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**BALLAST WATER DISCHARGE INTO COASTAL WATERS OF ENGLAND
AND WALES**

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ABSTRACT

A questionnaire was designed to assess the risk of introductions of alien marine organisms into coastal waters of England and Wales through discharge of ballast water from ships. It was sent to 127 ports in England and Wales in order to identify the areas of greatest risk, which will be further assessed in a future sampling survey. Replies were received from 111 (87.4%) of ports. Ballast water is discharged into just under half (48.7%) of ports in England and Wales. Few accurate records are kept by these ports but it is possible to gain a general overall picture of the current situation from the information supplied. It is estimated that there are more than 16,000 ballast water discharge operations annually and an estimated 16.8 million tonnes of ballast water is discharged. Oil and gas tankers contribute over 75% of this total. Only four ports (Bristol, King's Lynn, Middlesborough, and Milford Haven) reported discharge of ballast water originating from outside continental Europe. By volume, ballast water from this origin accounted for about 11% of the total for all ports, compared with 47% at ports where discharge originated only from other United Kingdom and Northern European ports. Most ports (79%) have no policy or regulations on management of ballast water discharge. Of the 13 ports which do have regulations, these are mainly

related to operational safety. Only five ports request compliance with IMO guidelines on ballast water management.

INTRODUCTION

Ballast water has been implicated as a medium for the introduction of alien marine organisms, some of which have had serious biological and economic impacts in their new environment (Hallegraeff & Bolch, 1992; Carlton & Geller, 1993). The International Maritime Organisation (IMO) has adopted guidelines for the safe management of ballast water (IMO, 1991) and is considering issuing regulations.

For UK coastal waters, it has been suggested that 42 alien species have been introduced since 1830, 18 of which have had some harmful effect, and 11 of these harmful species have become widespread (Eno & Clark, 1995). Nine of the 42 introductions may have been secondary, that is they were originally introduced (from outside Europe) into other European ports. Convincing evidence for the means of introduction is generally lacking, but ballast water is suggested as the vector in three cases, compared with 21 introductions through transport on the outside of ships' hulls and 12 introductions, both deliberate and accidental, associated with mariculture. There is no known mechanism for the remaining six introductions, and ballast water cannot be ruled out in these cases. These results compare with the documented introduction from ballast water of 14 species into Australia (Anderson, 1992) and 10 species out of a total of 20 unintentional introductions into the Baltic Sea (Jansson, 1994).

This report presents the findings from a questionnaire survey designed to obtain information to assist in assessing the risk of introductions of alien marine organisms, and the areas of greatest risk. The strategy for a sampling programme, in which the number and type of viable marine organisms transported in ballast water into the coastal waters of England and Wales will be determined, will be based on the results of this survey.

METHOD

Names and addresses of port and harbour authorities in England and Wales were obtained from information supplied by Lloyds Register and Marine Offices. A questionnaire was designed, based on that used by the SOAFD Marine Laboratory, Aberdeen for a survey of Scottish ports and harbours (Macdonald, 1994). The purpose of the questionnaire was to gather information on amounts of ballast water and associated sediments discharged and loaded in coastal waters around England and Wales and the sources of discharged ballast water. Information on current ballast

water management practices and any policies or regulations covering the loading or discharge of ballast water was also sought. This questionnaire, together with a covering letter, was distributed to 127 ports and harbours. Some ports either forwarded the forms to operators of shipping terminals in their area or provided the information for this to be done. Other ports suggested various shipping companies as possible sources of further information. Minor revisions were made to the questionnaire and a pilot survey was made of 35 of these shipping companies. Reminders and spare questionnaire forms were sent out to ports from which no reply had been received after six weeks.

RESULTS

Response

Replies were received from 111 ports (87.4% of those surveyed) or their associated terminals. The response from the pilot study of shipping agents was lower. Of the 35 surveyed, 12 replied (34%), of which 9 were responsible for vessels that were involved in ballast water exchange. The detailed information that 7 of the shipping agents supplied on a total of 1.153 million tonnes of ballast water discharge in 1,368 operations was useful, together with that supplied by the ports, in estimating average amounts of ballast water exchange by different types and sizes of vessel.

