80 million
tonnage of marine habitat removed every year from European and North American waters

13 million
is the average number of cu. metres extracted off the coast of England and Wales

QUENTIN BATES

FOR years I've walched a small dredger unloading marine aggregate at a quayside near my home ahd wondered jusI how much seabed gels craned ashore every time to become part of another stretch of motorway or an *otlice* block.

It's somelhing I've long mealll lo dig deeper inlo, bul I never did. Now, lhe ICES Working Group on lhe E/fecls oC Exlraclion of Marine Sedimenls (WGEXT) has pllblished a reporl lhal goes sorne way lo lifting lhe lid on lhis.

Look il up - all 200-plus pages of the comprehensive and pains·lakingly compiled reporl No. 297 are there at.www-iees.dk.

The figures are slarlling. According lo lhe report's edilors, 53 miliion eu. metres of sand and grave) are extraeted from lhe seabed wilhin lhe ICES area everyyear.

Take a few minutes with a calculator. Using a volume-to-weight conversion rate of 1.66, lhis puts lhe lolal al 88 mi tonnes taken each year from licensed ar.eas of the sea floor.

The world's wild fish calch is somewhere around 90 million tonnes annually, something lhal lhe various NGOs hard on the fishing industry's case are cerlainly aware of – but do lhey know (or carel lhal aboul lhe e/fects of lhis wholesale seabed extraction.

So, while 90 miliion tonnes of fish are caughl every year, another 80 million tonnes of marine habitat are also removed frulll the marine environment.

Taking ¡nto aceount the mechanics of lhe dredging business that Iimit activity te waters shallow enough for *these* vessels to operate, all of this comes from vulnerable sunlight-rich nursery grounds. The ICES sludy lakes in dredging activity across mostly .Europe and North America, but the North *Sea* is where the seriously large volumes are extracted in UI(and Nelherlands walers. Major players are taking significant volumes fol' a variety of uses from construction to beach replenishment.

Dutch dredgers have taken an average of 23.50 million eu. metres of material every year since and annual production in England and Wales comes te an average oí just over 13 million ell. mctres - of which around a quarter is exported to neighbouring countries.

It will take five years to recover the $12 million investment

The practicalities are simple enough. The Norlh Sea is surrounded by wealthy nations with highly active construction industries. Countries such as lhe Nelherlands. wilh virlually no resources of this kind of their own, have no choice but to take marine resources. Rocky nat10ns. such as Ireland and Sweden, have no significant dredging activity.

WGEXT's reporl makes uneomforlably familiar reading. Reporls of surveys conclude lhal lhe e/fecls of dredging activilyon lhe seabed can be eroded wilhin a few weeks in sorne cases, or can persist tor ycars oí evcn dccadcs in others.

eerily reminiscent of the work done lo eSlablish how long lhe lrails lefl by a sel of doors or a footrope remain on the *sea* bed and lhe simple answer is lhal there is no simple answer. This is something that is always specific.

To lhe layman, it's depressing reading. There are few firm conclusions, allhough WGEXT's report ends with a raft of recommendations.

These include lhal long-lerm investigations are need.ed to examine thc rccovcry of bcnthic and fish slocks, as well as lhe feasibility of restoring sensitive marine habitats where there *is* evidence of long-term or adverse e/fects of dredging.

Silence of the greens

THERE are uncomfortable conclusions to be drawn from the silence of the greens. Either they aren't looking or they don't want to know – or both. Fishing is a small and fragmented industry that has problems arguing its case outside its own immediate circle.

Construction – and the supply of marine aggregate – is a powerful business that knows what it's doing.

There is no visible interest from NGOs in marine aggregate extraction. Certainly, Greenpeace didn't grab headlines this summer by dropping rocks in front of dredgers.

Few isn't trying to make a wholesale snatch at European policy on aggregate dredging. Are there any instances of protestors shackling themselves to dredgers to stop them sailing or spray-painting slogans along the sides of dredgers in port?

There are NGOs that have some very friendly links with parts of the construction industry which have interests in marine resources. Anyone would imagine that an organisation that has consistently advocated continuing drastic cuts to fishing would also look at the wider picture.

They need to take into account the amount of marine habitat that's scooped up every year by its wealthy and publicity-conscious friend.

Dredging and dumping

EXTRACTION from lhe Shingle Bank - and lhe e/fecls on bolh sole and crab fishing in lhe easlem English Channel - are menlioned in lhe WGEXT report.

However, there is no conclusive evidence one way or lhe olher lo say whelher or nol dredging is lhe reason for reduced sole catches.

However, it should be obvious to anyone that extracting enough material to a project on lhe seale of lhe Channel Tunnel is going lo aller lhe environment.

This is especially taking into account that, in addition to the material actually removed, plumes of suspended matter are created downtide from the dredging area. Dredgers also routinely screen material as it comes aboard to filter out unwanted grades of sand which are sent back side.

This resembles a practice that fishing· refers to as 'discarding' and is widely condemned...

The dredglng business resembles Iishing in ways - its activities have a direct effect on marine ecosyslems. Bolh dredging and fishing Iike lhe same sort of ground - and it's no coincidence that prime sole ground also yields lhe finesl quality construction material.

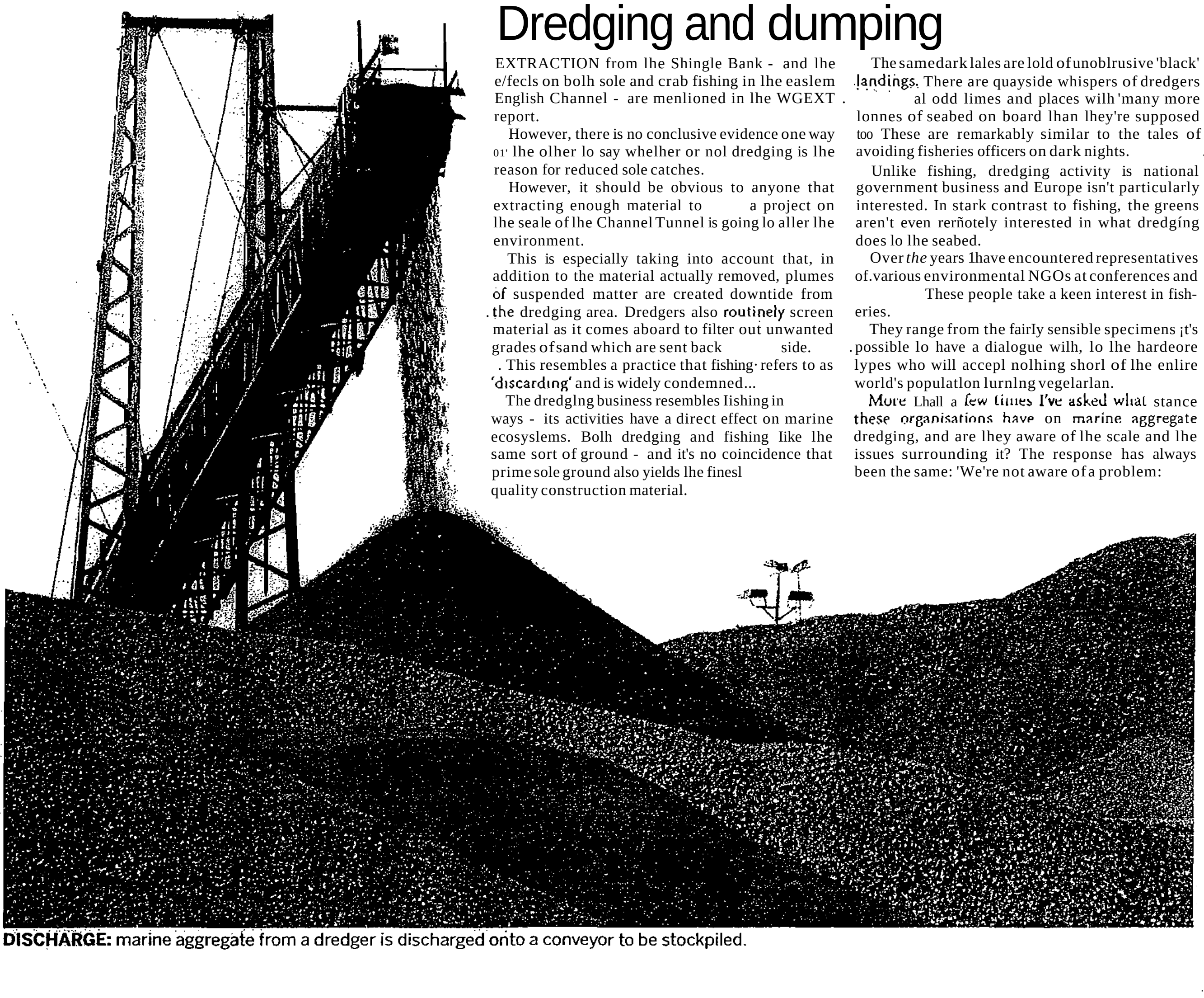
The same dark lales are lold of unoblrusive 'black' landings. There are quayside whispers of dredgers al odd limes and places wilh 'many more lonnes of seabed on board lhan lhey're supposed too These are remarkably similar to the tales of avoiding fisheries officers on dark nights.

Unlike fishing, dredging activity is national government business and Europe isn't particularly interested. In stark contrast to fishing, the greens aren't even rerñotely interested in what dredgíng does lo lhe seabed.

Over *the* years 1have encountered representatives of.various environmental NGOs at conferences and These people take a keen interest in fisheries.

They range from the fairly sensible specimens ¡t's possible lo have a dialogue wilh, lo lhe hardeore lypes who will accepl nolhing shorl of lhe enlire world's populatlon lurnlng vegelarlan.

More Lhall a few times I've asked what stance these organisations have on marine aggregate dredging, and are lhey aware of lhe scale and lhe issues surrounding it? The response has always been the same: 'We're not aware of a problem:



DISCHARGE: marine aggregate from a dredger is discharged onto a conveyor to be stockpiled.

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Effects of of marine sediments the marine environment 1998-2004

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ICES the Exploration of the Sea
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development, and no clear examples of such a system were encountered during this research. Technological advances and the ready availability of low-cost, rugh-power, desktop, Intranet or Internet environments are supporting the development of ERM systems in an efficient and timely manner. The use of component-based arcrutectures is now allowing complex systems to be modelled with multiple and scalable components; however, the use of expert opinion remains a very important factor in the success of such knowledge-based systems. Results obtained from spatial and analytical modelling tools for environmental risk assessment have a variety of uses (e.g. for comparative or relative risk analysis; cost-benefit analysis; scenario analysis; probabilistic analysis; decision matrix:; sensitivity analysis). GIS-based software applications will increasingly serve as powerful tools for the assessment and management of effective environmental risk because of their capacity to rapidly and accurately display and analyse huge volumes of spatial and non-spatial environmental data (including hazards and exposure).

5.3 Conclusions

The nature of the sediments being dredged by ICES Member Countries varies, depending on the availability of the natural sediment resources offshore and the national and international market requirement for these materials. The principal markets for marine dredged sediments vary between Member Countries, but in general, they can be broadly identified as construction aggregates, construction fill/land reclamation, and beach replenishment/coastal protection. As a consequence of the variations in resource availability and market demand, sorne national operations are concerned primarily with sand, whereas others are primarily concerned with gravel.

The use of marine sediments within ICES Member Countries varies greatly, depending to a large extent on the availability of alternative sources of material and of suitable marine sediments within national boundaries.

5.3.1 Resource mapping

There is increasing demand on marine space and resources across ICES shelf sea areas, partly because of the expansion of sorne maritime industries and also because of newer developments, such as offshore windfarms. These changes in marine use mean that conflicts can arise between different activities. Marine seabed maps provide important infonnation to assist in resolving conflicts arising from multiple uses of the seabed, and they are also an essential underpinning for the sustainable management of offshore resources.

It is evident that, within ICES Member Countries, there ís a growíng movement towards seabed and resource mapping prograrnmes, driven by several forward-Iooking and horizon-scanning exercíses that have recognized the need to underpin spatial planning and the sustainable use of seabed resources. Developments in survey methods, such as the use of acoustic techniques for accurate discrimination of sediment type, are also proceeding rapidly. This rapid pace of developments in the field of resource mappíng, driven by continuous improvements in acoustic techniques (e.g. sidescan sonar, multibeam bathymetry, and acoustic ground-discrimination systems), has radically altered approaches to the assessment of anthropogenic impacts on the seabed. In addition, their extensive use in wide-scale reconnaissance surveys (e.g. in a resource or conservation context) means that they are íncreasingly being employed by a growing number of ICES Member Countries as part of strategic national seabed mapping programmes. However, large parts of the ICES shelf sea area remain unmapped. Yet, trus baseline information is essential to the strategic management of

offshore resources and for the assessment of the broad-scale vulnerability of habitats and species to sand and gravel extraction. Such information is also becoming essential to the identification of potential environmental constraints (e.g. the location of fish spawning areas, sensitive and important species and habitats, archaeological features), allowing sustainable informed development. It is therefore important that seabed-mapping prograrnmes continue to be supported to simultaneously address the needs of governments and marine stakeholders by mapping prioritized areas of the seabed in a strategic manner.

5.3.2 Environmental effects

As noted in Section 4.1, awareness of the impacts of sand and gravel dredging, particularly in relation to the coast, goes back at least a century. However, interest in the environmental impacts of sand and gravel extraction dates back sorne 50 years and became more significant starting in the 1960s. Initially, concem focused on the potential impacts on the benthic macrofauna and consequential effects on fish resources and cornmercial fisheries. This interest has expanded over the years to include most components of the marine ecosystem.

Research has demonstrated that sand and gravel extraction can have a number of environmental effects on the seabed, including the removal of sediment and the resident fauna, changes to the nature and stability of sediments accompanying the exposure of underlying strata, increased turbidity, and the redistribution of fine particulates. Typically, this activityis assessed by ICES Member Countries not only from the standpoint of effects on the benthic fauna during and after the extraction event, but also for its ·effects on the wider resource, including dependent fish and shellfish populations and associated fisheries, coastal processes, and other legitimate interests, such as conservation and recreation. These issues are addressed as part of an EIA or by conducting targeted research.

Dredging can also lead to the production of plumes of suspended material. This material can arisefrom the mechanical disturbance of the seabed sediment by the draghead. However, the outwash of material from the spillways of the vessel hopper can generate a far greater quantity of suspended material. A further source of suspended material is the sediment fractions rejected during screening activities.

An increasing number of studies has concentrated on establishing the rates and processes of macrobenthic recolonization upon cessation of dredging. Typically, these studies indicate that marine sediment extraction causes an initial reduction in the abundance, species diversity, and biomass of the benthic cornmunity. Available evidence from such investigations, carried out in a variety of environmental conditions, suggests that substantial progress towards seabed "recovery" could be expected within two to three years of cessation of dredging in highIy dynamic environments, although this period can be greater in areas that are dredged repeatedly or where the seabed has been significantly altered.

5.3.3 Management of marine aggregate extraction operations

Not all countries have the same approach to the legislation and regulation of marine aggregate extraction, and it is inadvisable to prescriptively formulate a preferred option. However, although countries are free to organize their own legislation and regulation, it is important that they are transparent about their regulations, both to the industry and to NGOs.

Increasingly, the trend in legislation and regulation is to take environrnental issues into account in a formal way. The obligation to follow EIA procedures and to include EU directives in the management of marine aggregate extraction is operationalized.

Some countries have an overall marine legislation under which marine aggregate extraction is regulated. However, most countries have national laws on extraction, although it is ofien regulated by regional authorities.

Regarding the considerations required for regulation, risk assessment is a promising instrument, but in connection with the extraction of marine sediments and the possible effects on the environrnent, it is still far from mature.

5.4 Recornrnendations

The Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem (WGEXT) recommends the continued use of the "ICES Guidelines for the Management of Marine Sediment Extraction" (ICES, 2003) by national administrations within domestic consenting regimes for marine aggregate extraction.

1) ICES Member Countries and OSPAR contracting parties should continue to supply information about their marine aggregate industries to WGEXT, particularly iniormation relating to annual production rates, the area of seabed licensed, and the area of seabed dredged.
2) WGEXT recommends that iniormation on the design, implementation, and use of the results of monitoring programmes associated with aggregate extraction activities be shared with the working group so that best practice can be determined.
3) The dredging industry should continue to improve dredging technology and inanagement practices in order to ensure the sustainable development and use of these valuable, but finite sand and gravel resources.
4) Use of electronic monitoring systems and black-box monitoring equipment for surveillance of dredging operations in ICES Member Countries is recommended. The analysis of the data from these systems has continued to evolve, significantly improving their value as a management too!.
5) Where multiple dredging operations are proposed close to each other, and where the potential exists for cumulative or in-combination effects, a regional approach to development and assessment should be considered, for example, by means of a regional environrnental assessment.
6) Given the wide range of extraction operations in northem European and Atlantic waters,and the large diversity of seabed habitats, WGEXT continues to recommend that the specific requirements for any particular extraction operation be determined on a case-by-case basis, taking into account information from regional environrnental assessments, as appropriate.
7) Wherever possible, data and environmental management experience of the regulatory authorities and dredging industry should be made widely and proactively available to facilitate the continued development of best practice. For example, issues such as currency, completeness, and facilitated access should be addressed through web-enabled spatial databases and user-friendly GIS interfaces.
8) The aim should be to increase the spatial coverage and resolution of seabed maps and to encourage the adoption of common standards and practices.

9) WGEXT encourages ICES Member Countries to undertake programmes of habitat mapping, in arder to provide information to underpin licensing decisions *and/or* marine spatial planning initiatives in relation to the extractions of marine sedimento Such information will also be useful for sustainable management of the marine environrnent and the identification of features important to nature conservation.

10) There is a need for fundamental research into the effects of marine aggregate extraction on meiofaunal populations. Development of new taxonomic keys and further development of quantitative meiofaunal sampling methods for gravel substrates is required in order to perrnit quantitative sampling of meiofaunal assemblages in and around marine sediment extraction sites. