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Garrett Hardin, *The Tragedy of the Commons and the Firth of Forth*

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# Garrett Hardin, The Tragedy of the Commons and the Firth of Forth

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## ABSTRACT

Garrett Hardin's theory of the 'tragedy of the commons' is applied to the marine environment of the Firth of Forth, Scotland, where many biological resources were much more plentiful before 1800 than they are today. His ideas are tested against the history of herring fishing, oyster dredging and pollution in the area. In two cases, irreversible resource depletion is found and associated both with failure of self-regulation and external control, and notably with accelerated demand from outside; in the third case, river pollution, degradation occurs but is reversed. The reasons for this are discussed.

## KEYWORDS

Garrett Hardin; marine commons; herring; oysters; pollution; Scotland

## ACKNOWLEDGEMENTS

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## 1. INTRODUCTION.

Traditional use of resources is often associated with common rights, either on land or on sea, and the starting point for academic consideration is generally a reference to Garrett Hardin's famous 1968 paper in *Science*, the 'Tragedy of the Commons'.<sup>1</sup> Citation alone cannot do justice to its eccentricity. Though stated in terms of a general theory, it is not basically about how common land was managed but about how population control should be managed, the freedom to breed being presented as a common human right damaging to the global commons. Too many people lead to overuse of resources and pollution of the earth, so their activity needs curbing. Since the right to breed cannot be privatised in the same way as the right to use common land (privatisation might otherwise, in his opinion, be the best solution) the only way to proceed is by what he terms, rather scarily, 'mutually agreed coercion', not through compulsory gender segregation but through punitive taxation for those who breed. Needless to say, this Chinese approach is open to all kinds of objections, not least that of securing international agreement and the fact that it is consumption that threatens the global commons above mere numbers.

Hardin says surprisingly little here about the operation of traditional commons on land or sea, a subject that concerns many environmental historians and students of development, but what he does say is cogent. He argues that, except at very low levels of exploitation, the exercise of common rights must lead to overuse and disaster, because it always pays the individual commoner to overgraze or to overfish. The commoner gets for himself the entire benefit of an extra cow or an extra load of herring but pays only a fraction of the cost of overuse. The latter is a cost shared by everyone and does not fall on him alone. As all commoners will maximise their advantage and go for yet another cow or another catch, they will all be fatally tempted to become free-riders on the system, leading to the doom of mutual destruction. This, he says, can only be curbed by privatising the common right (as through enclosure) or by some form of 'mutually agreed coercion' (effective sanctions by higher legitimate authority against overuse). The commons to which he refers are not actual places on land or sea but common rights of use of an actual place or (in the case of human breeding) of an actual activity. Most common lands were already owned privately by higher authority, either by a lord or by the crown, a defined body of peasants having shared right of usufruct. In like manner, parts of the sea have always been subject to claims of national sovereignty and the seabed to claims of private or national rights: normally, an undefined number of fishermen and sailors have open rights of usufruct. But such rights to use land and water to practice a common activity are by definition shared and it is of these which Hardin speaks.

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1. G. Hardin, 'The Tragedy of the Commons', *Science* (1968): 1243–8.

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Today, Hardin is often inappropriately considered as a prophet and apologist of the neo-liberal right, because he is assumed to claim that reducing commons to private property solves everything. In respect of land and sea, he would indeed say that reduction of common rights to private property can be one solution but denies it is always possible or appropriate and, in developing his theory later, he made the distinction between the possibility of the commons succeeding with a small number of commoners such as a dozen and its greater likelihood of failure given open access or a larger number of commoners. Nor do his critics, like Elinor Ostrom, deny that commons can lead to tragedy, rather emphasising the frequency of successful long-time operation of the commons when the users themselves and not a higher authority agree on effective rules to keep use in balance with resource.<sup>2</sup> Economic historians have stressed how common rights in fields and woods could be exercised in medieval and early modern times so as to spread risk and minimise conflict rather than to maximise output, thus serving sustainability.<sup>3</sup> A risk-averse community was probably more typical than a profit-maximising one, in an age when risks of hunger and turbulence were both common and local.

Hardin concedes that at levels of light use the commons may survive, so we might conclude that examining the conditions that increase the level of use is also important. Mere population growth may add to the pressure if it adds to the number of commoners but at least as significant in respect of resource use is likely to be the growth of a significant external market and the concomitant improvement of technological means to satisfy demand. Expanding external demand is likely to drive up the number of people who want to exploit the commons. Rising profits will enable them to increase their capital inputs, improving the productivity and intensity of their exploitation. At the same time, infrastructure improvements affect market access and, as the exploitation is seen to be successful, this in turn increases the intensity. So, under modern capitalist conditions, if no effective controls can be put on the intensity of the exploitation in relation to the carrying capacity of the commons, disaster may follow.

One difference is clear between commons on land and sea. Hardin regarded the tragedy of the commons as having two dimensions: overuse and pollution. The latter is not usually very material on common land; fly tipping may be a nuisance but does not threaten destruction of the resource. It is a different matter in aerial or aquatic commons, where, for instance, carbon emissions or oil-slicks can bring disaster. Here we consider both the dimension of overuse and (more briefly) that of pollution. There are interesting differences.

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2. E. Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge, 1990). For the development of Hardin's ideas, see C. Clover, *The End of the Line* (London, 2004), pp. 133–5.
  3. P. Warde, *Ecology, Economy and State Formations in Early Modern Germany* (Cambridge, 2006).



MAP 1. The modern Forth

The Firth of Forth, Scotland, which is our theatre of investigation, is a large place, over fifty miles from the mouth of the River Forth below Stirling to the outer reaches beyond the Isle of May. It divides at Queensferry into the Upper Firth, estuarine and narrow, and the much longer and wider Lower Firth, a marine opening akin to a flat-sided fjord or sea-loch. The Firth of Forth has always been at the heart of Scotland, the site of the capital city of Edinburgh and its harbour of Leith, the entry point for most medieval and early modern trade from Europe and having shores among the driest, sunniest and most fertile in Scotland. Today (Map 1) its shores are also the location of a petrochemical industry at Grangemouth, a major oil transshipment platform at Hound Point, a gas-cracking and shipping plant at Mossmorran, a nuclear power station at Torness, large coal-fired power stations at Cockerzie and Longannet, a naval base at Rosyth, formerly a ship-breaking plant at Inverkeithing and an oil-rig construction plant at Methil, along with much more of the activity and detritus of a modern economy. It is also the location of the remains of a once renowned fishing industry.

Before the nineteenth century, the Forth of Forth was mostly at the stage of light resource use where Hardin concedes that little harm can be done. Fishing centred round a dozen small harbours, where in 1800 all the sale was comparatively local, though in earlier centuries there had been more export, including herring caught in the north and west of Scotland but dispatched from the Forth ports. There was also a long tradition of fishing in the wider North Sea, and along the Scottish coasts just beyond territorial waters, by Dutch fishing fleets

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and others. Though they did not actually enter the Firth to fish or come within the limit of three miles from the shore, beyond that zone they caught herring and other fish that would migrate in and out of it.

