UK Biodiversity Action Plan
Native Oyster Species Information Review

Final Report English Nature

Institute of Estuarine and Coastal Studies
University of Hull

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For and on behalf of the Institute of Estuarine and Coastal Studies	
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EXECUTIVE SUMMARY

The native or flat oyster (*Ostrea edulis*) has a long history of exploitation in the seas surrounding the British Isles. Evidence from discarded shells found amongst prehistoric as well as Roman archaeological remains shows that the species was historically an important source of food (Edwards 1997). Up to the beginning of the 19th century, stocks of the native oyster were relatively unexploited, until industries developed inland and the advent of the railway systems allowed transportation of perishable goods to the main population centres cheaply and quickly. As such, pressures on the natural oyster grounds around the British coasts increased. The east coast of England became increasingly important as the main centre of oyster production in Britain with the natural stocks present within the estuaries and coastal waters of the Colne, Blackwater, Crouch and Roach. Natural oyster beds at Whitstable and Seasalter quickly became exhausted, requiring restocking with oysters collected from other oyster grounds around the country and later from Ireland and France.

By the middle of the 19th century all available stocks around Britain were being exploited and most fisheries were showing signs of severe depletion, to such an extent that the Government was asked to remedy the situation. Following reports from Select Committees, legislation was enacted to try to conserve stocks. This included the removal of public rights of fishing from some grounds and their management in the control of local authorities, Sea Fisheries Committees and private companies and individuals.

Demand for oysters continued to grow and the levels of exploitation increased to a peak where it was recorded that 700 million oysters were consumed in London in 1864 (Philpotts 1890), with 120,000 men in Britain being employed in oyster dredging in the 1880s (Edwards 1997).

Such was the demand for oysters that the American oyster (*Crassostrea virginica*) was imported into the Britain and some of these were relaid on British oyster grounds. This also introduced American oyster pests, the slipper limpet and American oyster drill, which in turn severely impacted the already depleted oyster stocks within the country.

In the early 20th century, the decline of the fisheries continued with disease, cold winters and poor recruitment all contributing to the reduction in native oyster numbers, with only short term localised natural recoveries occurring on some grounds. By the 1960s particularly harsh winters had depleted oyster stocks within the south east oyster grounds to such an extent that the main oyster producing companies moved operations to the south west of England. Here the influence of the Gulf Stream ensured that the impacts of the cold winters was lessened in comparison to other areas. An absence of active management and maintenance of the former east coast fisheries has resulted in greater infestations of the area by the introduced pests. In the 1980s further problems were encountered within the oyster industry when the oyster disease *Bonamia ostreae* caused heavy mortalities on oyster beds, particularly within southern Britain. There has been relatively little further change in the distribution or size of natural populations of the native oyster since the late 1980s.

Natural native oyster production within England is mainly concentrated in the estuaries of the Fal and Helford Rivers in Cornwall and the Solent in Hampshire, the latter is now the largest oyster producing area within the UK. There has been a general change in the type of native oyster exploitation undertaken within the country since the 1960s. Natural wild populations are now generally too small and dispersed to be exploited commercially, such that there has been a move to the farming of oysters, with areas once noted for their large natural beds now being used for oyster cultivation. There has also been a change of species farmed following the development of methods of producing the required amounts of laboratory oyster spat.

this has allowed the commercial rearing of the Pacific oyster (*Crassostrea angulata*) in British waters which are normally too cold to allow the reproduction of this warmer water species.

The change in the distribution of the native oyster from the pre to post 1950s UK is shown in the distribution maps Figures I and II. From these it can be seen that the former large native oyster populations on the eastern side of Britain, in particular The Wash and the Firth of Forth have been lost. The distribution throughout much of the rest of the British Isles appears to be relatively similar, with the exception of the recorded losses of large offshore native oyster beds (e.g. Dogger Bank and the mid English Channel beds). The distribution maps, however, are somewhat limited as they do not indicate the size of the oyster populations within areas where their presence is recorded. In general, with the possible exception of the Fal and the Solent, where populations are recorded as occurring both in pre and post 1950s maps, the pre-1950s populations consisted of large, densely populated oyster beds which were naturally reproducing. The post-1950s records indicate a different trend, with many of the natural beds surveyed consisting of very sparse populations, in some cases with only a few individuals recorded. Areas such as Porthcawl, Swansea Bay and the Firth of Clyde still have small native oyster populations. However, these are only a fraction of their size in the 19th century and they consist primarily of old individuals with few young actively reproducing oysters present in the populations.

The distribution of the native oyster on the west coast of Scotland and in the Western Isles appears to have increased. Much of this distribution is attributable to the active farming of the native oyster within many of the bays and lochs on Scotland's west coast although, with the exception of Loch Ryan, most of this mariculture activity is on a small scale and secondary to the farming of the Pacific oyster. The distribution of the native oyster within

the wild appears to have increased in western Scotland. However, this may be due to the extensive survey work carried out over the last two decades in the area and thus more records being available for current populations within the smaller lochs and bays along the coastline.

Farmed stocks of native oysters are now being noted to be contributing to the numbers of oysters present in the wild, as they reproduce and some spat settles outside of the farmed area. This trend may be particularly important for Scottish fisheries and may account partially for the wide distribution of natural stocks, which closely reflects that of the farmed oysters. However, this may simply be due to oyster farmers choosing environments in which oysters grow well and where native stocks are already present. It is considered that the natural stocks were always present within these areas but these are now being enhanced by farmed oyster spatfalls.

In Northern Ireland the distribution of the native oyster is concentrated in the sea loughs, as shown both in pre and post 1950s records. Belfast Lough once had numerous large beds of oysters occurring throughout but these now appear to have all disappeared. The rest of Northern Ireland appears to follow a similar trend to that of western Scotland, with natural native populations occurring in the same areas now as in the 19th century but in smaller, more sparsely populated beds. Oyster farming has also become important within the loughs of Northern Ireland, with natural native stocks again being supplemented from spatfalls originating from farmed native oysters.

In general, throughout much of Great Britain the native oyster remains in a severely depleted state in the wild, having suffered for two centuries with over-exploitation, pests, disease, pollution and harsh winters. However, there does now appear to be the start of a small recovery, with natural stocks being supplemented in some areas with spat settlement from

farmed stocks and other oyster grounds being actively managed to ensure the conservation of stocks. This recovery is very small and may not persist as has often been the case in the past. Slight recoveries have been noted before but, often because of poor management, these have usually been followed by a further pressure on stocks and a subsequent collapse.

The introduction of non-native species has long been a problem associated with the oyster industry, with dramatic impacts evident over the last century through the introduction of pests and disease. The farming of non-native oyster species has itself resulted in escapes and the subsequent reproduction within the wild. For example early experiments undertaken at Conwy on the New Zealand oyster has resulted in a small but self sustaining population now being present in the wild in the Menai Straits. Although insignificant at this time there is therefore, a potential for future competition between the native and non-native oyster species, however, there are also potential commercial benefits of having another oyster species present in the wild.

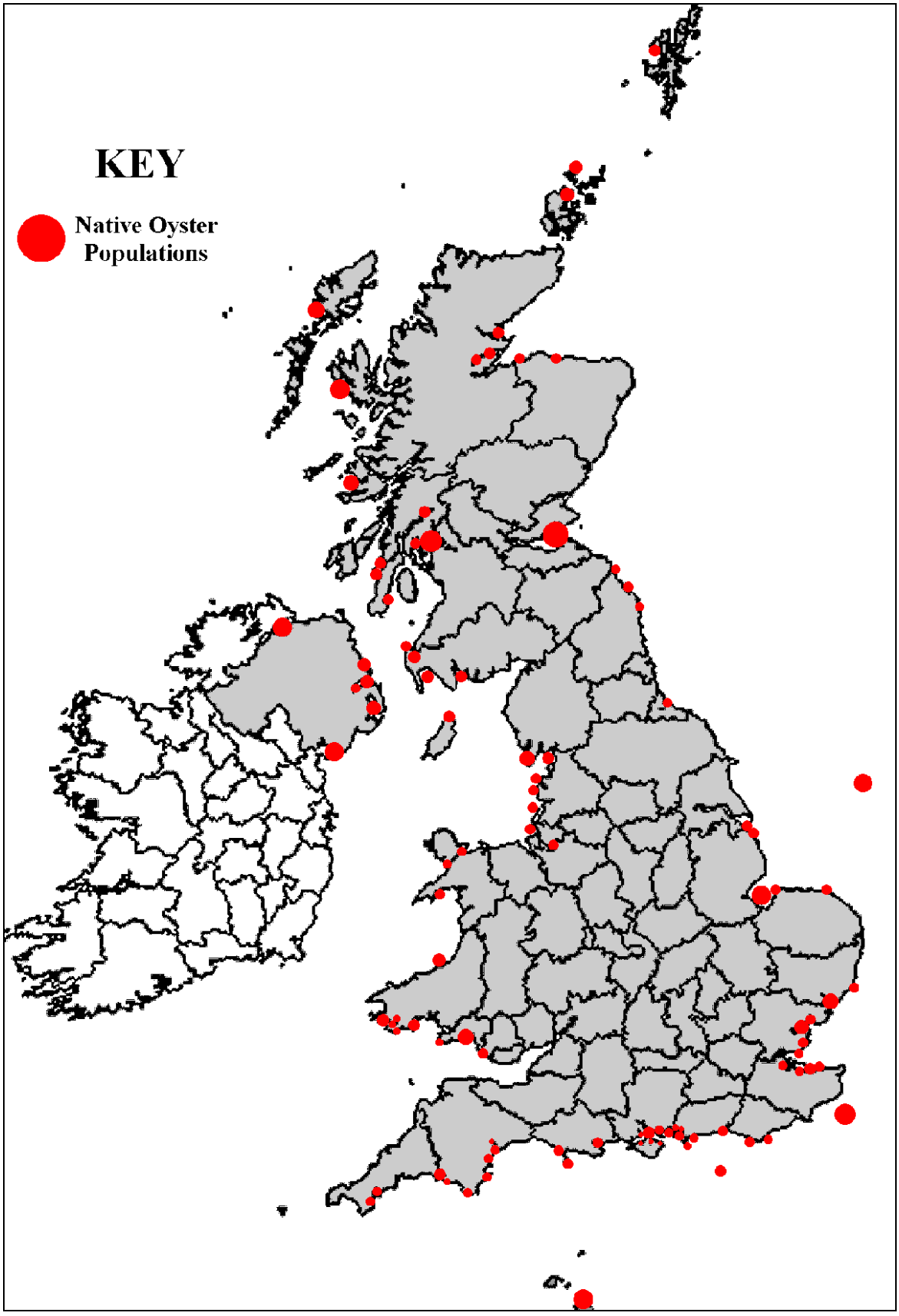

Figure I: Pre 1950s distribution of native oyster populations in the British Isles.

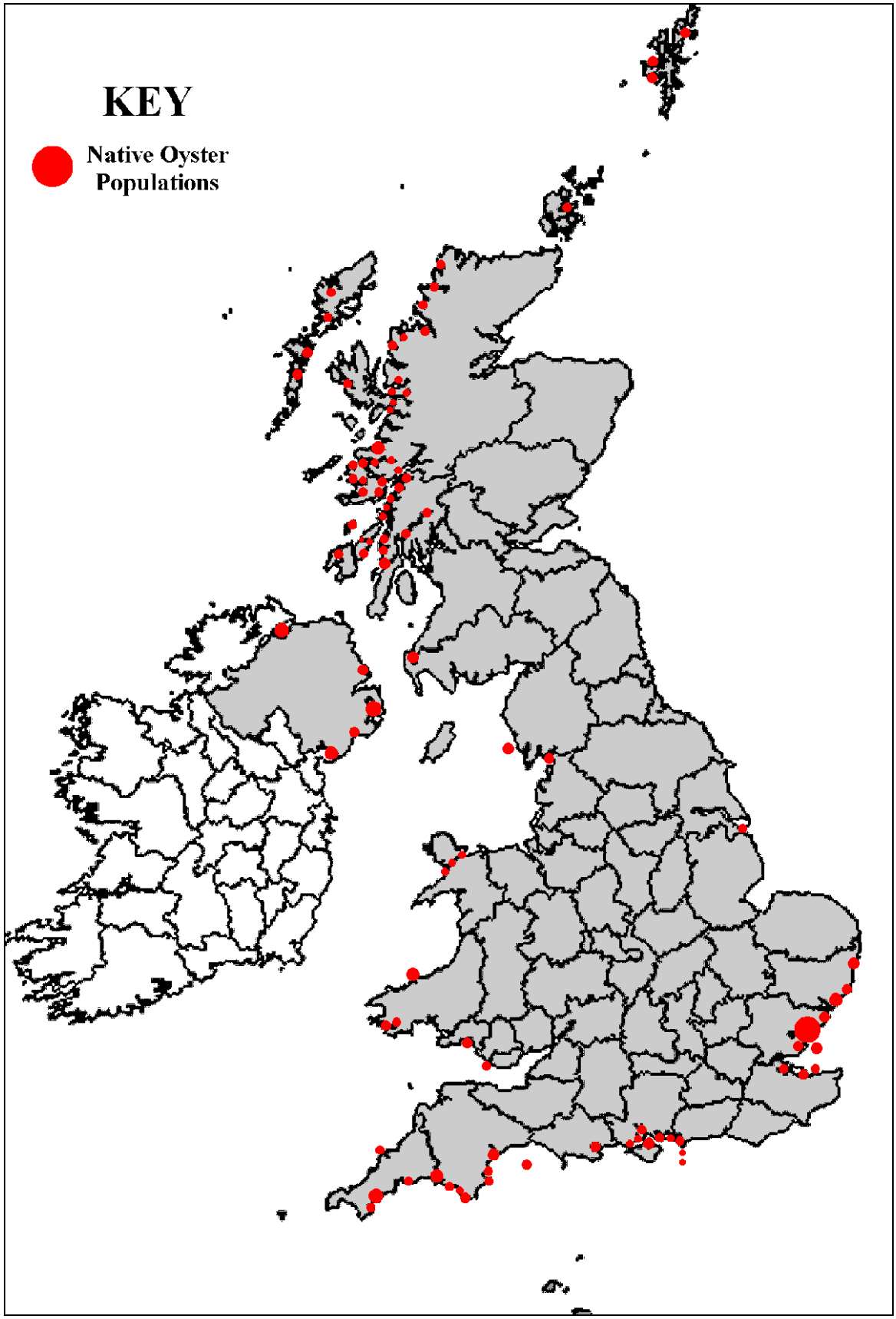

Figure II: Post 1950s distribution of native oyster populations in the British Isles.

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Given the nature of consultation, the above list may not be comprehensive and the authors would like to thank all who helped with the project in any way.

PART 1

1. INTRODUCTION

1.1 Objectives

The primary objective of this report is to bring together all possible information, published both formally and informally (internal reports) and anecdotal, to give the fullest and most detailed possible overview of the distribution, abundance (insofar as it is known) and fisheries of the native oyster (*Ostrea edulis)* in UK estuarial, coastal and territorial waters from the mid 19th century to the present day.

The report aims to collate all available data on the native oyster within the UK after extensive consultation with various bodies including:

- The Centre for Environment, Fisheries and Aquaculture Science (CEFAS);
- Ministry of Agriculture, Fisheries and Food (MAFF);
- Sea Fishery Committees;
- English Nature•Environment Agency (EA);
- Scottish Environmental Protection Agency (SEPA);
- Scottish Natural Heritage (SNH);
- Fisheries Research Service (Aberdeen Laboratory);
- Department of Agriculture and Rural Development for Northern Ireland (DARDNI);
- local shellfish growers and other sources of local knowledge;
- relevant specialist academia.

The report uses data compiled from published and unpublished material dating from the early 19th century to the present day. Information on oyster distribution and abundance is available in some literature dating from the early 1800s but becomes more readily available from the 1850s. Accurate details on abundance is limited prior to the advent of the Sea Fishery Committees statistics available from 1886 onwards.

Anecdotal evidence has also been gathered and inserted into the report to supplement the available information. Local knowledge particularly historical was found to be sometimes readily available in anecdotal form where a gap in printed material was found.

1.2 Report Structure

The report is divided into two main parts. The first part contains Chapter 1 the introduction, which sets out the objectives, report structure, and background of the UK Biodiversity Action Plan. Also included in the first part is a brief synopsis of the biology of the native oyster, its global distribution and some background history.

A review of those diseases which affect the native oyster is covered and their impacts on the status of oyster fishery assessed. The effects of nuisance organisms which compete with the oyster or parasitize it is reviewed, along with the impacts that introduced species have had on UK populations.

A history of legislation for the native oyster in the UK is also given in the first section. This covers important pieces of legislation since the early 1900s, together with a summary of the important legislation currently in place.

The second part of the report reviews separately the information for England, Wales, Scotland and Northern Ireland. The chapter for each country is sub-divided into sections on the history, distribution, abundance (where known) and fisheries for that area.

1.3 Background

In 1992 the Earth Summit in Rio de Janeiro was attended by over 150 nations with an aim to achieve an increased level of sustainability for the global environment. Biodiversity was seen as a primary indicator of the health of the various ecosystems and national environments. Therefore, the maintenance or enhancement of biodiversity worldwide was considered an important goal.

The Convention on Biological Diversity was a product of the Earth Summit, which committed signatories to develop national strategies for the protection and sustainable use of biodiversity. The UK was one of 167 nations which signed up to the Biodiversity Convention and in 1994 published its plan for the future, *Biodiversity: The UK Action Plan* (DoE 1994) and a further more detailed report in 1995 (DoE 1995).

The overall goal of the UK Biodiversity Action Plan (UK BAP) is:

To conserve and enhance biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms.

The objectives for conserving biodiversity which stem from this goal are to conserve and where practical enhance:

- the overall populations and natural range of native species and the quality and range of wildlife habitats and ecosystems;
- internationally important and threatened species, habitats and ecosystems;
- species, habitats, natural and managed ecosystems that are characteristic of local areas;
- the biodiversity of natural and semi-natural habitats where this has been diminished over recent decades.

A Biodiversity Action Plan National Targets Group was set up to oversee the development of a range of costed targets for biodiversity UK Steering Group Reports 1 & 2 (DoE 1995). A further sub-group, the Marine Sub-Group, was set up to ensure adequate representation on the development of marine action plans. Action plans were developed both for marine species (Species Action Plan) and for marine habitats (Habitat Action Plan). In February 1999 the work of the UK National Targets Group was completed resulting in 21 marine species or groups of species and 15 marine habitats being identified for action plans (DoE 1999).

Each action plan aims to provide a summary of the current status, the factors that cause a decline, and the proposed actions which are intended to improve the chances of maintaining or enhancing the extent and quality of habitats and the numbers of species.

The present report was commissioned by the Native Oyster Species Action Plan (NOSAP) Steering Group to provide a comprehensive review of the current and historical data on the native oyster as a first step towards implementing the action plan.

2. BIOLOGY OF OSTREA EDULIS

2.1 Description of the Oyster

The oyster belongs to the Phylum Mollusca and is classified amongst the Lamellibranchiata, a term which describes the feather-like gill structure. These gills have a dual function within the lamellibranchs, one of gas exchange and of feeding. Water is pumped from the mantle cavity across the gills by numerous cilia which aid in the movement of the water and also filter small particles for ingestion. The food consists of microscopic phytoplankton, resuspended microphytobenthos and detritus taken from the overlying water column (Horst 1982). The sorting of the particles is an active process, involving sieving, binding with mucous and transport to the mouth of acceptably sized pieces. Particles which are too large are actively rejected, dropped onto the mantle and discharged periodically as pseudofaeces, when the bivalve forcefully closes its shells.

Under favourable conditions and depending on emersion period, oysters will pump water throughout the day and remain open except for brief periods when faeces are expelled. Oysters which are uncovered at low tides are restricted in the amount of time they can remain open for and thus the amount of time available for respiration, feeding and removal of waste products. The species exposure tolerance dictates its distribution within an intertidal environment and is dependent on a number of factors, one of the most important of which is temperature (Newell 1970). The higher the temperature, the higher the species metabolic rate and the greater the oxygen debt during times of closure. The native oyster is well adapted for life on the lower middle shore and can survive days out of water, although the build up of toxic by-products dictates that an immersion needs to occur approximately every 24hours (Harris 1990). Although capable of survival under these conditions, other factors such as competition, increased physiological stresses and predation dictates that the normal distribution of the species remains below the mean low water mark.

When open, a mature native oyster can filter up to 10 litres an hour (Neild 1995), although this filtering rate is affected by the temperature, water velocity and concentration of particles within the water column (Walne 1974). Food intake, oxygen uptake and contaminant accumulation is dependent

on filtration rate, thus factors such as temperature which change the filtration rate will have a direct affect on the growth rate up to a point. Increased temperature increases growth rates but it also increases metabolic rates, requiring more food to be digested. Thus, greater temperature increases become counter productive. The filtering rate is also affected by the velocity of water and by the concentration of particles within the water column. Experiments on the Pacific oyster (*Crassostrea gigas)* show that an increase in water flow of 50% doubles the filtering rate (Walne 1974). Further experiments on *Crassotrea* show that water velocity is relatively more important in determining the amount of food available to natural populations than algal food concentrations (Wilson-Ormond *et al* 1997).

2.2 Reproduction and Development

Ostrea edulis is unusual in the manner in which it develops sexually. It is described as a protandrous alternating hermaphrodite, which involves developing in its first year of growth after settlement as a male and then changing sex bi-annually. In very favourable growing conditions a one year old oyster may mature in the first female phase and produce embryos, however, this usually does not occur until the second female stage is achieved, in the third summer. After this, the male and female phases alternate. The rate of maturation depends on a several conditions, principally water temperature and food availability. In Britain breeding normally takes place in the summer and each animal spawns twice, once as a male and once as a female.

In the male phase, the sperm produced by the oyster is discharged by the exhalent current whereas, in the female phase, the eggs are retained within the oyster on the gill filaments, sometimes up to several weeks. During this time the eggs are fertilised by sperm, brought in via the inhalent current and develop into veliger larvae within the mantle cavity. This brood stage lasts from one to two weeks, during which time the veliger develops a shell and eventually a foot. At this stage the larvae are described as pediveliger and are discharged into to the water column.

The relative fertility of each age group of the native oyster is shown in Table 1. An oyster 10cm in diameter may produce a brood of 750,000 to 1,250,000 (Cole 1956) with the amount of larvae produced possibly being related to the relative condition of the oyster (Walne 1974).

Table 1: Relative fertility of native oysters for successive age groups

Approximate Age (years)	Mean Diameter (mm)	Fertility (number of larvae)
1	40	100,000
2	57	540,000
3	70	840,000
4	79	1,100,000
5	84	1,260,000
6	87	1,360,000
7	90	1,500,000

(Reproduced from Walne 1974, based on studies undertaken at the Fisheries Experiment Station, Conwy)

The length of time the pedivelliger larvae spend within the water column varies between 7 and 14 days and depends on the water temperature, food supply, pH and possibly other factors. During this planktonic phase the larvae develop further in preparation for settlement. The larvae are described as plantigrade at this stage. Metamorphosis and then settlement occurs after a period of substratum selection. Experiments at Conwy have shown that larvae prefer to settle on the underside of horizontal surfaces, in the shade, on surfaces with a film of microbiological growth covering them and near to other settled spat or larvae. Selection of adequate surfaces is made following initial contact in which the plantigrade larva creeps about on a ciliated foot testing the surface. If the surface is unsuitable but within the critical period for metamorphosis, it has the ability to migrate and repeat the process elsewhere. Once the right surface is found the larva cements itself to the substratum, via a series of rocking motions undertaken whilst exuding cement from the byssal gland. Oysters prefer to settle onto clean hard surfaces, such as rock or the shells of other bivalves, although if these are unavailable after a number of attempts at settlement the oyster larvae has to settle regardless of substratum type. Once attached, rapid morphological changes produce the basic adult body shape and physiological features within 3-4 days

2.3 The Species and Distribution

The native oyster, *Ostrea edulis*, has a wide geographical range which extends from latitude 65° N in Norway, along the west coast of Europe as far as Spain, and further south along the Atlantic coast of Morocco. It extends into the Mediterranean, primarily along the north coast and penetrates into the Black Sea as far as the Crimea (Yonge 1960 and Walne 1965). The native oyster is found sublittorally to depths of 80 m and extends into estuaries, where it can tolerate salinities down to around 23 psu. Although capable of surviving in the intertidal zone, on the lower shore, intertidal populations are rare probably due to interspecific competition and predation, it is also shown that growth in oysters stops if exposure to air occurs more than 35% of the time (Spencer 1990). There is some evidence that several separate races occur within the species and that each separate race has distribution limited by its temperature spawning tolerance. Korringa (1957) studied various spawning populations and suggests that there is some genetic variability shown by *Ostrea edulis* in regard to apparent anomalies in spawning temperatures. The species normally requires temperatures of at least 16° C to undergo spawning. Water temperatures at the northern limits of the native oyster distribution rarely reach this level and the same is true for deep water populations. Viable populations have been documented in the Netherlands, Scandinavia and there was a very large one present within the Firth of Forth in the 1900s. Korringa (1957) states that there must be several physiological spawning races, genetically distinct from one another, which have different tolerances of temperature specifically for spawning to occur. Hence, northern populations will reproduce and remain viable in conditions not tolerated by southern populations. However, this feature is somewhat contradicted by information that some of the northern populations studied originated from brood stock imported from Brittany (Harding 1996). Experiments by Walne (1965) on spawning of warm water native oysters in colder conditions showed successful metamorphosis at 14-15° C. The success of the native oyster within such a wide geographical range may, therefore, be due to wide physiological tolerances and an ability to adapt to changes in temperatures, rather than genetic diversity. Populations which exhibit growth rates above those expected for certain conditions (Beiras *et al* 1995), may demonstrate wide physiological adaptability within the native oyster. There is also

some evidence that northern populations have adapted to the lower temperatures by having significantly raised metabolic rates in contrast to more southern populations. When in cold water this increased rate is not apparent, but transferal to warmer waters has shown the metabolic rates are greater than those of the oysters native to the warmer waters (Dittman 1997). This has significance for exploitation of the species and has resulted in the more northern populations of the native oyster being sought after as they exhibit relatively faster growth rates than oysters native to warmer conditions. However, disease has restricted the possibility of widespread use of this practice, as the main disease to have affected the UK in recent years, *Bonamia* (see section 2.4), was most prevalent in southern regions. The oyster populations have begun to exhibit degrees of resistance within these exposed populations but, owing to the lack of exposure, the northern populations have no resistance and would suffer if transplanted into areas where *Bonamia* has been and is still a problem (D. Hugh-Jones (Loch Ryan Oysters) pers. comm.).

2.4 Predators, Competitors, Parasites and Diseases of Oysters

The distribution of *Ostrea edulis* is significantly affected by the presence of nuisance organisms– those that prey on, parasitize, infect or compete with the species. The main organisms that affect native oyster populations are briefly described in this section, the effect they have had on UK populations will be expanded within Part 2 of the report where the distribution of *Ostrea edulis* is studied along with the reasons for any changes.

2.4.1 PREDATORS

The greatest impact on oyster populations by predators occurs in the younger stages as larvae or spat. Whilst in the plankton, oyster larvae are subject to the same predation pressures as other planktonic organisms, by fish and other free swimming predators, including larger predatory constituents of the plankton and some filter feeders such as the bivalves *Macoma balthica* and *Mytilus edulis*. Adult oysters themselves within densely populated natural beds, can constitute the greatest threat as the newly released larvae are inhaled and bound with mucous as pseudo faeces. Walne (1965) calculated

that at a filtration rate of 10 litres per hour, 21–91% of oyster larvae could be lost in areas with high densities of adults present, with the greatest risk occurring immediately following liberation into the water column. To counter this risk oyster larvae swim upwards on release, presumably as an adaptation to minimise the time spent near to the feeding adults.

Important predators within some parts of the UK are the oyster drills or tingles which are predatory gastropods. There are two species of tingle within the UK, the native species is the European rough tingle or sting winkle (*Ocenebra erinacea*), this was once abundant around most of the British coastline. However, exceptionally severe winters of 1940 and 1947 greatly reduced the population on the east coast of England to such an extent that recovery has still not occurred. The species is locally abundant in some areas of the west and southwest of Britain (Fish and Fish 1996).

An introduced species, the American whelk tingle or oyster drill (*Urosalpinx cinerea*) has had a significant impact on native oyster populations in Essex and Kent. It was first recorded in the UK in 1928 although it is thought to have been present for several years before it was noted, having been mistaken for *Ocenebra erinacea*. It may have been introduced to this country with consignments of American oysters (*Crassostrea virginica*), which, up to 1939, were regularly imported and relaid on the Thames Estuary oyster beds (Yonge 1960). The impact of the American oyster drill was substantial on the oyster grounds to which it was spread. It predates native oysters and each individual consumes about 40 oyster spat (5-20 mm in diameter) per year, with 58% of oyster spatfall reported as being devoured in the Crouch Estuary (Hancock 1954). Other studies have noted that the native oyster drill is still a threat to oysters in places where it maintains significant populations, *Ocenebra erinacea* killed 11% of 30-45 mm oysters laid on the sea bed in Southampton Water, within two months of laying (Key and Davidson 1981). The distribution of the American oyster drill is still centred around Essex and Kent (Spencer 1990) with only a slow limited dispersal noted since its first introduction facilitated by the oyster trade (Cole 1942). Its failure to spread further and faster is considered to be due to a combination of limited adult mobility and lack of a free swimming larval stage (Gibbs *et al* 1991) and controls on the movements of oysters around the country (S. Lockwood

(CFCM) pers. comm.). The populations in the south east of England have been severely depleted by the affects of tributyltin (TBT) in the water with none having been found intertidally in East Anglia since 1991, although, there are still live specimens and egg cases occurring outside the Blackwater and Crouch estuaries and possibly off Whitstable (JNCC 2001). TBT based antifouling paints were used for small boats up to the late 1980s such that the pollutant became concentrated in enclosed bays where many boats were moored. It has been shown to cause imposex, in dogwhelks and other neogastropods, which involves females developing a penis and suffering blocked oviducts, leading to reproductive failure (Spencer 1990). Many other species suffered detrimental effects from exposure to TBT (including oysters), which led to a ban on the use of products containing it in 1987 on boats <25 m in length. Although TBT affected both oysters and oyster drills the impacts on the latter species were greater initially and the recovery of the population has not yet started to occur. However, it is considered that the American oyster drill may become a significant predator again at some point in the future (Spencer 1990).

Both gastropods feed in similar ways, using the rasp-like radula to drill through the shells of young oysters. Spat are their principal prey but young oysters up to 3 years old may be preyed upon. The dogwhelk, *Thais lappillus*, has also been noted occasionally to attack oysters (Yonge 1960) and to be a particular threat to oyster spat on up-river nursery grounds (Cole 1956). This species however, is positively used by some oyster cultivators, as it preferentially feeds on small mussels which can compete for food and space with the oyster (Minchin and Duggan 1989).

The common starfish (*Asterias rubens*) will prey on oysters by pulling the valves apart, everting its stomach through the gap and digesting the flesh *in situ* and smaller individuals may take oyster spat. The common starfish or *fivefingers* was considered a greater threat to commercial oyster beds during the 19th century and was mentioned in many reports to the Select Committee on Oyster Fisheries, 1876 (HMSO 1876). Orton (1937) noted that dredgermen within the Thames took basket loads of starfish home to use as manure after they were taken during dredging, as a control measure. A recent news article (Scottish Fish Farmer 1997) highlights the problems that scallop farmers are having with

increased starfish predation, suggesting that oyster populations may also be suffering greater predation.

Sea urchins may eat some spat but the greatest problem comes as they browse on the oyster shell for lime and attached worms and barnacles. This process can result in thinning or sometimes complete destruction of the oyster shell (Orton 1937).

The shore crab (*Carcinus maenas*) is the most abundant and widespread predator in estuaries and coastal sites. The largest crabs up to 65 mm carapace width can eat oysters up to 10 g (Spencer 1990) but as these are relatively rare it is only oysters smaller than this size which are considered at risk. Both the shore crab and the velvet swimming crab (*Necora puber*) both occur subtidally and can therefore predate sublittoral beds of oysters.

2.4.2 COMPETITORS

Since its introduction in about 1880 from America with imported oysters (*Crassostrea virginica),* the North American slipper limpet (*Crepidula fornicata*) has become the native oysters most serious competitor for food and space in the UK. Since its introduction to Essex oyster beds at Brightlingsea it has spread north to Scottish waters and west around the coast and into the Irish Sea (Marine Pollution Monitoring Management Group 1998). The current distribution of *Crepidula fornicata* around the UK is shown in Figure 1. The slipper limpet has relatively fast growth rates, good tolerances to low salinity and temperature and no natural predators within the UK, which allows it to out compete the native oyster which are generally slower growing and more sensitive to environmental pressures. The limpet competes with the native oyster for food as unusually for a gastropod they are filter feeders and are therefore, likely to utilise the same food as oysters. Also like the oyster the slipper limpet is a protandrous hermaphrodite, forming permanent associations or chains (Orton 1912) and it is the dense chains and mats which form which represent the greatest form of competition for the oyster. Yonge (1960), states that in Essex 446 individuals were counted from a square meter of bottom and Walne (1956) estimated that 1150 tonnes of *Crepidula* inhabited a 5 mile

stretch of the Crouch Estuary (ten times the weight of oysters in the area). It is this density of limpets which works to smother a bed and the presence of large assemblages on the sea floor can cause increased settlement of mud from the water by slowing the velocity of the water in the immediate vicinity. This and the increases in waste products (e.g. pseudofaeces) can cause changes to the nature of the bed, to one of mud which is unsuitable for oyster settlement.

A lesser competitor for space is another introduced species, the Australian acorn barnacle (*Elminius modestus)*, introduced to Britain in the 1940s. This is a more serious competitor than the native acorn barnacles because, unlike the latter, the larvae of *Elminius* settle most heavily during and after oyster spatfall. They compete for settling space and during their first week of growth have been known to outgrow and smother settled oyster spat (Yonge 1960). The presence of barnacles settled onto oyster shells also presents an aesthetic problem in selling the oyster.

2.4.3 PARASITES

The boring sponge (*Cliona celata*) occurs throughout the UK and can infest older oysters. The shell can become riddled with small holes made by the sponge. In some areas of the country the sponge is particularly prevalent, for example in Falmouth harbour, infected oysters are termed as *rotten back* oysters and although the sponge does not appear to be a threat to the survival of infested oysters, it can affect the market value for cultivated forms.

Several species of marine worms of the genus *Polydora* inhabit oyster shells in the UK. Two species, *Polydora hoplura*, a species not native but introduced with Brittany oysters and *Polydora ciliata* have been proved to cause stunting of shell growth and loss of condition in the native oyster (Korringa 1976).

Some protozoan parasites have been found within *Ostrea eduli* which do not appear to affect health or condition of individuals, even when infested. Others, like the flagellate protozoan, *Hexamita*, have been found to cause significant mortalities within native oyster populations.

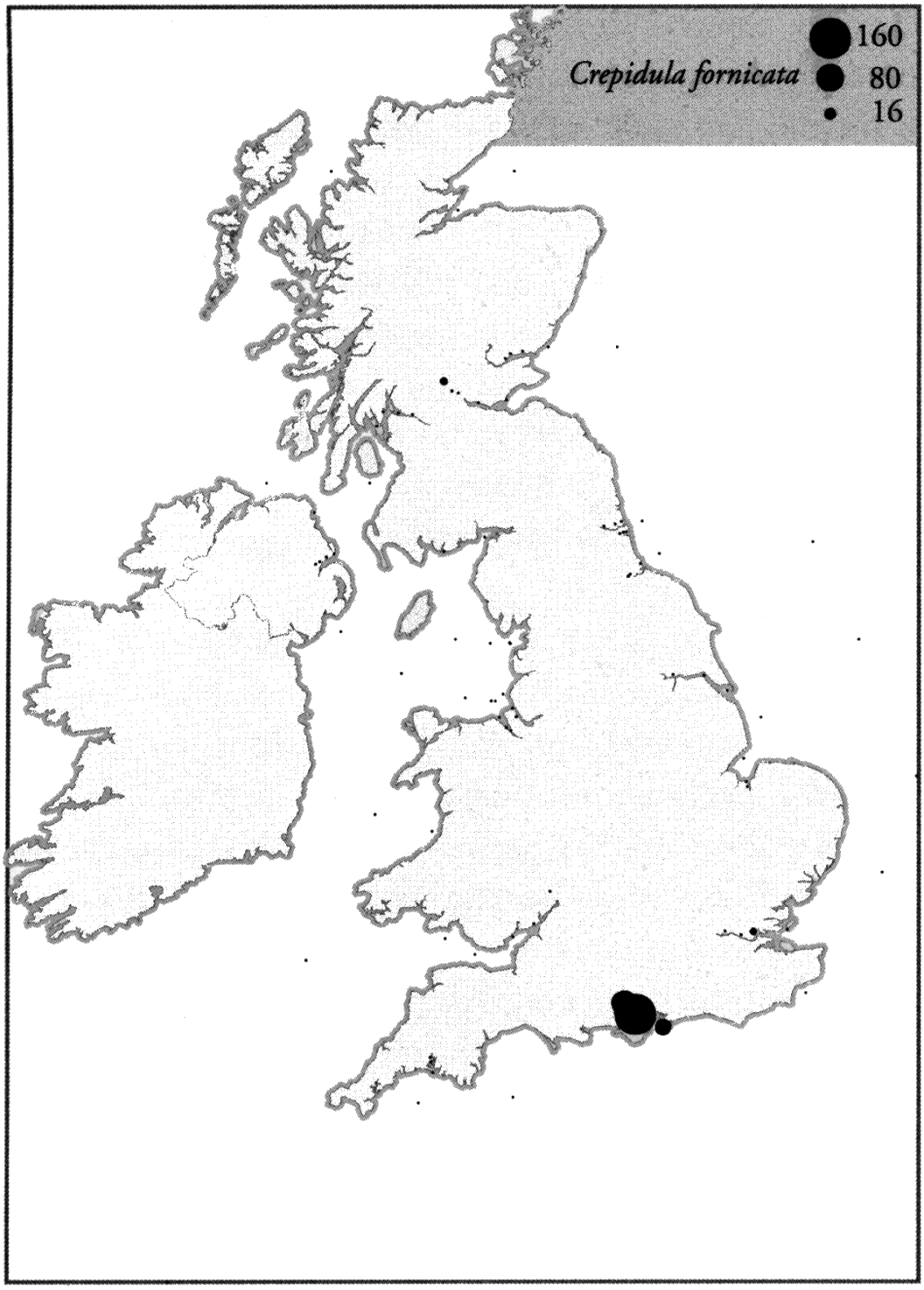


Figure 1: Distribution and numbers of the North American slipper limpet, *Crepidula fornicata*, in the United Kingdom. (reproduced from Marine Pollution Monitoring Management Group report, 1998).

