Impacts of Trailer Suction Dredgers on Fish Stocks and its Implications

Marine aggregates are of strategic and increasing importance to the UK construction industry (Highley et al., 2007). In addition, economic growth, migration towards coastal zones and high demand for energy and other natural resources are combining to make dredging projects more demanding and sensitive (van Muijen, 2008). In the face of this product innovation is needed to allow more accurate and better controlled dredging, minimize and if possible eliminate the negative effects of dredging on the environment and optimise its profitability (van Muijen, 2008).

This study focuses on the direct uptake (entrainment) of fish from trailer suction hopper dredgers (TSHD). The effects of TSHD used in navigation dredging are well documented (Reine & Clarke, 1998; Simenstad, 1988). Less well documented are the use of similar dredging plant in marine aggregate dredging although in 2005, it was identified as a major impact to be considered in Environmental Impact Assessment (Mineral Industry Research Organisation & Royal Haskoning 2005).
http://www.sustainableaggregates.com/library/docs/samp/m0005_samp_1_031.pdf

A review of scientific studies of entrainment associated with TSHD has been undertaken (Drabble, 2012a)
http://www.sciencedirect.com/science/article/pii/S0025326X1100573X

Environmental monitoring attendant with the granting of new marine aggregate licences in the Eastern Channel Region (ECR) in 2006 offers a unique opportunity to assess the effects of dredging upon fish. Projected theoretical fish entrainment rates are calculated (Table 1) based upon: abundance data from industry supplied 4m beam trawl sampling of fish species over the period 2005–2008; sensitivity data; and dredging activity and footprint derived from Electronic monitoring System (EMS) data. Results have been compared with actual entrainment rates and are broadly consistent with previous studies. The projections in Table 1 are considered to be conservative as the impact pathway for fish entrainment extends well beyond the active dredge zone owing to standard industry practice of trailing the dredge pipe between 1 and 2m off the seabed when turning, thereby allowing continuous running of the dredge pumps.

Figure 1 shows the dredge track for the Arco Axe on 7 Feb 2010, downloaded from www.MarineTraffic.com together with a plot of this track superimposed upon Area 474 in the Eastern English Channel where it was operating. There is nothing special about the date selected; rather it was a snapshot investigation to determine the extent of entrainment impacts, given the standard practice for TSHDs to trail the dredge pipe with the dredge pumps running. It will be seen that the vulnerability of fish to entrainment extends well beyond the extents indicated by EMS data.

Table 1 Projected estimates of fish entrained based upon study assumptions and total production

1	2	3	4
Taxon	**Common Name**	**Average density/m^2**	**Est. Fish Entrained (drahead footprint)**
			11668761.6
Trisopterus luscus	Bib	0.0046	53338
Scyliorhinus canicula	Lesser spotted dogfish	0.0024	28450
Aspitrigla cuculus	Red Gurnard	0.0020	23791
Callionymus lyra	Dragonet	0.0017	20282
Trigla lucerna	Tub Gurnard	0.0011	13363
Pomatoschistus sp.	Gobidae	0.0003	4007
Mustelus mustelus	Smooth Hound	0.0003	3023
Trigloporus lastoviza	Streaked Gurnard	0.0004	4973
Solea solea	Dover Sole	0.0002	2247
Pleuronectes platessa	Plaice	0.0002	2229
Agonus cataphractus	Pogge	0.0003	3393
Trisopterus minutus	Poor Cod	0.0013	14637
Diplecogaster bimaculata	Two-spotted clingfish	0.0001	1671
Scyliorhinus stellaris	Bull Huss	0.00007	839
Raja clavata	Thornback ray	0.0001	1280
Mustelus asterias	Starry smooth hound	0.00005	607
Scophthalmus rhombus	Brill	0.00003	370
Buglossidium luteum (juv.)	Solenette	0.00003	296
Blennius ocellarius	Butterfly blennie	0.00005	594
Microstomus kitt	Lemon sole	0.0002	1810
Phrynorhombus regis	Norwegian topknot	0.00008	907
Lophius piscatorius	Angler fish	0.00002	179
Gobiidae spp.	Gobies	0.0006	6886
Microchirus varigatus	Thickback sole	0.0004	4894
Ctenolabrus rupestris	Goldsinny	0.00001	148
Trachinus draco	Greater weaver	0.00004	413
Echiichthys vipera	Lesser weaver	0.00004	441
Hyperoplus lanceolatus	Greater sandeel	0.00002	275
Zeus faber	John Dory	0.00004	469
Sygnathus ?rubescens	Pipefish species	0.00001	62
Triglidae sp. (juv.)	Gurnards (juv,)	0.000004	48
Mullus surmuletus	Red mullet	0.00001	109
Arnoglossus laterna	Scaldfish	0.000003	39
Limanda limanda	Dab	0.00001	100
Solea ?lascaris	Black/flounder flounder	0.00003	319
Liparis liparis	Sea snail	0.00001	102