Farmers gathered seaweed from the shore as a resource to fertilise their land, keeping ground in constant cultivation where it was available. There was little pollution, as the settlements around the Forth regarded human excrement as too valuable to throw away: it was sold to farmers or used on the burgh fields.

Only in one respect, the exploitation of the oyster scalps off Edinburgh, was there anxiety about over-exploitation from time to time and that was when exports to England or the Netherlands were involved. But these disputes were settled, apparently before a strain on the productivity of the beds became irreversible.

The evidence from the nineteenth century is of a wealth of natural marine resources scarcely to be guessed at today. For example, the aforementioned oyster scalps covered fifty square miles. Scallop beds off Prestonpans and Cockenzie also stretched over several square miles but this was a shellfish used only for bait: 455 tons were landed in 1886. Mussel beds were no less important.<sup>4</sup> In the Upper Forth, sprats were so plentiful that fishermen claimed to be able to tell from the resistance to an oar the difference between a shoal of sprats and one of herring fry.<sup>5</sup> The 1860 opening night of the salmon fishery at the mouth of the River Forth produced in one set of nets 56 fish weighing 900 lbs.<sup>6</sup> In 1862, scientists, discovering for the first time how the herring bred near the Isle of May, described them as lying 'in tiers covering several square miles of sea bottom, and so close to the ground that the fishermen have to practice a peculiar mode of fishing in order to take them'.<sup>7</sup> In 1889 the Scottish Fisheries Board research vessel 'Garland' discovered a shoal of young whiting estimated to contain 230 million fish: the shoal 'extended like a sheet from Oxcar lighthouse to some eight miles beyond the Isle of May, a distance of 36 miles'.<sup>8</sup> There were in addition famous fishing grounds for flat fish, like the Fluke Hole off Pittenweem; for cod above Queensferry; and for cod and haddock off the Isle of May. In 1887, in the Eyemouth fishery district, crab fishing employed 500 men laying 14,000 creels; they caught 1.5 million crabs in 1885, half the total landed in Scotland.<sup>9</sup>

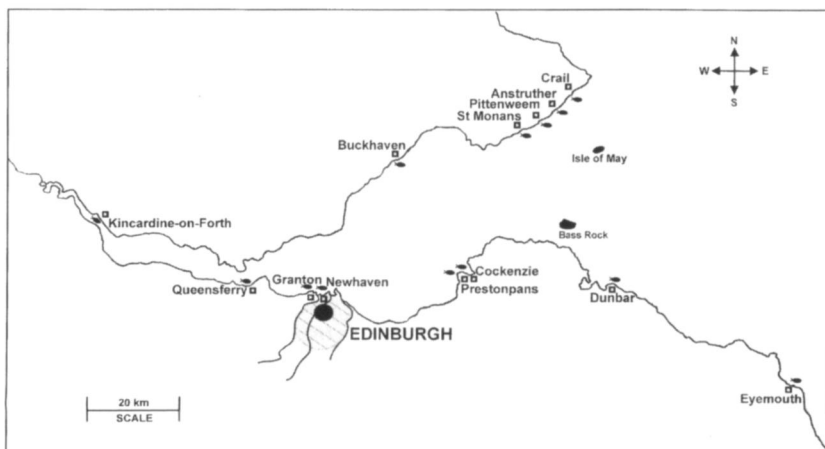
All this abundance has gone. There is no commercial fishing now for sprats, herring, whiting, cod, haddock or any sort of flat fish, though in recent years there have been tentative signs of some recovery for a few species, with the Firth functioning again as a wintering area for herring and sprats, and as a nursery for

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4. W. Fulton, 'The Past and Present Condition of the Oyster Beds in the Firth of Forth', *Annual Report of the Fishery Board for Scotland for 1895* (henceforth *Report FBS, 1895*, etc.), p. 244; *Report FBS, 1886*, p. lxiv.
  5. *Report by the Commissioners for the British Fisheries*, 1861, p. 7.
  6. *Scotsman*, 3 Feb. 1860.
  7. *Report FBS, 1883*, p. xvi.
  8. *Report FBS, 1889*, pp. ii, 175.
  9. *Report FBS, 1887*, p. xxxiv; *Report FBS, 1885*, p. lxi.

flounders. Oysters were thought to be extinct until a few were found alive by a scientist in the autumn of 2009. Scallops are in decline, although a few are still landed. Salmon come up only in small numbers but are increasing again. There is a creel fishery for crabs and lobster that employs some fishermen and part-timers and a valuable trawl fishery for smaller boats, catching *nephrops* or prawns that in the nineteenth century were not regarded as edible. That is all. There is little doubt that this decline is associated primarily with excessive exploitation of the resource either within the Firth itself or, in the case of migrant fish, also in the wider North Sea. In the three cases examined here, however, local people were exploiting vulnerable breeding grounds within territorial waters.

## 2. THE LAMMAS DRAVE AND THE WINTER HERRIN'

The most important sea fishery of the Forth in the nineteenth century centred on the Anstruther district, containing the ports of Anstruther itself with its suburb Cellardyke, neighbouring Crail, Pittenweem and St Monans and some smaller ports to the west, of which the biggest was Buckhaven. On the south of the Forth, the Leith fishery district contained also Granton, Newhaven, and Dunbar, with Eyemouth in its own district to the south, all considerable ports but not as significant as those of the Anstruther district (Map 2). Access to the Forth fishery and adjacent inshore waters was restricted to British boats, which in effect usually meant the local boats of these towns.



MAP 2. Fishing centres in the nineteenth century

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In the 1790s Anstruther had no more than a handful of open boats catching cod, ling, turbot, halibut, skate, haddock and flounders, as well as some herring, all caught inshore and sold to a range of towns – Cupar, Edinburgh, Stirling and Glasgow – within a 65 mile radius.<sup>10</sup> Only lobsters were sent a greater distance, to London. The technology of fishing in the Firth had not varied for centuries. It was observed as late as 1825 that ‘were an inhabitant of Cellardyke or Newhaven of the sixteenth century to rise from the grave, he would find himself quite at home’. His boat, his tackle and his bait were identical, so he might ‘fancy that he had only awakened from a dream’.<sup>11</sup>

The local herring fishing had been quite significant and wide-ranging in the period 1550–1720, with catches based both locally and in waters off the north of Scotland and in the Minch. For most of the eighteenth century, however, it had been relatively quiescent, partly because of lack of capital for more distant voyages, and partly from what contemporaries called ‘the disappearance of the herrings from their wonted haunts’.<sup>12</sup> If they had left the inshore waters, they were still abundant where the Dutch and others fished further out in the North Sea.<sup>13</sup>

Then the herring returned. There developed, relatively quickly after 1816, a summer fishery known as the Lammas Drave, which concentrated on catching breeding herring inshore. It failed between 1822 and 1835, but in the period 1836–1870 became extremely prolific, reaching a peak around 1860 when 215 boats from the area and beyond landed 83,000 crans (over 16,000 metric tonnes or possibly over 100 million herring) in the Anstruther district. For comparison, the production of salted herring around the whole North Sea around 1850 was in the region of 150,000 to 200,000 tonnes. The number landed in the Firth of Forth dropped quite suddenly in the next decade and by 1872 was down to 3,000 crans (under 600 metric tonnes), from which it never really recovered.<sup>14</sup>

These herring may be identified as a fringe part of the Buchan migratory population (one of three in the southern North Sea).<sup>15</sup> Possibly, the herring in the Forth were a distinct sub-population in their own right, as their disappearance was not paralleled by a diminution of the Buchan sub-population as a whole or any further detectable movement offshore of that population and they have never returned. The situation is not clear-cut but it looks like a ‘tragedy of the

10. J. Sinclair (ed.), *The Statistical Account of Scotland*, vol. x (*Fife*) (edn. D.J. Withrington and I.R. Grant, Wakefield, 1978), p. 30.