Hexamita was found within native oysters which had suffered significant mortalities whilst kept within storage basins in Holland (Mackin, *et al* 1952). Yonge (1960) considers the symptoms of the *Hexamita* outbreak, resembled those of a great epidemic of native oysters that occurred throughout European native oyster populations in 1920 and was at the time blamed on the disposal of excess munitions, in particular the disposal of the explosive TNT. Later studies proved that oysters confined with TNT and other explosives were relatively unaffected and oysters in areas where no munitions were disposed of suffered from high mortalities (Orton 1937 and Yonge 1960). It is, therefore, noted that occasional unexplained mass mortalities of native oysters may have been due to infections by protozoan parasites like *Hexamita*.

In 1969, another protozoan, *Marteilia refringens*, was found to be the cause of many native oyster mortalities throughout France. UK import controls at the time prevented the introduction of the disease into the UK. However, despite further strengthening the controls in 1974, another protozoan, *Bonamia ostreae*, entered the UK in infected native oysters, possibly imported from France. This lethal intracellular pathogen of the haemocytes of *Ostrea edulis* commonly causes over 90% mortalities in infected populations. Its spread is not fast naturally and all new areas infected after its first description in Brittany in 1979 have been associated with the movement of oyster stocks by the shellfish trade (Alderman 1984). In France, *Bonamia* caused the collapse of the native oyster industry on the Atlantic coast. In the UK it was first noted in the Fal Estuary, Cornwall, from testing carried out in 1982 and spread relatively rapidly to the Helford Estuary, to north and mid-Essex and to some parts of the south coast (Utting and Spencer 1992). Since this time little further spread has been recorded within the UK. The Centre for Environment, Fisheries and Agricultural Sciences (CEFAS), have undertaken a rigid programme of testing for *Bonamia* and *Marteilia* around the UK and restricting the movement of oysters to prevent further spread of the disease. Recent reductions in the occurrences of *Bonamia* in some areas may indicate that the controls up to the present have and continue to work. Testing for *Marteilia* in 1995 showed the whole of the UK to be free of the disease (MAFF 1995).

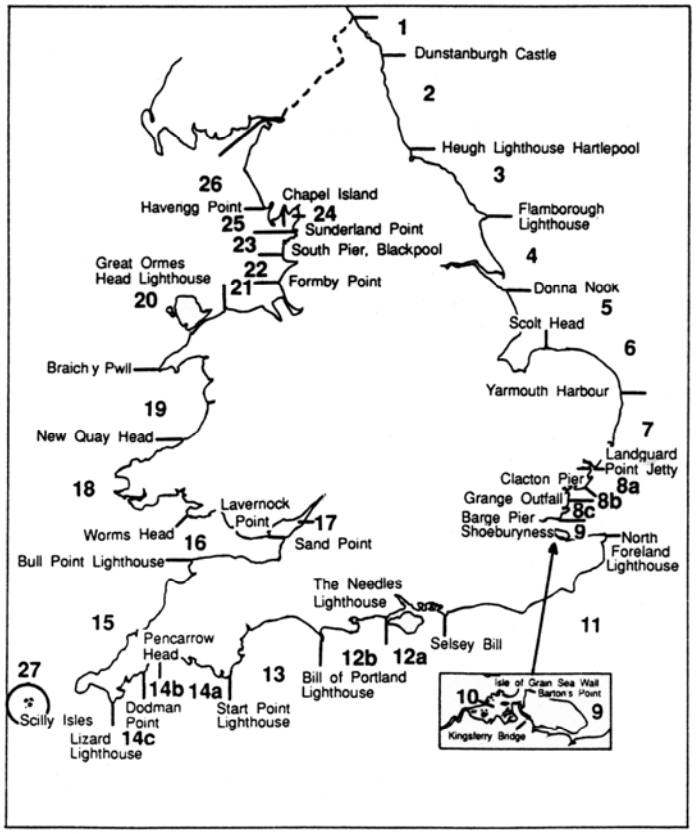
A programme was also set up to select *Bonamia* resistant native oysters in an attempt to supplement natural and cultivated native oyster populations with individuals more tolerant of *Bonamia.* Two strains, one obtained in 1985 (S85) and one obtained in 1989 (S89), have been tested. The S85 strain showed 4 times higher survival rates than a control group (Nacrigraven *et al* 1998) indicating that this may be the way forward as a means of controlling the *Bonamia* problem. It is also now becoming apparent that a significant proportion of the native oyster population, particularly within the southern oyster grounds within the British Isles, have begun to show a natural resistance to the disease, due possibly to the natural selection of *Bonamia* resistant oysters over the last 20 years (D. Hugh-Jones (Loch Ryan Oysters) pers. comm.). The results of sampling for *Bonamia*, *Marteilia*, *Mytilicola*, *Crepidula* and the American tingle by areas designated and numbered in the Molluscan Shellfish (Control of Deposit) Order 1974, as varied by the Molluscan Shellfish (Control of Deposit) (Variation) Order 1983 are shown in Figure 2 (Spencer 1990). *Mytilicola* is included as a part of the standard sampling programme, however, this disease affects the mussel *Mytilus edulis* and not the native oyster.

2.4.4 OTHER DISEASES AFFECTING NATIVE OYSTERS

Protozoan disease has been responsible for the majority of disease related mortalities in the native oyster. However, there is a wide range of other pathogens which affect the native oyster to varying degrees. For example bacterial diseases have not been widely recognised, although with the advent of more commercial molluscan hatcheries increased problems have been noted and *Ostrea edulis* larvae are particularly prone to infection. Larval vibriosis is a major hazard to summer hatchery operations; when introduced with water changes, *Vibriosis* can cause 100% mortality. Oxolonic acid is used to control the larval vibriosis but secondary infections caused by resistant organisms can require further antimicrobial measures (Alderman 1984).

Dutch shell disease is the only fungal infection of note to affect the native oyster, it has been found in juvenile native oysters within the UK (Cole 1956), after first having been noted in the Netherlands. The fungus causes the adductor muscle to be compromised, reducing the oysters power to close its

shell. Seriously infected individuals rapidly become emaciated and die although older oysters in good feeding condition can recover.



Key: Areas 1, 3, 5, 6, 19, 20, 21, 22, 23, 26 and 27 = no pests or diseases recorded; Areas 24 and 25 = *Mytilicola* only; Area 4 = *Crepidula* only; Areas 2, 7, 10, 11, 13, 14(a) (b), 15 16, 17, and 18 = *Mytilicola* and *Crepidula;* Area 9 = *Mytilicola, Crepidula* and American tingle; Areas 12(a) (b) and 14(c) = *Bonamia, Mytilicola* and *Crepidula;* Areas 8(a) (b) (c) = *Bonamia, Mytilicola; Crepidula* and American tingle.

Figure 2: Incidence of shellfish pests and diseases in England and Wales, (reproduced from Spencer 1990).

2.4.5 OYSTERS AS HOSTS FOR HUMAN PATHOGENS

Oysters are bivalve molluscs that feed by filtering out particles from the surrounding water, thus concentrating and bioaccumulating contaminants within the oyster if the particles on which the animals feed are contaminated. If microbial pathogens are present these too will become concentrated, some of them may be natural marine organisms, such as vibrios, others may arise from human or animal sources, in particular faecal material, e.g. *E.coli*.

Naturally occurring toxins can be produced by unicellular algae under certain conditions. The concentration of these algae and their toxins during ingestion by the mollusc may prove a hazard to human health. These neurotoxins produce three types of illness: Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP) and Amnesic Shellfish Poisoning (ASP). PSP is associated with algae of the genera *Alexandrium* and *Gyrodinium,* and the illness involves numbness of the mouth and fingertips, along with impaired muscle co-ordination. Respiratory distress and paralysis can also occur in severe cases and may prove fatal. DSP toxins are produced by the algae of the genera *Dinophysis* and *Prorocentrum*, which produce symptoms including diarrhoea, nausea, vomiting and abdominal pain (Anon 1996). ASP toxins are produced by diatoms of the genera *Pseudonitzschia* and severe cases can result in memory loss seizures and death, although there is no evidence to date, of any cases of ASP having been caused through the consumption of oysters in the UK. However, fishing for scallops has recently been banned in Scotland due to elevated concentrations of ASP within tested animals (Bisset 2000), it is therefore possible that oysters within the same area could also be affected.

Various legislation measures have been put in place to safeguard human health the most fundamental being the EC Shellfish Hygiene Directive (91/492/EEC) enacted in UK legislation under the Food Safety (Live Bivalve Molluscs and Other Shellfish) Regulations 1992 and further legislation in 1997 (See Section 3.3.2). All EU member states are required to monitor bivalve production areas for the presence and concentration of toxic algae species within the water and the concentrations of toxins within the bivalves.

Under the above Directive, bivalves are also monitored for the concentration of *E.coli* within the animal. This gives an indication of the degree of contamination from sewage to which the animal has been subjected. The most relevant biological aspect is that the shellfish should always comply with a standard of <230 *E.coli* and <300 faecal coliforms per 100 g of shellfish flesh. *Salmonella* and other pathogens are also tested for along with chemicals. Under the Directive all shellfish harvesting areas have to be classified according to the levels of faecal pollution affecting them.

2.5 Oyster Cultivation

A brief description is given here of methods of oyster cultivation which has been employed within the UK for at least the last 200 years. There have however, been local differences in culture technique developed within areas to adapt to specific conditions and customs. The aims of oyster cultivation were described by (Cole 1956) as: *The establishment of bottom conditions most suitable for the settlement, growth and fattening of oysters and the elimination of pests and competitors*. The oyster is one of the few marine species which it is possible to cultivate being sedentary and growing within shallow, occasionally intertidal waters which allow them to be actively managed and tended as necessary. Exploitation of wild natural stocks in the past was carried out mainly by gathering, full-grown oysters off intertidal beds at low tide or lifting them by boats from natural subtidal beds. Naturally occurring oyster beds with populations sufficiently large enough to support significant fishing efforts are now rare due mainly to over fishing during the 19th century. Natural supplies of mature oysters are now rare throughout Europe thus the management of beds now normally requires active stocking or full cultivation.

Native oyster cultivation consists of two basic stages, obtaining young oysters and tending them as they grow to maturity. Young oysters are obtained in two ways: the dredging of natural beds for spat and part grown oysters and the collection on private beds of spat which have been generated from nearby natural beds or from the private bed itself or others nearby. Oyster layings, both for growth or for on-growing of spat, may be on the foreshore in the intertidal zone or in greater depths of water. To optimise feeding and, therefore, growth, the oyster cultivator attempts to position the oyster layings at a point for constant immersion but not so deep as to make access too difficult. This can be achieved in some areas by placing the oysters at a point where they are only uncovered at low water on spring tides. The grounds need to be prepared prior to spat collection, to optimise the area of ground available for settlement. This is done traditionally by providing a hard surface for spat to settle on, *culch*, this can consist of old shells, broken crockery or tiles. Before the spatting season, the culch needs to be raked up and cleared of the sediment, weed and other settled organisms either physically or via chemical treatment (e.g. dilute copper sulphate solution). Regular maintenance of

beds to remove predators, pests or competitors together with weed and sediment, is needed to achieve optimum yield. Thinning out may also be required to allow the oysters optimum space for growth. Oysters in deeper water cannot be given the same degree of attention so management is undertaken by dredging up the oysters, removing rubbish and selecting oysters of a saleable size and then returning young under-sized oysters and the culch.

The spat, after reaching a size of half an inch or more in shell diameter, are called brood and are bought and sold for relaying to grow and fatten. In some areas the spat are allowed to grow to maturity on the beds where they first settled. Other management techniques involve removing the brood to an area known for its particular qualities in the fattening of the oysters or for imparting a particular taste to the flesh. Finally oysters may be moved into storage pits which periodically fill and empty with the tide allowing good accessibility and but keeping the oysters in good condition.

In addition to culturing practices greater changes have occurred with the advent of hatcheries growing spat, since the 1950s. Hatchery cultivation involves conditioning the oyster to spawn with cultured algal food and warm water then raising and lowering the temperature to induce spawning. Alternatively, the oysters can be opened and eggs and sperm extracted for external fertilisation. The larvae, when released by the oysters or produced externally are put to grow in rearing tanks and settle after a time on the underside of black plastic mats suspended within the tanks. After the spat reaches 2–5 mm it is scraped off the surface and placed in another tank to grow on. Spat can be sold to oyster farmers at varying sizes. This technique was developed mainly as a means of allowing farming of the Pacific oyster within the UK, where the water temperature tends to be too low for spawning to occur naturally. Some native oysters have been bred within hatcheries but have not grown on as successfully as Pacific oysters. The effects of *Bonamia* which infect and kill the young native oyster once in the sea in areas where it is prevalent, has also reduced the demand for the spat. It is, therefore, less of a risk to grow Pacific oysters. The growth rate of the Pacific oyster also is faster than that of the native with marketable sizes being reached even in the cold UK waters in 3–4 years in comparison to the native oysters 5–6 years. It is, therefore, now the Pacific oyster which is cultivated in larger numbers in the UK than the native oyster.

3. LEGISLATION

3.1 History of Legislation Which Relates to Oysters in the UK

Legislation which governs the exploitation and protection of the native oyster is diverse and has been built up over many years. Initially, the main legislation produced governed the sea bed and the ownership or title to the natural resources occurring therein. Later Acts were applied to manage and conserve stocks and to ensure the health and quality of the produce of the sea and to prevent any threat to human health (Neild 1995).

Laws relating to title to the ownership of the seabed can be dated back to the Norman invasion of Britain and the Doomsday Book. The monarch held total tenure to all lands, foreshore and territorial waters. Tenure was passed to vassals of the king after swearing allegiance and performing favours. This tenure was a gift bestowed by the Crown, which remained the ultimate owner of the grounds and as such, the Crown had the power to grant a Several Fishery. The latter is a fishing area severed from use by the public such that one person or group of persons has exclusive rights over the ground. The Crown also had the right to bar fishing or fowling in any river, to save it for the king. The Magna Carta in 1215 ceased the king's right to exclude fishing but not the right to grant a Several Order.

Under common law the public had, and continues to have, a right to fish within any tidal waters with the exception of where a property has been acquired exclusive of the public right or where the government has restricted the rights of common law within a specified area for specific reasons. Common law rights are further complicated by the granting of a title or estate to property adjacent to the shore. It can be the case that the property extends to low-water mark, in which case, the foreshore is not always the property of the Crown. Over time, dependent on the needs of the crown, this property right has been upheld or ignored.

Little change occurred over time which affected the native oysters or the fisheries. The main impact with regard to legislation came in the form of various attempts to fix prices or to restrict trade. In 1638 it was reported (Hore and Jex 1880) that an Admiralty Court judge recommended that restrictions be placed on the marketing of oysters which were too small and that an embargo, aimed at

preventing dwindling stocks of oysters being shipped abroad, be enforced. This had little impacts on stocks as loopholes were included in the ruling which allowed oysters to be exported to Dutch royalty at the bequest of the King, Charles I.

At this time, attempts were being made to build up the British fisheries (mainly herring), to compete with the Dutch, who with their government's support had built up an efficient industry. Various policies were put in place to encourage fishing, including putting a bounty on fish which was paid on the fishing boat, by the tonne. The pro-fishing policies had little effect on the UK fishing industry, until the collapse of the Dutch fleet after the Napoleonic wars. A board of seven Commissioners of the Herring Fisheries was set up which introduced quality control in the herring industry.

It was notable that whilst the herring fisheries were thus managed, oyster fisheries received little regulation. A customary close season of months with the letter R within them was observed by some areas, as early as 1577, and a prohibition on dredging for oysters between Easter and Lammas (August 1st) in the Thames Estuary has also been noted (Yonge 1960). This was not the normal situation and most closures were only observed on a voluntary basis, by isolated sections of the trade. A Select Committee of the House of Commons recommended in 1833 that a size limit of 2½ inches and a close season be adopted (Neild 1995), but it was not until a dispute with the French over common fishing grounds that, in 1843, an Act was passed which included a statutory close season. The close season was stipulated for the four summer months, during which time no boats could carry on board any equipment for catching oysters, or fish for oysters within three miles of the other country. The convention was for the guidance of both French and British fishermen but after protest, the British government decided not to enforce the close season within the three mile territorial waters and no attempt was made to enforce the law further into the channel. In 1852, after complaints from the French, the law was enforced outside the three mile limit, but not within; and in 1855 further powers to enforce the act were given allowing the powers of seizure of equipment and catches of those breaking the law.

In 1863, a Royal Commission on Sea Fisheries was set up to review the state of the British fishing industry. The work was carried out in two years and reviewed 86 separate places of fishing within the

UK and Ireland. The Commission concluded that there was no general shortage of sea fish and that trawling and netting should be allowed as they increased the supply of fish, with no permanent harm to the stocks. Oysters were, however, the exception as they were recorded by the Commission as *in a state of decline everywhere that they were noted* (Neild 1995). Despite evidence to the contrary, the Commission dismissed the evidence for a decline in the oyster industry and implied that, regardless of overfishing, no shortage of oysters could ever come. They reasoned that the inefficiencies of dredgers and the huge numbers of larvae an oyster produced would make the populations self sustaining regardless of fishing effort.

It appears that the general conclusions for the rest of the fishing industry, of deregulation and permitted uninhibited exploitation, were made to fit for the oyster problem. The main strategy for protection of the industry came in the form of a recommendation that more oyster fisheries should be privately managed, with Several Orders granted. Thus the common fishing rights, set out since the Magna Carta were changed. Management of the foreshore and territorial seabed was transferred in 1866 from the Commissioners of the Woods (Crown Estate managers), to the Board of Trade, allowing the Government to administer the ground. Furthermore, a bill to allow greater enclosure of the seabed was proposed in 1866, and in 1867 greater protection of private oyster beds was brought into law with respect to damage and theft.

In 1868 a new fishery act was passed which repealed all existing legislation and enacted a new convention with France and the enclosure of the seabed for the purpose of farming oysters. The new convention resulted in a shortened close season in the English Channel and the creation of two types of enclosure order:

- a ‘Several Order’ was introduced which gives an individual, company or corporation the exclusive right to fish for oysters or mussels within a given area;
- a ‘Regulating Order’ was developed, allowing restrictions to be placed on an oyster fishery. Restrictions included dredging and sizes of oyster taken and also the rights to licence and levy charges for the fisheries.

Two further amendments were made to the legislation by the House of Lords in order to protect property rights. The first prevented the loss of rights below the low water mark where held already,

should a person acquire land above the high water mark in order to gain fishing rights (as previously mentioned). The second required another level of assessment to be carried out before the an order could be granted. The overall process was, therefore, made time-consuming, quite expensive and uncertain of success, resulting in limited interest.

In 1876 a Select Committee was appointed to investigate the continuing decline of the oyster industry. It found, unlike the Commission ten years earlier, that the principal cause of the shortage of oysters was *to be found in the continual and constantly increasing habit of over-dredging for them in open waters* (HMSO 1876). No new regulations were brought into force as a result of the findings.

In 1877 the Fisheries Act was passed which gave powers to the Fishmongers' Company, which represented the industry, to become responsible for preventing the sale of fish unfit for human consumption. In 1888 the Fisheries Regulation Act was passed, which included the powers for a local authority to create local fishery committees with powers which included the ability to set by-laws and place limits on the size and condition of shellfish which could be removed from waters within their jurisdiction. Much of the legislation and wording of the 1888 Act remains unchanged within the Sea Fisheries Regulation Act 1966 (Parliament 2000).

The next major new piece of legislation to come about with regards to oysters came at the turn of the 20th century and came about as a reaction to increasing concerns over the safety of oyster consumption. In the 1890s many countries became aware that there was a connection between the consumption of oysters and outbreaks of typhoid fever. Investigations by Dr Timbrell Bulstrode in 1896 concluded that many of the oysters in England and Wales were laid close to the mouths of drains, and were therefore at risk from contamination (Neild 1995).

In 1899 an Oysters Bill was introduced, which gave county and borough councils the powers to test waters and prevent oysters being taken if the water was found to be too contaminated. The Bill was withdrawn, however, after difficulties designating the competent authority to test for the contamination. Following a major outbreak of typhoid in 1902, the ensuing investigation strongly implicated contaminated oysters as the cause of the typhoid. The Fishmongers' Company commissioned inspections of shellfish layings to ascertain pollution levels, with oysters from areas

found to be polluted being banned from sale and shellfish from the area, labelled as unfit for human consumption. The Fishmongers' Company in 1906 formed the Oyster Merchants and Planters Association, which attempted to ensure that all supplies of oysters were fit for consumption. Pressure was also put on the government and the Royal Commission for Sewage Disposal to improve sewage disposal and compensate owners of oyster layings which had to be closed. However, no government action resulted from this. Furthermore, in 1913–14, Local Authorities tried unsuccessfully to have Bills passed which would have given powers to prohibit sale of oysters and shellfish (Derby, Bolton and Preston).

In 1915 the Board of Local Government issued regulations under the Public Health Act which gave local authorities the power to close shellfish beds. The results of this legislation were to form a two tier system with, firstly, the Fishmongers' Company remaining responsible for the purity of oysters passing through London; this is still the situation today. Secondly, the local authorities were given the role of reacting to pollution incidents by determining the source of the pollution.

In 1949, the Coast Protection Act, returned the management of the foreshore and territorial seabed and the income from it, to the Commissioners of the Crown Lands (successors to the Commissioners of the Woods and now the Crown Estate) which has improved the ease of gaining a lease for shellfish farmers. The Crown Estate now holds title to many parts of the coast and manages its use partially through leasing the rights for its exploitation to other parties, this can include those wishing to set up aquaculture businesses. The Coast Protection Act also requires consent from the Department of the Environment Transport and Regions and consultation prior to setting up a farm for aquaculture in addition to a lease from the Crown Estates.

In the case of Northern Ireland, legislation was passed in 1964 to enable fishermen from both sides of the border to fish in each others territorial waters, subject to local regulations (Symes and Phillipson 1997).

In 1966, the Sea Fisheries Regulation Act provided a fundamental piece of legislation for the future control of fisheries, although as noted previously, the Act contained much of the original text included in the 1888 Fisheries Regulation Act. The 1966 Act defines the powers and responsibilities

of the Sea Fishery Committees for the management of inshore fisheries within England and Wales. It outlines current limits to their jurisdiction, 6 miles from baselines and powers for making by-laws, subject to approval by the Minister of Agriculture Fisheries and Food and, or Secretary of State for Wales. Fisheries are regulated in Northern Ireland by The Fisheries Act (NI) (1966). The 1966 Acts and much of the subsequent legislation is still in place today (see section 3.3).

3.2 Current Rights and Ownership

The minimum requirements for a new oyster fishery are: a claim to the foreshore by having land immediately adjacent to it, access to the site and reasonable transport and permission from the government departments responsible for the prevention of disease and harm to human health. In order to gain a concession to carry out oyster farming or dredging, the new entrant can set up in a place where a title already exists and buy or lease it from the current holder, obtain a new lease from the crown, or seek a Several Order for the site.

Around the UK, the rights to farm or dredge for oysters are held in different ways as a result of the gradual evolution of the rights to the seabed. The public has a common right to fish tidal waters. As noted this is except for where a property right has been obtained which excludes the common right. These rights come in a number of forms which are summarised in table 2.

3.3 Existing UK Legislation

The current fisheries legislation which has a direct impact on native oyster fisheries of the UK, is summarised in Table 3.

Table 2: Current property rights and ownership relating to shellfish exploitation in the UK.

Name of Right	Details
Manorial titles	To hold rights to the foreshore via ownership of the land adjacent, often challenged by the Crown (who would otherwise own the foreshore and the rights to it) or private claimants who also seek to make use of the resource.
Royal Charters	Rights granted to boroughs.
Private Rights (pre Magna Carta)	Grants of rights of a fishery to individuals by the Crown before Magna Carta (1215).
Pre-1866 private Acts of Parliament	Conferring rights on boroughs such as Colchester or Rochester.
Several Orders	Rights granted to individuals or other bodies, by governments under the Sea Fisheries Act 1868, and latterly under the Sea Fisheries (Shellfish) Act 1967.
Regulating Orders	Granted by Government giving rights to local authorities and Sea Fishery Committees, and harbour boards, empowering the named body to licence fishing, regulate it and levy charges. Also, to grant leases to individuals or other bodies or to sub-lease the rights.
Rights to sub-lease	Harbour authorities or local authorities can sub-lease moorings or fisheries if they have leased the rights to the foreshore from the Crown Estate or from the duchies of Cornwall or Lancaster.
Remaining rights	The Crown Estate or the Duchies of Cornwall or Lancaster hold title where none of the above is found.

Table 3: Main pieces of current legislation which affect fisheries within the UK (modified from Read *et al* 2000).

Fisheries Legislation	
International	United Nations Convention on Law of the Sea (UNCLOS), 1982. United Nations Convention Biodiversity (1992).
EU control:	Common Fisheries Policy 1983 Closed Areas (3094/86/EEC) Dangerous Substances Directive and Daughter Directives (76/464/EEC) Birds Directive (79/409/EEC) Shellfish Growing Waters Directive (79/923/EEC) Urban Waste Water Treatment Directive (91/271/EEC) Shellfish Hygiene Directive (91/492/EEC) Nitrate Directive (91/676/EEC) EC Habitats and Species Directive (92/43/EEC) Integrated Pollution Prevention and Control Directive (96/61/EEC) Environmental Impact Assessment Directive (97/11/EC) Water Framework Directive ((COM 2000) 219 final)
England and Wales	Sea Fisheries Regulation Act 1966 Sea Fish (Conservation) Act 1967 Sea Fisheries (Wildlife Conservation) Act 1992 Conservation (Natural Habitats *c*.) Regulations 1994 The Environment Act 1995 Sea Fisheries Regulating & Several Orders
Scotland	Fishing (Scotland) Act 1984. (Regulates up to 6 nautical miles) Inshore Fishing (Scotland) Act 1984 Inshore Fishing (Prohibitions of Fishing and Fishing Methods) (Scotland) Order 1989 Sea Fisheries Acts & By-laws
Northern Ireland	Foyle Fisheries Act (NI) 1952 Fisheries Act (NI) 1966 Fisheries (Amendment) (NI) Order 1981 Fisheries (Amendment) (NI) Order 1991

3.3.1 INTERNATIONAL LEGISLATION AND CONVENTIONS

The United Nations Convention on Law of the Sea (UNCLOS) requires states to assess the potential effects of activities which may cause substantial changes to the marine environment. Oyster fisheries can have impacts on the environment and may require management frameworks at national level (Brina and Pollard 1999).

UNCLOS also sets the territorial limits and baselines from which nations around the world calculate their fisheries. Exclusive Economic Zones (EEZs) are another important addition which came from UNCLOS, EEZs dictate the maximum area a nation can claim for exclusive resource exploitation, 200 nautical miles from the baseline. The UK does not claim an EEZ but exercises 'control' with respect to international agreements and conventions out to 200 nautical miles from baselines, or median lines (see UKBAP, Volume 5 - marine habitats and species, DoE 1999).

As detailed in Section 1.3, the Convention on Biodiversity (1992) requires the formulation of plans to maintain and enhance biodiversity around the world. The native oyster is one of the species identified by the UK as needing further protection.

3.3.2 EUROPEAN LEGISLATION

In the European Community an Exclusive Fisheries Zone (EFZ) was set up in 1977. The EFZ covers the same area as an EEZ but allows for six nautical mile exclusive access for each coastal state and a 6–12 nautical mile zone in which specific countries are allowed to pursue named fisheries (species) as a *historic right*. In the remaining areas of the EFZ different countries have varying access to specific areas (e.g. UK cannot fish in the Mediterranean, Greece and Italy cannot fish EU Atlantic waters, Spain/Portugal cannot fish North Sea (Area IV) or Irish Sea (Area VIIA). Following this, in 1983, the Common Fisheries Policy (CFP) provided the fundamental management agreements by which Europe manages the marine fish stocks.

The Closed Area legislation 1986 lays down certain technical measures for conservation of fishery resources, including size limits for shellfish and detailed restrictions on certain types of fishing, in certain areas, at certain times.

The Shellfish Waters Directive (79/923/EEC) (termed the *Shellfish Growing Waters Directive*) sets the standard for minimum quality of waters in which shellfish are grown It requires member states to designate coastal or estuarine waters as *shellfish waters* and lay down water quality standards to be achieved there. Initially the UK implemented the legislation via administrative means rather than legal measures. In 1981–83 it designated 29 shellfish waters in the UK on the basis that they would meet EC standards. After pressure from the EU and shellfish growers in 1997 the UK adopted the:

- Surface Waters (Shellfish) (Classification) Regulations 1997 (SI 1997/1332)
- Surface Waters (Shellfish) Directions 1997

This is the UK legislation whereby the Shellfish Waters Directive is fully implemented in the UK. To date 119 areas within England and Wales, 33 areas in Scotland and 10 areas within Northern Ireland have been designated as Shellfish Waters (CEFAS 2000). The EC Shellfish Hygiene Directive 91/492/EEC, is closely linked with the Shellfish Waters Directive. It is primarily a public health measure, which aims to protect consumers of shellfish by setting bacteriological standards for live bivalve molluscs. It requires the classification of all shellfish production areas according to their water quality (Table 4).

In the UK, the Directive was implemented by the:

- Food Safety (Live Bivalve Molluscs and Other Shellfish) Regulations 1992;
- Food Safety (Fishery Products and Live Shellfish)(Hygiene) Regulations 1998;
- Food Safety (Fishery Products and Live Shellfish)(Hygiene) Amendment Regulations 1999.

Table 4: Classifications of shellfish harvesting areas within the UK under the Shellfish Hygiene Directive 91/492/EEC.

Area Classification	Direction	Standard
A	Shellfish can be gathered for direct human consumption	<230 *E.coli* or 300 faecal coliforms per 100 g flesh
B	Can go for human consumption after purification in an approved plant, or after an EU approved heat treatment process or after relaying in an approved (Class A) relaying area (whether or not combined with purification).	<4,600 *E.coli* or 6,000faecal coliforms (90% compliance) per 100 g of flesh.
C	Can go for human consumption only after relaying for at least 2 months in an approved relaying area followed, where necessary by treatment in a purification centre or after an EU approved heat treatment process.	<46,000 *E.coli* or <60,000 faecal coliforms per 100 g of flesh.
Prohibited	Shellfish from these areas must **not** be subject to production or be collected	>46,000 *E. coli* or >60,000 faecal coliforms per 100 g of flesh.

A classified list of shellfish production areas is issued annually by MAFF and the designation under the Directive has resulted in the closure of shellfisheries in some polluted areas. Where available, information on the designated areas where oysters are harvested is included in this report, given on a regional basis for England (Section 4.2), Wales (Section 5.2), Scotland (Section 6.2) and Northern Ireland (Section 7.2). The proportions of each Class of shellfish harvesting areas in England and Wales is given in Table 5. In addition, relaying and heat treatment may be used to ensure that shellfish are safe to eat. Extensive research at Conwy (Walne 1960), showed that oysters can self-purify by flushing out microbes over time, if given an ample supply of clean water within this period. In England and Wales the relaying of shellfish is limited because there are only four approved relaying areas, therefore, shellfish from Class 3 areas will require extra expense to relocate to relaying

areas. For oysters heat treatment is not an appropriate means of purification as the product is marketed live and eaten raw.

Table 5: Classification of shellfish harvesting areas in England and Wales, 1 September 1999 (percentage of total classified sites, in each category).

Harvesting Area Category	Percentage
Class A	5%
Class B	69%
Class C	23%
Prohibited	3%

(reproduced from Lee,Younger and Lees, 2000)

The main pieces of European Union legislation which are used to regulate and protect fisheries have been discussed in this section. Much of the European legislation which relates to the native oyster or shellfish in general concerns the protection of human health and therefore requires the protection of the quality of water from which the shellfish are sought. These other European Directives include the Dangerous Substances and daughter Directives (76/464/EEC), Urban Waste Water Treatment Directive (91/271/EEC), Nitrate Directive (91/676/EEC) and the Integrated Pollution Prevention and Control Directive (96/61/EEC) all of which can have a direct impact on the quality of shellfish waters. Some general protection of the habitats of the oyster is also gained from both the Wild Birds Directive (79/409/EEC) and Habitats and Species Directive (92/43/EEC).

3.3.3 NATIONAL LEGISLATION

3.3.3.1 England and Wales

The principal legislation by which fisheries are managed within England and Wales, is via the 1966 Sea Fisheries Regulation Act, which defines the powers and responsibilities of the Sea Fishery Committees (SFCs). The coastline of England and Wales has been divided into 12 local sea fishery

districts, each of which has a Sea Fishery Committee which manages the inshore fisheries. Monitoring of inshore fisheries up to the 6 nautical mile limit is carried out by SFC fishery officers.

The SFCs are required under the Sea Fisheries (Wildlife Conservation) Act, 1992 to have regard to the conservation of marine fauna and flora, whilst exercising their duties. SFCs have also been identified as having a key role, as the *competent and relevant body*, in the implementation of the Habitats and Species Directive via the UK enabling legislation the Conservation (Natural Habitats etc.) Regulations 1994.

The Sea Fisheries (Shellfish) Act 1967 allows the granting of Several and Regulating Orders for fixed periods with an aim to improve regulation and management of fisheries. Several Orders place the rights to exploit the resource within the hands of private individuals, companies or responsible authorities. The applicant must satisfy the Minister of Agriculture that the use of the resource will benefit the fishery; the practice is also subject to inspection and review by MAFF. Regulating Orders are granted by the Minister of Agriculture to a responsible authority such as a local authority, harbour board or Sea Fisheries Committee to enable it to regulate a wild stock fishery. The latter have the powers to set by-laws and other regulatory measures, necessary to maintain and enhance the resource, whilst allowing the public access to it.

The Wildlife and Countryside Act 1981 also affects native oysters and fisheries, albeit in a limited manner, as it designates Marine Nature Reserves (MNR) which can restrict oyster fisheries, in agreement and association with the SFC which holds the by-law making powers.

The Environment Act of 1995 confers on the SFCs new powers to make by-laws, regulating fisheries to maintain or restore favourable conservation status as required by the Habitats Directive. Prior to this the by-laws were available for the management of fisheries with respect to fish stock conservation.

3.3.3.2 Scotland

It is generally accepted (Parker vs Lord Advocate 1904) that in Scotland, oysters and mussels are not within the public right of fishery, but are vested in the Crown *regalia minora*. Therefore, the right to take oysters and mussels must be *granted explicitly by the Crown, or expressly or tacitly given* (H. Kennedy (Crown Estate) pers. comm.).

Inshore fisheries remain under the central control of the Scottish Executive (Rural Affairs Department, SERAD). The main legislation is the Inshore Fishing (Scotland) Act 1984, this gives the Secretary of State powers to regulate fishing in specified inshore waters, and to prohibit the carrying of specified types of net or the use of mobile gear. Seasonal fishery closures can also be made under the Inshore Fishing (Prohibition of Fishing and Fishing Methods) (Scotland) Order 1989, issued under the Inshore Fishing (Scotland) Act 1984 and further amended in 1994, 1996 and 1999.

The Sea Fisheries (Wildlife and Conservation) Act 1992 gives SERAD limited scope to have due regard for wider environmental issues whilst managing fisheries (see section 3.3.4.1 England and Wales).

Interests in the Scottish fisheries, including the Scottish Fishery Department and the fishermen's organisations, endorse the findings of the Cameron Report (1970), which argued against the setting up of SFCs in Scotland. Instead, Local Access Management Committees are in the process of being set up which will have powers to institute voluntary agreements on access to fishing grounds and allowable types of gear, but they will not have the statutory powers of regulation that the SFCs have, (Symes and Phillipson 1995).

Little legislation is carried out in Scotland through the use of by-laws, generally more attention has been give to Regulating or Several Orders (Read *et al* 2000).

3.3.3.3 Northern Ireland

The inshore fisheries of Northern Ireland come under the jurisdiction of the Department of Agriculture and Rural Development Northern Ireland (DARDNI). Regulation is carried out under The Fisheries Act (NI) 1966 and The Fisheries (Amendment) Order 1981, amended again in 1991. As mentioned previously, an important feature is the *voisinage* principle where Northern Ireland and Republic of Ireland fishermen can fish within each other's territories.

Historically, the oyster fisheries of the whole of Ireland suffered a greater degree of regulation, when subject to UK administration in the 19th century. Many regulatory measures not deemed suitable for the British market were introduced in Ireland and apparent lack of trust in the ability of local institutions to govern themselves resulted in significantly increased regulation (Neild 1995). After the Irish Fisheries Act of 1842, the first attempts were made in Ireland to create private enclosures using legislative rights similar to later Several Orders in Britain. From 1845 onwards, Irish Fishery Commissioners were granting rights for private oyster beds and generally sought to improve fishery management.

PART 2

4. THE NATIVE OYSTER IN ENGLAND

Presentation of data for England will be by Sea Fisheries Committee districts. Historical information is given first, with all available information on general distribution of the species, fisheries and abundance covered under the heading for each individual district. Current information is provided in the same format wherever possible.

Historically, the numbers of native oysters landed and cultivated within England and Wales are so much larger than in Scotland or Northern Ireland that the latters figures are considered insignificant in calculations of overall UK production of native oysters (Neild 1995). It is not until recently that the cultivation of the Pacific oyster within Scotland has made the figures of oyster production relatively significant in comparison with English and Welsh figures. Therefore, the data for the change in numbers of oysters landed within the UK are included in this section and presented in Figure 3. Data are included from the first available sea fishery statistics produced from 1886 onwards published in the Annual Reports of the Inspectors of Sea Fisheries (1886-1938) and later in annual Sea Fisheries Statistical Tables (1910-2000).