An assessment of 4 m beam trawl sampling between 2005 and 2008 (licences having been granted in 2006) followed the review of entrainment. (Drabble, 2012b)
http://www.sciencedirect.com/science/article/pii/S0025326X11005753

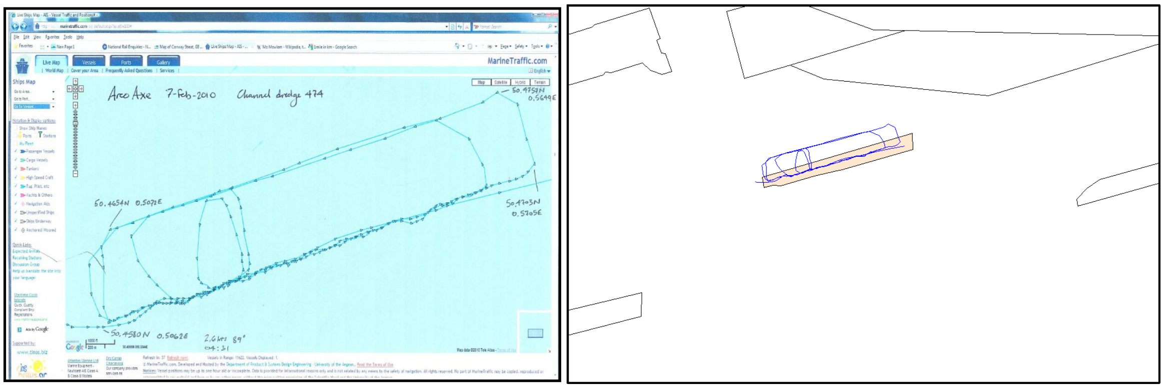

Figure 1 Track of the Arco Axe, 7 Feb 2010 with accompanying plot showing this track superimposed on Area 474 where it was operating; courtesy of www.MarineTraffic.com

The majority of fish species have shown marked reductions in abundance since commencement of dredging. Entrainment via the draghead has been identified as a possible contributory cause based upon the known vulnerability of selected species (Drabble, 2012a). Other environmental factors considered offer no explanation for the changes in abundance.

Comparative analyses with ICES data for plaice and sole over the study period demonstrate that changes in the East Channel Region do not result from seasonal flux in the wider populations. It is possible to predict with a degree of confidence the likely effects of dredging upon recruitment based upon changes in age group strength affecting species of the East Channel Association (ECA) population, to date. Fig. 2 shows the age length distributions of sole from the four years of sample data for the ECR. The age-length key has been calculated from the 2008 ICES data for area VIId. The 2005 data shows an abundance of age 1 sole, relatively high numbers of age 4 sole but low counts for ages 3 and 2. Low numbers for age 0 fish may be attributable to the unsuitability of the 4 m beam trawl for sampling this size fish and / or the lower abundance for this age group in the central areas of the English Channel. This pattern correlates very closely to the recruitment data for sole for ICES area VIId. Age 1 recruitment was high in 2005 but year groups 2 and 3 were low; age 4 fish form part of the 2001 class which was the strongest year class since 1990, the second strongest being 2004 (Cefas, 2009).

One might expect the 2006 age length distribution in Fig. 2 to reflect the ICES 2005 distribution with ages 2 and 4+ being strong and a relatively healthy age 1 recruitment. In contrast to expectations, no age 2 fish were sampled in 2006. In 2007, the age 3 group to some extent reflects the strong 2004 year class. The 2008 distribution is dominated by the age 4+ older fish that pre-date the commencement of dredging together with evidence of the relatively strong 2005 year class. The population age structure differs markedly from the ICES data that shows healthy age 1 and 2 groups for 2006 (Fig. 3). The analysis suggests that there has been both a reduction in the ECR sole population and interruption to recruitment, post 2005, which cannot be explained solely by natural variation. Similar results were observed from the equivalent analysis for plaice.