11. *Scotsman*, 15 Oct. 1825.

12. M. Rorke, ‘The Scottish Herring Trade, 1460–1700’, *Scottish Historical Review* 84 (2005): 149–165; J.R. Coull, *The Sea Fisheries of Scotland, a Historical Geography* (Edinburgh, 1996); T.C. Smout, *Scottish Trade on the Eve of Union* (Edinburgh, 1969); R. Sibbald, *The History Ancient and Modern of the Sherrdoms of Fife and Kinross* (edn. 1803), pp. 337–346, quote in notes, 340

13. B. Poulsen, *Dutch Herring: an Environmental History, c.1600–1860*, (Amsterdam, 2008).

14. P. Smith, *The Lammas Drave and the Winter Herrin’: a History of the Herring Fishing from East Fife* (Edinburgh, 1986), p. 158; Poulsen, *Dutch Herring*, p. 70.

15. Poulsen, *Dutch Herring*, pp. 76–7, 187–9, 221



commons' arising from an uncontrolled exploitation of what was perhaps a small and specialised population, netted inshore in the very act of spawning. Otherwise, one would have expected eventual recovery, even if it took a century.

The Lammas Drave was centred within a mile or two of the coast of north-east Fife, in an area called the Haikes between Boarhills and Fife Ness, another off the Isle of May and in the Traith or Fluke Hole between Pittenweem and St Monans, though some fishing certainly also took place further north and probably further out to sea, off Angus and Kincardineshire, with the catch brought into the Forth.<sup>16</sup> Most contemporaries put its failure down to the ways of Providence and the mysterious vagaries of their prey, though fishermen also believed that the Traith had been damaged by trawling, with eye-witness accounts of large clumps of herrings' eggs brought on board the trawlers, 'taking and tramping it underfoot, and then taking a shovel and heaving it over the side: it went to putrefaction'.<sup>17</sup> The fishermen of Anstruther and Pittenweem suspended fishing in the Traith in response but their neighbours at St Monans, who had pioneered the new trawling, carried on until the ground was closed by the Scottish Fisheries Board in response to the demands of their neighbours.<sup>18</sup> As this unfortunately resulted in no improvement, and when the Board could find no herring eggs, it was reopened again after two or three years: evidently the harm had already been done.

The boats themselves became larger and more numerous over this period and, by becoming decked, could sail further and remain at sea longer, though the use of steam power for fishing lay in the future in 1870. The introduction at this time of factory-made cotton nets, lighter and with a smaller and more regular mesh than the old hand-made hemp nets, greatly increased the catching capacity of the boats and particularly their ability to take immature fish.<sup>19</sup>

Connections to the market from Anstruther were also constantly improving and encouraging a greater intensity of exploitation and sale of fresh fish. As early as 1845 a regular service of steam cargo boats operated several times a week between Anstruther and Leith, Granton, Dundee, Aberdeen and Montrose.<sup>20</sup> By 1861 the railway had reached as far as Anstruther harbour. East Fife was now in touch with markets for fish throughout England and Scotland.

Other boats operating further out in the North Sea of course caught migrating fish that would otherwise have bred inshore but there was no general or obvious decline of herring in the North Sea as a whole at this point. The extinction of the Lammas Drave seems to have been only a local tragedy.

16. *Ibid.* pp. 144–5.

17. *Report of the Commissioners on Trawl Net and Beam Net Trawling Fishing* (P.P. 1884/5 C.4328), p. 90.

18. *Report on the Herring Fisheries of Scotland* (P.P. 1878 C.1979), p. xxviii; *Report FBS, 1883*, p. xiv.

19. Letter to the *Scotsman*, 18 Dec. 1873; *Report FBS 1891*, p. 183.

20. *Prospectus of the East of Fife Railway, 1845*, [www.fifehfs.org/Records/eastfiferailway.htm](http://www.fifehfs.org/Records/eastfiferailway.htm) Accessed 15 Apr. 2011.

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As the Lammas Drave decayed, Anstruther boats went further afield, as far north as Shetland and as far south as Yarmouth, and were effectively away all summer. Now, however, there developed another local herring industry also involving a breeding stock, the Winter Herrin', landing fish in the first three months of the year that were lean and difficult to cure but excellent for fresh fish sales made easy by the railway. The main spawning grounds of these fish had been known since the 1820s, or long before in some cases, and were all within the Forth up as far as Queensferry or off the mouth of the Forth, especially north and south of Fife Ness. Winter spawning herring belong to quite different populations from the summer spawning ones and are much less plentiful.

By the end of the nineteenth century Anstruther district had a fleet of sea-going decked herring drifters that concentrated on these herring in winter; the boats were equipped with cotton nets and steam capstans that could lift a much greater volume of nets than traditional man-handling; some were steam-propelled and some sail.<sup>21</sup> Landings increased rapidly in the early 1880s. In one week in February 1884, 12,000 crans (2,316 metric tonnes) were landed in Anstruther, with 880 wagon-loads of fish sent by rail and 3,400 telegraphs sent from the local post office relating to the trade.<sup>22</sup> In 1902, the best year before the First World War, a total of 317 boats (not all local) landed over 50,000 crans (about 9,650 metric tonnes), all in breeding condition.<sup>23</sup> Local fishermen spoke of their 'California', after the gold rush.

The winter fishing reached its peak in 1936 when 75,800 crans (about 14,630 metric tonnes) were landed, many now by ring-net, which some accused of catching too many small fish and of damaging the bottom spawning grounds. Some of these boats came from the west of Scotland and the North of England to enjoy the bonanza. In ways that recall the failed attempt in the 1860s by the fishermen of Anstruther and Pittenweem to dissuade their colleagues in St Monans to desist from their new trawling technology, in 1930 the St Monans fishermen ordered two Campbeltown ring-netters from the port without allowing them to land their catch and declared a boycott on all ring-net landings, only to have Pittenweem welcoming the pariah boats and offering a good price.<sup>24</sup> Fishermen have very long memories.