Ports where ballast water is exchanged

Of the 111 ports that responded, 63 (56.8%) reported some ballast water exchange operations. At nine ports (8.1%) this involved loading of ballast water only, giving 54 ports (48.7%) at which ballast water is discharged. The status of all ports surveyed in relation to ballast water operations is shown on Figure 1.

Amounts of ballast water discharged at ports

Many of the 36 ports that supplied information on the amounts of ballast water exchanged commented that this information was based on estimates and that accurate data could only be obtained by consulting ships' log books. Eleven ports were only able to supply estimates of the numbers, type and size of vessel involved in ballast water exchange operations and the remaining 16 ports where ballast water is exchanged did not supply any data. The total number of ballast water exchange operations reported (from 47 ports) was 23,815 per annum. Of these, 13,214 (55.5%) were ballast loading and 10,601 (44.5%) were ballast discharging operations. Extrapolating these data to all ports with ballast water discharge, including those from which no data were supplied and those from which no reply was received (assuming

the same ratio of ports with ballast water discharge as those that did reply), gives an estimate of over 16,000 ballast water discharge operations annually.

A reported total (from 36 ports) of 15.52 million tonnes of ballast water is exchanged annually at ports in England and Wales. Of this total, 61.4% (9.529 million tonnes) is loaded and 38.6% (5.992 million tonnes) is discharged. This load to discharge ratio of 1.6:1 compares with a ratio for Scottish ports of 0.03:1 (Macdonald, 1994). For ballast water discharge, it is possible to make an estimate for the 11 ports that only supplied numbers, types and sizes of ships involved in ballast water exchange operations, using this information and the calculated average amounts of ballast water discharged by these vessels (see below). This calculation gives an additional 4.935 million tonnes, making a total of 10.927 million tonnes. The relative amounts of ballast water discharged at individual ports in England and Wales is shown on Figure 2. Amounts ranged from 2.38 million tonnes per annum at terminals in the Tees (Middlesborough) to less than 1,000 tonnes at smaller ports such as Littlehampton. Extrapolating the data to obtain a total figure, as for the number of ballast water discharge operations above, gives an estimated figure of 16.8 million tonnes of ballast water discharged annually into ports in England and Wales. It is recognised that this is a very approximate value, which compares to an estimate of 25.7 million tonnes of discharge into ports in Scotland (Macdonald, 1994).

Amounts of ballast water discharged, by vessel

Ports and shipping agents were asked to record the types of vessel involved in ballast water exchange and to classify them, by size, into one of three groups: (a) less than 10,000 tonnes; (b) 10,000 to 100,000 tonnes; and (c) greater than 100,000 tonnes. Five categories of vessel type were recorded; bulk carriers; tankers (oil and gas); ferries; general cargo vessels; and other vessels (barges, tenders, tugs, etc.). Records were obtained for 8,816 ballast water discharge operations of which 94.5% were by ships in the smallest size group (a). Ships of size groups (b) and (c) accounted for only 4.3% and 1.2% of ballast water discharge operations respectively. All ships in the largest size group were tankers, and these accounted for 3.6% of ballast water discharge operations by all tankers. The average amounts of ballast water discharged by each type and size of vessel are shown in Table 1. Tankers of less than 10,000 tonnes are responsible for the most ballast water discharge operations. Large tankers make only a small contribution to the total number of discharge operations but because of the large volumes transported the amount discharged is significant. All tankers account for over 75% of the total volume of discharge. A high proportion of discharge operations is by ferries, but this is to maintain trim of the vessels and as the amounts involved in each operation are small the contribution to the total volume is low.