It is of note that no figures for production of Pacific oysters are included within the data, which therefore underestimates total production in more recent years (Neild 1995). Sea fishery statistics also report that totals for fish landed may or may not include any production carried out within fish farms, which again may reduce the accuracy of the data.

Figure 3 shows both the general decline in the oyster industry noted in the previous sections which occurred in the whole of the UK, and the short-term recoveries which occurred on occasion but did not produce a major recovery in the industry.

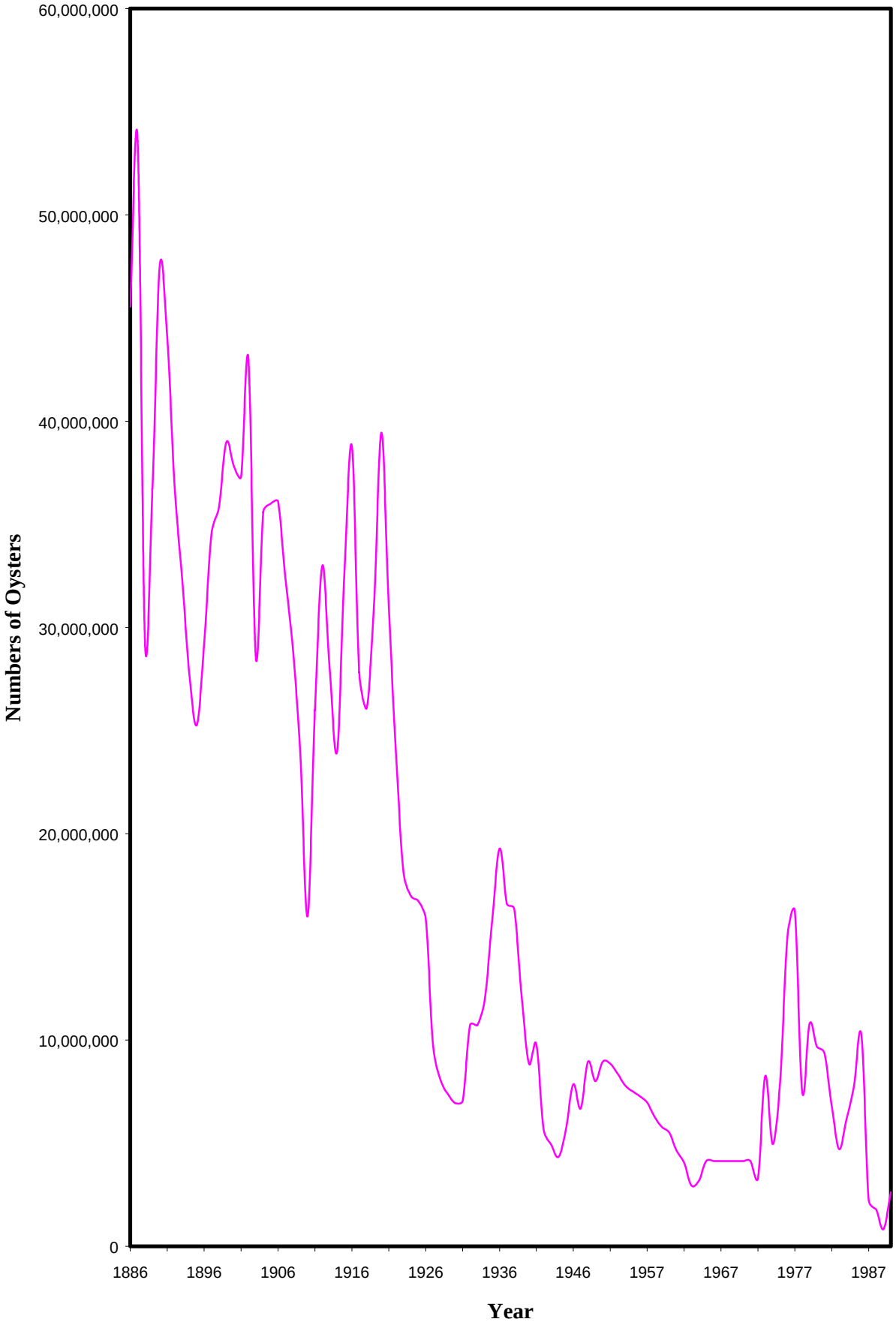


Figure 3: Native oyster landings in the UK (1886-1990)

4.1 Historical Information

4.1.1 NORTHUMBERLAND (BERWICK TO NORTH SHIELDS)

4.1.1.1 Berwick

Mention was made that in the 1860's oysters were present in North Berwick, found near the Bass Rock (wainea.demon. 2001).

4.1.1.2 Holy Island

Holy Island has had an oyster fishery for 600 years which according to various tourist information sources was originally created and managed by the monks of Lindisfarne. Buckland, in his report to the Select Committee on Oyster Fisheries in 1876 (HMSO 1876), described the oysters of Holy Island as very *handsome and fat* an unscientific description but sufficient to indicate the health of the fishery at this time.

4.1.1.3 Alnmouth

Records of have been made of an experimental laying of oysters at the mouth of the River Aln (HMSO 1876). This breeding experiment by the Duke of Northumberland failed due to the unsuitable substratum, sand. Further mention of this was made in a Brief History of Alnmouth where it was stated that in the late 18th century, oyster beds were built within the river but that these soon silted up. The nature of the coast further south within this region was described by Buckland as *containing nothing but rocks*.

4.1.2 NORTH EASTERN (SOUTH SHIELDS TO CLEETHORPES)

4.1.2.1 Tees

Buckland reported in 1876 that *there are not many oysters within the Tees* in his report to the Select Committee on Oyster Fisheries (HMSO 1876). In 1909 a Fishery Order was taken out for the mussel

fishery in the Tees but this showed a marked decline by 1914. This was attributed to increased manufacturing and reclamation of the of the Tees tidal foreshore, by the deposit of slag and other trade refuse (HMSO 1886-1938). The lack of oysters on the Fishery Order may indicate that the presence of a few, that were noted 30 years earlier, had disappeared. This was probably due to the same increased pollution and land reclamation which was causing the collapse of the mussel fishery.

4.1.2.2 Filey

Mention has been made that oyster shells have been found with Roman remains at Filey but no evidence of any local oyster beds appears to be available (Dobney *et al* 1996). Given the nature of Roman trade and transport mechanisms oysters found within waste deposits at Filey may have originated elsewhere possibly from the renowned oyster beds from the Thames Estuary which were heavily utilised by the Romans during their occupation of Britain (Yonge 1960).

4.1.2.3 Humber

Records exist of oysters being landed from within the Humber Estuary but that the numbers have been insignificant in comparison with other fishing activities in the region. Note was made that at Grimsby numbers of oysters landed have had little impact on the total landings of the shellfish since the early 1900s (Rees 1982). Mention is made by Bulstrode (1911) and Alward (1932) of the importance of 19th century oyster fisheries in the Humber where oysters were taken in quantities from the Tetney and Saltfleet grounds, both on the South bank of the Humber/North East Lincolnshire coast. Alward (1932) gives evidence of large offshore beds of oysters which were being utilised by Hull and Grimsby fishermen, in the eastern part of the North Sea. Buckland (HMSO 1876) also referred to large North Sea oyster beds producing large oysters, called the *Dogger Bank* oyster after the area of the North Sea where they were dredged. The extent of these beds was said to be 80 miles long and 20 miles wide and it is likely that it was these beds which the Hull and Grimsby fishermen utilised. In 1915, 3,000 oysters in total were landed in Grimsby, this is compared to a figure of 45,860 in 1913. Although figures prior to this time are not available it appears that the numbers of

oysters landed had decreased significantly from the levels indicated by Buckland to the time just prior to the First World War.

4.1.2.4 Cleethorpes

Animals taken on distant grounds were sometimes laid down in storage pits, *lays*, in the vicinity of the Clee Ness mussel beds to condition them for sale. This was carried out during the close season for local oyster fishing. The area used in the conditioning of the oysters was called the *Scorp*, a patch of hard ground off the Cleethorpes sea-front. An enclosed area was marked out and called the pit, and was sanctioned from the Woods and Forest Commission (Crown Estate). The area ran parallel to the beach for approximately one mile and with a depth seaward of one third of a mile. Tending and harvesting of the oysters took place at neap tides and was carried out by hand. Late modifications to the site included boreholes to tap into fresh groundwater supplies in an attempt to enhance the fattening of the oysters (Radcliffe 1996), with no evidence existing that there was any improvement in the oysters from the work. Following a number of cases of typhoid fever in 1903 caught by visitors to Cleethorpes from oysters, it was found that the source of the poisoning had been the oyster beds resulting from their proximity to sewage outfalls. This resulted in the total and permanent closure of the Cleethorpes beds. The main firms based at Cleethorpes, Osbornes and Mussons, moving their operations to Hunstanton on the Norfolk coast to continue their oyster production.

4.1.3 EASTERN (DONNA NOOK TO SHOTLEY)

4.1.3.1 The Wash and Norfolk Coast

The Wash is described by Buckland (HMSO 1876) as: *A large tract of shallow water which is cultivated on one side by the Corporation of Boston and on the other by the Corporation of Lynn.* The Corporation of Boston applied for, and was granted, a Regulating Order in 1870 which granted them 122 square miles to manage under the Boston Deeps Fishery Order. In 1876, the Boston Corporation reported to the Select Committee (HMSO 1876), that there were no oysters within

Boston Deeps. The Regulating Order was granted for both mussels and oysters and the records from the Sea Fishery Reports (HMSO 1886-1938) show no oysters have been taken from the area since the Order was granted. The inclusion on the Order of oysters may be an indication of the past presence and success of an oyster fishery, on the Boston Deeps, which no longer existed at the time of the report. Evidence given to the Select Committee in 1876 suggests that 1,000 oysters a day were dredged from the Order area at one time. However, in the opinion of the local smack owners, the closure of the oyster beds for three years, which occurred prior to them gaining the right to continue dredging, ruined the beds through lack of maintenance.

The Lynn Deeps were reported to be in a similar state of decline (HMSO 1876) and attributed by fishermen to both a period of closure whilst the Regulating Order was being implemented and a closed season enforced in the summer. The Lynn Corporation was said to employ 40–50 boats with 4–5 men per boat, most of them operating out of Boston. At the same time, it was also reported that The Wash contained a bank 40 miles long of which 33 miles was outside the jurisdiction of either the Lynn or Boston Corporations powers. Here it was said oysters were still plentiful and fished constantly. By 1915, the old oyster fishery within The Wash had all but disappeared with only *odd oysters* being taken by fishermen who were now concentrating on mussel fishing only. The exception to this was a relatively new fishery developed at Le Strange (Hunstanton). Fishery companies moved from Cleethorpes to Hunstanton after the closure of the former beds due to sewage pollution (see section 4.1.2.4). Relaying of oysters (both native and American) and mussels was undertaken on the beds throughout the First World War, but this appears to have had little success. By 1926, no oysters were cultivated on the site, with only mussels being exploited. In 1933 an experiment was carried out and 10,000 native and Portuguese oysters were relaid at the site, but the following year none could be found and it was stated that the experiment would not be repeated (HMSO 1886-1938). In 1936 and 1937 some oysters were dredged but no attempt was made to continue the oyster fishery by transplanting any further stock to replace that harvested.

There was also noted a number of large fattening beds on the coast of Norfolk present within rivulets and streams. The smaller oysters taken from the Boston and Lynn Deeps were used primarily on these beds, and those at Cleethorpes prior to their closure. This practice of dredging for the smaller oysters was suggested at the time by the Select Committee on Oyster Fisheries 1876 to be part of the reason for the observed collapse of the fisheries. Oyster fishermen strongly argued against this and blamed it on the close seasons imposed as a means of alleviating the problems (HMSO 1876).

4.1.3.2 River Orwell

The estuary of the River Orwell at Ipswich supported a major oyster fishery in the mid 19th century, with oyster brood being laid down after being harvested from elsewhere. Natural spatfalls were also recorded by the Ipswich Oyster Company in 1874, noting a good fall within enclosed waters (HMSO 1876). Other comments made by the company at the time were in relation to conflicts of interest with other fishermen, some of whom it was recorded, were dredging for oysters on private fisheries whilst declaring that they were only dredging for floating fish. The Ipswich Oyster Company declared it wanted greater powers to instate a fisheries officer, to inspect boats suspected of poaching and to restrict other fishing over private grounds to the hours of daylight (HMSO 1876).

4.1.4 ESSEX AND KENT (HARWICH TO DUNGENESS)

The Essex and Kent region historically contained the most important oyster beds within the country, not just for numbers but also for quality. Although *Ostrea edulis* is termed the native oyster today, in the past it was only oysters which had spatted and been reared in the tidal rivers and creeks between South Foreland and Orford Ness, an area where the substratum is London Clay, that were termed *native*. The oysters which could be named as *natives* commanded a greater price at market and those cultivating the oysters took great pride in not relaying brood from other oyster stocks onto *native oyste*r beds.

Generally, the Essex and Kent oyster grounds were producing many oysters up until the end of the 19th century and were still regarded as the largest producers and of the best quality product, within the country. The grounds were originally populated by wild stocks of native oysters and were self-sustaining. Overexploitation led to a decrease in natural spatfall and resulted in an eventual decline in numbers of oysters present on the public beds. Stocks on private grounds were initially maintained by imports of brood oysters from other areas but were later, also detrimentally affected by the introduction of the American slipper limpet, which came to infest many of the most important beds within the district. In 1895 an extremely severe winter caused severe mortalities of oysters throughout the region, increasing the pressures on the fisheries further. Harsh winters had been known before and the use of good management was known to reduce mortalities in hard times. Prior to the First World War, it was the custom to remove oysters from up-river sites in Essex and Kent, which were known to suffer from the effects of severe weather, and relay the oysters in pits dug at the sides of the estuaries. Mortalities within these pits was greatly reduced but the pits required extra labour costs to maintain them in a good state of repair. Cole (1949) states that the reduced labour availability during and after the war, coupled with the increased workload required to control the slipper limpet, resulted in a decrease in the relaying of oysters into the pits. Also, mild winters during the 1920s and 30s, coupled with the depression and slack oyster trade led to no maintenance being undertaken on the pits and the majority falling into a state of disrepair. The problems for the fisheries were exacerbated by two very severe winters in 1939-40 and 1946-47 where the losses experienced ranged from 50% or less on a few beds in 1940 to almost 100% losses in some upstream grounds the following year; the average losses for the whole of the east coast reached 75% (Cole 1940).

The occurrence of two extreme events of severe weather, caused those major oyster companies who did not rely solely on true *native* oysters to seek other warmer grounds in the south west of Britain. Three major companies transferred the main parts of their operations to the estuaries of the Fal and Helford Rivers, boosting the production in the south west but reducing that in Essex and Kent which further reduced the ability of the east coast oyster beds to recover. Many became derelict and were

overwhelmed by the slipper limpet. More severe weather was experienced in the east and south coasts in 1962-63 producing 70–95% mortalities on the Essex and Kent grounds (Waugh 1964).

4.1.4.1 River Colne

The oyster beds of Colchester and Whitstable were historically amongst the most famous and important beds within Britain. The fisheries of the Colne Estuary were mainly exploited by fishermen from Colchester and Brightlingsea. Rights to the oyster fishery in the Colne had been granted by Richard I for *time immemorial*, to the Corporation of Colchester.

The area of the Colne Fishery was 6 miles in length and 2 miles in width. Within this area there was reported in 1876 to be over 100 private oyster layings, leased from the Corporation (HMSO 1876). The largest company within Colchester, the Colne Fishery Oyster Company had a workforce of 73 in 1807, which increased to 280 in the early 1840s and over 400 in 1866 (Neild 1995). These figures are increased by the presence of apprentices who were not counted in official figures. A petition to Parliament in 1836 mentioned that there was up to 2,500 dredgermen within the parishes adjoining Colchester who were dependent on seeking oysters. It was also stated that in 1844 the Colne Fishery employed 500 fishing smacks and 2,000 men (Benham 1971). Between 1852 and 1862 the fishery was reported to have produced an average of 4,374 bushels of oysters annually, equivalent to a total of approximately 7 million oysters (1 bushel=approx 1,600 four year old oysters. (Yonge 1960)). The area of the oyster beds was guarded by the Corporation of Colchester and at various times leased as a whole, or else for a fee allowed local fishermen to dredge them (Yonge 1960). Any disputes arising from the fishery and individuals' rights were heard within an Admiralty Court held each year at East Mersea Stone.

From as early as the 18th century the Colne fishery, via an Act of Parliament came to be managed by a company of dredgermen and later, in 1870, the fishery was managed by a board consisting half of representatives of the Corporation of Colchester and half of dredgermen. Part of the management of the Colne included preventing sales of oysters for consumption in summer, although relaying during

this time was allowed. It was reported that prior to 1869 the Colne was a self perpetuating bed, with sufficient spatfalls to ensure viable oyster populations each year (HMSO 1876). From 1869 onwards both spatfall and the fishery progressively declined. This decline was gradual, slowed probably by the early management regime which protected the stocks to an extent but could not maintain the levels of exploitation seen in the 1850s and 1860s.

In 1876 100 boats were reported to be working out of Colchester, which mainly fished the deep sea beds (HMSO 1876). An account was included within the report of the extent of beds which were regularly exploited by Colchester oyster fishermen. Given below is a list of the areas fished by one Colchester oyster dredgerman over 42 years of fishing, taken from the account within the 1876 report. The areas fished were:

- For the south side of the English Channel: Jersey (south, middle and north grounds), Calvados, Fécamp, St.Vallery, Dieppe, Boulogne, Etables, Calais, Gravline, Dunkirk, Ostend, Durloo Channel, West Hinder and West Caple.

- On the north side of the English Channel: Helford, Falmouth, Portland Roads, Chichester Harbour, the Solent, Stokes Bay, Osborn Bay, Selsea Bill, Bognor, Shoreham, Seaford, Eastbourne, Straits of Dover (including all the mid channel beds).

- On the east coast of Britain: southward of Goodwin Sands, Kentish Knock, Shipwash, Orfordniss, Cromer, Lynn Deeps, the Humber, the Firth of Forth, the Blackwater, Hanford Water and Harwich Harbour.

Unfortunately, the narrative within the report gives no account of the numbers, if any, of oysters gained from each of these sites. Mention was also made of the technique employed by the oystermen in the search for financially viable beds. In brief, it was stated that dredging was carried out in a fairly random manner, after a site had been initially chosen, using experience gained of the conditions in which wild oysters would most likely be found in. If a test dredge contained sufficient oysters (40–50 individuals per dredge) the bed was regarded as commercially viable and the dredgers would continue until their holds were full or the oysters ran out.

4.1.4.2 River Blackwater

Comparisons of the difference management of fisheries can have when compared with unmanaged can be seen in the relative success of the Colne fishery compared to the earlier and more widescale decline of the Blackwater fishery. Equivalent in size and type, the difference between the two fisheries was the Blackwater was a public fishery with no restrictions on dredging, either for time or size of oysters. The Blackwater, therefore, became an area for dredging immature oysters for relaying in adjoining areas, a practice which steadily increased from the mid 19th century. The Colne fishery was restocked from the Blackwater and it was considered at the time of the Select Committee Report (1876) that the Blackwater provided excellent conditions for breeding but poorer conditions for fattening oysters. This may have been a belief put forward by the owners of adjoining private beds, to justify their continued exploitation of what was a public resource.

In 1868 the Blackwater (Essex) Oyster Fishery Order was granted, giving The Fish and Oyster Breeding Company rights over 350 acres of fishery within the Blackwater Estuary. Two other companies had tried to claim rights to the same ground, but the applications were refused on the grounds that the area requested was too large and potential improvements too vague. Another application for an area near Maldon, was rejected due to the company in question (Maldon Corporation) trying to use a Regulating Order to confer rights on their company, where the private fishing rights were already in dispute at the time.

In 1875 the Blackwater grounds covered by the Several Order were not producing any oysters. By 1915 no mention is made of a Blackwater Several Order in Fisheries Reports (HMSO 1886-1938).

The Tollesbury and Mersea Native Oyster Fishery Company was founded in the 1870s by a group of fishermen from Tollesbury, Mersea, Salcott and Bradwell, for the purpose of restoring and cultivating the oyster fishery in those parts of the Blackwater not already under private rights. The company's capital was converted into shares which were put on sale, allowing anyone who wanted to, to have a stake in the fishery. Half of the shares were made available for the fishermen to purchase and half for

the public, at £5 a share. The company set by-laws to manage the fishery, under the Tollesbury and Mersea Fishery Order and appointed water baliffs to police it. The baliffs were noted as being remarkably successful in catching and prosecuting poachers. Shares within the company were gradually acquired by the main exporter in Whitstable, which reduced public interest and led to a subsequent decline in the fishery. More recently a revival in the public ownership of the shares has occurred. The Tollesbury Company is the oldest surviving limited liability company in England (qlink. 2001).

Sea Fisheries Reports during the First World War show this fishery was doing relatively well, with good spatfalls noted and estimates of stock on the ground being approximately 4 million mature and 23 million immature oysters in 1916 (HMSO 1886-1938). At this time, the impact of the slipper limpet on the oyster beds within the region was already beginning to be noted. Limpet recruitment was very heavy in the area in 1916, this also coincided with a particularly harsh winter which caused heavy mortalities within the fishery. The management of the fishery slowed its decline but the period between the wars still saw the greatest reduction in oyster production from the beds. Some recovery occurred in the late 1930s with several good spatfalls, but the severe winters of 1939-40 and 1946-47 reduced the fishery to a level which had not changed in 1949 when Cole (1949) commented on it. The problem with limpet infestation continued ensuring that the oyster population did not recover to any great extent.

4.1.4.3 Rivers Roach and Crouch

The Roach and Crouch Estuaries have long been heavily exploited for oysters with the first recorded fishery being noted when Charles I granted exclusive rights to the Crouch Estuary to the Mildmay Family. In 1661 the rights to the oyster beds in the estuary were leased to local companies and over the years Crouch Oysters became well known . By the late 18th century the oyster beds were commanding large rents and employed many men, some in cultivation and others to protect the beds from thieves (burnham. 2001).

Both the Roach and Crouch estuaries supported good fisheries, with the River Roach fishery having been achieved by an Act of Parliament, the Roach River Fishery Act 1864. A further Several Order was granted in the estuary, the Paglesham Fishery Order, in 1874. The fisheries remained in good order with only a gradual decline noted. The presence of slipper limpets together with severe winters, prevented a recovery of the fisheries to their former levels, with heavy recruitment of limpets coinciding with light spatfalls of oysters. As elsewhere in the region good management slowed the decline of the fisheries but could not stop it.

4.1.4.4 Southend

In the early 18th century oyster breeding grounds were found offshore of Southend which led to an expansion of the settlement at the time (southend-index. 2001). No further records of the oyster beds were seen within the 19th century records which may indicate that the beds were fished out.

4.1.4.5 Rochester and Medway

The Medway once supported a thriving oyster industry used by a number of large companies. Overfishing appears to have diminished the fishery, with many companies competing for spat to relay on their own grounds. Between 1868 and 1876 various sections of the grounds were leased by the Rochester Company to a number of other smaller companies. All recorded no natural spatfall on the fishery during this period (HMSO 1876).

4.1.4.6 Faversham

A co-operative, The Company of Free Dredgers, was noted as working the Faversham Oyster Fishery in the time of Henry II (1154) and shipping oysters to Holland (Collard 1902). The company was later called The Faversham Oyster Company and was regarded as owning the oyster beds in the vicinity of Faversham. Reports (HMSO 1876) were made by the company in 1876 that spatfalls had been indifferent in the preceding years but it can also be seen that the level of exploitation of the local resource had increased from 37 bushels taken in 1868 to 110 bushels in 1875. No size restrictions

were placed on harvested oysters at this time although a close season between May and August was adopted.

4.1.4.7 Whitstable

The greatest oyster beds in terms of numbers produced were to be found in Whitstable in the 19th century. The dredgers worked on the Kentish Flats, in an area of approximately 6 square miles within which some areas were specifically noted for their breeding characteristics whereas others areas were noted for the fattening which occurred on oysters relaid in them. The Whitstable Oyster Company owned most of the grounds with an area 1¾ miles north to south and 2 miles east to west. Within this was an actual laying ground of a mile square with other space for moorings (Figure 4).

The area cultivated by the Whitstable Oyster Company was policed constantly by three watch boats to prevent poaching This area differed from the surrounding public grounds, in that it was protected from the action of tides and waves, by the presence on the eastern side of the grounds of a boulder and shingle bank. This bank was known as *Whitstable Street* and acts as a breakwater, it is also thought to have had Roman origins as building foundations could be seen at low tide (Collard 1902).

The numbers of men working for the Whitstable Oyster Company increased from 36 in 1793, when the company was created out of an ancient corporation in the nature of a guild, to 408 in 1866 (300 directly working on the oyster beds). Although pride was taken to maintain Whitstable oysters as *native*, it was not unknown for oysters from elsewhere to be relayed on the grounds. In 1769 notice was given in the *Kentish Gazette* that £600 of oysters had been bought by the Oyster-men's Company of Whitstable (the forerunner of the Whitstable Oyster Company) from West Country Oysters, for relaying on the Whitstable grounds (Collard 1902). The use of the beds was similar in 1876 when it was reported that the beds were used mainly for fattening. Brood and spat were obtained mainly from the Essex coast but also from Ireland and Holland and occasionally, exceptionally good spatfalls benefited the beds and boosted the imported stock on the beds. The level of care and maintenance that the beds received was large, with 8 men per acre being employed for the job (Yonge 1960).

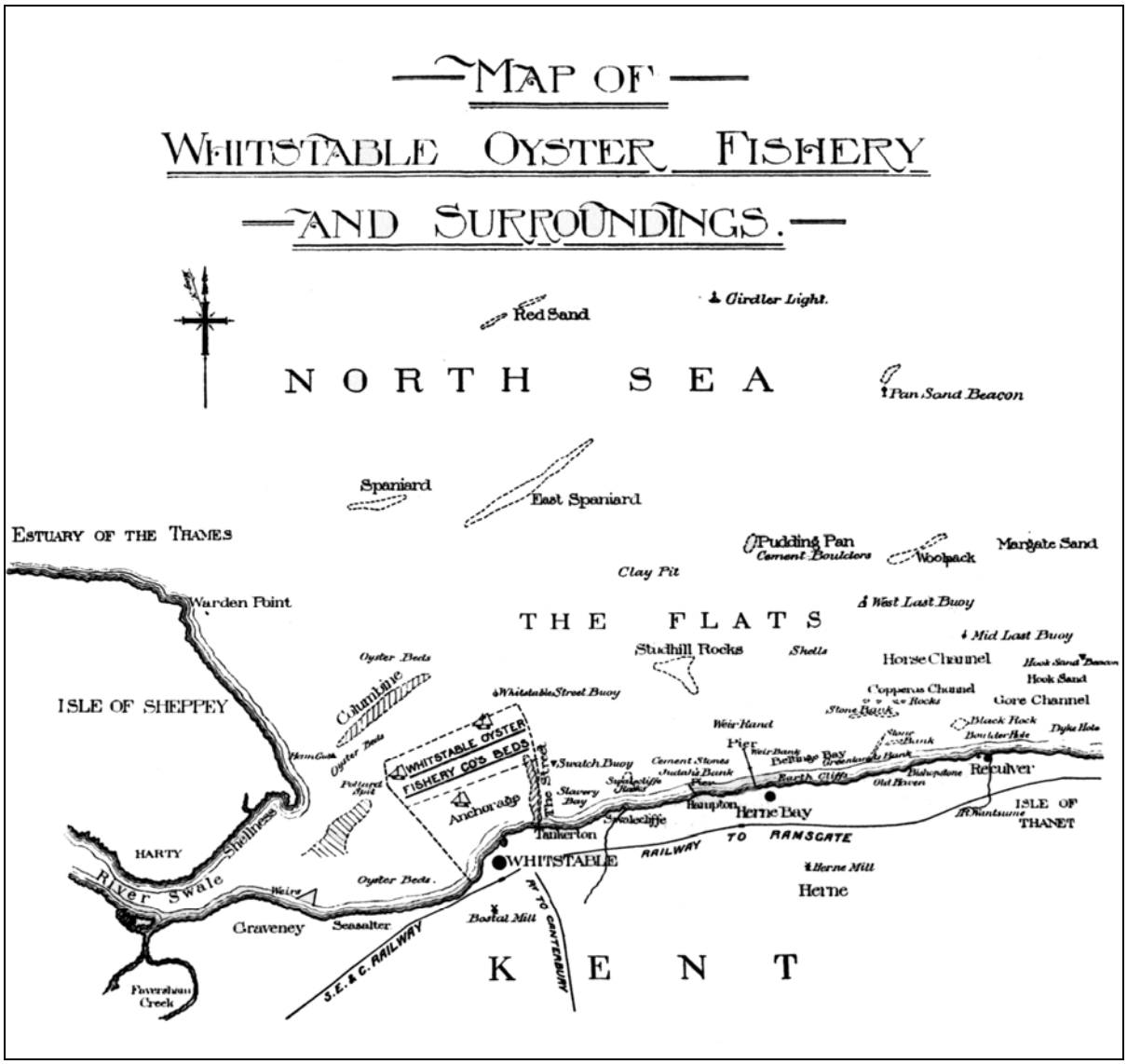


Figure 4: Map of Whitstable Oyster Grounds in 1902 (reproduced from Collard 1902).

The beds were dredged normally on a daily basis, care for the beds and removal of pests was carried out on three days and harvesting for the London market carried out on the following three days. Collard (1902) reports that immense quantities of oyster brood were brought from France and elsewhere to fatten on the Whitstable beds, with total annual production given at between 10 and 15 million oysters; 300 men were employed at this time and 80 fishing smacks were involved with oyster fishing from Whitstable. In 1913 the numbers of oysters landed remained the same at 14 million but by 1950 this had dropped to 4 million and following the severe winter of 1962, to 39,000 in 1963.

4.1.4.8 Herne Bay

The Herne Bay oyster fishery was located to the east of Whitstable and was operated under the jurisdiction of the Herne Bay Fishery Act 1864. Under this Act, 9 square miles of fishing grounds were allocated to the Herne Bay Oyster Company and it appears, through evidence given to the Select Committee 1876, that the fishery had already suffered from a considerable collapse in fortunes prior to the granting of exclusive rights in 1864. It was reported that its earlier status as a public fishery resulted in the grounds being in a depleted state. Despite a large investment in spat and brood to relay on the beds, the Herne Bay Oyster Company declared little success by 1876 (HMSO 1876). An investigation was held in 1874 and 1875-76 into the condition of the grounds which were found to be in an *unsatisfactory* state; this was defended by the company by stating that when they received the grounds they were already devoid of oysters.

No note is made of the fishery in later Sea Fisheries Reports which suggests that the fishery never recovered and was eventually abandoned (HMSO 1886-1938).

4.1.4.9 Ramsgate and Margate

No fisheries were recorded within Ramsgate or Margate but note was made by Buckland (1876) of the deep-sea oysters which were landed there, probably from the deep beds located within the English Channel (HMSO 1876).

4.1.5 SUSSEX (RYE TO SELSEA BILL)

4.1.5.1 Brighton

There were no recorded fisheries adjacent to Brighton although Fleet (1850) indicates that boats based at Brighton dredged for oysters on off-shore grounds. The beds lay 30 miles to the S.S.W of Brighton in about 30 fathoms (55 m). Note is made that between 400 and 500 oysters were taken per trawl but were considered as low quality *Brighton Oysters* which only commanded a low price.

4.1.5.2 Shoreham

This oyster fishery became important after the arrival of the railways in the second half of the 19th century. Newly discovered large natural beds of oysters off the Shoreham coast attracted many new fishermen to the area, swelling the normal oyster fishermens numbers within the town. These fishermen came mainly from East Anglia and brought prosperity to the town, which lasted until the end of the century. At its height, in 1869, the port had a total fishing fleet of 295 boats and employed 740 men and 89 boys (ourworld.compuserve. 2001). Storage pits were also constructed around the Adur Estuary for the purpose of keeping harvested oysters alive and in good condition, prior to transportation to market. No fattening of the oysters was undertaken during this time.

The oyster fishery was a natural one and, unlike the Thames grounds, was not restocked from imported brood, it therefore, suffered considerable overfishing. One newly discovered bed off Shoreham was notably reported as being dredged out within 48 hours of its discovery (HMSO 1876). By the end of the 19th century the oyster beds no longer supported economically viable populations of oysters and there has been no recorded recovery since.

4.1.5.3 Selsey Bill

Oysters were noted to be present by Buckland, arising from the sinking of a ship within the area. After this event oysters were reported as being dredged from the surrounding site (HMSO 1876). No other mention of Selsey with relation to oysters has been noted and the occurrence of oysters, arising from the sinking of a ship is considered unlikely (S. Lockwood (CFCM) pers. comm.). Therefore, it is possible that the sinking of the vessel concentrated attention and fishing effort within the area (wrecks are targeted by fishermen) and thus, a previously unexploited oyster ground could have been discovered.

4.1.6 HAMPSHIRE, ISLE OF WIGHT AND DORSET (EMSWORTH TO LYME REGIS)

4.1.6.1 Chichester and Emsworth

The area of sheltered waters present around Hayling Island has a history of oyster dredging and cultivation dating back to the Roman times (Hantsweb 2001). The port of Emsworth was important with respect to oyster quality and numbers in the middle of the 19th century, with two separate Several Orders granted in 1870 (45 Acres) and 1871 (300 Acres) for the Emsworth Channel. Further development occurred with the establishment of breeding grounds in Chichester Harbour. The largest development of the local oyster fishery occurred with the opening of the Brighton and South Coast Railway in 1865 which allowed direct access to inland markets, particularly Billingsgate in London. The South of England Oyster Company utilised the new commercial operations, made possible with the opening of the new railway, which occurred at around the same time as the company was formed; prior to this the beds around Hayling East had been privately owned (Hantsweb 2001).

In 1902, mayoral banquets were held in Winchester and Southampton and in both instances many people who attended developed enteric fever (typhoid). Four people who attended the Winchester event subsequently died and the cause of the typhoid outbreak was eventually traced to oysters, supplied to both events, from the beds at Emsworth. Although this had a major effect on oyster fisheries around the UK, and resulted in a greatly reduced production in the Hayling Island area, it did not spell the immediate end of the fishery. The initial survival of the fishery was due mainly to the Government's inaction on the shellfish hygiene case thereby, allowing the fishery which was proven to be contaminated to remain open. Although the Emsworth fishery was noted to have collapsed following the 1902 incident the fishery was still in existence and oysters were still being landed, albeit on a greatly reduced level in 1924. No oysters were taken from the site and little spatfall was noted from 1925 to 1937, when an unsuccessful attempt was made to restock the beds with imported native oysters (HMSO 1886-1938).

4.1.6.2 Langstone

Langstone Harbour was developed by the Victorians following the opening of the Hayling Branch line on the London, Brighton and South Coast Railway in 1865 (Havant Borough 2001). The development consisted of a series of lagoons which were formed by the construction of London Clay embankments topped by chalk, shingle and brickearth, which enclosed parts of the intertidal area.. Significant timber pallisades were also constructed towards the seaward side of the beds. The lagoons filled with water via tidal overtopping of the embankments, with subsequent outflows regulated by sluices and wind driven pumps to maintain good levels and quality of water on the beds and allowing access when necessary (Havant Borough 2001).

The fishery declined gradually until pollution and disease forced its closure after the First World War. The site fell into a state of dereliction with the embankments eroded and the sluice gates collapsed. In 1963 the railway, which had allowed the increased exploitation of the site, was closed and the area was purchased by the council for refuse disposal, which occurred until 1974.

This pattern of decline and closure was noted for many of the small oyster grounds in the creeks and estuaries in the vicinity of Hayling Island and Portsmouth (Cole 1949). With no major oyster beds being noted east of the River Yealm in comparison with the list given by Bulstrode in 1896 (cited in Cole 1949) which included Bosham, Emsworth, Chichester and Poole. The oyster grounds on these sites were later reported by Cole (1949) as being abandoned. At the peak of its productivity, there were reported to be up to 40 boats operating out of Bosham working the oyster beds within the Solent (Sussex Life 2001). The oysters that were dredged were brought back to private lays within the harbour although, this fishery ended after the First World War with the appearance of the slipper limpet. In recent years the former beds are being revitalised.

4.1.6.3 The Solent (Hamble & Isle of Wight)

The estuaries of the Medina and Newtown Rivers on the Isle of Wight were classed as fattening and artificial breeding grounds by the time of the Select Committee report (1876). Only one spatfall had

been noted within the Medina since 1867. The main private oyster beds on the Medina were operated by the Isle of Wight Oyster Fishery Company Ltd, although a large amount of the area appears to have remained as a public fishery. The decline of the beds can be seen by the reduction in amount of oysters sold from this fishery, from 1,766,715 in 1868 to 315,000 in 1875. The public fishery almost certainly was suffering a similar, if not worse, decline as up to 1876 it had served as the primary source of brood and spat to be relayed on the neighbouring private grounds. Intensive dredging for brood within the summer months was carried out, with an associated decrease in recruitment to the beds being dredged.

Newport had a fairly successful oyster fishery in the mid to late 19th century as did the private company located at St Helens. The natural oyster beds within the Solent had suffered the same decline as other grounds with a free unregulated resource. The public grounds were again utilised by local dredgermen, who harvested adults as well as stock for selling on to relay on other private grounds, also large numbers of oysters from the Solent were removed to Irish grounds. In separate attempts to regulate the whole of the Solent, two groups of companies attempted to have the whole of the Solent included in a Regulating Orders in 1866. Despite the Board of Trade recognising the advantage of having active management and conservation by interested parties, it refused the applications on the grounds that the area was too extensive and the companies had too many conflicting interests in neighbouring areas. The oyster grounds, therefore, gained no real regulation and oysters became scarce.