By 1950 the winter herring was completely finished. There were no more herring of any sort left in and around the Forth in sufficient quantities to sustain a fishery. Both the Lammas Drave and the winter herring vanished after fortunes had been made from their bounty, with those who made those fortunes acting as though the living natural resource was some kind of mineral to be mined away. The very limited recovery – with some herring coming into the Forth in winter again – does not provide the basis yet for another fishery.

21. Smith, *Lammas Drave*, pp. 51–76.

22. *Report FBS, 1884*, p. xviii.

23. Smith, *Lammas Drave*, p. 78.

24. *Ibid.* p. 114.

With the demise of the Forth winter herring fishery, the last winter-breeding stock in the North Sea appeared to have been fished out.<sup>25</sup> It looks to be a clearer instance of the tragedy of the commons than the first example, as it cannot be the case that the herring simply moved elsewhere.

Two other points must be added. No foreign fishermen were present at any time during the raids on the breeding stock, as this all took place in British territorial waters, though an effect of foreign fishermen preying on migrating stock of these winter herring further out in the North Sea again cannot be ruled out. And the British state and fisheries science made only limited attempts to regulate it. The Fishery Board had been established in 1809 to promote the herring trade and, though much of its work initially was in regulating the curing of herring for export, it was also responsible for the general welfare of the sea fisheries. Initially relatively interventionist (for example in relation to net mesh size), it was upstaged in 1866 by the *Report of the Royal Commission on the Sea Fisheries of the United Kingdom*, with Thomas Huxley as its main influence, which established an orthodoxy that the seas were inexhaustible.<sup>26</sup> It was the age of Cobden and Bright and Huxley's maxim was that fishing should take place 'where you like, when you like and how you like'. In 1868, a new Sea Fisheries Act swept away all earlier statutes that restricted sea fishing in any way.

That was the high-tide of *laissez-faire*. The Board, in due course reconstituted as the Fisheries Board for Scotland, in a series of regulations from 1885 responding to fishermen's own pressures and following another Royal Commission, closed the main waters of the Forth and all coastal waters within three miles of the shore to beam trawlers.<sup>27</sup> This was mainly to avoid the conflicts that inevitably arose from damage by trawling gear to the nets of herring drifters and the lines of pelagic fishermen but it was also expected to have a conservation effect on stocks. T.W. Fulton, the very talented Scientific Superintendent to the Board in the 1890s, deduced that the whole North Sea was over-fished because more effort in terms of boats and nets was needed to catch a given amount of fish. A frank critic of Huxley, he also believed that three miles was much too limited a definition of inshore waters.<sup>28</sup> A more serious point was that no-trawling zones hardly equated with no-take zones and other methods of fishing were also extremely destructive. Besides, until long after the Second World War, the view that the seas were inexhaustible, though challenged, was still beguiling to the minds of scientists, who still disagreed on the need to take formal measures to preserve pelagic fish.<sup>29</sup> When, in the 1970s, the wider plight of herring did

25. W.C. Hodgson, *The Herring and its Fishery* (London, 1957), p. 16.

26. See the comments in *Report FBS, 1891*, pp. 173–5.

27. *Report FBS, 1885*, pp. xxiii–iv. For a helpful map of areas closed in Scottish waters at different dates, see J.R. Coull, *Sea Fisheries*, p. 150.

28. *Report FBS, 1891*, p. 187.

29. A. Forte and J.R. Coull, 'Fishing and Legislation', in J.R. Coull, A. Fenton and K. Veitch, *Boats, Fishing and the Sea, A Compendium of Scottish Ethnography*, 4 (2008): 180.

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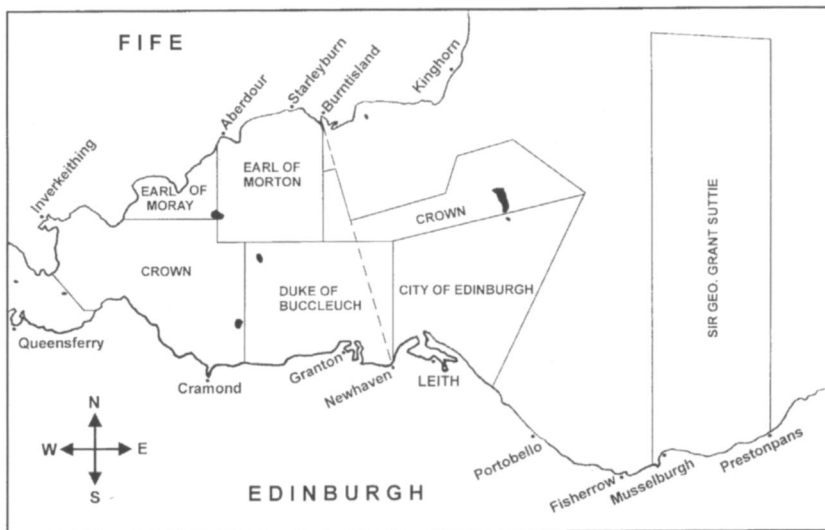
lead to international agreement to ban any fishing of the species in the North Sea for six years, it was apparently too late to hope for quick recovery for the Forth stocks. Though the herring moratorium has generally been a great success, neither the local summer breeding stock of the Lammas Drave nor the Winter Herrin' have returned.

The story of herring can be repeated for virtually all the other fish in the Firth of Forth. There is now no commercial fishing either of other pelagic species like sprat, sparring or mackerel or of demersal species like cod, codling, had-dock and flat fish. In each case the essence of the tale is uncontrolled take made easier by modern technology, though in some of these cases foreign fishermen may be as much to blame as the locals. Self-restraint by the fishermen has not worked and coercion has not been mutually agreed in time. The most singular thing about the Forth herring was that its doom was sealed before the post-war technology of sonar location, seine nets and big boats.

## 3. OYSTER WARS

The case of the oyster scalps is somewhat different, for several reasons.<sup>30</sup> Firstly, they were a different kind of commons, mostly without open access, but where elite individuals and a corporation had ownership of different portions of the sea bed and named communities the common rights to exploitation. Secondly, in this case there is no evidence of technological advance tempting the commoners to over-exploitation. Primitive small triangular dredges were dragged along the bottom from open sailing boats. Steam boats elsewhere enabled oyster dredges to become larger and work for longer but there seems no evidence that they were used in the Forth before 1868, when the scalps were already badly damaged.<sup>31</sup> Thirdly, the scalps showed signs of liability to serious depletion as early as the eighteenth century and were already effectively exhausted well before the end of the nineteenth. Lastly, the Scottish oysters are among the most northerly in Europe and therefore at the edge of their range. Their breeding success was notoriously irregular, with some years of heavy sprat fall and others of minimal production, which implies a natural disadvantage in the face

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30. The two main sources for this section are Fulton 'Oyster Beds' and J. Wilson, *Society of Free Fishers of Newhaven: a Short History*, ed. R.M.Black (Edinburgh, 1951). Fulton was the principal scientist of the Scottish Fisheries Board and writes without obvious bias though possibly with a degree of professional scepticism about fishermen: Wilson (who died in 1889) is an apologist for the Society who blames the proprietors and private lessees for the catastrophe. See also University Marine Biological Station, Millport, *Conservation of the Native Oyster *Ostrea edulis* in Scotland* (2007), Scottish Natural Heritage Commissioned Report No. 251 (ROAME No. FO2AA408), which follows Fulton; and T. McGowran, *Newhaven-on-Forth, Port of Grace* (Edinburgh, 1985), which follows Wilson.
31. National Archives of Scotland (NAS), GD265/9/1 Minute Books of the Free Fishermen's Society, ff.125; Wilson, *Free Fishermen* p. 88.



