of the study area hold a significant number and types of dangers for mariners. Mew (1974,1-2) includes a passage in his book which gives a vivid picture of the problems mariners encountered on the south-western coast of the Isle of Wight, 'The wind blows a whole gale from the south-west and the sea breaks in fury on the beach below. In the offing some vessel is trying to beat her way out of the bay, sails battered and gone, every sea sweeps over her, until the odds become too heavy against her, and she drives ashore to become a wreck, smashed to atoms and her crew drowned'.

Medland provides a fuller description of the hazards around the Isle of Wight (1995:5-6). The sentence from his book, already quoted in Chapter 1, 'The Island's 100 km coastline is unevenly scattered with a succession of appalling marine hazards which leave little room for luck and good seamanship in adverse conditions' applies just as well to the rest of the coastline and waters of the study area.

7.2 Maritime Hazards of the Study Area

Starting in the east, (see Figure 7.1) Selsey Bill with the rocks and banks, which extend almost 8 km offshore, guards the eastern entrance to The Solent and provides a trap for the unwary or those trying to take a short cut. The coast between Selsey Bill and the entrance to Chichester Harbour is a lee shore in the prevailing south-westerly winds and is particularly a danger to any ship trying to enter that harbour from the east. This part of the coast and the rocks and shallow waters off Selsey Bill are also a trap waiting to ensnare any ship blown before the wind from the anchorages of Spithead and St. Helen's. The entrance to Chichester Harbour has the combined dangers of the bar and the East and West Pole Sands that extend at least 2 km off shore. On spring tides the outgoing stream can reach 6½ knots (Brackenbury, 1981:74) and the entrance should not be attempted in strong SE and W winds. The harbour provides good shelter, but at low tide the water is reduced to narrow

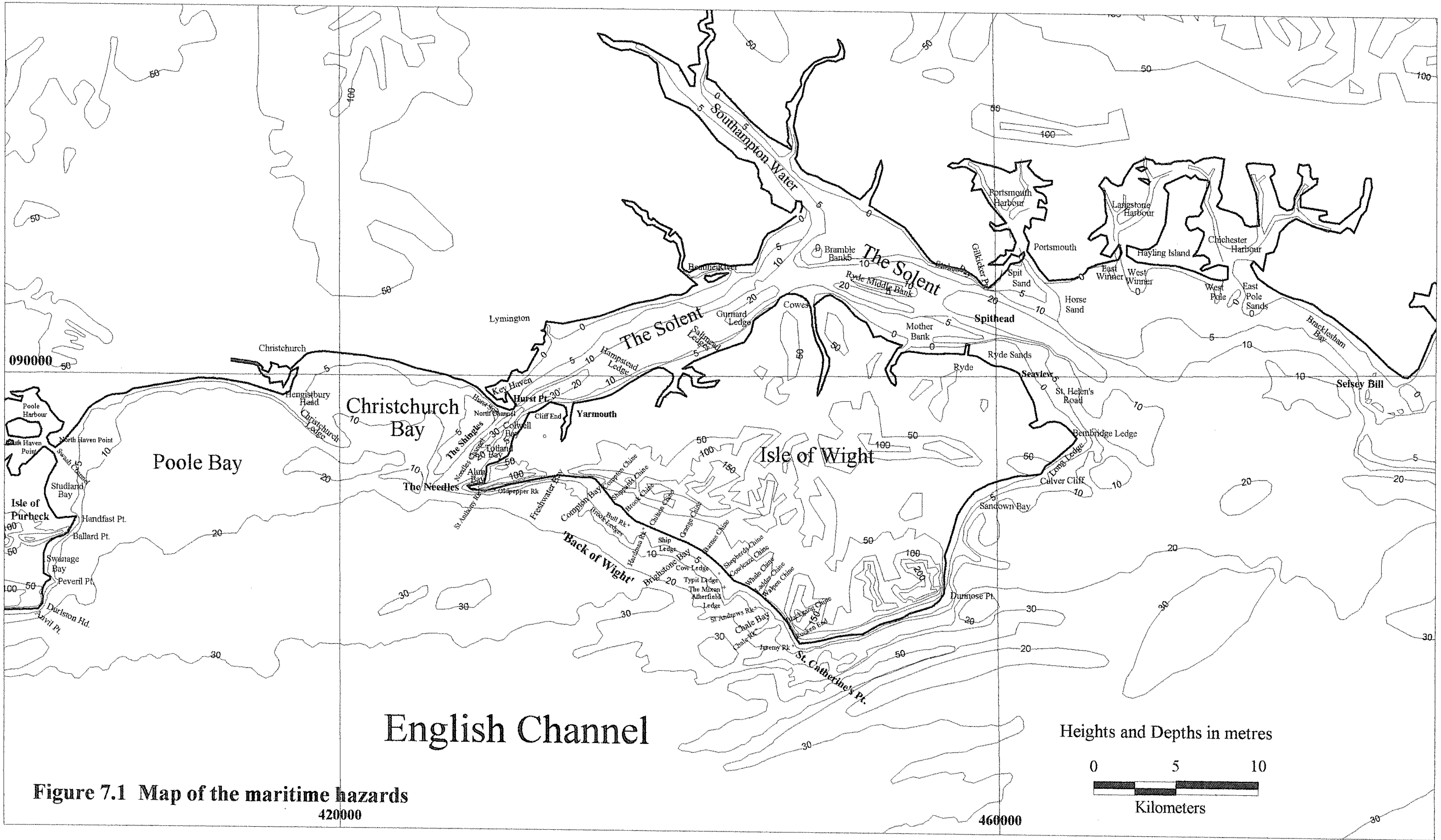


Figure 7.1 Map of the maritime hazards

channels lined by mud and sand banks.

To the west of Chichester Harbour is Langstone Harbour with similar dangers at its entrance, the bar, the East and West Winner Banks and a strong tidal stream. As would be expected a similar warning applies to trying to enter in strong winds. Inside Langstone provides good shelter, but dries to narrow channels at low water.

Further west again lays Portsmouth Harbour with its narrow entrance facing south-east. The long main entrance channel runs between two large sandbanks, Spit Sand and Horse Sand. The tidal stream through this entrance runs at up to 4-5 knots on the flood (Brackenbury, 1981:70). Inside the harbour opens out to a large expanse, much of which is filled with mud banks at low tide. The suitability of Portsmouth Harbour has made it the important naval base it is, with a naval history that goes back, perhaps with gaps, to Roman times.

The long Solent shorelines of the Hampshire mainland from Portsmouth to Hurst Point, sheltered from the worst of the south-westerly storms by the Isle of Wight, still provide dangers for the mariner. The coastline from the entrance to Portsmouth Harbour to Gilkicker Point is a lee shore in easterly gales with the added danger of the offlying Spit Sand and the Hamilton, Haslar and Harrow Banks. To the west of Gilkicker Point the coastline runs to the north-west. It is a lee shore for the ships anchored in the eastern Solent as the wrecks in Stokes Bay testify. In the centre of the East Solent lies the Ryde Middle Bank that is a danger, at low tide, to vessels drawing about 3½ metres or more.

Both the Solent and Southampton Water are rias, part of the ancient Solent River system (Everard, 1954:57). Although almost completely surrounded by land, in strong wind and with the wind blowing against the strong tidal currents the waters of the Solent can become 'a raging tempest' (Medland, 1995:5). The wind is funnelled by the land and accelerated (Watts, 1987:64 & 122). Shallow mud and sand banks line the shore of the Solent and Southampton Water, but the main channel is deep. On the Hampshire shore of the West Solent are the three havens of the Beaulieu River, the port of Lymington and Keyhaven tucked in behind Hurst Spit.

Medland (1995:5) describes the coastline of the Isle of Wight from Seaview to Yarmouth as 'the safest stretch with its gentle shoreline and fine harbours, sheltered from the prevailing winds by the Island's long ridge of high chalk downs'. However this does not explain why Ryde Sands is the resting-place of a number of wrecks blown there by the easterly gales (see Chapter 8), which although infrequent make the eastern end of the island so treacherous. Also the entrance to Cowes Harbour where more wrecks are located. Between Cowes and Yarmouth are three rock ledges, Gurnard, Salt Mead and Hamstead, which protrude into the Solent. They are not a major danger to those who navigate with caution, but still need to be avoided.

At the western end of the Solent is the narrow entrance between Hurst Spit on the Hampshire side and the Point at Cliff End on the Isle of Wight, a distance of about one kilometre. This constriction results in the tidal stream achieving 5 knots on the ebb. The North Channel, close to the Hampshire coast, allows small craft to escape into the quieter waters of Christchurch Bay. Larger craft have to use the Needles Channel that runs between The Shingles, 'a mountainous shoal of pebbles about 5 km long and almost as high as the sea' (Medland, 1995:5), and the Isle of Wight. The Shingles almost completely blocks this entrance to the Solent, a major danger that has caught many a ship. To the west of Yarmouth and through the Hurst narrows the three bays of Colwell, Totland and Alum, line the Isle of Wight side of the Needles Channel. They are the sites of a number of wrecked vessels that did not make it into or out of The Solent, either because of too much wind or too little. Warden Ledge, between Colwell and Totland Bays, juts out into the main channel for about three quarter of a kilometre. Medland (1995:5) writes until the last century this part of the coastline was an unbroken stretch of high overgrown cliffs and boulder-strewn beaches. The narrow gap between The Shingles and The Needles is also a major danger to ships with its fast tidal steam, accelerated winds, confused seas and propensity for fog (see Chapters 8 and 9). Medland (1995:5) states The Needles have been called 'the terror of all mariners'. Passage notes (Brackenbury, 1981:50) provide the following warning for ships entering the Needles Channel, 'If the wind should be fresh onshore do not close with the land unless certain of your position', advice which many a mariner wishes they had followed.

Between the Isle of Wight and the Isle of Purbeck lie Christchurch Bay and Poole

Bay. Christchurch Ledge, which lies between the two bays, is probably the remains of the receding coastline and a headland. What is left of the headland is now Hengistbury Head (Small, 1964:49). The harbour of Christchurch, now very different from when it was a major port of entry (Cunliffe, 1993:201), has a very narrow and difficult entrance only suitable for small vessels. The stream through the entrance is 'fierce on the ebb' and should only be attempted during the high water stand particular to the Solent region.

Poole, like Christchurch, was an early port (Cunliffe, 1993:147), but unlike Christchurch, still is an important commercial port. The harbour is very large, almost 160 km in circumference (Coles, 1973:88), and provides good shelter behind the small islands within it. The entrance, via the Swash Channel, can be difficult, especially on the ebb and over the bar in strong winds between south and east (Brackenbury, 1981:45). In the narrow entrance between the North and South Haven Points the ebb can reach 9 knots in springs. Outside Poole Harbour, lies Studland Bay, which provides a good anchorage and is sheltered from winds from south through west to north-west. This bay is frequently used as a refuge and was probably used by early sailors as an anchorage while waiting to enter Poole or Christchurch Harbours.

Further to the west lie five headlands, Handfast Point, behind which Studland Bay shelters, Ballard Point marking the northern tip of Swanage Bay, Peveril Point on the southern tip of Swanage Bay, Durlston Head and Anvil Point. Under certain conditions rough water occurs off all of them (Brackenbury, 1981:43). Off Handfast Point and Ballard Point a south-westerly or southerly wind blowing against the ebb tide causes overfalls (D'Oliveira & Lees-Spalding, 1990:230). Off Peveril Point, Peveril Ledge extends almost half a kilometre to seaward and causes a race, which extends about 1.5 km to seaward, and can be particularly violent on the ebb against a south-westerly wind. At the peak of the ebb the tide runs at 3 knots. On the flood the tidal stream sets towards the ledge at up to 1½ knots. Between Durlston Head and Anvil Point a race occurs on the ebb and once again is roughest in a south-westerly wind.

Returning to the Isle of Wight, between the Needles and St. Catherine's Point to the east lies the most treacherous stretch of the Island's coastline, The 'Back Of Wight', with the highest number of wrecks recorded in the area. This 29 km stretch of coast, with the shallow indentations of Compton Bay, Brighstone Bay and Chale Bay and the small deep cut Freshwater Bay, is armed with numerous rocks; St. Anthony Rock, Oldpepper Rock, Bull Rock, Hardman Rock, The Mixon, Saint Andrews Rock and Jeremy Rock, and ledges; Brook Ledges, Ship Ledge, Cow Ledge, Typet Ledge and Atherfield Ledge. The cliff lined coast is punctured by numerous chines; Compton Chine, Shippards Chine, Brook Chine, Chilton Chine, Grange Chine, Barnes Chine, Shepherds Chine, Cowleaze Chine, Whale Chine, Ladder Chine, Walpen Chine and, probably the most famous of them all, Blackgang Chine. This stretch of coastline, lying at right angles to the prevailing wind has been the trap into which countless numbers of vessels have fallen, embayed. It is notorious for blinding fogs, a steady ocean swell and driving south-westerly storms from the Atlantic Ocean (Medland, 1995:6). It is the most exposed of all the coasts of the Solent area, with a fetch of about 5,000 km from the coast of Brazil. Probably the most dangerous part of this coast, with Atherfield Ledge at its western end and St. Catherine's Point at the east, is Chale Bay. 'The Receiver General of Wrecks for the Isle of Wight' as *The Times* once called it. At St. Catherine's the land rises steeply to 236 metres. On the coast the cliffs rise to about 150 metres at the base of which lies 'the boulder strewn chaos of Rocken End where the currents are faster, the beach slopes steeper' (Medland, 1995:6). If the embayed mariner manages to avoid the gnarled outcrops of Rocken End he is sometimes faced with an even more horrifying danger, St. Catherine's Race. It is one of the worst around the British Isles. Ships swamped and sunk in the race often disappeared with all hands and without any trace of wreckage.

The steep, rock-strewn, coast from St. Catherine's eastwards to Dunnose Point has no havens. Sandown Bay is little better, with steep, high cliffs it provides shelter from south-westerly winds but is open from the south to the north-east, another embayment trap, this time in southerly and easterly winds.

The eastern end of the Isle of Wight is no friend to the mariner with, the 90 metre Culver Cliff, the broad rock shelf of Long Ledge, and offshore shoals and rocks. The most dangerous of all is the submerged ridge of Bembridge Ledge, lying just offshore at the eastern extremity of the island; it is another renowned graveyard of ships.

Between Bembridge Ledge and Seaview lies St. Helen's where the Roads have been through history, and still are, being use as a safe anchorage. The whole of the Isle of Wight acts as a barrier to the south-westerly winds. Though that is not always enough as it was proved by the hurricane of 26/27th November 1703 (see Chapter 2). The Roads are also wide open to easterly and north-easterly winds when the adjacent coast becomes a lee shore.

Chapter 8 - Meteorology

8.1 Introduction

Not all of the wrecks included in the database have associated reports on the weather conditions. A major problem in identifying the weather at the time of the wrecking is that the coastguard records for the Solent Area, which would have provided over 200 years of daily weather records, were destroyed in the Trinity House archive during the Second World War blitz of London. Therefore other meteorological records have to be used to build up a representation of the weather in the Solent area. This is of necessity a modern representation as a large percentage of the meteorological records, especially those prior to the Meteorological Office daily records commencing in 1861, concentrate on the weather which would be of interest to a landsman, i.e. rain, snow, drought, thunderstorms and 'tempests'. The recording of wind speed, wind direction and sea state are infrequent or absent. In addition the early Meteorological Office records do not always record wind speed and where it does exist may not be accurate (Palutikof, Holt & Skellern, 1997:225). Extrapolation will be required for earlier periods when the climate was different.

Details of the weather in early periods in England can be found from such documents as journals kept by various people and manorial account rolls. An example of the latter is from the Bishopric of Winchester (Ogilvie & Farmer, 1997:115) which cover the longest period of time for which weather information is available. This type of weather information becomes prevalent from the twelfth century, but declines in the fifteenth. Here again the type of weather recorded is that which primarily affects agriculture (Ogilvie & Farmer, 1997:118) and concentrates on the summer and autumn periods. Lamb (1977:372-4, 384-5), provides details of the European climate covering the period of this study which McGrail (1998:259) summarises when he writes that the climate, back to *c.*1000 BC was generally as it is now. Ogilvie & Farmer (1997:115) modify Lamb's descriptions by suggesting the terms 'Medieval Warm Period' and the later 'Little Ice Age' should be used with caution as the later research shows the climatic pattern was far more complex. Their summary of

Medieval English weather is a long time-scale cooling *c.*1240 - 1340, warming to *c.* 1510, and thereafter cooling again. Lamb (1982:201) provides more detail in suggesting the warmth of the early sixteenth century was due to an increased frequency of anticyclones in the zone between latitudes 45 to 50° N giving westerly winds over northern Europe. For the period 1550 to after 1700 there were frequent anticyclones north of 60° N giving winds from between northeast to southeast south of that latitude. The cooling of the climate in the early sixteenth century had noticeable economic effects. It caused the decline of the Norwegian herring fishing industry due to the fish moving from the Norwegian coast further into the North Sea to find warmer water, which was to the benefit of the Dutch and English fishermen (Lamb, 1982:218). Later in the seventeenth century the Dutch economy was affected adversely by the occurrence of major storms that broke the dykes and caused flooding together with lower farming and fishing yields (Lamb, 1982:218). The average winter temperatures for central England for the period 1670 to 1700 indicate that the ground would have had snow coverage for 20 – 30 days compared with 2 – 10 in the twentieth century (Lamb, 1982:221). The River Thames froze over at least eleven times during the seventeenth century. Conversely there were also some very hot summers, for example 1665 and 1666, famous for the last major plague outbreak and great fire respectively in London. From approximately 1700 there was erratic warming. The first lasting about 20 years followed by others in the 1740s to 1750s and 1780 to 1808 (Lamb, 1982:232). It was not until the late nineteenth or early twentieth century that the warming became more consistent (Lamb 1982:239-241) even so the coldest weather since the 1690s occurred in England during 1810 to 1819.

8.2 British Isles Meteorology

The British Isles, situated on the west coast of the European landmass between 50°N and 60° N has a climate dominated by polar fronts (Palutikof, Holt & Skellern, 1997:220). The instability of the polar front causes depressions to form, which track across the Atlantic taking a favoured path between Iceland and Scotland. By the time the depressions reach the British Isles they are generally in a maturity or decay phase, which result in an occlusion. The weather of the British Isles is distinguished by frequent strong winds (Palutikof, Holt & Skellern, 1997:220 & 240).

Both the prevailing and strongest winds predominantly blow from the southwest. The strongest winds are felt on the west coast, particularly in the northwest, decreasingly to the south and east. The highest wind speeds occur at the coast and exposed upland locations. The number of gales occurring each year varies considerably as indicated in Figure 8.2.

8.3 English Channel Meteorology

The English Channel forms a waterway which lies roughly in a WSW - ENE direction, just over 550 km in length. It is approximately 185 km wide at its western end and 37 km wide at its eastern end, the Strait of Dover. Under the influence of the prevailing southwesterly and westerly winds, blowing across the North Atlantic, the climate is windy, very cloudy, damp and rainy (M.O.446b(3), 1940:7). Nearly all kinds of weather may occur in any month. The two major threats to ships are gales and fog. Poor visibility at sea may occur at any time of the year, but is infrequent, with a chance of occurrence of about 7% in the central part of the Channel. The percentage frequency of visibility of not more than 1.85 km (fog) and not more than 9.3 km (mist) in the central part of the English Channel are shown in Table 8.1 (M.O.446b(3), 1940:61) below:

Table 8.1 - Frequency (%) of Fog and Mist in the Central English Channel

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fog	2	2	3	3	4	5	3	4	2	1	2	1
Mist	13	21	20	17	19	19	17	16	15	11	11	16

In the winter SW winds predominate, in Spring there is an increase in N and NE winds especially on the English coast, in Summer the direction is mainly between SW and NW, in Autumn N and NE winds predominate on some parts of the English coast but for most areas SW or W winds prevail (M.O.446b(3), 1940:11-18). Gales occur most frequently in December and January and are infrequent from April to

September. The chances of a gale are about 30 times greater in January than in June in the central area of the Channel (M.O.446b(3), 1940:21). The most frequent direction for gales at all times of the year in the central part of the Channel are from the W or SW and when accompanied by rain, blow in violent gusts. In the English Channel gales occur on 10-20 days per year (Chandler & Gregory, 1976:70). The monthly frequency of wind direction and force 8-12 winds for the western and central parts of the English Channel, based on observations between 1855-1938, are shown in tables 8.2 and 8.3 below (M.O.446b(3), 1940:Table II).

Table 8.2 - Monthly Frequency (%) of Wind Direction in the Western and Central English Channel

	N	NE	E	SE	S	SW	W	NW	Calm
Jan	11.1	7.2	5.2	7.2	14.0	19.0	19.0	13.8	1.0
Feb	6.1	12.1	15.2	11.2	10.6	17.0	15.0	9.3	2.0
Mar	6.1	13.3	13.3	8.1	9.3	14.8	16.0	11.3	3.0
Apr	9.0	11.3	11.1	9.0	8.1	13.1	16.3	13.2	8.0
May	9.0	11.0	11.1	6.1	7.0	15.1	15.1	13.0	8.0
Jun	11.0	12.0	10.0	7.0	7.1	14.1	16.1	13.0	8.0
Jul	9.0	7.0	6.0	4.0	7.0	22.1	22.1	13.2	4.0
Aug	6.0	6.1	7.0	7.0	10.0	20.1	22.2	12.0	4.0
Sep	9.1	9.0	8.0	5.0	9.2	16.4	18.3	13.5	5.0
Oct	7.1	15.4	12.2	8.1	8.6	15.8	17.5	10.3	3.0
Nov	12.3	12.9	11.5	10.3	8.4	10.7	17.0	14,4	0.6
Dec	9.2	9.5	8.1	9.1	11.4	18.0	19.0	13.9	0.8

The southwest coast of England is one of the stormiest coasts of the British Isles, with an average of 32 gales per year (M.O.446b(3), 1940:23). The central part of the English Channel has an average of 25.5 gales per year, approximately 20% of which may be classed as severe - Beaufort Force 10 or above. Table 8.4, below, shows the average number of gales on or near the central part of the south coast of England (M.O.446b(3), 1940:22).

Table 8.3 - Frequency (%) of Force 8-12 Winds in the Western and Central English Channel

	N	NE	E	SE	S	SW	W	NW	Totals
Jan	<0.1	0.2	0.2	0.2	1.0	2.0	1.0	0.8	6.0
Feb	0.1	0.1	0.2	0.2	0.6	1.0	2.0	0.3	5.0
Mar	<0.1	0.3	0.3	<0.1	0.3	0.8	1.0	0.3	3.0
Apr	0.0	0.3	<0.1	0.0	0.1	0.1	0.3	0.2	1.1
May	0.0	0.0	<0.1	<0.1	0.0	<0.1	<0.1	0.0	0.2
Jun	0.0	0.0	0.0	0.0	<0.1	<0.1	<0.1	0.0	0.2
Jul	0.0	0.0	0.0	0.0	0.0	<0.1	<0.1	0.2	0.4
Aug	0.0	<0.1	0.0	0.0	0.0	<0.1	0.2	0.0	0.3
Sep	<0.1	0.0	0.0	0.0	0.2	0.4	0.3	0.5	1.0
Oct	0.1	0.4	0.2	<0.1	0.6	0.8	0.5	0.3	3.0
Nov	0.3	0.9	0.5	0.3	0.4	0.7	1.0	0.4	5.0
Dec	0.2	0.5	0.1	0.1	0.4	2,0	2.0	0.9	7.0

Table 8.4 - Average Number of Gales on or near the Central Part of the South Coast of England

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3.5	3.1	2.4	1.1	0.6	0.3	0.6	1.4	1.2	3.1	4.0	4.4

The gales predominantly blow from the west or southwest.

8.4 Solent Meteorology

Mist and fog can form when the atmosphere contains an adequate concentration and size of water droplets and the air is then cooled below its dew point (Chandler & Gregory, 1976:211). This can occur when a current of warm air passes over colder sea or land or when the air is cooled as it is forced to rise by high ground. The environment to produce both of these conditions exists on the Isle of Wight, particularly on the southwest coast where in summer the south-westerly air stream is forced to rise by the tall chalk cliffs. In the winter that coastline is the first land the warm south-westerly air meets having picked up moisture from the Atlantic Ocean. On the coast of the Isle of Wight the chance of the occurrence of fog is therefore higher than in the Channel at over 10%, exceeding 20% locally (M.O.446b(3), 1940:63), with the greatest frequency in spring and early summer when the sea temperature is low.

Table 8.5 below shows the variation of the frequency of poor visibility through the year. It details the average number of days per month of poor visibility - less than 3.7 km - at Calshot and Portsmouth. The figures derive from statistics collected between 1927-1936 (M.O.446b(3), 1940:61):

Table 8.5 - Average Number of Days of Visibility Less Than 3.7 km

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calshot	8.0	9.0	11.0	6.0	3.0	3.0	3.0	4.0	6.0	6.0	8.0	8.0
Portsmouth	11.0	7.0	4.0	1.0	0.3	0.0	0.3	0.4	0.7	2.0	9.0	12.0

Note:

The Calshot figures are for visibility at 0700,1300 and 1800 while the Portsmouth figures are for 0900 only.

Observations at Calshot have shown that apart from the seasonal variation the chances of poor visibility are greater with land winds in winter and with sea winds in summer (M.O.446b(3), 1940:72). Table 8.6 details the percentage frequency of poor visibility - less than 1.85 km - with winds of different direction and speed.

There is also diurnal variation (Chandler & Gregory, 1976:Table 9.1) where restricted visibility occurs predominantly around dawn, or shortly afterwards, and that the best visibility tends to occur in the afternoon with the visibility reducing during the night.

Table 8.6 - Frequency (%) of Visibility of less than 1.85 km at Calshot Under Different Wind Conditions

	N	NE	E	SE	S	SW	W	NW	Totals
Calm	-	-	-	-	-	-	-	-	16.0
1-3 knts	6.0	2.0	2.0	1.0	0.0	1.0	1.0	6.0	19.0
4-6 knts	10.0	4.0	5.0	2.0	0.5	0.7	2.0	7.0	31.0
7-10 knts	5.0	3.0	4.0	2.0	0.5	2.0	0.5	3.0	20.0
Over 10 knts	1.0	2.0	2.0	1.0	1.0	6.0	0.5	0.7	14.0
Total	22.0	11.0	13.0	6.0	2.0	9.0	4.0	17.0	

The percentage frequency of winds from the eight points of the compass, for each month, for Calshot and Portsmouth are detailed in tables 8.7 and 8.8 below (M.O.446b(3), 1940:table I). :

Table 8.7 - Frequency (%) of Wind Direction at Calshot

	N	NE	E	SE	S	SW	W	NW	Calm
Jan	9.0	8.0	6.0	5.0	14.0	23.0	20.0	14.0	0.6
Feb	20.0	11.0	10.0	7.0	7.0	16.0	13.0	14.0	2.0
Mar	13.0	13.0	15.0	5.0	8.0	12.0	15.0	15.0	4.0
Apr	19.0	8.0	9.0	7.0	7.0	13.0	14.0	19.0	4.0
May	21.0	14.0	11.0	6.0	5.0	14.0	11.0	15.0	3.0
Jun	19.0	8.0	10.0	4.0	8.0	19.0	16.0	15.0	0.7
Jul	15.0	5.0	7.0	4.0	7.0	20.0	21.0	18.0	3.0
Aug	11.0	7.0	9.0	3.0	7.0	21.0	21.0	16.0	5.0
Sep	22.0	9.0	6.0	6.0	8.0	17.0	15.0	16.0	1.0
Oct	10.0	9.0	5.0	3.0	5.0	27.0	20.0	19.0	2.0
Nov	13.0	10.0	6.0	8.0	11.0	16.0	17.0	17.0	2.0
Dec	12.0	14.0	7.0	7.0	14.0	14.0	15.0	14.0	3.0

Note:

The statistics for Calshot are for the years 1926-35 and the time of observation 0700 GMT.

Table 8.8 - Frequency (%) of Wind Direction at Portsmouth

	N	NE	E	SE	S	SW	W	NW	Calm
Jan	8.0	13.0	8.0	8.0	4.0	21.0	16.0	19.0	3.0
Feb	9.0	11.0	8.0	8.0	6.0	21.0	18.0	16.0	3.0
Mar	10.0	15.0	8.0	7.0	5.0	19.0	17.0	18.0	1.0
Apr	11.0	18.0	8.0	8.0	5.0	13.0	17.0	19.0	1.0
May	5.0	19.0	10.0	14.0	6.0	17.0	15.0	13.0	1.0
Jun	9.0	14.0	8.0	11.0	4.0	15.0	20.0	18.0	1.0
Jul	9.0	9.0	5.0	8.0	6.0	21.0	21.0	20.0	1.0
Aug	7.0	7.0	4.0	8.0	5.0	21.0	25.0	21.0	2.0
Sep	9.0	15.0	10.0	13.0	4.0	15.0	12.0	19.0	3.0
Oct	8.0	14.0	10.0	13.0	6.0	17.0	11.0	18.0	3.0
Nov	13.0	17.0	6.0	7.0	3.0	12.0	16.0	23.0	3.0
Dec	9.0	11.0	6.0	6.0	5.0	23.0	20.0	17.0	3.0

Note:

The statistics for Portsmouth are for the years 1926-36, except 1929 and the time of the observations 0900 GMT.

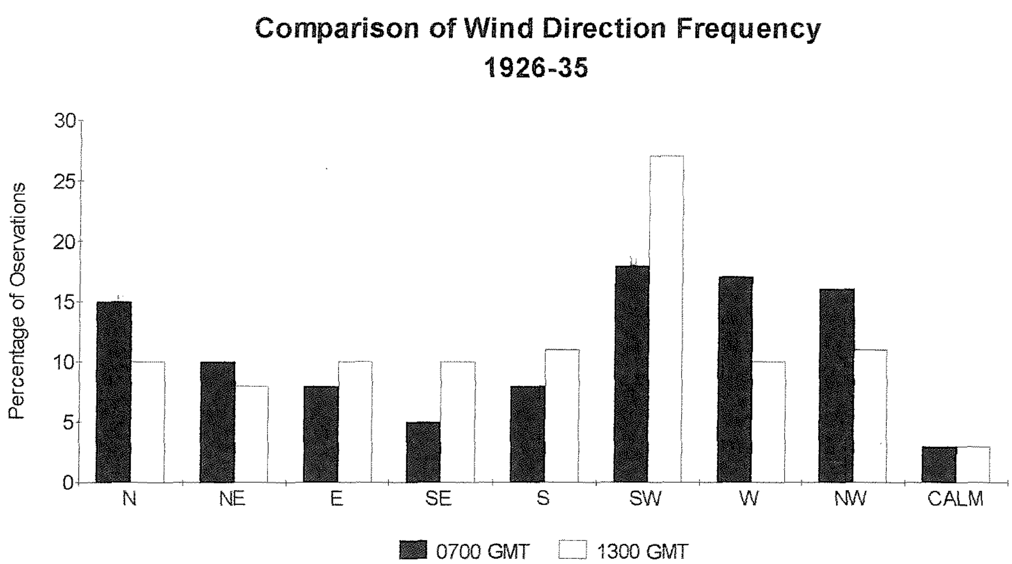


Figure 8.1 Comparison of wind direction frequency at Calshot, 0700 GMT and 1300 GMT

The wind is not constant and varies both in speed and direction. Table 8.9 below compares the recorded wind direction observations at Calshot at 0700 GMT and 1300 GMT (M.O.446b(3), 1940:table I).

The annual average number of days of gales at Calshot, is 6 and at Portsmouth, 11. The average number of days on which gales occur each month at Calshot and Portsmouth are shown in table 8.9 (M.O.446b(3), 1940:table I):

Table 8.9 - Average Number of Days on which Gales Occur at Calshot and Portsmouth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calshot	1.0	0.9	0.3	0.3	<0.1	0.1	0.2	<0.1	0.3	0.4	1.0	1.0
Portsmouth	2.0	2.0	0.7	0.6	0.1	0.5	0.5	0.5	0.9	1.0	1.0	1.0

Note:

The statistics for Calshot are from the years 1926-35 and for Portsmouth from the years 1926-36, except 1929.

The number of gales that occur in any one year is very variable, as shown in figure 8.2 below.

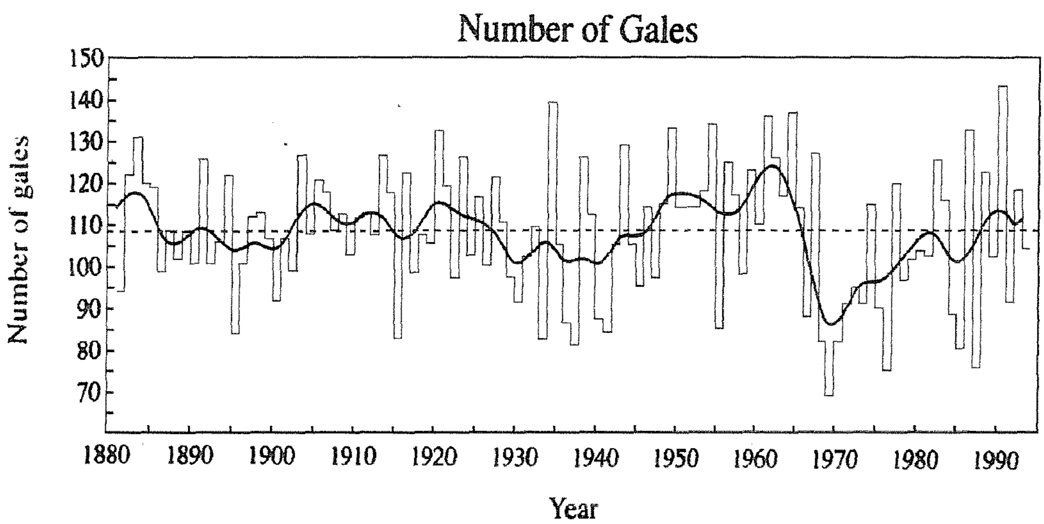


Figure 8.2 - Number of gales per year for the Northern British Isles

(Palutikof, Holt & Skellern, 1997:figure 11.13)

For the period 1871-1900 the number of gales each year in the Channel varied from 10 in 1875 to 34 in 1883. The number also varied from 3 to 15 in winter, 0 to 8 in spring, 0 to 7 in summer and 2 to 14 in autumn (M.O.446b(3), 1940:23). In addition wind does not blow at constant speeds, it gusts as shown in figure 8.3 below.

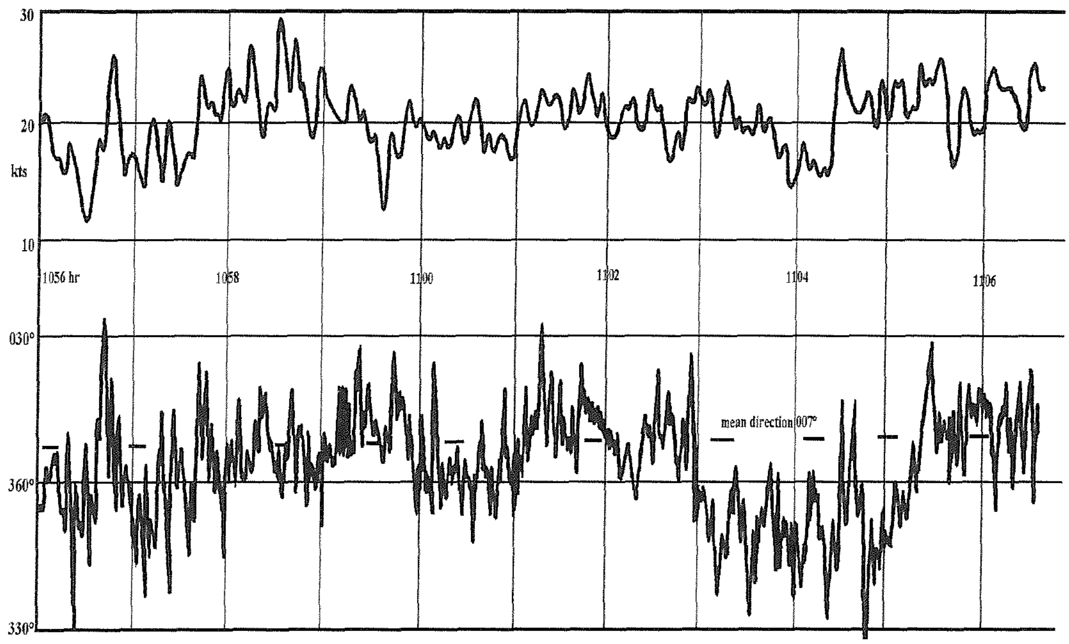


Figure 8.3 - A Day-time Wind Trace(Anemogram) (Watts, 1987:figure 3.3)

The upper trace is the wind speed and the lower trace is the direction. The wind veers as it gusts, that is, it changes direction clockwise, and backs, changes direction anti-clockwise, as the gust passes, or lulls (Watts, 1987:65). This change of direction can be as much as 45° (Watts, 1987:Table 3A).

Chandler & Gregory (1976:60) state that over the open sea the ratio of the gust velocity to the mean wind speed is approximately 0.3. This increases over the land; e.g. a mean wind of 30 knots would gust to approximately 35 knots over the open sea, about 37 knots over the coast and too much greater speeds over the land. Table 8.10, below details the gust speeds which can be expected at different wind speeds over the open sea and under the influence of land (Watts, 1987:tables 2.B & 2.C).

Table 8.10 - Wind Gust Speeds

	Beaufort Force	Speed (knots)	Maximum Gust Speed
On the open sea, Day or Night.			
	3	7-10	10-15
	4	11-16	17-24
	5	17-21	26-32
	6	22-27	32-41
	7	28-33	42-50
	8	34-40	51-60
Under the influence of land, Day.			
	3	7-10	14-20
	4	11-16	21-32
	5	17-21	30-38
	6	22-27	40-49
	7	28-33	45-53
	8	34-40	54-64
Under the influence of land, Night.			
	3	7-10	13-19
	4	11-16	21-30
	5	17-21	31-38
	6	22-27	40-49
	7	28-33	48-56
	8	34-40	58-68

To contextualise this for the study area, a force 8 gale, with a mean wind speed of 34 - 40 knots, could gust to 64 knots, the upper mean speed range limit for a force 11 violent storm, in the day time and to 68 knots, the speed of a force 12 hurricane, at night, over an exposed coastal location such as the south coast of the Isle of Wight.

Gusts during stormy weather are responsible for the majority of the damage caused by storms.

Variations in the frequency of winds from different directions during a day are usually small inland, but over the coast can be very significant (Chandler & Gregory, 1976:70). These variations can be caused by land and sea breezes, which develop due to the differential heating or cooling of the air over the sea and the land. In the Solent the sea breezes are from the SE to the SW and land breezes from the NW to the NE. Sea breezes often reach a speed of 10 to 15 knots and will strengthen or reduce the wind or change its direction.

Other factors have also been shown to affect the direction and strength of the wind. Watts (1987:47) identifies that, during the period of his study at Thorny Island, May to August inclusive in the years 1960 and 1961, when the wind speed was 18 knots, or greater, its strength varied with the state of the tide, increasing as the tide came in and decreasing as it went out. Representative figures are 18 knots before high water; 21 knots at high water with a highest gust of 35-40 knots and then a reduction to 15 knots after the tide had turned. Wind statistics recorded at Thorney Island show that with consistent strong winds, the maximum gusts occurred roughly one hour later each day, which matches the cycle of high water times. Unfortunately the Meteorological Office do not seem to have carried out any work in this area to prove whether it is a real phenomenon or not or why it should occur.

Chapter 9 - Effects of Topography

9.1 Introduction

The topography of the study area has significant effects on many of the factors that have been considered in identifying the causes of shipwrecks. The strong tidal streams and the hidden rocks, ledges and sandbanks have already been identified in Chapter 7, Maritime Hazards. Coastal winds are often subjected to localised steering by small-scale topographical features (Smith, 1976:251-252) and can be channelled even by the modest height of the Lymington to Calshot shore (Watts, 1987:64).

9.2 Effects of Topography on the Wind

The effects the topography of the coast has on the wind can be indicated by the variation in the records of wind direction and speed for the study area and demonstrated by the Synchronous Charts for the Royal Charter Gale in 1859 (Fitzroy, 1861). The Fitzroy charts are of the weather before and after the Royal Charter Gale recorded at a number of locations around the British Isles. Figure 9.1 below is an extract of one of the charts and shows the wind recorded within the study area at 9am on the 24th October.

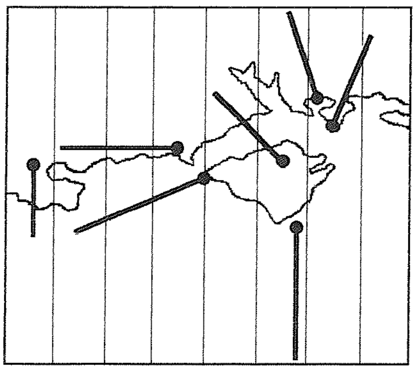


Figure 9.1 Recorded Winds at 9am, 24th October 1859 (Fitzroy, 1861)

There is considerable variation in direction and speed. The direction of the wind is indicated by the direction of the line drawn to leeward of a station where the wind was recorded. The length of the line indicates the wind speed. The wind direction recorded at the various locations became more consistent as the wind strength increased.

The effect of the shoreline topography on the wind flow and velocity can be determined from Watts (1987:120-122;Figs. 4.9 & 4.10) proposition as to the flow of sea breezes over the Isle of Wight and the shore between Seaton and Lyme Regis. The high cliffs are a totally dense barrier that will channel the wind along the shore until it can escape up river valleys, chines or bays (see Figure 9.2 below). The channelling effect on the wind also increases its velocity.

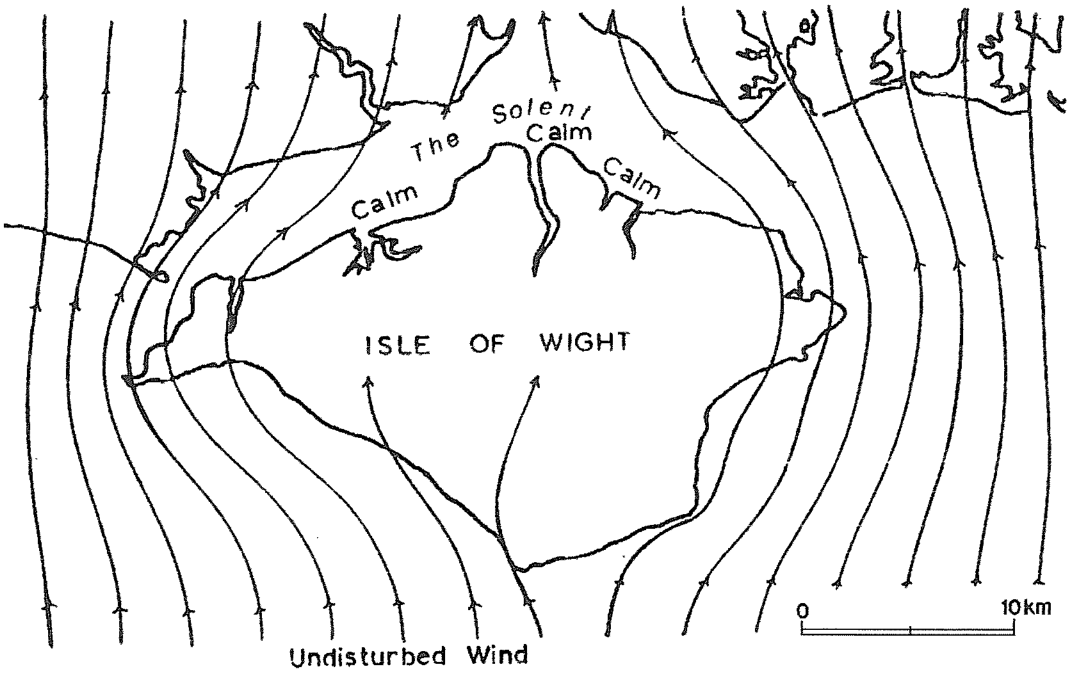


Figure 9.2 Possible sea breeze airflow across the Isle of Wight and the Solent (Watts, 1987:Fig. 4.10)

Similar flow diagrams can be envisaged for winds blowing in different directions. For example in a prevailing south-westerly, at the Needles the wind will be divided and accelerated, one part being channelled along the West Solent and the other parallel to the high cliffs of the south-west coast of the Isle of Wight until it reaches one of the many chines where it turns inland

In addition to the deflection of the wind in a horizontal plane a barrier in the path of the wind provides a lee. This lee can extend to 30-40 times the height of the barriers before the wind regains its full strength (Watts, 1987:109). The other aspect of the effect of barriers on wind is the resultant airflow to windward. This is applicable in the area of the high cliffs on the southern coast of the Isle of Wight and the Isle of Purbeck. Watts (1987:112-114) shows the wind rises to pass over the barrier and eddies form beneath it (Figure 9.3 below). This effect begins at a distance of up to 9 times the height of the barrier. The disturbance to the wind varies with the wind at different angles of incidence to a barrier (Watts, 1987:Fig 4.7a-c) when part of the flow may be deflected along the barrier.

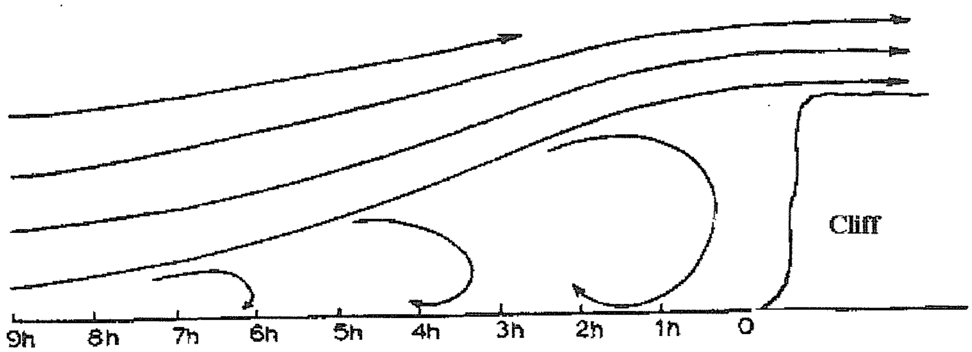


Figure 9.3 **Wind flow over solid barrier** (after Watts, 1987:Fig. 4.5)

Just east of the Needles the effect of this could commence to be felt almost one and a half kilometres to seaward and at St. Catherine's Point almost two kilometres to seaward.

Chapter 10 – Conclusions

10.1 Introduction

Chapter 4 detailed a large number of statistics derived from the historic reports of the shipwrecks included in the database, not all of which enable spatial parameters to be deduced. This chapter concentrates in determining the factors that will enable the potential locations of sailing vessel shipwrecks to be identified.

The reports and accounts of shipwrecks provide many different examples of the sequence of events that result in ships becoming wrecked. These include;

> The fireship *Mermaid Prize* which was burnt to the waterline in Portsmouth Dockyard on the 25th February 1693 when the Captain's servant dropped a lighted candle in a store room (Hepper, 1994:15).
>
> The collier *Seahorse*, chased ashore in Horseshoe Bay, Ventnor, Isle of Wight, by a French privateer on the 14th February 1757 (Mew, 1974:53).
>
> The sailing vessel *Hopkins*, on the 29th April 1781, which was laid on the mud at Gosport in Portsmouth Harbour to stop a leak and as the tide went out she fell over (Larn & Larn, 1995:Section 1).
>
> *H.M.S. Royal George* that capsized and sank at Spithead on the 29th August 1782 while being heeled to repair a hull fitting below the waterline (Medland, 1995:16-17).
>
> The brigantine, *Falcon*, wrecked at Dunnose Point, Isle Of Wight, on 2nd June 1860, when caught by a gale while anchored on the beach unloading coal (Phillips, 1995:12-13).
>
> The ketch, *Echo*, sunk on the Shingles Bank on the 12th March, 1883, when

she hit a wreck and stove in several planks while loading shingle from the bank (Larn & Larn, 1995:Section 1).

The brigantine, *Constance Ellen*, swept on to the Bass Rock, in the Needles Channel, on the 14th February 1894, by the current when the wind died (Phillips, 1988:83-85).

The ketch rigged barge, *Firefly*, on the 9th January 1906, struck by a huge wave on the starboard quarter, off St. Catherine's Point, thrown over on her port side and sunk (Mew, 1974:37-37).

Even though these sequences of events are many and varied there are shipwrecks that fit into readily identifiable patterns. The following group is an example;

The *Talé Bauré*, a Swedish brig, which was embayed in a SE gale and driven ashore at Culver Cliff, Sandown Bay, Isle of Wight, on 23rd March, 1866 (Phillips, 1988:63-66).

The *Alpheus Marshall*, a Canadian barque, caught close inshore in a gale and driven on to Atherfield Ledge, Isle of Wight, on 9th February, 1879 (Medland, 1995:31-32).