Aflalo (1904) wrote that: *The only fishery in the Solent is the oyster-fishery belonging to Paskins at Newtown. A few little boats are, it is true, engaged in desultory hooking out of Portsmouth and Southampton, but their aggregate catching power is so small as to be negligible.* The oyster fishery was therefore still considered important in comparison to other fishing activities and other areas where oyster dredging was carried out, despite the noted decline in the numbers being taken from the Solent. The oyster industry within the Solent followed the pattern of many within the UK with a continued decline through the First World War and a noted collapse after 1920.

In recent years the oyster grounds of the Solent have undergone something of a revival. This is thought to arise from the transport of oyster larvae from imported oysters laid in nearby areas, to the Solent and gradually multiplying. In the 1950s about 100 tonnes of young Brittany oysters and some half grown Dutch oysters were laid in the estuaries of the River Beaulieu and the River Newtown on the Isle of Wight. This was considered as a financial venture which failed but in 1971 the area was surveyed and the beds of the Beaulieu Estuary and Stanswood Bay was found to be full of oysters.

4.1.6.4 Poole

Poole Harbour suffered a very similar fate as other fisheries already noted within the region. Extensive beds which were once productive, were being fished out by the end of the 19th century. Extensive mortalities of oysters were noted in 1920 (HMSO 1886-1938), this was followed by a short recovery of the fishery, with 150,000 oysters reported as being taken from the grounds in 1926. At this time reports were made of an infestation of a sponge-like organisms smothering some parts of the oyster fishery. By 1934, no oysters were dredged from the grounds, following a notable decline of the fisheries over the previous decade.

4.1.6.5 The Fleet

Oyster fishing and culture in the The Fleet Lagoon has been recorded since before medieval times (Copperthwaite 2001). Oysters occurred naturally within the lagoon behind Chesil Beach and were exploited by many different people. Early rights to the oyster grounds were held by the abbot at Abbotsbury, but these was taken in 1543 by Henry VIII and passed on to Sir Giles Strangways, the descendants of whom still hold title to the grounds today. In 1630 an unsuccessful attempt was made to drain part of The Fleet in a bid to reclaim land. This put further pressure on an oyster fishery which had already been persistently exploited, resulting in a notable reduction in the populations within the lagoon. In 1743 Captain Lysle made the first attempts at oyster farming within the lagoon by importing 30 tonnes of seed oysters from Concale, France in an attempt to increase the diminished natural population within The Fleet.

Cultivation on a small scale appears to have been carried out within the lagoon for the next century. However, no large fishery was noted as being present at the time of the Select Committee on Oyster Fisheries (1876), with Buckland stating in the report that the area would be good for oyster production, but was quite muddy. This may suggest that siltation contributed to the decline of the fishery. In 1880 a Fever Isolation Hospital was opened at Ferrybridge near to the oyster beds and is considered by Copperthwaite (2001) as the reason for the final closure of the beds. In the 1970s the area once again started to be utilised for oyster production, first in trials by MAFF and later by oyster farming, although it is now the Pacific oyster which is cultivated in The Fleet.

4.1.7 DEVON, SOMERSET AND AVON (AXMOUTH TO PLYMOUTH ALONG THE SOUTH COAST AND CLOVELLY TO THE SEVERN ESTUARY ALONG THE NORTH COAST)

4.1.7.1 River Exe

In the General History of the County of Devon (GENUKI: Devon History 1850), extensive oyster beds are noted as being present at Starcross, Newton-Ferrers, and Topsham. Further note is made of the presence of 19th century oyster fisheries in the Exe Estuary (Combs-families. 2001). At Star-Cross there were oyster beds to which oysters were brought from Weymouth, Poole, Saltash and the Teign Estuary and that the beds were used for the fattening of the oysters prior to them being sent to market at Exeter. In 1865 Ellis noted that 10 persons were working within the oyster fisheries. He also notes that within the preceding 2–3 years the oyster had become increasingly scarce within the estuary, due to overdredging. The quality of the Exe oyster is stated as being comparable to that of the best Thames varieties, with good flavour. Given the quality of the Exe oyster, the Exeter Naturalists Club undertook an experiment to try to reintroduce the oysters, to parts of the river which had been dredged out; the experiment was only partially successful.

4.1.7.2 River Teign

As noted above, in the 19th century oysters from the Teign were harvested and taken to the Exe beds for fattening. They were also taken to fattening grounds within the Thames, for eventual sale within the London markets. In 1865, two people were employed full time within the oyster fisheries (Ellis 1865).

4.1.7.3 River Dart and Salcombe

In 1865, the oyster industry employed 40 people within the Dart and on the coast (Ellis 1865). In 1872 a Several Order, the Salcombe River Fishery Order was granted which covered an area of 96 acres within the estuary for the cultivation of oysters and mussels. The owner of the fishery rights, J. Russel, unsuccessfully carried out an experiment to relay American oysters on to the beds in 1872-73 and the company who took on the venture, the Anglo-American Oyster Company was liquidated soon afterwards (HMSO 1876). There is no other indication of any other significant commercial activity taking place on these oyster beds.

4.1.7.4 Plymouth Sound and River Tamar

In 1865, the oyster fisheries employed 10 people within the Tamar Estuary and 5 within Salcombe Creek, with many small naturally reproducing oyster beds being noted as exploited within the Tamar and its tributaries (HMSO 1876).

4.1.8 CORNWALL (RAME HEAD TO BUDE)

4.1.8.1 Fal Estuary and River Helford

Ellis (1865) noted the increasing scarcity of oysters within England and how merchants were seeking further afield within Britain and Ireland for brood to replenish the large beds within East England and France. This had a financial effect on the productive beds within the Fal Estuary with the price of oysters rising from 2 shillings (£0.10) per tub to 20 shillings (£1.00). In turn, this produced a very

large increase in the numbers of dredgers within the area and reports of unscrupulous activities, as fishermen competed to exploit the resource. Up to 300 dredging boats were noted working within the harbour at one time and the oyster fishery employed 380 men from Falmouth Harbour.

A *Tub* was a traditional measure which Ellis (1865) stated would normally hold 900 mature oysters although, in 1865 oysters were being taken at far smaller sizes from the Fal, thereby allowing 1,800 oysters to fill a tub. Ellis expressed concern at the over-dredging of the beds at this period and the need for greater legislation to control the over exploitation.

The extensive natural beds of the Fal Estuary, which covered an area of approximately 4,000 acres from Truro to the mouth of the river at Pendennis Point, were administered by the Corporations of Truro and Falmouth under powers conferred on them by Provisional Orders made under Part III of the Sea Fisheries Act 1868. This allowed for the management of the northern fisheries by the Truro Corporation and the more southern extent by the Falmouth Corporation. Three applications were made for Several Orders for the oyster grounds, with two being granted, which gave the two corporations the powers to issue licences and charge for the right to dredge. Other rules laid down were to limit the size of oysters taken and the times of dredging, rules for varying closure times and other by-law making powers. With regard to Truro, by-laws made in 1879 required that dredged culch must be relaid and that the maximum hours for dredging were nine per day. In 1889 further by-laws extended the standard closed season to include April and September.

Further by-laws applicable to both fisheries were made in 1896 and 1898 by the Fowey Board of Conservators, under the powers conferred by the Sea Fisheries Regulations Acts 1888 to 1894. Prior to the outbreak of the First World War, the beds of the Fal Estuary became highly contaminated with sewage discharged from the town of Truro. Consequently the Fishmongers' Company banned all oysters from the estuary, except for two small privately owned creeks. Although they did not prevent the dredging of the oysters, they did prevent their sale for consumption. The overall result of this ban was to force the sale of the Fal oyster to foreign businesses for the specific purpose of relaying. The oyster trade within the Fal thus became dependent on the European market, specifically the French,

which was stopped with the outbreak of the First World War and resulted in associated hardship for the local oyster dredgers. An investigation into the problem was undertaken by Professor Gardiner of Cambridge University (HMSO 1886-1938), who suggested using the under exploited resources of the neighbouring Helford Estuary for purposes of oyster relaying. Gardiner highlighted the fact that the Helford, at the time, had no sewage contamination at all and had the possibility of becoming an important fishery in its own right. The initial experiment began in 1915 and covered the whole of the Helford Lower Rights, which were managed by Prof. Gardiner for the Duchy of Cornwall. The success of the venture can be seen by comparing statistics for the 1915 catches, with those of the 1919 season. In 1914-15 the sale of oysters was 71,000 compared with 1,250,000 in 1918-19, the stock on the ground was under 100,000 in 1915 compared to an estimated 5,500,000 in 1919. The fishery was called the Duchy Oyster Farm and good management involving high intensity bed preparation, culch laying and the favourable quality waters with no slipper limpet presence, combined to make the grounds good for oyster culture.

In 1924 surveys by Orton (1927) showed a decrease in oyster production on the Fal beds despite improvements in water quality and quite stringent management. A minimum in production was reached in 1926 (Orton 1927), it was reported in *The West Briton* newspaper that the continued decline was due to over-dredging but that the beds could be nursed back to good condition with careful husbandry.

Orton's survey of the Fal Estuary in 1939 showed little recovery from the slump of 1926, which was attributed to the lack of available culch on the grounds and therefore little suitable substrate for settlement in large areas of the Estuary (Orton 1940). Further problems were recorded with the presence of tube worms and burrowing sponges within the Estuary, which affected the oysters. However, these problems were minor in comparison with the effects that the slipper limpet were having on oyster grounds in the south east of England at the same time.

Yonge (1960) stated that the fisheries of Cornwall were amongst the most productive within the country. This was due to a number of factors, but primarily the oyster grounds had suffered less

severely from pests, diseases and severe weather than other areas within England and the movement of oyster producing companies, previously based within the Thames region, had boosted production. The coldest winter for 200 years occurred in 1962-63, with 95% of stock around the UK being destroyed (Key 1991). The oysters within the south west of England although affected, did not suffer the same degree of mortalities as other grounds and were therefore quicker to recover. This period marked a shift in the importance of oyster production from the most important areas in terms of oyster production moving from the east of England to the south west.

The relative success of the Fal and neighbouring grounds was attributed to the successful use of by-laws limiting the effects of overfishing and dealing with problems effectively, as when they arose. The maintenance of low impact fishing techniques within the main fishery also contributed to the overall survival of the fishery, with by-laws having been made to prohibit the use of powered vessels or powered winches for oyster dredging. This ensured that the fishery never became too industrialised and that each fishermen could be assured of a share of the oysters on the grounds.

4.1.9 CHESHIRE AND LANCASHIRE (WIRRAL TO BARROW)

4.1.9.1 Mersey Basin and Liverpool

Oysters were recorded as being caught within the Mersey Estuary near Warrington until the late 18th century (Mersey Basin-a brief history 2001). At the beginning of the 19th century rapid expansion of the textile industry in Lancashire led to a great increase in chemical wastes being discharged directly into the rivers and seas of the region, this had a direct detrimental effect on the natural oyster beds which went into a steep decline and never recovered. In 1886 a survey of Liverpool Bay and surrounding seas by the Liverpool Marine Biological Committee noted occasional individuals of the native oyster within dredges from Liverpool Bay as well as Southport (Liverpool Marine Biological Committee Report 1886). The same survey reports the numbers of oysters at Blackpool and Fleetwood as being rare and that fewer numbers still, occurred in the north of the Isle of Man.

Blackpool was renowned for its oyster trade, especially amongst holiday makers, but the supply came mainly from Ireland and Beaumaris in North Wales, there were no oyster beds of note off the Blackpool coast.

Extensive native oyster beds have also been noted as having been present within the waters adjacent to Walney Channel, Barrow-in-Furness and North Morcambe Bay (W. Cook (North Western and North Wales SFC) pers. comm.) although further information on these oyster grounds is not recorded.

4.1.10 CUMBRIA (MILLOM TO SILLOTH)

No written records were found of the occurrence of any native oysters off Cumbria, although, some native oysters may have been present at the South of the district (Cumbria SFC unpubl.).

4.2 Current Information

The current information for the native oyster distribution, abundance and fisheries in England comes from a number of sources. Wherever possible the most up-to-date information available has been included, however, as not all surveys and information gathering took place at the same time it should be noted that data comparisons are not always possible and that information contained within one figure or table may be made up of data from different times.

The primary data sources for fisheries information were *The coastal fisheries of England and Wales, Part III: A review of their status 1992-1994.* (Gray 1995), *JNCC Coasts and Seas of the U.K. Regions 5-13.* (eds Barnes *et al* 1995) and summary information provided by the Sea Fishery Committees for each district in England.

General occurrence information is taken primarily from the Marine Nature Conservation Review (MNCR) and the National Biodiversity Network with any additional information from other published sources and anecdotal records added in where found.

4.2.1 NORTHUMBERLAND (BERWICK TO NORTH SHIELDS)

4.2.1.1 Fisheries

Gray (1995) recorded that one man cultivated both Pacific and native oysters to a lesser extent within *poches* (large mesh sacks), on the intertidal mudflats south of Holy Island (Gray 1995). There are no other oyster fisheries recorded within this region and the Northumberland SFC recently noted that this fishery now only cultivates Pacific oysters (Northumberland SFC unpubl.). Table 6 shows the designated bivalve mollusc production areas within the region that produce oysters (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters).

Table 6: Designated bivalve mollusc production areas producing oysters in Northumberland (effective from 1 September 2000).

Production Area	Bed Name	Oyster Species	Class	Comment
Holy Island	Ross Links Area	Pacific	B	Classification may be subject to review

Reproduced from CEFAS figures required under EC Directive 91/492/EEC

4.2.1.2 General Occurrence

No record has been made of any native oysters being found within any surveys which have taken place within this region.

4.2.2 DURHAM, CLEVELAND AND YORKSHIRE (SOUTH SHIELDS TO CLEETHORPES)

The location of cultivated and natural native oyster populations is given in Figure 5.

4.2.2.1 Fisheries

The North Eastern Sea Fisheries Committee records no commercial fisheries for wild stock within the region and no cultivation. There are records of some oysters occasionally being taken by vessels from Cleethorpes, Tetney and Humberston (Gray 1995) but this is probably small isolated numbers of oysters taken as a by-catch from other fishing efforts. Records are also made in the NRA (1993) Humber Estuary Management Plan that oysters are fished from Immingham to South Ferriby but with reduced levels since over exploitation damaged stocks in the 1970s.No areas are designated as bivalve mollusc production areas for the production of oysters (Pacific or native) within the region, also Scarborough is designated as a prohibited area for bivalve mollusc production, with a ban on production and collection at all sites in the area.

4.2.2.2 General Occurrence

The presence of the native oyster is marked on a native oyster distribution map given in Davidson *et al* (1991), which confirms the presence of the oyster off the Cleethorpes coastline. Data for this map are taken from 102 review sites. However, no note is made of this presence in the later MNCR database or on the National Biodiversity Network map.

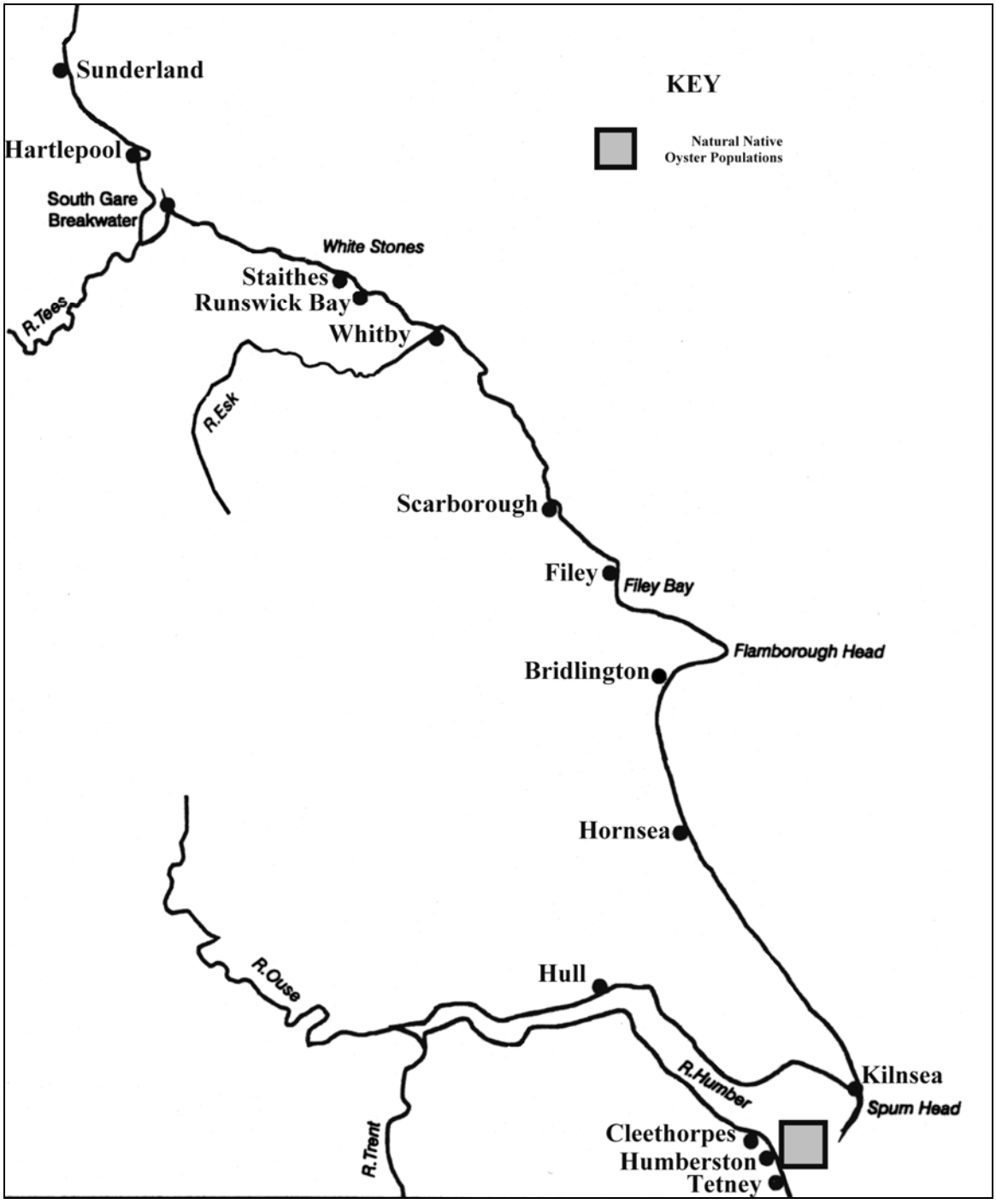


Figure 5: Map of Durham, Cleveland and Yorkshire, showing cultivated and natural oyster populations (modified from Gray 1995).

4.2.3 LINCOLNSHIRE, NORFOLK AND SUFFOLK (DONNA NOOK TO SHOTLEY)

Data for the location of cultivated and natural native oyster populations is contained in Figure 6.

4.2.3.1 Fisheries

The majority of oysters cultivated within the region are Pacific which are cultivated within The Wash and some of the small estuaries on the North Norfolk coast. Native oysters are only farmed on a few sites (Gray 1995). Native oysters are cultivated within the estuaries of the Rivers Blyth and Ore and Butley Creek (Gray 1995). Holding pits have also been constructed within the latter two, to store molluscs prior to first sale. Naturally occurring native oysters are dredged in small quantities from beds within the Deben Estuary. Table 7 shows the designated bivalve mollusc production areas within the region that produce oysters from September 2000 (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters).

Table 7: Designated bivalve mollusc production areas producing oysters in Lincolnshire, Norfolk and Suffolk (effective from the 1 September 2000).

Production Area	Bed Name	Oyster Species	Class	Comment
The Wash - Boston	Clay Hole, Toft Ridge and Toft South	Pacific	B	Classification may be subject to review
Brancaster	Brancaster	Pacific	A	
Blyth	Blythburgh	Pacific	B	Classification may be subject to review.
River Alde	Home Reach	Pacific	B	
Butley	Creek	Pacific	B	

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

4.2.3.2 General Occurrence

There is no record of native oysters having been noted in recent surveys of the region although there is evidence of small numbers of natives present within the Deben as some dredging is recorded of natural stocks as previously noted (Gray 1995).

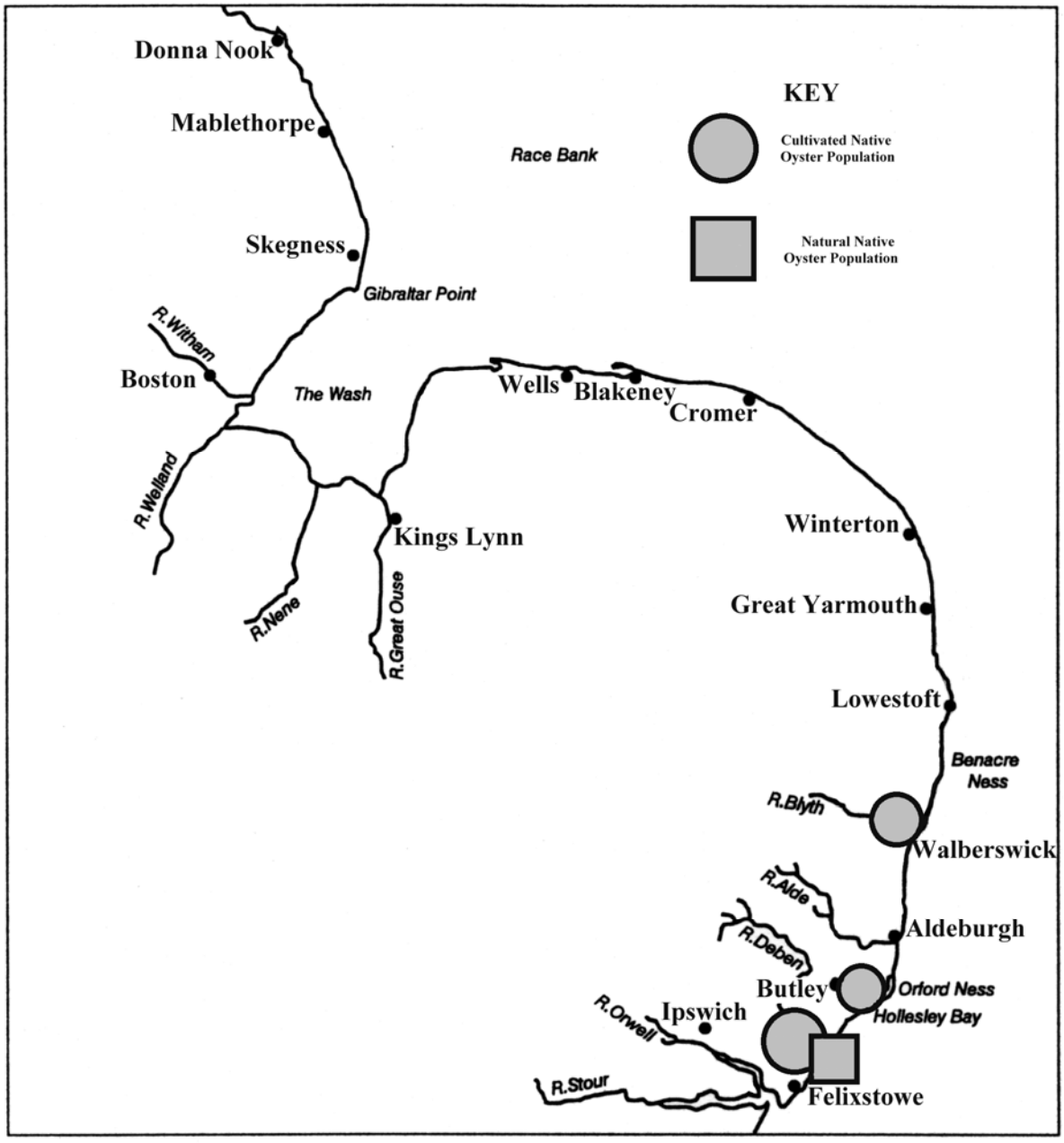


Figure 6: Map of Lincolnshire, Norfolk and Suffolk, showing cultivated and natural oyster populations (modified from Gray 1995).

4.2.4 ESSEX AND KENT (HARWICH TO DUNGENESS)

4.2.4.1 Fisheries

There are wild and cultivated native oyster stocks along the Kent and Essex coast (Figure 7). In some areas, hatchery reared Pacific and native oysters are relaid onto growing beds during spring, later harvesting occurs from late summer through to spring. Kent and Essex by-laws limit the length of oyster dredges to a total of 4 m per boat and prohibit the taking of oysters with a diameter less than 6.5 cm. Wild oyster fisheries off the coasts of both Essex and Kent start in late September. Up to six Kent based boats work the free grounds to the 'East of Street' and the Kentish Flats and one or two Essex boats work grounds close to the mouth of the Blackwater Estuary. The boats work on average 4 days per week and the smaller boats take around 400 oysters per day, whereas some of the larger vessels can take up to 2000 oysters. Most of the oysters are sold on to Essex based growers to be relaid for fattening on private grounds.

4.2.4.1.1 HAMFORD WATER (HORSEY ISLAND)

Native oysters, as well as Pacific, are cultivated within Hamford Water at Horsey Island. A Several Order for oysters, granted in 1963, covers an area of 25 ha within which the oyster fishery occurs.

4.2.4.1.2 RIVER COLNE - (BRIGHTLINGSEA AND WIVENHOE)

Bonamia ruined the native oyster fisheries of the River Colne in the 1980s, following the gradual decline already noted from the turn of the century. However, a slow recovery has been noted since the early 20th century. Several boats, based within the Colne, dredge for native oysters further offshore.

4.2.4.1.3 WEST MERSEA (INCLUDING TOLLESBURY)

The Blackwater Estuary has had two several orders granted within it: The Tollesbury and Mersea (Blackwater) Fishery Order (1938, renewed in 1999), covering 894 ha and the Old Hall Farm Creek Oyster Fishery (1972) covering 5 ha.

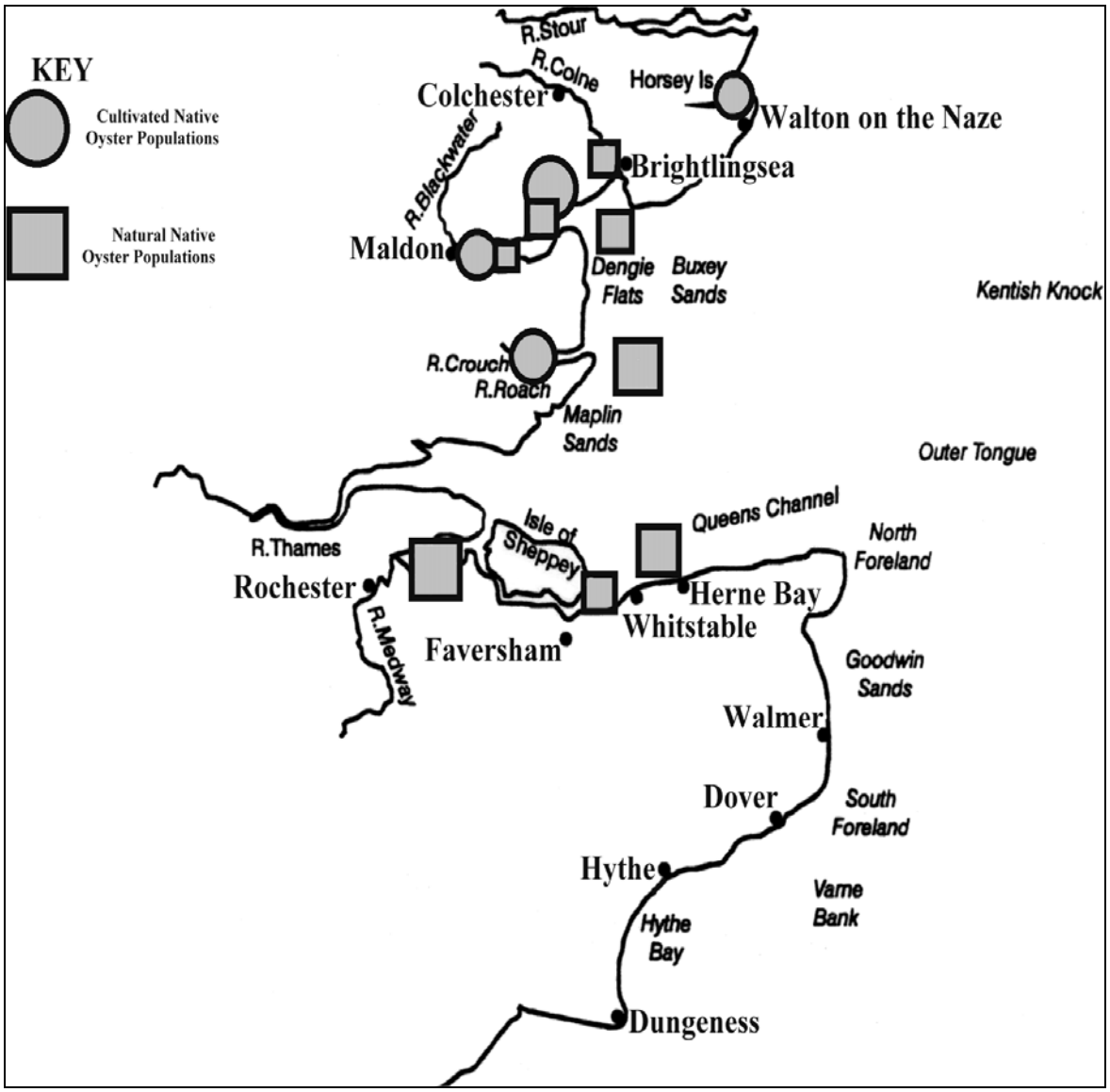


Figure 7: Map of Essex and Kent, showing cultivated and natural oyster populations (modified from Gray 1995).

Native oysters are cultivated within both areas, which include both the main channel and some of the neighbouring creeks. Natural stocks, which had suffered losses due to *Bonamia* have recovered to an extent, and are harvested from late summer through winter. Note has also been made that the Pacific oyster is increasing in numbers in the wild and is fished commercially on a small scale within the estuary, chiefly by hand gathering (Kent and Essex SFC unpubl.). This may suggest that there is a degree of limited reproduction occurring from the farmed Pacific oysters within the area. The affects of TBT had a significant impact on the fishery in the early 1980s but a recovery of stocks was evident following the prohibition of its use in 1985. Also within the fishery considerable effort has been made recently to revive the natural native oyster stocks, by encouraging increased spat settlement, as well as increasing the amount of native oysters relaid in the creeks surrounding the main channel. . Efforts have been made to lift and clean culch already present on the bed of the grounds, by dredging with a chain mat dredge (5 m scaffold pole with attached chains). This culch cleaning was carried out between May and June, which prepared the grounds to receive summer spatfall from the relaid native oysters present in neighbouring creeks. The relaid oysters originate mainly from the Solent and an estimated 40 tonnes per year are laid during spring and on-grown for marketing the following autumn. The management of the grounds to accept spat from this stock has resulted in an increase in oyster stocks since 1998, with vessels taking 180 kg/day and an annual production of 3-4 tonnes. Care is taken within the fishery to limit the spread and initial infection of *Bonamia* on the fishery, measures include spreading out recent good spatfall, not using the same dredges on different grounds and cleaning down of boats. Good management, warmer summers and increased rainfall are all thought to have contributed to the increased productivity of the grounds

4.2.4.1.4 MALDON AND BRADWELL

Both Pacific and native oysters are cultivated from late summer through to early spring. The grounds are leased from the Maldon District Council Several Fishery and only a small amount of native oysters is cultivated. Some natural native stocks used to be fished within the Several Fishery,

however this ceased about 1982 due to stock levels falling to an uneconomic level and little recovery has been noted since.

4.2.4.1.5 RIVER CROUCH AND ROACH

Gray (1995) reports that several boats dredge for both Pacific and native oysters on private beds within both the estuaries of the Crouch and Roach and wild oysters are taken from nearby offshore beds. A Several Order, The River Roach Oyster Fishery Order was granted in 1992 for an area of 2.5 ha within the estuary.

4.2.4.1.6 MEDWAY AND SWALE ESTUARIES

The small harbour of Queenborough on the Isle of Sheppey has a small fishing fleet which normally exploits stocks of cod, whiting and sprat. Since the early 1990s the poor state of these fisheries has led to a concentration on fishing for whiteweed (*Tubularia indivisa*) and oysters, the dredging of oysters is frequently carried out by the smaller boats when the weather is poor and confines them to coastal waters.

4.2.4.1.7 FAVERSHAM AND WHITSTABLE

Most of the fishing rights of large areas of the Medway Estuary are held by the Freemen of Rochester, therefore, the boats from around Faversham and Whitstable dredge for natural stocks mainly in the Swale Estuary. There were three full time boats in 1995 based within Oare Creek which mainly used trawl gear and took some native oysters from these beds. Four boats based in Whitstable regularly dredged for oysters in 1995. The natural beds showed significant recovery in the 1990s, following the effects of *Bonamia*, so began to receive more attention from the local dredgers, especially with the landings of cod and whiting being poor. Some privately owned oyster grounds are used to occasionally grow-on native oysters dredged from the wild. Table 8 shows the designated bivalve mollusc production areas within the region that produce oysters from September 2000 (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters).

Table 8: Designated bivalve mollusc production areas producing oysters in Essex and Kent. (effective from the 1 September 2000)

Production Area	Bed Name	Oyster Species	Class	Comment
Walton Backwater	Twizzle, Kirby Creek and Mill Lane	Native and Pacific	B	Seasonal Classification 1 September to 31 March Inclusive
Colne	Peewit Island and Pyefleet Spit	Native and Pacific	B	Classification may be subject to review.
West Mersea	Strood Channel and The Nothe	Native r	A	Area classified at higher level but with marginal compliance
West Mersea	Tollesbury and Freeground	Native	B	
West Mersea	Salcott	Native and Pacific	B	
West Mersea	Little Ditch	Native and Pacific Oyster	B	
Blackwater	Goldhanger	Pacific	A	Area classified at higher level but with marginal compliance
Blackwater	Bench Head and St Peters Flats	Native	A	Monitoring reduced /suspended as beds are not being commercially harvested
Blackwater	Batchelor Spit	Native	A	
Blackwater	The Nass	Native	B	
Crouch	Althorne Creek and Purleigh Shawl	Native	B	
Crouch	Outer Crouch	Native	B	
Roach	Paglesham Pool	Pacific	A	Seasonal classification, 1 June to 31 August inclusive, Class B at all other times
Roach	Devils Reach, Quay Reach, Dunthopes, and Pondlays Middleway	Native	B	
Roach	All other beds	Pacific	B	
Swale	Swale River (bed 4)	Native and Pacific	B	
North Kent Coast	Pollard	Pacific	A	Classification may be subject to review
North Kent Coast	East Last Bank, Clite Hole and The Street	Native	B	
North Kent Coast	Kentish Flats	Native	A	

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

4.2.4.2 General Occurrence

As noted previously beds of wild native oysters occur sporadically along the Kent and Essex coast oyster beds are known to occur offshore of Brightlingsea, Burnham-on-Crouch and Faversham. Wild oyster beds also occur within the estuaries of the Rivers Colne and Blackwater, and in the Medway and Swale Estuaries, some oysters are also still known to occur on the Whitstable and Kentish flats. Surveys included on the MNCR database show native oysters occurring to the south-east of West Mersea.

Note is made both by Gray (1995) and by Kent and Essex SFC (Kent and Essex SFC unpubl.) that there are Pacific oyster populations in the wild which appear to be self sustaining. This indicates that a significant number of farmed oysters within the area may have reproduced and settled outside of the private oyster grounds, which is considered unlikely due to the normal temperature requirements needed for spawning by the Pacific species. If this is the case then this escape of non-native species may prove to be significant in the future.

4.2.5 SUSSEX (RYE TO SELSEY)

The location of cultivated and natural native oyster populations is given in Figure 8.

4.2.5.1 Fisheries

The native oyster is dredged in the west of the region with oysters being taken from the opening of the oyster season on the 1 November until its close on 30 April, dredging is allowed between 0730-1530, Monday to Friday. These by-laws only apply to the public fisheries, which Sussex SFC polices, and also include a minimum allowable landing size of 70 mm diameter for native oysters. In practice it is noted that the fisheries do not continue to be exploited after more than a few weeks when all the oysters of a marketable size have been taken.

4.2.5.1.1 CHICHESTER

The only note made of any cultivation of the native oyster within the region is within an area covered by the Emsworth Channel Fishery Order (1975) within this private fishery some cultivation of Pacific as well as native oysters was noted Gray (1995). Replenishment of all beds within the region relies on natural spawning and settlement to replenish stocks. Some maintenance and restocking of culch does occur to maintain substratum for spatfall.

In 1995 four boats from Selsey were noted to dredge the beds in Chichester Harbour along with the 6 full time and 18 part time fishermen who were based within the harbour (Gray 1995). In 2001 there are 8 members of the Several Fishery Federation, who commence fishing on the private grounds several weeks prior to the opening of the public oyster beds. Ten other boats are also noted as having the potential to join these boats on the public grounds when the public oyster fishing season begins. The Public and Several Fisheries open with around 35-40 bags being landed (each bag containing 25-30 kg), after the initial boom catches fall to 5-8 bags and then to 3-5 when only 2-3 boats continue fishing. Most dredging is completed within a month when many of the boats seek alternative grounds like Langstone Harbour and the Solent. Table 9 shows the designated bivalve mollusc production areas within the region that produce oysters from September 2000.