MAP 3. Firth of Forth oyster beds, showing the boundaries of ownership and line of 1868 dividing award to Andersen (west) from award to the Newhaven fishermen (east)  
*Source:* adapted from Fulton, 1895.

of heavy exploitation and explains some of the fluctuations in numbers in the eighteenth and nineteenth centuries.

The main scalps were in two groups (see Map 3). The largest group lay between Queensferry and Portobello and the Fife shore. These were divided between five proprietors, including the Crown, but the two most prolific in the eighteenth and nineteenth centuries belonged to the town fathers of Edinburgh and to the successors of Viscount Tarbert, first the Dukes of Argyll and after 1812 the Dukes of Buccleuch. These two scalps were mainly exploited by a collective known as the Society of Free Fishermen of Newhaven, itself unique in the region, as most fishermen, here as elsewhere, were fiercely individualistic. The paid-up membership of the Free Fishermen varied in the nineteenth century from about 140 in 1805 to about 272 in 1838, with a considerable problem at times of dissent from the management of the society and refusal to pay dues.<sup>32</sup> The corporation of Edinburgh initially charged them no rent to fish for oysters. The other main group of scalps, off East Lothian, belonged to Sir George Grant Suttie and his heirs, and was fished by men from the local ports of Fisherrow, Prestonpans and Cockenzie. The Newhaven men maintained that their privilege to fish the town's scalps was based on a charter from James IV but they could

32. NAS: GD 265/9/1 Minute Books ff.61, 184-5.

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not produce such a document in court and later relied instead on what they called 'an immemorial right'.

From as early as 1663, anxiety arose because oysters were being sold in great quantities by the Newhaven fishermen to Dutch boats, causing a shortage and an increase in price in the Edinburgh market. The town council stepped in by forbidding such sales. The same thing happened again in 1742, except that now foreigners were specifically identified as buying small brood oysters to restock their own beds.<sup>33</sup> It was this external demand for undersized oysters for breeding and growing on elsewhere that seems subsequently to have generated most of the pressure on the Forth stocks. The council drew up detailed rules forbidding the sale or export of oysters under a certain size, imposing a closed season between April and September and requiring the Newhaven men to watch and protect the town's scalps from unauthorised fishing by others. Nine years later they rescinded the right of the Society because they had continued to sell to foreigners and instead awarded it to a private Leith firm but this did not work either and the privilege reverted to the Newhaven fishermen.<sup>34</sup>

The town council, however, had no power over the fishermen of the towns of Fisherrow, Prestonpans and Cockenzie, who paid rent to different proprietors to dredge the East Lothian scalps and also those off the Fife coast to the north of Edinburgh's own. These fishermen were employed after about 1770 by merchants in Leith to meet demand in the Netherlands and England and oysters were again sent in enormous quantities to Holland and London, including many to replenish the beds of the Medway. Newhaven men were apparently not above joining in with illegally fished produce from the town's scalps. Oysters more legitimately fished also went to the north of England and elsewhere in Scotland such as Glasgow and Dundee. The total take between 1773 and 1786 has been calculated to have reached thirty million oysters a year, though the needs of the Edinburgh market itself as late as the 1830s was variously estimated at only between 1.7 million and five million.<sup>35</sup>

The first scalps to show unmistakable signs of exhaustion were those off East Lothian, which, by 1786, were in particularly bad condition, from the excessive sales of brood oysters which only went to the external market. The local fishermen then began to trespass on the Edinburgh scalps, involving spectacular running fights with the Newhaven men, and the town council again struggled to establish control with similar rules to those of 1742.<sup>36</sup> The eighteenth century ended with general complaints of a dearth of oysters, with the number of boats employed in East Lothian halved and average catches per boat per day down from at least 4,000 to around 500. In the first quarter of the nineteenth century

33. This and similar instances of the sale of brood oysters with the apparent assistance of Newhaven fishermen are mentioned in Fulton, 'Oyster Beds' but not in Wilson, *Society*.

34. Fulton, 'Oyster Beds', pp. 245–7.

35. *Ibid.* pp. 248–251.

36. Wilson, *Society*, p.61; Fulton 'Oyster Beds', pp. 247–8.

oysters remained 'scarce and dear', with catches of 150–200 being regarded as good and exports even of sizeable oysters to traditional markets such as Newcastle forbidden.<sup>37</sup>

The town council were so concerned at what they believed to be the continued evasion of the regulations by the Newhaven fishermen that they began to charge rent, £25 a year from 1815. In 1824 they put the scalps up for public auction but let them back to the Society for £50 a year and £100 security for fulfilment of the conditions. This seems to have coincided with a remarkable fall of oyster spat,<sup>38</sup> and the town's scalps began to recover their old profusion. Prices had risen at the start of the century to as high as 5s. per hundred but were said to have fallen by 1828 to 3d. per hundred and oysters were so abundant that supposedly a crew 'could have filled their boat in six hours'. In 1833 the council reduced the rent to the Society to £25 again.<sup>39</sup>

At this point everything began to go wrong. Apparently with at least the tacit consent of the council, exports resumed to England and the Netherlands but, from at least 1825, quantities of brood oysters were again shipped out,<sup>40</sup> certainly illegally and the closed season was also disregarded. The total export of oysters in the years 1834–6, from the town's scalps alone, has been estimated at sixty million, half these in 1836 alone: 'the fishermen were reaping a golden harvest'.<sup>41</sup> Efforts to re-establish effective control failed in the next two years and in 1839 the council determined on a radically different approach. They let the scalps by auction to an Essex syndicate led by George Clark of Cricksea, near Burnham-on-Crouch, for ten years (later reduced to five) at £600 a year, removing the restrictions on catching small oysters and agreeing to buy a fixed quantity of large oysters at 9d. per hundred for the consumption of the town. Clark primarily wanted small and brood oysters to stock his beds on the Crouch. The Newhaven fishermen men tried to stop the auction by legal means and, when this failed, continued to fish the beds regardless: the council raised an action of trespass against them; the fishermen responded by raising an action of declarator against the town, claiming immemorial right. The Court of Session did not give its judgement until 1845 and for some time both the Newhaven fishermen and George Clark's men fished unhindered. The Newhaven men sent forty to fifty boats over the town scalps daily, on the pretext of really fishing the other privately owned beds in the area, of which they had leases, demarcation between the different grounds at sea being almost impossible. Clark, understandably fearing that there would be no oysters left for him, sent sixty to seventy English smacks with 400 men, each boat employing six dredges and thus being much more powerful and damaging than the local boats. It was in effect anarchy: Clark

37. *Ibid.* pp. 247–9

38. According to oral tradition related later; *Scotsman*, 21 Nov. 1876.

39. *Ibid.* pp. 249–250; Wilson, *Society*, p. 64.