The French sailing vessel, *Georges Henri*, blown ashore at Ladder Chine, Chale Bay, Isle of Wight, when unable to make headway against heavy seas in a SW Beaufort Force 8 wind, on 2nd September 1883 (Mew, 1974:11 & 64).

The ketch, *Cameo*, went on to Ship Ledge, Brighstone Bay, Isle of Wight, when embayed in a SW Beaufort Force 6 wind, on 6th April 1890 (Mew, 1974:18 & 63).

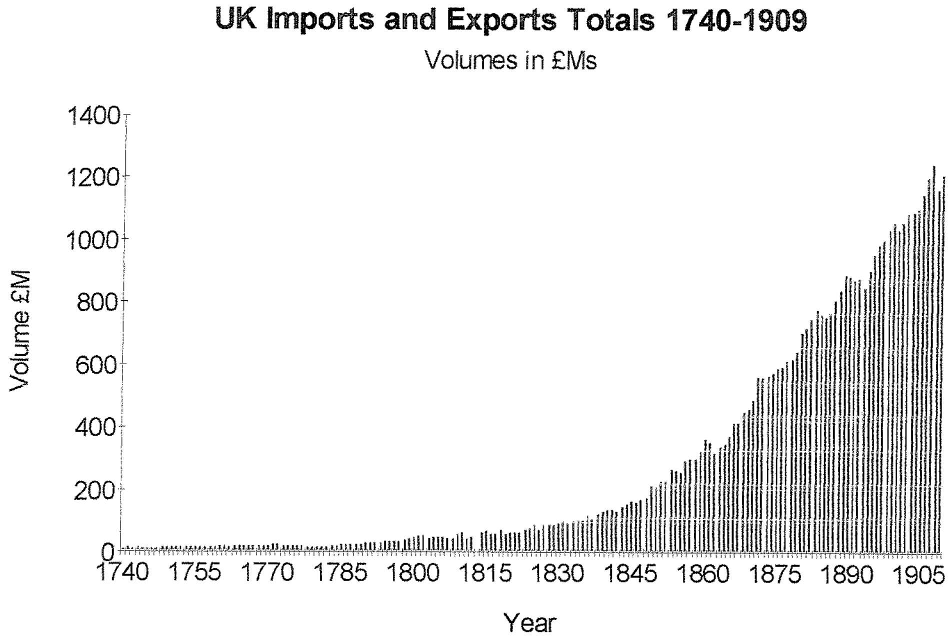
The schooner, *Dizzy Dunlop*, which ran on to Atherfield Ledge when embayed in the same strong SW breeze (Mew, 1974:18 & 63).

The French, brig, *Jeanne Benoni*, driven on to rocks at St Catherine's Point when embayed while trying to beat down the English Channel against a gale (Phillips, 1995:32-34).

Analysis of the number and locations of shipwrecks are major elements in the development of the predictive model. In addition there are the influences of trade patterns together with the periods when particular socio-economic or political considerations have an influence on trade and shipping and would have had an effect on the position and occurrence of shipwrecks. For example, following the abortive invasion of England by the Spanish Armada there are no records of any Spanish vessels being wrecked in the study area for a period of over one hundred years (see Table 4.10). Also there are the numbers of naval and transport vessels wrecked during the Napoleonic period when Portsmouth was not only a major naval base but also a mustering point for convoys (Phillips-Birt, 1967:51).

10.2 Volume of Shipping

In Chapter 5, Trade Routes and Volumes, it was suggested that it was logical to assume that the number of shipwrecks would be directly proportional to the volume of maritime traffic at any given location. The number of ships sailing in the study area on an annual basis is impossible to derive accurately. It is also not possible to identify exact trade figures, as there are many gaps in the records, but the customs records for England can possibly be used to indicate trends. For example with the increase in trade from the seventeenth century and the colonial expansion of the European powers, the number of ships sailing the English Channel would have increased. Also as Britain became a major force in European trade, British trade figures can possibly be used as an indicator of how the volume of trade, and hence the number of ships sailing the Channel, increased. The graph in Figure 10.1 shows the values for all overseas trade standardised at 1697 prices. As a large proportion of that trade was through London with countries for which the English Channel trade route would have been used (see Section 5.3), this graph can perhaps be used as an indication of the maritime traffic in the study area.



Note: The zero value for trade in 1813 is because Schlote (1938:Table 7) does not provide a figure for that year.

Figure 10.1 UK imports and exports 1740-1909 (Schlote, 1938:Table 7)

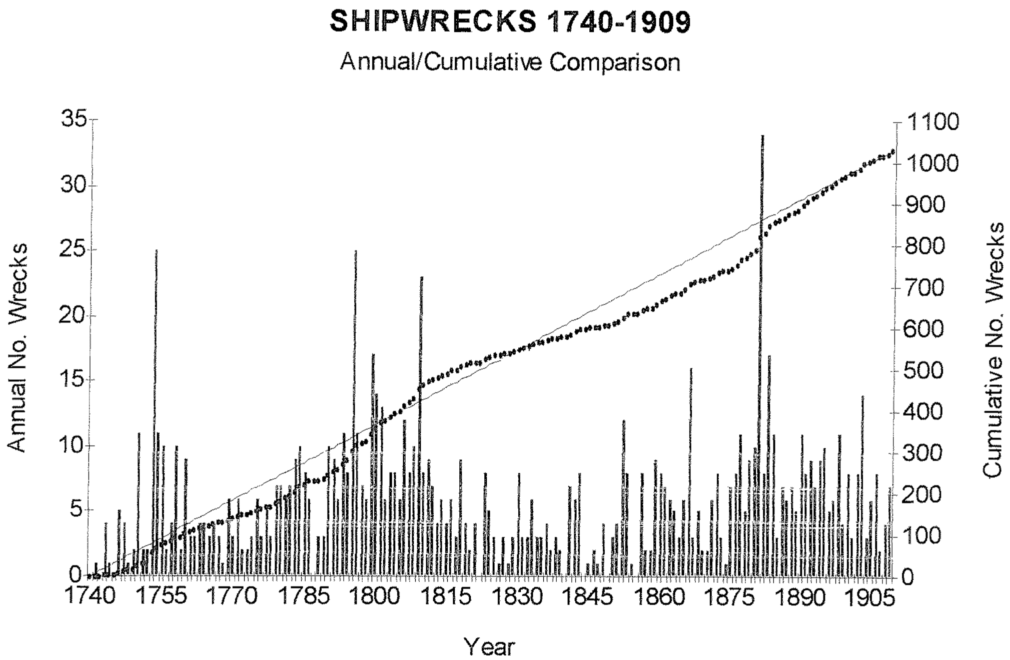


Figure 10.2 Annual/cumulative numbers of shipwrecks 1740-1909

The annual numbers of shipwrecks in the study area for the period 1740-1909 provide a very different distribution (see Figure 10.2) from that for trade. Whereas, the graph in Figure 10.1 is basically skewed towards the later dates when the trade increase becomes almost exponential, the graph in Figure 10.2 is multi-modal. This suggests that the number of shipwrecks is in fact not directly proportional to the volume of shipping and that other factors have a much greater influence on the causes of vessels being wrecked. Even so, logically, the volume, direction of flow and focus of the maritime trade must have affected both the number and location of the shipwrecks in any given period of time.

The Industrial Revolution (1760-1840) made a considerable difference to Britain's trade and by the mid-nineteenth century forty percent of all traded manufactured goods was produced in Britain, while a quarter of the world's trade passed through British ports (C.O.I., 1994:12). At the same time Britain became more dependent upon imported food. From the middle of the 1820s Britain's trade expanded vigorously (Schlote, 1938:42).

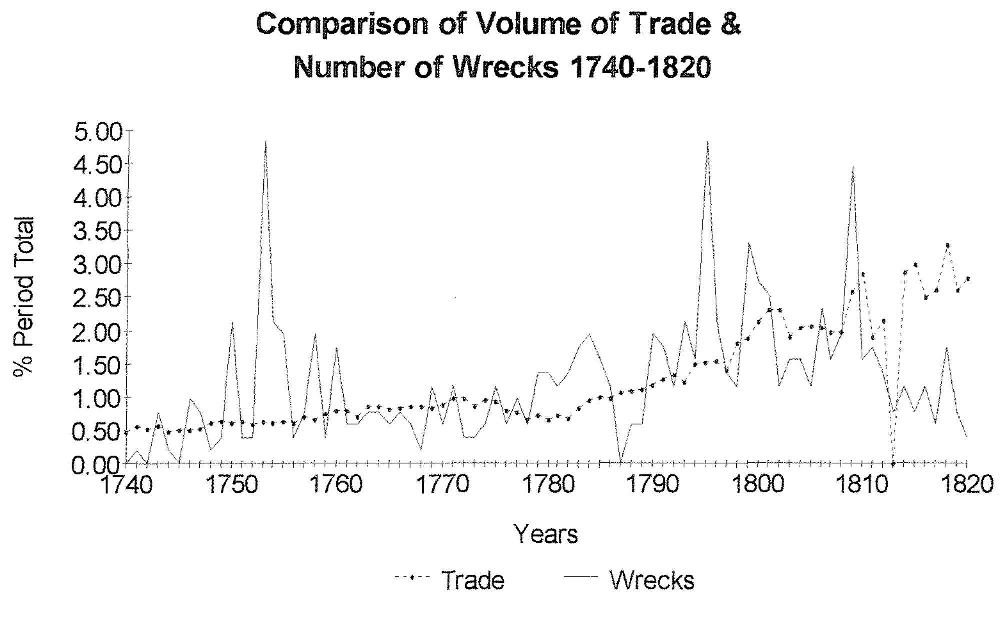


Figure 10.3 Comparison of the annual volume of trade and number of vessels wrecked 1740-1820

A closer look at the period 1740 to 1820 (see Figure 10.3) appears to suggest there may be a relationship between the frequency of vessels wrecked and the volume of shipping. Apart from the annual variation and peaks in the values for the number of shipwrecks, the two lines follow a similar increasing trend until about 1810 when the number of shipwrecks declines.

The annual variation and peaks in the numbers of shipwrecks for the period 1740-1909 suggest evidence of the influence of other factors. Figure 10.2 shows clearly the annual variability of the numbers of shipwrecks. It also shows how the cumulative number of shipwrecks oscillates around the constant mean represented by the straight line on the graph. There are four time periods where the annual number of shipwrecks increases above the mean of 6.06; the middle 1750s, the late 1770s to the early 1780s, the late 1790s to the early 1810s and the late 1870s to the early 1890s. All, except the last of these periods, coincide with periods of warfare affecting the English Channel. The first period is close to and overlaps the Seven Years War (the high annual total in 1773 is analysed in detail below). The middle two periods coincide with the war of 1778-1883 and the Revolutionary and Napoleonic Wars 1793-1816. The annual mean for these periods are 6.5 and 9.875 respectively. During these periods of hostility vessels of Britain and her allies probably kept close to the English coastline, a situation that probably gave them less room to manoeuvre if they got into trouble. They would also, possible, have put to sea in marginal weather conditions in an attempt to avoid being caught by the enemy. In other words they took greater risks. The reduction in shipwrecks during the latter part of the Napoleonic War could be due to improved confidence on the part of ship owners and captains, when following the battle of Trafalgar, the French Navy became much less of a threat.

The period from the end of the Napoleonic War to the commencement of WWI was one of peace in the English Channel. Both the cumulative and the annual values of the graph in Figure 10.2 shows that after 1810 there was an overall decline in the number and rate at which ships were being wrecked until about 1880. The annual mean for the number of shipwrecks during that period is only 4.73. There then followed an increase in the numbers over a period of about fifteen years. This is not principally due to the high annual total for 1881 as the mean for 1882-1895 is 8.43. This increase is perhaps surprising considering it was a time of peace, (there was increased tension between the European powers, but no direct hostilities), and particularly so considering the developments that had been made which would have improved safety at sea.

Over time there had been many technical developments to ships and their equipment that would have improved their safety. Bosscher (1995a:7) identifies two such developments, the steering wheel introduced about 1703, which must have made steering a given course much easier than a tiller and the triangular headsail, in the latter part of the seventeenth century, which would have improved the capability of a vessel to sail close-hauled. The latter of these two developments was the precursor to the development of more easily managed sail plans with smaller, but increased number of sails that made for faster and safer voyages (French, 1995:28-29). There was also a trend for vessels to become larger (French, 1995:24-27). The increase in the size of ships can be clearly seen in Table 4.17 in the middle to late eighteenth century. The nineteenth century saw the introduction of the use of iron and steel in vessel construction both for the hull and rigging. This allowed much larger vessels to be built. In addition there was an increase in the use of and number of fore and aft sails (Allington, 1993:154-162). This particularly applied to the vessels in long distance overseas trade. The more easily handled sail plans and the improved hull shapes were also diffused down to the smaller wooden sailing vessels. These would have improved the capability of sailing to windward and hence safety.

The use of iron also brought the introduction of chain cable for anchors, rather than hemp rope, about the beginning of the nineteenth century (Kemp, 1976:125). The stronger and heavier chain cable must have made anchoring safer. Although the number of vessels that can be identified as being at anchor before being wrecked is small there is a definite division about 1860 in the description of how they were wrecked. The earlier descriptions are of vessels being parted from their anchors while the latter state the vessels dragged their anchors.

As already mentioned in Chapter 2 the nineteenth century saw considerable pressure being put upon the government to improve safety at sea. Samuel Plimsoll was a prime mover in highlighting the use of overloaded and unseaworthy vessels. His work culminated in the introduction of the Merchant Shipping Act, 1876 which gave the Board of Trade strict powers of inspection and made the Plimsoll Mark compulsory.

The introduction of lighthouses would have provided for safer navigation, especially in poor visibility, (the details of the building of lighthouse at the Needles and St. Catherine's Point are covered in Chapter 6) not just for ships within the study area, but also those sailing along the south coast of England and especially from the west. The main lighthouses are (Nicholson, 1995:appendix; Larn & Larn, 1997:section 6); Eddystone, first lighthouse lit, 1698; Portland Bill, first lighthouse lit, 1716; Longships, first lighthouse lit, 1795; Bishop Rock, first lighthouse lit, 1858; Wolf Rock, first lit, 1870. Most important is perhaps the change, in 1811, to the light of the fourth Eddystone lighthouse from 24 tallow candles providing a light of 67 candle power to Argand lamps providing 1,980 candle power. As the quality and strength of the lights and the distance they could be seen improved, for example the five Eddystone lighthouses (Nicholson, 1995:18-43), their benefit would increase. The greater availability of chronometers would have made navigation out of sight of land and hence landfalls safer. As navigation 'up Channel' improved so the ratio of the numbers of ships sailing in either direction being shipwrecked should have reduced. This is clearly the case as shown in Figure 10.67. It is also about this time that the Hydrographic Office commenced making charts and tidal information available commercially and providing updated information. These again would have made for safer navigation, but it is not possible to prove any direct link.

In addition to the above there were other changes that had an influence on the numbers of sailing ships in the Channel, these were the development of the steamship and the development of the railways. The development of the steamship was in its early phases. French (1995:32) identifies that 298 steamships were registered in 1830. The 1840s saw the development of the railways (Jackson, 1983:75-76, 92-93 & 96). There was also a movement of British trade to the northern ports that would have reduced the percentage of the shipments passing through the English Channel. By 1789-91 the ports of the north east and the north west handled 41 per cent of the tonnage entering and 51 percent of the tonnage leaving England and Wales while London's share had fallen to 37 per cent and 27 per cent respectively (Jackson, 1983:31). The share for the ports of the south coast was only 4.3 percent entering and 2.2 percent clearing. Another indicator of the level of British trade traffic in the English Channel is that the total duties payable on ships and goods at Bristol in the early 1820s were more than double those at London and Liverpool and three times those at Hull. This indicates, perhaps that a large proportion of the trade that would at earlier times have gone to London and south coast ports was going to Bristol, although it is recognised that the level of duties payable at Bristol at that time were high (Jackson, 1983:31). The above suggests that the relationship between the number of shipwrecks and the number of vessel sailing in an area as indicated by Figure 10.3 may in fact exist.

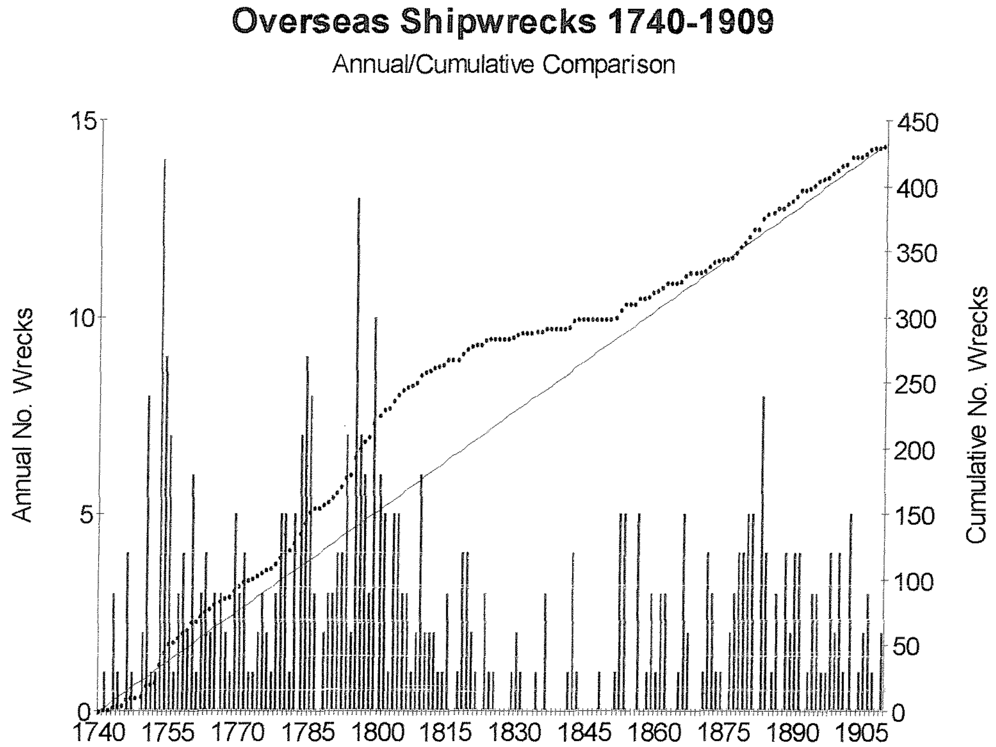


Figure 10.4 Comparison of the annual and cumulative numbers of shipwrecks for the Overseas subgroup 1740-1909

The decline in the frequency of vessels being wrecked, from about 1810 to 1880 applies particularly to the Overseas subgroup (see Figure 10.4). The frequency does not then increase to the same extent as for the Coastal and Local subgroups (see Figures 10.5 and 10.6). The Overseas subgroup would probably benefit most from the safety improvements with their owners and companies best placed to afford to take advantage of them. The introduction of the steamship probably also had the greatest impact on this subgroup. The timing of the improvements to maritime safety make it

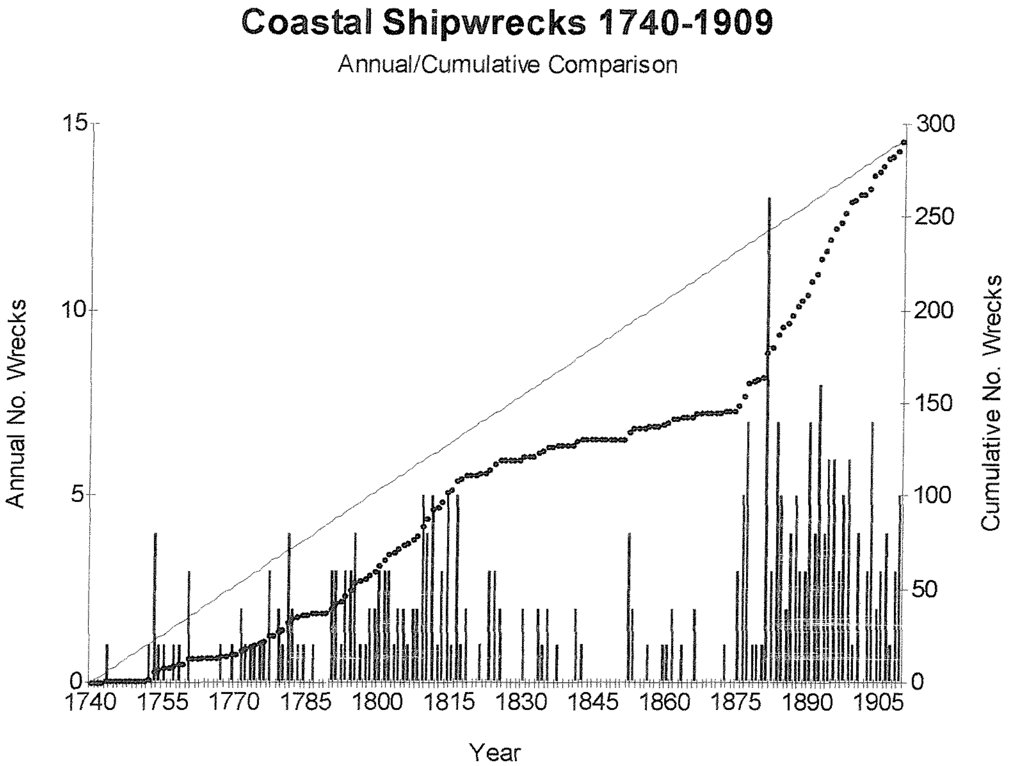


Figure 10.5 Comparison of the annual and cumulative numbers of vessels wrecked for the Coastal Subgroup 1740-1909

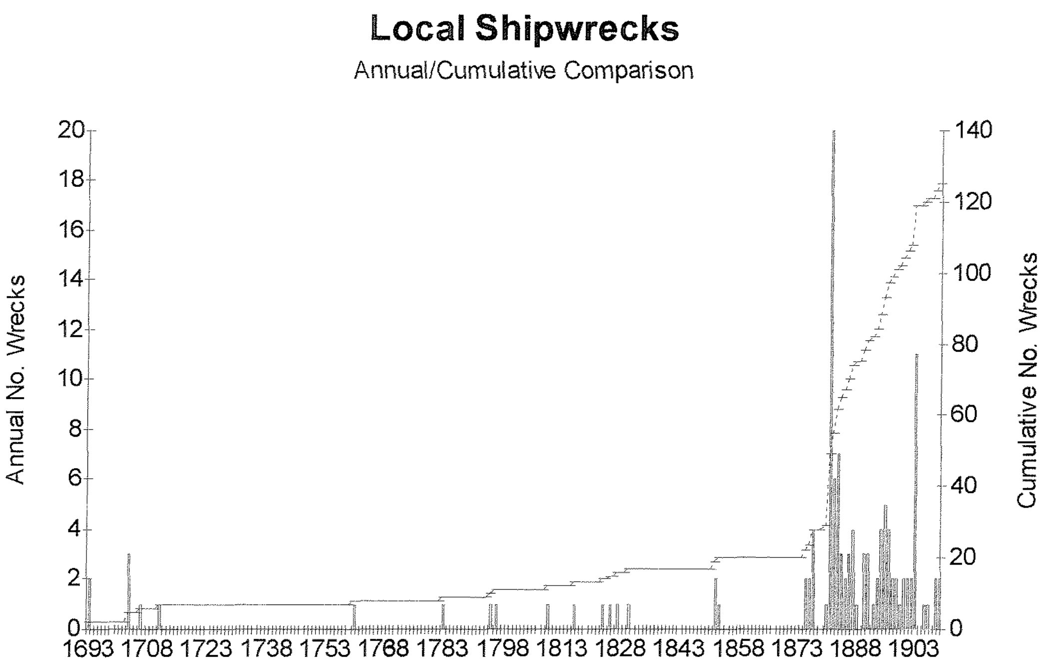


Figure 10.6 Comparison of the annual and cumulative numbers of shipwrecks in the Local subgroup

appear that the most benefit should not have been felt until the end of the 1810-1880 period. Particularly with regard to the availability of the Needles and St. Catherine's lighthouses at a time only just prior to the increase in the relative frequency of Coastal (see Figure 10.5) and especially Local (see Figure 10.6) shipwrecks. It is therefore difficult to link the availability of these developments directly with the reductions in the frequency of shipwrecks and visa versa, but their proximity must be of significance.

The difference between the rate of growth of the Coastal and the Local subgroup shipwrecks and the Overseas subgroup shipwrecks is likely explained by Williamson (1959:353). He states that in the later decades of the nineteenth century the sailing ship was slowly losing its hold on world trade to the steam ship. No large British full rigged ships were built after the 1890s. Smaller vessels remained in demand, with the Channel and its anchorages, alive with the small vessels carrying all the cargoes for which they could compete against the railways on freight charges and where speed of delivery was not an issue. In this competitive environment it is possible that essential maintenance of vessels was being delayed or overlooked completely, manning levels reduced and vessels sailing in what would have been considered marginal conditions. Owners and captains would have taken greater risks to remain in business.

If the relationship between the volume of shipping and the number of shipwrecks does exist then it would be expected that a high proportion of the wrecks would occur at or adjacent to the locations where shipping would pass or gather. This would include locations such as trade routes, harbour entrances, straits and anchorages. The whole of the study area can be considered as being on or adjacent to trade routes, be it the English Channel or the track a vessel would take to sail to or from many harbours or anchorages and therefore that particular aspect is difficult to prove definitively.

The profile of the Local subgroup of shipwrecks is very different from that of the total database. For example, of the sample of 125 shipwrecks, 63 were in ballast.
Of another 37 where the cargoes are described, they consisted, predominantly (67%), of building materials; shingle, sand, chalk, stone, bricks, roofing slates, cement, timber and pipes; 3 were carrying mud and 3 coal. Only 2 were carrying foodstuff,

wheat and oats. The number of Local ships wrecked, for which information is available, is very low and sporadic until the third quarter of the nineteenth century. The dramatic increase may be due to the development of pleasure yachting or improved reporting of shipwrecks both officially and in newspapers as a result of social pressures (see Chapter 2, Maritime Records). Also the improvements in the safety aspects of ships brought about by the same social pressures may not have been introduced so effectively on smaller vessels. If this is the case then the database is possibly biased towards 'non-local' maritime traffic. The effect of this on the conclusions reached is impossible to quantify, but on balance, considering that all vessels would be affected by the weather and the topography in the same way, only the numbers of shipwrecks at any given location would change and not the locations themselves.

The analysis above has identified a number of competing factors that together present a complex picture of when and why ships are wrecked. None are based on hard evidence, but logic suggests they had a major influence on the cause of shipwrecks. None provide the type of data that is essential for the development of a GIS based model except that over time the numbers of vessels wrecked in any given area will vary dependent upon political, social and economic circumstances.

The existence of a relationship between the number of shipwrecks and the volume of maritime traffic is supported to some extent by the distributions of the shipwrecks. The locations of the shipwrecks in Figures 4.1, 4.6 and 4.7 show little significant variation. The distributions for the Coastal (Figure 4.6) and Overseas (Figure 4.7) subgroups vary, apart from the number of shipwrecks, with a greater proportion in open water and on the southwestern coast of the Isle of Wight for the Overseas subgroup. The Coastal subgroup has more shipwrecks in the inner waters of the study area. The thematic density maps (Figures 10.7 & 10.8) show this difference more clearly. The regions with the highest density of shipwrecks from the Coastal subgroup are at the entrance to Poole Harbour, Studland Bay and the Shingles bank. The second highest densities are at the entrance to Portsmouth Harbour, near Portsmouth and Ryde.

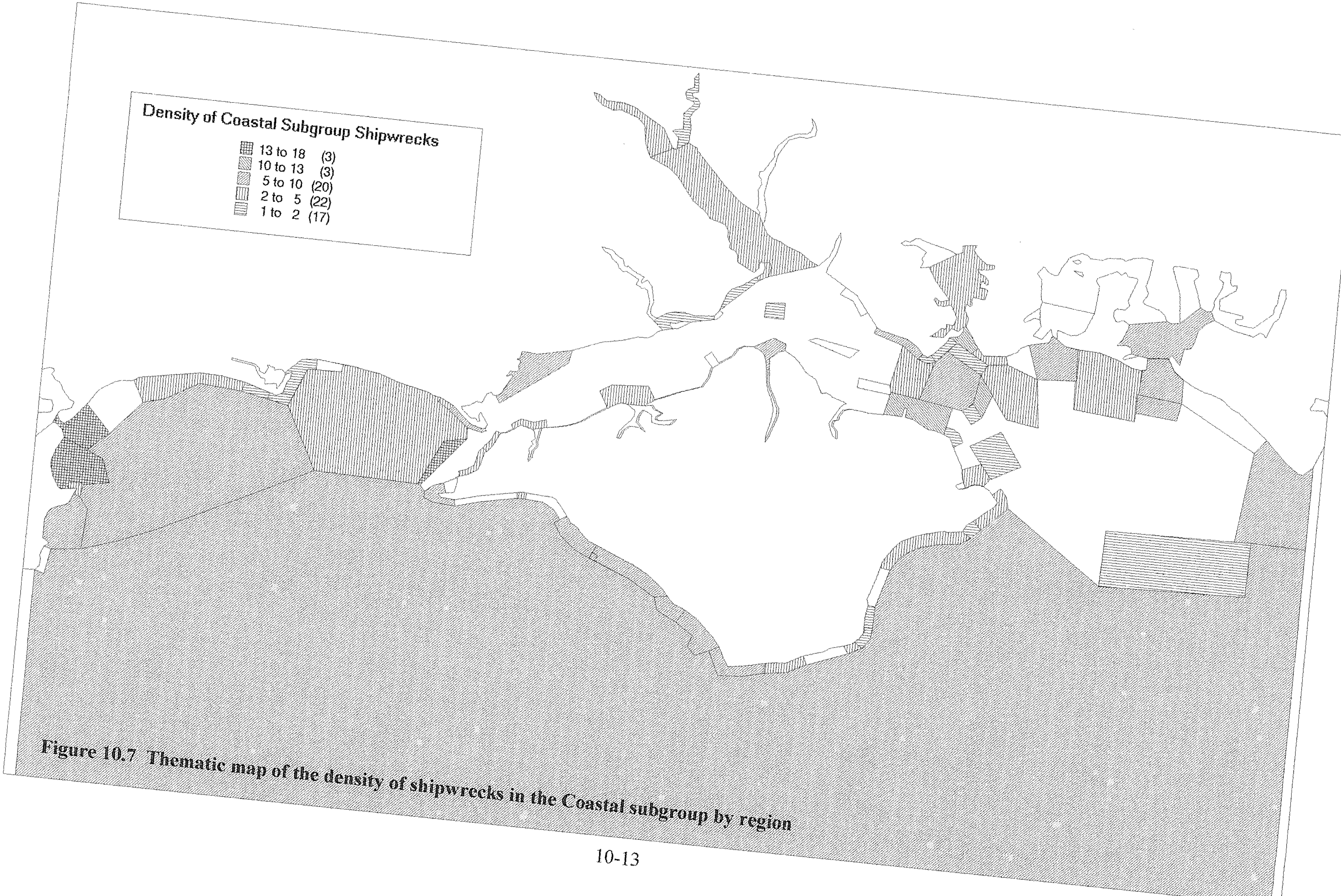


Figure 10.7 Thematic map of the density of shipwrecks in the Coastal subgroup by region

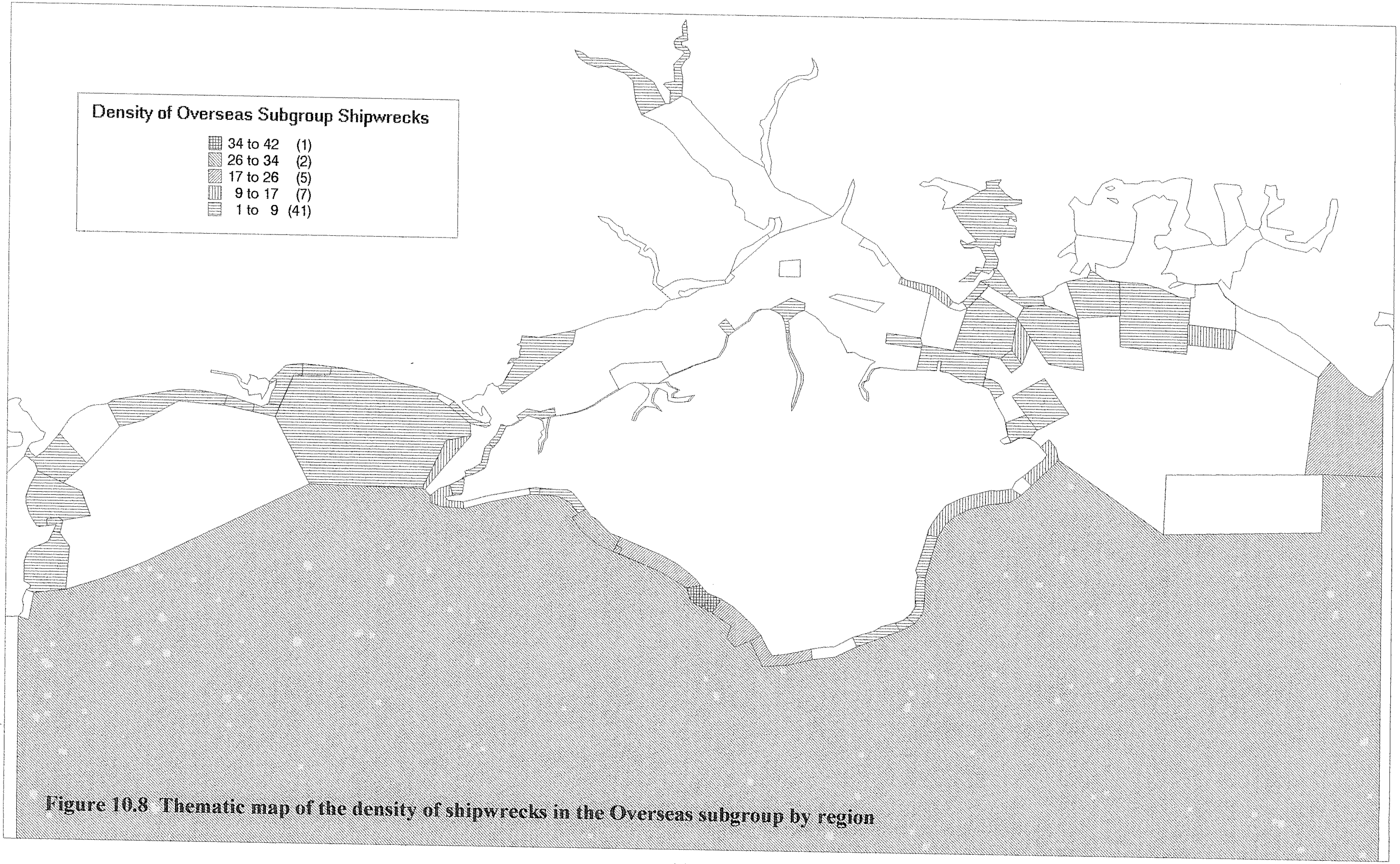


Figure 10.8 Thematic map of the density of shipwrecks in the Overseas subgroup by region

Figure 10.9 Thematic map of the density of wrecked vessels in the Local subgroup by region

The Overseas subgroup has the highest density of shipwrecks at the 'Back of Wight' between St. Catherine's and Brook. This diversity probably highlights the major differences between the two subgroups with the vessels of the Coastal subgroup using the local harbours and sailing within the Solent thereby being wrecked on the dangerous Shingles bank and the extensive shallows off Ryde. This is reinforced by the statistics that only 34 (7.88%) of the Overseas subgroup were sailing to or from ports in the study area while this applied to 173 (58.25%) of the Coastal subgroup. The difference in distribution is much more marked if compared with the Local subgroup (Figures 4.41 and 10.9), but this subgroup is small and any comparisons should be treated with caution.

Table 4.4 lists 255 (23.29%) vessels as being wrecked at a harbour entrance. This is a significant number and perhaps supports the relationship identified above, but the entrance to a harbour is a dangerous place for a sailing ship because of the limited room to manoeuvre. This is particularly so for a number of the harbours of the study area which have extensive banks at their entrances. Taking Tables 4.4 and 4.5 together the number of vessels wrecked while in anchorages is 89 (8.13%) this does include some double accounting with the anchorages off harbour entrances. That number is also probably significant as anchorages are normally considered to be relatively safe places for a vessel to be.

The only location that can be considered a strait in the study area is at the western end of the Solent where shipping is constricted by the narrow entrance between Hurst Point and the Isle of Wight (see Figure 7.1). The position of the Shingles bank blocking the western approach realistically extends the strait from The Needles to narrows at Hurst Spit. The strait therefore includes a number of the regions used in the GIS analysis, they are, the Shingles, Alum Bay, Totland Bay, Colwell Bay, Hurst and The Needles. This would give a total of 100 (9.03%) shipwrecks reported as being in that vicinity. It would be expected that the majority of the vessels wrecked in the strait would have been either sailing to or from a Solent port, but of the 77 for which either the port of embarkation or the destination is known only 34 are so identified. Those not sailing to or from ports in the study area were perhaps seeking shelter. Only 18 of these shipwrecks have associated weather reports, all but 3 of which were of winds of

Force 6 or above. This equates approximately to the same ratio for all shipwrecks with associated weather reports, but what is not known is what was the weather forecast at the time.

The difference in the distribution of shipwrecks identified in the thematic maps is reinforced by the figures in Table 4.6. Each subgroup differs, to some degree, in the distribution of the risk of each of the five location types analyses. The Overseas and Up Channel subgroups are the most similar with 65.41% and 67.37% of the shipwrecks occurring in bays and on headlands. This similarity is probably a result of the Up Channel subgroup including 295 (72.3%) of the Overseas subgroup. The most dangerous locations for vessels in the Coastal, Down Channel and Local subgroups are harbour entrances, with 34.49%, 31.11% and 38.57% of the shipwrecks for those subgroups respectively. There is not the same degree of overlap of the shipwrecks included in those three subgroups. The Down Channel subgroup has 47 (20%) from the Local subgroup and 85 (36.17%) from the Coastal subgroup. Vessels in these three groups would be expected to be entering or leaving or anchoring off the harbours in the study area that would therefore represent congregation points for those vessels. In addition most of the harbour entrances in the study area are narrow with off lying banks and therefore must present a difficulty, if not a danger, to sailing vessels in certain conditions. The Local subgroup has 13 (18.57%) of vessels wrecked in anchorages. As the study area is probably the home waters for most of the shipwrecks in that group this is not unexpected. The proviso with this group must again be that it is very small and should be treated with caution.

Table 4.6 also emphasises the differences between the Coastal and Overseas subgroups with 44.59% of the shipwrecks in the former occurring at harbour entrances and in anchorages compared with only 21.17% of the latter. Also only 39.72% of the Coastal subgroup were in bays and on headlands compared with the Overseas subgroup's 65.41%.

The two areas where the highest numbers of vessels were wrecked are at the 'Back of Wight' and in the 'Vicinity of Portsmouth'. The 'Back of Wight' includes the regions; St. Catherine's, Chale Bay, Atherfield, Brighstone Bay, Brook, Compton Bay, Freshwater Bay, The Node, the Needles and the 'Back of Wight' (see Figure 4.2). The 'Vicinity of Portsmouth' area is where naval ships would have anchored or manoeuvred and includes the following regions; Portsmouth Harbour, Portsmouth Harbour Entrance, Gosport, Southsea, Spithead, Spit Sand, Gilkicker, Stokes Bay, Ryde, Seaview, St. Helens Road, No Man's Land, Horse and Dean Sands and near Portsmouth (see Figure 4.2). The numbers of shipwrecks for each of the five subgroups in these two areas are detailed in Table 10.1.

Table 10.1 – Numbers (%) of Shipwrecks in the 'Back of Wight' and the 'Vicinity of Portsmouth' for the Five Subgroups

Subgroup	'Back of Wight'	'Vicinity of Portsmouth'
Coastal	17.17	21.21
Overseas	42.45	10.28
Up Channel	46.32	6.86
Down Channel	19.57	20.00
Local	2.86	32.86

Table 10.1 also indicates the difference between the Local subgroup and the other four subgroups with very few vessels wrecked to the south of the Isle of Wight (see also Figure 10.9). This is perhaps due to the inshore route, between the mainland and the Isle of Wight, being used rather than local knowledge of the dangers of the 'Back of Wight'.

The presence of Portsmouth, a major naval base, within the study area would possibly be considered to have a considerable impact on the location of shipwrecks especially close to the base. The impact appears to be relatively small. Of the 223 shipwrecks located in the 'Vicinity of Portsmouth' only 33 (14.8%) can be positively identified as British naval vessels or transports. In the study area as a whole only 70 of these vessels can be identified – 11.11% of vessels identifiable by function.

The above has shown that there is some form of a relationship between the number of shipwrecks and the number of vessels sailing in a particular area. It has equally shown that there are other factors that contribute to the causes of vessels being wrecked and their location.

10.3 Peak Annual Totals

The graph in Figure 10.2 is multi-modal with particular peaks in the number of shipwrecks at the years 1753, 1795, 1809, and 1881. The year with the highest total is 1881 with 34 vessels wrecked in the following locations (see Figure 10.10 below):

SW Isle of Wight;			
	Off The Needles	= 1	11 Mar
	Brook Ledge	= 1	21 Jan
	Off St Catherine's Pt.	= 1	3 Mar
NE Isle of Wight;			
	Ryde	= 7	18 Jan(5), 14 Oct, 15 Oct
	Cowes Roads	= 1	13 Oct
NW Isle of Wight;			
	Totland Bay	= 1	18 Jan
Dorset;			
	Poole Harbour Entrance	= 1	23 Mar
	Poole Bay	= 1	18 Mar
Hampshire;			
	Portsmouth	= 1	3 Mar
	Langstone Harbour Entrance	= 1	8 Feb
	Chichester	= 1	21 Dec
	Hayling Bay	= 1	28 Oct
	Selsey	= 15	18 Jan(12), 24 Jan, Dec, 17 Dec

(See Figure 7.1 to identify locations)

A large proportion, 18, of them occurred on the 18th January in an E or SE storm, 12 of which were fishing boats caught on the beach at Selsey and smashed to pieces in what is only described as a gale. Another 5 vessels of various types were shipwrecked off Ryde in winds described as E or SE storm force 10. The other vessel was wrecked

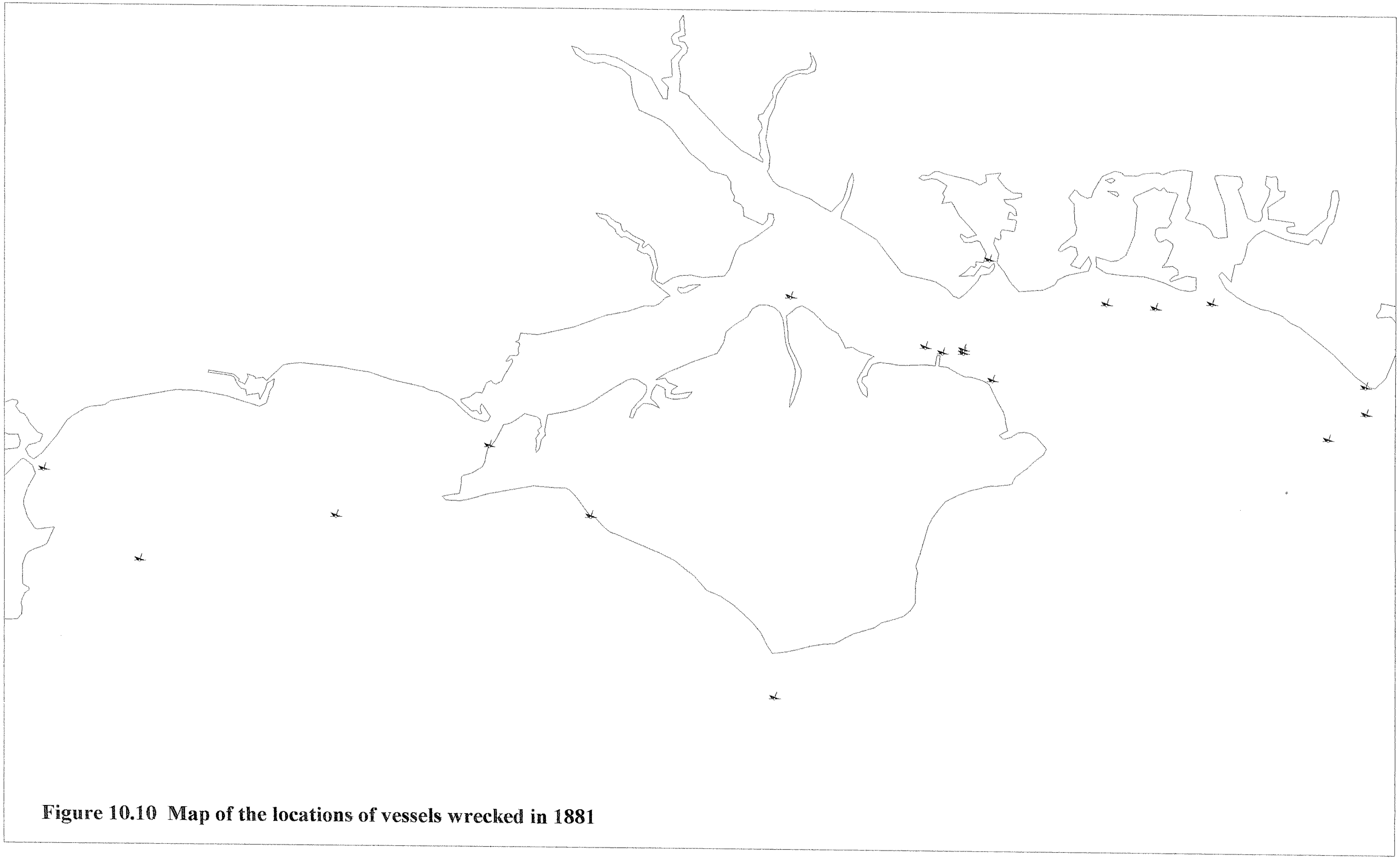


Figure 10.10 Map of the locations of vessels wrecked in 1881

in Totland Bay in an E storm force 10 wind. Of the remainder, a further 9 were also wrecked in strong winds.

In 1753 there are 25 shipwrecks recorded. They were shipwrecked in the following locations (see Figure 10.11 below):

SW Isle of Wight;			
	Compton Bay	= 1	10 Jan
	Brighstone	= 1	10 Jan
	Atherfield	= 2	10 Jan, 13 Dec
	Chale Bay	= 3	10 Jan(2), 14 Jan
	St. Catherine's Pt.	= 2	16 Feb, no date
SE Isle of Wight;			
	Dunnose Point	= 1	10 Jan
NE Isle of Wight;			
	St. Helen's	= 1	12 Jan
	Ryde	= 1	no date
NW Isle of Wight;			
	The Needles	= 1	24 Apr
Dorset;			
	Durlston Bay	= 2	13 Jan
	near Poole	= 2	10 Jan, 23 Jan
Hampshire;			
	near Hurst Castle	= 1	16 Jan
	Southampton	= 1	16 Jan
	near Chichester	= 3	16 Jan, 19 Jan, 21 Sep
	Off Isle of Wight	= 3	16 Jan(2), 19 Jan

(See Figure 7.1 to identify locations)

H.M.S. Assurance, struck Goose Rock, just inside the Needles, in the twilight of a misty dawn on the 24th April. The reason given is that the Master did not know the rock was there and sailed too close to the Needles. There are no details of how the other vessels were wrecked. Of the 23 shipwrecks for which a date is available 19 occurred in January. Of the 7 ships shipwrecked on the 10th January, 5 were on the

Figure 10.11 Map of the locations of vessels wrecked in 1753

SW coast of the Isle of Wight, 1 at Dunnose Point, and 1 near Poole. On the 16th January 5 ships were wrecked; 1 near Hurst castle; 2 off the Isle of Wight; 1 at Southampton, near St Denys; and 1 near Chichester. No references to storms in January 1753 have been identified, but the series of shipwrecks occurring in that month are suggestive of a series of gales, perhaps violent storms occurring and that on the 10th January the wind was from the south-westerly quadrant. The 3 ships shipwrecked on the 12th/13th January, 1 at St. Helen's and 2 at Durlston Bay are suggestive of a gale from the easterly quadrant.