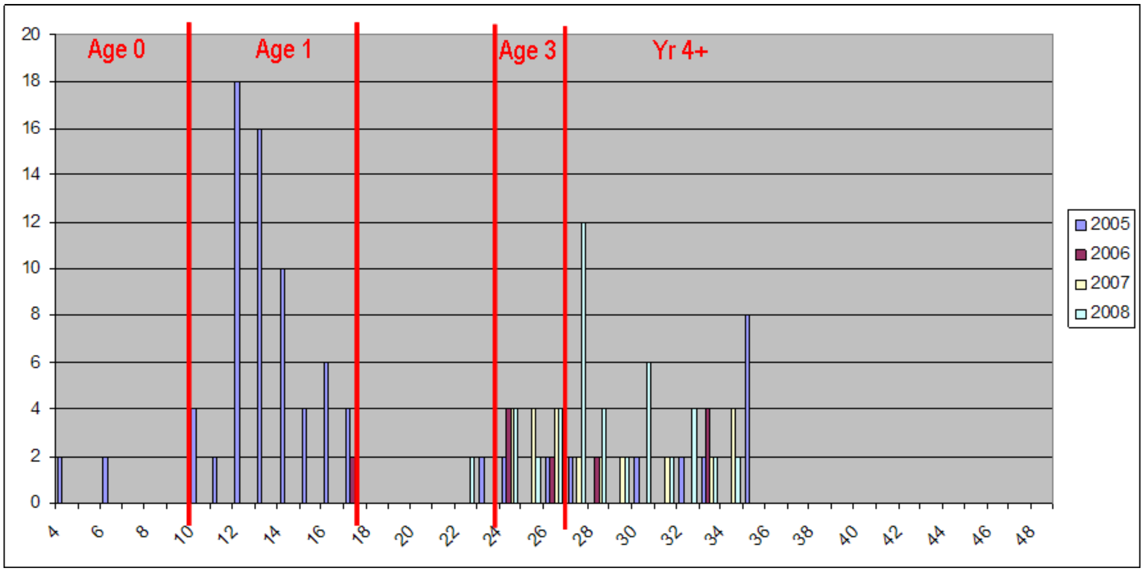

Figure 2. Changes in length distributions and age for sole in the ECA over the period 2006–2008.

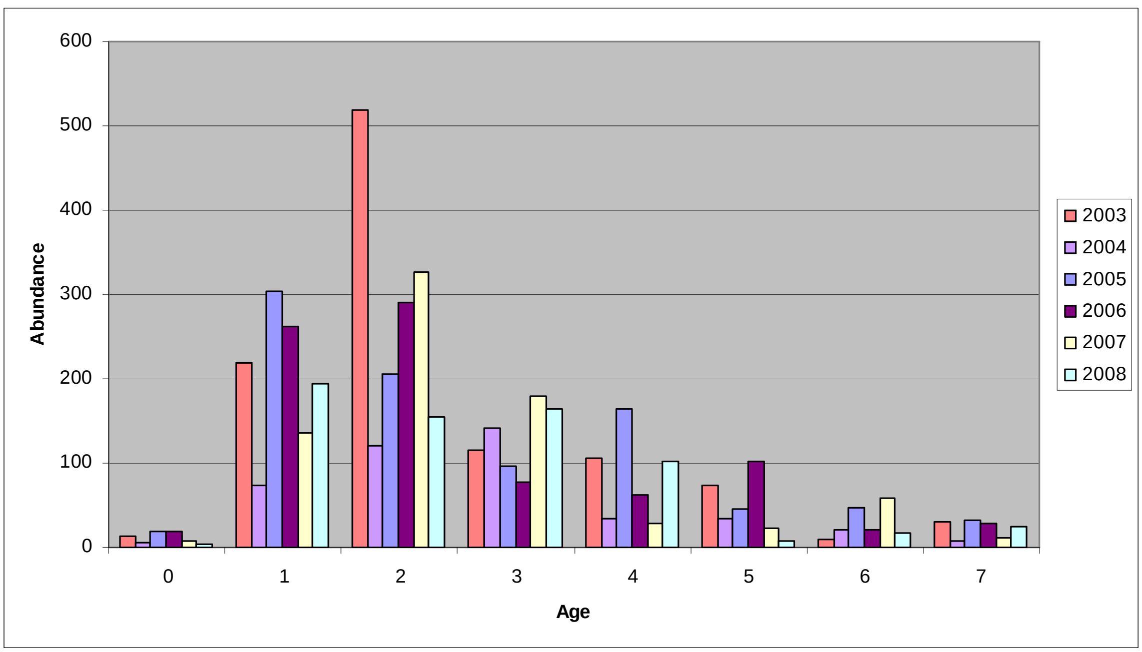

Figure 3. Abundance by year and age of sole for ICES Area VIId.

The official position of the ECA of dredging companies is to discount any effects of aggregate dredging upon fish, there being no statistical difference between the 'control' sites in their survey and the impacted sites. Given that the impact pathway extends well beyond the licence boundary from the dredge sites (Figure 1), the validity of these sites as 'controls' and the conclusions drawn by the ECA are questionable. Clear differences in population structure between the ECA and the ICES data over the period 2005-2008 reinforce this argument.

This new evidence of entrainment impacts from TSHDs has implications for impact assessment of aggregate, navigation and capital dredging. There are strong policy drivers for the introduction of a faunal friendly dredging system (FFDS) (Drabble, 2009 and 2012b) to reduce impacts on benthic fish / epifauna including the achievement of good environmental status under the Marine Strategy Framework Directive and minimising risks to migratory species under the Eel Recovery Plan and the salmon action plans (SAP) developed under the Environment Agency's sea trout and salmon fisheries strategy.

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