40. *Scotsman*, 15 Oct 1825.

41. Fulton, 'Oyster Beds', p.251.

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claimed damages from the city and in 1841 the town allowed him to break the lease. Next year the Newhaven men legally resumed the lease. It is impossible to calculate what damage had been done.<sup>42</sup>

In 1845, the Court of Session found that the Society of Free Fishermen indeed had an immemorial and exclusive right to fish the town's beds, subject to rules laid down by the council for supply of the town and for 'the permanent preservation of the said oyster scalps'. The council in 1842 had formally reiterated the old regulations, especially those relating to size and the prohibition of sale of seeding oysters, but in effect now abandoned any serious attempt to control the fishermen. For the next twenty years they did as they liked, including resuming the bulk sale of brood oysters to the English and Dutch, mainly carried on from the small haven of Starleyburn, on the Fife shore between Aberdour and Burntisland, so as to be out of sight of officialdom. It is very unlikely that the Society of Free Fishermen even tacitly condoned such behaviour and indeed in 1857 they appointed two fishermen to supervise the trade in oysters at Newhaven pier. But their control over their members seems often to have been more tenuous than they cared to admit. The system of self appointed inspectors lasted one year but was revived again between 1866 and 1872.<sup>43</sup>

In 1865, the town council at last commissioned a report from Dr James Bain, an Edinburgh naturalist, on the condition of the scalps. Bain warned that unless action was immediately taken to stop the 'ruinous and short-sighted system' of dredging undersized and brood oysters, the scalps 'will soon cease to be productive, or be entirely destroyed'. The council appointed, for the first time, an official to try to prevent the export of undersized oysters from Newhaven, but overall this had little effect. Brood oysters were still dredged on the town scalps but landed at Starleyburn on the pretext that they had been taken from beds where there were no restrictions.<sup>44</sup>

In 1868, The Duke of Buccleuch decided to rent his own scalps, which by then were considered the only truly valuable ones left, to John Anderson, fishmonger in Edinburgh, on condition that the latter employed Newhaven men to fish for him. Anderson had already by then secured leases for the Crown scalps to the west and those in the possession of the Earl of Morton to the north. The Newhaven men refused to work for Anderson, who offered derisory wages, and he consequently employed English boats. The locals chased off the intruders, throwing stones and injuring the fishmonger's agent, later defying police boats and triumphantly cruising the Forth flying the black flag, though they denied that the black flag was anything other than what they normally flew when they were fishing. When two policemen attempted to make arrests in Newhaven,

42. Fulton, 'Oyster Beds', pp. 250–3; Wilson, *Society*, pp. 63–5.

43. Fulton, 'Oyster Beds', pp. 253–7; Wilson, *Society*, pp. 79–83; NAS:GD265/9/1 Minute Book ff. 88, 112–4.

44. Fulton 'Oyster Beds', pp. 255–6. Wilson does not refer to this report.



they were attacked by the fishermen and their wives and children. There was no legal retribution.<sup>45</sup>

In the same year, the new Sea Fisheries Act empowered the Board of Trade, on request, to make an Order for the establishment or improvement of oyster and mussel fisheries on public (i.e. Crown) ground, which Order would confer the exclusive privilege of working such grounds providing this was done to the satisfaction of the Board. The Newhaven men applied for such an Order for the public grounds lying north of the Town's scalps, which Mr Anderson opposed, lodging a similar application of his own.<sup>46</sup> Interestingly, his lawyer, at the public enquiry that followed, used an argument that would be familiar to Garrett Hardin:

the fishings would be better conducted by one man than a thousand. It would be in the interest of Mr Anderson not merely to make an interest off it this year – it was his interest to cultivate it. He had no interest in indiscriminate spurning [sic] of the ground. His interest was all the other way. On the other hand it was quite plain that the interests of the Society of Free Fishermen of Newhaven, numbering 2000 individuals, could not be the same. The interests of each fisherman would be to take what he could get. The part he protected he did not preserve for himself – he preserved it for his neighbour. He was only one in a thousand.<sup>47</sup>

The Board, though, was not completely persuaded and awarded all the oyster fishings (including by agreement those in private hands) east of a line from Newhaven to Burntisland on the opposite shore to the Newhaven men and that to the west to Mr Anderson. Clearly it was hoped to stop the Newhaven men from trespassing on the other scalps that Anderson leased, while preventing the supply of oysters from being monopolised by a single interest. In the event, neither party satisfied the Board with their standards of stewardship. The Newhaven men simply carried on as they had always done and Anderson (who complained of their continuing trespass) neglected to clean or maintain the scalps under his concession. Though he laid some oysters down and suspended catches after 1873, according to his critics he failed to control starfish predation as the Society of Free Fishermen did or to take other appropriate conservation measures. At the same time, there was another period of poor spat fall, so that the beds failed to become replenished even in Anderson's fallowed beds. The Orders were cancelled in 1877 and the decline of the scalps continued to its inevitable denouement.<sup>48</sup>

45. *Glasgow Herald*, 12 Oct. 1868. See also McGowran, *Newhaven-on-Forth*, pp.130–3. Thanks to Mairi Stewart for this reference and other help in this section.

46. Fulton, 'Oyster Beds', pp.257–8.

47. *Scotsman*, 10 June 1869. Note that he greatly exaggerated the membership of the Society of Free Fishermen.

48. Fulton, 'Oyster Beds', pp. 258–260; 'Oyster Fisheries of the Firth of Forth', *Scotsman*, 21 Nov. 1876; Wilson, *Society*, pp. 70–7.

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Within a short time the scalps were effectively worked out. Catches from the town's scalps fell from 8.6 million in 1867 to 370,000 ten years later and 60,000 in 1887 and the other beds were no better off. Oysters continued to be caught as by-catch with mussels or clams until around 1920 but the fishery was dead by the last quarter of the nineteenth century. Suggestions that Scottish oyster beds could be rejuvenated by systematic reseedling on the French model were made from 1882 onwards but do not seem to have been followed up, at least in the Forth, despite specific recommendations from the Fisheries Board from 1889 and later.<sup>49</sup>

From time to time the question has been raised as to whether it was not pollution rather than over-exploitation that caused the demise of the scalps. Except in respect of certain scalps west of Queensferry (see below) this seems unlikely. Pollution would possibly have made the shellfish dangerous for human consumption and might well have rendered their recovery from low levels more difficult but would not of itself have been a prime cause of their extinction. The Forth mussel beds still flourish despite having been subject to very serious pollution.<sup>50</sup> There is evidence from the 1880s, when the oyster catch had already been reduced to less than one per cent of what it had been two decades before, that there was then still a much richer variety of molluscs and weeds along the Edinburgh foreshore than there was a century later and that the worse impacts of sewage came later.<sup>51</sup>