In 1795 there are 25 shipwrecks recorded in the following locations (see Figure 10.12 below):

SW Isle of Wight;			
	Brooke Bay	= 1	6 Feb
	Brighstone Bay	= 2	9 Feb, Nov
	Chale Bay	= 1	13 Mar
	St. Catherine's Pt.	= 1	3 Nov, no date
	'Back of Wight'	= 1	10 Mar
SE Isle of Wight;			
	Ventnor	= 1	1 Dec
Dorset;			
	near Poole	= 1	30 Jun
Hampshire;			
	Shingles	= 1	13 Nov
	Stokes Bay	= 2	23 Sep
	Gosport	= 1	10 Nov
	Portsmouth	= 6	23 Sep, 18 Nov(5)
	Portsmouth Harbour	= 1	13 Nov
	near Chichester	= 2	30 Oct, 25 Dec
Solent;			
	Spit Sand	= 2	1 May, 18 Nov
	Spithead	= 1	18 Nov
	Mother Bank	= 1	9 Nov

(See Figure 7.1 to identify locations)

Figure 10.12 Map of the locations of vessels wrecked in 1795

The distribution of the shipwrecks in this year is very different from 1753 with the majority in the Portsmouth/Solent area. Politically the difference is that England was at war with France. Five of the ships are identified as Transports, 2 of which plus another unidentified ship type had sailed from Germany. The high proportion of vessels wrecked in the Portsmouth/Solent area could therefore be due to supply ships and transports having collected at Portsmouth. During the eighteenth century many fleets gathered at Portsmouth, which was the principal rendezvous and departure point for naval expeditions (Phillips-Birt, 1967:51). When these rendezvous coincided with major storms ships were wrecked, as, for example, during the hurricane of 26-27th November 1703 when 3 fleets of naval ships, transports, victuallers, storeships, tenders and 40 merchant ships, almost 300 in total, were gathered off Portsmouth and Cowes (Winton, 1989:49). Thirteen naval ships from Portsmouth were scattered and wrecked.

On the 23rd September, 3 vessels were wrecked, 2 in Stokes Bay and 1 near Portsmouth. The weather was a violent SW gale, which would make Stokes Bay a lee shore – a very dangerous place for a sailing ship. In the period 30th October to 24th November 12 vessels were wrecked. Of these, 5 were on the 18th November, all at Portsmouth - 3 were transports. The weather is described as a violent gale. This was known as the 'Christian's Storm' after Admiral Christian, the commander of a fleet which had just set sail for the West Indies. A number of the ships were damaged causing the fleet to return to Portsmouth. Several ships were lost (Jeffery, 1933:549). The vessel wrecked on the Mother Bank on 9th November was at anchor and cut her cable, presumably to escape the gale that was blowing, but went aground.

In 1809 there are 23 shipwrecks recorded (see Figure 10.13 below). The vessels were wrecked in the following locations:

SW Isle of Wight;			
	Brighstone Bay	= 1	no date
	Brook Bay	= 1	no date
NW Isle of Wight;			
	Yarmouth Roads	= 1	14 Apr

Figure 10.13 Map of the locations of vessels wrecked in 1809

Dorset;

	near Poole	= 2	17 Jan, 20 Jan
	near Christchurch	= 1	30 Jan

Hampshire;

	Shingles Bank	= 2	10 Jan, 17 Aug
	Stokes Bay	= 8	30 Jan
	near Portsmouth	= 3	30 Jan, 8 Feb, 19 Dec
	Southsea Beach	= 2	30 Jan

Solent;

	Horse Sand	= 1	30 Jan
	Isle of Wight	= 1	27 Jan

(See Figure 7.1 to identify locations)

This distribution of the shipwrecks is very similar to 1795 and is also in the period of the Napoleonic War. It is note worthy for the fact that 13 vessels were wrecked on the 30th January in what is described as a violent WSW gale, which blew for two days and caused damage ashore at Portsmouth and vicinity. It is possible the ships were part of the fleet which rescued the British army from Spain after the battle of Corunna, as 11 of the ships are described as transports of which 2, plus another vessel of unidentified type, had come from Spain.

10.4 Peak Monthly Totals

The total number of shipwrecks each month is detailed in Table 4.1. The thematic maps, Figures 10.14 to 10.25 show the density of shipwrecks in each region for each month. These vary considerably over the twelve months, with the smallest variances during the summer period due to the low totals. The 'Back of Wight' regions and those in the vicinity of Portsmouth feature frequently with the highest densities of shipwrecks, but in terms of viable analysis the numbers are very small. The percentage totals of all vessels with an identifiable location wrecked each month in these two areas are detailed in Table 10.2. The combined total monthly percentages for the two areas are reasonably consistent even though the values for each area, especially for the vicinity of Portsmouth, have a significant variance.

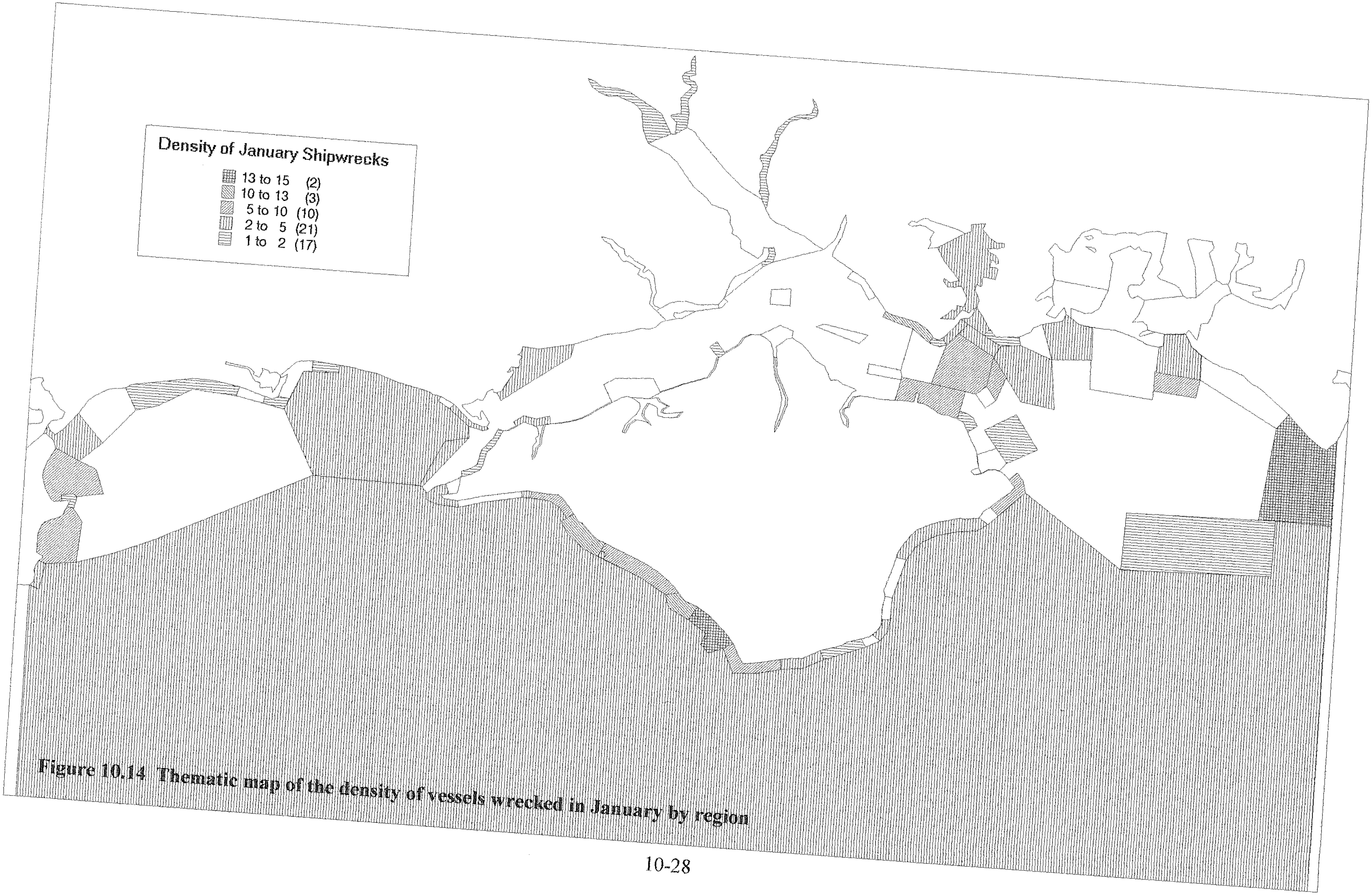


Figure 10.14 Thematic map of the density of vessels wrecked in January by region

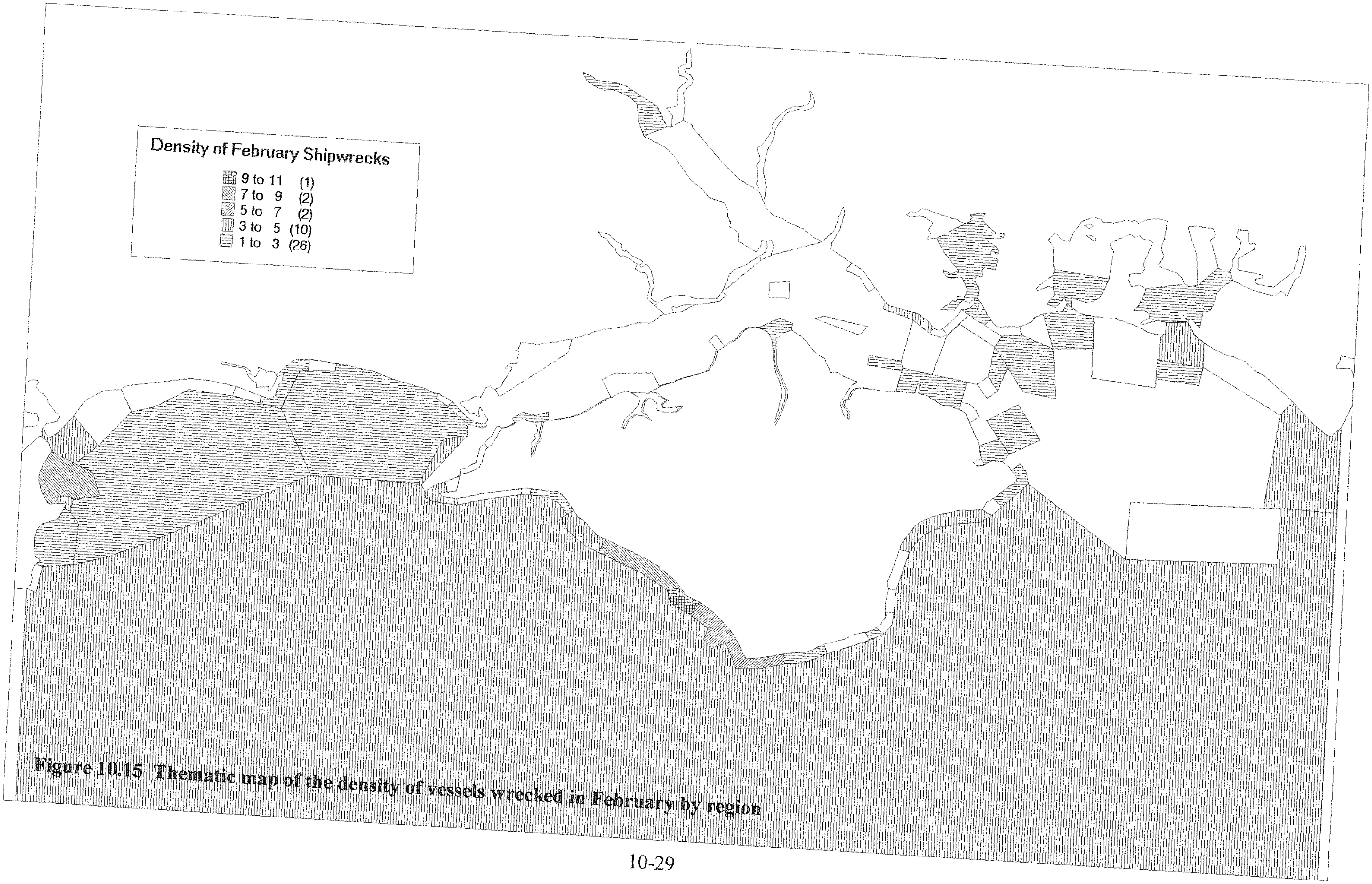


Figure 10.15 Thematic map of the density of vessels wrecked in February by region

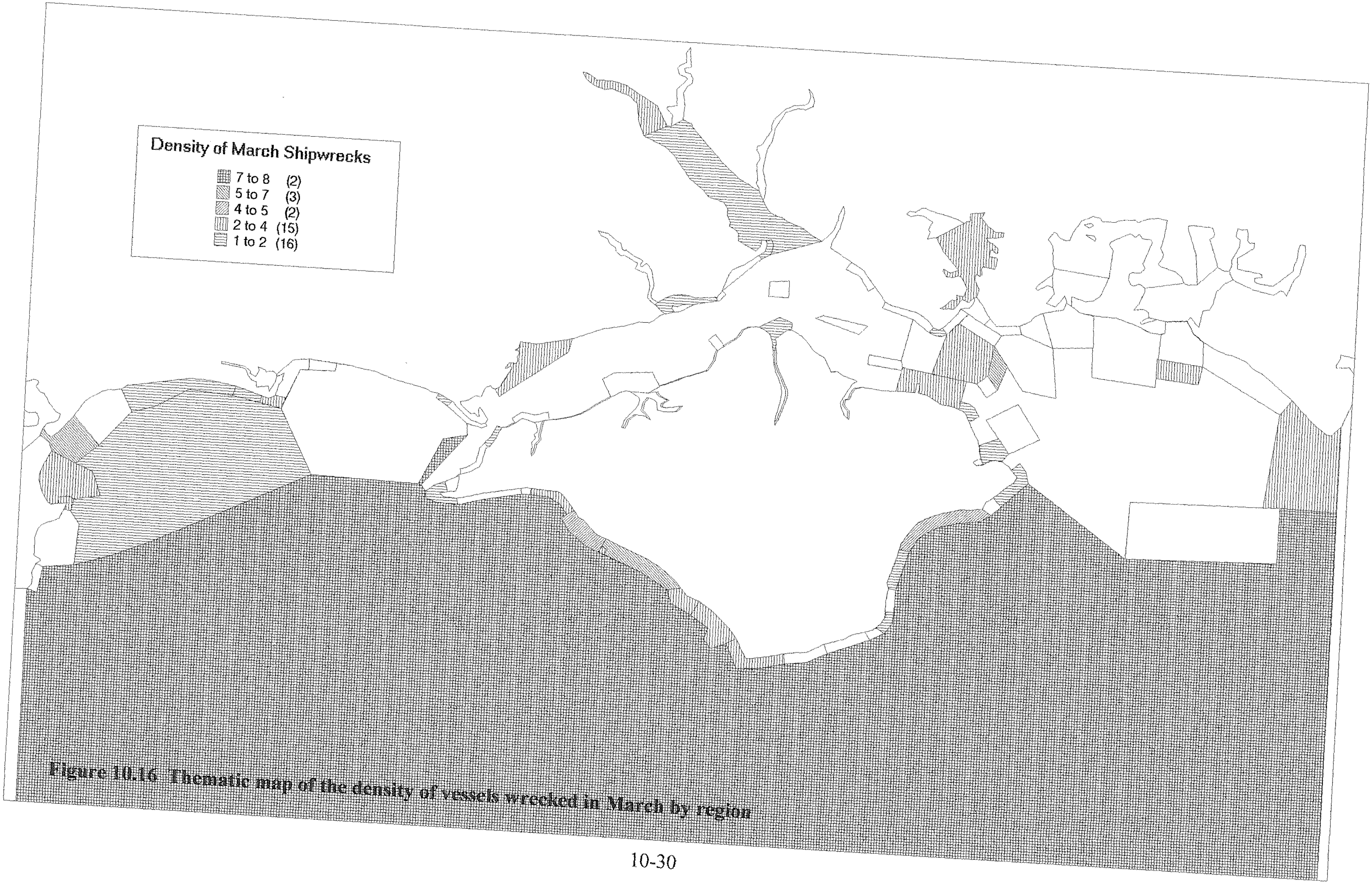


Figure 10.16 Thematic map of the density of vessels wrecked in March by region

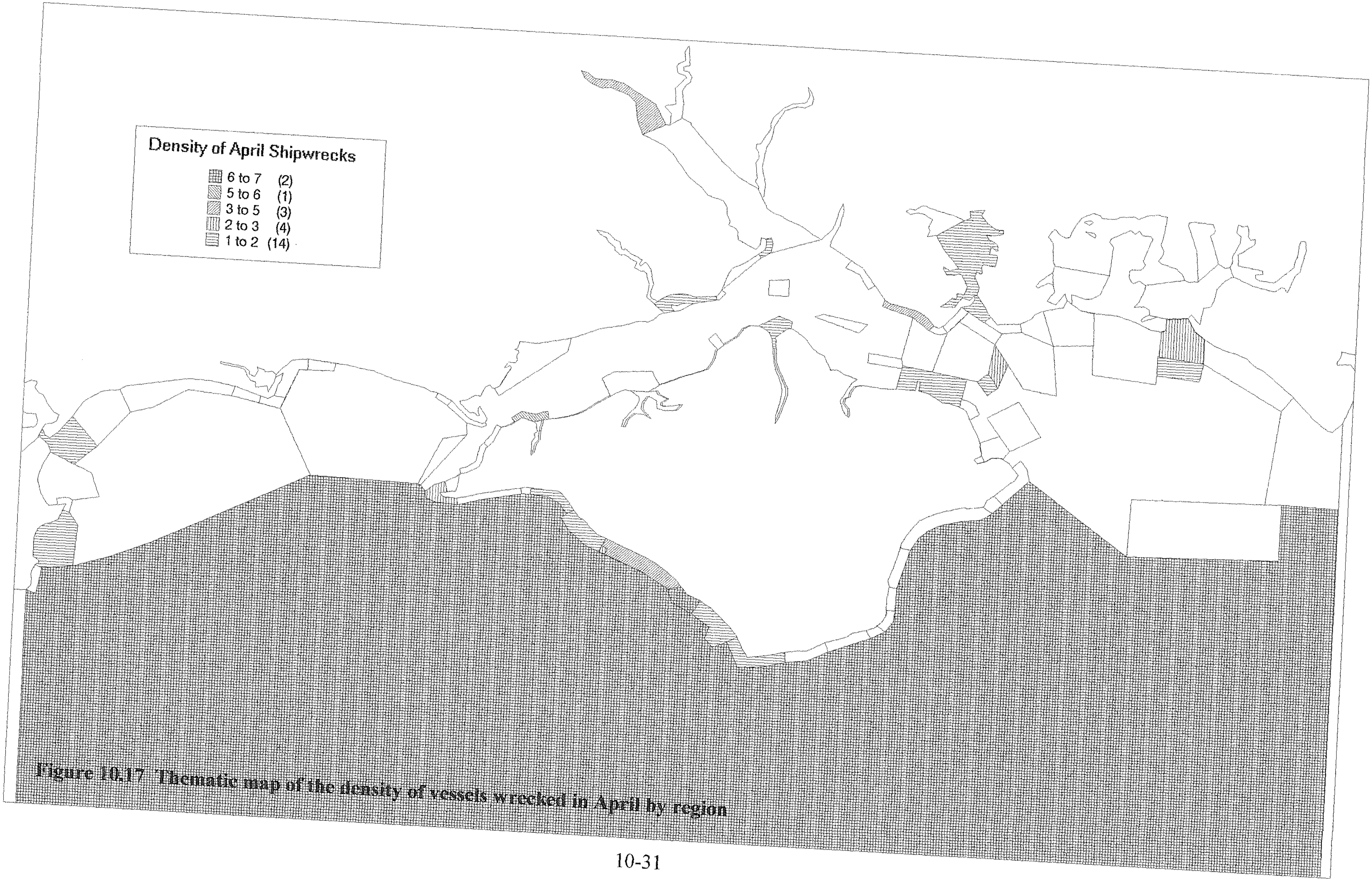


Figure 10.17 Thematic map of the density of vessels wrecked in April by region

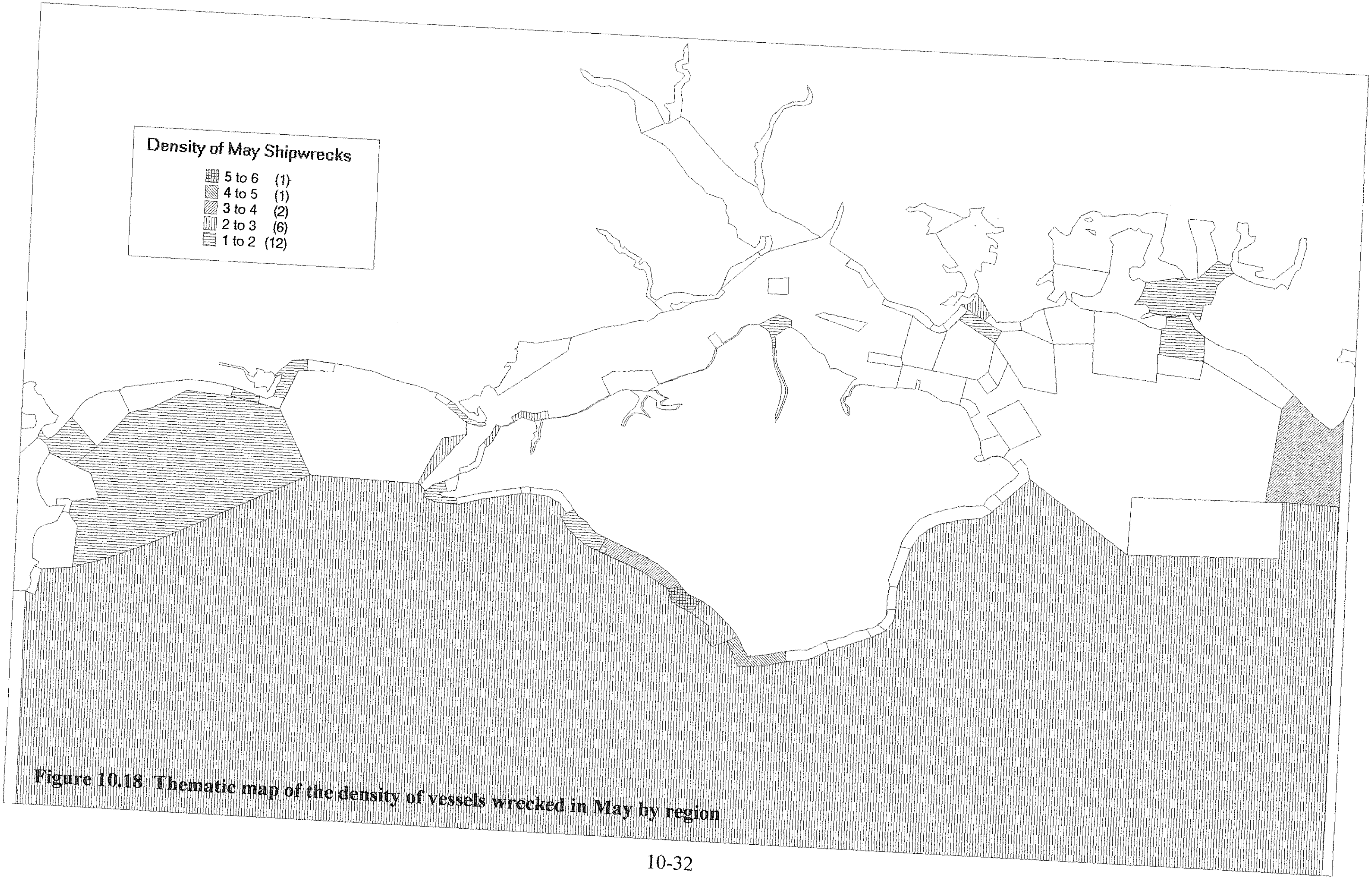


Figure 10.18 Thematic map of the density of vessels wrecked in May by region

Figure 10.19 Thematic map of the density of vessels wrecked in June by region

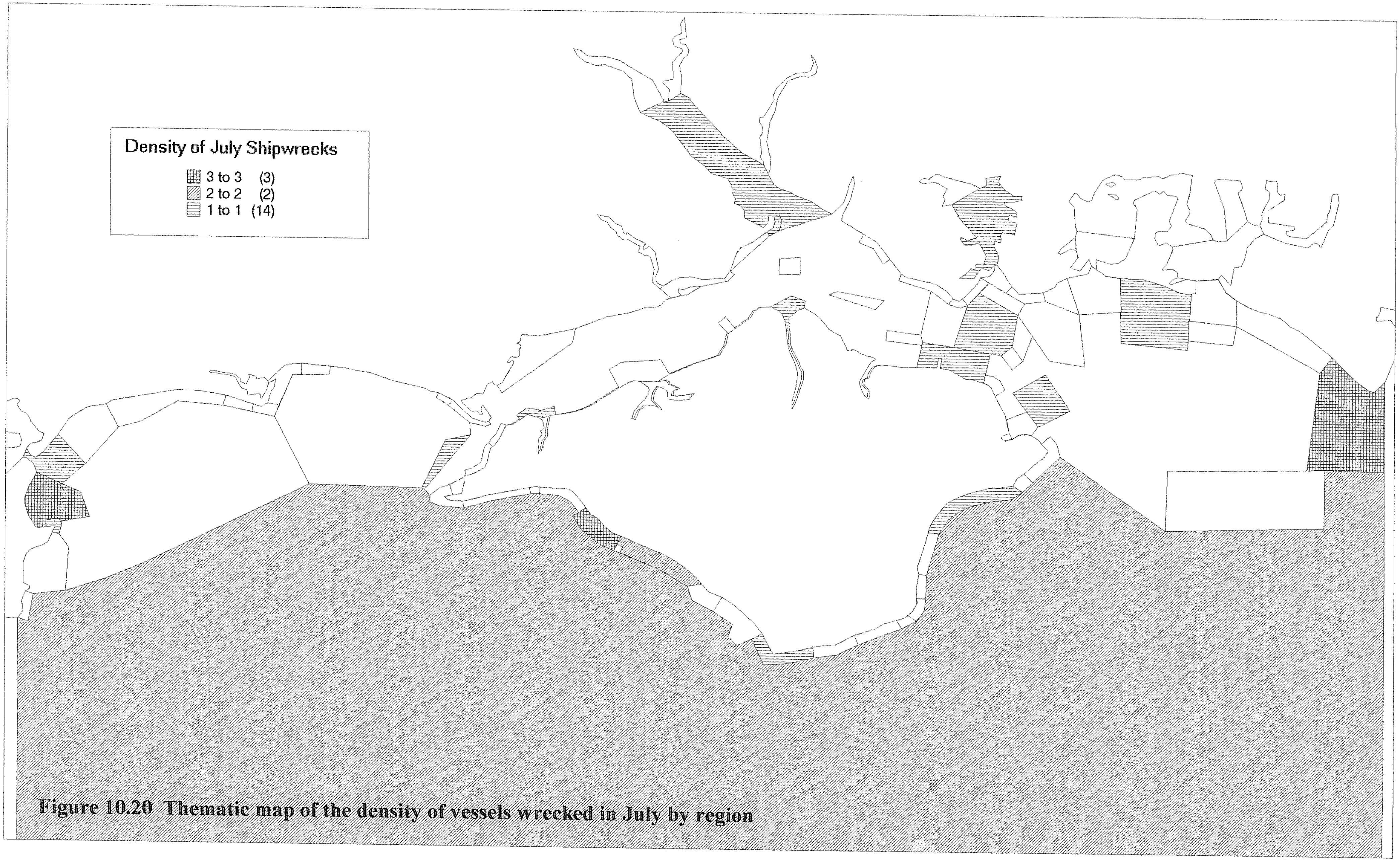


Figure 10.20 Thematic map of the density of vessels wrecked in July by region

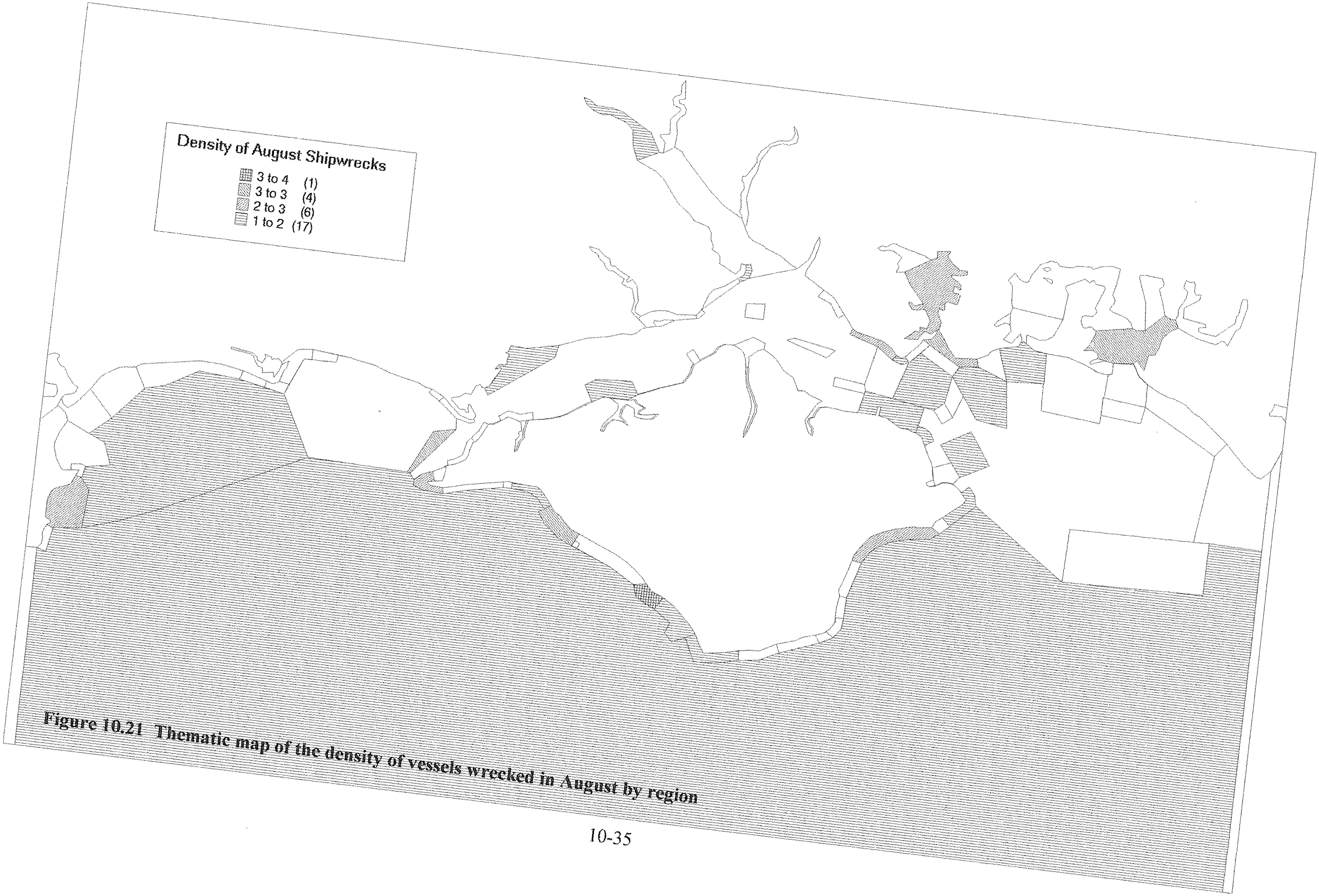


Figure 10.21 Thematic map of the density of vessels wrecked in August by region

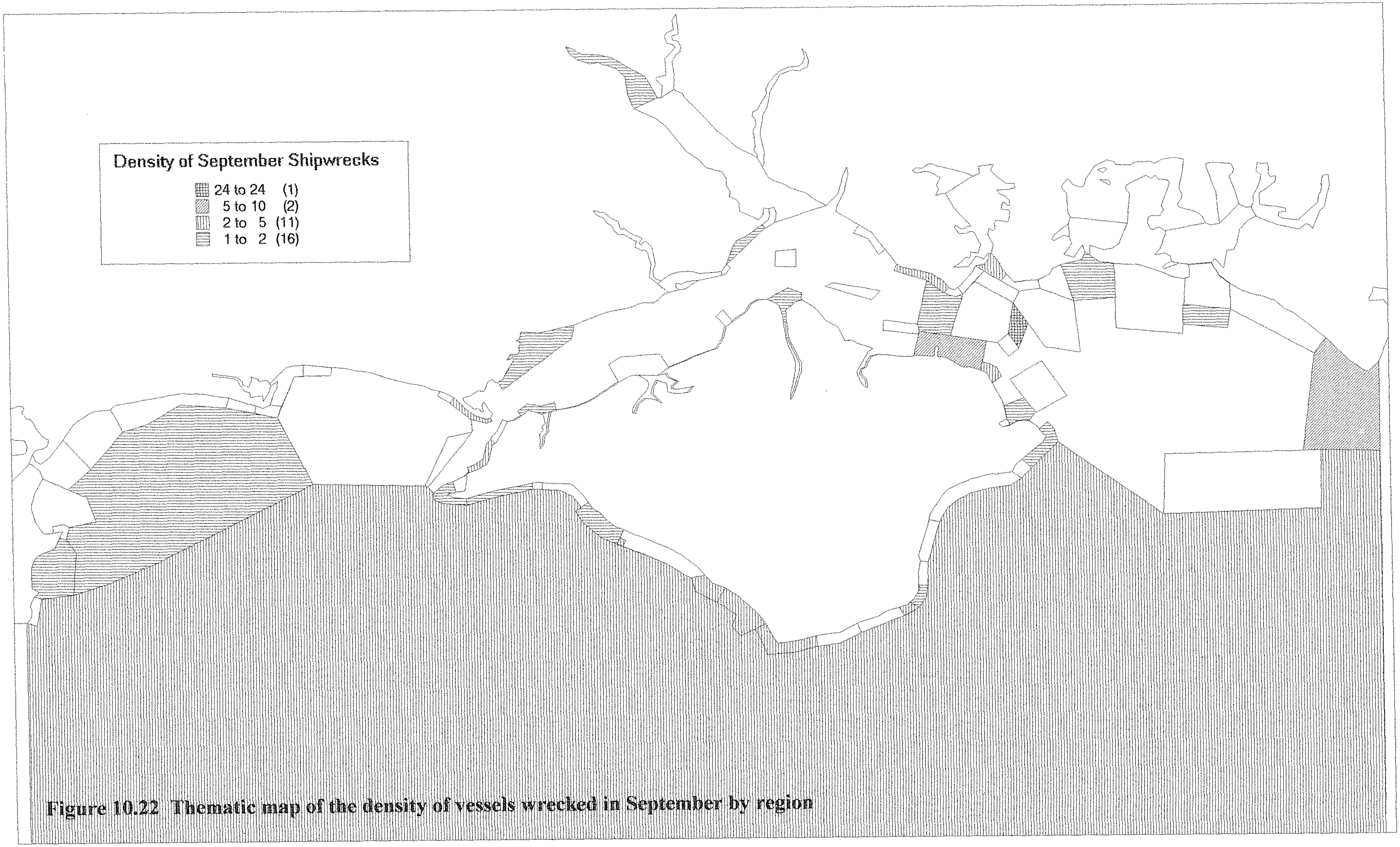


Figure 10.22 Thematic map of the density of vessels wrecked in September by region

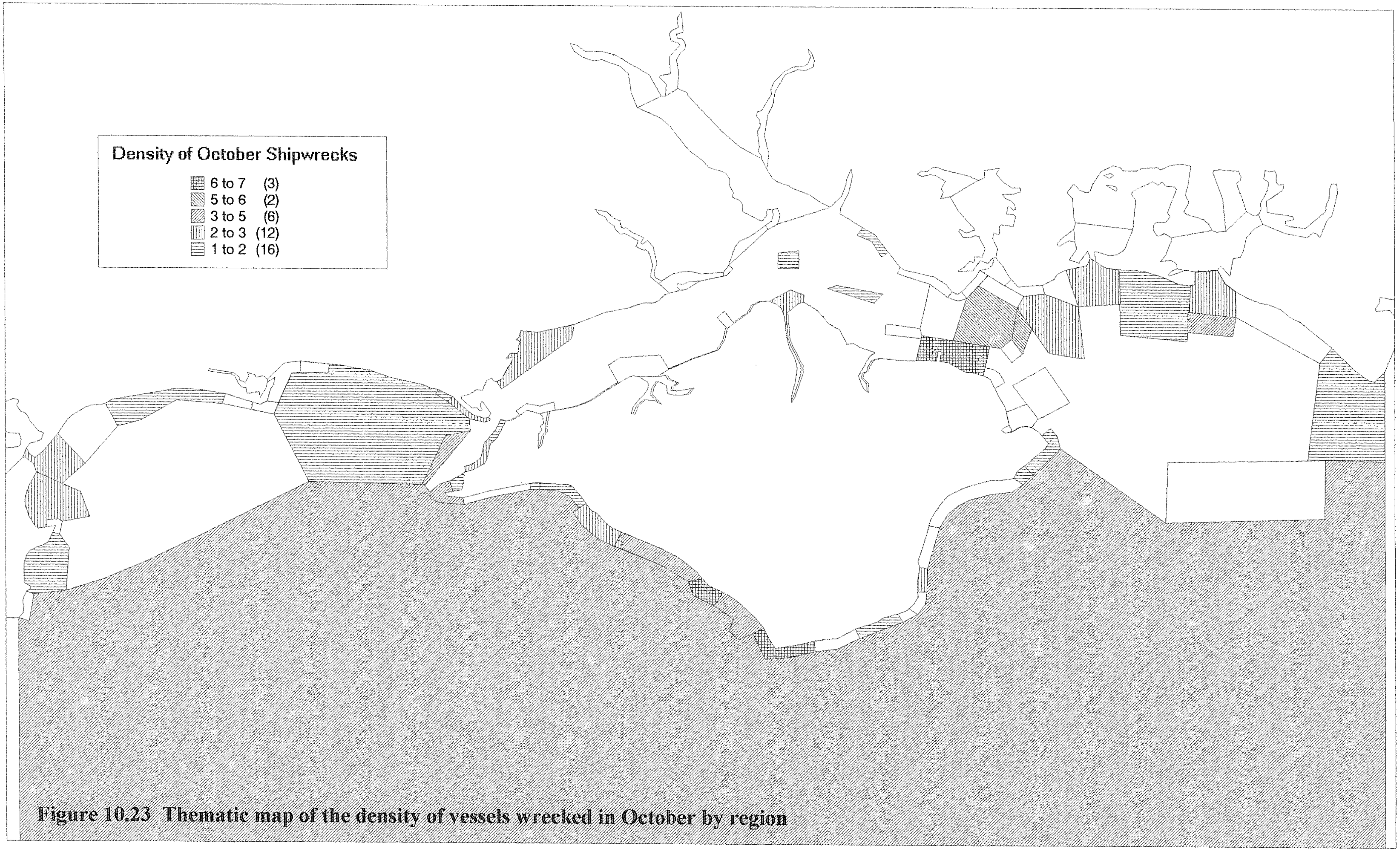


Figure 10.23 Thematic map of the density of vessels wrecked in October by region

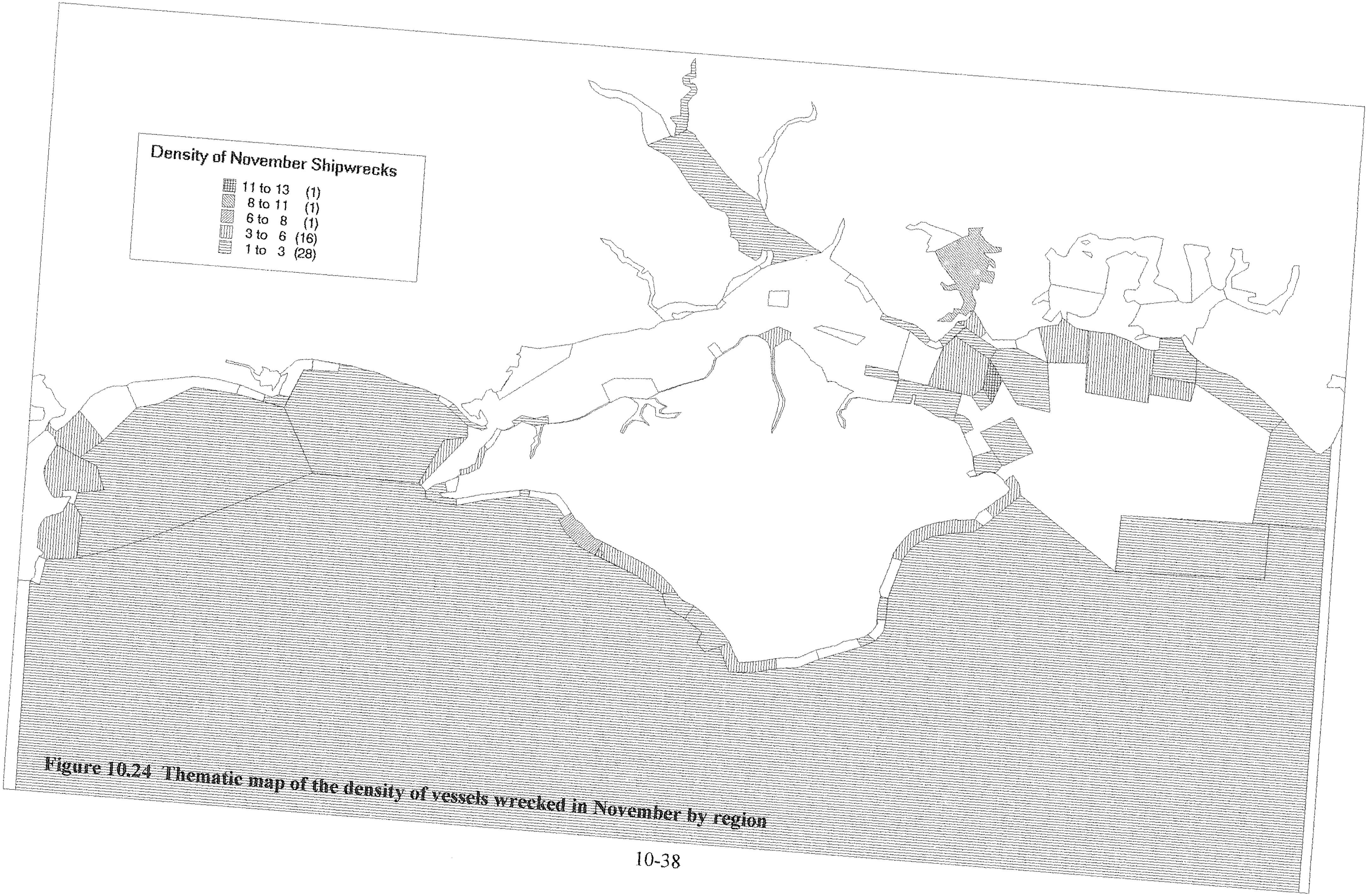


Figure 10.24 Thematic map of the density of vessels wrecked in November by region

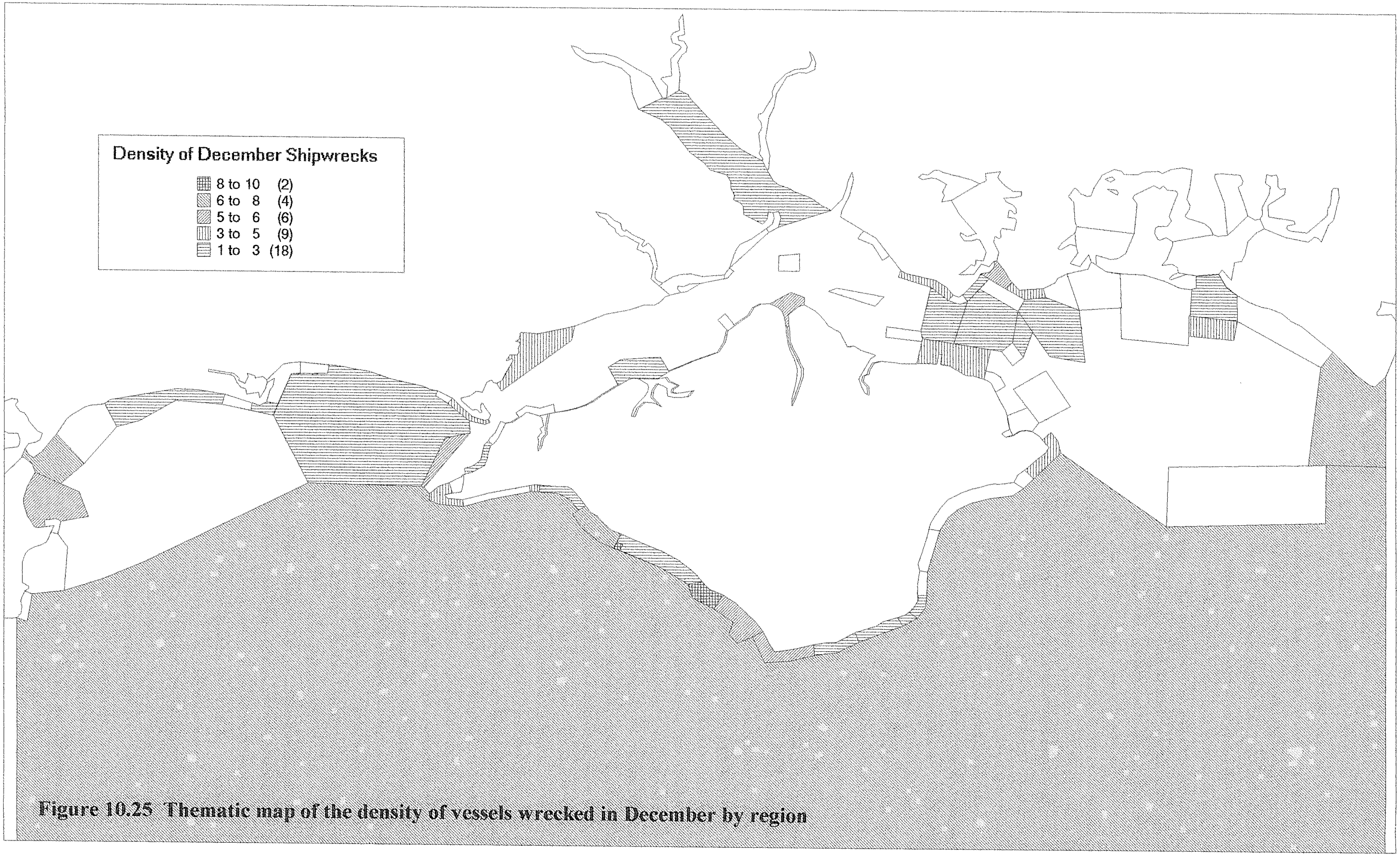


Figure 10.25 Thematic map of the density of vessels wrecked in December by region

Table 10.2 – Numbers (%) of Vessels Wrecked Each Month at 'Back of Wight' and 'Vicinity of Portsmouth' Areas

Month	'Back of Wight'	Vicinity of Portsmouth	Total
January	32.25	21.57	53.92
February	35.14	9.09	44.23
March	24.24	13.13	37.37
April	32.33	18.52	51.85
May	42.86	7.14	50.00
June	30.77	19.33	50.00
July	20.00	13.33	33.33
August	25.00	31.25	56.33
September	13.75	50.00	63.75
October	32.98	19.15	52.15
November	19.53	31.25	50.78
December	33.85	16.15	50.00

Table 10.3 – Monthly Totals, 1140 – 1909, Adjusted for January & September High Daily Totals

Month	No. Wrecks	%
January	173	17.39
February	111	11.16
March	99	9.95
April	54	5.43
May	42	4.22
June	26	2.61
July	30	3.02
August	48	4.82
September	60	6.03
October	94	9.45
November	128	12.86
December	130	13.07

The daily totals detailed in sections 10.3 (Peak Annual Totals) and 10.5 (Peak Daily Totals) show that the months of January and September feature singular events with relatively high numbers of vessels wrecked, 30th January 1809, 18th January 1881 and 21st September 1238. Deducting these high daily totals provides a significant smoothing of the monthly totals from those indicated in Figures 4.8 to 4.10 (see Table 10.3). Analysis of all the other factors available on the shipwreck database does not provide any consistent results. The individual numbers involved in each of the groupings are so small that a single multiple shipwreck event has a significant effect on the results.

10.5 Peak Daily Totals

There are numerous instances in the database of multiple shipwrecks on the same day. Of these, eight are of five or more ships:

- 21st September 1238, over 20 ships were sunk at Portsmouth in a storm.
- January 1704, 10 ships wrecked on the south coast of the Isle of Wight.
- 10th January 1754, 5 ships wrecked on the SW coast of the Isle of Wight.
- 11th November 1800, 5 ships wrecked, 3 at Portsmouth, 1 on Horse & Dean Sands and 1 at Langstone Harbour.
- 12th January 1843, 7 ships wrecked, 4 between Stokes Bay and Hayling Island, 2 at Spithead and 1 at Atherfield.
- 10th February 1866, 5 ships wrecked, 4 in Studland Bay and 1 at Christchurch, the wind was SE then SW gale force.
- 11th February, 1866, 5 ships wrecked, 2 at the entrance to Poole Harbour, 1 in Studland Bay, 1 on the bar of Christchurch Harbour and 1 at Langstone Harbour, the wind was SW force 10-12.
- 10th September 1903, 7 ships wrecked, 2 at Ryde, 1 at Yarmouth Roads, 1 at Bembridge, 1 at Hayling Island, 1 in Stokes Bay and 1 at Southsea, the wind was described variously as WNW force 9, NNW force 8, NW force 10, WNW force 5 and heavy gale.

The analysis of both the highest annual and daily occurrences of shipwrecks suggests there is a strong correlation between the incidence of shipwrecks and high winds. In addition the direction of the wind appears to have an influence on the location. What is also clear is that the conjunction of numbers of vessels and strong winds cause the highest single day groupings of shipwreck occurrences. This also reinforces the proposition that there is a relationship between the number of vessels in an area and the occurrence of shipwrecks.

10.6 Wind Conditions

Not all of the instances of multiple shipwrecks on the same day have associated weather reports, but the information that is available suggests there is a link between bad weather and vessels being wrecked. On the database 394 of the shipwrecks have an associated report of the wind conditions. One problem with these is that they may be subjective, especially those which do not quote a Beaufort Scale Force number. This applies particularly to the reports from before the scale came into general use, probably about the middle of the nineteenth century.

Another problem is that although there may be other shipwrecks on the same days as those with reports on the wind conditions it cannot be assumed the conditions were the same. For example on 3rd March 1881 the reported wind for the vessel wrecked off St Catherine's Point was S force 6 while for the vessel wrecked off Portsmouth the wind was blowing ENE hard. As identified in Chapters 8 and 9 the wind direction is not consistent across the Solent area. The strength and direction may vary considerably within short periods of time and can also be blowing from different directions and at different strengths in different locations. Even in a given position the wind direction and strength will vary during the day. For example the reports of the two vessels wrecked on 18th March 1868, on the Owers Shoal, document the wind conditions for the stranding of the brig *Caberfeigh* as ESE force 9, while those for the brigantine *Bethesda* are E force 10. Therefore only documented wind reports can be used for analysis. The numbers of shipwrecks, which occurred in different wind conditions, are listed in Table 4.21.

The Board of Trade statistics, for the British Isles, for 1871, quoted by Bascom (1976:77) indicate that more than half of the ships lost by 'stress of weather' were in wind strengths of force 6 and below. Only 30 per cent were lost in strong gales and hurricanes. Table 4.21 shows that in the study area only 27% of the vessels were wrecked in winds of force 6 and below while 43% were in winds of force 9 and above. The percentage for force 8 and above (gales, storms and hurricanes) is 66%. These figures again suggest the shipwrecks in the study area have a different profile from the Board of Trade statistics. This must mean that the occurrence of shipwrecks is, to some extent, dependent upon local conditions. Table 4.22 details the comparative percentages of the number of vessels wrecked in the different Beaufort Scale winds for the five subgroups. The overseas subgroup has the highest percentage of vessels wrecked in the strongest winds, Force 8 to 12. This may be due to them being further from a safe haven than the vessels, particularly, of the Coastal and Local subgroups. The figures from Table 4.22 suggest that the mix of local, coastal and overseas maritime traffic in any particular area will have a significant influence on the ratios of vessels wrecked in different strength winds.

Comparing the percentage numbers of shipwrecks lost in different wind strengths with the percentage frequency that winds of those strengths occur identifies a large variance, see Table 10.4 below.

Table 10.4 – Numbers (%) of vessels wrecked in different Beaufort Force winds and the frequency (%) of those winds in the Western and Central English Channel and at Calshot (M.O.446b(3), 1940:tables II & III)

Beaufort Force	Wind		Shipwrecks %
	Channel	Calshot	
8-12	2.7	0.3	63.4
4-7	48.0	39.0	30.3
1-3	45.3	57.7	5.2
0, Calm	4.0	3.0	1.1

The numbers of shipwrecks occurring in each month of the year was shown in Table 4.2. Figure 10.26 shows the comparison between those figures and the average number of gales on or near the central part of the south coast of England for the period 1876-1915 (M.O.446b(3), 1940:22):

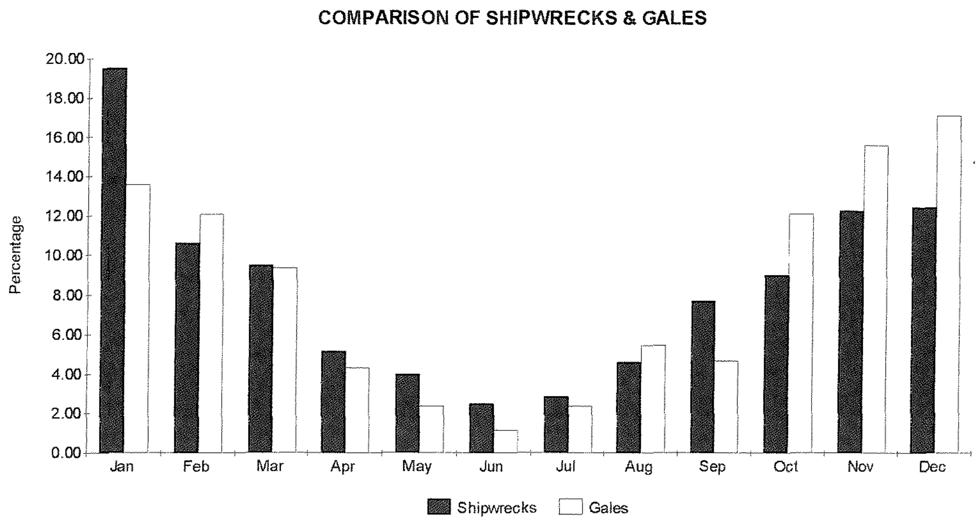


Figure 10.26 Number (%) of shipwrecks per month compared with the average number (%) of gales per month on the central part of the south coast of England 1876-1915

There appears to be similar distribution of the number of shipwrecks per month and the number of gales per month. Kolmogorov-Smirnov tests show there is no significant difference, using a significance level of 0.05, between the shipwreck distribution and gales recorded at Calshot, Portsmouth and the central part of the south coast (M.O.446b(3), 1940:22 & table I). Regression analysis indicates a strong relationship between the number of shipwrecks and the frequency of gales in the central part of the south coast of England. The coefficient of determination was 72.9%. This indicates that 72.9% of the variation in the number of shipwrecks that occur each month relates to the number of gales (winds Force 8 and above).

The scatter plot of the number of shipwrecks each month against the frequency of gales each month for the south coast indicates that the plot for January could be considered as an 'outlier', or very different from the other plots (see Figure. 10.27). The number of shipwrecks for January is 204 and the frequency of gales 3.5. If the figures for January are excluded from the regression analysis the coefficient of determination increases to 91.35% suggesting that in January there may be additional factors that affect the occurrence of shipwrecks for that month. As identified in section 10.4 Peak Monthly Totals, there were two occasions during January when

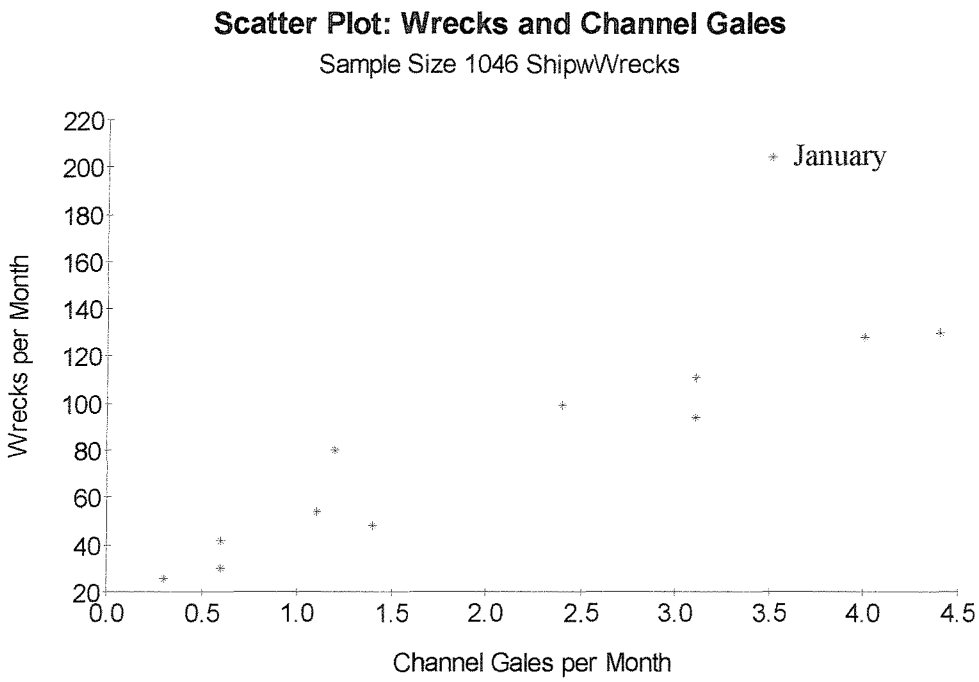


Figure 10.27 Scatter plot of number of shipwrecks each month against the frequency of gales on the south coast of England

high daily totals of shipwrecks were recorded and one in September. If the adjusted number of shipwrecks each month is used regression analysis returns a coefficient of determination of 84.80% indicating a very strong relationship.

Regression analysis was also carried out comparing the frequency of shipwrecks each month with the frequency of gales at both Portsmouth and Calshot within the study area. The coefficient of determination for Portsmouth was 66.72% and for Calshot 76.12% both indicating a strong relationship exists. Using the adjusted number of shipwrecks each month reduced the coefficient of determination marginally for Portsmouth to 63.39%, but increased that for Calshot to 82.39%.

The direction of the wind is recorded for 276 shipwrecks. The number for each of the eight compass direction segments is shown in figure 10.28 below. A comparison of the recorded wind direction for the shipwrecks with that for the western and central parts of the English Channel (49° - 51° N, 0° - 5° W), Hurn, Calshot and Portsmouth presented a confused picture. Regression analysis returned coefficients of determination for the English Channel (M.O. 446b(3), 1940:table II), Hurn (Chandler

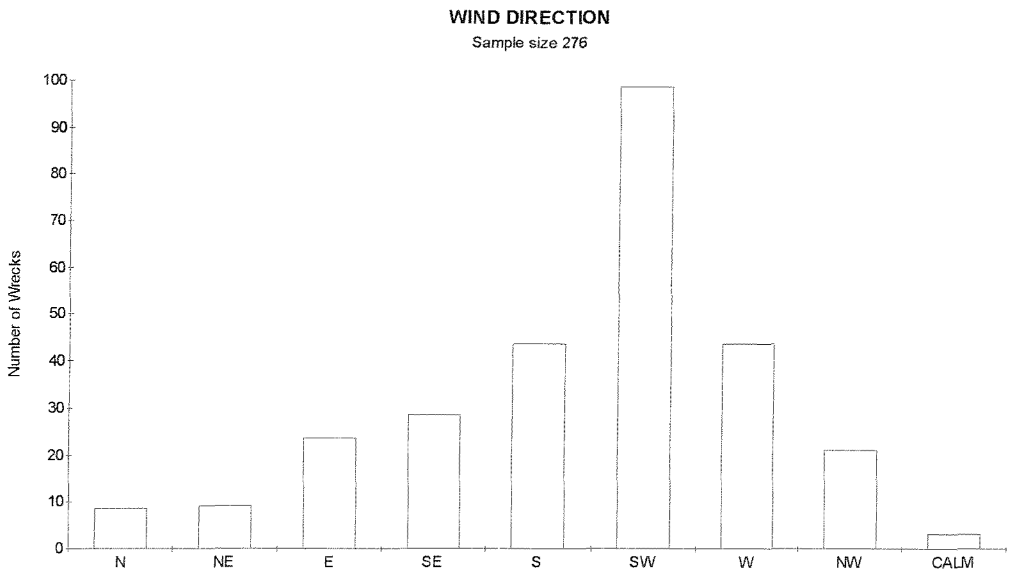


Figure 10.28 Number of shipwrecks by reported wind direction

& Gregory, 1976:table3.4), Calshot at 0700 GMT and Portsmouth 0900 GMT (M.O. 446b(3), 1940:table I) of 44.44%, 59.67%, 27.13% and 23.3% respectively. This variation is almost certainly caused by the difference in topography of the locations of the weather recording stations (Chandler & Gregory, 1976:47). Diurnal variation can also have a significant affect (see Chapters 8 and 9). Table 10.5 below details the percentage frequency of land and sea breezes for Calshot in the month of August, 1932 (M.O. 446b(3), 1940:19).

Table 10.5 – Frequency of Winds (%) from the Sea (SE-SW) and the Land (NW-NE) at Calshot, August, 1932

GMT	0100		0700		1300		1800	
	Sea	Land	Sea	Land	Sea	Land	Sea	Land
	26	32	26	35	39	23	64	19

The recorded wind directions for 0700 and 0900 are liable to be affected by the land breezes (M.O. 446b(3), 1940:16) and those in the late afternoon/evening by sea breezes. In addition the wind tends to be at its weakest in the morning, increasing in strength into the afternoon (M.O. 446b(3), 1940:18). It is probably therefore, more realistic to compare the recorded wind directions for the shipwrecks with the recorded wind direction around midday. Regression analysis comparing the shipwreck wind direction data with that recorded for Calshot at 1300 GMT returned a coefficient of determination of 85.24% indicating a strong relationship. Figures 10.29 and 10.30 below show the comparison of the two sets of wind direction data.

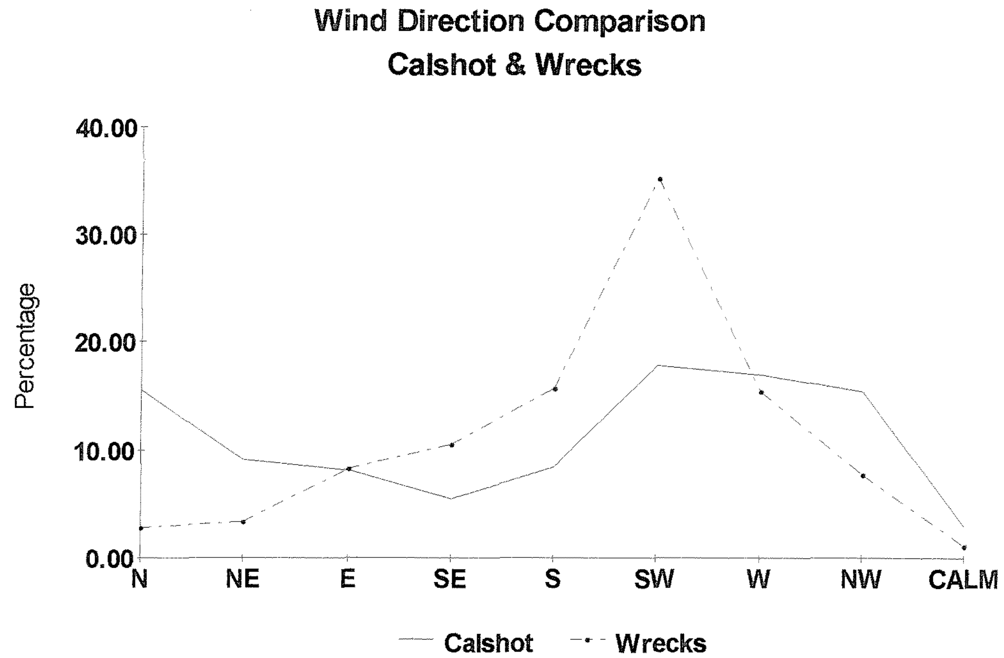


Figure 10.29 Comparison of the recorded wind direction for shipwrecks and for Calshot 1300 GMT

The highest numbers of shipwrecks occur on coasts that present a lee shore to the most frequent winds. Particularly the SW coast of the Isle of Wight, between the Needles and St.Catherine's Point, which accounted for 31% of the shipwrecks and has a fetch of about 5,000 km. A further 16.45% of the shipwrecks occurred on the coast and sandbanks between Lee-on-the-Solent and Selsey Bill, which is also, a lee shore to the prevalent winds. This suggests there is a relationship between wind direction and the location of shipwrecks

Each of the bays and harbour entrances were analysed to identify their aspect (open direction to one of the eight compass points used in the wind direction analysis). Banks and headlands were not included as they are generally multi-aspect. Regression analysis of the number of shipwrecks in the bays and harbour entrances for each aspect against the wind direction data for Calshot, 1300 GMT returned a coefficient of determination of 81.00%. This identifies that lee shores are a major risk to sailing ships.

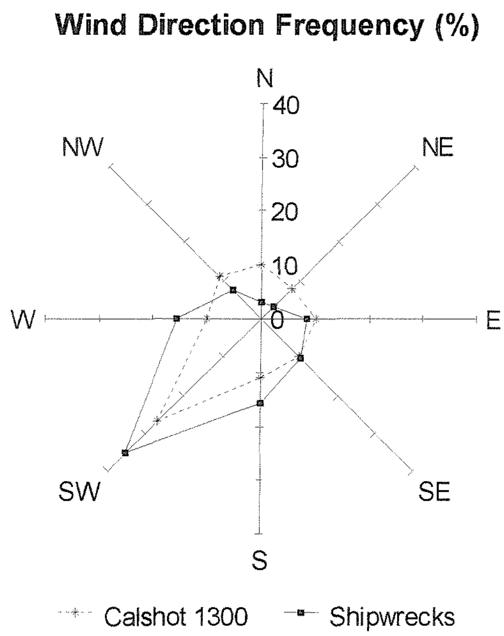


Figure 10.30 Polar diagram comparing the frequency of winds from eight compass directions for vessels wrecked and Calshot 1300 GMT

Further analyses of the reported wind directions for shipwrecks and the number of shipwrecks for each bay and harbour entrance aspect was carried out against the frequency of different strength winds from the eight compass points. Generally as the strength of the wind increased so did the correlation. The coefficient of determination for the shipwrecks reported wind directions against the reported winds at Calshot of Beaufort Force 4-7 was 82.23% and for Force 8-12, 56.47%. For the number of shipwrecks for each aspect against the reported winds at Calshot for Beaufort Force 4-7 the coefficient of determination was 43.52% and for Force 8-12, 85.87%. The difference in the strengths of the relationships for the two wind strength groups is due to the higher number of shipwrecks in the bays with aspect to the Southwest, particularly the Southwest coast of the Isle of Wight, which is the direction of the

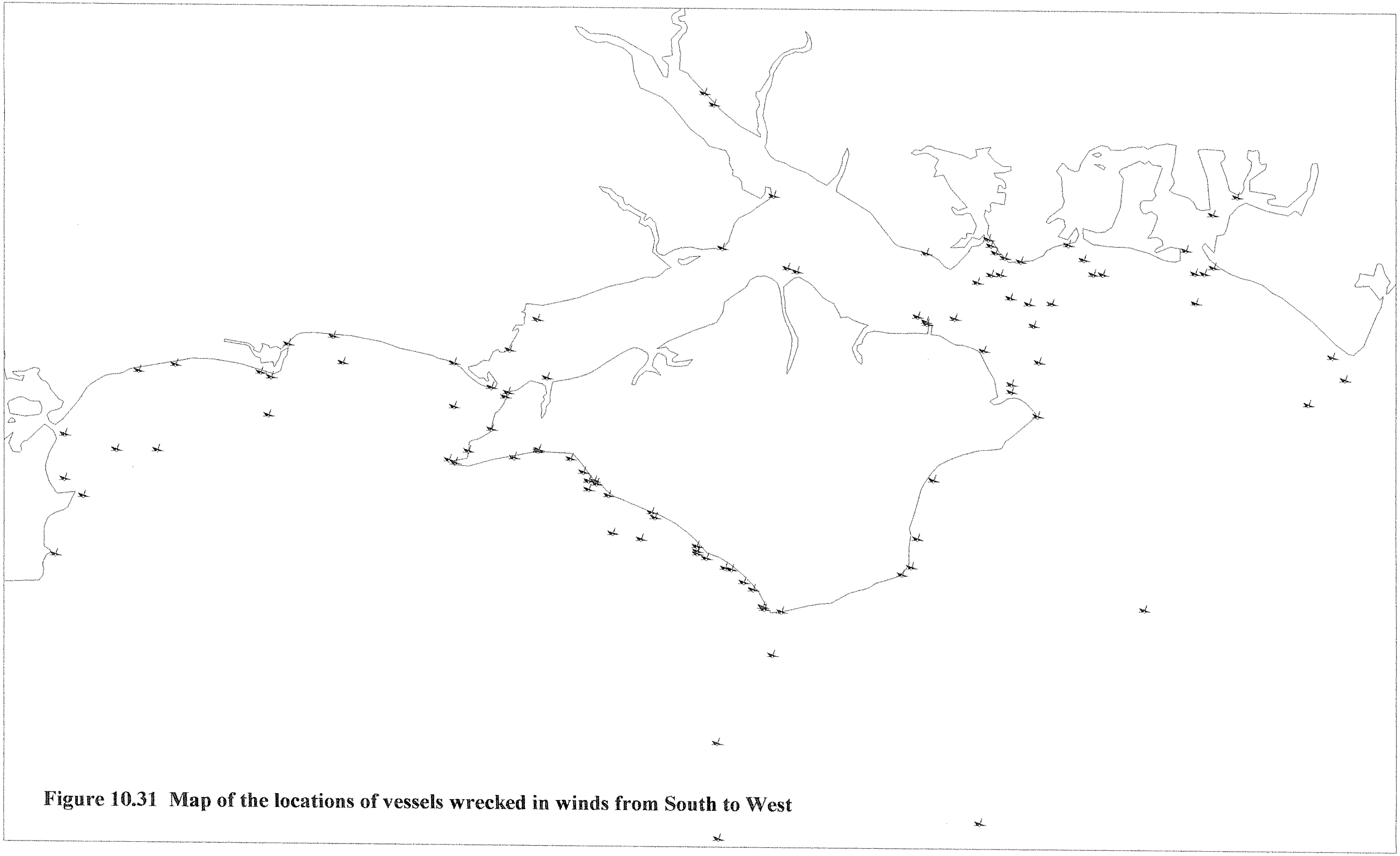


Figure 10.31 Map of the locations of vessels wrecked in winds from South to West

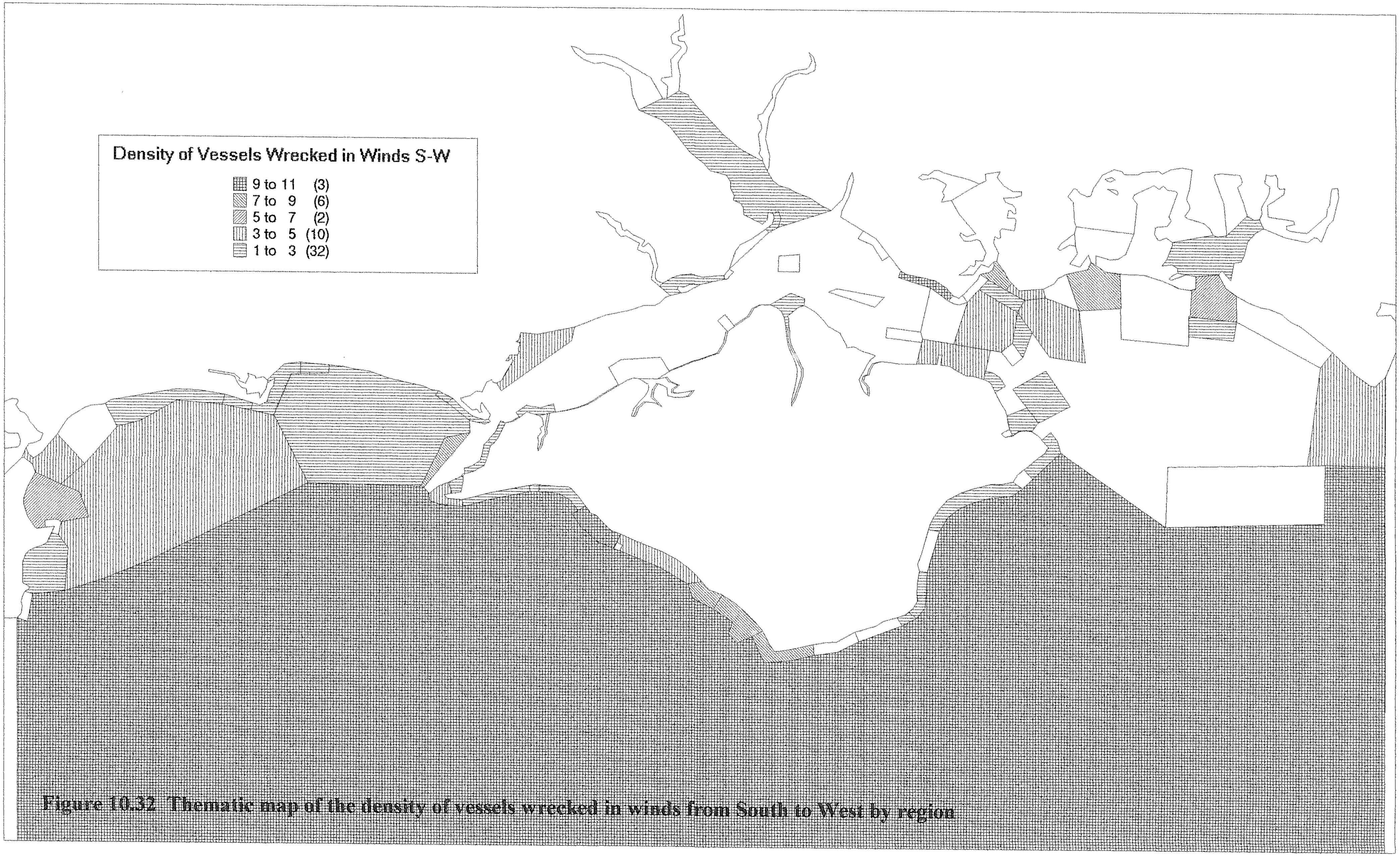


Figure 10.32 Thematic map of the density of vessels wrecked in winds from South to West by region

Figure 10.33 Map of the locations of vessels wrecked in winds from Northeast to Southeast

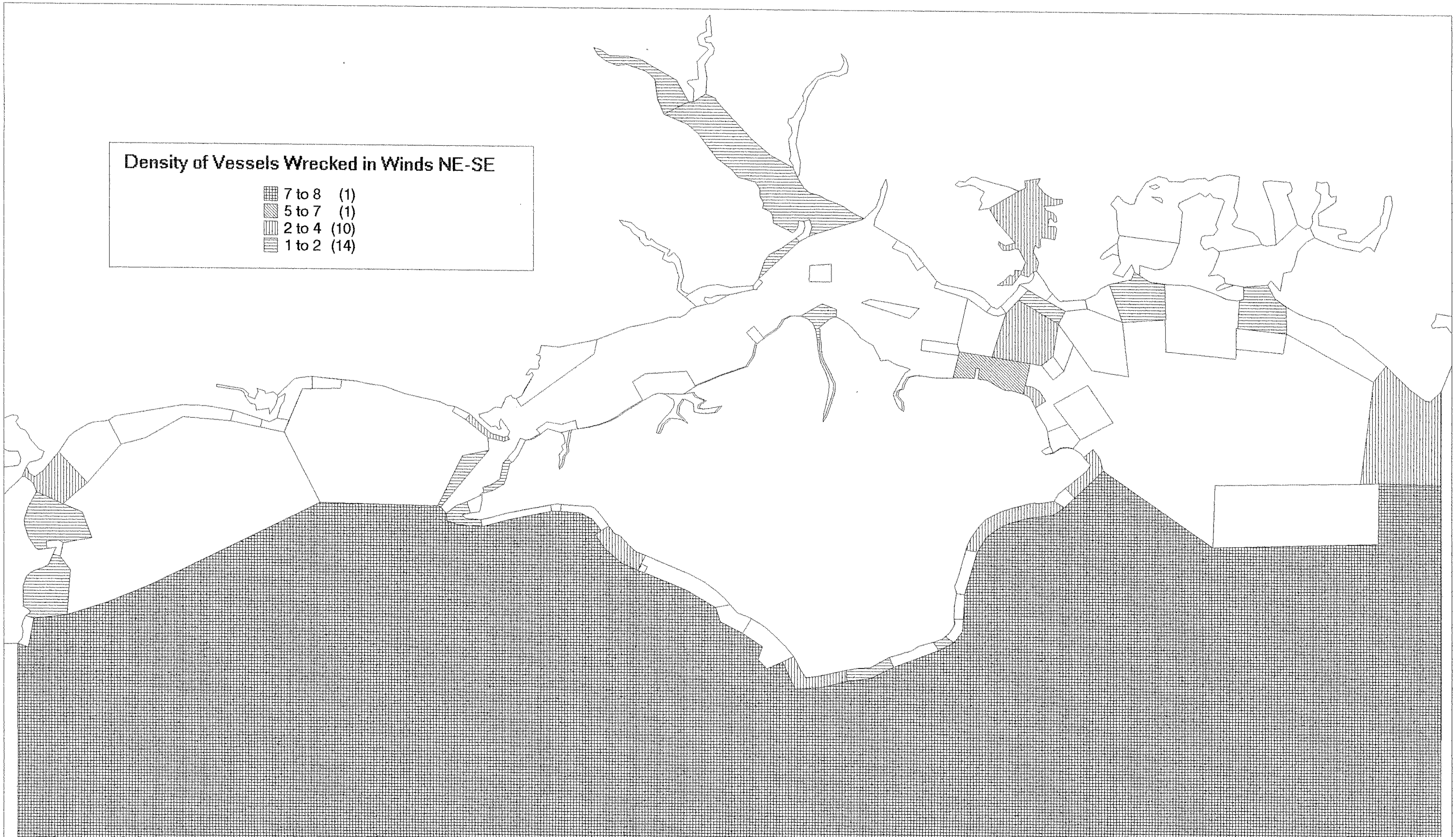


Figure 10.34 Thematic map of the density of vessels wrecked in winds from Northeast to Southeast by region

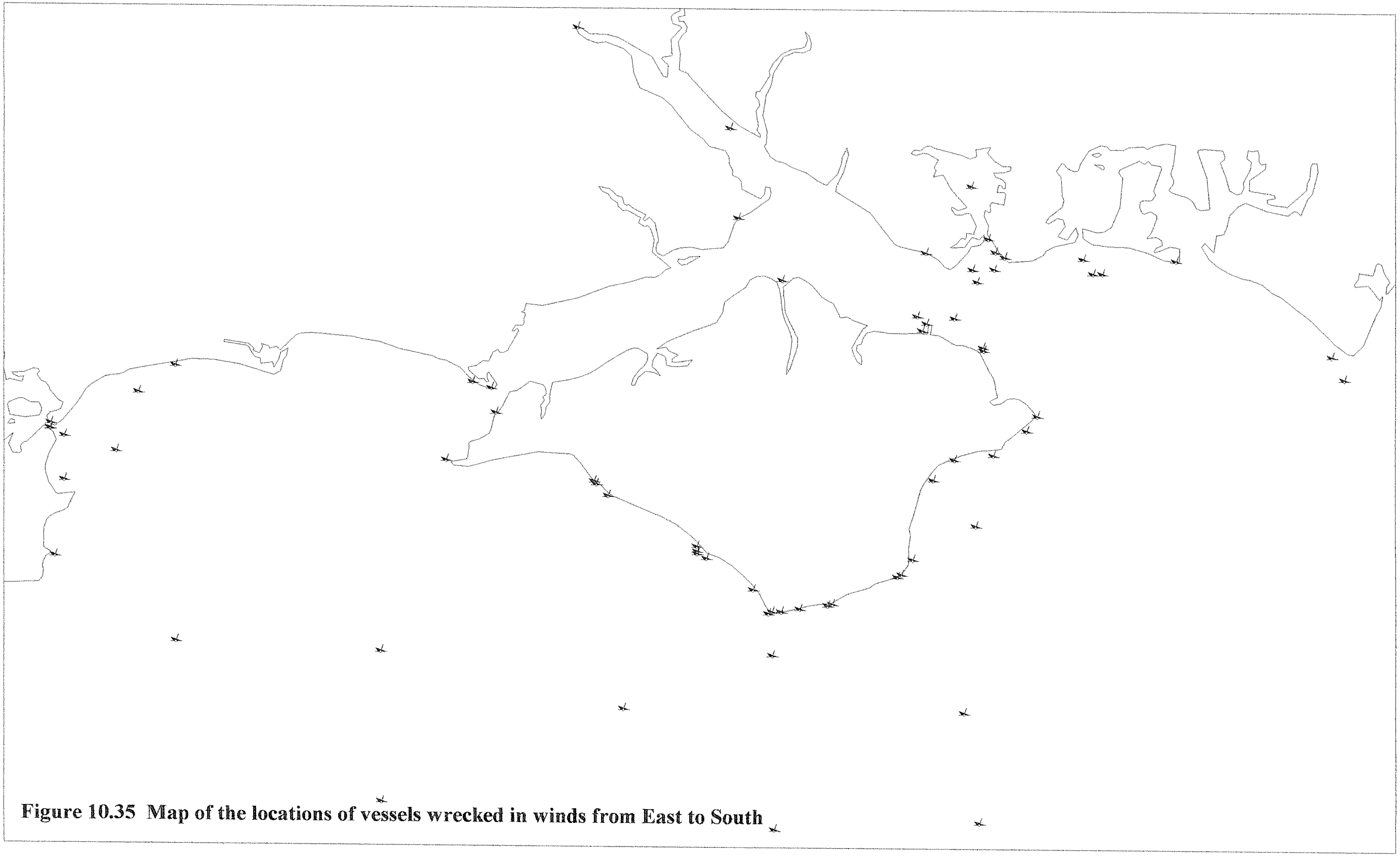


Figure 10.35 Map of the locations of vessels wrecked in winds from East to South

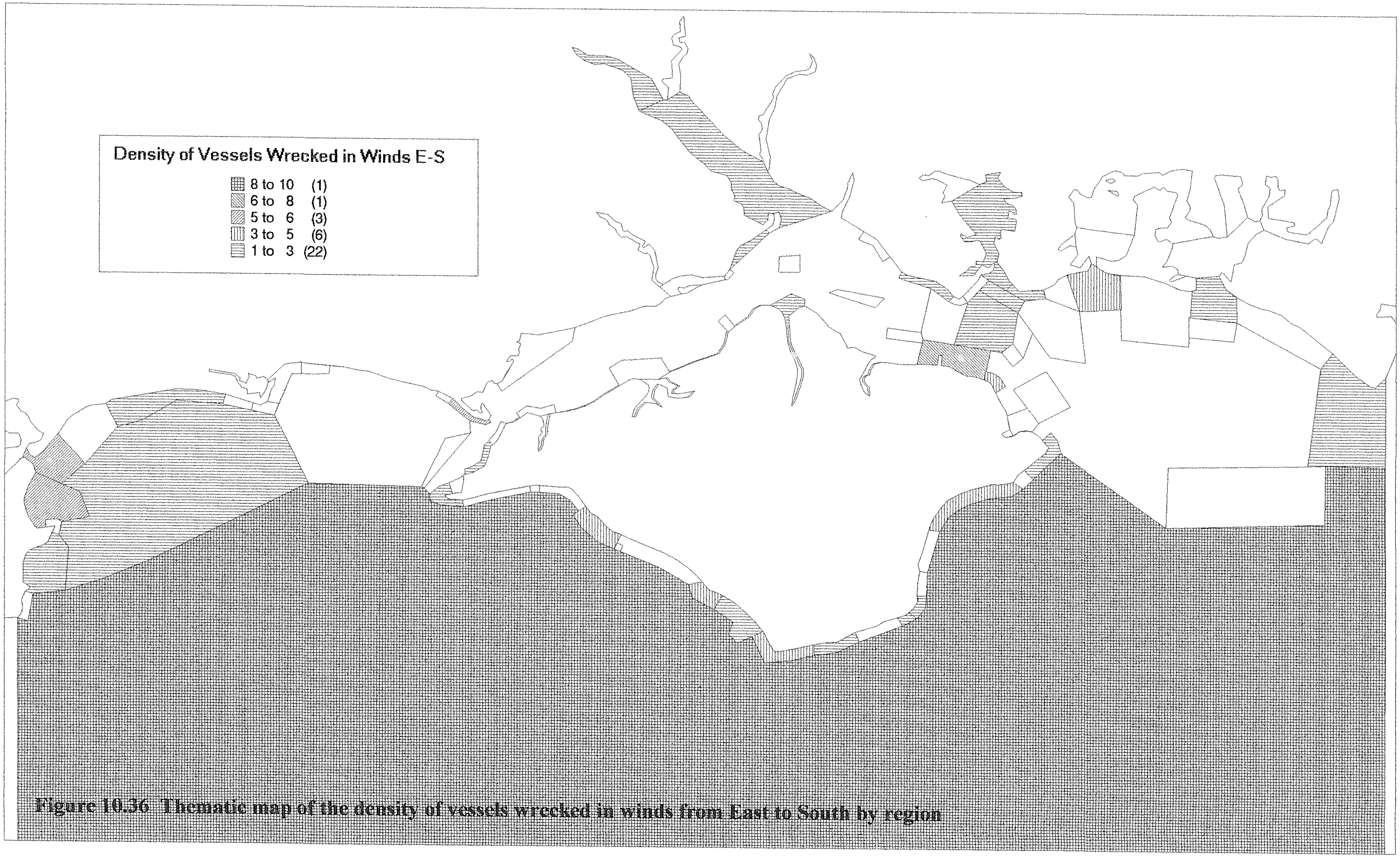


Figure 10.36 Thematic map of the density of vessels wrecked in winds from East to South by region

highest frequency of strong winds (see Table 8.3).

The maps in Figures 10.31, 10.33 and 10.35 show the locations of vessels wrecked in winds from the three sectors that can be considered to create lee shores. The thematic maps (Figures 10.32, 10.34 & 10.36) show that more vessels are wrecked on lee shores than on shores facing other directions. Many of the vessels wrecked at Spithead (off Portsmouth) can be attributed to the presence there of sandbanks which would provide a lee danger.

The highest proportion (35.22%) of wrecks occurred in Southwest winds. The winds have a tendency to be canalised and flow along the English Channel (Chandler & Gregory, 1976:47) with the greatest frequencies from 230° – 250° and 050° – 070°. The prevailing winds in the study area are from the Southwest and West (see Chapter 8 Meteorology). More importantly it is from this sector that gale force winds are most common (M.O.4466 (3), 1940:21 &22). The relationship between the frequency of gales and shipwrecks has already been covered (see above). The fact that these Southwest winds have the longest fetch, up to the whole distance across the Atlantic from South America, before they crash into the Isle of Wight then the high frequency of vessels being wrecked in south-westerly winds is even more understandable.

10.7 Poor Visibility

Another weather condition, which is a major hazard to mariners, especially before the days of radar and radio and satellite based navigation systems, is poor visibility. Although the incidence of thick fog seldom exceeds an annual total of 15 days at Southampton and Calshot it is far more frequent at the Needles and to the east of Spithead (Macmillan, 1964:60). Unfortunately there is no recorded data available for those locations. Figure 10.37 shows the average number of days per month the visibility is less than 3.7 km at Calshot. A comparison with the adjusted number of shipwrecks and the number of days of poor visibility at Calshot is shown in figure 10.38 below. Regression analysis identified that the coefficient of determination is 70.24% indicating that a strong relationship exists.

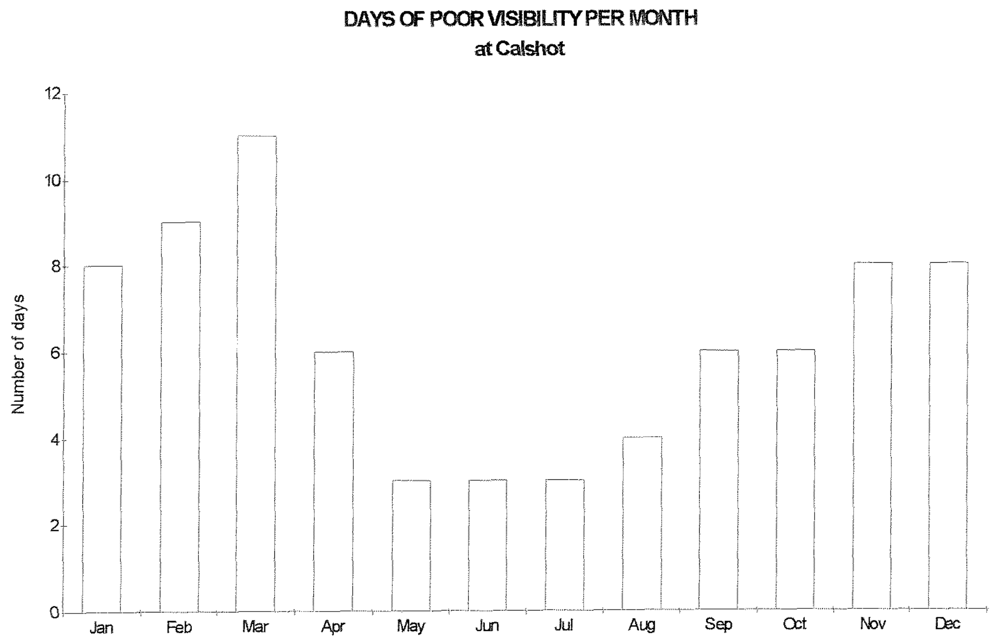


Figure 10.37 Average number of days with visibility of less than 3.7 km at Calshot 1927-36 (M.O.446b(3), 1940:Table VI)

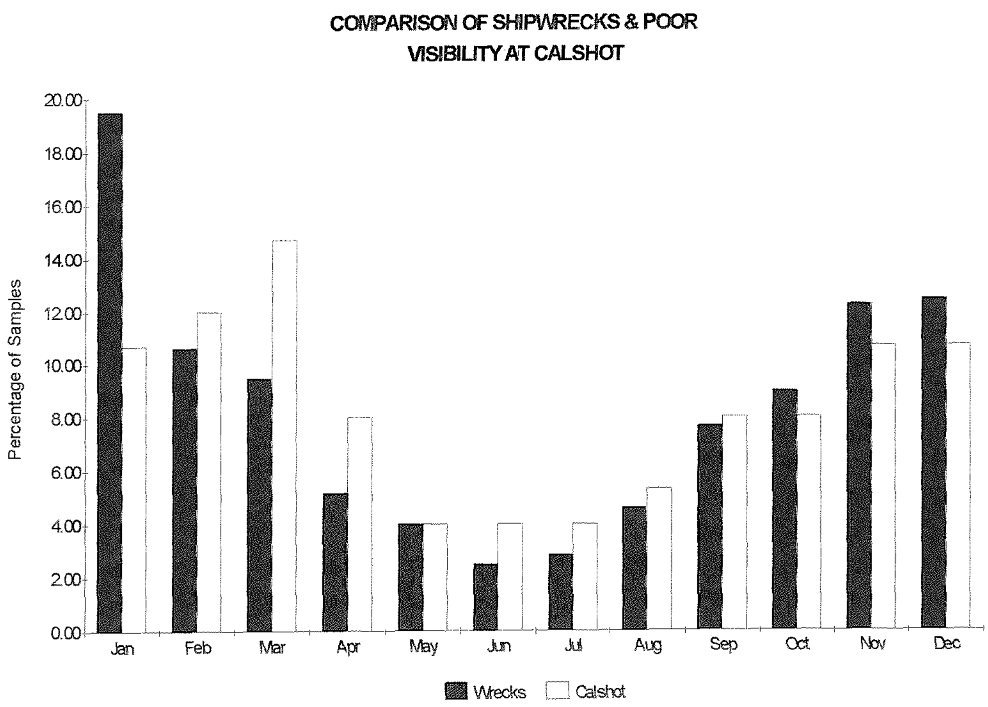


Figure 10.38 Comparison of numbers of vessels wrecked and days of poor visibility at Calshot per month

Apart from fog and mist, other conditions cause impaired visibility. Of the 512 shipwrecks where the weather or time of day is known 64.65% were in what could be considered impaired visibility. This includes the vessels that were wrecked in any one of haze, fog, mist, rain, snow, thick weather, poor visibility, dark weather, winds of Beaufort Force 8 and above; at night or in twilight. Figure 10.39 below, shows the monthly distribution of the shipwrecks that occurred in impaired visibility.

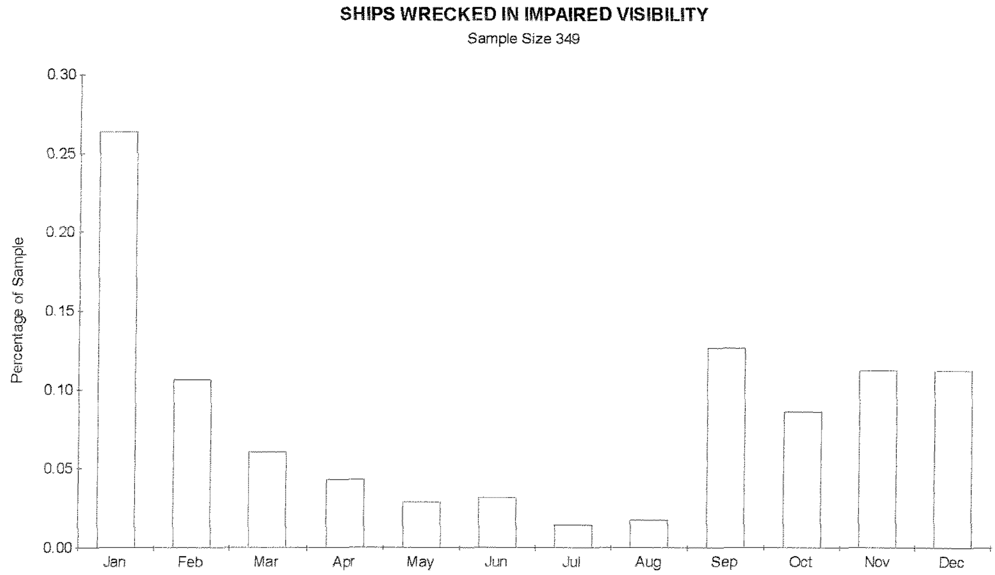


Figure 10.39 Monthly distribution of numbers of vessels wrecked in impaired visibility

The distribution of shipwrecks in Figure 10.40 differs to some degree from the distribution of all the shipwrecks shown in Figure 4.8, but regression analysis identifies that the coefficient of determination is 84.85% showing there is a very strong relationship between them. When both sets of figures are adjusted for the high daily values in January and September (see section 10.4 Peak Monthly Totals) the regression analysis returns an increased coefficient of determination of 91.34%. This suggests there is also a strong relationship between the frequency of impaired visibility and the frequency of vessels being wrecked. Figure 10.41 shows the density of the vessels wrecked by region. For the adjusted total of shipwrecks the density of the near Portsmouth, Stokes Bay, Ryde and Selsey Bill regions would be reduced to the 7 to 12 shipwrecks division.