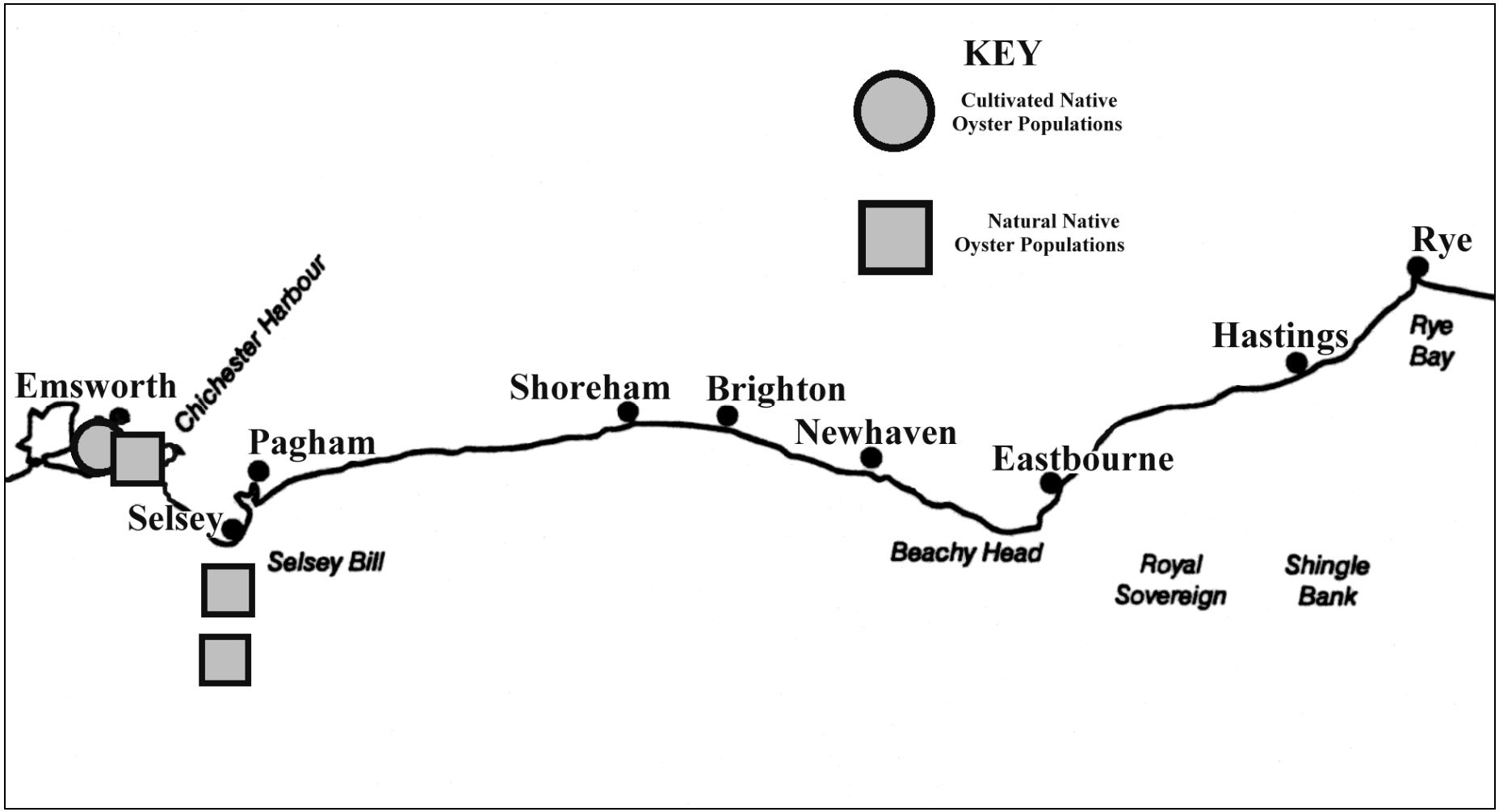


Figure 8: Map Sussex showing cultivated and natural oyster populations (modified from Gray 1995).

Table 9: Designated bivalve mollusc production areas producing oysters in Sussex. (effective from the 1 September 2000).

Production Area	Bed Name	OysterSpecies	Class	Comment
Chichester Harbour	All beds except Birdham Spit	Native	B	

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

4.2.5.2 General Occurrence

There are six records of native oysters occurring within the region in the MNCR database. All of the records refer to the area immediately adjacent to Chichester and Selsey Bill although two of these are up to 5 miles offshore.

4.2.6 HAMPSHIRE, ISLE OF WIGHT AND DORSET (EMSWORTH TO LYME REGIS)

The location of cultivated and natural native oyster populations are given in Figure 9.

4.2.6.1 Fisheries

4.2.6.1.1 SOLENT

Through gradual evolution of property rights within the Solent since the 1970s there now exists a considerable patchwork of differently regulated areas, as well as overlapping rights within the fishing community. The Solent area covers public oyster grounds, private fisheries (Several Orders) and a regulated fishery (Regulating Order). The regulated fishery within the Solent covers over 40 square miles and extends from Hurst Spit to just east of Portsmouth. The Regulating Order which covers this area is the Solent Oyster Fishery Order (1980) and is administrated by the Southern SFC which sets and polices the by-laws for the fishery, licences are also required to work the Solent grounds.

The fishing season varies annually to some extent, but is generally from 1 November to Christmas and then from mid February to late March. The maximum number of potential licences which can be issued is 90, with between 65 and 85 taken out each year. In its first regulated season (1980) a high number of licenses were granted due to the manner in which the Fishery Order was granted, which allowed all fishermen involved in the fishery at the time of the drafting to obtain a licence. Since this time a combination of economic factors and action by the Authorities to restrict fishing to only those carrying it out on a full time basis, has led to a reduction in the numbers exploiting the resource (Guillotreau and Cunningham 1994). There is also a ban in effect on the use of metal toothed dredges on the grounds.

The management of the oyster beds has led to the Solent being one of the few areas within the UK which has healthy stocks of native oysters and may be a reason why the grounds have not been badly affected by *Bonamia* relative to other south coast fisheries. There has however, been a switch over the last 15 years in the positions of the greater concentrations of oysters within the Solent.

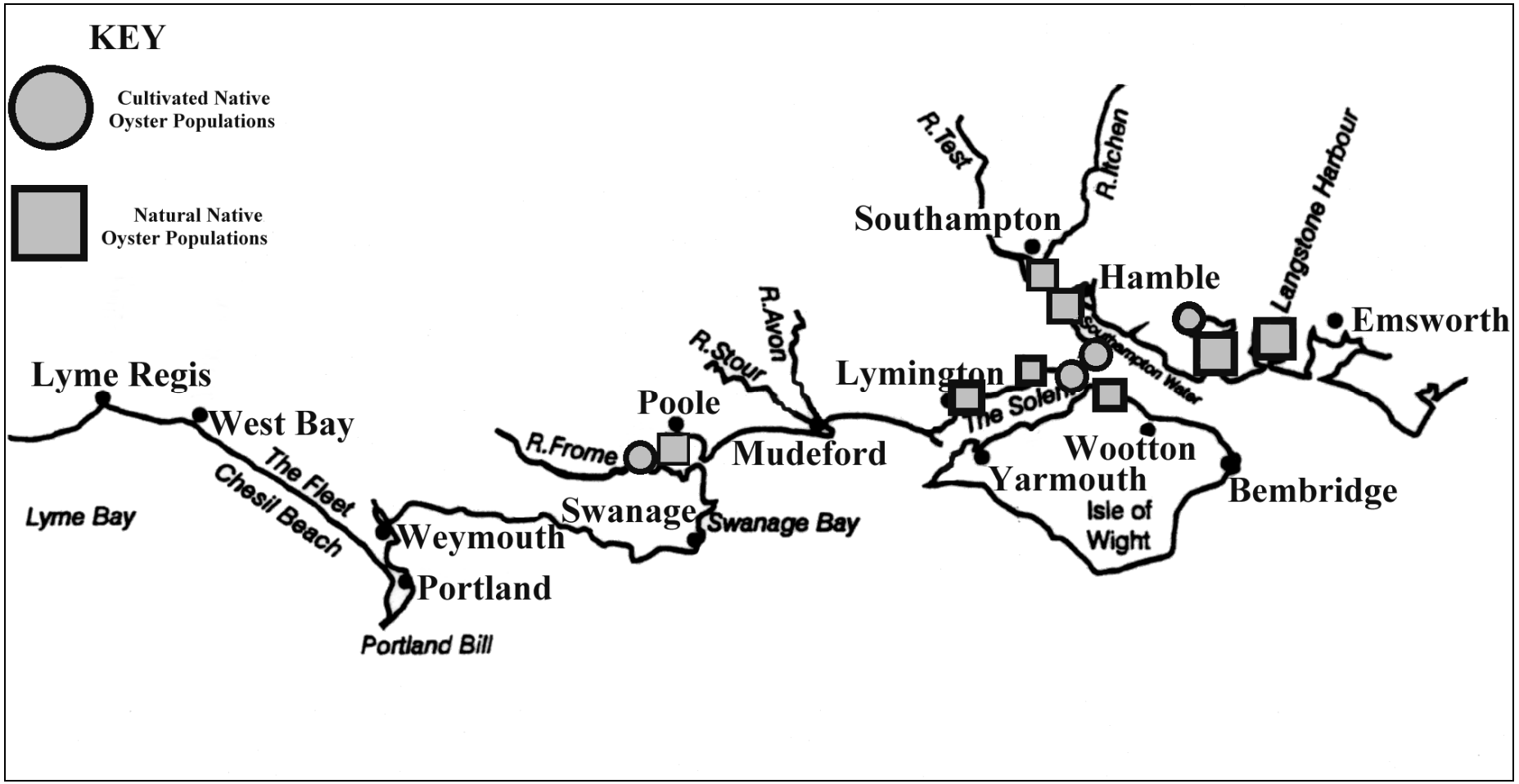


Figure 9: Map of Hampshire, Isle of White and Dorset, showing cultivated and natural oyster populations (modified from Gray 1995).

The Western Solent has not seen any significant change in numbers over this time whereas the Eastern Solent has stocks of oysters at the highest levels ever recorded. Estimated landings for 1999-2000 were more than 550 tonnes.

There are two Several Orders granted within the Solent: the Calshot Oyster Fishery Order (granted in 1982 for periods of 7 years at the end of which an extension must be applied for) covering 223 ha, and the Stanswood Bay Oyster Fishery Order (1973) covering 262 ha. Both fisheries are run by co-operatives of fishermen and each usually has 40 members who carry out fishing for approximately 10 days per year at members discretion. Stocks within these fisheries are considered to be at a high level. Two other Several Orders were applied for and granted in the 1980s: the Southampton Water (Chilling) Oyster Fishery Order 1984 and the Portchester Channel Oyster Fishery Order 1986. Both of these fisheries granted exclusive fishery rights to the companies involved, Brownwich Reach Oystermen Ltd and Portsmouth Harbour Oyster Society Ltd respectively, and were issued for a period of seven years before renewal was required. The Chilling Several fishery came to an end and an extension to the term of the several order was not applied for, primarily due to the level of poaching which was occurring on the grounds (Guillotreau and Cunningham 1994). The Porchester Channel Order was also not renewed at the end of its term in 1993 and the co-operative ceased to exist.

There are extensive public native oyster beds within Langstone Harbour and Southampton Water which both have good levels of stock. These beds are managed by the Southern SFC and have a number of by-laws which control the fishing efforts on them: the fishing season is from 1 November to the end of February, maximum dredge length is 1.5 m with a 3.0 m maximum aggregate length per vessel, a minimum landing size (oysters which pass through a circular ring of internal diameter 70 mm cannot be retained). Stocks on the oyster beds have increased in recent years, this is thought to have occurred partially because fisheries for the non-native hard shelled clam, M*ercenaria mercenaria,* have declined since the 1980s following a fall in demand, allowing more room on the grounds for the expansion of the oyster beds.

The Newtown fishery on the north side of the Isle of Wight is fished by a private company and another private fishery exists in the estuary of the River Beaulieu to the west of Southampton Water. The latter was important in the 1970s and early 1980s having imported Brittany oysters and stocks were built up, the spatfall from which were thought to have caused the regeneration of the Stanswood Bay fisheries. *Bonamia* has, however, caused severe mortalities within this fishery.

4.2.6.1.2 LYMINGTON

Lymington supported 25-30 boats in 1995 (Gray 1995) most of which were part time and varied the target fish species dependent on the season. During the winter it is also used as a base for up to a dozen visiting oyster dredgers, the numbers being dependent on the available oyster stocks, length of season and other limitations imposed by the Southern SFC.

4.2.6.1.3 KEYHAVEN

As for many of the small ports and harbours within the vicinity of the Solent, a few small vessels may dredge for native and Pacific oysters from December to April (Gray 1995), after this period they target other fish species. The percentage of vessels working on a part time basis has continued to increase over the last 10 years.

4.2.6.1.4 MUDEFORD AND CHRISTCHURCH

Several boats based within this large harbour dredge for oysters concentrating mainly between The Needles and Poole (Gray 1995).

4.2.6.1.5 POOLE

Poole Harbour is covered by a combined Regulating and Several Order, The Poole Fishery Order 1995 which covers an area of 3,220 ha and relates to oysters, mussels, cockles and clams. The Order allows the Southern SFC to lease ground within the area for mollusc cultivation and to regulate the wild fisheries through licensing and close seasons.

Poole Harbour used to have extensive oyster beds throughout its area, but in 1986-87 an outbreak of *Bonamia* severely decreased the native oyster population. There are still a few wild oysters within the harbour but not in any commercially viable numbers. Some of the leased grounds are still used to fatten oysters relaid from elsewhere and there is a designated relaying area for native oysters, at South Deep, but mussels and clams remain the most exploited species in the Harbour.

Poole Bay used to have numbers of native oysters large enough for small scale commercial exploitation, however, following a reduction in numbers this fishery has almost completely ceased.

Table 10 shows the designated bivalve mollusc production areas within the region that produce oysters from September 2000 (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters.

4.2.6.2 General Occurrence

Records from surveys included on the MNCR database show 19 areas within the region where the presence of the native oyster has been noted, 14 of these sites were in or adjacent to Poole Harbour, 3 sites were within Southampton Water and 2 were located in the West Solent. One site within Poole Bay was recently dredged to obtain native oysters for testing for notifiable diseases. Two hours of dredging yielded ten oysters and no further oysters were dredged when the survey was extended to include the neighbouring areas. The same area was reported by a local fisherman to have produced about 1 tonne of oysters per day prior to the late 1980s and overfishing was given as the explanation for the collapse of the fishery locally (I. Laing (CEFAS) pers. comm.).

Table 10: Designated bivalve mollusc production areas producing oysters in Hampshire, Isle of Wight and Dorset. (effective from the 1 September 2000).

Production Area	Bed Name	Oyster Species	Class	Comment
Langstone Harbour	Sinah Lake	Native	B	
Langstone Harbour	All other beds	Native	C	Classification may be subject to review
Portsmouth Harbour	Eastern Beds	Native	B	
Portsmouth Harbour	Western Banks	Native	B	Area classified at higher level but with marginal compliance
Southampton Water	All Beds	Native	B	
Solent	Ryde Middle Bank, Kings Quay, The Butts, Lee-on-Solent, Hill Head, Bramble Bank, Lepe, East Sowley, Sowley, Lymington Bank, Peel Bank and Motherbank	Native	B	
Solent	Pennington Bank	Native	B	Area classified at higher level but with marginal compliance
Solent	Osborne Bank	Native	C	
Solent	SW of Gilkicker	Native	C	Area classified at a lower level due to enforcement issues
Solent	Stanswood Bay	Native	B	
Solent	Saltmead Ledge and Thorness	Native	C	Area classified at a lower level due to enforcement issues
Solent	Spitbank, Stokes Bay, Newtown Bank, East of NE Ryde Middle and Ryde	Native	C	
Medina	Wharf	Native	C	
Newtown	Clamerkin Creek	Native	B	
Newtown	Western Haven and Rivermouth Inner	Native	C	
Totland Bay		Native	B	
Beaulieu	Needs Ore and Bucklers Hard	Native	C	Classification may be subject to review
Lymington River	All Beds Below Railway Bridge	Native	C	
Keyhaven	Keyhaven River	Native	B	
Poole	Harbour (except Wareham Channel)	Native and Pacific	B	
Poole	Bay	Native	B	Classification may be subject to review
Portland	Fleet-Bed F1	Pacific	A	Area classified at higher level but with marginal compliance
Portland	Fleet-Bed F2	Pacific	B	Monitoring reduced /suspended as beds are not being commercially harvested

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

4.2.7 DEVON, SOMERSET AND AVON (AXMOUTH TO PLYMOUTH ALONG THE SOUTH COAST AND CLOVELLY TO THE SEVEN ESTUARY ALONG THE NORTH COAST)

The location of cultivated and natural native oyster populations is given in Figure 10.

4.2.7.1 Fisheries

4.2.7.1.1 RIVERS DART, AND EXE

The Dart and Exe estuaries have traditionally grown native oysters but at present have very low stocks and none are at a level considered as commercially viable. The reduction in oyster numbers within the Exe in particular is thought to be mainly due to lack of working of the grounds, which has allowed them to become fallow after the usual setbacks of poor spatfall, disease and severe winters. These reduced oyster numbers to levels where the continued tending of the beds was too expensive to continue. Until the 1980s, exploitation of native oysters still occurred within the Dart Estuary, however, the effects of tributyltin (TBT) from antifouling paints used on boats within the harbour affected the oyster populations to such an extent that the fishery became uneconomic.

Both of the estuaries were used as relaying areas for spat brought from other sites, chiefly Cornwall, but the outbreak of *Bonamia* and *Marteilia* within Europe placed restrictions on the movement of oysters and the trade has completely ceased; the Dart was recently tested and is now free of disease. Plans to restock the beds in the Dart and maybe the Exe were considered in the mid 1990s, although the difficulty of obtaining disease free spat and the high price, has prevented any work being carried out as yet by the Devon SFC (Devon SFC unpubl.).

4.2.7.1.2 RIVER TEIGN

The estuary of the River Teign has a Regulating Order in operation on it, The River Teign Mussel Fishery Order (1966). Although this Order chiefly concerns management of mussels within the 156 ha area of Teignmouth, oysters are included in the species covered by the order although there is no indication of the presence any native oyster fisheries or cultivation within the estuary.

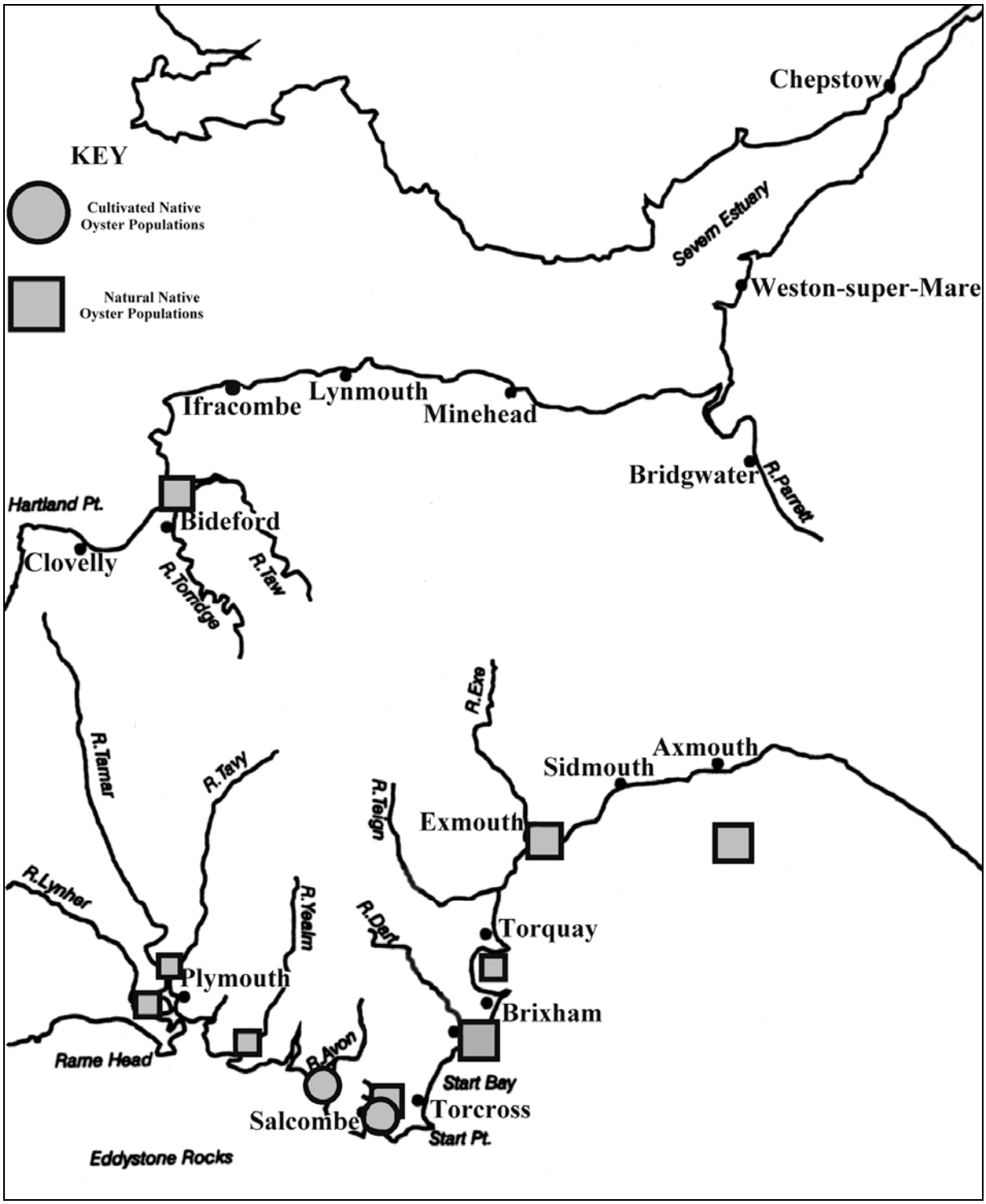


Figure 10: Map of Devon, Somerset and Avon, showing cultivated and natural oyster populations (modified from Gray 1995).

Gray (1995) noted that Teignmouth was one of the most important areas within England and Wales for the cultivation of the Pacific oyster.

4.2.7.1.3 KINGSBRIDGE ESTUARY

The Kingsbridge Estuary has both Pacific and native oysters cultivated within it and there are also wild native oyster stocks present, which are generally harvested by hand. The fishing fleet for the Kingsbridge Estuary is predominantly based at Salcombe (Gray 1995).

4.2.7.1.4 RIVERS AVON AND YEALM

The Avon Estuary in 1995 had a few fishermen cultivating mussels and oysters (Gray 1995). The Yealm Estuary also has small stocks of native oysters and the Devon SFC and local fishermen would like to increase the numbers. It has been tested regularly by CEFAS and is free of any *Bonamia* or *Marteilia* parasites, however movement of oysters into or out of the estuary are severely limited by the legislation despite repeated attempts to have the restrictions removed. Therefore, until movement restrictions are lifted no expansion will occur on the native oyster fishery (Devon SFC unpubl.).

4.2.7.1.5 PLYMOUTH SOUND AND RIVER TAMAR

The Tamar Estuary has commercially viable stocks of native oysters within it, however, it and the Plym Estuary, fall within the area designated Prohibited (Class D) under the Shellfish Waters Classification and, therefore, no harvesting of oysters for human consumption can take place. Improvements in sewage treatment scheduled under the EU Urban Waste Water Treatment Directive may improve conditions enough to allow oysters to be removed to purification areas prior to sale. However, logistical and financial constraints may mean that this is still not a commercially viable option, as seen with oyster stocks present within the estuary of the River Lynher.

4.2.7.1.6 APPLEDORE AND BIDEFORD

Natural stocks of oysters are harvested from the common estuary of the Torridge and Taw Rivers although this is carried out on only a small scale (Gray 1995). No further information on the levels of exploitation are available.

Table 11 shows the designated bivalve mollusc production areas within the region that produce oysters from September 2000 (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters).

Table 11: Designated bivalve mollusc production areas producing oysters in Devon, Somerset and Avon (effective from the 1 September 2000).

Production Area	Bed Name	Oyster Species	Class	Comment
Exe	Powderham	Pacific	B	Area classified at higher level but with marginal compliance
Exe	All other western beds	Pacific	B	
Teign	Arch Brook	Pacific	C	
Teign	Gappa Bank	Pacific	C	
Dart	Waddeton	Pacific	B	
Dart	Flat Owersand and Sandridge Boathouse	Pacific	C	
Bigbury and Avon	Westbank and Eastbank	Pacific	B	Area classified at higher level but with marginal compliance
Salcombe	Geese Quarries	Pacific	C	Classification may be subject to review
Yealm	Foxcove and Thorn	Pacific	B	
Plymouth	Lynher	Native	C	Classification may be subject to review
Taw/Torridge	Zeta Berth	Pacific	C	

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

4.2.7.2 General Occurrence

One note is made in the MNCR database of the occurrence of wild native oyster populations within the Salcombe and Kingsbridge Estuary. The data used in the Conservation and Estuaries Review shows five sites in South Devon, from the River Exe to the River Tamar, where native oysters were noted, and one bed in North Devon, these correspond to the natural beds in the Devon estuaries already noted above. This is further confirmed by other surveys undertaken by the Devon Wildlife Trust and The Oil Pollution Research Unit which show the native oyster to occur in 14 sites: 3 within the Dart Estuary, 1 in the Exe Estuary, 3 within the Plymouth Estuaries, 1 in Salcombe Estuary, 5 in littoral surveys off Torbay and 1 in Lyme Bay.

4.2.8 CORNWALL AND ISLES OF SCILLY (RAME HEAD TO BUDE)

The location of cultivated and natural native oyster populations is given in Figure 11. Oyster beds in Cornwall are all based within estuaries and the Environment Agency is the acting Sea Fisheries Committee in these areas.

4.2.8.1 Fisheries

4.2.8.1.1 ST MAWES

Native oysters are cultivated within the estuary of the River Percuil, although in 1995 stocks were low following outbreaks of *Bonamia* in the1980s (Gray 1995). There is a private Several Order covering the fishery within the estuary.

4.2.8.1.2 HELFORD

Native oysters were cultivated within the Helford Estuary till the outbreak of *Bonamia* caused a switch to a mussel fishery. As the oyster fisheries in the region have recovered the area has again become used for the relaying of a lot of the stock of oysters from the estuary of the River Fal and is covered by a private Several Order. It was reported that in 1995 200,000 oysters were dredged each year between early September and April (Robson 1996).

4.2.8.1.3 FAL ESTUARY

The largest oyster fishery within Cornwall is located in the Fal Estuary. This is a wild stock fishery fished by non-motorised vessels only and is controlled by the Port of Truro Regulating Order (1936), under the auspices of the Port of Truro, which in turn is run by Carrick District Council. The Regulating Order covers an area of 1,101 ha covering most of the area of the upper reaches of the Fal Estuary and gives the Council the powers to set by-laws. One of the most significant was the banning of all oyster fishing carried out by motorised vessels or lifting by motorised winches.

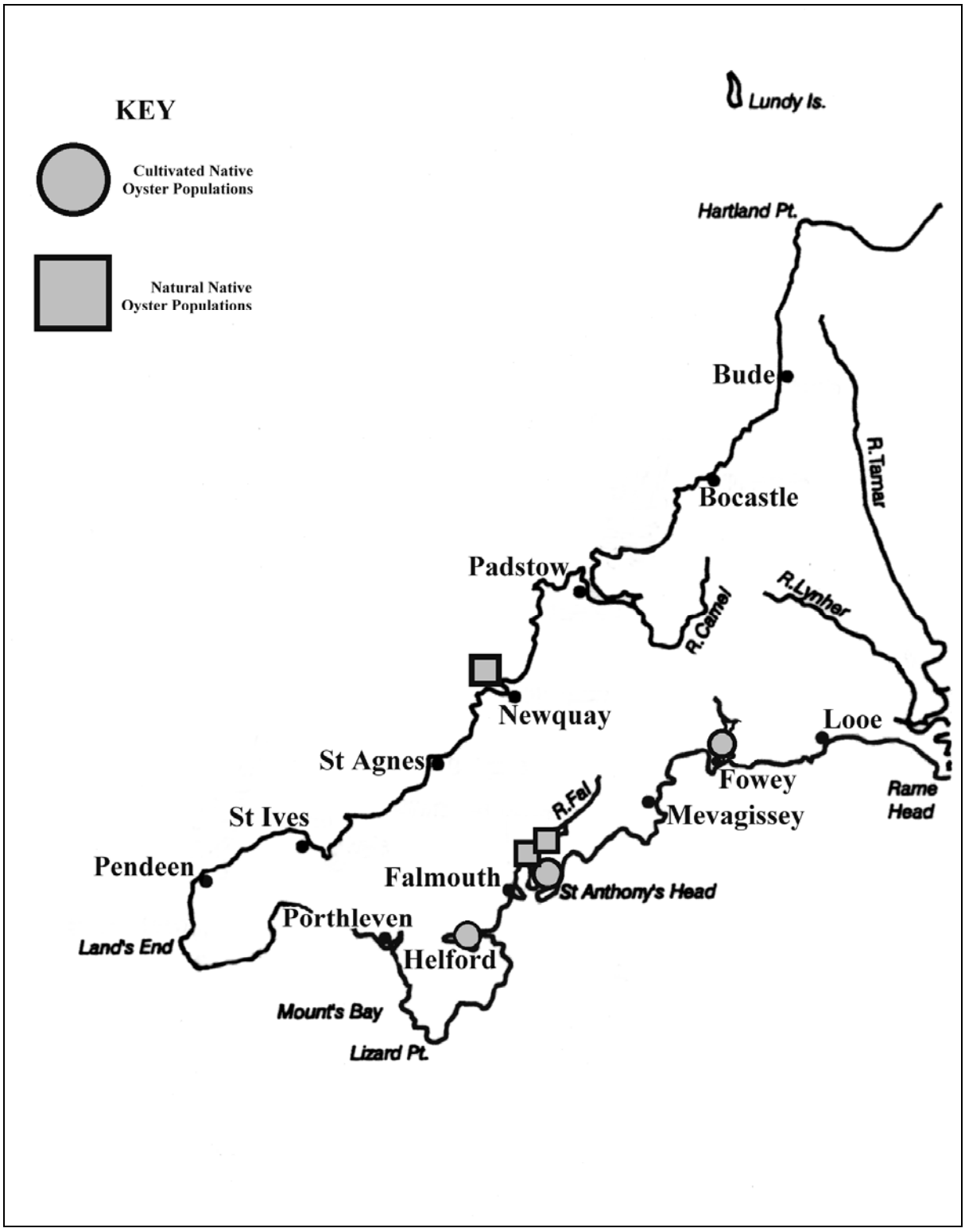


Figure 11: Map of Cornwall, showing cultivated and natural oyster populations (modified from Gray 1995).

This by-law has resulted in a reliance on favourable weather conditions to carry out dredging, therefore, preventing the overexploitation of the oyster grounds and has been cited as a reason for the relative success of the Fal fishery during periods when other similar fisheries were failing. Some dredging of the oyster grounds used to be carried out from rowing boats, called *wink* boats, however, few of these are still in service and used mainly on a part time basis. The decrease in fishing from rowing boats is thought to be due mainly to the decline of the oyster beds within the more sheltered areas of the estuary, which were the areas primarily exploited by the rowing boats (C. Speedie (Cornwall WT) pers. com.).

The main area of the fishery, between St Just and Mylor, now has greater stocks and so in recent years there has been an increase in the number of boats returning to the fishery. As many as 20 boats are currently working, albeit some part time and more are being refitted to return to service each year. Between 1992 and 1995 an average of 300,000 to 400,000 native oysters a year were dredged from the Fal and in 1996 a harvest of 500,000 was expected. Most of these oysters were destined for relaying, as previously noted, mostly on the Helford grounds. Smaller oysters are often relaid on the shore for fattening.

Water quality has become a contentious issue within the estuary with the opening of a new long sewer outfall within the Fal and there is concern that sewage pollution will affect the status of the beds as well as the quality of the oysters. Coupled with the problems of point source pollution, the national problem of diffuse pollution from agriculture and drainage runoff is causing increased concern for the Fal fisheries. Difficulties in controlling diffuse pollution sources have made it difficult to maintain water quality in some estuaries.

4.2.8.1.4 FOWEY ESTUARY

The Fowey Estuary has been noted to have small beds of the native oyster within it but nothing of any commercial importance.

4.2.8.1.5 ISLES OF SCILLY

The Isles of Scilly have no recorded native oyster grounds or fisheries (Gray 1995). Pacific oysters were cultivated for a while but this practice has ceased following the lack of success of the fisheries. The latter was due mainly to the lack of suitable sheltered areas for the siting of the fisheries.

Table 12 shows the designated bivalve mollusc production areas within the region that produce oysters (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters).

Table 12: Designated bivalve mollusc production areas producing oysters in Cornwall (effective from the 1 September 2000).

Production Area	Bed Name	Oyster Species	Class	Comment
Fowey	Pontpill and Wisemans	Pacific	B	
Truro River	Grimes and Maggoty Bank	Native	B	
Fal	Flushing and Falmouth Wharves	Native	C	
Fal	Meads	Native	C	Classified at a lower level due to enforcement issues
Fal	All other beds	Native	B	
Fal	Pandora Beach	Pacific	B	Classification may be subject to review
Percuil	All beds	Native and Pacific	B	
Camel	Gentle Jane and Porthilley	Pacific	B	
Camel	Longlands	Pacific	B	Classification may be subject to review

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

4.2.8.2 General Occurrence

The MNCR database records 10 surveys which note the presence of native oysters, all of which were located within the Fal Estuary and the feeder rivers. One record is made on the Conservation and Estuaries Review distribution map for the area of Newquay Bay in North Cornwall.

4.2.9 CHESHIRE AND LANCASHIRE (THE WIRRAL TO BARROW)

The location of cultivated and natural native oyster populations are given in Figure 12**.** Gray (1995) notes that there is a fishery for cultivated native oysters, Pacific oysters and clams located at the north end of Morecambe Bay, although later surveys only mention cultivation of Pacific oysters which may indicate the native oyster fishery has ceased. W. Cook (North Wales and Northwest SFC) pers. comm. states that since he has worked within the region (from 1978) he has only seen two individual native oysters taken from the wild indicating the general scarcity of the native oyster within the region as a whole.

Table 13 shows the designated bivalve mollusc production areas within the region that produce oysters, from September 2000 (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters).

Table 13: Designated bivalve mollusc production areas producing oysters in Cheshire and Lancashire. (effective from the 1 September 2000).

Production Area	Bed Name	Oyster Species	Class	Comment
Morecambe Bay - Roosebeck	Roosebecks 1, 2, 2A and Foulney Twist	Pacific	B	

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

No note is made of any native oysters being recorded from surveys undertaken in the region and no records are included of native oyster presence within the MNCR database or the National Biodiversity Network.

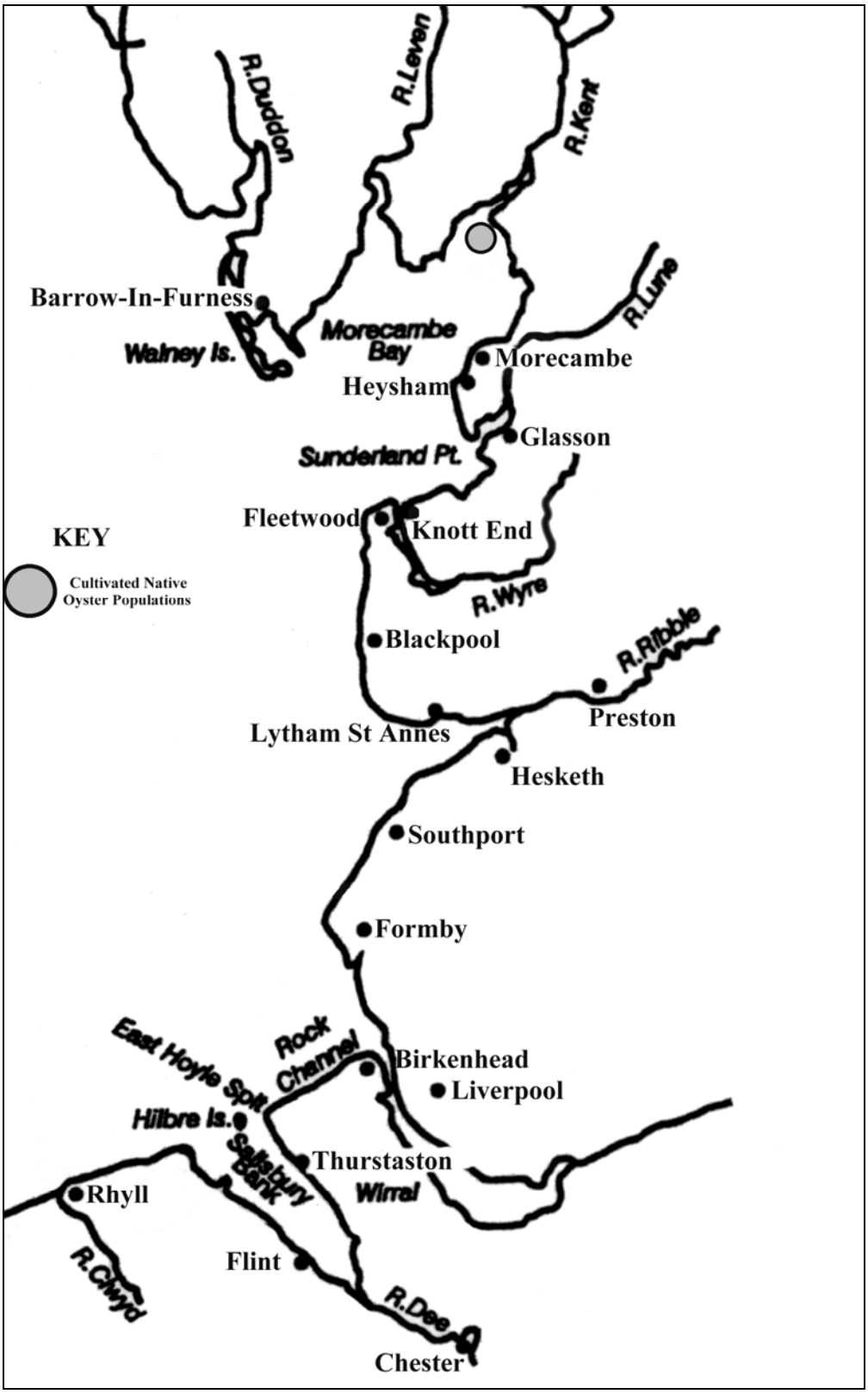


Figure 12: Map of Cheshire and Lancashire, showing cultivated and natural oyster populations (modified from Gray 1995).

4.2.10 CUMBRIA (MILLOM TO SILLOTH)

The location of cultivated and natural native oyster populations are given in Figure 13. The only records of any native oysters within the region come from the Cumbria SFC where it is recorded that some are present at Selka Rocks, south of Ravenglass (Cumbria SFC unpubl.). This site is 5-8 miles long and has an abundance of old dead oyster shells on the bed but only the occasional old live specimen. There are no other occurrences of the native oyster within the region and no areas are designated as bivalve mollusc production areas for the production of oysters (Pacific or native).

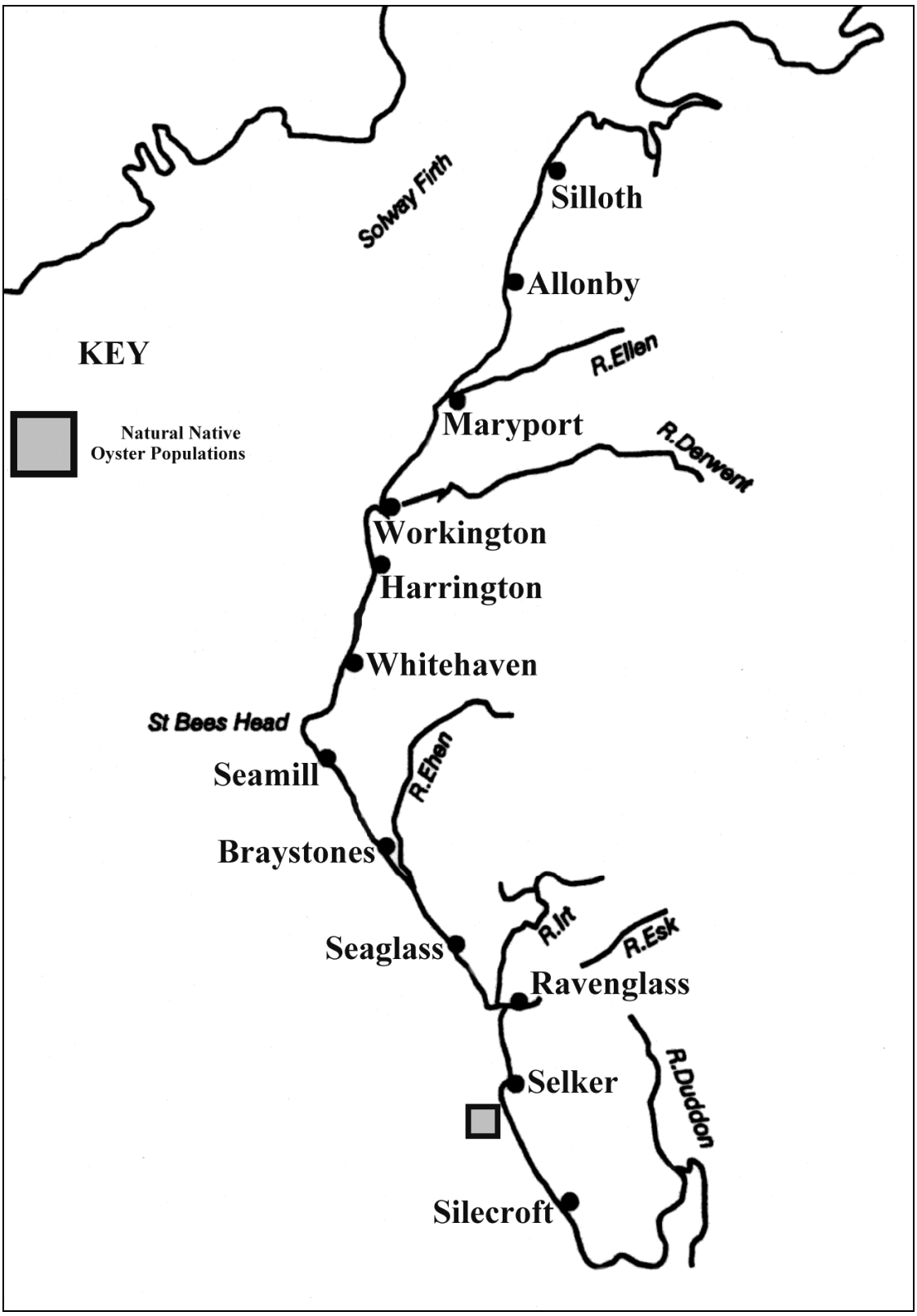


Figure 13: Map of Cumbria, showing cultivated and natural oyster populations (modified from Gray 1995).

5. THE NATIVE OYSTER IN WALES

Presentation of data for Wales will be by regional district with the regions being the same as those adopted by the Sea Fishery Committees of Wales. Historical information will be dealt with first, with all available information on general distribution of the species, fisheries and abundance covered under the heading for each individual district. Current information will be covered in the same format wherever possible also with information for fisheries and general occurrence considered separately.

5.1 Historical Information

5.1.1 SOUTH WALES (CHEPSTOW TO MOYLEGROVE)

5.1.1.1 Porthcawl

There were significant sized oyster beds off the coast of Porthcawl and into the Bristol Channel which have historically been exploited by local fishermen and were fished extensively within the 19th century (South Wales SFC unpubl.). The beds off Porthcawl appear to have been sublittoral, natural and self perpetuating with no specific management measures or by-laws to control exploitation (HMSO 1876). Despite being overfished to the extent that the catches taken from the beds no longer became economically viable the grounds continued to support sparse populations.

5.1.1.2 Swansea Bay and the Mumbles

A large trade in oysters has been well established within Swansea Bay since medieval times and it is possible that Romans utilised the resources during their presence along the South Wales coast. The oyster beds were recorded as being the most prolific in Britain during a tour of Wales by the first Duke of Beaufort in 1684. Later the Duke's descendants profited by charging rent for the *plantations* of oysters maintained on his waterside (Rogers and Gabb 2000).

In the 17th century most of the dredging for oysters was carried out in rowing boats similar to the *wink* boats used on the Fal Estuary today, although, most of the hauling was carried out by women at the

time. Later in the 19th century, sail power was introduced and *skiffs* were used to tow the dredges of a local design over the oyster beds. In the 1860s 180 boats were operated on the oyster grounds, each with a three strong crew. At its peak, the oyster industry as a whole employed 600 including those harvesting the oysters plus 40 others (mainly women) bagging the oysters and 10 men transporting the bags to the railway station, for transporting around Britain, in particular the market at Billingsgate, London. A direct delivery was also made by ship to Bristol.

In 1871 a Regulating Order was granted for Swansea Bay which covered an area which extended into the Bristol Channel and totalled 107 square nautical miles. As a management measure, the Regulating Order also included the issuing of licenses without which dredging could not be undertaken. In 1873, 180 boats were working the beds but the Corporation of Swansea, who administered the grounds, decided later that this level of exploitation was unsustainable and measures were agreed to conserve stocks within the area. These stocks had already experienced a large increase in exploitation since the late 1860s, prior to this time 60-80 boats were noted as exploiting the grounds. The fishery was, therefore, closed every year for the months of May, June and July to attempt to conserve stocks. A minimum landing size of 2 inches was also adopted although in 1876, an Inspector of the Fisheries stated that he thought a minimum landing size of 2½ inches would be required to conserve stocks more adequately. Approximately 15 square miles of the grounds containing the oyster beds was also shut off to act as a nursery although, the ban on dredging within this area was occasionally lifted after protests by the local dredgermen, which resulted in many boats working the area in the short time that the beds were open to acquire their share of the oysters.

Smaller oysters less than five years old were relaid in *plantations* within subtidal waters, adjacent to the foreshore at Mumbles, until they were sufficiently large enough to market. Other smaller beds termed *perches*, were present on the foreshore at Mumbles where each local fishermen had title to an area of 16½ square feet of space, marked out with lines of pebbles and a floating log. Each Oysterman would tip his catch at the end of the day into his area to tend later or to leave until they were required for sale. The importance of oysters was indicated by the fact that Mumbles was

formerly Oystermouth and also in the diet of the residents. A main constituent of the diet of the residents of the Mumbles at the time was oysters and there are records of oyster omelettes, oysters in breadcrumbs and oysters with the regular fish and chips (Rogers and Gabb 2000).

Other fishing villages and small harbours around the Gower coastline were noted as exploiting the local oyster grounds. For instance, oysters were noted as being caught in great quantities at Port Einon early in the 19th century (Epicure 2001). However, by the late 1870s pollution from the River Tawe and the primitive sewerage system at Southend, and overfishing had had a devastating effect on the oyster population, despite the efforts of the Swansea Corporation to minimise the damage. In 1871 18,200,00 oysters were landed, this had halved by 1873 to 9,050,000 and then to 3,810,000 by 1875. This decline continued within the fishery and by the start of the First World War, 921,000 were harvested.

In 1920 the oyster disease which afflicted much of the European population affected the Swansea beds thus indicating that it was unlikely to have been caused by TNT disposal, as none occurred in the vicinity (see section 2.4.3). The result of the disease was a complete collapse in stocks resulting in 10,000 being landed in1924 from which there was no recovery and by 1930 the last skiff to work the beds was retired. Another contributing factor to the failure of the oyster beds to rejuvenate naturally was the closure and abandonment of the roughly walled enclosures at Mumbles. Wright (1935) suggested that these enclosures with the artificially high densities of oysters within them, contributed a significant amount to the recovery of beds following earlier declines and that the ready supply of larvae produced by these beds would have helped to maintain the natural grounds. Wright (1935) also claimed that a certain amount of pollution was seen to affect the oyster grounds. The River Tawe was noted to have been badly polluted by effluent from the copper smelting works situated on its banks. In addition, the dumping of clinker and ash from coal burning vessels and of refuse from dredgers was seen to have had a deleterious affect as did oil pollution noted occasionally in the vicinity of the oyster beds (Wright 1935).

In 1931 the Ministry of Agriculture investigated the problem of the Swansea fishery and declared that the fishery would be developed in accordance with the Ministry's recommendations. This resulted in the renewal of the Fishery Order for the Swansea Bay area. Surveys in 1934 found that some beds near Mumbles were in a reasonable condition, based on the fact that there was a good proportion of young oysters within the population. Experimental work, involving reworking of the grounds and oyster relaying, by the South Wales SFC was cited as the reason why these beds were in a better condition than equivalent neighbouring areas (Wright 1935).

The input from the Ministry came too late to revive the fishery and in 1936 only 1,320 oysters were landed. In 1936, the fishermen were noted to have sought more secure employment and were unwilling to risk investing in the grounds further or to restock them due to the uncertainty within the oyster industry at that time (HMSO 1886-1938) and in 1937 the oyster beds were noted as being no longer worked. In 1949, the South Wales SFC looked further into the possibility of reviving the industry but concluded that it would not be viable to do so. In 1979, the 1931 Swansea Fishery Order was revoked.

5.1.1.3 Pembrokeshire

Historically, Tenby was the most important fishing port in Wales with herring and oysters as the main species targeted by the fishermen throughout the 19th century. The areas fished originally were those adjacent to Tenby, but by the end of the 19th century overfishing became an issue. There was a common problem associated with Welsh fisheries of exploitation from vessels based within English ports and harbours, for example in the 19th century Brixham fishermen visited the area on an annual basis. As oysters (as well as other fish stocks) became more scarce, initially fishermen moved further out into Carmarthen Bay, followed by the Bristol Channel approaches and south and east coast of Ireland (MacGarvin and Jones 2000). The fisheries of Tenby declined severely at the end of the 19th century and the port ceased to be important commercially by the start of the First World War.

Other small harbours within the Pembrokeshire coastline historically have had wild oyster fisheries which were exploited in a sustainable manner up until the middle of the 19th century. These included the fishing villages of Angle, Stackpole and Lawrenny, recorded by Lewis (1833) as being places where the men were engaged in oyster dredging. Lawrenny was described as having many inhabitants who dredged in winter for oysters which were found in great abundance and conveyed principally to London markets in boats from Chatham and Rochester.

Milford Haven became the most important fishing port within Wales at the end of the 19th century, a position which it has maintained to the present day. Many vessels used the port as a base from which to carry out fishing within the Bristol Channel approaches, along with utilising the fishing grounds off the east and south coasts of Ireland. Buckland (1876) described the oysters taken from beds at Milford Haven as excellent, second only to the pure *natives* of south east England, and that they were used occasionally as stock to relay on grounds at Whitstable. However, the oyster fisheries were suffering the same as those in Swansea, with a large scale decrease of catches reported to the Select Committee in 1876 (HMSO 1876). Between 1843 and 1868 the grounds had received a degree of protection from a local Act, brought about within the Convention Act signed with France, which allowed for restrictions on fishing effort and a close season. However, the Act was not fully implemented and was thought not to apply to waters within the 3 mile limit (see section 3.1). As the Royal Commission on Sea Fisheries (1863) wanted to deregulate the whole fishing industry to encourage expansion, the local Act was repealed in 1868 (see section 3.1). Consequently 8 years later the Milford Haven oyster grounds showed a decrease in oyster numbers, a decrease in average sizes of oysters being landed and general harm having occurred to the beds after the repeal (HMSO 1876).

The poor state of the fishery was also attributed by the superintendent of the Harbour Department, to the practice of dredgers from Laugharne, a fishing village located on a neighbouring estuary, using dredges with horse-skins tied beneath them. This resulted in the effective removal of all oysters from spat to breeding adults on the grounds where they were used. If this was the case, then it would certainly have damaged the fishery. However, as was noted in the Royal Commission on Sea

Fisheries (1863) it is also not unusual for local fishermen occasionally to blame bad fortune on the practices of the *foreigners* ruining the local stock (Neild 1995) and the use of horse and cowhide chafers on rough ground was commonplace in trawl fisheries up until the 1960s (S. Lockwood (CFCM) pers. comm.) making the fishermen's claim disputable.

5.1.2 NORTH WALES (CARDIGAN TO WIRRAL)

5.1.2.1 New Quay

Lewis (1833) records that there were significant numbers of oysters occurring off the coast in the area of New Quay and in the same year Haslam (1833) reports that there were unmolested beds of oysters 1½ miles north of New Quay Head. Both reports refer to the oysters as high quality and occurring in numbers. No further records could be found of the New Quay oyster beds or of any other occurrences within the area of Cardigan Bay.

5.1.2.2 Pwllheli

Pwllheli was noted to have had oyster beds present on banks off the coast to the west of the town, these were marked on charts but there are no historical data for their extent and any exploitation (E. I. S. Rees (University of Bangor) pers. comm.).

5.1.2.3 Menai Strait

Oyster cultivation occurred within the Menai Strait prior to setting up the Fisheries Experiment Station, Conwy. Old constructions of walls within the northern part of the Strait on the intertidal shore are believed to be the remains of old areas used for the relaying and cultivation of shellfish probably oysters and mussels, these have been long since deserted (W. Cook (North Wales & North Western SFC) and E. I. S. Rees (University of Bangor) pers. comm.). Oysters were cultivated within the Menai Strait by the research station at Conwy from 1920 until the laboratories closure in 1999. When large enough, oysters were taken the 20 miles to the trial ground at the Tal-y-foel site on the south western corner of the Anglesey, where they were relaid. This facility was purely for research purposes so was never established as a self perpetuating oyster population. Recent surveys have

shown that New Zealand oysters (*Ostrea lutaria)*, on which research was undertaken in the 1970s have become established within the area of the old research beds and are slowly spreading (E. I. S. Rees (University of Bangor) pers. comm.).

Grounds adjacent to Beaumaris on Anglesey were noted in the Select Committee Report (1876) as being used as areas for the relaying of oysters harvested within Ireland. These were brought to the Menai Straits, primarily for maintaining the condition of the shellfish whilst in storage, prior to selling in the markets of Liverpool. These grounds were used by the English oyster buyers since the early 19th century, a practice that was halted for a while as English buyers switched operations to Arklow in Ireland, the practice was resumed in 1846 for financial reasons. Although affected by the French Convention Act, the use of Beaumaris as a storage facility appears to have continued until as late as 1880 (Holt 1901).

5.2 Current Information

5.2.1 SOUTH WALES (CHEPSTOW TO MOYLGROVE)

The location of cultivated and natural native oyster populations is given in Figure 14.

5.2.1.1 Fisheries

Wild stocks of oysters are harvested from a few estuaries and coastal beds although poor water quality has affected a few estuaries, forcing the closure of some beds. No evidence of cultivation of the native oyster was found, although Pacific oysters are cultivated in the Carew River (Pembrokeshire).

The South Wales SFC sets by-laws for the native oyster, including: the minimum landing size (70 mm circular diameter gauge); permitting of hand gathering only unless carried out under an Authorisation which allows use of a toothed dredge of a maximum 4 m aggregate length and exclusion of vessels >14 m registered length from fishing within 3 miles of the coast. They also enforce national legislation (ie, closed season of 14 May to 4 August from Sec 16(i) Shellfish Act 1967) and have the powers to close a shellfish bed in order to conserve stock.

5.2.1.1.1 PORTHCAWL

In 1992, approximately 14 tonnes of oysters were fished off the coast of Porthcawl from natural beds, but since this time the grounds have not produced a similar harvest and is only an occasional fishery. Current records produced by the South Wales SFC state that one boat occasionally fishes the waters adjacent to Porthcawl in the autumn.

All the beds are sublittoral and their state is not known although they are believed to be quite old with predominately large old oysters upon them.

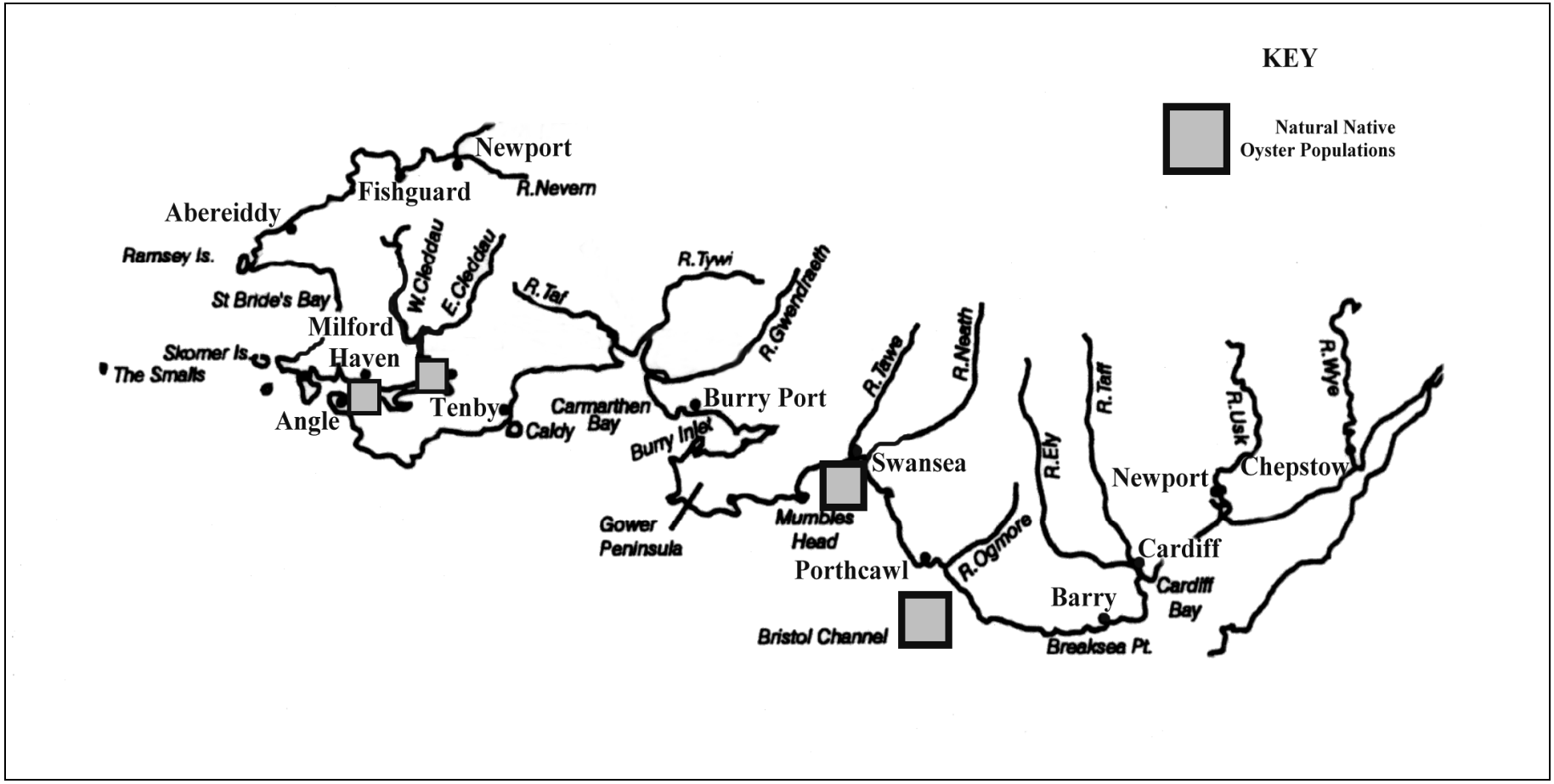


Figure 14: Map of South Wales, showing cultivated and natural oyster populations (modified from Gray 1995)

5.2.1.1.2 SWANSEA AND MUMBLES

There are patches of oyster beds still present off the Swansea and Mumbles coast with some being exposed on large spring tides. The beds that still exist are predominately composed of large old specimens with little signs of recent recruitment and there are old oyster grounds with dead oyster shells present on many of the beds.

The slipper limpet is still a significant problem within the bay and certainly reduces the possibility for natural oyster spat settlement on the old beds. One or two boats occasionally fish the grounds, although this is normally dependent on the success of other fisheries, which are considered as their primary targeted catch.

5.2.1.1.3 PEMBROKESHIRE

There is an occasional natural native oyster fishery present within Milford Haven where dredging is carried out under a permit issued by the South Wales SFC for a limited period each year. The harvesting by up to 5 boats takes place between 1 October and 31 January on beds upstream of Neyland Bridge, during the fishing season and recently renewed interest has been expressed for their dredging below Neyland Bridge (S. Lockwood (CFCM) pers. comm.). On intertidal beds, spring tides sometimes expose the upper stocks on the beds which can be gathered by hand, a process which does not require the same Authorisation as dredging does. In 1992, 10.2 tonnes were dredged from the Milford Haven beds which constituted approximately 2% of the total UK production, other recent annual landings have totalled between 2 and 10 tonnes. The water quality of the oyster beds is Classified B and in 1999 the harvested oysters were purified locally.

Following the oil spill by the tanker *Sea Empress* in February 1996, a closure order was imposed as a precautionary measure on fin and shellfishing within the area. The Closure Order was progressively lifted as tests revealed fish and shellfish were uncontaminated and finally repealed in September 1997.

5.2.1.2 General Occurrence

Records from the MNCR database correlate with the known oyster distribution with respect to natural fisheries. One note is made of the presence of oysters to the south of Porthcawl, eight further records give locations in Milford Haven and the estuary of the River Cleddau.

Table 14 shows the designated bivalve mollusc production areas within the region that produce oysters, from September 2000 (Pacific oyster details are included to compare distribution of the cultivation of native and Pacific oysters).

Table 14: Designated bivalve mollusc production areas producing oysters in South Wales (effective from the 1 September 2000).

Production Area	Bed Name	Oyster Species	Class	Comment
Milford Haven	Cleddau River - Jenkins Point to Picton Point	Native	B	
Milford Haven	Cleddau Bridge to Jenkins Point	Native	B	Area classified at higher level but with marginal compliance
Milford Haven	Carew River	Pacific	B	

(Reproduced from CEFAS figures required under EC Directive 91/492/EEC)

5.2.2 NORTH WALES (CARDIGAN TO WIRRAL)

The location of cultivated and natural native oyster populations is given in Figure 15 but there are no records of any cultivation of native oysters currently taking place within the region. Cultivation of the Pacific oyster occurs both within the Menai Strait and in the *inland sea* between Holy Island and Anglesey. A distribution map produced in 1982 shows both these sites to be cultivating the native oyster, although this now appears to have ceased. Similarly no areas are designated as bivalve mollusc production areas for the production of oysters, Pacific or native, within the region.

The National Biodiversity Network map of native oyster distribution around the U.K., shows three positions within and around the area of the Menai Straits where the native oyster has been recorded. There is also a record made on the MNCR database of a native oyster population occurring off Cardigan Island to the south of Cardigan Bay No other records have been found of the occurrence within the Cardigan Bay area of any further populations of the native oyster, despite the inclusion on the MNCR database of survey results covering the much of the coastline between Cardigan Island and Pwllheli. The absence of the native oyster, particularly within the sheltered bays and estuaries of the region has been noted as unusual particularly as there are mussels, cockles and scallops along the coast (S. Lockwood (CFCM) pers. comm.), although some of this lack of occurrence may be attributable to the lack of suitable substratum within a large proportion of the estuaries and bays within the region, (E. I. S. Rees (University of Bangor) pers. comm.).

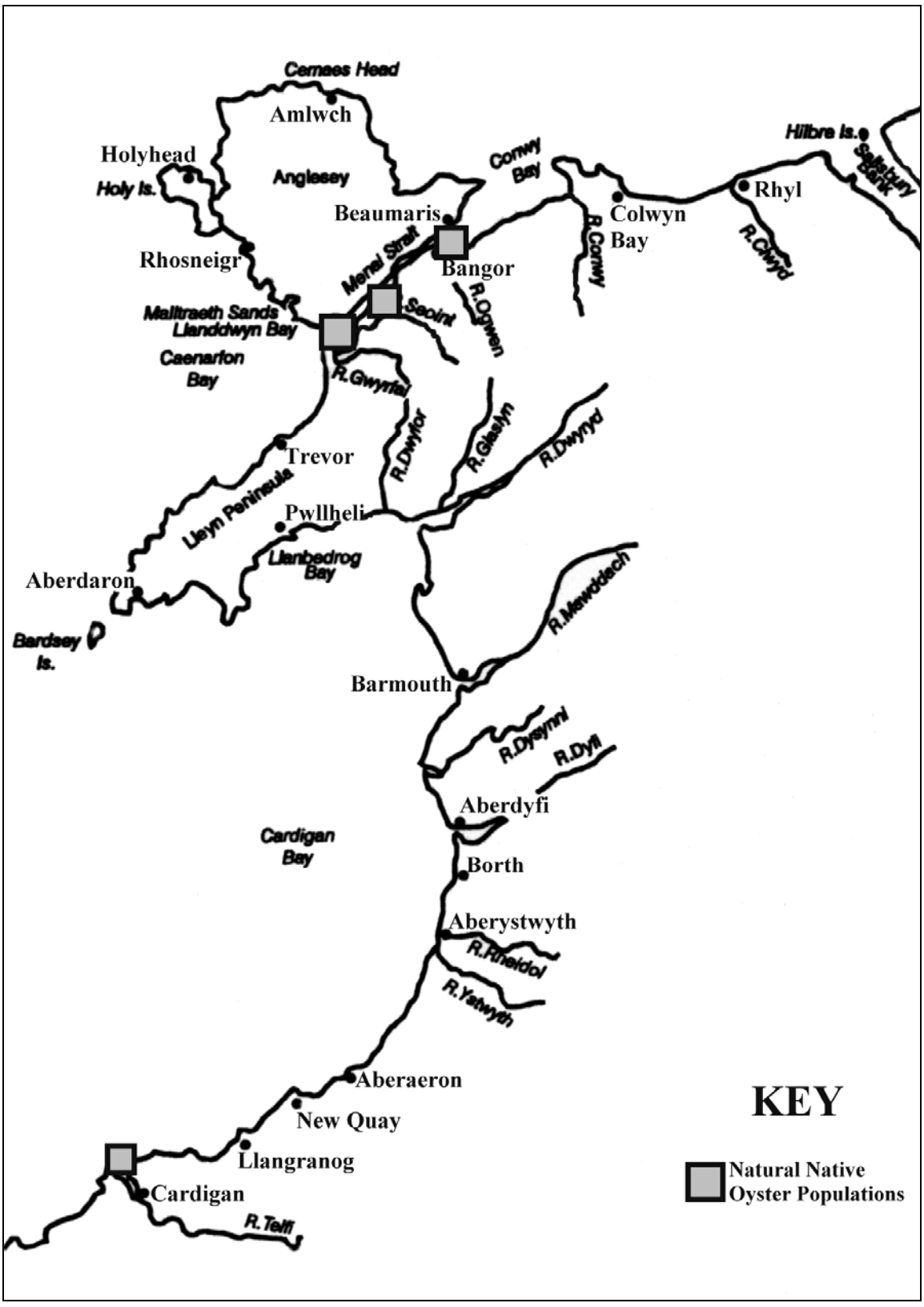


Figure 15: Map of North Wales, showing cultivated and natural oyster populations (modified from Gray 1995).

6. THE NATIVE OYSTER IN SCOTLAND

Historical information is given here including all available information on general distribution of the species, fisheries and abundance covered under the heading for each individual district. Current information is covered in the same format wherever possible and includes information of fisheries and general occurrence considered separately.

6.1 Historical Information

6.1.1 WEST COAST (DUMFRIES TO TONGUE PLUS WESTERN ISLES)

Many of the lochs and inlets on the west coast of Scotland have had small beds of native oysters present within them which were primarily utilised locally. Fisheries occurred in the Western Isles off the west coasts of Lewis and Skye, and off the coasts of Mull; in Argylleshire in Loch Sween and West Loch Tarbert; and in Ayreshire in Loch Ryan, Luce Bay and Wigtown Bay (Millar 1961), (Figure 16). The nature of the local communities, small and isolated, combined with a predominantly rocky substratum had resulted in a historically low impact exploitation of these small oyster beds.

With increasing industrialisation and the advent of the railways, the isolated communities became more accessible and journey times to major centres of population were reduced considerably. The railways initially increased demand for natural oyster populations from the English coast but as these were fished out, alternative beds throughout the UK were sought. The oysters which were acquired ranged from full grown stock marketed for the table to brood and spat sought for relaying on oyster beds on the east coast of England. The pattern was the same for the west coast Scottish oyster beds, in common with the English and Welsh coasts and with little legislation to protect stocks the main known oyster grounds were overexploited with many becoming uneconomic for further exploitation.

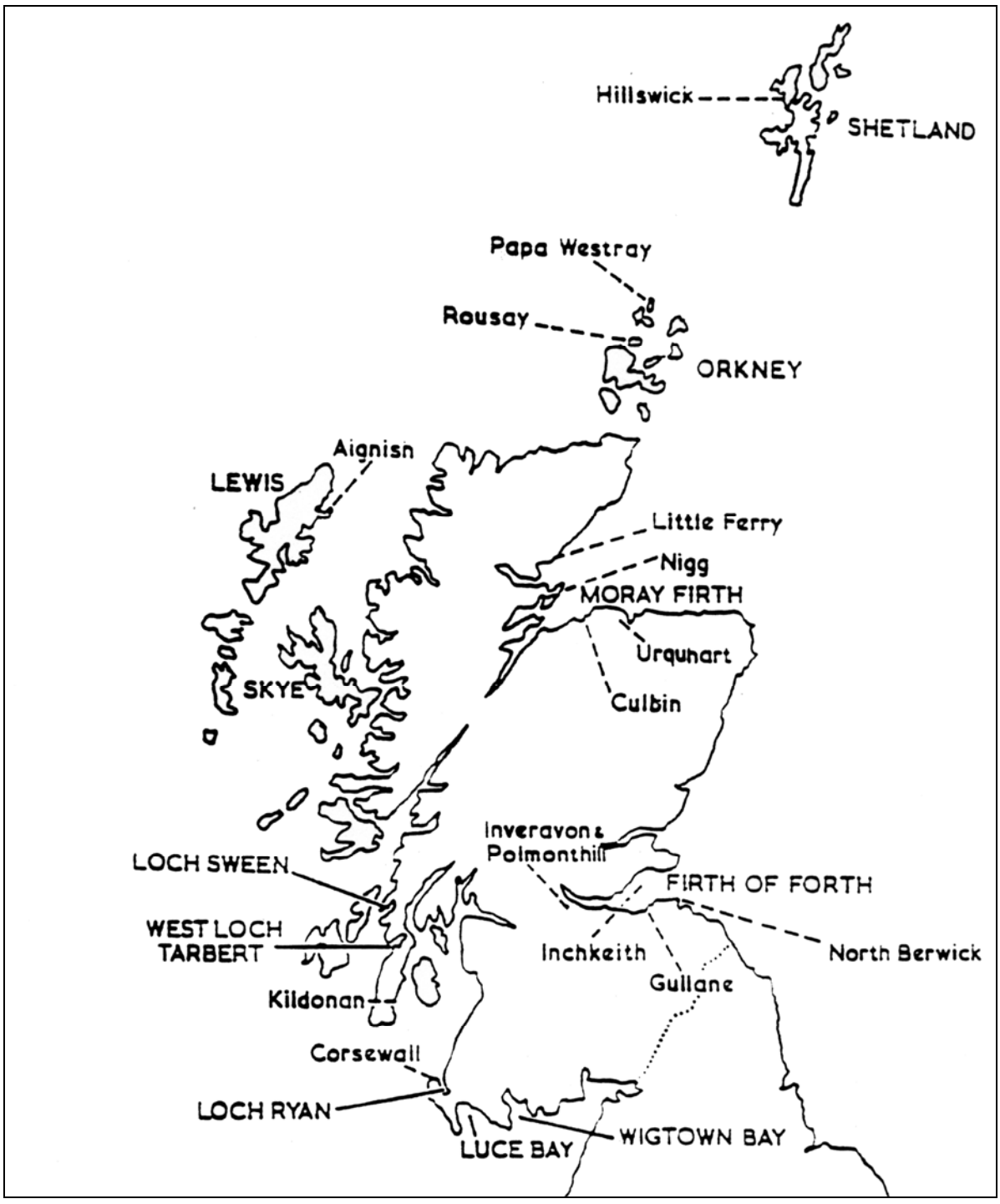


Figure 16: Distribution of the native oyster within Scotland in the 19th century (reproduced from Millar 1961).

6.1.1.1 Loch Ryan

For a long time Loch Ryan was one of the most important natural oyster fisheries within Scotland but it suffered the same pattern of increasing exploitation as the rest of the west coast grounds. In 1876, Sir William Wallace reported to the Select Committee on Oyster Fisheries (1876) about the denuded state of the beds within Loch Ryan, resulting from *the great demand for young oysters to lay down in the Thames Estuary* (HMSO 1876). Sir William was the Baronet of Loch Ryan and held exclusive fishery rights to the most of the grounds within the loch. Dredging for oysters was carried out by locals under licence from the estate, which involved them paying a levy for the right to dredge as well as adhering to local by-laws, set for the fishery and policed since 1822. The by-laws included a close season of at least four months, a minimum landing size of 2½ inches and a ban on fishing at night. However, despite the use of these restrictions, far earlier than any imposed in England, the large oyster companies of England had such a demand for oyster brood and spat, that the local fishermen did not adhere to the by-laws hence Sir William considered only allowing the exploitation of the grounds by those men actively employed by himself.

Despite these regulations, the numbers of oysters harvested from the loch continued to increase with landings reaching a peak between 1907 and 1914, when an average of 1,500,000 oysters were landed annually. This was followed by a gradual decline in the fishery which continued until 1954 when the fishery became commercially non-viable (Millar 1961).

Unlike some oyster fisheries, however, the oyster beds did not die out. This may have been due to a number of factors, including the management regime already in place, as well as not having major slipper limpet infestations and later *Bonamia*, which severely affected equivalent English fisheries.

6.1.1.2 Firth of Clyde (Holy Loch)

The Holy Loch oyster fishery, located within the Firth of Clyde, had been almost as large as the Loch Ryan fishery in the early 19th century (HMSO 1876). However, it appears to have suffered more

severely from the effects of over exploitation. A Several Order, The Holy Loch Fishery Order was granted in 1869 but by 1876 was deemed a complete failure.

In a review of the Mollusca of the Clyde Sea area, Allen (1962) found the populations of native oysters scarce, and those that were found were mostly the remnants of cultivated oyster beds. Only one report of oysters at Buttock Point, Bute showed any significant numbers of oysters outside Loch Ryan. The full distribution noted by Allen (1962) was the presence of oysters north and south of Cambeltown, Loch Tarbert (Loch Fyne), mouth of Loch Striven, Arddarroch, Balloch Bay (Cumbrae), Holy Loch, Sanda Island, Gare Loch, Inveraray, Ardnadamall and Lochgoilhead. Since the 1960s many of these areas have become sites for cultivation of the Pacific oyster.

6.1.2 EAST COAST (PORTSKERRA TO BURNMOUTH, PLUS ORKNEY AND SHETLAND ISLES)

6.1.2.1 Firth of Forth

The oyster beds of the Firth of Forth were once the most important within Scotland and have been shown to have been exploited by the Romans. Evidence for the exploitation has come from the presence of Forth type oyster shells found alongside other Roman artefacts in sites around the Firth of Forth with one site recorded by as *containing cartloads of dead oyster shells* (Fulton 1896). Fulton (1896) considers that the Forth oyster grounds continued to be exploited throughout the medieval period although written records of the exploitation do not begin until the late 17th century.

The first records of the catches and revenues earned from the beds, suggest that over exploitation may have already been occurring on the Forth oyster grounds and that there was *reckless fishing* by foreign vessels. Some of the catch landed from the Forth beds was destined for either London or Dutch markets. With no restrictions on the size of oysters taken, the oysters were much sought after as brood for relaying on the large private oyster grounds of east England. Between 1773 and 1776 4,000,000 oysters a year were transported to London mainly for relaying, which was approximately a

fifth of the total amount of oysters dredged annually. Yonge (1960) suggested that the catch from the Forth oyster grounds was in excess of 20,000,000 per annum at the end of the 18th century.

The Forth oyster beds had always been self sustaining and with no artificial re-stocking taking place, although with the continued exploitation of the beds the City of Edinburgh Council considered that the stocks would not last without some form of protection. In 1836, the Council imposed size limits on oysters to be sold, coupled with a ban on foreign exports, which appeared to have been partially successful with catch sizes showing a certain amount of recovery (Millar 1961). Subsequently, the Council leased the rights to a major part of the fishery, to an English oyster company for £300 per annum, and relaxed the previously successful fishery limitations. The result was that the company dredged unhindered, taking all sizes of oyster at all times of the year (Fulton 1896). By the middle of the 19th century the oyster landings were a tenth of the amount seen in the fishery at its peak. The nature of the beds, being large and present on fairly flat grounds encouraged the use of heavier, more efficient dredges which further increased the rate of the decline of numbers and also destroyed the natural reefs of which the oysters were an integral part.

Towards the end of the 19th century the state of the Forth fishery was recognised as in serious decline and a number of attempts were made to protect it via legislation. A close season was re-instated by an Act of Parliament, to protect the beds in June and July. Five Several Orders were granted for the Forth, two for mussels, two for oysters and mussels, and one for oysters alone. The Fisheries (Oyster, Crabs and Lobsters) Act 1877 gave the power for the Board of Trade to *temporarily restrict or prohibit dredging for oysters or fishing for edible crabs and lobsters on certain banks, or within certain areas.* Further protection was gained through the Clam and Bait Beds Act 1881 which conferred legal protection on bait beds from beam trawls.

In the early 1870s Scottish fishermen tried to protect their dwindling stocks from the English smacks, based in Brightlingsea, which had travelled to the Forth to dredge. In boats loaded with stones, the Scots attacked the Englishmen who had to be protected by the police and finally a Royal Navy gunboat (Neild 1995).

Despite all the new legislation, it was noted that little change occurred with the actual fishing practices within the Forth. Harding (1996) attributed this lack of success to problems with gaining an Order and the effectiveness of the Board of Trade in enforcement within Scotland. Devolution of the regulatory powers occurred late in the 19th century, giving power to the Scottish Fisheries Board, but the stocks within the Forth were thought to have fallen below a critical level. The decline continued with numbers taken from the beds being 114,700 in 1884, 31,500 in 1889 and 27,300 in 1895 (Thomas and Saville 1971).

In 1920 it was recorded that no commercial landings were made from the Forth oyster fishery, which was officially closed in the same year. The last recorded landings of oysters occurred in 1925 and a survey conducted in 1957 revealed that no oysters were present on the grounds within the Forth (Millar 1961).

6.1.2.2 Inverness and other East Coast Oyster Beds

Oyster beds were present within Cromaty Firth which were the property of the Countess of Sutherland. Buckland (1876), described the site as having good natural beds although considered them as not suitable for cultivation, being too silted up and covered in seaweed (HMSO 1876).

Millar (1961) also noted the presence of other oyster beds present on the east coast of Scotland during the 19th century. These included Little Ferry, Nigg, Culbin and Urquhart on the Moray Firth, Rousay and Papa Westray on the Orkneys, and Hillswick on the Shetlands (Figure 16). These were all natural grounds which became over exploited and are now only present in scattered small beds. Many were noted in the middle of the 20th century for their suitability as sites for mariculture and were subsequently developed for the cultivation of native and Pacific oysters, with varying degrees of success.

6.2 Current Information

6.2.1 WEST COAST (DUMFRIES TO TONGUE, PLUS WESTERN ISLES)

6.2.1.1 Fisheries

There are now very few natural oyster fisheries in Scotland supporting commercially valuable populations of oysters. With the exception of Loch Ryan, all other natural oyster beds are too small to support any large or prolonged exploitation by the fishing industry. It is therefore cultivation which produces the majority of oysters within Scotland, although, as elsewhere Scottish fish farmers have predominantly chosen to farm the Pacific oyster rather than the native species. The relative difference in annual production of Pacific and native oysters in Scotland throughout the 1990s can be seen in Figure 17. The production of the native oyster within Scotland showed a general trend of gradual increase within the 1990s although production of edible sizes fluctuated greatly; there was a minimum of 1,000 in 1990 and a production peak of 182,000 in 1995. Figure 18 shows the production of farmed native oysters in Scotland both for the table and for on growing.

Cultivation of the native oyster occurs mainly along the west coast of Scotland, with many small bays and inlets providing ideal conditions for mariculture without the poorer water quality which have and continue to affect their English counterparts (Neild 1995). Oyster farming often occurs with or near the farming of salmon. The latter can have an adverse effect on the quality of the waters used for shellfish farming and thus affect the oysters. Salmonid farming results in an increase in the organic loading of the waters with uneaten food and faecal material (Gowen *et al* 1988) Fish waste products also can increase bacterial and viral loadings within the water and increased chemical pollution with the occurrence of waste biocides and pesticides may contaminate the oysters and produce sublethal responses. Most of the effects caused by fin fish farms tend to be localised and therefore only shellfish farms nearby will normally show any significant affects. However, such impacts will cause conflicts between the industries.

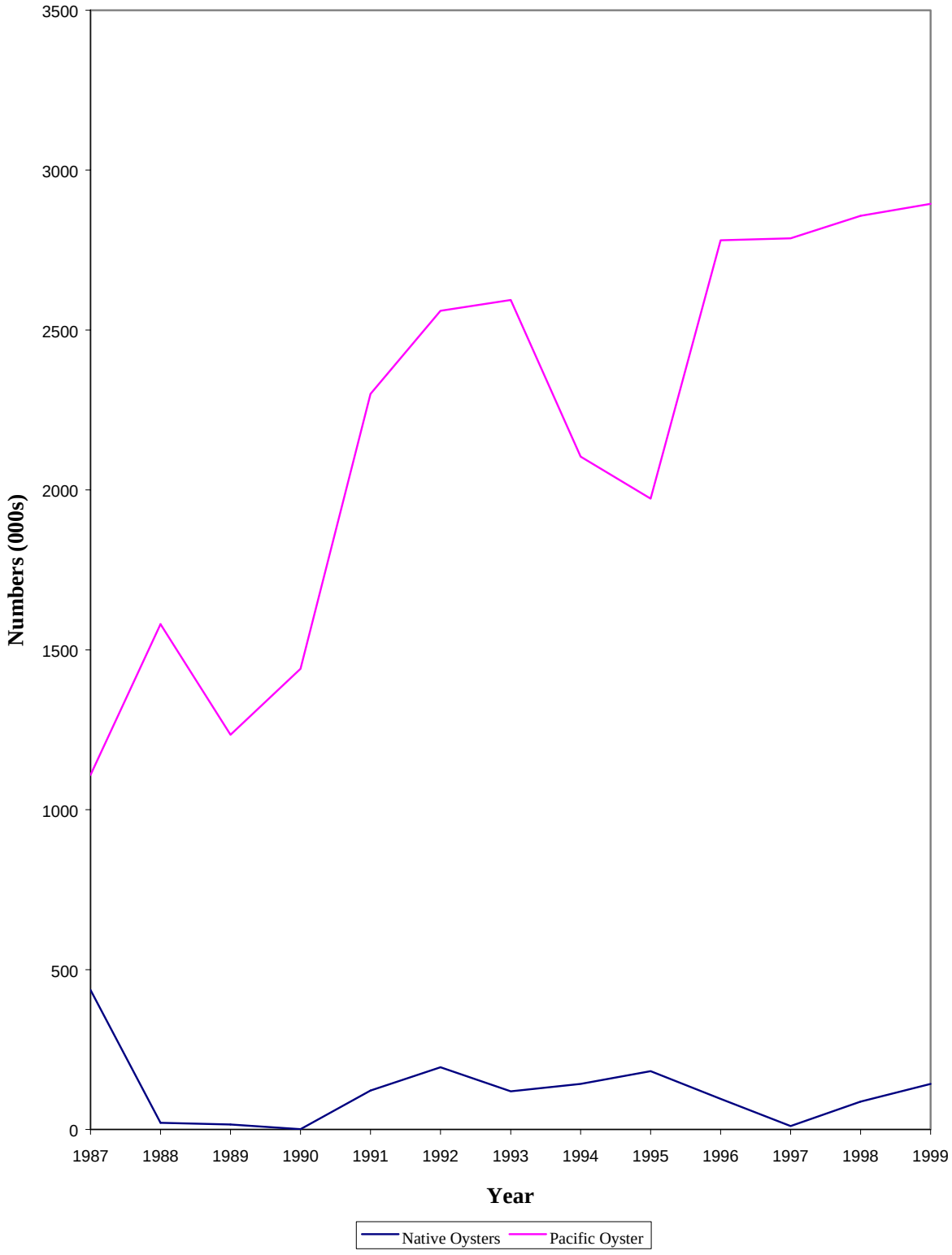


Figure 17: Farmed production of native and Pacific oysters for the table in Scotland (1987-1999).

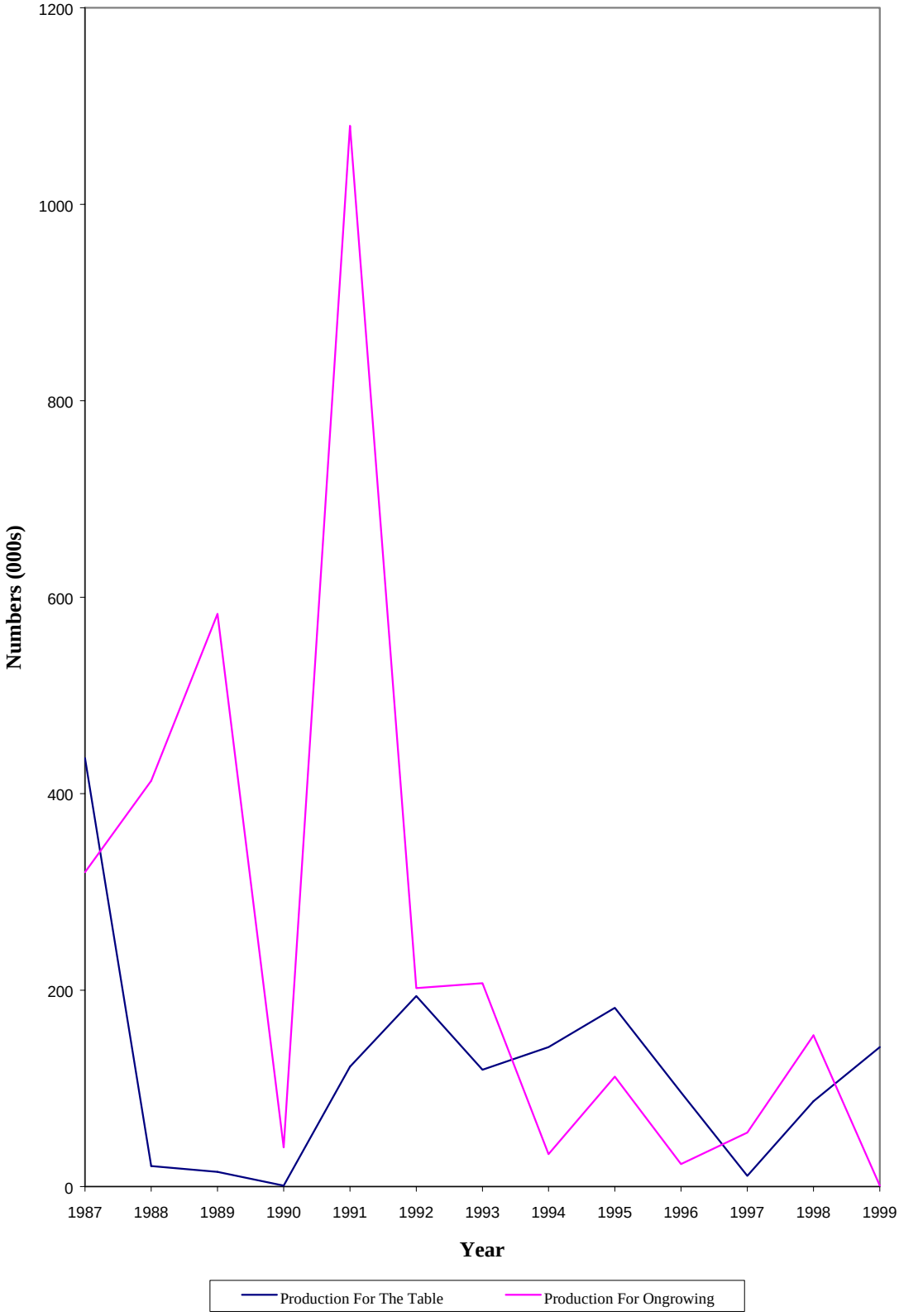


Figure 18: Shellfish company production of native oysters in Scotland (1987-1999).

The distribution of salmonid and molluscan farm sites by region throughout Scotland is given in Figure 19. Although this map was produced in 1991 there is an inter-annual variation in the production of the farmed native oyster. The numbers of companies producing the native oyster regionally in Scotland in 1999 are given in Table 15.

Table 15: Number of companies producing native oysters in 1999 by Region.

	Highland	Orkney	Shetland	Strathclyde	Western Isles	Total
Production For The Table	3	0	0	3	0	6
Production For Ongrowing To Other Producers	0	0	0	1	0	1
No Table Production But Actively Ongrowing	1	3	1	1	0	6

Reproduced from Scottish Shellfish Farms Annual Production Survey 1994-1999. (Note: Strathclyde region includes Dumfries and Galloway. No production occurs for the East Coast from the Grampian south).

Regional maps for the sites of shellfish farms within Scotland are given in Figures 20, 21 and 24. Although most sites primarily produce Pacific oysters, the cultivation technique is roughly the same as that for the native species (Scottish Shellfish Farms Annual Production Survey 1994-1999), hence cultivation of both species sometimes occurs at a site. The information therefore does not distinguish between the two species and the relative production values for the two species can vary on an annual basis within the site. The only Bivalve Production Area in Scotland designated for the production of *Ostrea edulis* is located within Loch Ryan. This is Class A from January to April inclusive, at all other times the area is Class B.

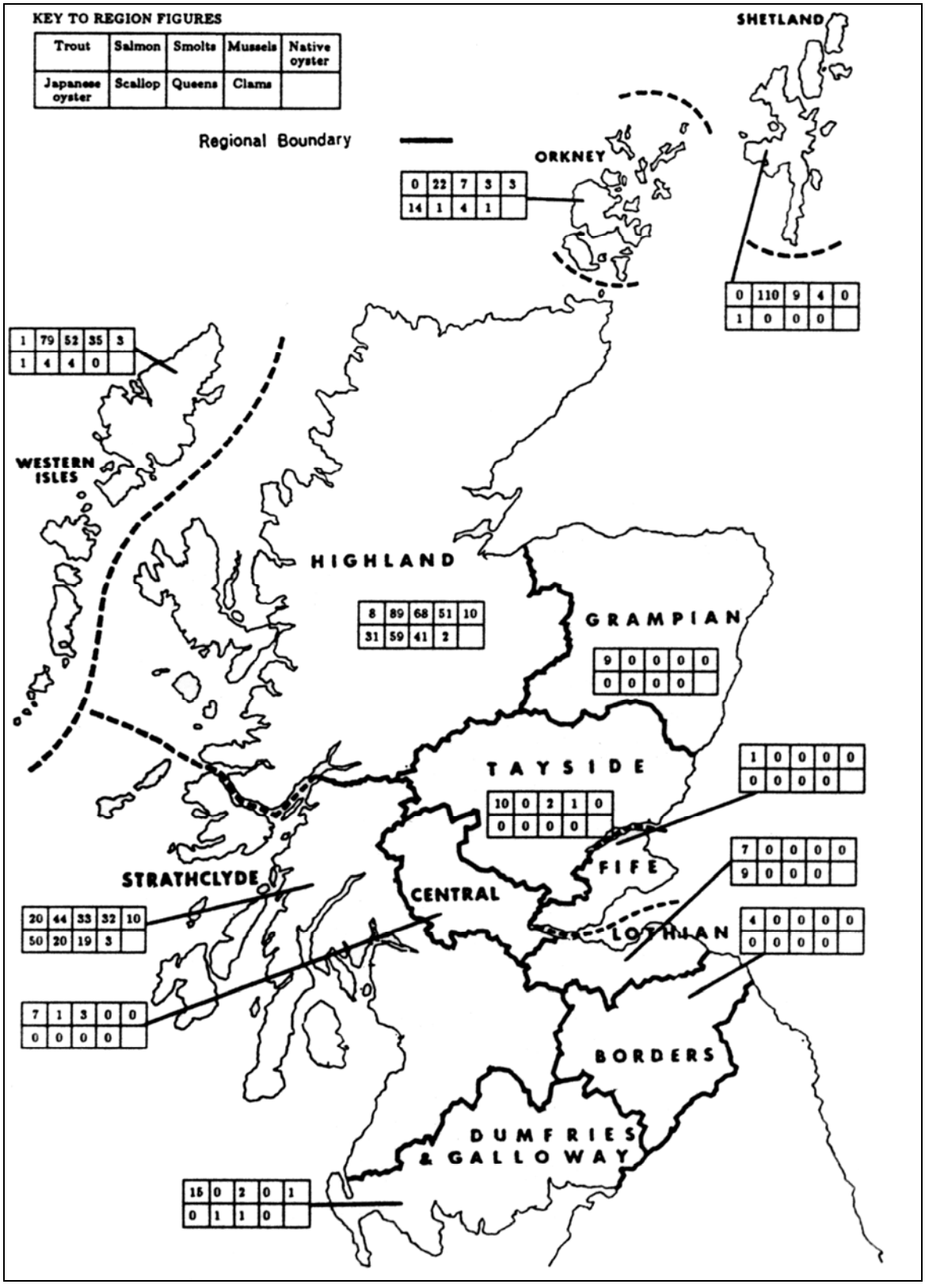


Figure 19: Distribution of salmonid and molluscan farm site, by region, within Scotland (reproduced from Munro, 1991, in Scottish Marine Biological Association Newsletter 3).

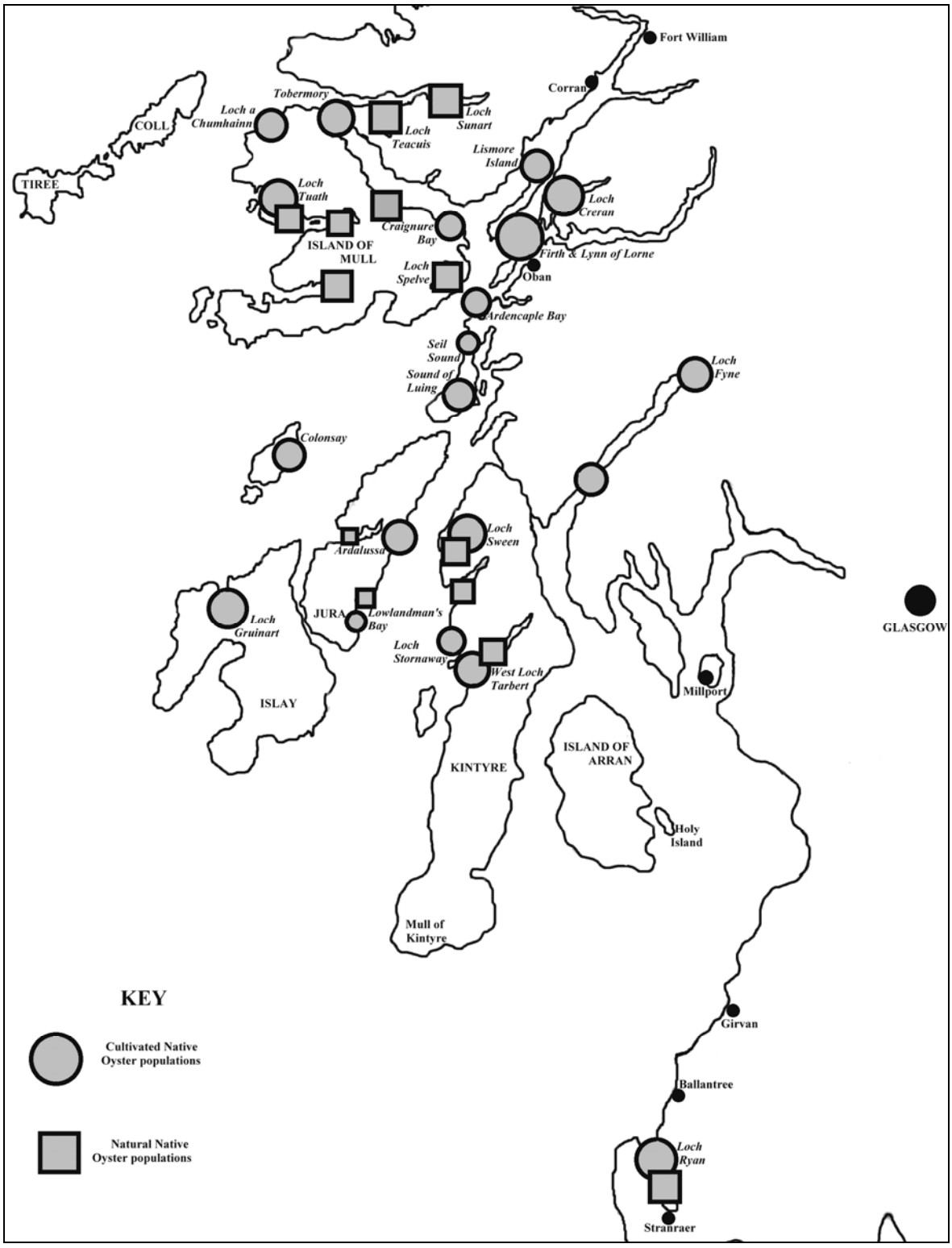


Figure 20: Map of South-west Scotland showing the location of cultivated and natural native oyster populations, (produced using data from the MNCR database, National Biodiversity Network and JNCC Coasts and Seas of the UK).

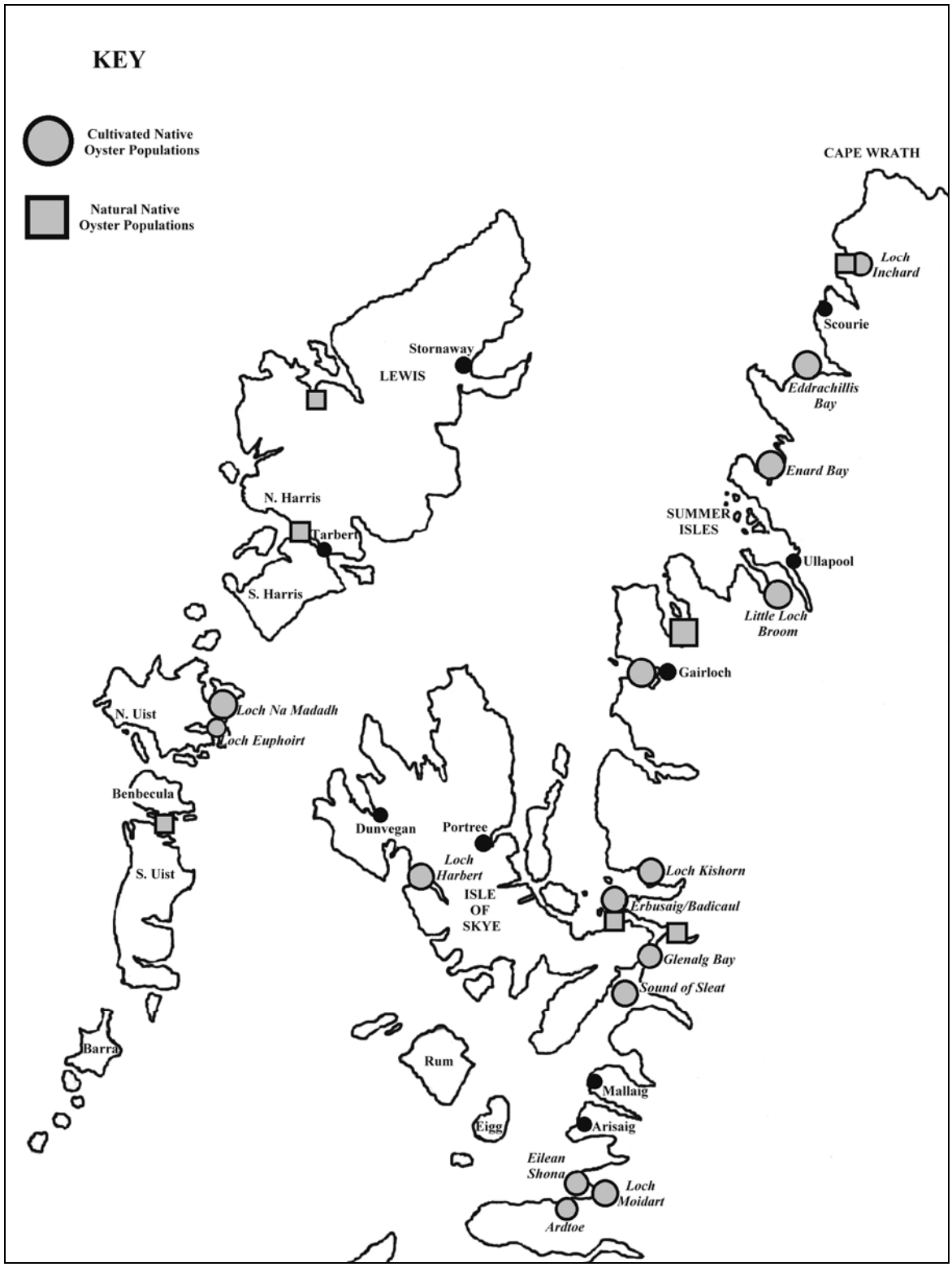


Figure 21: Map of North-west Scotland and The Western Isles, showing the location of cultivated and natural native oyster populations, (produced using data from the MNCR database, National Biodiversity Network and JNCC Coasts and Seas of the UK).

6.2.1.1.1 LOCH RYAN

As indicated above, the only area designated under the Shellfish Hygiene Directive for the production of native oysters within Scotland is Loch Ryan which lies to the extreme south of the Clyde Sea area and is geographically separate from the other Clyde and west coast sea lochs (Conner and Little 1998). The relative isolation of Loch Ryan, is reflected in the types of community which are present within it and as such it shows similarities to the warmer inlets in southern Britain (Howson 1989).

Since the commercial operation of oyster dredging within the loch ceased in 1954, some recovery of stocks has occurred. An intermittent fishery has continued and oyster stocks have now recovered to the extent that the loch now contains one of Scotland's few naturally occurring significant native oyster populations. Their scale allows them to be commercially exploited in a financially viable way. Apart from small scale collection and by-catch elsewhere, Loch Ryan can be regarded as the last remaining natural commercial native oyster population in Scotland (Drinkwater 1987).

In addition to the naturally reproducing stocks, the loch also supports a certain amount of cultivation which produces up to 90% of the farmed native oysters within Scotland (D. Hugh-Jones (Loch Ryan Oysters) pers. comm.). It is also a designated Shellfish Water under EC Directive 79/923 the Shellfish Waters Directive (Scottish Natural Heritage 2000).

A survey of the Loch undertaken in 1989, as part of the Nature Conservancy Council's extensive program of sea loch surveys, shows the extent of the distribution of *Ostrea edulis* within the loch (Figure 22).

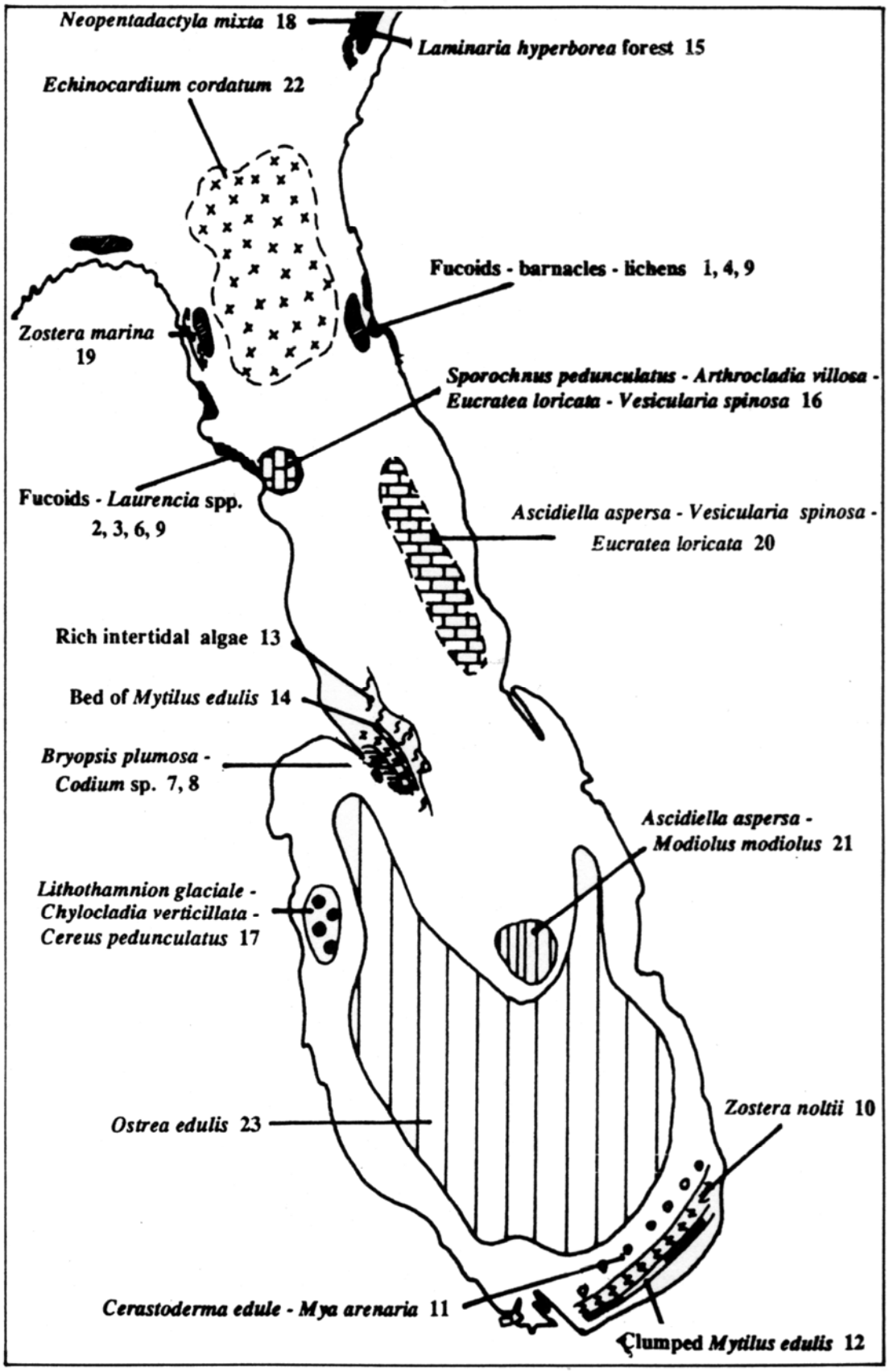

Neopentadactyla mixta 18
Laminaria hyperborea forest 15
Echinocardium cordatum 22
Fucoids - barnacles - lichens 1, 4, 9
Zostera marina 19
Sporochnus pedunculatus - Arthrocladia villosa - Eucratea loricata - Vesicularia spinosa 16
Fucoids - *Laurencia* spp. 2, 3, 6, 9
Ascidiella aspersa - Vesicularia spinosa - Eucratea loricata 20
Rich intertidal algae 13
Bed of *Mytilus edulis* 14
Bryopsis plumosa - Codium sp. 7, 8
Ascidiella aspersa - Modiolus modiolus 21
Lithothamnion glaciale - Chylocladia verticillata - Cereus pedunculatus 17
Ostrea edulis 23
Zostera noltii 10
Cerastoderma edule - Mya arenaria 11
Clumped *Mytilus edulis* 12

Figure 22: Distribution of communities within Loch Ryan, (reproduced from Howson, 1989).

6.2.1.1.2 OTHER FISHERIES ON THE WEST COAST OF SCOTLAND

Other native and Pacific oyster farms are present throughout the west coast of Scotland and the Western Isles. Figures 20 and 21 indicate that the native oysters may be cultivated on the west coast at: West Loch Tarbert, Loch Stornaway, Loch Fyne, Loch Gruinart, Lowlandmans Bay, Loch Sween, Ardalussa, Colonsay, Sound of Luing, Seil Sound, Ardencaple Bay, Firth of Lorne, Loch Creran, Lismore Island, Craigmore Bay, Loch Tuath, Loch a Chumhainn, Tobermory and Lismore Island. North-west coast cultivation is at: Ardtoe, Loch Moidart, Eilean Shona, Glenelg Bay, Erbusaig/Badicaul, Sound of Sleat, Loch Kishorn, Loch Harport, Gair Loch, Little Loch Broom, Enard Bay, Eddrachillis Bay and Loch Inchard. The cultivation in the Western Isles is at: Loch Boisdale, Loch Euphoirt and Loch Na Madadh.

6.2.1.2 General Occurrence

The distribution of the native oyster on the west coast of Scotland is similar to that for native oyster farms within the region. This may be due to mariculture activities being created where conditions for oyster production are good and therefore within the same areas natural populations may still be occurring and self-perpetuating on a limited basis. The occurrence will also be caused by farmed populations reproducing and giving rise to wild populations. General surveys indicating locations of native oysters are summarised in Figures 20 and 21 although it is likely that small, isolated natural communities exist in many more of the lochs and bays of the west coast than is recorded.

The native oyster is recorded at four places in Loch Ryan, from a survey in 1988. Three records from a survey in Loch Sween in 1984 also reveal the presence of oysters within the Linne Mhuirick rapids. The MNCR database also include native oyster presence at two sites in West Loch Tarbert. Routine sampling carried out between 1993 and 1995, investigated trace metals concentration within fish and shellfish and reported native oysters occurring within the regions of the North Minch, South Minch and Clyde. No record was included of specific sites within the regions (Brown and Balls 1997).

6.2.2 EAST COAST (PORTSKERRA TO BURNMOUTH, PLUS ORKNEY AND SHETLAND ISLES)

6.2.2.1 Fisheries

There are no fish farms noted on the mainland east of Loch Inchard which cultivate native oysters, and the Isles of Orkney and Shetland carry out on-growing of natives at three and one sites respectively. No production is reported to take place on these islands, the information contained in Figure 23 shows only generalised cultivation of oysters within the islands with no specific sites highlighted. As noted previously, the year-to-year choices of shellfish farmers whether or not to cultivate native oysters makes data on the distribution very variable and subject to change.

6.2.2.2 General Occurrence

No native oysters have been recorded in any survey carried out within the region since 1974. At that time the species was recorded from two surveys on the Shetland Isles at Gruting Voe and Swarbecks Minn (Figure 23). Large numbers of dead shells occur on the intertidal flats at Culross, Torry Bay and Blackness in the Forth Estuary (Elliott pers. obs.). In addition an application received by the Department of Agriculture and Fisheries in the 1980s for the reintroduction of farmed native oysters imported from the Netherlands did not lead to commercial operation (Forth River Board unpubl.). It was considered by the applicant that the Forth oyster had been particularly adapted to the low water temperature of the Scottish East coast and that a stock of this type remained on Dutch beds.

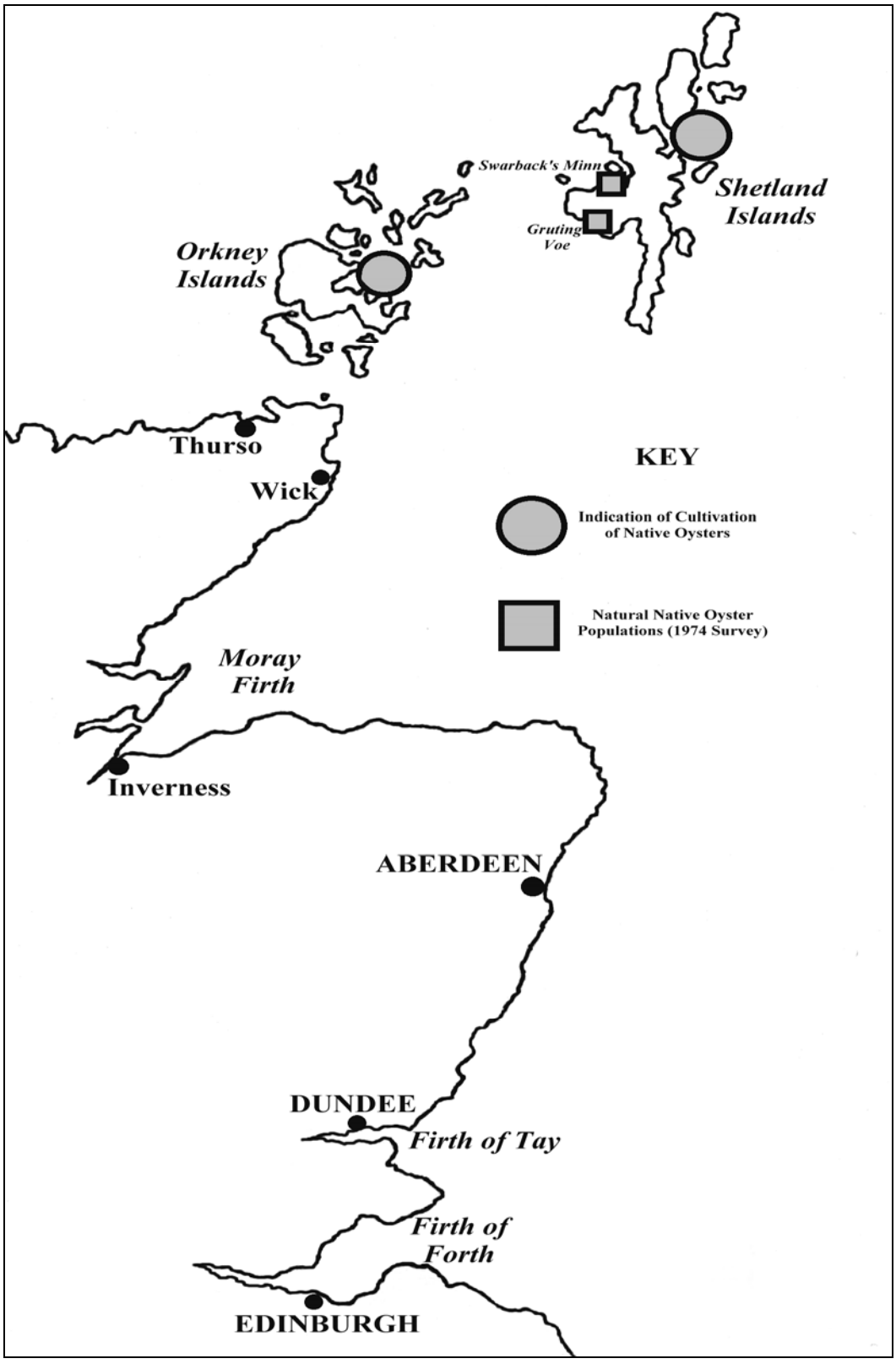


Figure 23: Map of East Scotland and the Orkney and Shetland Islands, showing the general location of cultivation of native oysters and natural native oyster populations recorded in a 1974 survey,

(produced using data from the MNCR database, National Biodiversity Network and JNCC Coasts and Seas of the UK).

7. THE NATIVE OYSTER IN NORTHERN IRELAND

Historical information will be dealt with first, with all available information on general distribution of the species, fisheries and abundance covered under the heading for each individual Lough or Bay. Current information will be covered in the same format wherever possible also with information for fisheries and general occurrence considered separately. Although the historical information may relate to the whole of the island of Ireland, the current information is given only for Northern Ireland.

7.1 Historical Information

As noted previously the treatment of Irish fisheries by the British Government was different to the treatment of those in Great Britain. Local considerations in Ireland led to a far more stringent set of legislative measures to manage fisheries within the country. In an effort to encourage the improvement of Irish oyster beds the Government adopted a policy in the 19th century of granting licenses to individuals which gave them exclusive rights over defined oyster producing grounds. The continued holding of the licence was dependent on annual reports on the state of the oyster beds which had to be seen to be being worked efficiently, for the licence not to be revoked. The first licence was granted in 1842 (Maggennis *et al* 1983) and it became apparent that in order to continue to produce sufficiently large numbers of oysters to maintain a licence, the Irish oyster producer had to restock the beds artificially. The first recorded restocking of private beds occurred in 1862, initially this was from other local beds but from 1875 onwards, oysters were imported to Ireland from elsewhere in the UK and France.

Public oyster beds in Ireland had been used for the harvesting of oyster seed and spat, to relay on private layings, as well as for the harvesting of mature adults. In 1901 a report to the Chief Inspector of Fisheries (Holt 1905), stated that nearly all public oyster beds within Ireland had been dredged out and that obtaining native oyster seed was becoming more and more difficult. Therefore, despite the relatively greater legislative measures and their earlier adoption within Ireland, the oyster fisheries still suffered the same fate as those in Great Britain.

7.1.1 LOCH FOYLE

Local knowledge indicates that there were oyster fisheries in Lough Foyle over a very long period, although there were no written records until 1836 when John Barrow wrote that *there is an extensive oyster bank in the Lough* (Went 1962). These beds were recorded as very productive and in 1836 supported eighty boats with four men working each boat (Partridge *et al* 1982). By 1864, the numbers of boats working the grounds had declined to forty or fifty boats (Went 1962), which was the first recorded indication of the decline of the fishery.

The natural beds within the lough suffered from overfishing towards the end of the 19th century and also from the effects of the disease, which greatly reduced most stocks within the whole of Ireland and throughout Europe in 1920. The public beds remained active throughout the early part of the 20th century, although effort was on a greatly reduced level to that seen in the peak period of production. Sporadic use resulted in a reduction in stocks to a commercially uneconomic level. This was subsequently followed by a partial recovery and a renewed interest in the fishery, a pattern of the exploitation of the oyster grounds which continued through much of the 20th century. In 1948, the main banks within the lough were surveyed but live oysters were found to be rare and many dead shells were dredged from areas which had been previously worked by the local dredgermen (MacDonald and McMillan 1951).

In 1952 a joint Northern Ireland/Republic of Ireland body created the Foyle Fisheries Commission, by an Act to *provide for the management, conservation and improvement of the fisheries in the Foyle area*. The primary concern for the Commission has tended to be for the salmon fisheries but regard has also been given to the exploitation of other finfish, shellfish and seaweed.

7.1.2 LARNE LOUGH AND BELFAST BAY

Oysters have long been dredged from Belfast Lough with Wakefield (1812) noting that *excellent oysters are fished from within the bay* and Went (1962) indicated that in 1819 *oysters of reasonable size and good flavour* were found on the banks and along the shore of Holywood, Co. Down (Went 1962).

The oyster industry was once important to the inhabitants of the town of Carrickfergus. For example, in 1846 a large proportion of the population was employed in fishing, specifically for cod, lobsters and oysters and in 1864 four boats were used to fish for oysters from Carrickfergus (Went 1962). In 1857 and 1858 reports on zoological surveys carried out by the Belfast Dredging Committee to assess the marine zoology of the coasts of Antrim and Down concluded that *Ostrea edulis* was abundant at various depths from near low water mark to 25 fathoms (Hyndman 1858 and 1859). Low numbers of native oysters were found in some areas surveyed. For example, a site to the north of Larne Lough had only one old living oyster and only a few dead shells were produced from surveys of Larne Lough itself. In 1857 it was reported that oysters occurred on various beds through the bay although the main ones occurred between 1 and 8 fathoms. A bed was found adjacent to the Copeland Islands which had been worked for four years and was nearly worked out.

A strong decline in the natural oyster populations of both Belfast Bay and Larne Lough was indicated in 1857 together with a reduction in the number of fishermen working the beds. This reduction in the workforce was not only due to scarcity of oysters, but a general lowering of prices, caused in part to the increased importation of oysters from Greencastle, Stranraer and Whitehaven (HMSO 1866).

In 1857 no cultivation or artificial restocking of beds was carried out, all exploitation occurred on naturally self perpetuating oyster grounds. In 1891 there were about 20 boats recorded fishing for oysters still within Belfast Lough but by 1903 only occasional dredging was carried out on a few depleted oyster beds (Went 1962).

7.1.3 STRANGFORD LOUGH

There is some indication that Strangford Lough once had a self-sustaining native oyster population, which supported a fishery of up to 20 boats employed in oyster dredging. Brown (1818) recorded that oysters of the genus *Ostrea* were present within Strangford Lough in large numbers, with the specimens being *large and perfect* but by 1903 oyster beds within the lough had ceased to exist, (Went 1962). In more recent years, native oysters were recorded in low numbers from throughout the lough and in 1954 a few were recorded as occurring off Whiterock with oyster beds charted but dead shells were much more common than live specimens (Williams 1954).

7.1.4 CARLINGFORD LOUGH

Extensive oyster beds are known to have been exploited from within Carlingford Lough for several hundred years, with Pocock (1752) recording that 400 vessels commonly came to the harbour every year to *fish for herrings and oyster fishing for Dublin,* which was the chief support of the town of Newry (Went 1962). Brown (1818) reported that inferior examples of *Ostrea edulis* had been recorded from Carlingford Lough and in 1836 it was stated that the beds were covered by mud but that small numbers of oysters were gathered at low tide (Went 1962). Fishing in the Lough began in November and carried on until the last Monday in March, with most of the oysters gathered being sold on the bankside but a small amount sent on to Liverpool. Sometimes the catches were kept within *parcs*, to maintain healthy live oysters until marketing. The area surrounding the lough was owned at the time by the Marquis of Anglesey who charged 5 shillings per boat per annum to fish the lough (Went 1962).

The oyster fishery failed between 1845 and 1861, with some recovery occurring in1862. The oyster grounds were all public, except for one to the south of Carlingford and suffered from overfishing to the extent that in 1874 the beds were declared *fished-out*. Later these beds were revived by the importing stocks of American, Portuguese and British oysters. At the turn of the century Carlingford was again an important centre for oyster production, with the presence of two major natural oyster beds at the head of the lough which yielded 1,500,000 oysters annually (Partridge *et al* 1982). In 1903, the grounds were being dredged by approximately 80 boats from 1 November to 15 January, giving seasonal employment to around 240 men.

Carlingford was also used as a storage and fattening site for American oysters (*Crassostrea virginica*), which were destined primarily for markets on the west coast of England and the Isle of Man, to serve the holiday trade. Carlingford Lough is the only sizeable sea lough on the east coast of Ireland, except Wexford and this position was used to service both the Northern Ireland main centres of population, as well as those in the north west of England. An estimated 25-30 million oysters were relaid annually on the intertidal plots at Omeath and in the Newry estuary. The American oysters

were shipped from North America to Ireland, in barrels in March/April, and laid directly onto the grounds at Carlingford, until the summer holiday season in Britain. During the season (1 July to end of October) the oysters were harvested and shipped to Britain, the trade gave an estimated 32 people seasonal employment.

The natural native oyster grounds declined at the start of the 20th century due mainly to over exploitation and eventually died out in the 1920s or 1930s. The American oyster trade ceased at around the same time.

7.2 Current Information

The location of cultivated and natural native oyster populations are given in Figure 24.

7.2.1 LOUGH FOYLE

Lough Foyle is a large semi-enclosed bay situated at the northern most part of Ireland which acts as an estuary for the Rivers Foyle, Roe Faughhan and a number of smaller tributaries. The lough has an area of approximately 200 km^2, a length of 27.5 km and a maximum width of 12.5 km, with a constricted mouth 1.5 km. It forms part of the border between the Republic and Northern Ireland within the counties of Donegal and Derry.

A number of commercial fisheries exist within the lough including salmon, whitefish, mussels as well as native oysters. The native oyster beds within the lough entirely natural and self-sustaining, with five main beds and several smaller beds known to exist scattered around the lough (Figure 25). Some native oysters are also found growing within beds of mussels in some areas of the lough. The total area for the native oyster beds is given as approximately 550 ha, most of which are located along the Donegal coast (McKelvey *et al* 1993).

Although the grounds have always been naturally self reproducing, in 1970 the Department of Agriculture and Fisheries, Northern Ireland (DANI), attempted to increase recruitment artificially by the introducing 250,000 spat. When the oyster stocks were assessed by Partridge *et al* (1982), the majority of oysters were found to be large and probably dating to good spatfalls in the early 1970s. It is possible that these were the surviving oysters from the DANI experiments. Current population levels are considered to be high due to the restocking that took place in the early 1970s (J. Hayes (DARDNI) pers. com.). Records for 1993 show the amount of native oysters dredged from the lough as averaging 200 tonnes per annum, however, fluctuating recruitment was thought to have resulted in the lower figures of 150 tonnes per annum between 1989 and 1992 (McKelvey *et al* 1993).

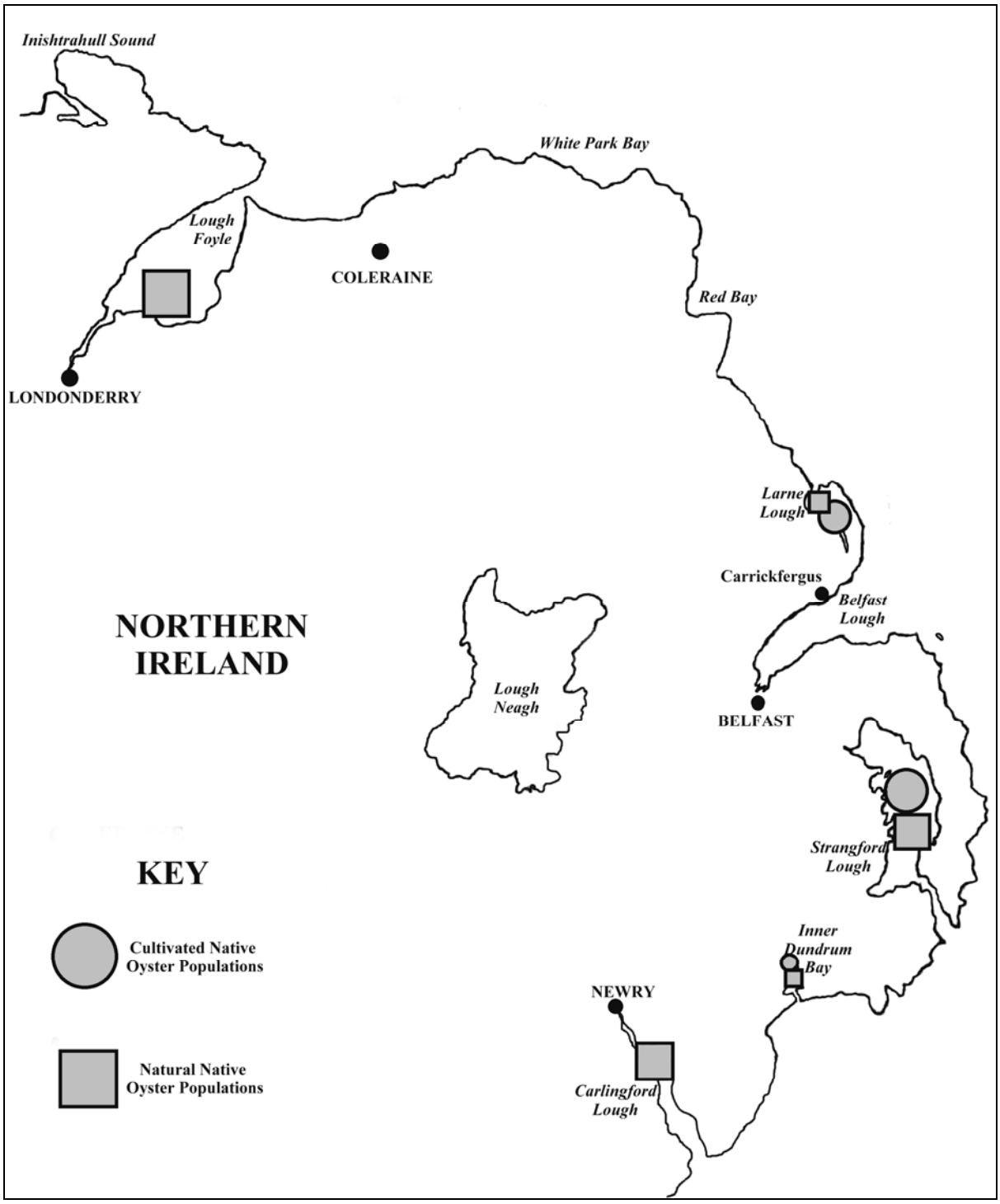


Figure 24: Map of Northern Ireland showing distribution of cultivated and natural native oyster populations (produced using data from the MNCR database, National Biodiversity Network and DARDNI pers. comm.).

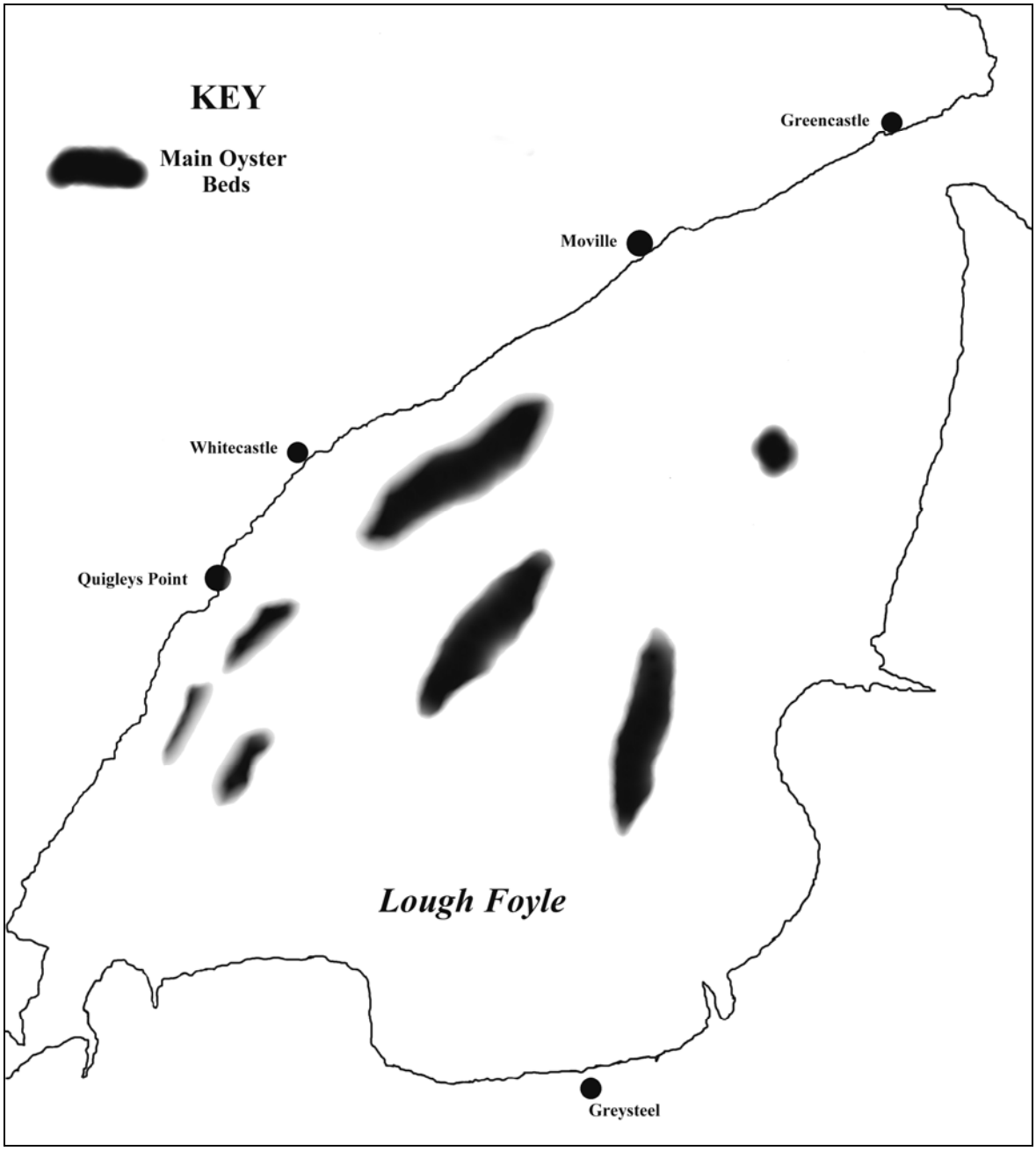


Figure 25: Map of Lough Foyle showing main oyster beds (reproduced from McKelvey *et al* 1993).

This figure had increased to approximately 400 tonnes per annum by 1995 (McCaughan and Robson 1995). Successful breeding within the natural population of the lough is restricted to two or three consecutive years, every six to eight years, as controlled by environmental temperature during the breeding season (McKelvey *et al* 1993). The lough now supports a small dredge fishery with approximately 100 small boats operating during the fishing season (D. Roberts and R. Kennedy unpubl.), these are subject to the local by-laws which include a minimum landing size of three inches (7.5cm) and an oyster dredging season which lasts from the beginning of September to the end of April. Recently the grounds have been subject to closures due to DSP and there are also conflicts between the oyster and mussel cultivation industries within the lough (D. Roberts and R. Kennedy unpubl.).

The Loughs Agency, a cross-border management body, has now succeeded the Foyle Fisheries Commission, taken responsibility for the regulation of the lough and it has the authority to sub-lease areas of the lough. The lough is outside of the Department of Agriculture and Rural Development (NI)s statutory remit such that landings from the fishery take place in the Republic of Ireland and so they are not included in any UK fishery statistics.

7.2.2 LARNE LOUGH

There are small numbers of naturally occurring native oysters within Lough Larne, which were the subject of a proposed scheme to re-establish a viable natural native oyster fishery within this lough, as well as in Strangford Lough, (McCaughan and Robson 1995). Most native oysters within Lough Larne are cultivated and are grown in bags on tressles. Larne Lough has 7 sites licensed to cultivate native oysters and it is thought that these farmed oysters have helped to maintain the natural population, by augmenting the numbers through the spawning of the cultured oysters (Figure 26) (J. Hayes (DARDNI) pers.com.).

7.2.3 STRANGFORD LOUGH

No recorded exploitation occurs on the natural native oyster stocks present within Strangford Lough as the size of the beds and sparse density of the oysters are commercially non-viable. A Shell Fishermans Co-operative has licensed 5 separate areas of the lough and has artificially re-seeded these grounds with native oyster spat, harvesting of these areas is carried out by dredging from boats.

Farming of native and pacific oysters does take place within the lough, with 8 sites licensed to cultivate native oysters (Figures 27 and 28). Various methods of cultivation are used within the lough, dependent on the specific site and include bottom cultivation and cultivation carried out using bags and trestles. Small oysters (<30 g) are grown within the bags on the trestles and once they have exceeded an individual weight of 30 g they are transferred onto mats laid out on the intertidal area, where they are allowed to on-grow until they reach a marketable size. Both techniques, bottom or bag and trestle cultivation, are adopted to grow-on brood and spat produced from elsewhere and any commercial stock retained within the lough originates from hatcheries or from Lough Foyle (Kennedy and Roberts 1999). Stocks of native oysters are also *over-summered* in Strangford Lough, with an estimate of 125,280 individuals retained in 1997 (Kennedy and Roberts 1999).

7.2.4 INNER DUNDRUM BAY

A single licensed operator, Dundrum Bay Oysters, grows native and Pacific oysters along river channels within the bay area (Figure 29). Bags and trestles are used and this cultivation appears to have increased natural stock following the spawning of the cultivated oysters.

7.2.5 CARLINGFORD LOUGH

Carlingford Lough is approximately 15 km long and varies from 2 to 6 km in width, its depths reach 36 m at its outer part, with a navigable channel running along the centre of the lough. Renewed interest in cultivation of oysters began in the1970s, with trial transplants of native Clarinbridge oysters undertaken in the lough, with good results. However, other trials using hatchery produced Pacific oyster brood and spat led to the rejuvenation of the oyster industry within the lough. Most of cultivation up to the mid 1980s was carried out with the Pacific oyster in cages on the seabed. In

1982, only one producer, at the top of the lough, had chosen to cultivate the native oyster, despite a trial in 1979-80 which gave encouraging results on the use of hatchery produced native oyster spat (Partridge *et al* 1982). In the same report it was noted that there was little prospect of reviving the former dredged native oyster fisheries, in Rosstrevor Bay and Newry Estuary. The bay site had become covered in a deep layer of mud since active working of the beds had ceased and the Newry Estuary area, although being clean, would need a source of high quality brood or spat to become established. Currently Carlingford Lough as well as Belfast Lough have one site each which are licensed to cultivate native oysters, but neither are active at present.

Most of the Loughs which have active cultivation of native oysters occurring within them also have small natural populations. Within Strangford Lough, no natural native oyster populations of any significant size have been recorded for over 100 years. During a survey of the lough in 1997 (Kennedy and Roberts 1999), only one fragmented, low density bed was recorded and this was composed of relatively few, isolated individuals attached to rocks and stones. An estimate for the total wild native oyster population was calculated for the lough and was 109,975 individuals.

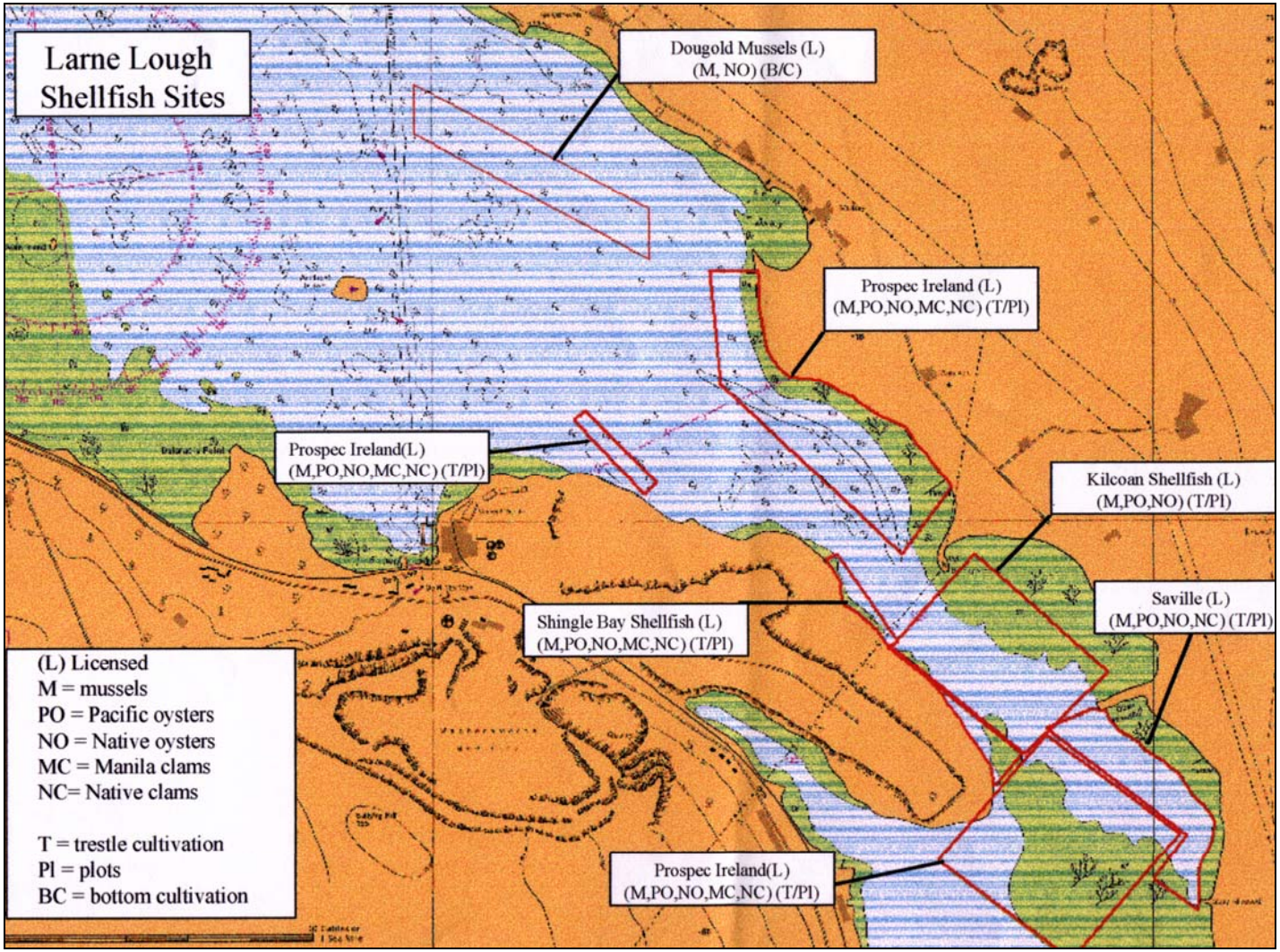


Figure 26: Map of Larne Lough, showing types of cultivation occurring and licensed areas (figure supplied by DARDNI).

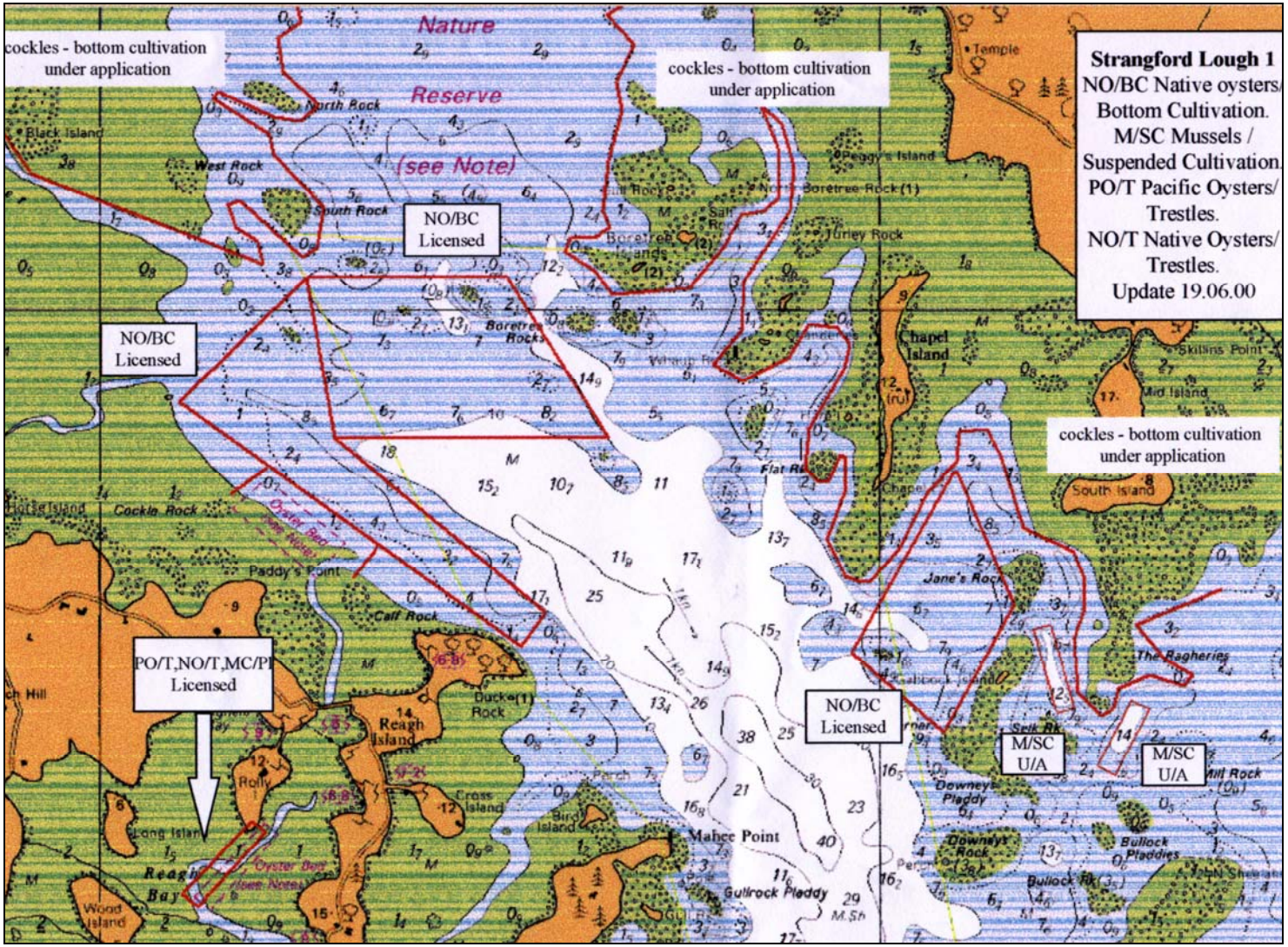


Figure 27: Map of Strangford Lough (North), showing types of cultivation occurring and licensed areas (figure supplied by DARDNI).

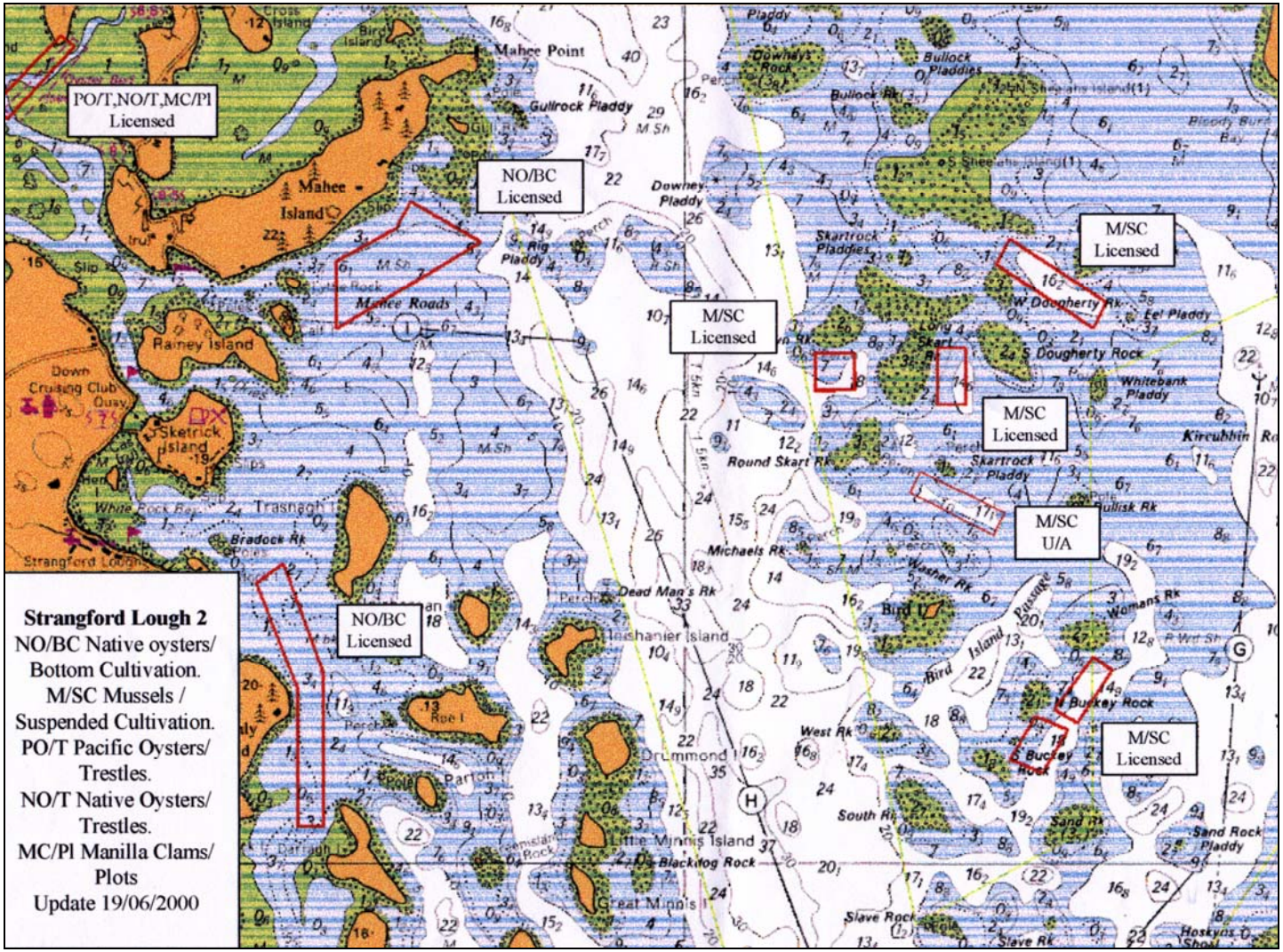


Figure 28: Map of Strangford Lough (South), showing types of cultivation occurring and licensed areas (figure supplied by DARDNI).

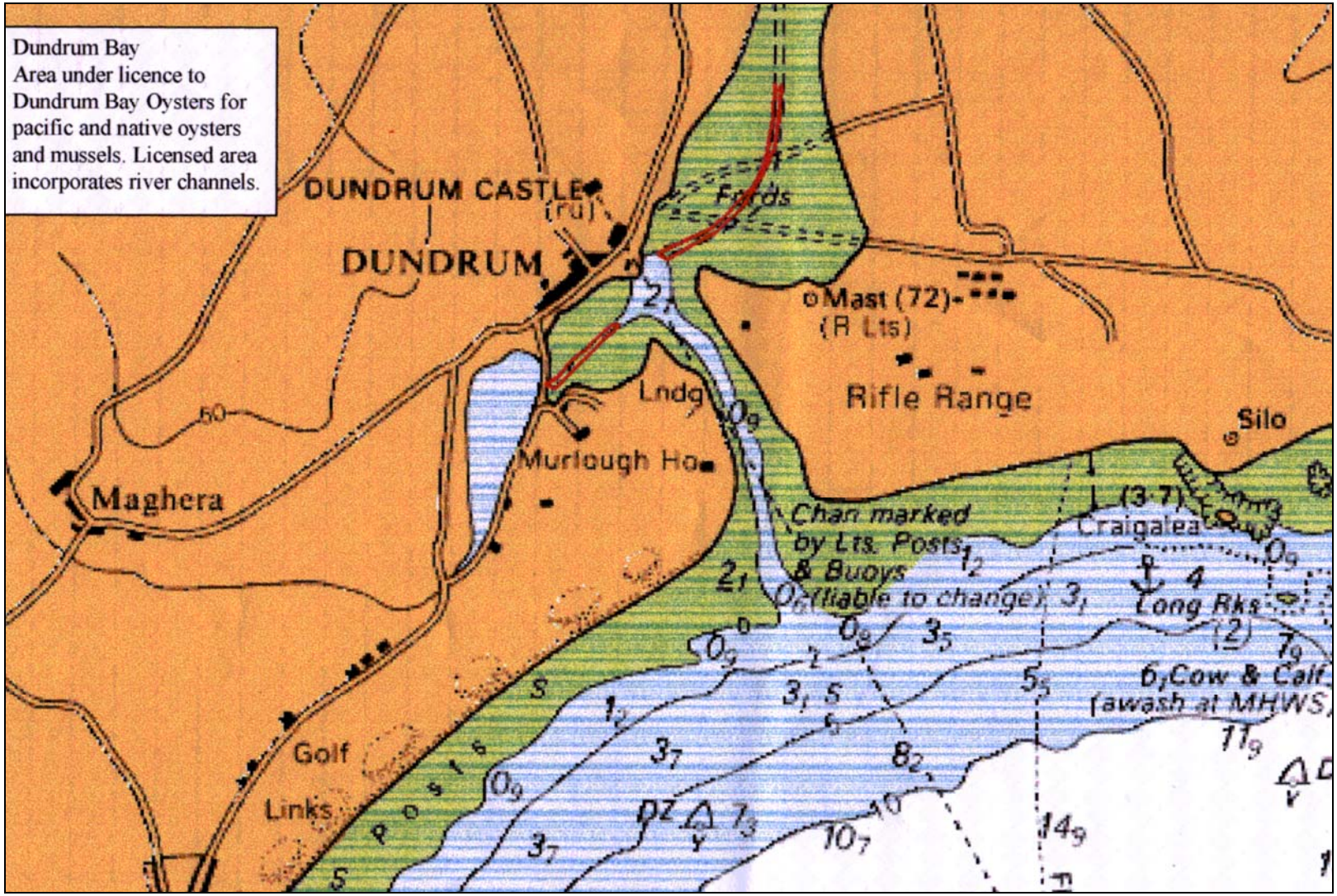


Figure 29: Map of Inner Dundrum Bay, showing areas licensed for the of cultivation native oysters, (figure supplied by DARDNI).

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