We also need to consider the degree to which alterations in the climate could have affected the productivity of the beds through a cooling of the sea temperature. Climate forcing as a main cause seems unlikely since the oysters had already survived much lower temperatures during the Little Ice Age, when, in 1608, the upper part of the estuary actually froze so that people could walk over from Airth to Alloa. Yet, a species at its climatic limit is much more fragile and a run of cold winters late in the nineteenth century could very well have helped to push the depleted population of oysters over the edge.<sup>52</sup>

Here we seem to have an instance of a tragedy of the commons, due not to any lack of private ownership of the right to exploit, which in Hardin's view should have stopped the tragedy developing – the Society of Free Fishers was a

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49. W.A. Smith, 'Oyster Cultivation in Scotland', in D. Herbert (ed.), *Fish and Fisheries: a Selection from the Prize Essays of the International Fisheries Exhibition, 1882* (Edinburgh, 1883), pp. 28–36; *Report FBS, 1889*, p. xxvii; Fulton, 'Oyster Beds', pp. 275–9.
50. Fulton, 'Oyster Beds', p. 263; J.R. Wennersten, *The Chesapeake: an Environmental Biography* (Baltimore, 2001), ch. 5, shows how heavy pollution and oyster beds co-existed in Chesapeake Bay.
51. G. Leslie and W.A. Herdman, 'Invertebrate Fauna of the Firth of Forth', *Proceedings of the Royal Physiological Society of Edinburgh*, 6 (1881): 277–313; A.J. Berry and S. M. Smith, 'Aspects of the Molluscan Fauna of the Rocky Shores of the Firth of Forth Estuary, Scotland', *Proceedings of the Royal Society of Edinburgh*, 93B (1987): 431–447.
52. A. Dawson, *So Foul and Fair a Day: a History of Scotland's Weather and Climate*, (Edinburgh, 2009). Reference to the Forth freezing over on p. 111.

collective owner (or tenant) of the right to fish but it was legally replaced on two occasions by conventional private individuals who did no better. The problem was over-exploitation, apparently engendered by an irresistible external market for immature oysters needed to replenish beds elsewhere and a lack of law and order over the scalps. 'Mutually agreed coercion' did not work because the problem of preventing trespass and enforcing regulation at sea or in harbour proved so difficult. Had the marine 'commons' all belonged to one owner – for example entirely to the state, as in France – enforcement might have been easier. The French made a better job of conserving their oyster fishing industry than either the British or the Americans or most other Europeans. Also, more resources to police the Forth grounds were perhaps not made available because sections of public opinion were clearly on the side of the fishermen.

Both with the herrings and the oysters, therefore, those who exploited the marine commons neither proved capable of self-restraint nor were forcibly restrained by law. Science did not see the need for restraint in the case of herring until it was too late and, in the case of the oyster, a lack of adequate resources or will to provide them, compounded by mixed ownership of the commons, made restraint impossible and tragedy inevitable.

#### 4. POLLUTION AND ITS CURE

When we turn from the over-exploitation of the Forth to its pollution, the story is strikingly different. Here again a tragedy occurred but was it ultimately largely reversed.<sup>53</sup>

In the course of the nineteenth century, the Firth of Forth became the sump of east central Scotland. The first serious pollution was caused in the first half of the century by enormous quantities of peat, perhaps millions of tons, floated down the River Forth from reclamation of the bogs in the Carse of Stirling.<sup>54</sup> The peat floated and sank in the Upper Forth, changing the nature of some of the shores and parts of the bottom of the estuary: the famous sands of Culross Bay, admired by Cobbett and Turner, became mud and fisheries were damaged.<sup>55</sup> This pollution came to an end towards 1865 as further investment in land reclamation

53. The problem of pollution is discussed at greater length in T.C. Smout, 'Urbanisation, Industrialisation and the Firth of Forth', forthcoming in S. Castonguay and M.D. Evenden (eds.), *Urban Waters: Rivers, Cities and the Production of Space in Europe and North America*, (Pittsburgh, 2011).

54. J.G. Harrison, 'East Flanders Moss, Perthshire, a Documentary Study', *Landscape History*, xxx (2008): 6–20.

55. J. Geddie, *The Fringes of Fife* (Edinburgh 1894), pp.19–20; H.M. Cadell, *The Story of the Forth* (Glasgow, 1913), p. 278. See also the admiralty chart reproduced in J.C. Wilcocks, 'The Best Means of Increasing the Supply of Mussels for Bait', in D. Herbert (ed.), *Fish and Fisheries: a Selection of Prize Essays from the International Fisheries Exhibition, 1882*, (Edinburgh, 1883), p. 168, for evidence of 'drifted peat' on the north shore.

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turned unprofitable but the damage was long lasting. Fishery Board soundings as far downstream as Charlestown around 1895 'found the bottom to consist of hardened mud; the dredge was full of lumps and nodules'.<sup>56</sup> The fact that it was mixed with the shells of smothered oysters confirmed in their mind earlier allegations of damage. The 'duffy' ground continued for some distance on both shores below Queensferry but had not there killed all the oysters and 'there is no evidence that this cause affected the great stretch of oyster grounds east of Mickery Island, with which we are dealing'.<sup>57</sup>

There were also signs of serious damage to fish breeding grounds in the Upper Firth. The Fishery Board in 1890 described the bottom as muddy with occasional patches of gravel but still supporting populations of flounders, sprats, eels, herring and codling. They added, however, that the two or three grounds once noted as breeding grounds for herring had vanished and said of a good gravel bank for breeding codling that either dredging to improve Bo'ness harbour or 'the muddy silt of the Firth' had covered it recently and the fish had disappeared.<sup>58</sup> They never returned. However, the extinction from the Firth of the spurling, a fish so common below Stirling bridge in 1838 that 'every stone, plank and post appears to be covered with their yellowish covered ova', must have been due more to chemical pollution than to the peat, as they were reported as providing 'a most remunerative branch of the industry' as late as 1895, though 'of little importance' only five years later.<sup>59</sup>

Throughout the region, in the nineteenth and early twentieth centuries, growth of population and industry led to serious pollution of all the rivers (Map 4). In some places the main problem was human sewage, in others chemicals and fibres from textile works (as on the Devon discharging into the River Forth) and paper-mills (on the Esk and Leven), from coal washing detritus (as on the Leven) and, for a time around 1870, from paraffin works near Stirling and Linlithgow (on the Forth and Almond, where tributary streams could in places be ignited). Distilleries and breweries also sent spent grain and other waste into the rivers at several points.<sup>60</sup>

Edinburgh had the biggest sewage problem, with its population growing from 40,000 in 1750 to ten times that number by 1900. By the middle of the nineteenth century the old system of spreading the human dung of the city onto the surrounding farms was unable to keep up and, to avoid the growing problem of disease, the city turned, like others throughout Britain, to the water closet and the sewer, which either flushed into the rivers and hence out to sea or ran down