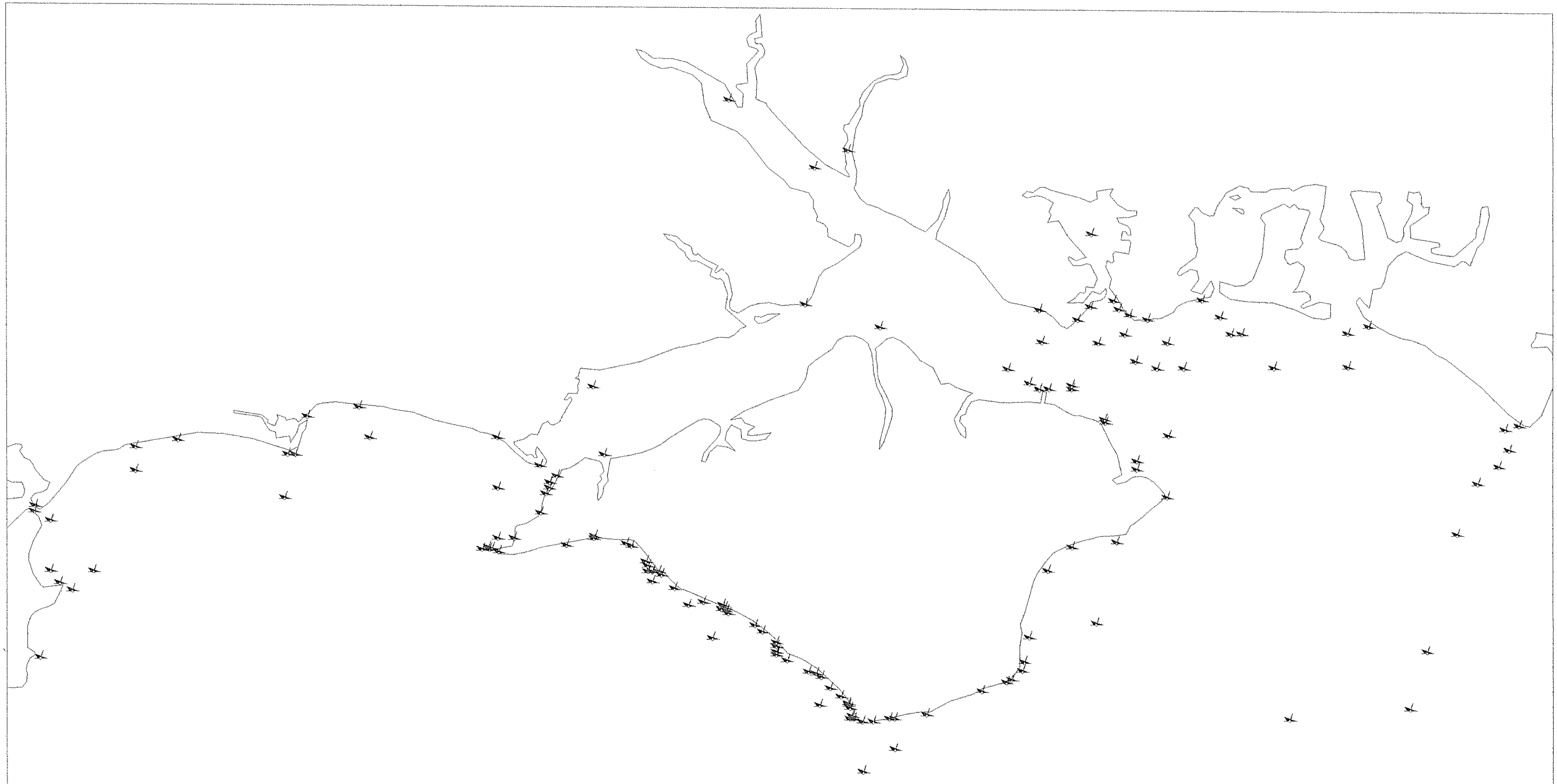


Figure 10.40 Map of the locations of vessels wrecked in impaired visibility

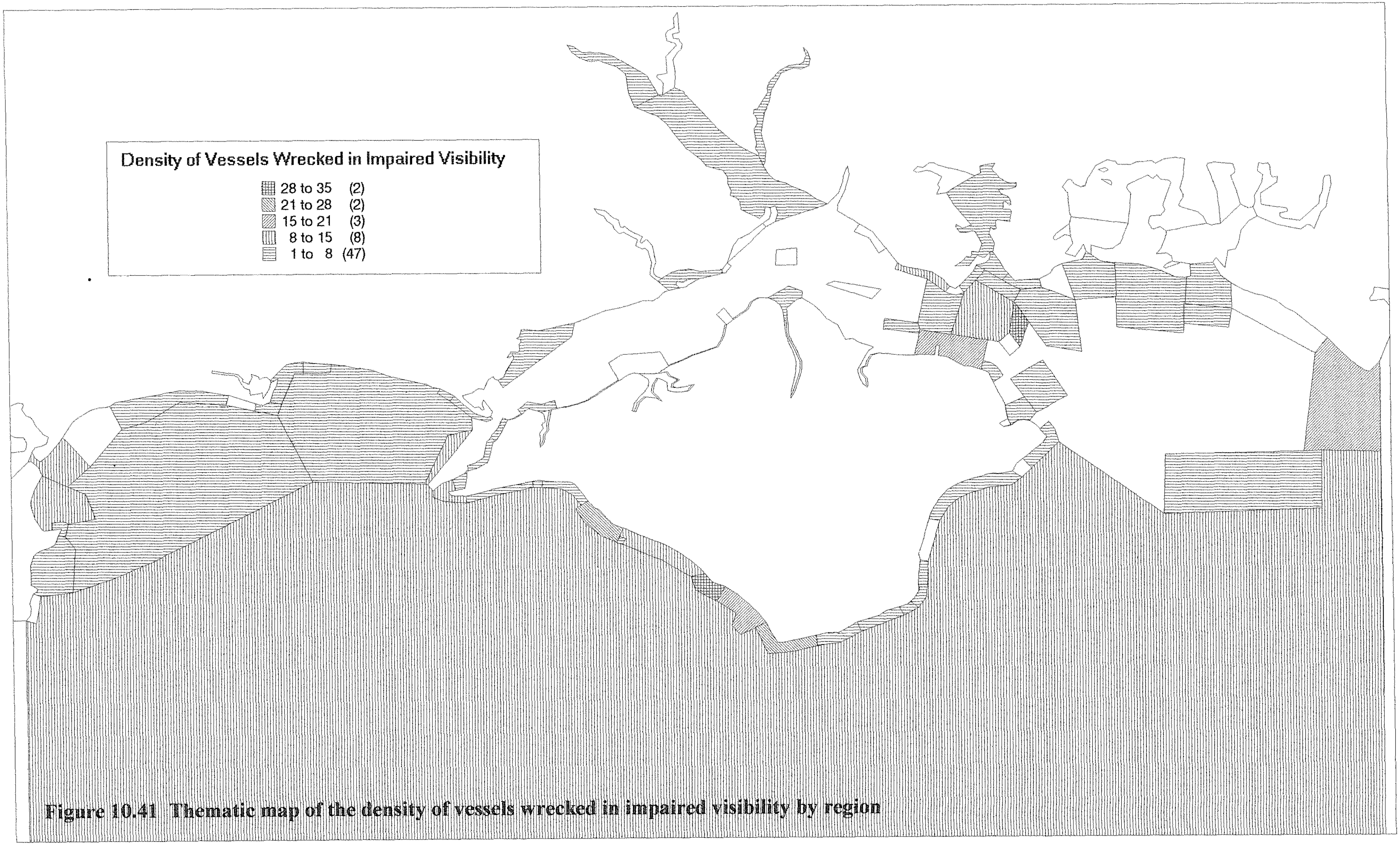


Figure 10.41 Thematic map of the density of vessels wrecked in impaired visibility by region

10.8 Tides

An analysis of the shipwrecks on the database, for which the time of wrecking is known, compared with the tides was carried out to see if there was a correlation between shipwrecking and periods of the strongest tidal streams. This does not appear to be the case as the distribution is evenly spread throughout the entire low_water-to-low_water cycle. A further analysis of the number of shipwrecks occurring on the different days of the 14-day tidal cycle indicates a bias for them occurring at springs and to a lesser extent at neaps (see Figure 4.59). The number of shipwrecks at springs and springs + 1 day are the highest, 100 and 75 respectively. This could, perhaps, be due to a larger number of ships entering or leaving harbours at springs when there would be a greater depth of water at high tide or being caught at anchor awaiting the tide. If this were the case then the harbours the ships had departed from or were

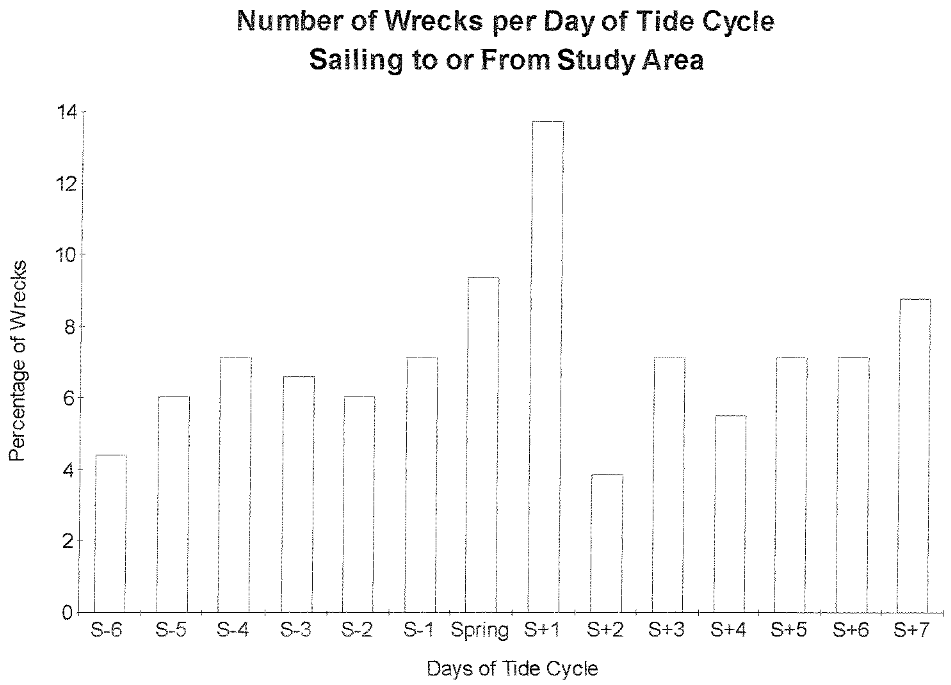


Figure 10.42 Numbers (%) of ships wrecked, sailing to or from the study area, on the different days of the tidal springs/neaps cycle

sailing to would be in or close to the study area. In support of the above hypothesis the voyages made by vessels wrecked when sailing to and from ports in the study area plus those vessels at anchor and moored were analysed. Of these 234 vessels, 34.6% were wrecked at springs or 1 day either side (see Figure 10.42 above). This compared with 27.7% for all shipwrecks and shows some, if not compelling support for the hypothesis. Tidal streams flow faster at springs tides which gives rise to rougher seas when the wind is against the tide. Both would make it more difficult for shipping and could possibly contribute to vessels being wrecked.

The analysis of shipwrecks by the tidal cycle only provided data supporting the prediction of the timing of vessels being wrecked not their location. Figures 4.60 to 4.73 suggest there is little, if any difference in the locations where vessels are wrecked on the different days of the tidal cycle. The thematic density maps (Figures 10.43 to 10.56) for the 14 days of the tidal cycle suggest the distribution of shipwrecks to be random. The high density of 20 wrecked vessels in the near Portsmouth region 2 days after spring tides is entirely due to the 20 vessels that foundered at Portsmouth on 21st September 1230.

Analyses of the frequency of shipwrecks for the five subgroups during the tidal cycle show no consistent pattern. The problem with analysing the shipwreck statistics down to lower levels is that the numbers become smaller and the viability of the result produced must be questioned for its validity. For example of the total of 100 vessels wrecked at springs only 39 had details of the wind direction and 40 the wind strength.

10.9 Cargoes Carried

The Board of Trade statistics for the period 1859-1868 (Bascom, 1976:76) show that of the ships lost 27 per cent were colliers; 19 per cent had cargoes of stone or ores; 7 per cent were fishing vessels; 47 percent carried other goods or were in ballast. The shipwreck database show that of the 593 vessels where the cargo is recorded; 11.17 per cent were colliers or carrying coal; 7.17 per cent carried stone or ores and only 4.44 per cent of the shipwrecks were identified as fishing vessels. The database shows a wide variance of cargo e.g.; 14.17 per cent wine and spirits; 7.5 per cent timber; 6.0 per cent fruit & nuts; 6.0 per cent salt; 5.83 per cent grain and flour; 5 per cent wool and cloth etc; 4.5 per cent clay and chalk; 3.33 per cent various oils; 2.83 per cent

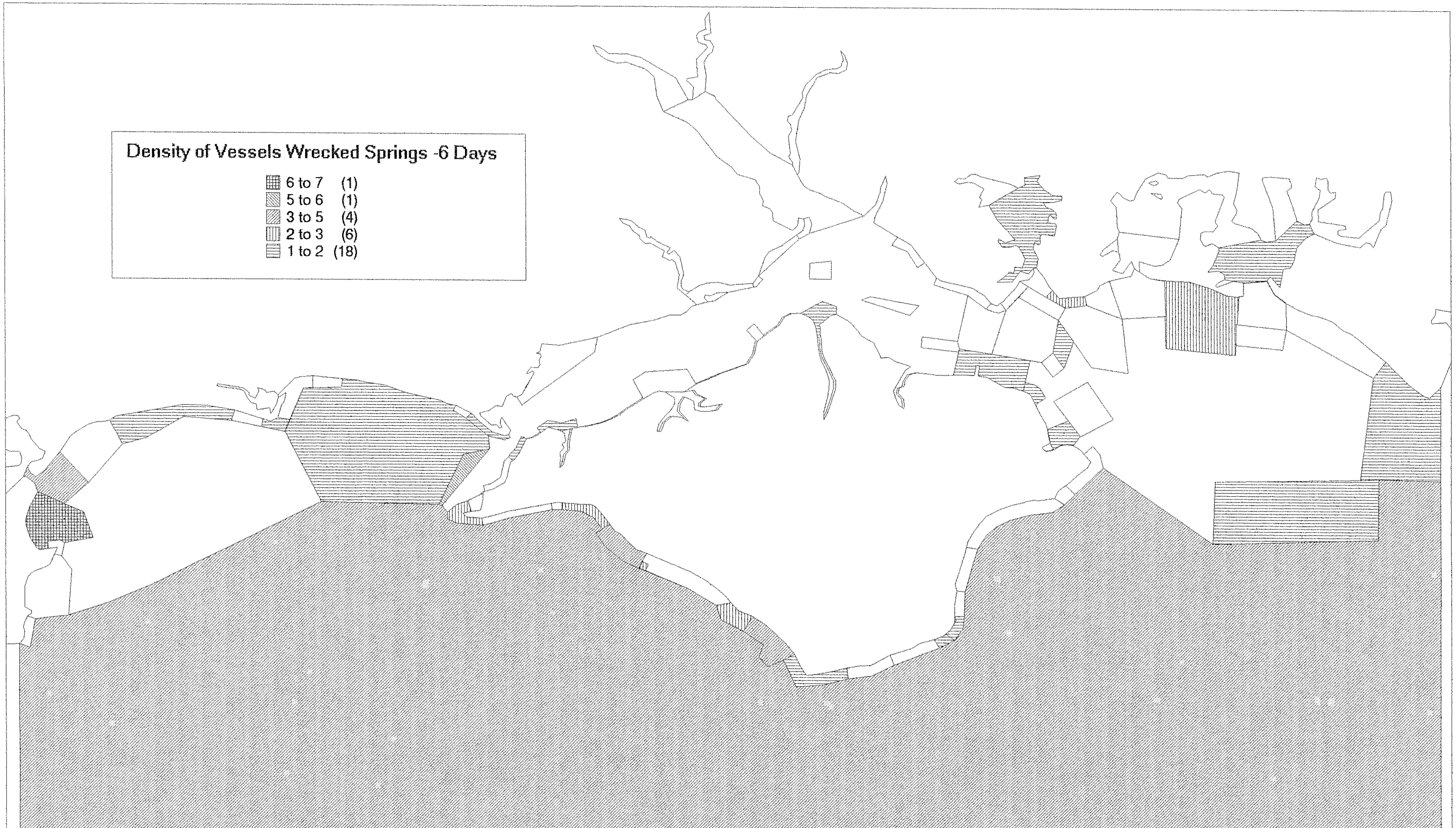


Figure 10.43 Thematic map of the density of vessels wrecked six days before spring tides by region

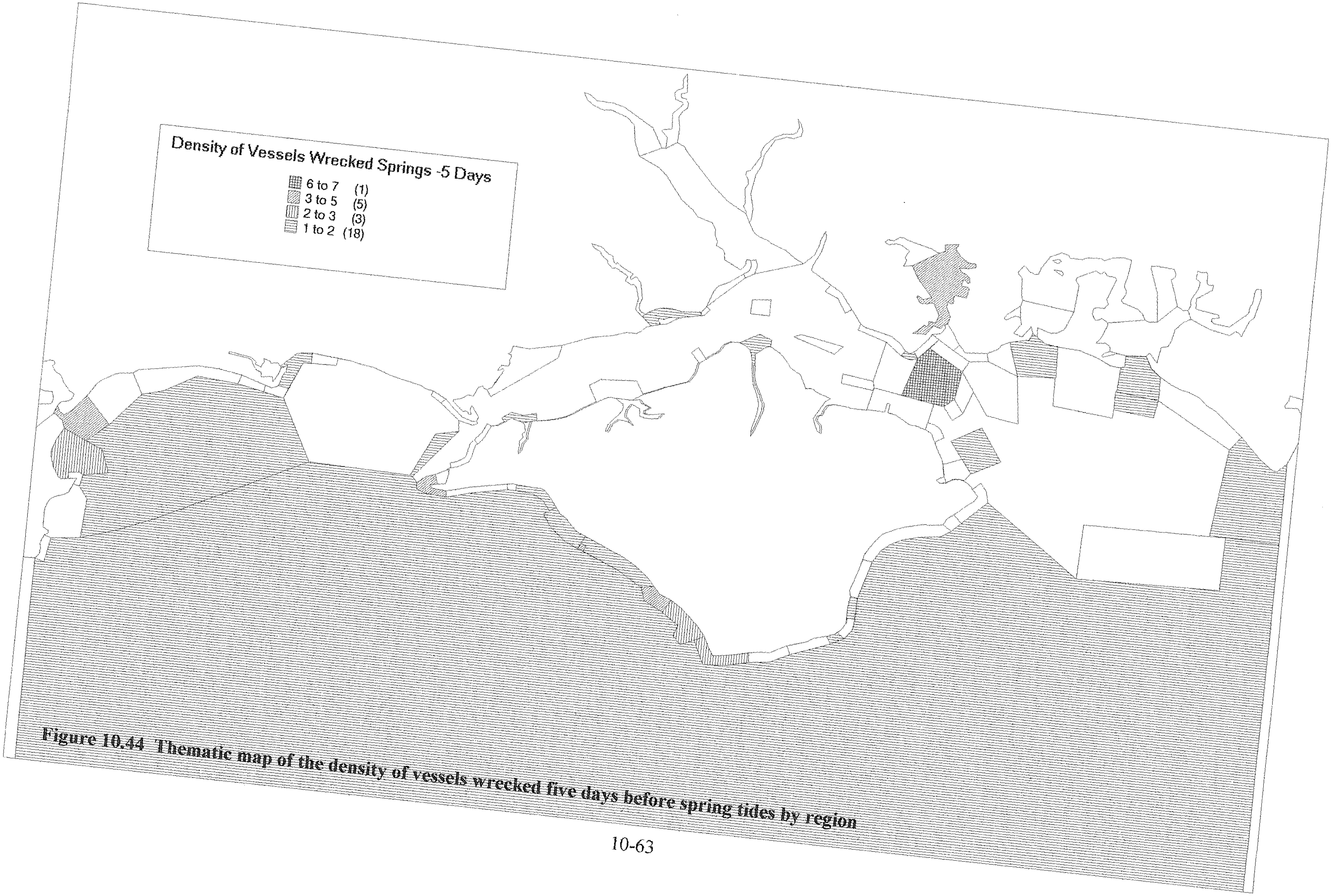


Figure 10.44 Thematic map of the density of vessels wrecked five days before spring tides by region

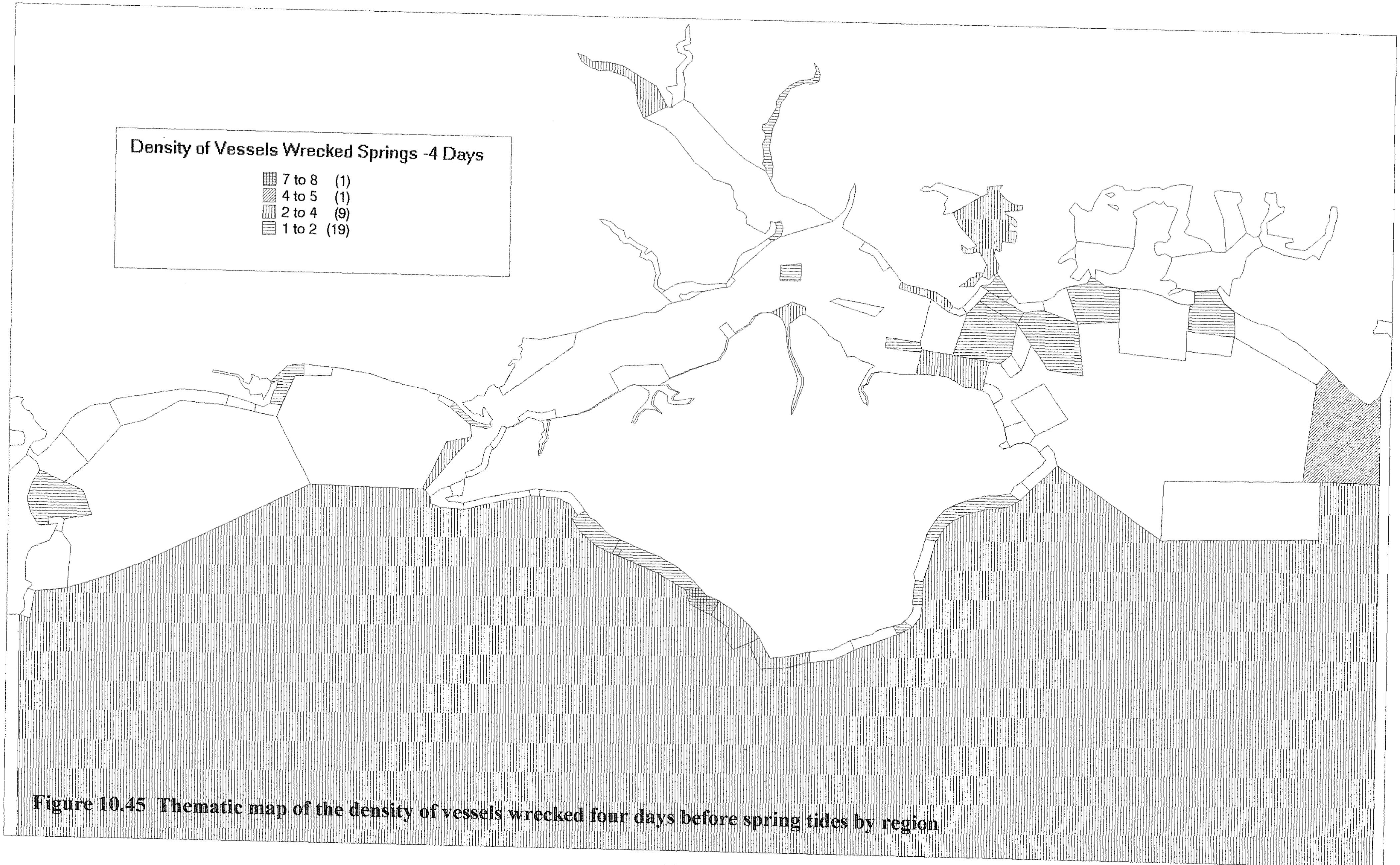


Figure 10.45 Thematic map of the density of vessels wrecked four days before spring tides by region

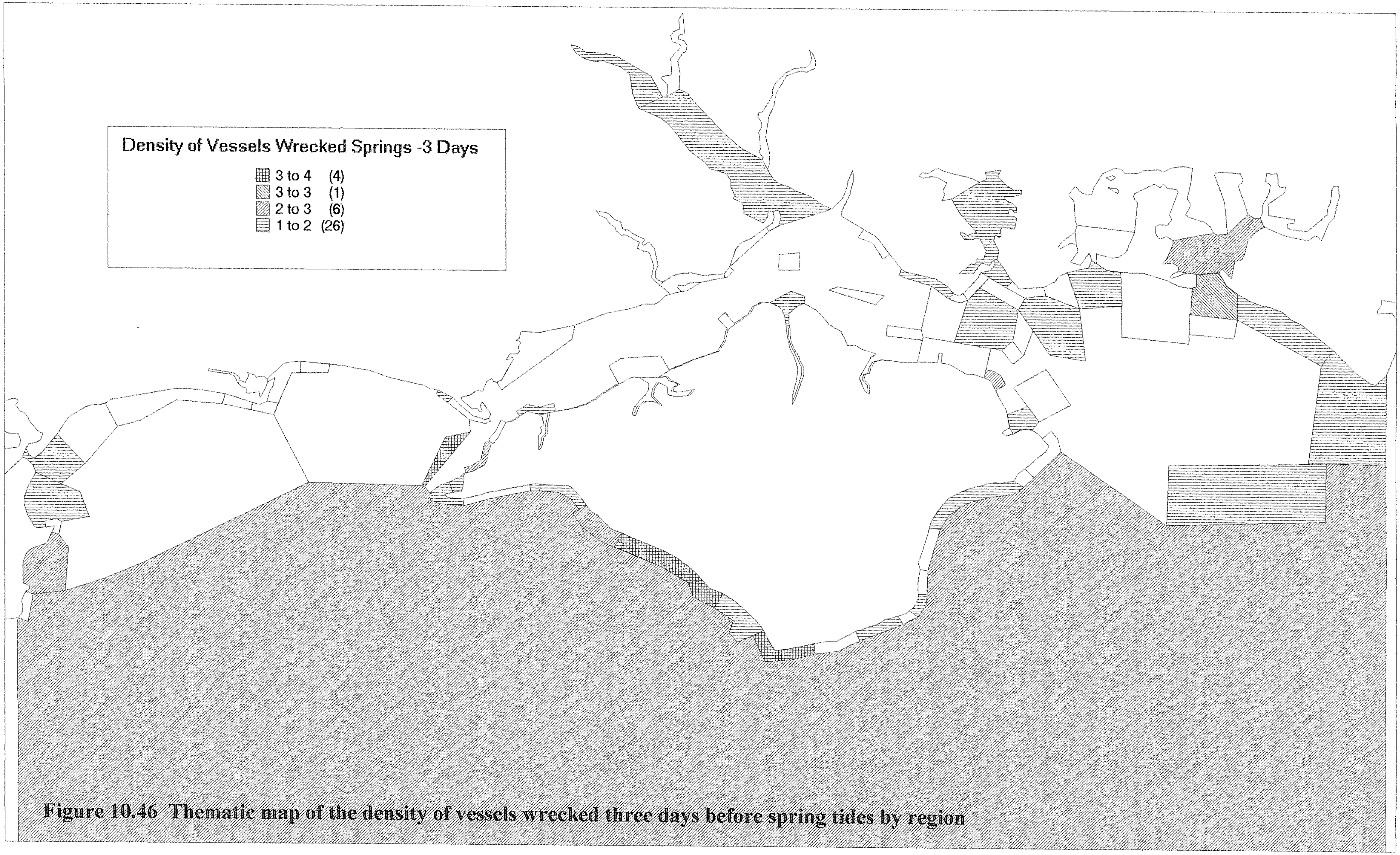


Figure 10.46 Thematic map of the density of vessels wrecked three days before spring tides by region

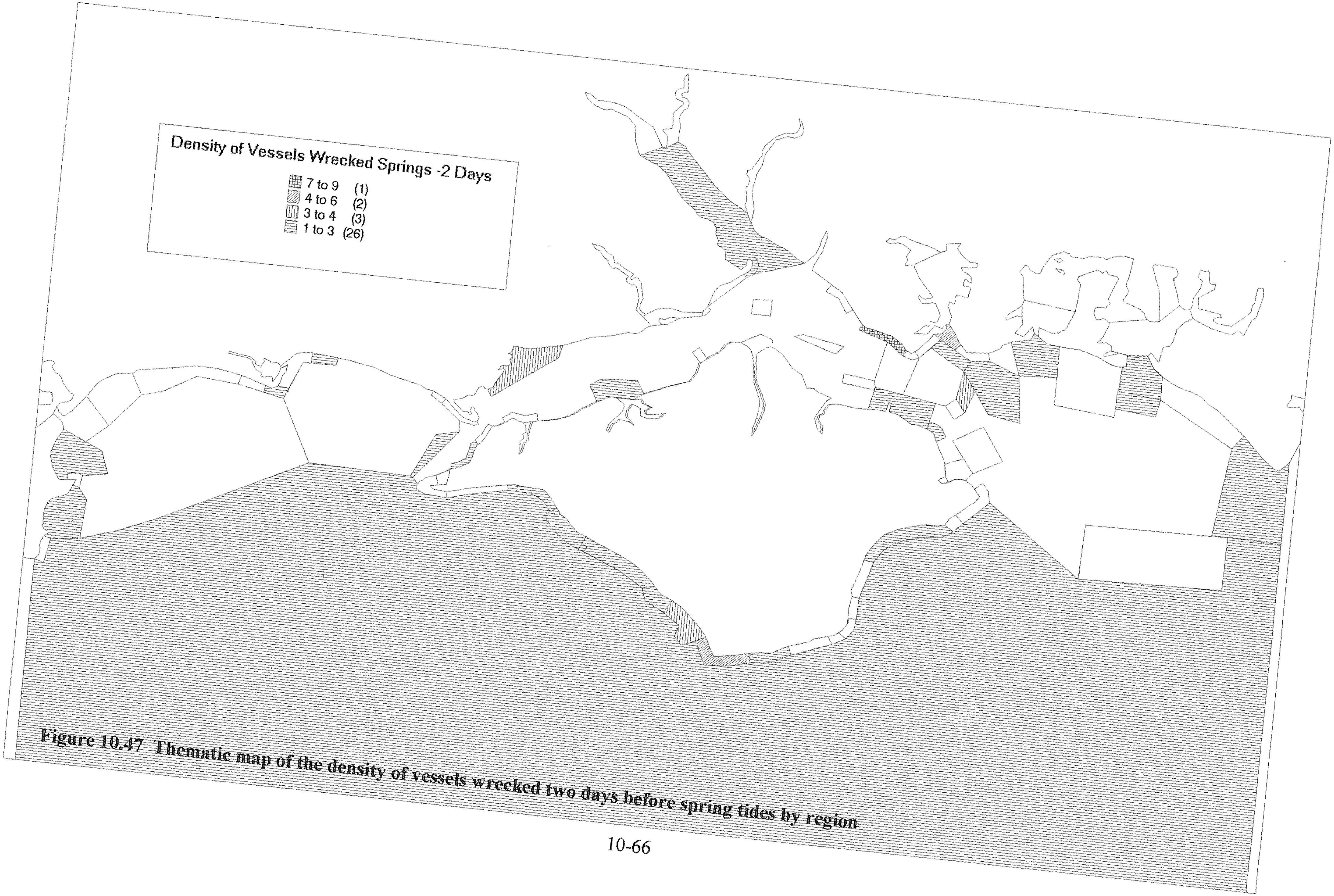


Figure 10.47 Thematic map of the density of vessels wrecked two days before spring tides by region

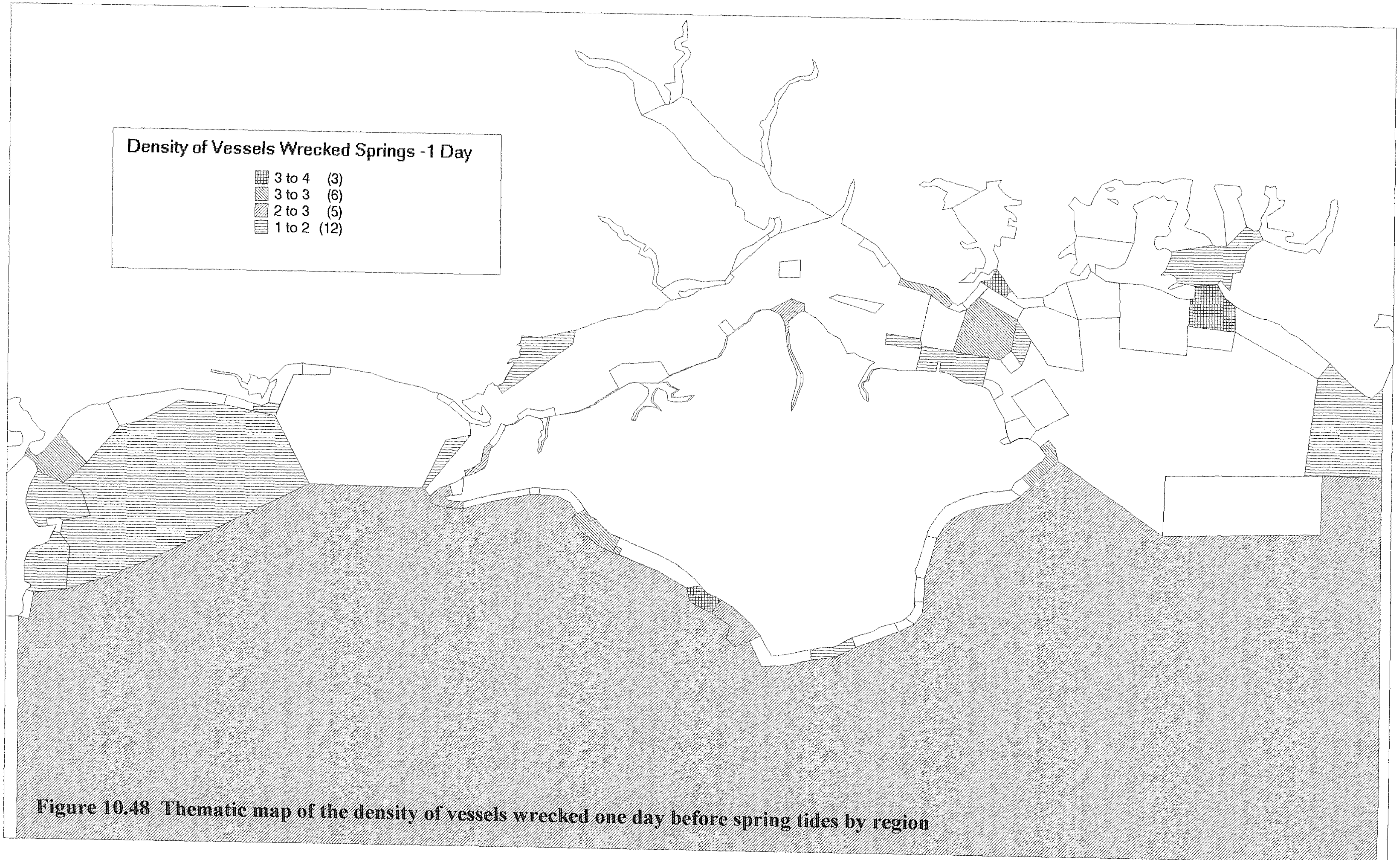


Figure 10.48 Thematic map of the density of vessels wrecked one day before spring tides by region

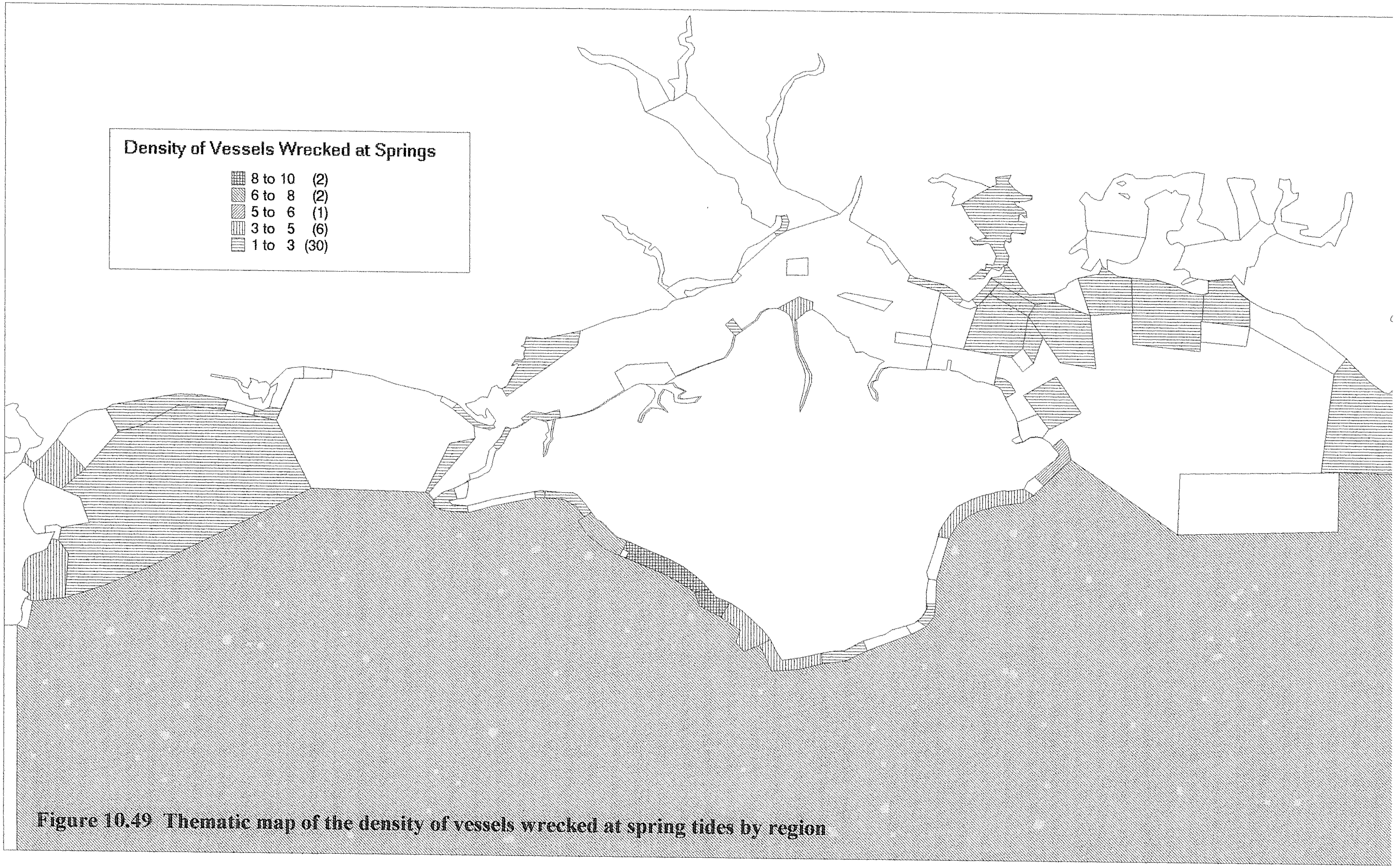


Figure 10.49 Thematic map of the density of vessels wrecked at spring tides by region

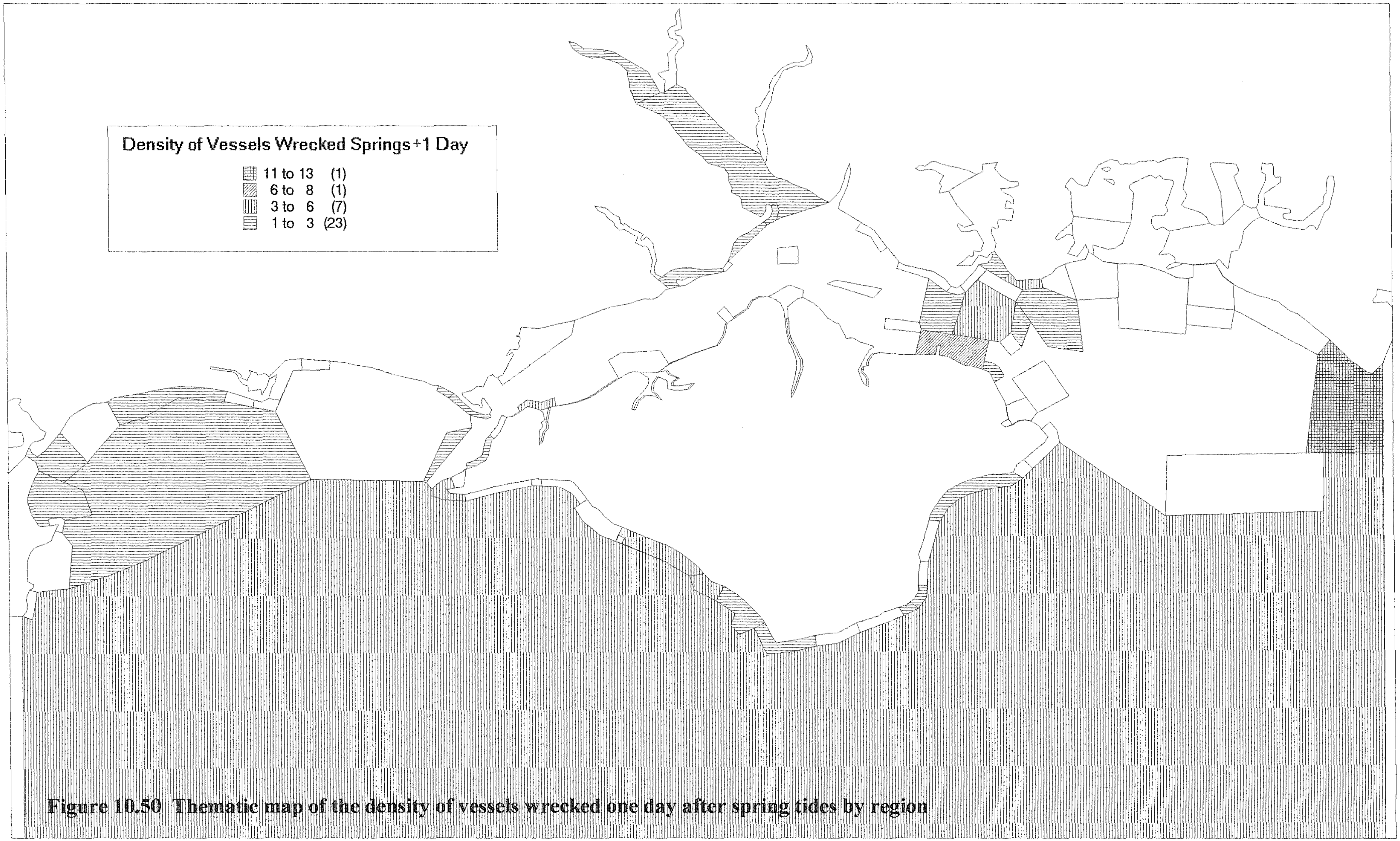


Figure 10.50 Thematic map of the density of vessels wrecked one day after spring tides by region

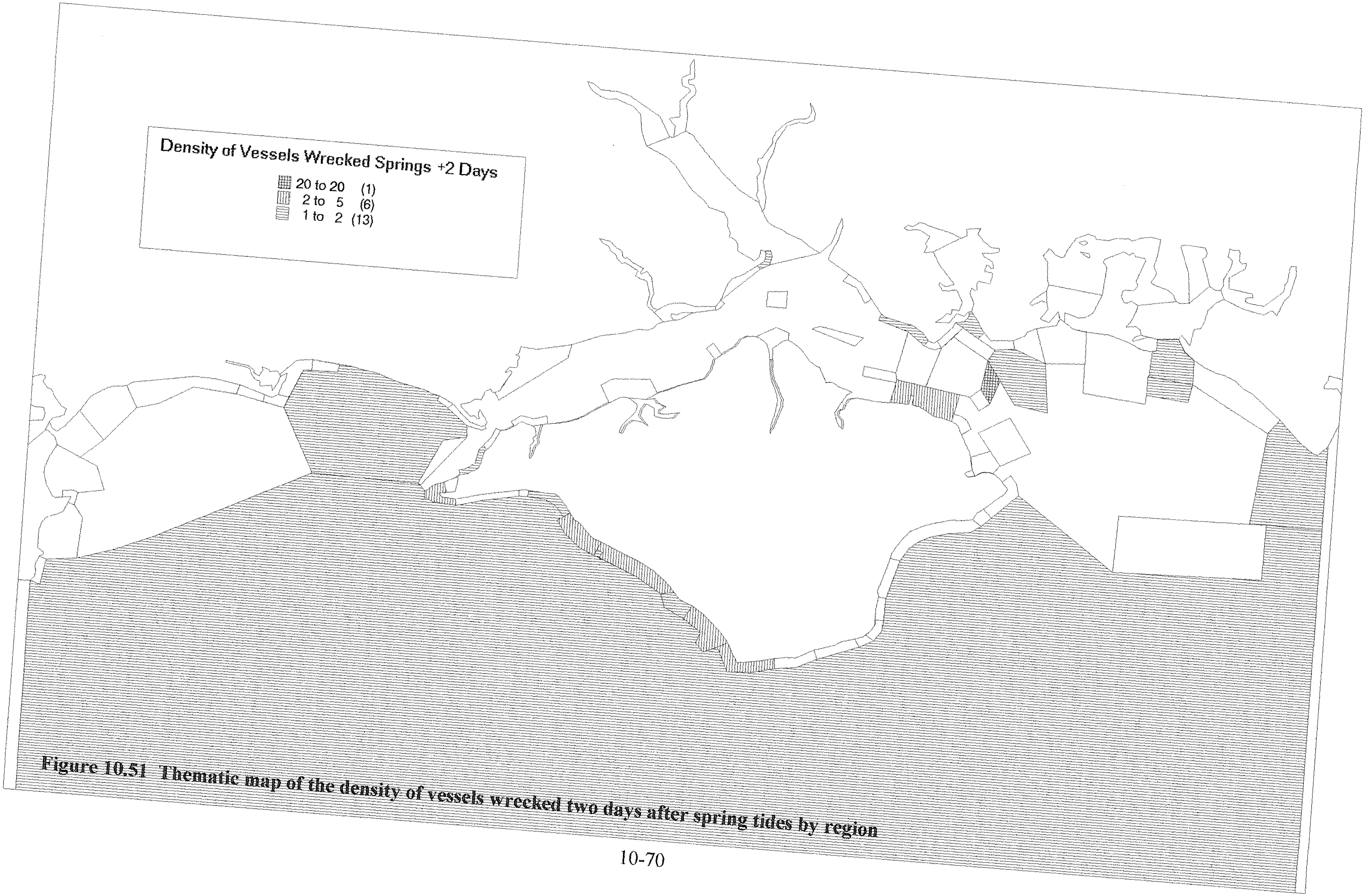


Figure 10.51 Thematic map of the density of vessels wrecked two days after spring tides by region

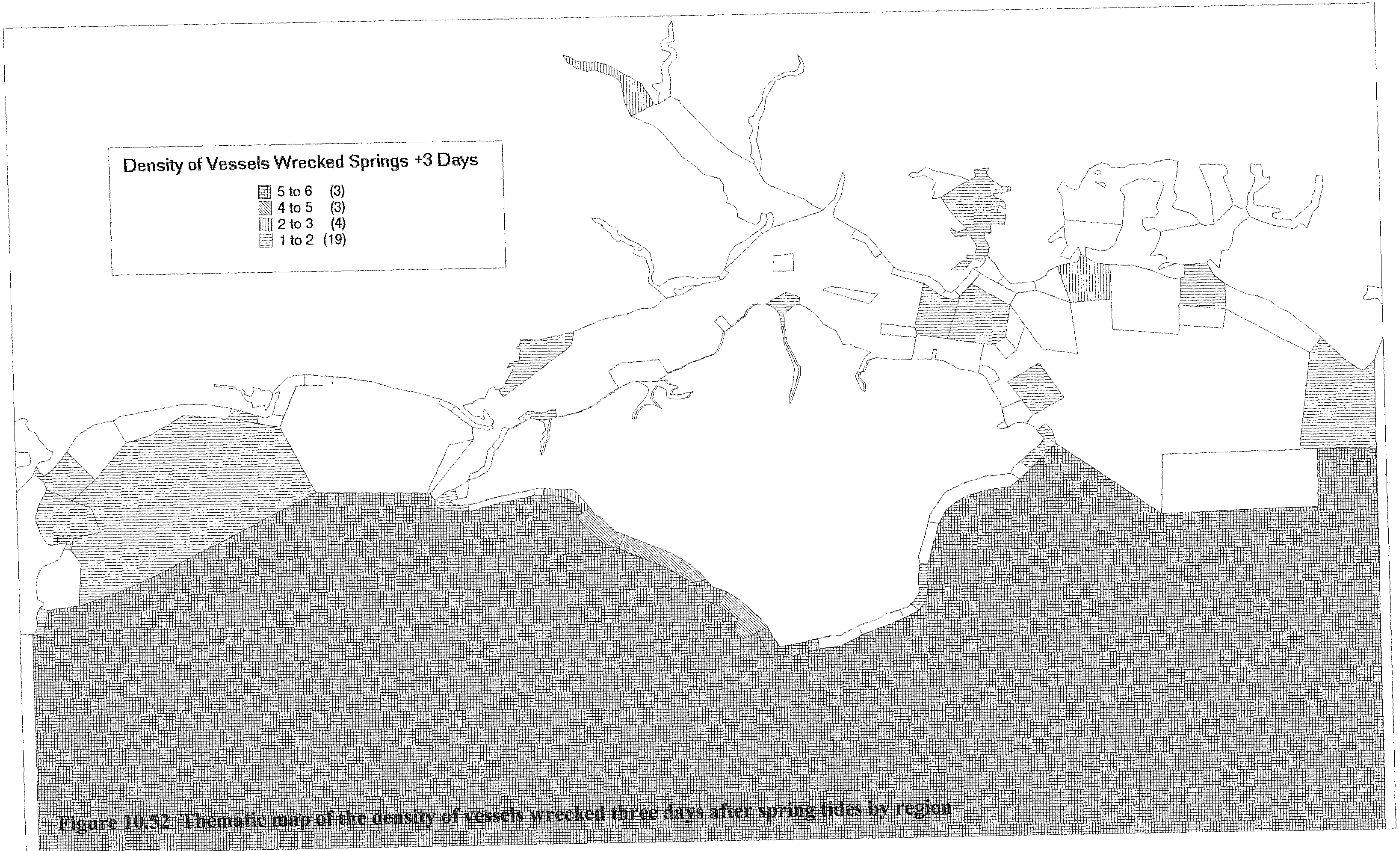


Figure 10.52 Thematic map of the density of vessels wrecked three days after spring tides by region