Amounts of ballast water discharged by origin

Information on origin of discharged ballast water was not always provided and was not sufficiently detailed to obtain accurate estimates of volumes from specific countries of origin. The data were divided into four categories, according to ports in areas of origin: United Kingdom only; UK and Northern Europe; some ships from elsewhere in Europe; some ships arriving from outside Europe. The origin of ballast water discharged at ports in England and Wales classified according to these categories is shown on Figure 3. Only four ports reported discharge of ballast water from ports outside continental Europe. These were Bristol, King's Lynn, and certain terminals at Middlesbrough and Milford Haven. Ships arrive in ballast at these ports from the Americas, Australasia, Africa, India, and the Far East. From such information as was provided by these ports it was estimated that about 11% of the total discharge volume for all ports originates from outside Europe. This compares with 47% of the total volume discharged with a known origin of other United Kingdom and Northern European ports only. These results must be treated with caution as ballast water may have been loaded at a site other than the previous port of call.

Ballast water management

Most ports (79%) have no policy or regulations on management of ballast water discharge. Of the 13 ports which do have regulations, these are mainly related either to operational safety or to preventing chemical pollution. In the latter case ballast water from cargo tanks cannot be discharged or, in the case of some oil terminals, can only be pumped into dedicated on-shore facilities. No consideration is taken of potential biological content. Only five ports request compliance with IMO guidelines on ballast water management. Sampling of ballast water is carried out at only five ports and again this is related to chemical rather than biological content. Some respondents were aware that the National Rivers Authority took water samples in the vicinity of the port. Only three of the 111 respondents were aware of any problems associated with the discharge of ballast water.

DISCUSSION

Information on ballast water exchange operations at ports in England and Wales is limited, but sufficient data has been obtained from the questionnaire survey to give a general overview of the situation and estimates of the amounts involved. The data collected will be valuable in determining a strategy for a sampling programme to assess the risk of introducing unwanted alien marine organisms.

A high proportion of the ballast water discharged originates from within the UK or Northern Europe, giving a risk of further dispersal of unwanted marine organisms that may become introduced in this region. A recent study (Sherwood, 1995) in which 7 ships from Northern Europe were sampled over a 5 month period identified 31 living species in ballast water, one of which, the diatom *Chaetoceros fragile*, may be a relatively recent introduction to European waters.

Oil and gas tankers contribute the greatest volume of discharged ballast water. The amount discharged annually exceeds one million tonnes in 4 areas, the Tees, Milford Haven, Southampton and the Tyne. The first two of these receive some ballast water from outside Europe, as do ports at Bristol and King's Lynn, which each receive over 500,000 tonnes annually.

In a UK context, less ballast water is discharged in England and Wales than in Scotland, but discharge operations are more frequent, from a greater proportion of smaller vessels, and more ports are involved. Some ports receive only small quantities, but there will still be a risk of introducing any alien marine organisms contained in this ballast water.

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TABLE 1

Average volume (tonnes) of ballast water discharged by various types and sizes of vessel involved in this operation at ports in England and Wales. The proportional contribution (percentage) made in terms of number of discharge operations and volume of ballast water discharged annually are also given.

Type of vessel	Size of vessel	Average discharge (tonnes)	Percentage of total discharge operations	Percentage of total volume discharged
Bulk carrier	a	660	18.31	10.35
Tanker	a	1,230	31.53	33.22
	b	7,330	1.88	11.80
	c	28,500	1.24	30.27
General cargo	a	630	17.45	9.42
Ferry	a	90	19.74	1.52
	b	110	2.40	0.27
Other	a	500	7.45	3.19

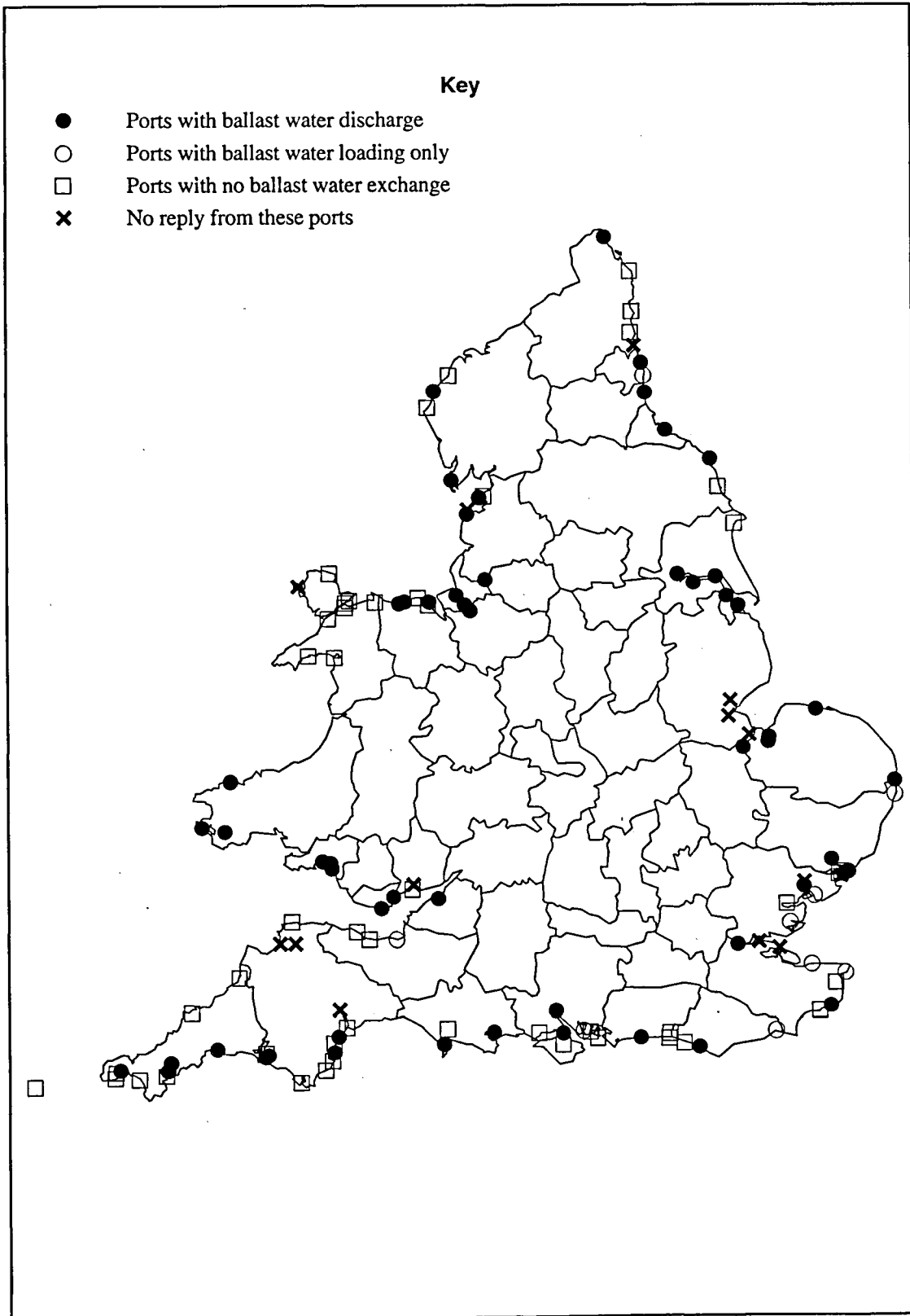


FIGURE 1: *Ballast water exchange at ports in England and Wales. Data from replies to questionnaire, March 1995.*