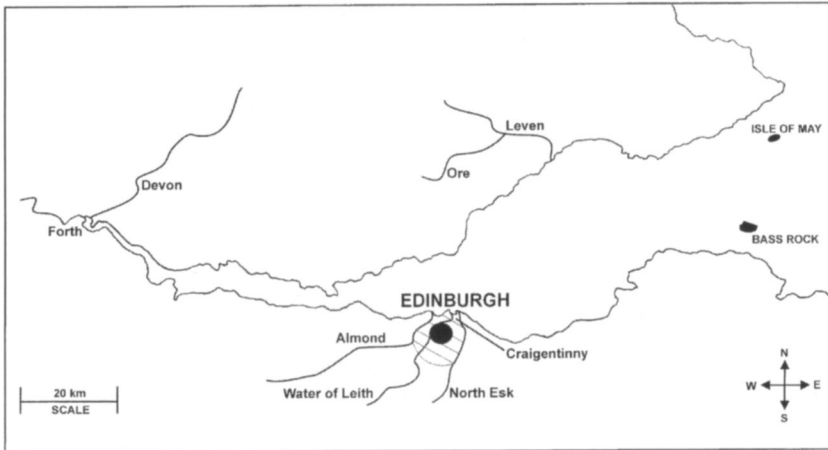
56. Fulton, 'Oyster Beds', p.263.

57. *Ibid.*

58. *Report FBS, 1890*, pp. 178–9.

59. *Report FBS, 1895*, p. viii; P.S. Maitland, 'The Freshwater Fish Fauna of the Forth Area', *Forth Naturalist and Historian*, 4 (1979): 33–48; Harrison, 'East Flanders Moss': 12–14.

60. *Royal Commission on the Pollution of Rivers, Fourth Report* (Parliamentary Papers 1872, xxxiv, two volumes).



MAP 4. Main polluted rivers, c.1870.

to irrigation meadows at Craigentenny, an early and initially admired form of sewage farm, which did not, however, remove most of the effluent. Raw sewage in the rivers was increasingly unacceptable and, by 1922, the meadows had also become less profitable. Thereafter, all the sewage of half a million people was sent straight to the sea, screened and disintegrated but otherwise untreated, mingled with the discharge of Edinburgh's breweries, through eight major outfalls along eight miles of coast. Here, until around 1980, it provided sustenance for flocks of sea-duck of several species hitherto relatively rare in the Forth. But the rivers themselves remained a toxic brew of chemicals for migrating fish and the marine benthos below the outfalls was altered dramatically by the sewage.<sup>61</sup>

Worst of all the rivers by the 1930s were the Leven and Ore in Fife, discharging at Levenmouth, carrying the waste of chlorine from paperworks, bleaches from spinning mills, grain from a distillery, coal mine detritus and the risk of pollution from a cyanide factory, creosote works, linseed oil mills, salt works and industrial laundries: 'the extent of deliberate or accidental pollution from these industries is unknown'.<sup>62</sup> Levenmouth at least was situated at a point where the Firth of Forth is wide and open. In the Upper Firth the outpouring of sewage and chemicals was opposed by the tides between relatively narrow banks. This at times created a barrier, impassable to migrating fish, of seriously de-oxygenated

61. *RC Pollution of Rivers*, pp. 1, 21–2; S. Mullay, *The Edinburgh Encyclopedia* (Edinburgh, 1996), p. 16; L.H. Campbell, 'The Impact of Changes in Sewage treatment on Seaducks Wintering in the Firth of Forth', *Biological Conservation*, 28 (1984): 173–180.

62. R. Shand, 'Rise and Fall of Seaduck at Levenmouth', *Fife Bird Report 2006*, pp. 150–5.

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water that moved up and down opposite the town of Alloa depending on the tide; in 1961 this was found to be present on eighteen of the 25 days sampled.<sup>63</sup>

This situation of gross pollution of the Forth was brought under control by a series of steps. The first significant legislation concerning river pollution dates from 1876 but was of limited effect before 1951. From this point, improvements began to take place by stages, assisted by the decline of industry in the area over the next fifty years. Fife County Council, for instance, began a scheme in 1949, which took 16 years to complete, to run pipes up the Leven and Ore to keep the sewage away from the river water, though they discharged the slightly screened sewage into the sea at Levenmouth. Similarly, in the Upper Firth attempts were made to clean up industrial processes and, most importantly of all, in 1978 Lothian Regional Council opened a new primary sewage treatment plant costing £56 million, dumping the solid residues by boat (the *Gardy Loo*) in deep water outside the confines of the Firth of Forth.<sup>64</sup>

The turning point, in fact, came in the 1970s, when Britain joined the European Economic Community, obliging the dirty man of Europe to clean up his act before the directives on sea water pollution came into operation. Growing public disgust at gross pollution also led to the creation of supervisory and treatment bodies of steadily growing authority and scale, culminating in the Scottish Environmental Protection Agency in 1996 and Scottish Water in 2002, together with a raft of legislation based on the principle that the polluter pays. All these provided the means to clean up the Forth.

Nothing is totally successful – diffuse pollution from agricultural run-off and pollution of the shoreline from plastic and other dumped rubbish remain problems. But the sea is incomparably cleaner. In the Upper Firth, levels of oxygen rose from 3.48 mg/l in 1988/92 to 4.65 in 2003/07, and mercury in fish and mussels dropped from 5.5mg/kg dry weight in 1983 to 0.4 in 2005.<sup>65</sup> Dolphins and sometimes whales are again seen as high as Queensferry. Mutually agreed coercion can work when the polluters are readily identified and there is a will to make it effective.

So what of the theory of the commons? Whatever the case on land, the tradition of common use at sea in the Forth was effectively anarchy but worked when the resource was so large and the old ways of light use allowed everyone to do as they liked without harming their neighbour. When, in the nineteenth century, these old ways of light use came to an end, this happened so speedily that no rules were agreed or enforced and the tragedy of emptying the sea of resources ran its course. In the twentieth century greater efforts were indeed made to control fishing but were relatively successful only in the case of the

63. D.S. McLusky, 'Ecology of the Forth Estuary', *Forth Naturalist and Historian*, 3 (1978): 13–14.

64. J.W. Kempster, *Our Rivers* (Oxford, 1948); Shand, 'Levenmouth'; Mullay, *Encyclopedia*, p. 316.

65. *SEPA View*, 40 (2008), p. 4.

partial recovery of the herring in the North Sea, thirty years after a moratorium imposed under the Common Fisheries Policy. This recovery, as we have noted, did not extend to the traditional breeding grounds in and around the Firth of Forth. Only in respect of pollution did mutually agreed coercion completely work in the end and this needed strong top-down government.

Was this acceptable, despite the cost, because the offence of pollution, highly visible, was against many hundred thousand land-dwellers in and around the Firth, who, in the course of the twentieth century, came to have the money and the leisure to enjoy the rivers and the sea? The offence of resource exhaustion, by contrast, took place out of sight below the waves and affected only a few thousand fishermen, who could in any case be argued to have brought it upon themselves. Wider society was not really affected by the loss of locally sourced herring and oyster, since there were various food substitutes easily obtainable. One of the lessons is perhaps that we do not care a great deal about local sustainability as long as the global market can still provide cheap alternatives.