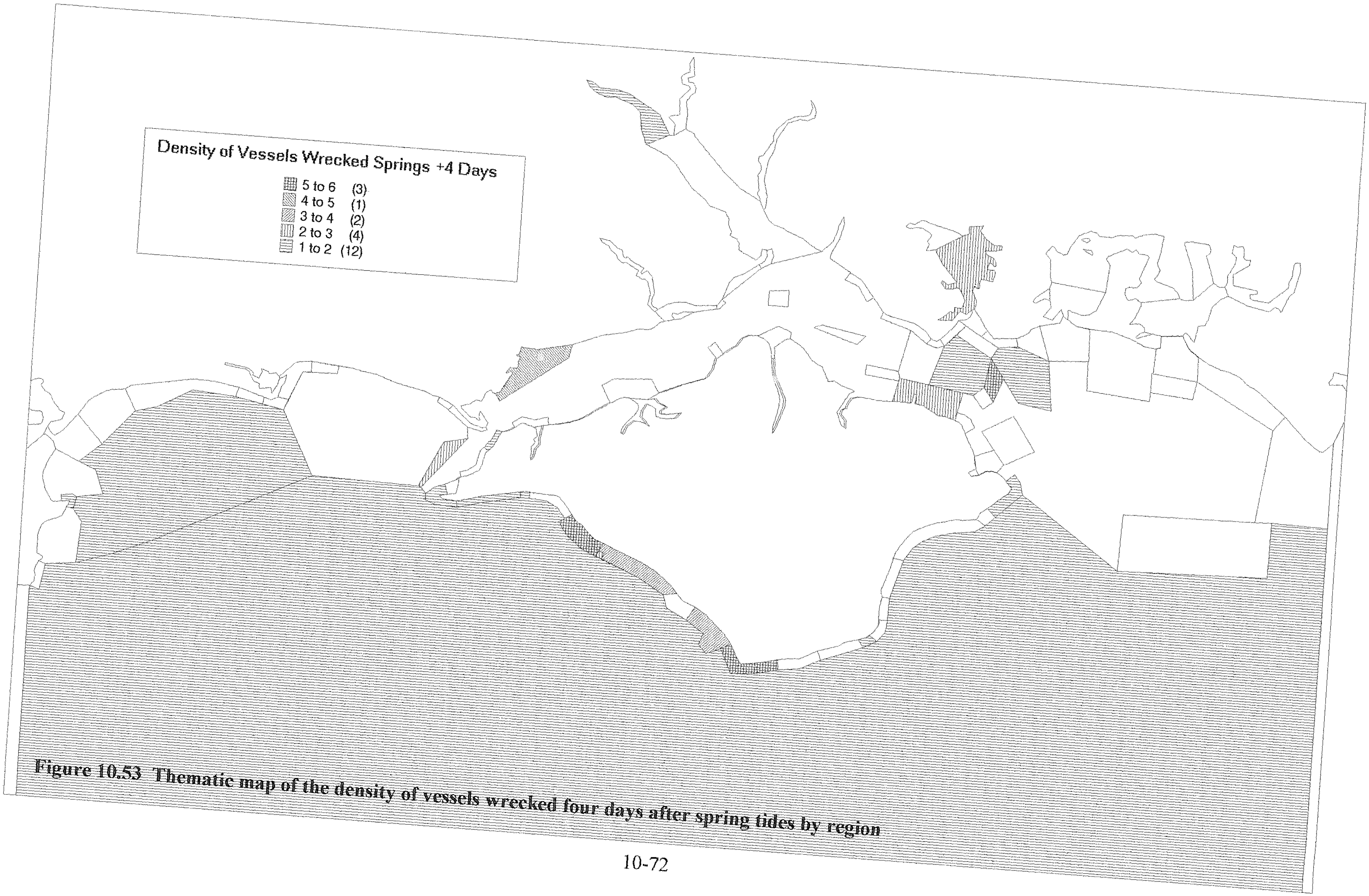


Figure 10.53 Thematic map of the density of vessels wrecked four days after spring tides by region

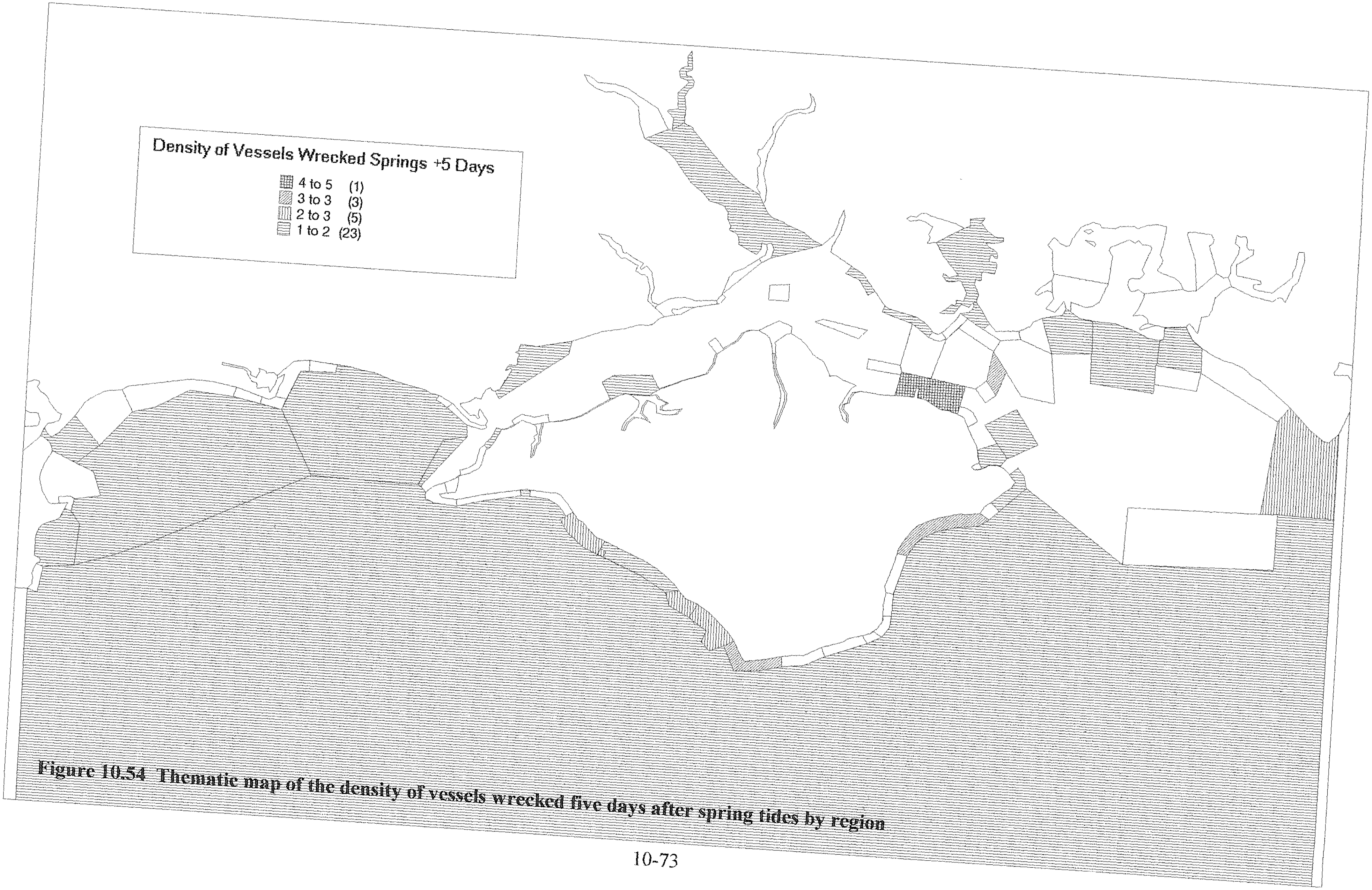


Figure 10.54 Thematic map of the density of vessels wrecked five days after spring tides by region

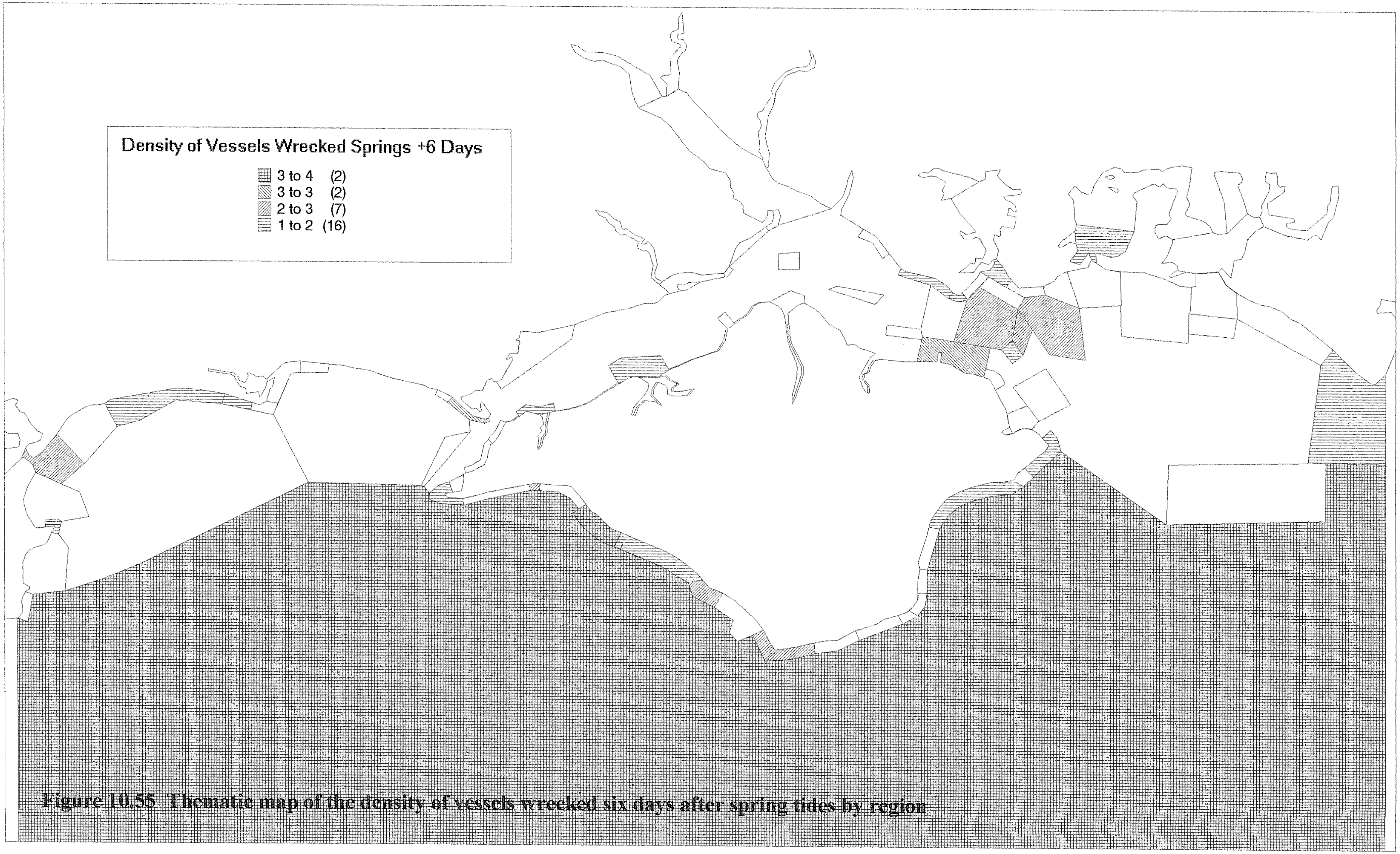


Figure 10.55 Thematic map of the density of vessels wrecked six days after spring tides by region

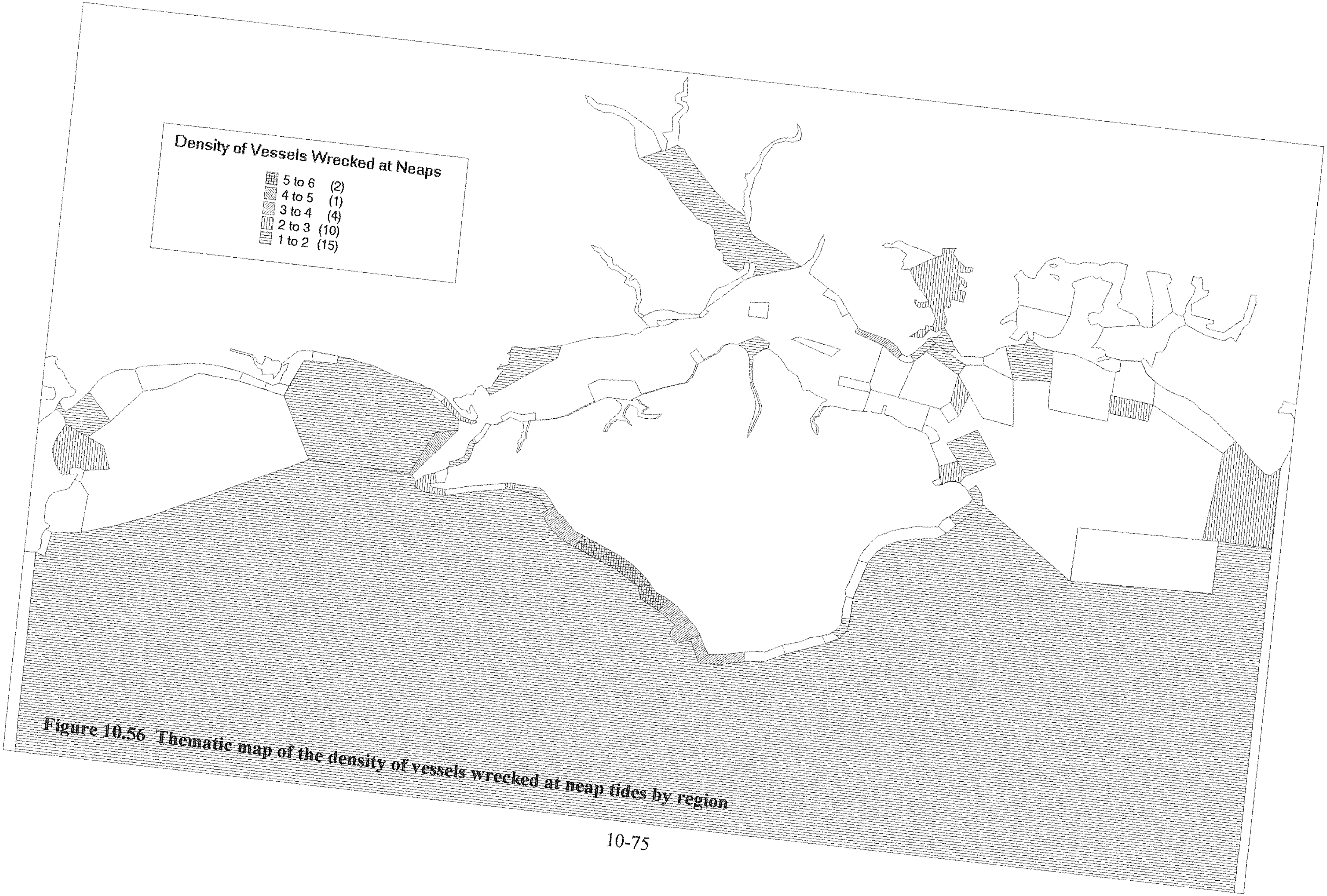


Figure 10.56 Thematic map of the density of vessels wrecked at neap tides by region

sugar; and 2.17 per cent tobacco. More significantly, perhaps, 19.83 per cent were in ballast, although this also includes yachts.

The cargo carried does not appear to provide any indications to the locations of shipwrecks except that certain cargoes are more likely to be carried by coastal vessels compared those sailing overseas.

10.10 Coastal/Overseas Traders

In the terms of Bascom (1976) all the shipwrecks considered in this study are coastal. The waters of the English Channel are shallow in relation to the depths of the oceans and none of the shipwrecks are more than 28 km from land. Even so the coastal vessels, especially those sailing to and from ports in the study area, would probably sail closer to the shore than the overseas trade vessels. Figures 4.6 and 4.7 certainly show a higher proportion of shipwrecks closer to the mainland for the Coastal

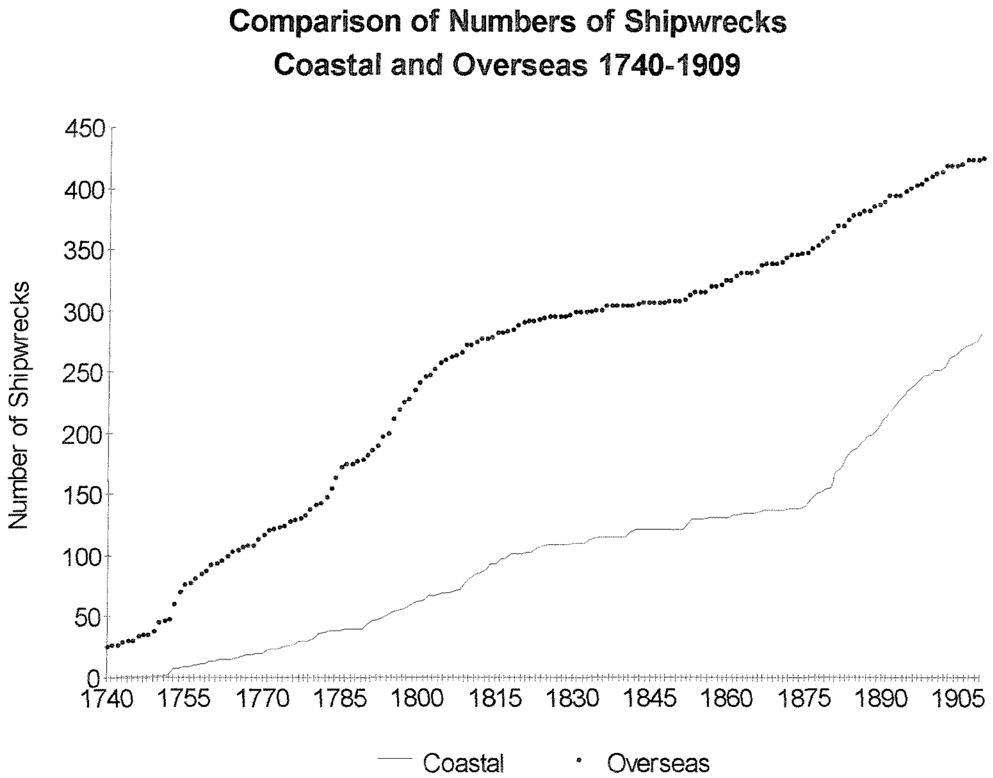


Figure 10.57 Comparison of the cumulative numbers of Coastal and Overseas subgroup vessels shipwrecked from 1740 to 1909

subgroup and more shipwrecks offshore for the Overseas subgroup. The Board of Trade statistics for 1859 to 1868 state that about half of the ships wrecked were in coastal trade (Bascom, 1976:76-77). Of the 762 shipwrecks on the database where the port they sailed from and/or their planned destination are listed, only 31.9 per cent can be identified as being British Isles coastal (Including the Channel Islands and Ireland). Prior to 1740 only 2 shipwrecks identifiable as British Isles coastal vessels and 26 as vessels in overseas trade are included in the database. The graph above (Figure 10.57) shows the comparison of the cumulative numbers from 1740. As already discussed in section 10.2, Volume of Shipping, above it is noticeable that from about 1875 the numbers of Coastal subgroup shipwrecks increases rapidly compared with that of the Overseas subgroup. If the ratio between the two groups of shipwrecks from about 1875 is indicative of what it should have been pre 1875 then there are many wrecks of vessels in the British Isles coastal trade not recorded. If the Board of Trade figure, of half the ships wrecked having been in coastal trade, is representative then there should be approximately another 70 coastal trade vessels wrecked in the study area between 1740 and 1909.

10.11 Age of Vessels

With regard to the age of vessels lost, the Board of Trade statistics for 1958-1969 (Bascom, 1976:78) show that 10 per cent were 'nearly new', 38 per cent were less than 15 years old, 34 per cent were 15-30 years old, 18 per cent were more than 30 years old, with several dozen 60-100 years old. Of 295 shipwrecks on the database for which the age is known 19 per cent were 0-5 years old, 18.8 per cent less than 15 years old, 33.2 per cent 15-30 years old, 28 per cent over 30 years, of which 2 percent were over 60 years old. The oldest ship was 93 years old and 9 were shipwrecked in the same year they were built.

While the age of a vessel may be a contributory factor to her being wrecked and the incidence of a high proportion of very young vessel wrecking, a possible indicator of poorly built ships, neither provides any direct evidence as to the possible locations of shipwrecks. The maps of the locations of shipwrecks for the different age groups (Figures 4.49 – 4.52) do not show any marked differences except for the 0 to 5 years

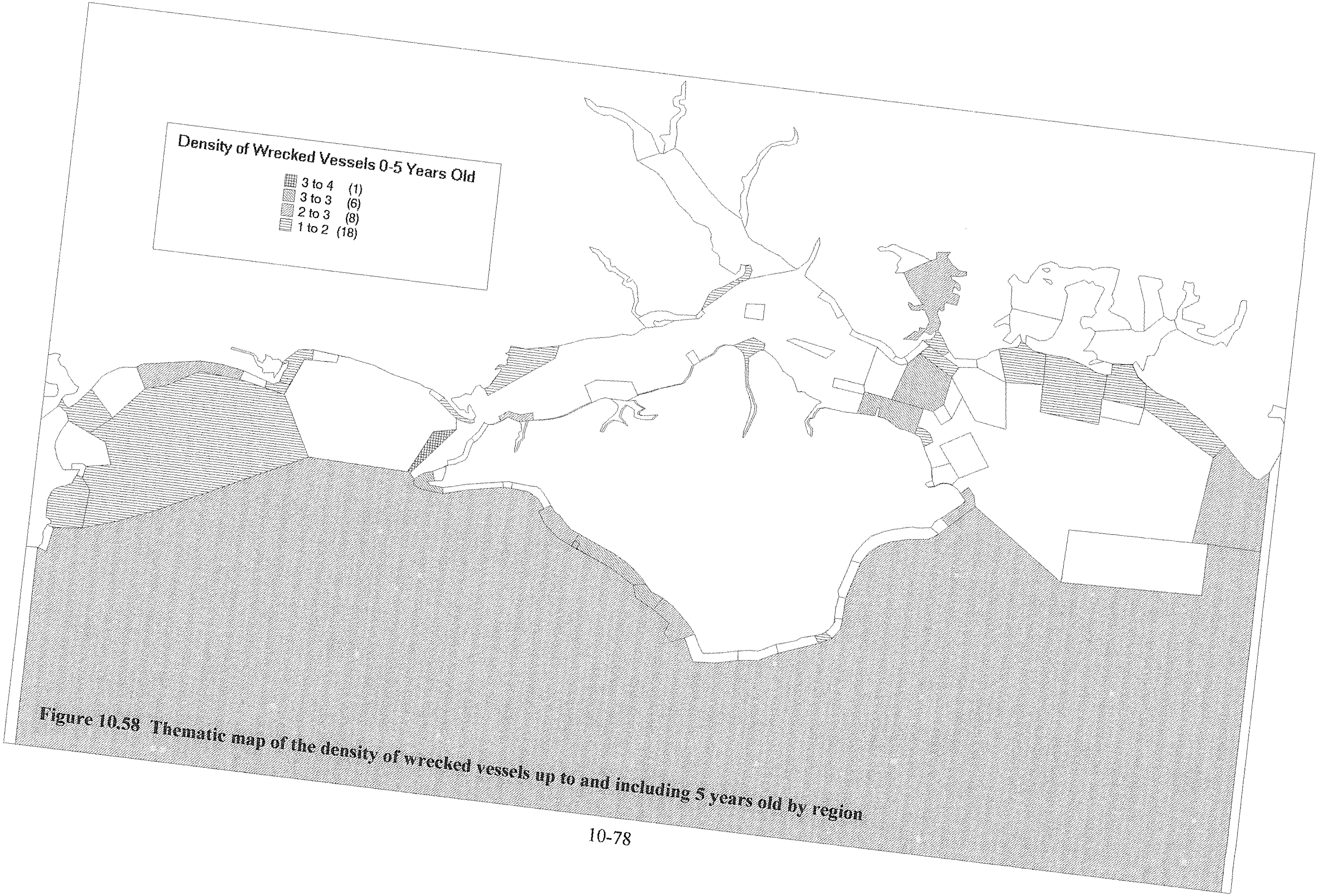


Figure 10.58 Thematic map of the density of wrecked vessels up to and including 5 years old by region

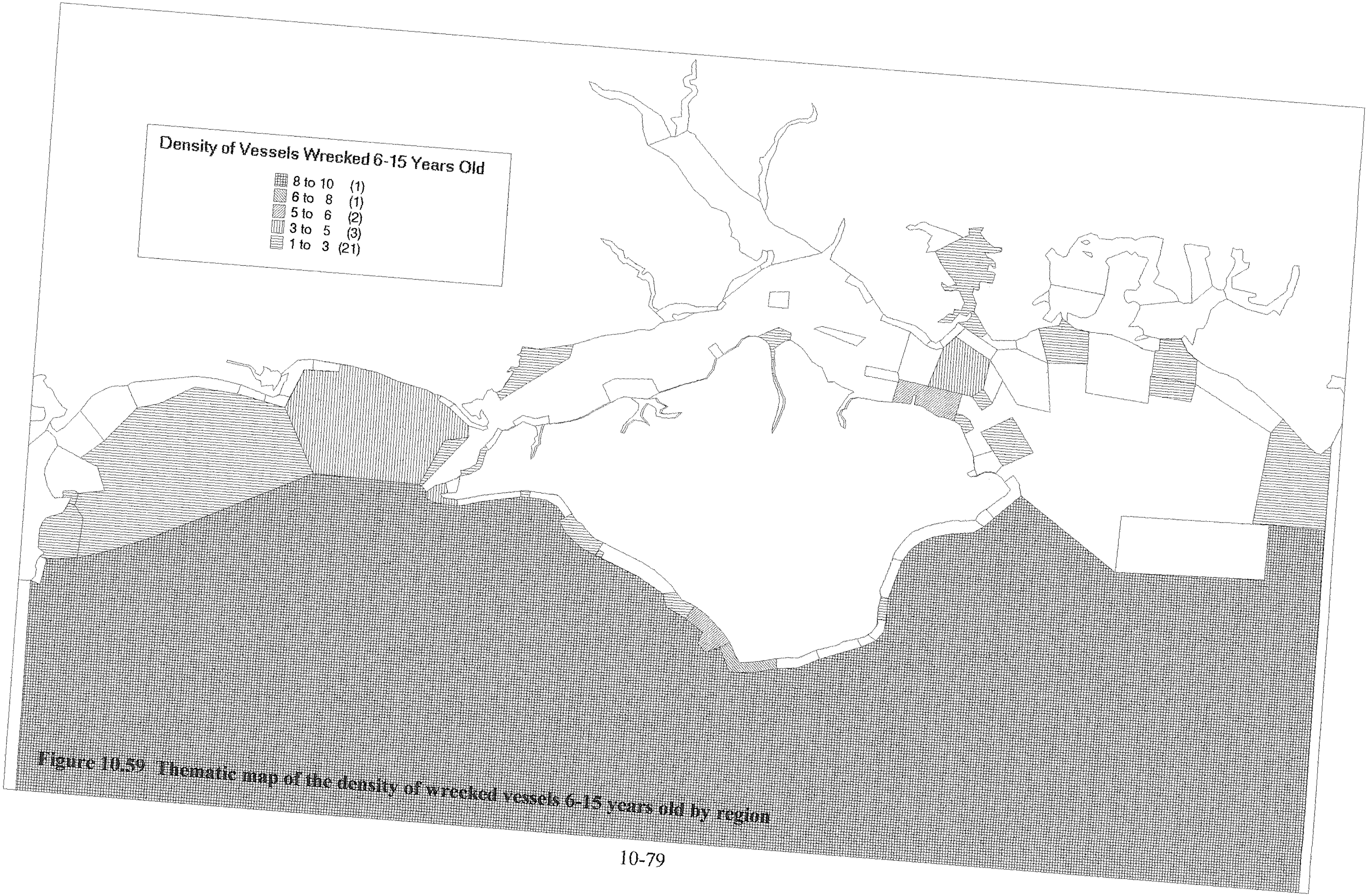


Figure 10.59 Thematic map of the density of wrecked vessels 6-15 years old by region

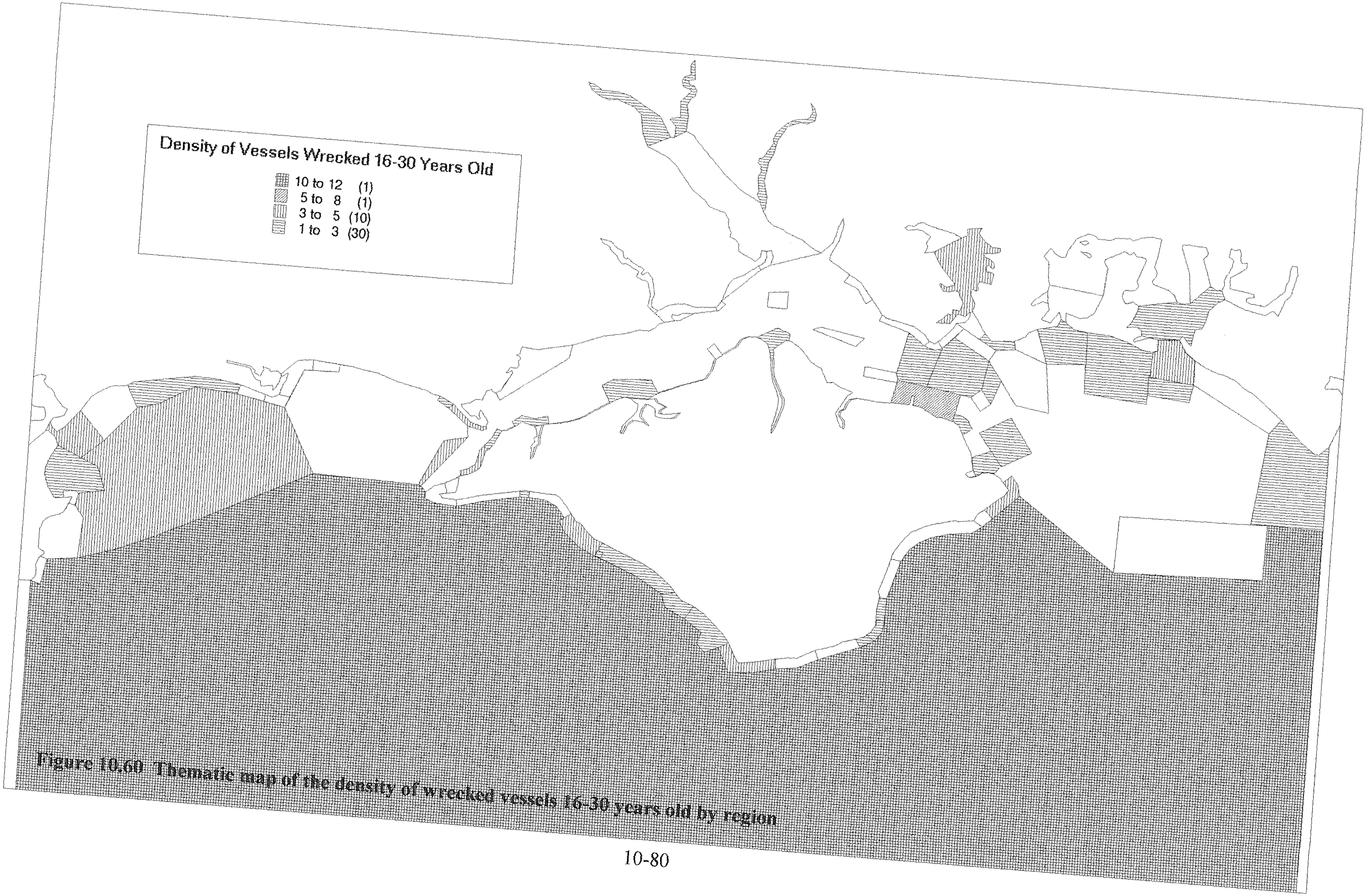


Figure 10.60 Thematic map of the density of wrecked vessels 16-30 years old by region

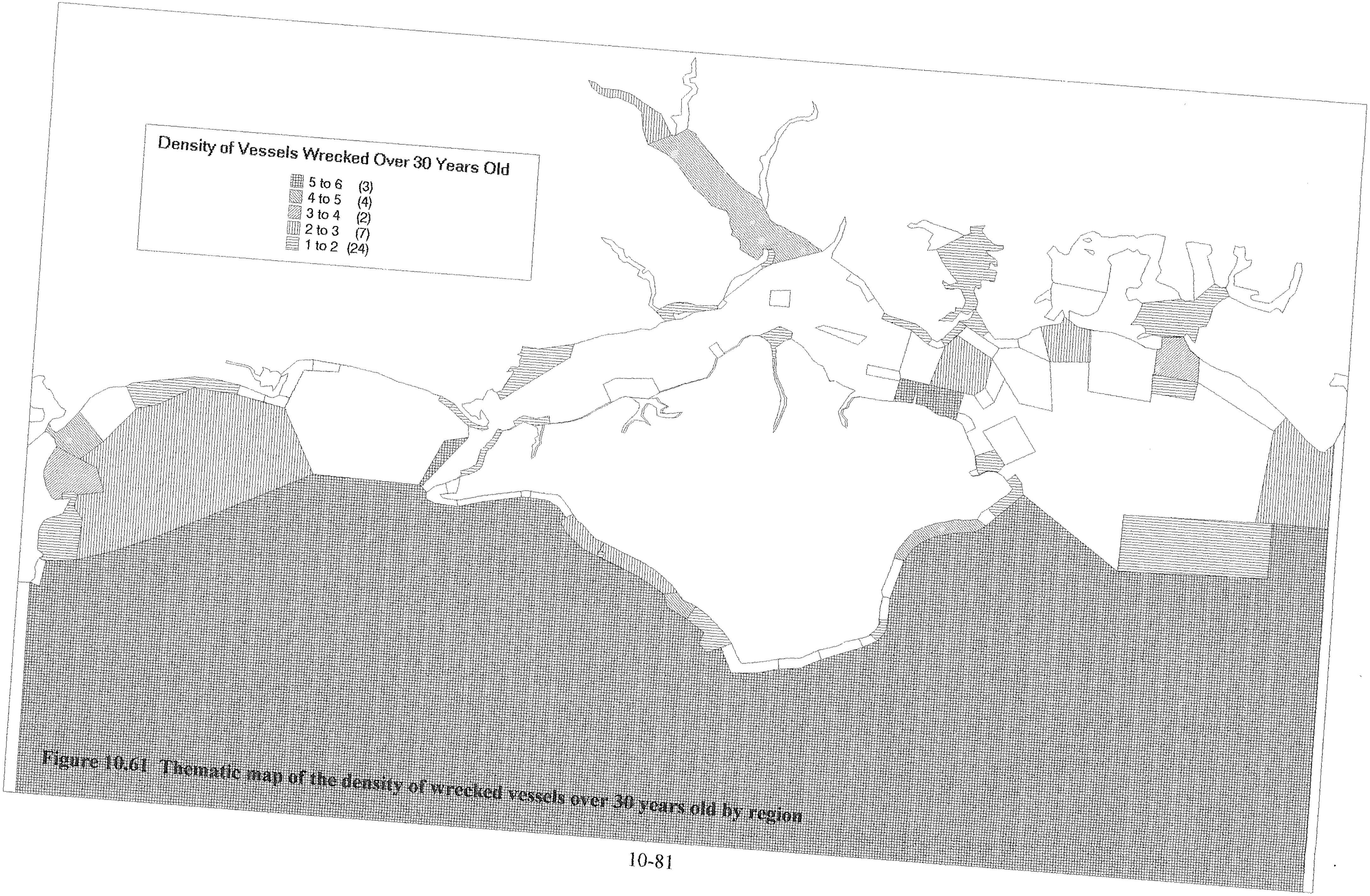


Figure 10.61 Thematic map of the density of wrecked vessels over 30 years old by region

old age group where there are very few vessels wrecked in open water. The numbers in each age group are too small for any reliable statistical comparisons to be made.

The thematic density maps (Figures 10.58 to 10.61 above) show that for vessels up to and including 5 years old there is a very even spread with 4 shipwrecks in fifteen of the regions. For the other three age groups the highest density of shipwrecks is in the open waters of the English Channel. Apart from these there does not appear to be any other significant trends.

10.12 Sizes of Vessels

The size of the vessels is another factor identified. In the Board of Trade statistics for 1871 (Bascom, 1976:78); 42 per cent were under 100 tons; 36 per cent were 100-300 tons; 14 per cent were 300-600 tons and 8 per cent over 600 tons. To provide a more accurate comparison for the earlier shipwrecks prior to 1786, tonnage should be increased by 34 per cent (French, 1995:15) to compensate for the change in the formula for measuring tonnage. This only affects 48 of the shipwrecks, but as they cover a wide range of tonnages it is probably significant. The profile of the tonnages

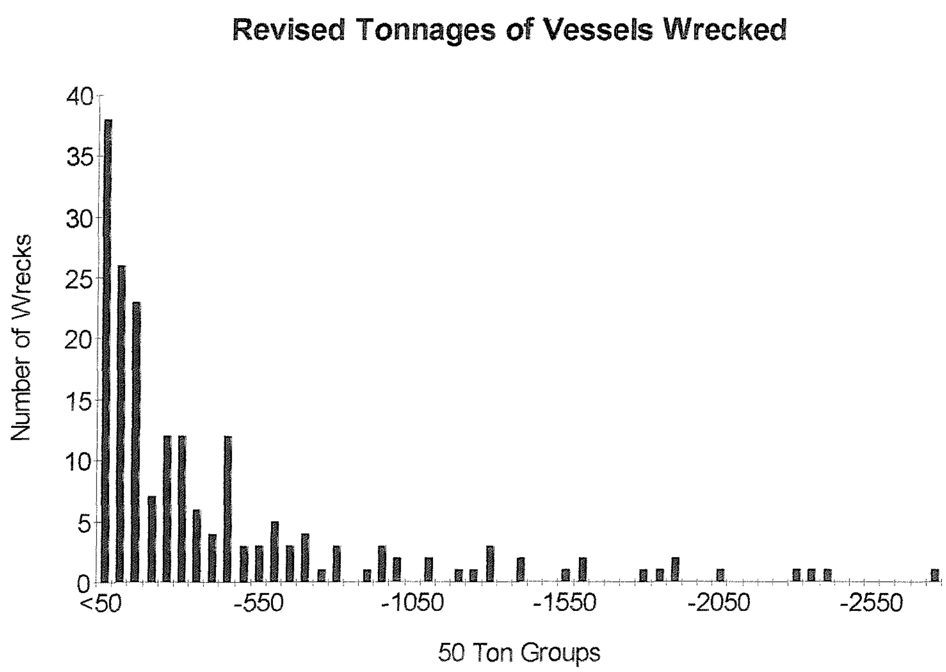


Figure 10.62 Revised size of vessels

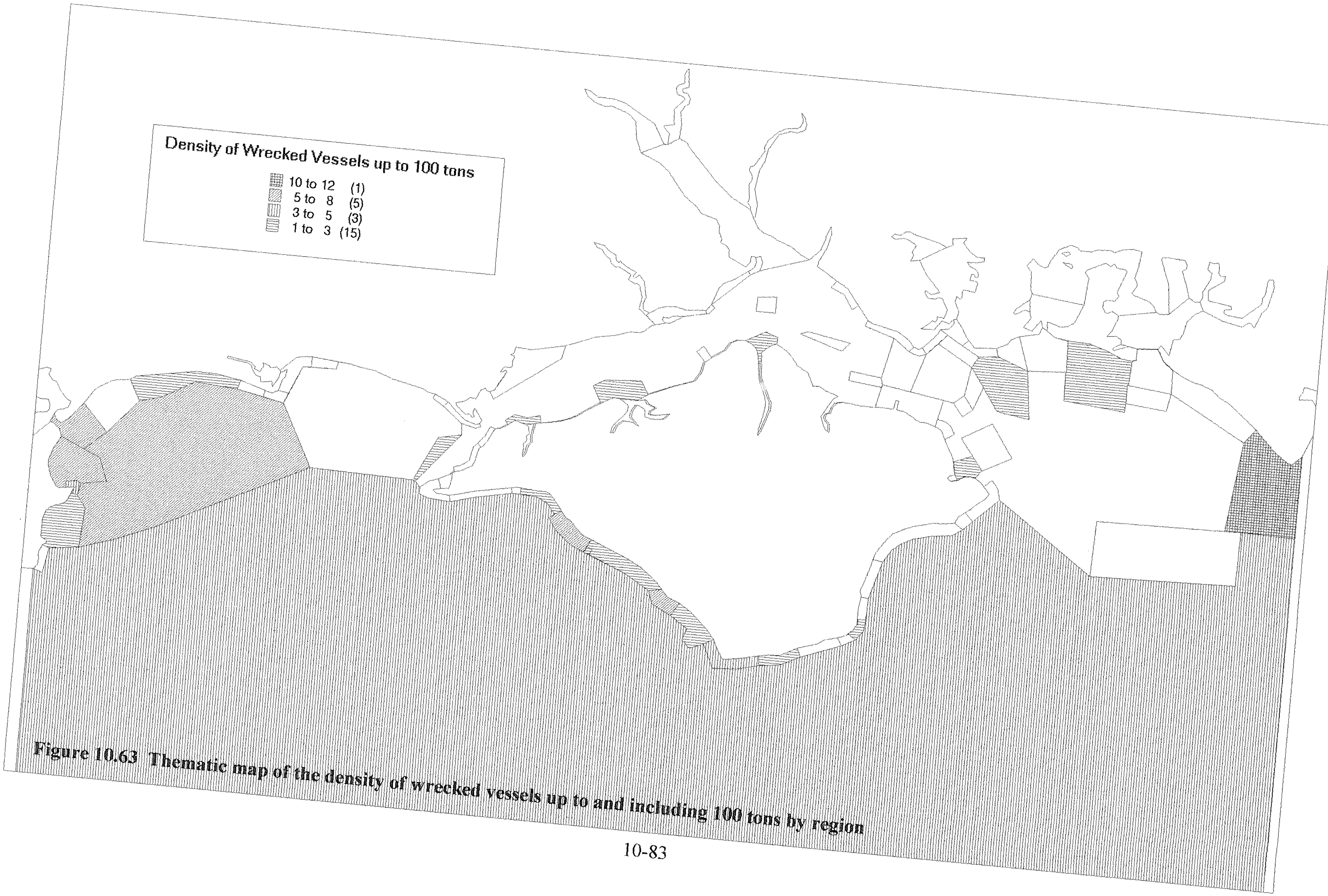


Figure 10.63 Thematic map of the density of wrecked vessels up to and including 100 tons by region

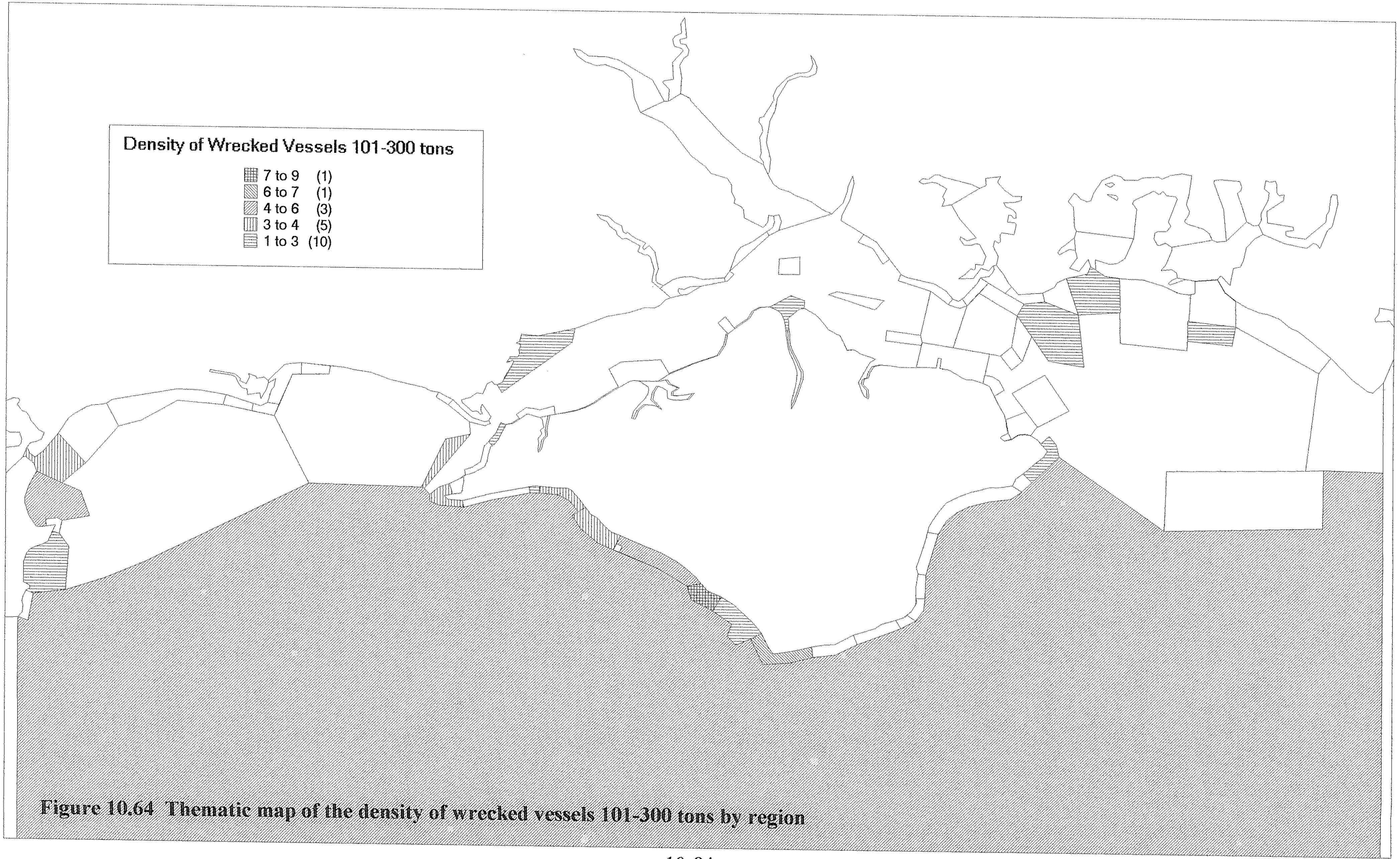


Figure 10.64 Thematic map of the density of wrecked vessels 101-300 tons by region

Figure 10.65 Thematic map of the density of wrecked vessels 301-600 tons by region

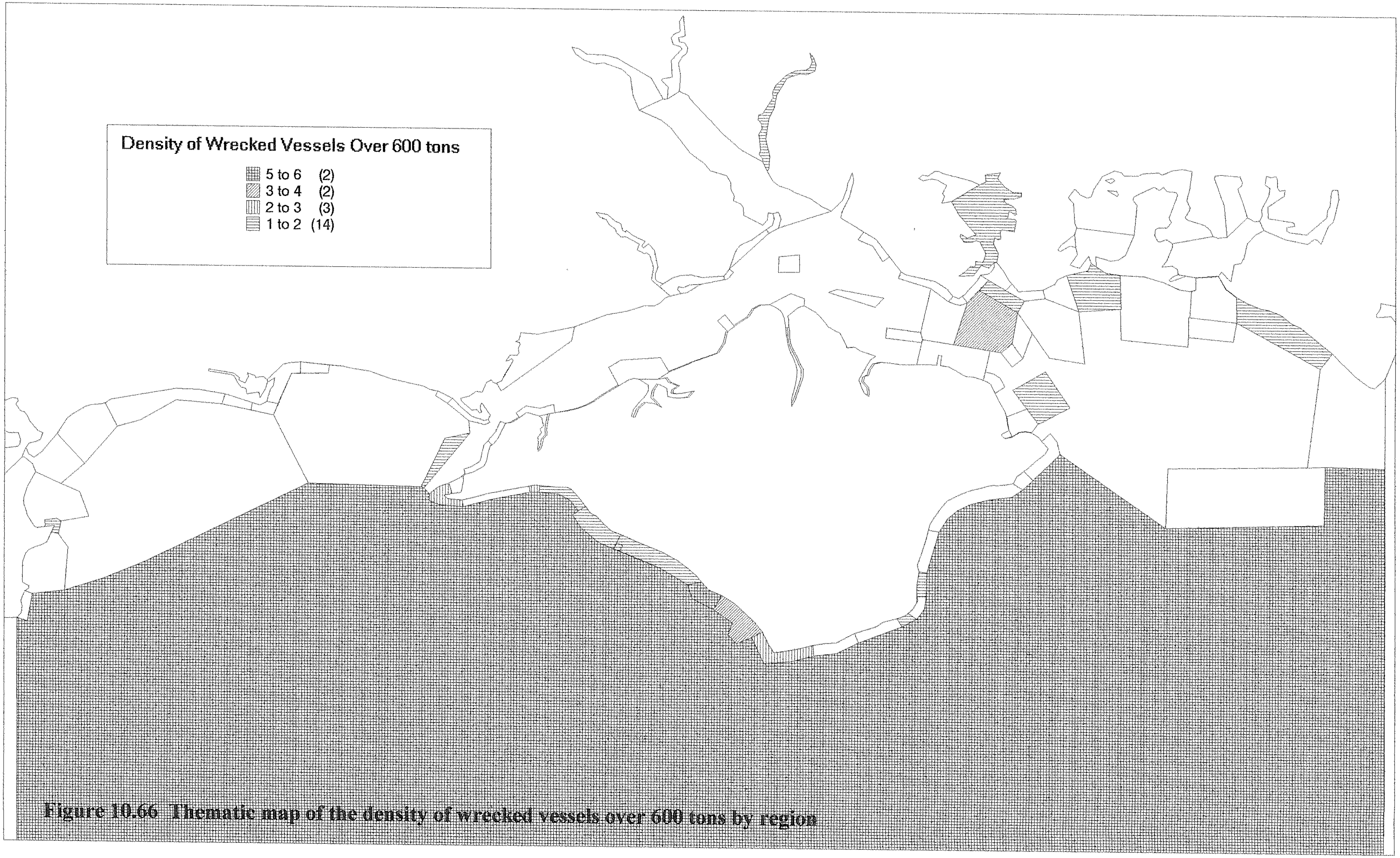


Figure 10.66 Thematic map of the density of wrecked vessels over 600 tons by region

of the vessels wrecked with the adjustment prior to 1786 is shown in Figure 10.62 above. The revised figures from the shipwreck database are; 33.86 per cent under 100 tons; 38.57 per cent 100-300 tons; 17.46 per cent 300-600 tons; and 20.11 per cent over 600 tons. This shows a difference to the Board of Trade figures especially in the larger tonnages. This is probably due to the presence of the naval base at Portsmouth. The size profile is different for early periods because ships were generally smaller. It was not until the sixteenth century that larger ships, approaching 2,000 tons were built (Unger, 1980:36). In 1359, for example, a survey of shipping in East Anglia shows 88.7 per cent were of less than 100 tons (Friel, 1995:32).

The thematic maps for the size groups (Figures 10.63 to 10.66) show for the vessels up to and including 100 tons the highest density is in the Selsey Bill region, but this is entirely due to the 12 fishing vessels wrecked on 18th January 1881 (see section 10.4 Peak Monthly Totals). The second highest density is in the Poole Harbour Entrance region, perhaps an indication the smaller vessels were in the coastal trade or sailing locally. The highest density for the 101-300 tons group is in the Atherfield region and the second highest in the St. Catherine's and the English Channel regions. The highest density for the 301-600 tons group is also in the Atherfield region and the second highest in the Brook, Brighstone Bay and English Channel regions. Atherfield and the English Channel regions have the highest density for the over 600 tons group with the St. Catherine's, Chale Bay, the Needles and Spithead regions second. The regions with the highest density of wrecked vessels of the three larger groups suggest they were possibly more involved in the overseas trade. This is further supported by the fact that 43 (62.32%) of the 69 vessels of 100 tons or less were in the Coastal and Local subgroups and there were only 17 (14.17%) vessels over 100 tons in the Coastal subgroup and none in the Local subgroup.

10.13 Conclusions

The shipwrecks in the study area have a very different profile from those of the British Isles as a whole reported in the Board of Trade statistics. Although they cover a much longer time period it is probable they represent the type of shipping and trading that was operating in the English Channel and particularly within the Solent region. This should not detract from the universal application of the GIS model as many of the statistics detailed above are not of the type that will form the principal basis of the model. Those that will, include the presence of maritime hazards, weather, the likely course of the ship, the destination of the ship and the location of known shipwrecks.

The graphs and statistics suggest there is a strong relationship between the occurrence of shipwrecks and weather conditions, particularly strong winds, wind direction and poor visibility. The locations of the shipwrecks have a close correlation with the direction of the prevailing winds. Approximately one third of the shipwrecks were lost on the south-western coast of the Isle of Wight, 'the Back of Wight'. This is the part of the Solent coastline with high cliffs and off-lying rocks, which takes the full brunt of the predominant west and south-westerly strong winds, and has a fetch of up to 5,000 km which, under the right conditions, can enable very large waves to develop (Bearman, 1989:12). The area also experiences the highest proportion of days of fog and poor visibility. The weather therefore has a considerable impact on the number and location of shipwrecks.

If the effect on the wind of the topography of the Isle of Wight (see Chapter 9) is also considered the scenario can be envisaged of a ship running up the English Channel in a gale, or possibly beating against a gale. The visibility is poor with precipitation and spray obscuring the land. Then suddenly high cliffs are seen close ahead, the helm is put hard over, but the wind has changed, no longer a steady blow, but confused as it tries to find a way around or over the barrier presented by the cliffs. The sails no longer power the ship and the waves drive it ashore. Alternatively the wind changes now driving the ship along the coast, suddenly the wind changes again and drives the ship ashore into the chine. A third conclusion is the ship is trapped by the sweeping arms of the bay or the off lying rocks and ledges and drives on to them tearing out its bottom.

Knowledge of tides and tidal streams was a basic skill of the earliest recorded sailors (see Chapter 6). They are therefore unlikely to have been a major contributor to the causes of shipwreck. Unknowns such as leeway or the up Channel surface drift are more likely causes. The inability of mariners to be able to fix their position in poor visibility together with the lack of accurate charts must have made the likelihood of the above scenario occurring much greater. A ship entering the English Channel from the Atlantic, before the development of both accurate charts and accurate astronomical navigation instruments, was totally dependent upon land being sighted for an accurate position to be established.

The introductions of navigational instruments such as the sextant in 1757 (Bosscher, 1995a:9), and the chronometer and with them the more practical method of calculating a ship's longitude made a significant advance in ship safety when approaching land. The benefit accrued in the study area however, would have been limited. If the weather were good the mariners would have been able to see the land and fix the position of the ship, if not, they would not have been able to use a sextant, as they would be unable to see the stars or the horizon. The greatest advantage would have been for vessels entering the Channel from the Atlantic and/or approaching a landfall. Even though James Cook had used a copy of John Harrison's watch on his second voyage of Pacific exploration, 1772-1775, it was not until the nineteenth century that improvements in the manufacturing and reduced costs made the chronometer widely available (Kemp, 1976:201-202 & 167).

The convenience, to those who could afford it, of Captain Grenville Collins' chart of the Solent and the Isle of Wight with its accompanying sailing directions would have improved the safety of local pilotage, but would probably not have given any significant improved benefit to passing traffic. The distributions of the shipwrecks with the predominance outside the waters of the Solent suggest that the detail of those inner waters was not a major influence on the wrecking of vessels. The emphasis appears to be more on either the locating or identification of the landmarks of the Isle of Wight so that a vessel's exact position could be ascertained. For that purpose the Grenville Collins chart should have been of benefit.

Without an accurate visual position the mariner was dependent upon the essential, but perhaps imprecise lead and line and the weather to be able to use it. Table 4.13, identifies that more than twice as many vessels sailing up the English Channel from the Atlantic were wrecked in the study area compared with those sailing down to the Atlantic. Those that reached the Isle of Wight were the 'survivors', many others having been lost on the coasts of Cornwall, Devon and Dorset, each of which have their own perils for the mariner. Ships entering the English Channel from the Atlantic after a long voyage, such as an East Indiaman (Kemp, 1976:763), with a crew suffering from the affects of scurvy and poor food that made them too weak to handle their ships, were particularly at risk.

The small margin between sailing a safe course and being wrecked for a vessel sailing up the Channel can be shown by the following example. If a course is set from a position 10 km off Start Point to pass 10 km south of St. Catherine's Point it only requires an error of approximately 2° for the vessel to run on to the rocks at St. Catherine's Point of an error of approximately 5° for the vessel to run onto Atherfield Ledge. Such small margins are easily exceeded in rough weather or due to a variety of reasons including:

- An inaccurate compass.
- Poor helmsmanship.
- The difficulty of steering in a following sea.
- Poor navigation;
    - An under estimate of leeway.
    - An under estimate of the inset of the tidal stream into the bays.

If coastal and cross Channel traffic is also taken into account then the number of vessels wrecked while sailing 'up Channel' is 408 and 'down Channel' 235. Figure 10.67 shows the comparison of these two groups between 1740 -1909. Up to 1740 the numbers are very small. From 1740 to approximately 1820 a greater number of vessels sailing 'up Channel' are wrecked compared with those sailing 'down Channel'. From 1820 the numbers are much closer and in the decades 1840, 1860 and 1880 more vessels sailing down the English Channel are wrecked than sailing up. The data from the reports on the shipwrecks give no indication as to why this occurred although the improvements to navigation must have had some influence, as would the other factors analysed in Section 10.2 above.

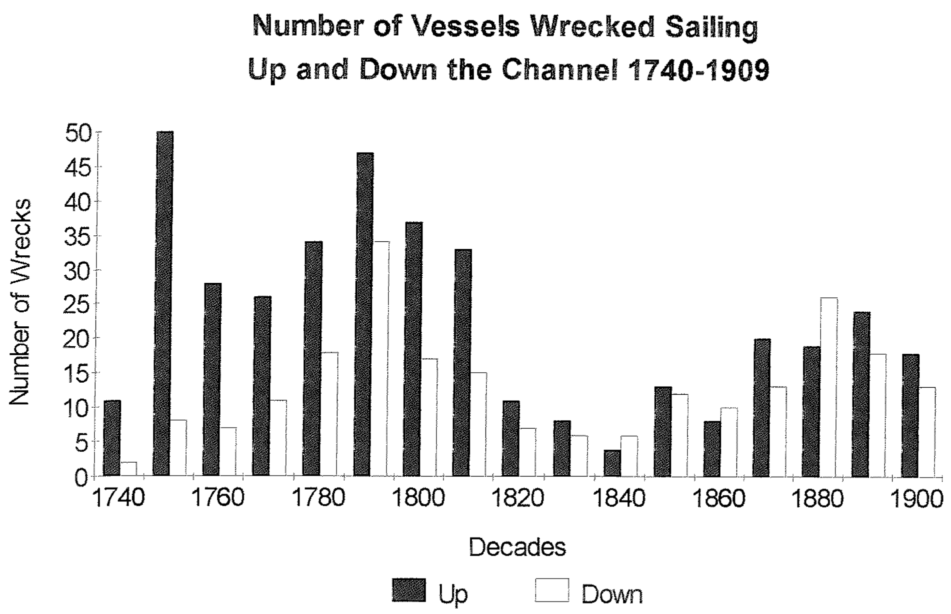


Figure 10.67 Comparison of the numbers of vessels wrecked sailing up and down the English Channel by decade 1740-1909

The difference in the rate of growth between imports and exports (see table 10.6 below) does not appear to explain the change in the number of ships being wrecked. The value of imports and exports over the same period increased from £28.078 million and £20.185 million to £617.491 million and £416.524 million respectively (Schlote, 1938:table 7). It has already been identified above that the annual number of shipwrecks did not match the rate of increase in the volume of British shipping and the above supports this deduction.

Table 10.6 - Rate of Growth of British Overseas Trade (%), 1800-1900

Period	Imports	Exports	Re-exports
1800-1825	1.3	1.2	2.1
1825-1840	3.3	4.0	4.6
1840-1860	4.5	5.3	5.5
1860-1870	4.4	4.4	3.9
1870-1890	2.9	2.1	2.5
1890-1900	2.6	0.7	0.8

(Schlote, 1938:table 8)

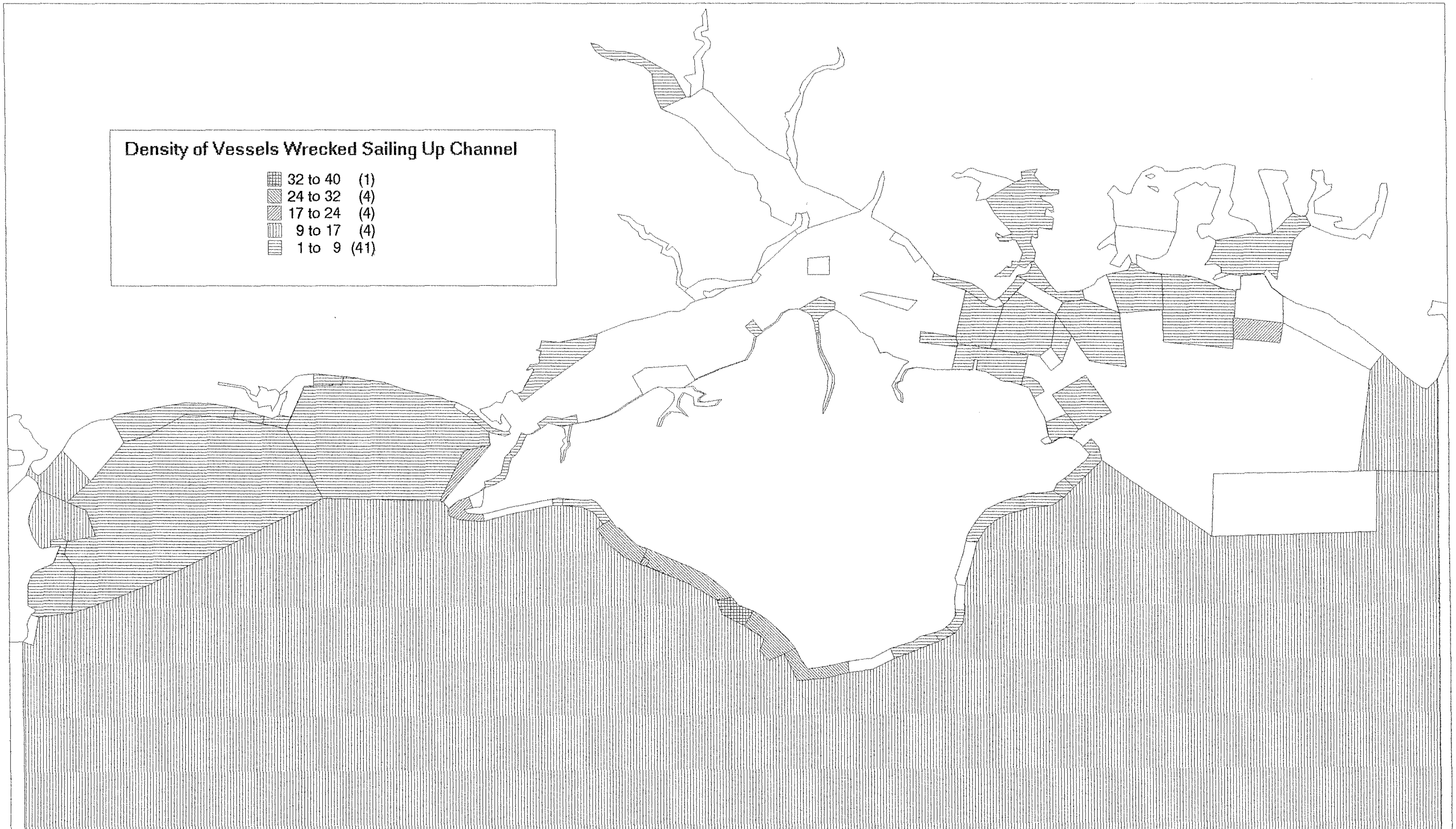


Figure 10.68 Thematic map of the density of wrecked vessels in the Up Channel subgroup by region

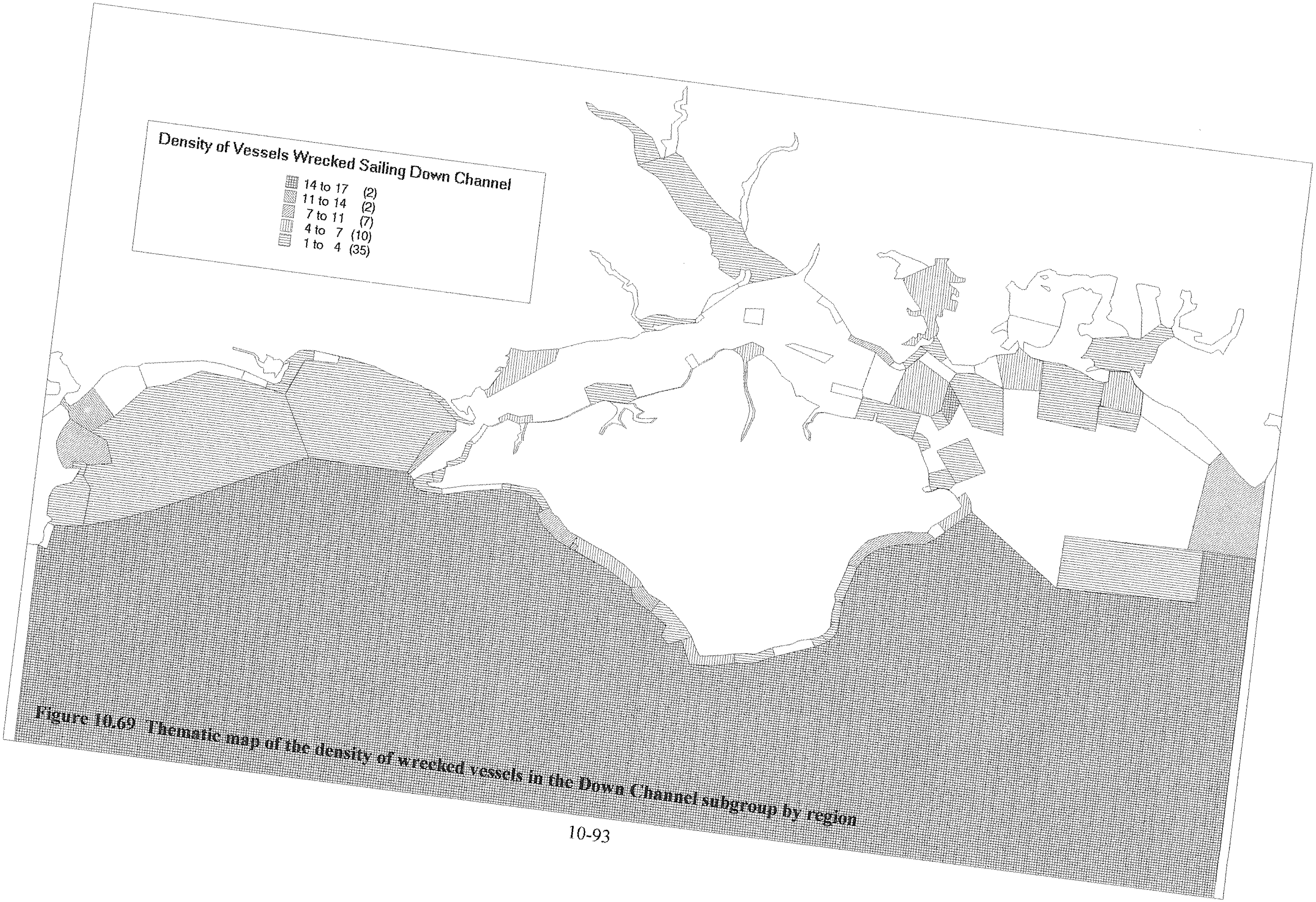


Figure 10.69 Thematic map of the density of wrecked vessels in the Down Channel subgroup by region

The thematic density map for the Up Channel subgroup (Figure 10.68) shows the highest density of vessels wrecked in the Atherfield region and the second highest in the Chale Bay, Brighstone and Brook regions. This suggests the Isle of Wight was a major hazard to vessels sailing up the English Channel.

The highest densities of shipwrecks for the Down Channel subgroup (Figure 10.69) are in the English Channel, Poole Harbour Entrance and Near Portsmouth regions. The second highest densities are in the Atherfield, the Shingles bank, Studland Bay and 'Back of Wight' regions. Apart from the now obvious danger of the southwest coast of the Isle of Wight the locations of the high density regions suggest perhaps the vessels of the Down Channel subgroup were using the anchorages and ports of the study area to shelter or await a favourable wind.

The Local subgroup thematic density map (Figure 10.9) shows a fairly even spread across the regions and with shipwrecks from this subgroup only located in the St. Catherine's and the Needles regions of the south coast of the Isle of Wight. This suggest perhaps local shipping was very aware of the dangers of that coast and kept well clear or alternatively used the inner Solent routes close to the mainland.

The thematic map of the vessels wrecked by stranding (see Figure 10.70) clearly shows that shallow water and the coast are the prime danger points. Vessels wrecked by foundering (see Figure 10.71) are predominately located in open water. The surprise from that map is the number of vessels that foundered off Cowes, the reason for which is unknown. Collisions are concentrated in both open and congested waters.

The records show there are many underlying and direct causes of vessels being wrecked, ranging from pure accident to total incompetence on the part of one or more of the officers and crew (Grocott, 1997:Appendix A). It is apparent that those causes do not necessarily provide the factors that are required in predicting the location of a shipwreck. The worst hazard for a sailing ship is running aground at night or being blown on shore by a storm (Bascom, 1976:71). The analysis of the database has identified the weather as being a major factor in the cause of shipwrecks. The topography of the coast is another, especially if ships can become embayed in areas

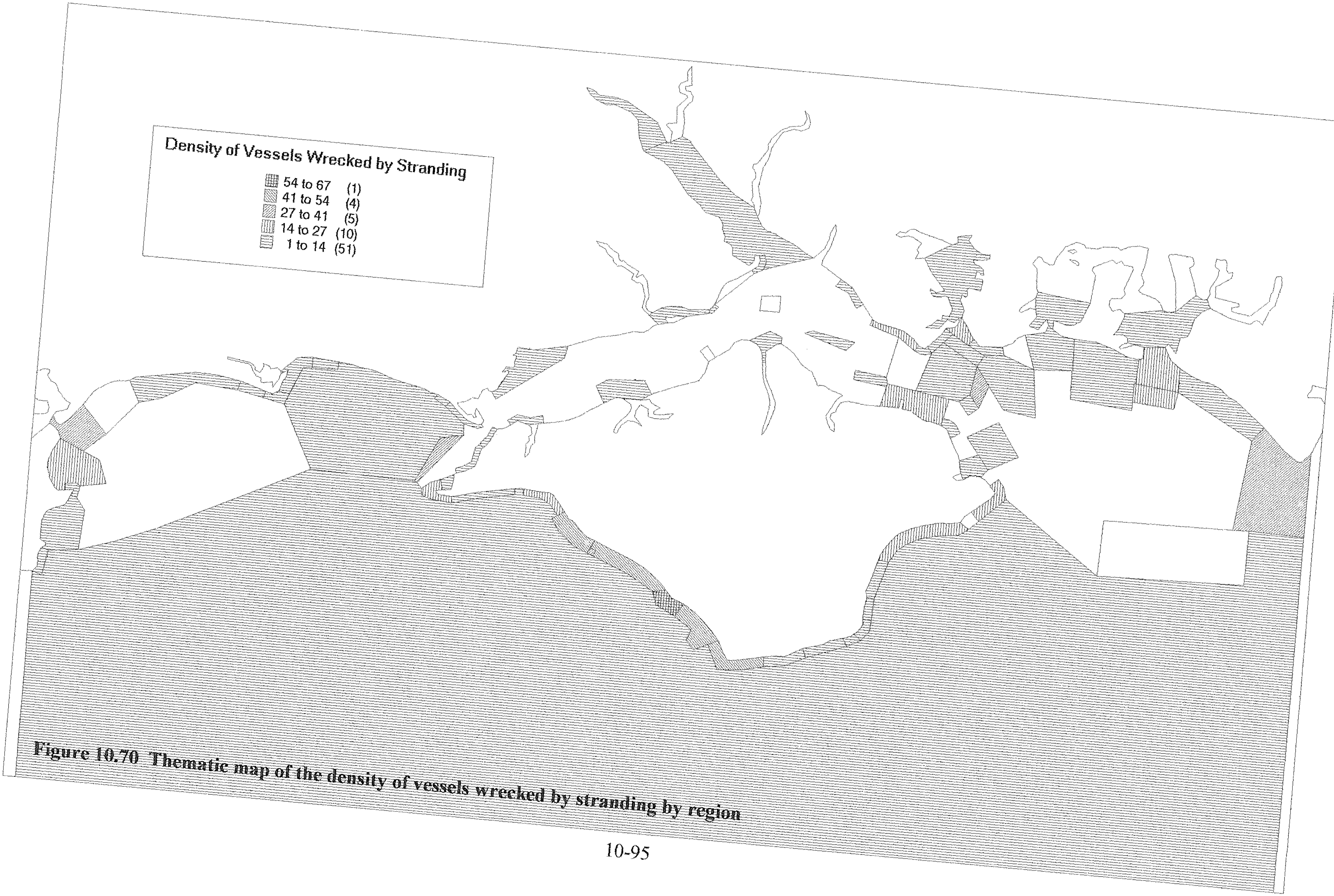


Figure 10.70 Thematic map of the density of vessels wrecked by stranding by region

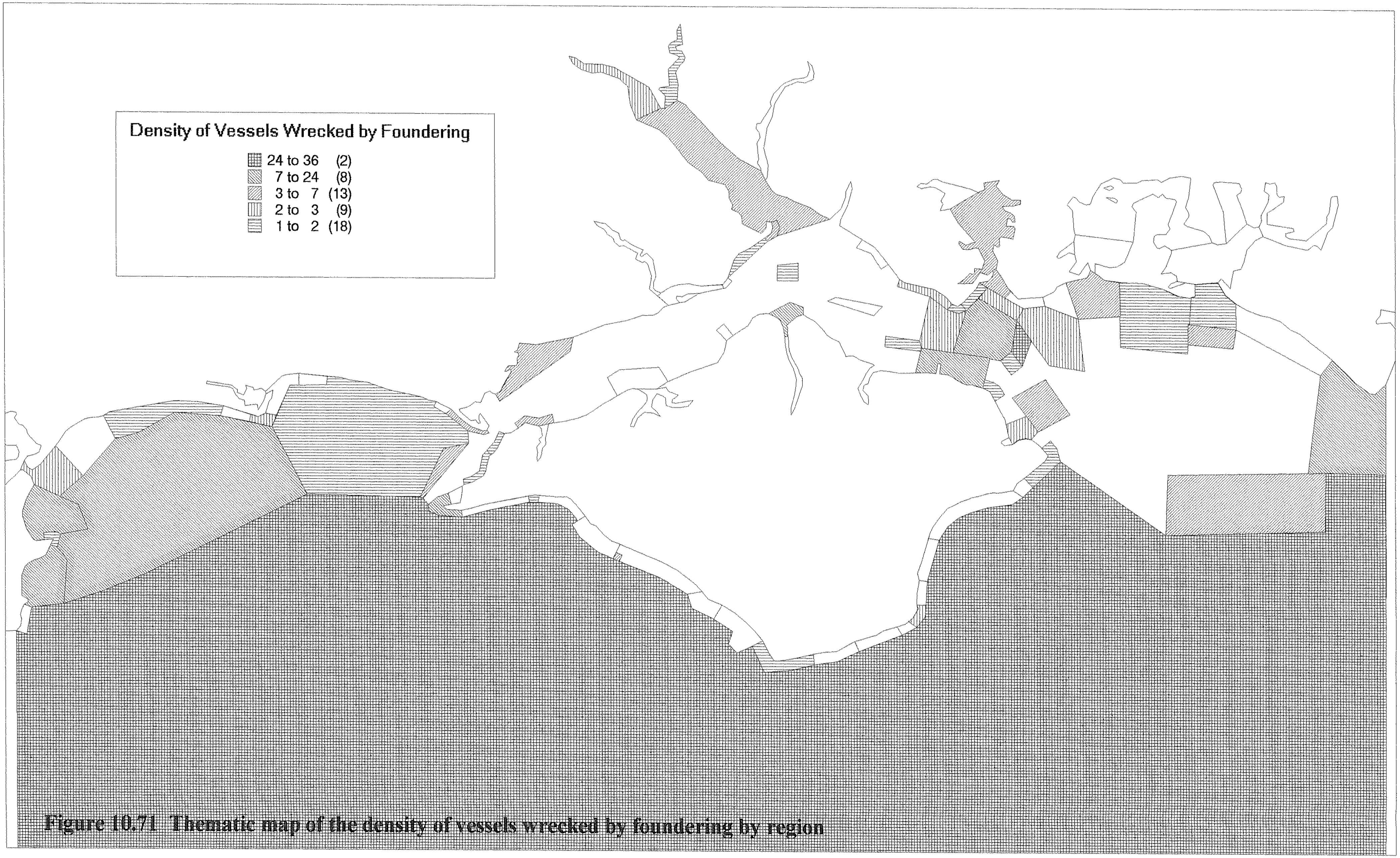


Figure 10.71 Thematic map of the density of vessels wrecked by foundering by region

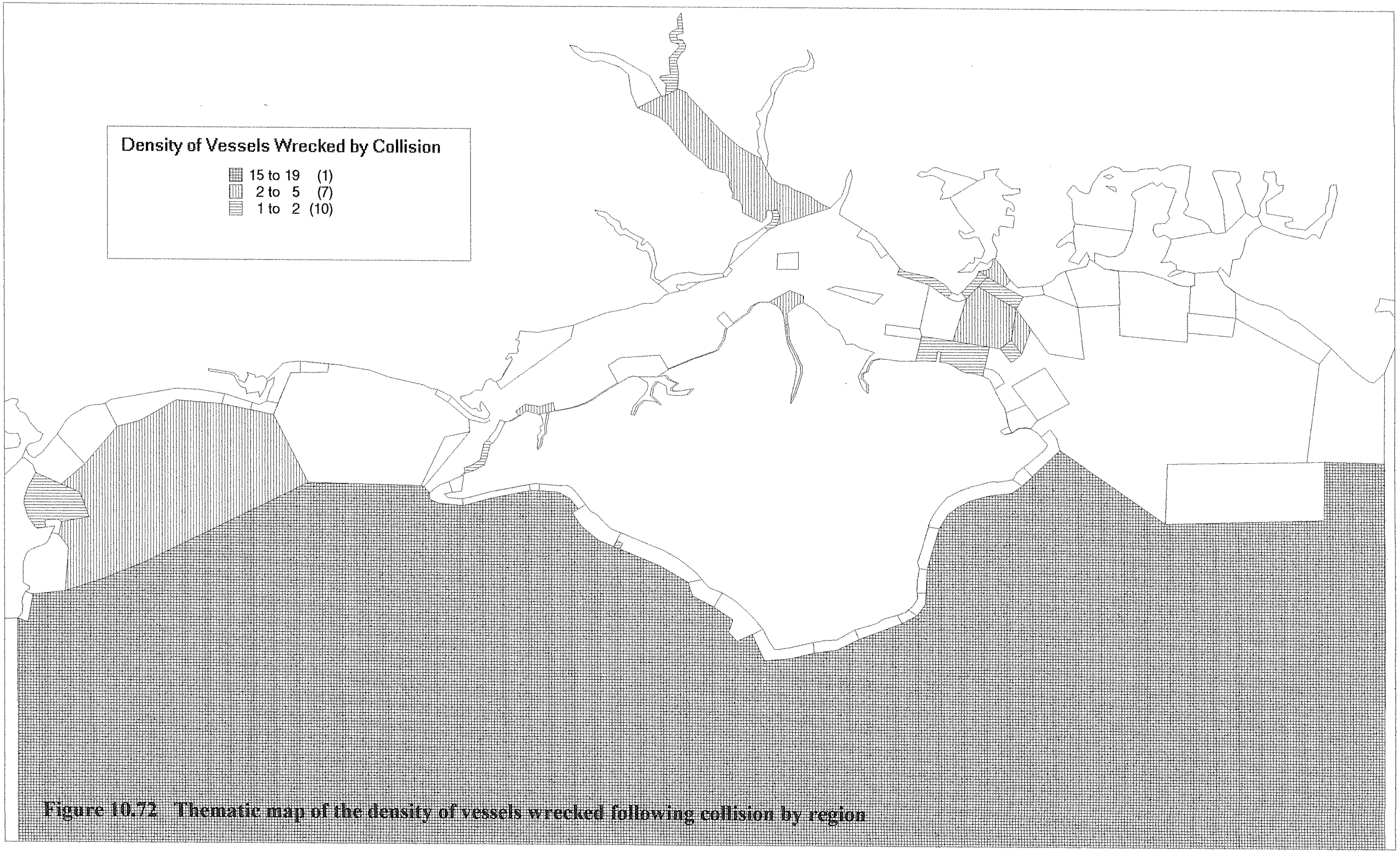


Figure 10.72 Thematic map of the density of vessels wrecked following collision by region

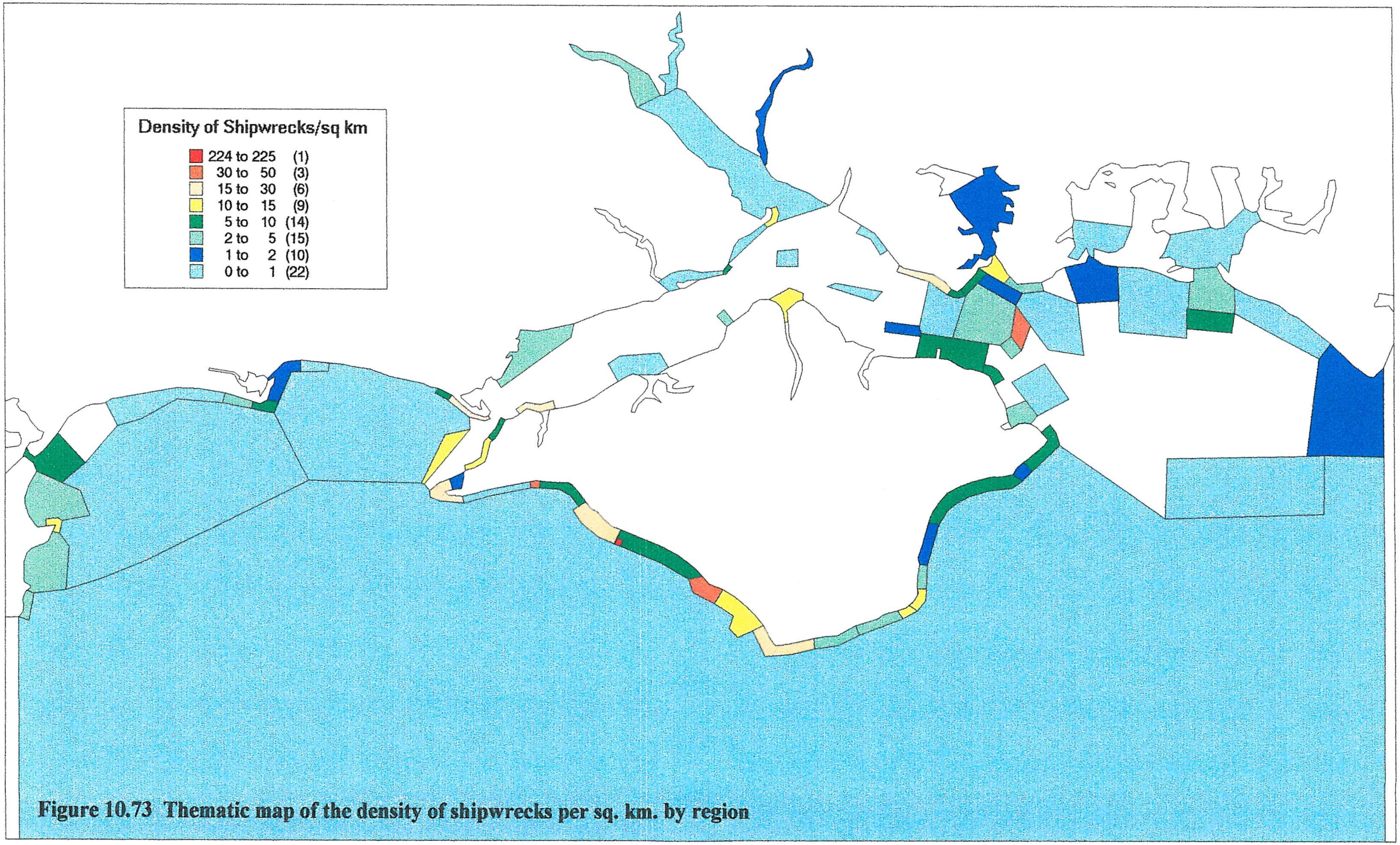


Figure 10.73 Thematic map of the density of shipwrecks per sq. km. by region

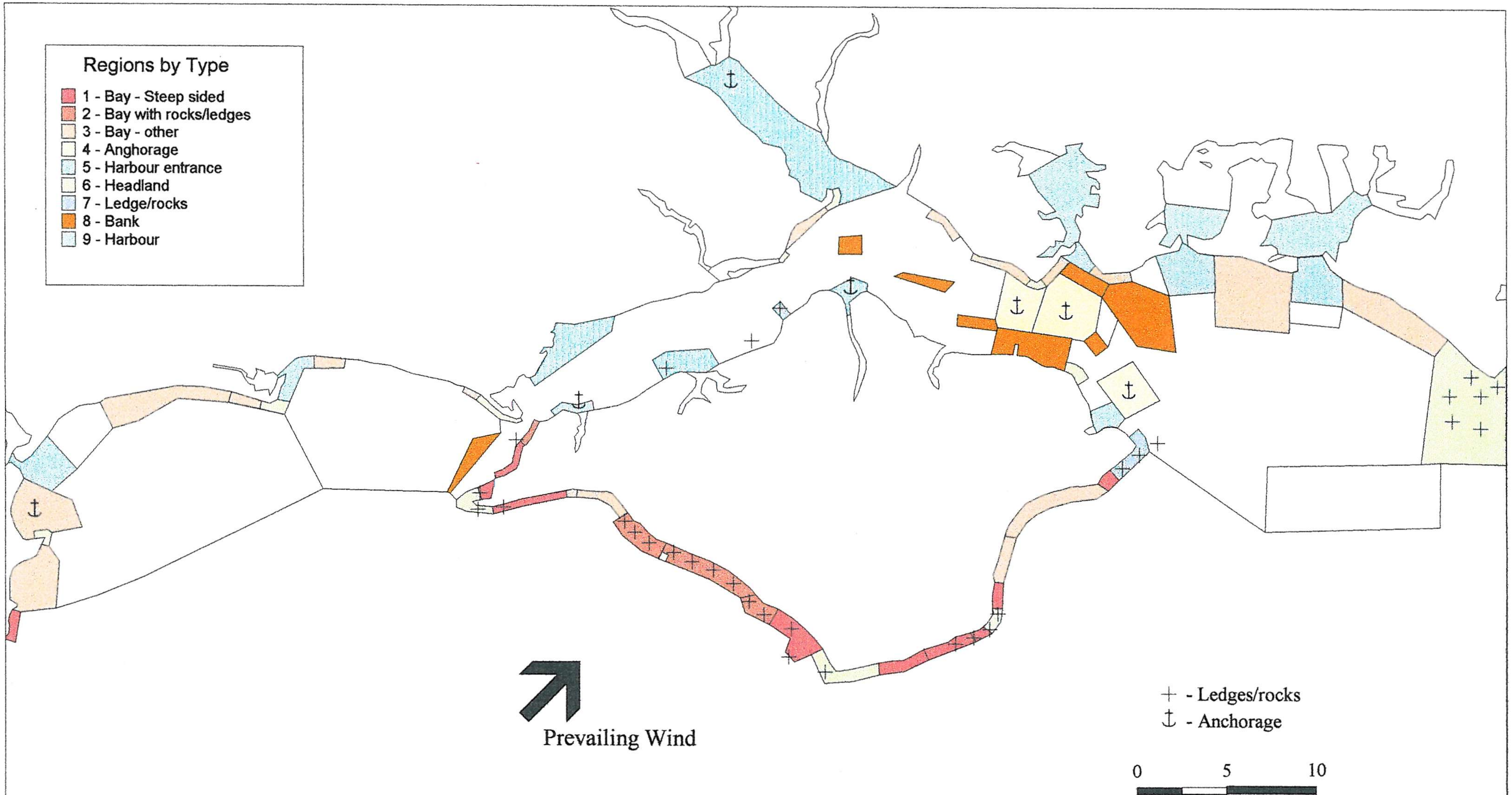


Figure 10.74 Thematic map of regions by hazard type

with high cliffs and off lying rocks and ledges. The lack of accurate and up to date navigational data and navigation marks capable of being seen, or heard in poor visibility is probably another factor, but is difficult to prove. There are human influences in the choice of areas of the coast that become harbours and the routes that vessels would take sailing to and from those harbours, but those choices would normally be made on the basis of factors such as the geomorphology of the coastline and the weather pattern. The human influence is therefore limited to inattentiveness that causes a vessel to stray from the safe course and the inability to control the forces of nature, which drive ships to their doom. While it cannot be identified with clinical precision where shipwrecks will occur, the analysis of the database has exhibited clear trends. In general terms, what can be identified is that the most likely location of shipwrecks is in steep sided bays facing the prevailing wind and especially those with off lying rocks and ledges and in areas where there is a high probability of poor visibility. Anchorages and the entrances to harbours, especially those with off lying sandbanks and/or narrow entrances, also rate highly. Isolated dangers such as rocks, ledges and banks will also be the sites of shipwrecks, but probably not in such large numbers. Apart from those most likely locations a shipwreck can occur anywhere. Figure 10.74 shows the regions by hazard type (the 'Back of Wight', Near Portsmouth and Near Chichester regions have not been included as they do not link directly to any topographical feature, similarly open water regions, e.g. English Channel, have also been excluded). A comparison of Figure 10.74 with Figures 10.73 and 4.4 show why the 'Back of Wight' is such a dangerous place – bays with ledges and rocks facing the prevailing wind and a high prevalence of fog due to the high cliffs at each end.

10.14 The Model

The results of this research have presented a very complex picture of the factors that contribute to the cause of shipwrecks and that indicate the likely locations of those shipwrecks. Any model built using these factors, would also, necessarily, be complex. To simplify it would detract from the potential accuracy of the model.

For any given area a basic predictive model can be provided by the density of shipwrecks by region as identified in Figure 4.3. A more accurate model would probably be provided by the density of shipwrecks per sq. km. as detailed in Figure 10.73 above. Even so, as identified by the various analyses of the five subgroups, the more information there is available, the greater the potential accuracy of any predictive model developed.

Three of the factors analysed point directly to the possible locations of shipwrecks; these are the numbers of shipwrecks at each of the location types detailed in Table 4.4, the frequency and strength of winds from different directions (see Section 10.6 and Figures 10.28 and 10.29) and the aspect of a bay or harbour entrance relative to the frequency of those winds. They will provide a basic level model, but it will not be definitive. For example the bays on the Southwest coast of the Isle of Wight have the same aspect to the wind but different densities of shipwrecks (see Figures 4.3 and 10.73.). They are the base, or Level 1 predictors. Further tuning of the model will be achieved by applying other factors. The Level 2 predictors are the location of underwater obstructions, fetch, tidal streams and currents. Level 3 predictors are the locations of ports and channels and the predetermined routes to reach them negotiating known navigational hazards. In certain circumstances, if sufficient information were available about a particular vessel, it would be possible to predict where it was probably wrecked, for example the ports the vessel was sailing from and to or the wind direction when it was wrecked.

The locations of a core of shipwrecks, probably the majority in any given coastal area, will be predictable using the parameters identified in this study. Shipwrecks, which are caused by human failings/nature or atypical natural occurrences, will possibly be in locations that are not predictable. The regression analysis suggests that perhaps the 80:20 rule applies, with the locations of 80% of the shipwrecks being predictable and 20% unpredictable. This means that every part of the seabed has the potential to contain the remains, in part or whole, of a shipwreck, but the potential will be greater in the areas highlighted by the parameters identified in this study.

The results of this study have proved that analysis of historical records of shipwrecks for a given area provides a coherent picture of the distribution of shipwrecks in that area and, more importantly, detailed evidence of the reasons for those shipwrecks occurring. That evidence has provided the parameters for constructing a significant level of predictability primarily based on weather patterns and coastal topography, with subsidiary factors of seabed topography and tidal streams. This allows the development of a model for:

- Identifying the likely locations of shipwrecks in any given region

and

- Evaluating the potential of any given location as the site of shipwrecks.

It is this model that will provide the means to improve the management and protection of the maritime archaeological resource. The model would be the foundation capability for the establishment of an effective maritime archaeological resource evaluation procedure for the given area. That procedure would combine the analysis of historic shipwreck records with other underwater survey and location methods. This would be an integrated system that would include seismic reflection, ROV and diver survey and monitoring (Dean, *et al.*, 1992:Ch 8 & 9;Hanks, 1995;Hanks, 1996;Quinn, *et al.*, 1997a;Quinn, *et al.*, 1997b;). The analysis of historical shipwreck records would identify the level of risk of shipwrecks being present in an area and assist in the appropriate survey and monitoring methods being chosen to provide the level of capability required. For large geographical areas the analysis of shipwreck records would assist the management of the archaeological resource by indicating where the majority of shipwrecks are likely to be located and by providing the data to prioritise particular areas for the effective deployment of that resource.

This thesis presents an innovative approach to the protection of maritime cultural heritage that can be applied worldwide. It offers the means of improving the levels of management and protection provided currently by making available a process to predict the areas where shipwrecks are most likely to be located so that protective measures can be put in place. The parameters derived in areas for which historic records exist can be applied where such records are scarce or none existent. This research is based on the analysis of historic shipwreck records of an important maritime area, but it is only a small proportion of the British Isles, or indeed the world. The findings need to be tested in other areas to prove their validity, an activity that should be initiated in the immediate future. As the research was only applied to sailing vessels a similar study should also be carried out for engine driven vessels, both to identify if there are any differences and to enable the application of the same improved levels of management and protection to this group of wrecked vessels.

Chapter 11 - Extrapolation

11.1 Introduction

The model provides a baseline indicator of the concentrations of wrecks of the historical period. It does not take into account the large numbers of abandoned vessels that would complicate the picture even further. However, the myriad of reasons why shipwrecks occurred throughout history mean that a vessel could come to grief almost anywhere there is water. The cautionary message for heritage managers and developers alike must be that the human factors governing all past vessel movements means that while we may predict where shipwrecks are likely to be, we cannot predict where they will not be.

While the historic database cannot be used simplistically for retro-predicting the wreck sites of prehistory, this work nevertheless allows some of the primary differences in the patterns of seafaring in prehistory to be postulated. Therefore, on a macro scale, searches for lost or abandoned boats could be focused in more specific locations (e.g. it would not be expected that large numbers of boats sailed up and down the English Channel in prehistory in the manner seen in historic periods). Although areas such as the 'Back of the Wight' were just as dangerous, it is unlikely that the same concentration of wrecking events occurred there.

It could be argued that if the primary factors in wrecking - weather and major coastal topographic features - were the same in prehistory, then the coarse nature of reconstructed shorelines based on estimates of sea level change are not necessarily an impediment to a base level of prediction being derived from the historic period data. Of course the chances of any archaeological survival of these casualties depends on site formation aspects (Muckelroy, 1980a:28-31 & 178-179).

This chapter discusses the approach to be taken in constructing a predictive model to identify the potential locations of archaeological shipwreck sites. In general terms the most likely locations will be adjacent to trading routes, particularly where they come close to land. At a more detailed level they will be located at maritime hazards, headlands, banks and rocks, at locations where ships are forced to come close to maritime hazards such as harbour entrances and, the most dangerous locations of all, the bays that are turned into lee-shore traps by the wind, possibly aided by the topography of the land. The previous chapter detailed the parameters that need to be applied, but there are others, which depending on circumstances may also need to be taken into account. The study area is used as model to provide examples of how these should be applied.

11.2 Time Period

Perhaps the most important of these additional factors and from which much else stems, is the date or time period. The effects of changing patterns of trade have already been identified in Chapter 5, but there are also political, social, economic, technological and environmental pressures, as identified in Chapter 10, which cause the pattern of maritime activity to be altered. The parameters developed in Chapter 10 are based primarily on data from a time period when these pressures were reasonably consistent. If these parameters are to be used to create a predictive model for earlier periods then the differences in marine activity brought about by those pressures must be considered.

11.3 Geomorphology

For the early period of human maritime activity it is necessary to consider the difference in sea level relative to the land and the changes this would have caused in the geomorphology of the littoral zone, particularly the shoreline, rivers and underwater hazards, such as banks and rocks. In addition there are the changes to the shoreline that would have resulted from the erosive action of wind and waves, landslip and sediment deposition and transport. Taking the study area as an example, the geomorphology of the shoreline has changed considerably since the last Devensian glaciation. At that time the sea level in the Celtic Seas was approximately 135 metres lower than today (Hamblin *et al.*, 1992:75). The Atlantic shoreline would have retreated to a position between Cornwall and Brittany, and the British Isles would have been joined to continental Europe by the Channel River valley (Dyer,

Figure 11.1 Map of the study area c5000 BP

1986:7; Jones, 1981:263). Dating from probably the Tertiary Period, (Velegrakis, *et al.*, 1999:74) the Solent River flowed through the study area from, what is now, Poole Harbour, across Poole and Christchurch Bays, through the Solent, then turned south to join the Channel River flowing into the Atlantic Ocean. The ridge of chalk that runs through the centre of the Isle of Wight in a east/west direction at that time continued to Handfast Point in the Isle of Purbeck (Allen & Gibbard, 1993:525-526) and formed a southern barrier to the river. As the sea level rose in the Flandrian period, from the glacial low, the English Channel valley and the Solent River were inundated, but the upper reaches of the Solent River had already been disrupted prior to this when the eastern and central parts of the chalk ridge were breached by the three south flowing rivers. Poole Bay was flooded during the late part of this Flandrian Transgression (Velegrakis, *et al.*, 1999:84) followed later by Christchurch Bay *c* 7,000-7,500 BP. The final event was the separation of the Isle of Wight from the mainland providing the link between Christchurch Bay and the Solent. The flooding of the area would have exposed the soft Tertiary rocks to erosion by the sea. Dyer (1975:242) suggests this erosion would probably have been rapid while Cunliffe (1978:15) estimates the erosion in the area of Hengistbury Head to have been 4-5km over the last 12,000 years. Velegrakis, *et al.* (1999:86) state that the establishment of the Christchurch Bay-Solent link would have dramatically changed the hydrographic regime of the area that may have caused extensive marine erosion.

During the Mesolithic the sea level rose rapidly and by the Neolithic the sea level would have been only approximately 6 metres lower than today (Dyer, 1975:242). In establishing the probable coastline at that time taking the 6-metre depth contour on a modern chart would only give a poor approximation. The effects of erosion and accretion would also need to be taken into account.

Coastal erosion is still taking place, particularly in Poole and Christchurch Bays and along the southern coast of the Isle of Wight (Small, 1964:49). Wave action cuts into the base of the cliffs, but rain is more destructive cutting gullies and causing mass slippage. This is especially severe at Barton-on-Sea. In the shelter of the river inlets accretion has taken place forming mudflats and salt marsh. The prime areas being between Hurst Castle and the Beaulieu River and on the western shore of Southampton Water (Small, 1964:48-49). This is particularly the case following the arrival of *'Spartina Townsendii'* (perennial rice-grass) first reported in Southampton Water in 1870. Sand spits have been created obstructing the entrances to Poole Harbour and Christchurch Harbours and shingle spits have grown at Hurst Castle and Calshot.

The geomorphology of what is now the seabed will also have changed due to the effects of sediment deposition and transport. Seismic Profiling (Dyer, 1975:242) shows that in the area of the Nab Tower the Solent River cut into the bed rock to a depth of over -46m OD and adjacent to the Ryde Middle Bank to a depth of over -30m OD. Off the eastern end of the Ryde Middle Bank the bedrock is cut to -36m OD (Hanks, 1996:Figure 3.6) and the current seabed there is now -24m OD (Hanks, 1996:Figure 3.9) giving a covering of 12m of sediment. The Solent River channels have been infilled with sediment to varying levels through the study area. Although the sedimentation is a continual process, with sediment entering the Solent from both the east and west, Pethick (1984:68) suggests that most coastal sedimentation was completed during the rapid, post-Devensian, glacial sea level rise. It is probable that in the Solent the main period of sedimentation would have followed the creation of the Christchurch Bay-Solent link with the transport of material from Christchurch Bay.

From the above it can be seen that the geomorphology of the study area has changed considerably over time. Long & Tooley (1995:Figure 9b), using the result from core samples taken at Stansore Point on the north shore of the Solent, suggest sea levels of -6m OD *c* 5500 BP and -2M OD *c* 2000 BP. These heights, together with the Cunliffe (1978:15) estimate on erosion rate, provide the initial input for deriving the possible geomorphology of the study area.

Figure 11.1 is a map of the simplified estimated coastline of the study area *c* 5000 BP. Mean sea level would have been approximately 6m below that of today. This probably meant the coastline would have been further to seaward (Small, 1964:49-50) with; the mainland coastline further south, the Isle of Wight larger, the Solent and Southampton water narrower, and the harbours smaller. The starting point for the estimate of the coastline depicted in figure 11.1 was the 6m depth contour. The cliff-lines of Christchurch Bay, Poole Bay and the Isle of Wight were moved seaward by a distance based on Cunliffe's (1978:15) estimate of the rate of erosion. The rate of erosion was assumed to be constant and a distance of approximately 2km calculated. Less exposed cliff-lines were assumed to have eroded at a lower rate and moved a smaller distance. The coastline within the Solent, especially the north coast of the Isle of Wight, was assumed to have changed the least. The Needles and Old Harry rocks, which are the remnants of the chalk ridge that ran from the Isle of Wight to the Isle of Purbeck, have been extended further to seaward. Other features, such as harbour entrances, are pure guess work. The mud, sand and shingle banks were probably not as extensive (Small, 1964:48-49), but by how much is not known. How this would have affected the entrances to the harbours of Poole, Christchurch, Lymington, Portsmouth, Langstone, Chichester, Ryde, New Town and Yarmouth is indeterminate. The Shingles, which almost block the western end of the Solent and the Bramble Bank, at the entrance to Southampton Water, which are both sedimentary, were probably not as extensive. The Ryde Middle Bank, which only has a thin sediment cover, is cut from the Tertiary rock. At this period the highest parts of the bank would probably been uncovered at low tide and the rest would have been shallows (Hanks, 1995:B-7). The mud banks and flats along the north coast of the West Solent and in the rivers enhanced by the *'Spartina Townsendii'* would not have been as extensive or even have existed.

Taking that model of the geomorphology of the study area and a modern chart it is possible to both interpolate and extrapolate a model of the study area for any time period. Together with a model of human activity for that time period the probable effects on maritime activity can be derived.

11.4 Maritime Activity

During the Mesolithic the human population of the British Isles was probably in the region of 20,000 (Bewley, 1994:40). This means that the density in any given area was likely to have been very sparse, unless it had a particular attraction in terms of food and material resources or was a meeting place or place of religious significance. As a river valley and shallow maritime environment the Solent would have been a prime location for hunter/gatherers to live, but, even so, unlikely to have supported more than a few small bands of people.

At the beginning of the Mesolithic period Britain would still have been joined to Continental Europe by a low plain divided by major rivers which as the sea level rose became the North Sea and the Channel (Dyer, 1990:24). As the waters rose, wetlands would have been created where there had previously been dry land. These areas would have provided good hunting of birds and animals for the people living there as well as fish, marine mammals and molluscs in the shallow coastal seas. The rivers and marshes would have created travel and communication problems for people who would still have been living the nomadic life of the hunter/fisher (Mithen, 1994:106-111). These problems may have been the catalyst that led to the development of boats to help the people to travel and hunt the new wetlands. Ellmers, (1996a:12) suggests the first boats were used by reindeer hunters during the latter part of the Magdalenian period (16,000 - 10,000 BC). The incentive for their development was that the reindeer were easier to kill while they were swimming and the fish easier to catch in deeper water. In a cold environment that does not support the growth of sizeable trees the materials are still available to build hide boats and during the Mesolithic the technology was also available (McGrail, 1996:25). It is not until the sixth century BC that documentary and pictorial evidence of their use in the British Isles is available (McGrail, 1996:24), but they could have been in use much earlier as indicated by the finds of wooden paddles at middle Stone Age sites in the British Isles, Denmark and Schleswig-Holstein (Ellmers, 1996a:16-17). By about 5000 BC boats were being used in open waters as indicated by the remains of cod found in the middens of the Danish Ertebolle Culture. More notable, perhaps, are the indications that white whale, killer whale and dolphin were being harpooned at sea, which suggests reasonably substantial boats and a significant level of boating skills. The ease of travel and the transportation of heavy or large loads by boat, compared with by foot must have been recognised. With the conditions generated by the rising sea level in the Channel perhaps this type of craft was used on the Solent area.

A large number of Mesolithic sites, predominantly only of flint scatters, have been identified in Hampshire. They were temporary campsites used in hunting and foraging for food (Bewley, 1994:41). Many from the coastal regions have been eroded away or covered by the rising sea level (Cunliffe, 1993:29). Mesolithic material has been found on the Solent coasts after being exposed by tidal action and by excavations below the present mean sea level (Jacobi, 1981:20). Momber (2000:90-91) identifies a number of the sites and also reports on worked and burnt flints dated at 6430-6120 BC found at Bouldnor Cliff, Isle of Wight at a depth of -11m OD.

With the improving climate and the afforestation of the land the availability of substantial trees became available to produce heavier and more robust boats (Ellmers, 1996a:15). Logboats have been excavated in almost every country in northwest Europe (McGrail, 1978:4-13). The oldest example, found near Pesse in the Netherlands, dates from about 6,300 BC (Ellmers, 1996a:15). The oldest logboat found in Britain dates from *c* 2,000 BC and was excavated at Catherinefield, Locharbriggs, Dumfriesshire, but that does not suggest that was the earliest date of their use.

Farming reached Britain *c* 4,500 BC (Dyer, 1990:29). The seed corn and domesticated sheep, goats, cattle and pigs which formed a large part of the core of this approach to food procurement were not indigenous to Britain (Dyer, 1990:30;Cunliffe, 1993:37) and would have been brought from the European mainland, possibly Flanders (Barker, 1985:197; Sherratt, 1994:179;). Such movement would surely have required vessels of a reasonable size and sea going qualities, perhaps large log boats or skin covered boats like the Inuit whaling *umiak* or the Irish *curragh* (Barker, 1985:197; Dyer, 1990:30). Johnstone (1988:139) describes two cows or twenty-one sheep as a good load for a Kerry *curragh*. By this time, with the inundation of coastal lands, the need for transport and the development of fishing as a primary source of food, the skills necessary to cross the Channel and the necessary vessels are likely to have been developed. Severin's voyage of the *Brendan* across the Atlantic proved the capabilities of the hide boat - although she was not an authentic reconstruction of a prehistoric boat (Severin, 1978). Any evidence that supports the interchange of materials or ideas between Britain and the Continent after the breaching of the straits of Dover must also be evidence of cross-Channel transport by vessels of some type. If there were vessels capable of crossing the Channel then they would have been very capable of use in the rivers and coastal waters of the study area.

McGrail (1996:31-36) identifies three chronological groups of shallow draft planked craft from finds in England, Wales and Denmark, the earliest of which has been dated to *c*1900 BC (Cunliffe, 2002:14). They suggest a long tradition of shallow draft planked craft which may have been widely used in the east and south of the British Isles from the beginning of the second millennium BC or perhaps earlier (Adams, 2001:XX). The known plank boats can not be considered as being seaworthy (McGrail, 1993:204;1996:37) and would have been mainly used on, lakes, rivers and in estuaries, but could also have been used in sheltered waters such as the Solent and limited short trips in suitable weather conditions. The boulders of Isle of Wight (Bembridge) limestone in the round barrow at Puncknowle, on the Dorset coast, a distance from point of origin of 125 km, is perhaps evidence of such coastal shipping (Tomalin, 1996:17). Tomalin notes the amount of stone is "approximately that which could be used as ballast in a boat of the Ferriby size". The logboat found at Hasholme, North Humberside, dating from *c*300 BC is an example of a cargo carrying river craft, it could carry 5.5 tons (McGrail, 1997:361). It is, perhaps, an example of the type of local craft that may have operated in the study area.

There is undeniable evidence of links between Wessex and Brittany during the Bronze Age (Briard, 1993:186). Assembleges indicate shipping and fishing activity at Wootton, Isle of Wight, from the Early Bronze Age (Tomalin, 1992:1) and the locations of Early Bronze Age Bell Barrows and later Bronze Age burials indicate the possible location of other settlements (Tomalin, 1996:15). Pottery of Breton style or inspiration together with daggers with common features have been found in Wessex and on the Isle of Wight. Also British style pottery has been found in Brittany (Briard, 1993:187-188). Further evidence of cross Channel trade is provided by the Moor Sand, near Salcombe, and the Langdon Bay, near Dover, wrecks which have yielded Breton material (Muckelroy, 1980b:100-107). Unfortunately the type of vessels are unable to be identified, but any craft capable of a cross-Channel trading voyage must have been a certain minimum size, possibly 8 metres with a crew of 3 people (Muckelroy, 1980b:108).

The earliest evidence of boats being used in trading is identified by the location of riverbank markets on three small islands in the river Elbe associated with the Ertebolle/Ellerbek culture and dated to *c* 4000 BC (Ellmers, 1996a:19). When maritime trading was developed vessels were beached or anchored in sheltered positions in coves, bays and inlets, or behind offshore islands or headlands (McGrail, 1998:267-273). Collectively they provide very little if any archaeological evidence of the activity and therefore cannot be used to estimate the amount of trade or shipping that was involved. It is not until the volume of trade increased and/or rulers sought to control the trade that there was a need to establish more permanent trading places. Rivers would have provided both the means to collect goods for trade from their hinterland and the access and means to distribute traded goods inland (Cunliffe, 2001:32). For example, in the Iron Age Wessex was in a position central to the trade and exchange routes of southern Britain, as Cunliffe (2001:250) describes it – a route node. The entrepôt for Cross Channel trade to these routes was Christchurch Harbour from which the rivers Stour and Avon lead inland. With Christchurch as the major port-of-trade in the study area there were also probably coastal links with the other rivers and goods would almost certainly have been collected from and distributed to the hinterlands of those rivers.

McGrail (1993:200) proposes that, although early prehistoric archaeological distribution patterns do not show which Cross Channel routes were used, later distribution patterns and seamanship suggest the main routes that would have been used. One of these, the mid-Channel route, Spithead to the Seine (McGrail, 1997:280-281;McGrail, 1997:Figure 10.1.4;Cunliffe, 2001:58)) is of particular interest, as is the possibility it may have linked with the coastal route from Christchurch Harbour to Mounts Bay, Cornwall (McGrail, 1997:280). This means early maritime trade traffic may have used the Solent as a through route and/or a stopping place and almost certainly as somewhere to shelter from rough weather. The Cross Channel routes linked Britain with the Continent and the trade routes of the central and eastern Mediterranean. It is possible to conceive of a route from Mounts Bay, eastwards along the coast of Britain, to Christchurch then across the Channel by the shortest route to Normandy, perhaps using the Cap de la Hague (although the tidal streams in that area are particularly strong) as a navigation beacon and then along the Northeast coast of France to the Seine. An alternative would be to sail from Spithead direct to the mouth of the Seine with the prevailing southwesterly winds on the beam.

The earliest firm evidence of the type of sea-going ships that brought trade to the Solent is from coins minted by the Celts, *c*100 BC, on the coast of Normandy (Ellmers, 1996b:68). They show a war-chariot with the driver holding a model of a ship aloft. It is a high-sided sea-going ship with a mast and yard and with animal heads at stem and stern. The description provided by Caesar when he wrote of the large, strong, oak-built sailing ships of the Veneti in north-western Gaul fits with the pictorial representation on the coins (*Gallic War III.*13). He describes the Veneti as 'superior to all others in their knowledge and experience pertaining to the sea' and having a good working knowledge of astronomy (*Gallic War VI.*14). He also writes 'the Veneti have a great many ships and regularly sail to and from Britain' (*Gallic War III.* 8). With such ships, knowledge and experience the Veneti would have been capable of crossing the Channel, even at its widest part. The Blackfriars Ship 1, dating from the 2nd century AD, (Marsden, 1994:36 & 80) and the St. Peter Port, Guernsey ship, which sank *c* 285 AD, (Rule, 1990:55; Ellmers, 1996b:70), probably represents the Celtic method of shipbuilding current during the Roman period.

Christchurch Harbour remained the major port of the study area (Cunliffe, 1993:127, 154-155 & 164) until the middle of the 1st century BC when trade was disrupted completely and never re-established. This may have been due to the Roman conquest of Gaul and Caesars establishment of friendly relations and treaties with the tribes of eastern Britain, which probably included trading monopolies (Cunliffe, 1993:208). Following the Roman invasion the political as well as the trade focus moved towards the Thames and Essex (Cunliffe, 2001:33). This led to the development of the British East Coast ports, London was established as a city and trading centre by the Romans (Milne, 1995:41). The Romans communications network radiated from *Londinium* (Cleere, 1978:38-39) as the roads system indicates. It was the link, by sea, to the rest of the Roman communications network centred on Rome. Even so, as the southern ports maintained their trading links, although they had lost their monopoly (Cunliffe, 1982:52), there would still have been merchant traffic from Gaul as well as local vessels in the Solent. The Romans used Chichester, Poole and possibly Bitterne (near Southampton), which had been linked to London by roads, to supply their army. These facilities were possibly used for commercial trade after the army's requirements declined (Cunliffe, 2001:56).

With the Roman conquest of Britain, trade both within Britain and with other provinces flourished (Hayes, 1993:106). The Solent, with the Roman settlement and port of *Clausentum* (Bitterne), and later the fort at Portchester, near Portsmouth and at

Carisbrooke, on the Isle of Wight (Fulford, 1996:Figure 15) must have seen a significant level of shipping, warships as well as merchantmen. There was also a Channel Fleet as indicated by the appointment by Rome, in AD 283, of Caraucius to command the fleet with a commission to clear the seas of the pirates and provide defence against the raiding parties which came primarily from southern Scandinavia and the Low Countries (Johnston, 1981:48). The fact that the Imperial forces sent by Rome when Allectus murdered and usurped Caraucius landed at Lepe or Bitterne and then marched north to Winchester, suggests the Solent may have been of military importance to the Romans.

Following the end of Roman rule the focus of trade again changed. How much cross Channel trade remained is unknown. There was foreign trade in the east of Britain, but most of the evidence, until the 7th century, relates to luxury goods (Welch, 1992:116). Kent was the end of a major trade route through the Rhine valley and over the Swiss Alps to Italy, the Adriatic and the eastern Mediterranean (Welch, 1992:117). During that period the trade to the study area was probably primarily coastal with perhaps a little from across the Channel. Later in the Norman period there was a shift in the focus of trade towards France and the English Channel with direct overseas trade to the study area. The development of maritime trade after this time has already been detailed in Chapter 5.

11.5 Weather Patterns

Chapter 10 presented the evidence that indicated that weather patterns play a major role in the occurrence and location of shipwrecks therefore when the one changes so would the others. McGrail (1998:259) describes the weather pattern for the period 1000 to 500 BC as one with winds generally from the northwest or north in the summer and west in the winter. This together with the assumption that the earliest sailors were not likely to put to sea during the winter months (McGrail, 1998:259-260) suggests there would have been very few vessels wrecked at that time. Those that were would most likely be wrecked on the westerly facing shores or banks open to the west. The Northwest to North winds in the summer would be blowing predominately offshore and only creating lee shores with a very short fetch. The most likely locations for shipwrecks at that time would have been the short stretch of the

Isle of Wight coast from the Needles to Cliff End at the Hurst narrows. Hurst Spit is unlikely to have been so extensive at that time and the extent of the Shingles Bank is an unknown (see above). This suggests the Needles Channel and the Hurst narrows would not have been as much of a danger as they are today. Any change in the frequency of strong winds or poor visibility would have changed the frequency at which shipwrecks occur, but not where they would occur.

11.6 Application of Model

The brief description above of the development of early trade and maritime traffic shows that for that early period the locations of wrecked craft of any type are unlikely to match the pattern for sea going vessels developed in Chapter 10. The earliest craft are more likely to have been discarded on the bank of a river or stream and left to decay when they became damaged and beyond repair. With the development of markets the locations of abandoned and possibly wrecked craft would have been augmented to include the routes between the markets and the settlements and camps as well as around the markets themselves. As the sea level rose the Solent River would have widened and the mouths of its tributaries backed up towards the land. The position of any archaeological remains of these craft will therefore be in the parts of the study area that have been inundated. In addition any boats that were abandoned in locations that became exposed to destructive wave energy, particularly during storms, would probably have been broken up and dissipated by longshore transport.

With the development of larger and more substantial craft, and the capability to carry heavier loads and travel further and safer, the markets would have attracted trade from further afield and hence the various routes the traders took would have increased. This would have further extended the range of locations where vessels could have been wrecked. The parameters derived in Chapter 10 will apply to models for time periods when larger sea-going vessels were developed and cross-channel trade established. The growth of Hengistbury Head as an important trade centre would have provided a focus for the commercial traffic. The entrance to Christchurch Harbour, as with all other harbours in the study region, would have been very different to today, probably wider and easier to enter. Studland Bay would have provided a sheltered anchorage from winds from the arc North to Southwest and is the most likely place for vessels to

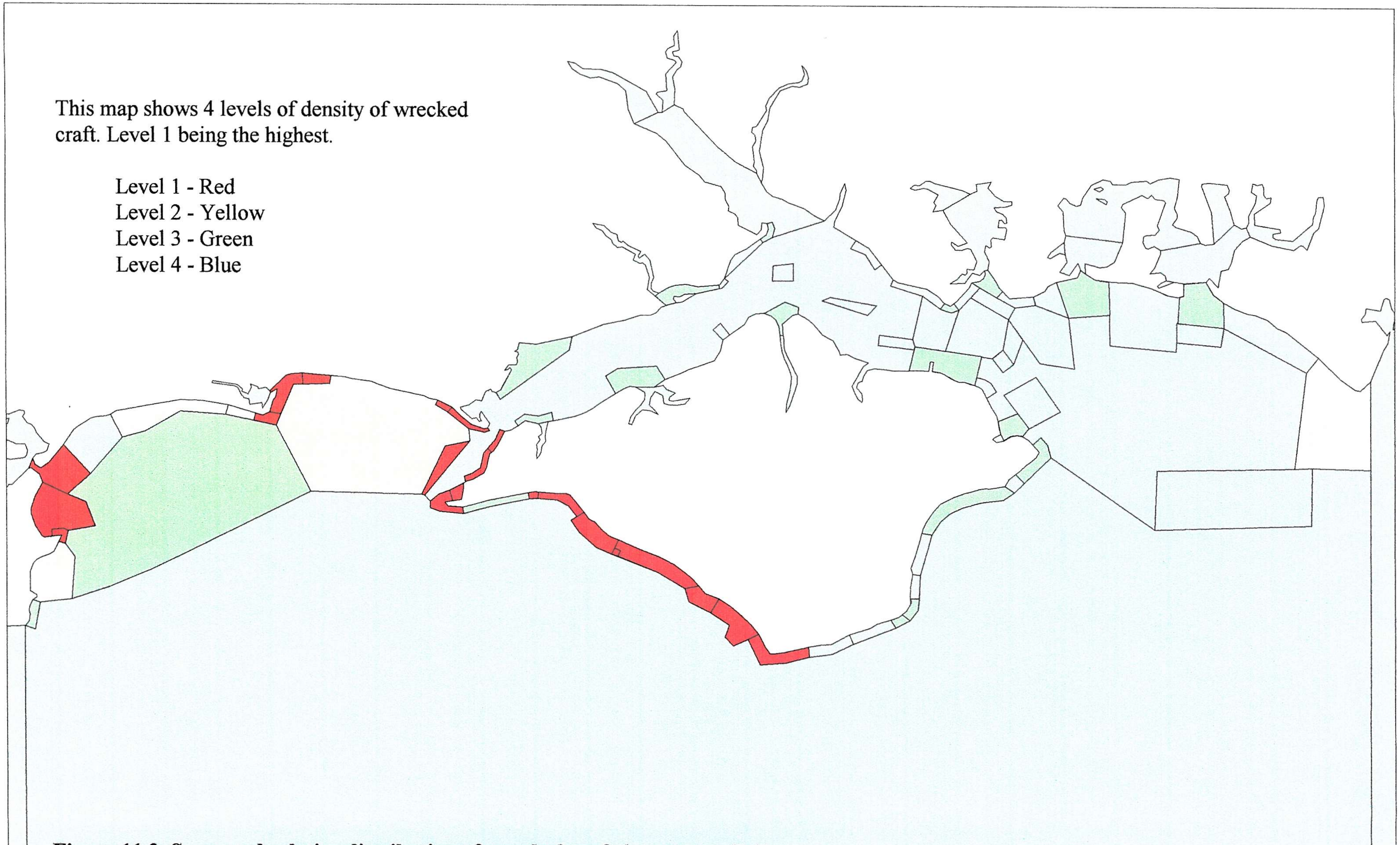


Figure 11.2 Suggested relative distribution of wrecked craft 1st century B.C.

wait at anchor before entering Christchurch Harbour. If the weather patterns were similar to present times, then the parameters for locating shipwreck sites would be those identified in Chapter 10. There would be a higher ratio of wrecks in Poole and Christchurch Bays and possibly Alum, Totland and Colwell Bays on the Isle of Wight, and the Shingles bank. There would be no concentration of shipwrecks off Portsmouth (see Figure 11.2).

Larger ships and heavier cargoes together with increased volumes of trade would have raised the need for deepwater harbours and loading/unloading facilities. This does not mean that the use of beaches stopped as indicated by the wrecking of the collier brigantine *Falcon* on 2nd June 1860, at Dunnose Point after being caught by a gale while anchored on the beach unloading. In addition coastal erosion and or silting of river estuaries (Jackson, 1983:14-15) would have made some ports unusable. The resulting changes to the maritime environment and shipping movements caused by the political, social, technological and environmental pressures must be taken into account when building the model to predict the likely locations of wreck sites. For example, for the study area during the Late Iron Age perhaps the Overseas and Local subgroups should be used to provide the parameters for the model. From the Roman to the Late Saxon/Early Mediaeval period the Coastal and Local subgroups may provide the best basis for the model and then for the Norman period the Overseas subgroup would also need to be used. In addition the relative importance of trading places and ports needs to be applied as they change over time. Prime examples of this are Chichester Harbour, for reasons already described above, and Portsmouth. Portsmouth is not fed by any significant rivers and is therefore unlikely to have been used as a link to a hinterland as were other ports of the study area. Although the Romans built the fort at Portchester, which must have generated some maritime traffic, it is not until the Middle Ages, when a direct road link with London was built, that the port became the muster point for expeditions to Normandy (Cunliffe, 2001:55 & 57). It is not until the sixteenth century, when Henry VIII built the naval base and dockyard at Portsmouth that it began to develop into the premier Royal Navy port (Loades, 1992:2-3). The density of shipwrecks in the 'Vicinity of Portsmouth' is therefore likely to be lower than the statistics in Chapter 10 suggest until at least the seventeenth century.

This study has identified clearly that the environment has a major influence on the likely position of sailing vessel wrecks. The geomorphology of the shoreline and the weather pattern combining to provide the principal parameters in identifying those positions. These factors enable the parameters, which change over time, to be developed that point to the likely locations of shipwrecks. It has also been identified that there are many other influences that must also be taken into account to provide the most accurate predictive model. The parameters identified by this study must be adapted and given the necessary weightings to fit the circumstances of the time period and geographical area for which the likely locations of shipwrecks are to be predicted. As already stated in Chapter 10 the more information that is available about a vessel the more accurate will be the predicted location. This applies equally to the geographical area and the time period.

The changes in the geomorphology have been covered earlier in this chapter. In terms of weather the changing wind patterns over time (see Chapter 8) must have had an influence on the locations of shipwrecks. The westerly winds of the early sixteenth century would have made the 'Back of Wight' the principle area for the locations of shipwrecks. The north-east to south-east winds of the period 1550 to 1700 would have made areas such as those at the eastern end of the Isle of Wight and between Studland Bay and Christchurch Harbour more dangerous. Perhaps these latter winds had an influence on why Portsmouth Harbour did not develop during much of that period, as it would have been difficult to sail out of the harbour and in bad weather the entrance would have been a lee shore to winds from the east to south. The same winds would have made the anchorages of the eastern Solent untenable.

Bibliography

Adams, J. 2001. 'Ships and boats as archaeological source material'. in. Gibbins , D. & Adams, A. (eds). *World Archaeology*, **32.3**: 292-310

Admiralty. 1959. B.R. 45(I). *Admiralty Manual of Navigation*, Vol. I. London:HMSO

Admiralty. 1971. N.P.27. *Channel Pilot*. Taunton:Hydrographic Office

Admiralty. 1997. Chart No. 5600.1. *Outer Approaches to the Solent*. Taunton:Hydrographic Office

Allen, L. G. & Gibbard, P. L. 1993. 'Pleistocene Evolution of the Solent River of Southern England'. *Quaternary Science Reviews*. Vol **12**: 503-528

Allington, P. 1993. 'The Changing Problems of Shiphandling in the Nineteenth Century'. in. Gardiner, R. & Greenhill, B. (eds). *Sail's Last Century*. London:Conway: 154-164

Archibald, E. H. H. 1987. *The Fighting Ships of the Royal Navy*. Poole: Blanford Press

Ashton, T. S. 1960. 'Introduction', in, Schumpeter, E.B. *English Overseas Trade Statistics 1697-1808*. Oxford:Clarendon: 6-14

Baker, T.H. *Records of the Seasons. Prices of Agricultural Produce and Phenomena Observed in the British Isles*. Second edition with additions. Original. Met. Office Archive

Ballard, R. D., McCann, A. M., Yoerger, D., Whitcomb, L., Mindell, D., Oleson, J., Singh, H., Foley, B., Adams, J., Piechota, D. & Giangrande, C. 2000. 'The discovery of ancient history in the deep sea using advanced deep submergence technology', *Deep Sea Research Part I*, **47**: 1591-1620

Barker, G. 1985. *Prehistoric Farming in Europe*. Cambridge

Bascom.W, 1976. *Deep Water, Ancient Ships The Treasure Vault of the Mediterranean*. Newton Abbot:David & Charles

Bearman, G. (ed.). 1989. *Waves, Tides and Shallow-Water Processes*. Milton Keynes: Open University

Beaver, P. 1971. *A History of Lighthouses*. London:Davies

Bewley, R. 1994. *Prehistoric Settlements*. London:Batsford

Bolton, J. L. 1980. *The Medieval English Economy 1150-1500*. London:Dent & Sons.

Bosscher. P. 1995a. 'Introduction', in, Gardiner. R. & Bosscher, P. (eds). *The Heyday of Sail*. London:Conway: 7-9

Bosscher, P. 1995b. 'Merchant Shipping of the British Empire', in, Gardiner. R. & Bosscher, P. (eds). *The Heyday of Sail*. London:Conway: 10-33

Brackenbury, M. 1981. (ed.). *The Cruising Association Handbook*. London:Cruising Association

Briard, J. 1993. 'Relations between Brittany and Great Britian during the Bronze Age', in Scarre, C. & Healy, F. (eds). *Trade and Exchange in Prehistoric Europe*. Oxbow Monograph **33**: 183-190

Burwash, D. (1947). *English Merchant Shipping 1460-1540*. Toronto

Carus-Wilson, E. M. & Coleman, O. 1963. *England's Export Trade 1275-1547*. Oxford:Clarendon

Chandler, T. J. & Gregory, S. 1976. (eds). *The Climate of the British Isles*. London:Longman

Cleere, H. 1978. 'Roman Harbours in Britain South of Hadrians Wall', in Taylor, J. duP. & Cleere, H. (eds). *Roman Shipping and Trade*. CBA Report **24**: 36-40

Cobb, H. S. (ed.). 1961. *The Local Port Books of Southampton, 1439-40*. Southampton

C.O.I.(Great Britain, Central Office of Information, Reference Services). 1994. *Britain's Overseas Trade*. London:HMSO

Coles, K. A. 1973. *The Shell Pilot to the South Coast Harbours*. London:Faber &

Faber

Cunliffe, B. 1978. *Hengistbury Head.* London:Paul Elek

Cunliffe, B. 1982. 'Britain, the Veneti and Beyond'. *Oxford Journal of Archaeology.* **1(1)**: 39-68

Cunliffe, B. 1993. *Wessex to A.D. 1000.* Harlow:Longman

Cunliffe, B. 2001. *Facing the Ocean.* Oxford

Cunliffe, B. 2002, 'People of the Sea'. *British Archaeology.* **63**: 12-17

Davis, R. 1962. *The Rise of the English Shipping Industry In the Seventeenth and Eighteenth Centuries.* London:Macmillan

Davis, R. 1973. *English Overseas Trade 1500-1700.* London:Macmillan

Davison, M., Currie, I. & Ogley, B. 1993. *The Hampshire and Isle of Wight Weather Book.* Westerham:Froglets

Dean, M., Ferrari, B., Oxley, I., Redknap, M. & Watson, K. 1992. *Archaeology Underwater.* London:Nautical Archaeological Society & Archetype

Defoe, D. A. 1991. *A Tour Through the whole Island of Great Britain*, Furbank,P.N., Owens, W.R. & Coulson, A.J. (eds). Newhaven and London:Yale

D'Oliveira, B. & Lee-Spalding, I. J. (eds). 1990. *The Macmillan & Silk Cut Nautical Almanac.* London:Macmillan

Du Boulay, E. 1911. *Bembridge Past and Present.* Ryde:Observer Press

Dyer, J. 1990. *Ancient Britain.* London:Guild

Dyer, K. R. 1975. 'The buried channels of the 'Solent River', southern England', *Proceedings of the Geological Association.* **86**: 239-245

Dyer, K. R. 1986. *Coastal and Estuarine Sediment Dynamics.* Chichester:Wiley

Ellmers, D. 1996a. 'The Beginnings of Boat Building in Central Europe', in Gardiner, R. & Christensen, A. E. (eds). *The Earliest Ships*. London:Conway: 11-23

Ellmers, D. 1996b. 'Celtic Plank Boats and Ships, 500 BC – AD 1000', in Gardiner, R. & Christensen, A. E. (eds). *The Earliest Ships*. London:Conway: 52-71

Everard, C. E. 1954. 'The Solent River; A Geomorphological Study', *Transactions and papers 1954, Institute of British Geographers,* **20**: 41-58

Fitzroy, R. 1861. *Storms of the British Isles*. London:Board of Trade

Flinn, M. W. & Stoker, D. 1984. *The History of the British Coal Industry*. Vol.2. Oxford:Clarendon

Foster, B. (ed.). 1963. *The Local Port Books of Southampton, 1435-37.* Southampton

French, C. 1995. 'Merchant Shipping of the British Empire', in. Gardiner, R. & Bosscher, P. (eds). *The Hayday of Sail*. London:Conway: 10-33

Friel, I. 1983. 'Documentary sources and the medieval ship: some aspects of the evidence', *The International Journal of Nautical Archaeology*. **12:** 41-62

Friel, I. 1995. *The Good Ship*. London:British Museum

Frith, A. 1993. 'The Management of Archaeology Underwater', in. Hunter, J. & Ralston, I. (eds). *Archaeological Resource Management in the UK.* Stroud:Alan Sutton

Fulford, M, 1978. 'The interpretation of Britain's late Roman trade: the scope of medieval historical and archaeological analogy', in. Taylor, J. du Platt & Cleere, H. (eds). *Roman Shipping and Trade: Britain and Rhine Provinces. The Council for British Archaeology, Research Report No.* **24**: 59-69

Fulford, M. 1996. 'Roman Hampshire', in. Hinton, D. A. & Hughes, M. (eds). *Archaeology in Hampshire: A Framework for the Future*. Hampshire County Council: 31-34

Greenhill, B. 1993. 'The Merchant Sailing Vessel in the Twentieth Century', in, Gardiner, R. (ed.). *Sail's Last Century*. London:Conway: 98-117

Greenhill, B. 2000. 'The Rise of Ocean-Going Merchant Steamships', in. *Maritime Life and Tradition* No. **9:** 46-63

Grocott, T. 1997. *Shipwrecks of the Revolutionary & Napoleonic Eras.* London:Chatham

Goss, J. 1993. *The Mapmakers Art.* London:Studio Editions

Hanks, A. H. 1995. *An Assessment of the Effectiveness of Seismic Reflection Surveys in the Archaeological Evaluation of Marine Environments.* BA Hons. Dissertation. Southampton:Unpublished

Hanks, A. H. 1996. *An Assessment of the Practical Application of Seismic Reflection Surveys in the Evaluation of Underwater Archaeological Sites and Environments.* MSc Dissertation. Southampton:Unpublished

Hamblin, R. J. O, Crosby, A, Balson, P. S, Jones, S. M, Chadwick, R. A, Penn, I. E. & Arther M. J. 1992. *The Geology of the English Channel.* London:HMSO

Harland, J. 1984. *Seamanship in the Age of Sail.* London:Conway.

Hatcher, J. 1973. *English Tin Production and Trade before 1550.* Oxford:Clarendon.

Hatcher, J. 1993. *The History of the British Coal Industry.* Vol. 1, Oxford:Clarendon

Hayes, A. 1993. *Archaeology of the British Isles.* London:Batsford

Hepper, D. 1994. *British Warship Losses in the Age of Sail, 1650-1859.* Rotherfield:Boudriot

Hildred, A. 1997, 'Forward', in, Larn, R & Larn, B. *Shipwreck Index of the British Isles* Vol. I., London:Lloyds Register of Shipping: iv-v

Hopkins, K. 1983. 'Introduction', in. Garnsey, P, Hopkins, K. & Whittaker, C. R. (eds). *Trade in the Ancient Economy.* California: ix-xxv

Hutchinson, G. 1994. *Medieval Ships and Shipping.* Leicester: London

Jackson, G. 1983. *The History and Archaeology of Ports.* Tadworth:World Works

Jacobi, R. M. 1981. 'The Last Hunters of Hampshire', in Shennan, S. J. & Schadla Hall, R. T. (eds). *The Archaeology of Hampshire.* Hampshire Field Club Archaeological Society, Monograph No. 1: 10-25

James, T. B. (ed.). 1990. *The Port Book of Southampton 1509-10.* Vols. I & II. Southampton

Jeffery, R. W. 1933. *Was it wet or fine? Being an account of English weather from chronicles, diaries and registers.* Oxford

JNAPC (Joint Nautical Archaeology Policy Committee). 1989. *Heritage at Sea: Proposals for the Better Protection of Archaeological Sites Underwater.* London: National Maritime Museum

Johnston, D. E. 1981. 'The Roman Period', in. Shennan, S. J. & Schadla Hall, R. T. (eds). *The Archaeology of Hampshire.* Hampshire Field Club and Archaeological Society, Monograph No. 1: 46-55

Johnstone, P. 1988. *The Sea-craft of Prehistory.* London:Routledge

Jones, D. K. C. 1981. *The Geomorphology of the British Isles, Southeast and Southern England.* London:Methuen

Kemp, P. (ed.). 1976. *The Companion to Ships and the Sea.* Oxford

Knowles, B. 1951. *Southampton, The English Gateway.* London:Hutchinson

Lamb, H. H. 1977. *Climate, Past, Present and Future.* Vol. 2. London:Methuen

Lamb, H. H. 1982. *Climate History and the Modern World.* London:Methuen

Lamb, H. & Frydendahl, K. 1991. *Historic Storms of the North Sea, British Isles and Northwest Europe.* Cambridge

Larn, R. & Larn, B. 1995. *Shipwreck Index of the British Isles.* Vol. 2. London:Lloyd's Register of Shipping

Larn, R. & Larn, B. 1997. *Shipwreck Index of the British Isles.* Vol. 1. London:Lloyd's Register of Shipping

Lewis, E.A. 1993. *The Southampton Port and Brokage Books, 1448-9.* Southampton

Loades, D. 1992. *The Tudor Navy.* Aldershot:Scolar

Long, A. J. & Tooley, M. J. 1995. 'Holocene sea-level and crustal movements in Hampshire and Southeast England, United Kingdom', in Jr Finkl (ed.). *Holocene Cycles: Climate, Sea Levels and Sedimentation. Journal of Coastal Research (Special Issue).* **17**: 299-310

McEwen, G.J. 1991. *Freak Weather.* London:Robert Hale

McGrail, S. 1978. *Logboats of England and Wales.* BAR **51**

McGrail, S. 1993. 'Prehistoric Seafaring in the Channel', In Scarre, C & Healy, F. (eds). *Trade and Exchange in Prehistoric Europe.* Oxbow Monograph **33**: 199-211

McGrail, S. 1996. 'The Bronze Age in Northwest Europe'. in Gardiner, R. & Christensen, A.E. (eds). *The Earliest Ships.* London:Conway: 24-38

McGrail, S. 1997. 'Studies in Maritime Archaeology'. BAR **256**

McGrail, S, 1998. *Ancient Boats in N.W. Europe*, Harlow:Longman

MacGregor, D. 1993. 'The Wooden Sailing Ships: over 300 Tons', in. Gardiner, R. & Greenhill, B. (eds). *Sail's Last Century.* London:Conway: 20-41

McKee, A. 1968. *History Under the Sea*, London:Hutchinson

Macmillan, D. H. 1964. 'The Hydrography of the Solent and Southampton Water', in. Monkhouse, F. J. (ed.). *A Survey of Southampton and Its Region.* Southampton:British Association for the Advancement of Science: 51-65

Marcus, G.J. 1961. *A Naval History of England.* Vol. I. London:Longman

Marsden, P. 1994. 'Ships of the Port of London, First to Eleventh Centuries AD', *English Heritage Archaeological Report.* **3**

May, W. E. & Holder, L. 1973. *A History of Marine Navigation.* Henley-on-Thames:Foulis

Medland, J. C. 1995. *Shipwrecks of the Wight*. Freshwater:Coach House Publications

Merson, A.L. 1964. 'Southampton in the Sixteenth and Seventeenth Centuries', in. Monkhouse, F. J. (ed.). *A Survey of Southampton and Its Region*. Southampton:British Association for the Advancement of Science: 218-236

M.O. (Meteorological Office). 1940. M.O.446b(3), *The English Channel*, Weather in Home Waters and The North-Eastern Atlantic, Vol. II, Part 3. London:HMSO

Mew, F. 1974. *Back of Wight*. Newport:County Press

Milne, G. 1995. *Roman London*. London:Batsford

Minchinton, W. E. 1969. (ed.). *The Growth of English Overseas Trade in the Seventeenth and Eighteenth Centuries*. London:Methuen

Mithen, S.J. 1994. 'The Mesolithic Age', in. Cunliffe, B. (ed.) *The Oxford illustrated Prehistory of Europe*. London:BCA: 79-135

Momber, G. 2000. 'Drowned and Deserted:a submerged prehistoric landscape in the Solent, England'. *The International Journal of Nautical Archaeology* **29.1**: 86-99

Muckleroy, K. 1980a. *Archaeology Underwater*, London:McGraw-Hill

Muckelroy, K. 1980b. 'Two bronze age cargoes in British waters'. *Antiquity* **LIV**: 100-109

Nicholson, C. 1995. *Rock Lighthouses of Britain*, Caithness:Whittles

Ogilvie, A. & Farmer, G. 1997. 'Documenting the Medieval Climate', in Hulme, M. & Barrow, E. (eds). *Climates of the British Isles Present, Past and Future*. London:Routledge: 112-133

Palutikof, J., Holt, T. & Skellern, A. 1997. 'Wind Resource and Hazard', in Hulme, M. & Barrow, E. (eds). *Climates of the British Isles, Present, Past and Future*. London:Routledge: 220-242

Palutikof, J. & Skellern, A. 1991. *Storm Severity over Britain*, Report to Commercial Union, Norwich. Climatic Research Unit, University of East

Anglia.

Pelham, R. A. 1964. 'Medieval Southampton', in. Monkhouse, F. J. (ed.). *A Survey of Southampton and Its Region.* Southampton:British Association for the Advancement of Science: 208-218

Pethick, J. 1984. *An Introduction to Coastal Geomorphology.* London:Arnold

Phillips, K. 1988. *Shipwrecks of the Isle of Wight.* Newton Abbot:David & Charles

Phillips, K. 1995. *Shipwreck! Broken on the Wight.* Newport:Island Books

Phillips-Birt, D. 1967. *Waters of Wight.* London:Cassell

Platt, C. 1978. *Medieval England.* London & New York:Routledge

Power, E. & Postan, M. M. 1933. *Studies in English Trade in the Fifteenth Century.* London:Routledge

Quinn, R., Bull, J. M. & Dix, J. K. 1997a. 'Imaging Wooden Artefacts using Chirp Sources', *Archaeological Prospection, Vol.* **4**: 25-35

Quinn, R., Bull, J. M., Dix, J. K. & Adams, J.R. 1997b. 'The *Mary Rose* site-geophysical evidence for palaeo-scour marks', *The International Journal of Nautical Archaeology* **26.1**: 3-16

Rance, A. 1982. 'Yachting', in. Elliott, R. (ed.). *The Maritime Story of Southern England.* Tavistock:Heritage: 34-35

Robinson, A. H. W. 1962. *Marine Cartography in Britain.* Leicester

Ruddock, A.A. 1951. *Italian Merchants and Shipping in Southampton 1270-1600.* Southampton

Rule, M. 1990. 'The Romano-Celtic ship excavated at St. Peter Port, Guernsey', in McGrail, S. (ed.). *Maritime Celts, Frisians and Saxons.* CBA Research Report **71**: 49-56

Salzman, L.F. 1931. *English Trade in the Middle Ages.* Oxford:Clarendon.

Schlote, W. 1938. *British Overseas Trade From 1700 to the 1930's*. translated by, Henderson, W. O. & Chaloner, W. N. 1952. Oxford:Blackwell

Schumpeter, E.B. 1960. *English Overseas Trade Statistics 1697-1808*. Oxford:Clarendon

Severin, T. 1978. *The Brendan Voyage*. London:Book Club Associates

Sherratt, A. 1994. 'The Transformation of Early Agrarian Europe: The Later Neolithic and Copper Ages 4500-2500 BC', in Cunliffe, B. (ed.). *The Oxford Illustrated Prehistory of Europe*. London:BCA: 167-201

Small, R. J. 1964. 'Geomorphology', in. Monkhouse, F. J. (ed.). *A Survey of Southampton and Its Region*. Southampton:British Association for the Advancement of Science: 37-50.

Smith, K. 1976. 'The Climates of Coasts and Inland Water Bodies', in. Chandler, T.J. & Gregory, S. (eds). *The Climate of the British Isles*. London:Longman: 248-263

Smith, G. 1995. *Hampshire & Dorset Shipwrecks*. Newbury:Countryside Books

Steane, J. M. 1985. *The Archaeology of Medieval England*. Beckenham:Croom Helm

Studer, P. (ed.). 1913. *The Port Books of Southampton (1427-30)*, Southampton Record Society, **xv**. Southampton:Cox & Sharland

Taylor, E.G.R. 1956. *The Haven Finding Art*. London:Hollis & Carter

Temple Patterson, A. 1964. 'Southampton in the Eighteenth and Nineteenth Centuries', in. Monkhouse, F. J. (ed.). *A Survey of Southampton and Its Region*. Southampton:British Association for the Advancement of Science: 227-235

Temple Patterson, A. 1966. *A History of Southampton 1700-1914*. Vol **1**. Southampton

Tomalin, D. J. 1992. *Wootton-Quarr Survey: Project Design*. Unpublished

Tomalin, D. J. 1996. 'Towards a new strategy for curating the Bronze Age landscape of the Hampshire and Solent region', in Hinton, D. A. and Hughes, M. (eds). *Archaeology in Hampshire: A Framework for the Future*. Hampshire County Council: 13-25

Unger, R. W. 1980. *The Ship in the Medieval Economy 600-1600*. London:Croom Helm

Unger, R. W. 1994. 'Introduction', in. Gardiner, R. (ed.). *Cogs, Caravels, and Galleons*. London:Conway: 7-10

Velegrakis, A.F, Dix, J.K, & Collins, M.B. 1999. 'Late Quaternary evolution of the upper reaches of the Solent River, Southern England, based on marine geophysical evidence', *Journal of the Geological Society, London*. Vol.**156**:73-87

Ville, S. 1993. 'The Transition to Iron and Steel Construction', in. Gardiner, R. & Greenhill, B. (eds). *Sail's Last Century*. London:Conway: 52-73

Waters, D. W. 1958. *The Art of Navigation in England in Elizabethan and Early Stuart Times*. London:Hollis & Carter

Waters, D.W. 1962. 'Science and Techniques of Navigation in the Renaissance', in, Singleton, C.S. (ed.). *Art, Science, and History in the Renaissance*. Baltimore: Johns Hopkins: 189-237

Watts, A. 1987. *Wind and Sailing Boats*. Newton Abbot:David & Charles

Weightman, G. 1990. *London River*. London, New York, Sydney & Toronto:Guild

Welch, M. 1992. *English Heritage Book of Anglo-Saxon England*. London, New York, Sydney & Toronto:BCA

Willan, T.S. 1938. *The English Coasting Trade 1600-1750*. Manchester

Williamson, J. A. 1959. *The English Channel*. London:Collins

Winton, J. 1989. *The Naval Heritage of Portsmouth*. Southampton:Ensign