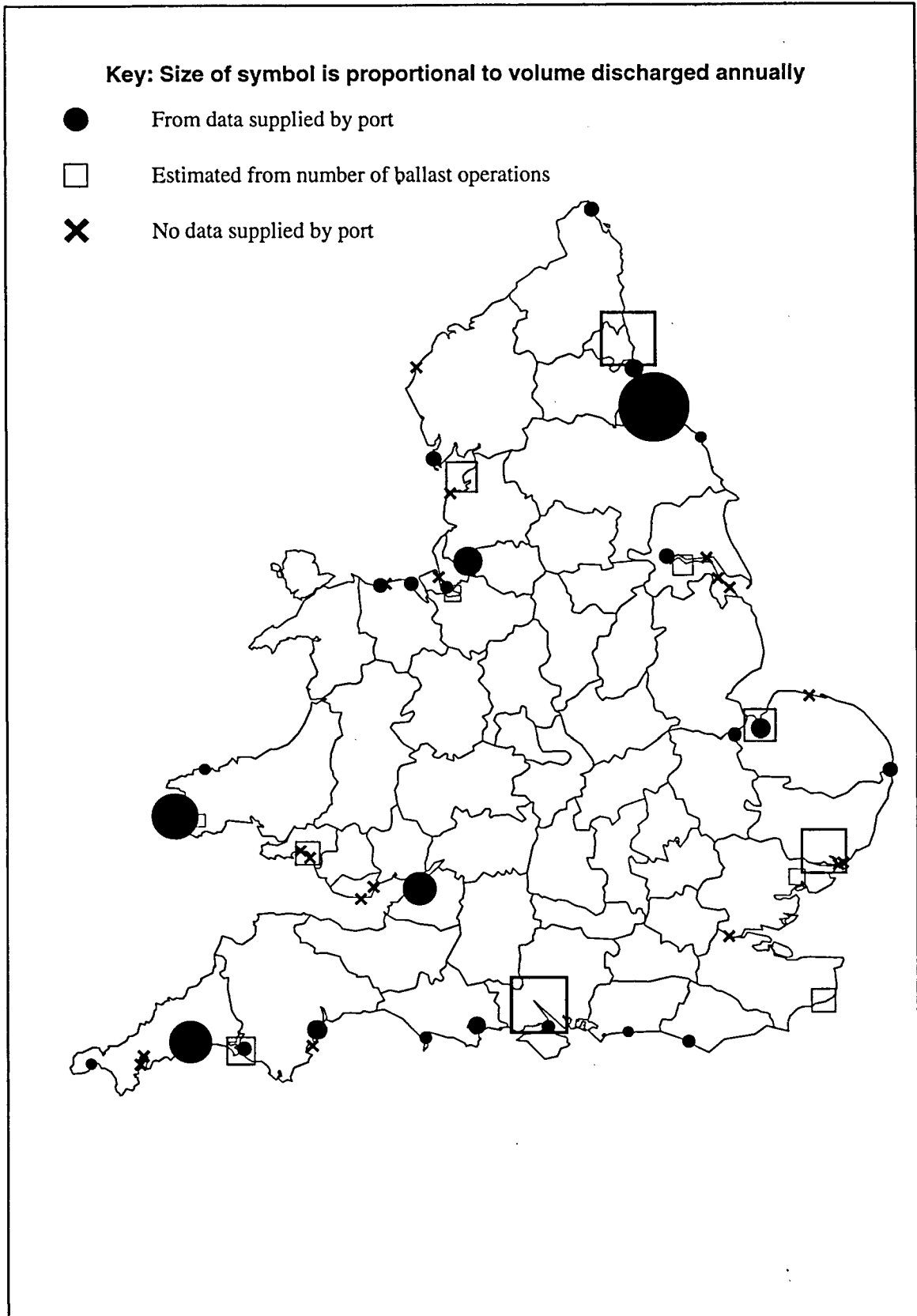


FIGURE 2: *Relative volumes of ballast water discharged at ports in England and Wales. Data from replies to questionnaire, March 1995, for all respondent ports at which ballast water is discharged.*

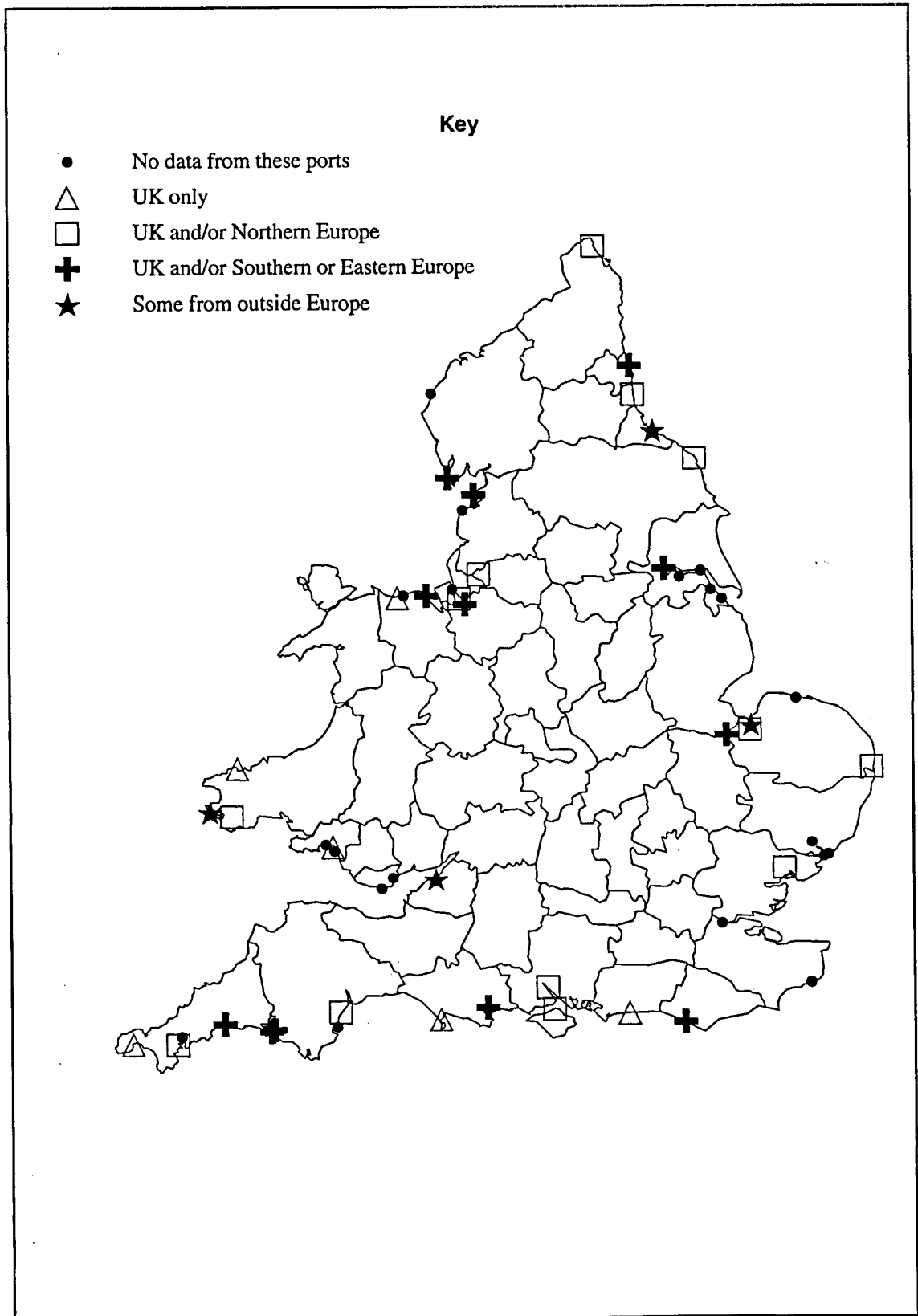


FIGURE 3: *Origin of ballast water discharged at ports in England and Wales. Data from replies to questionnaire, March 1995, for all respondent ports at which ballast water is discharged.*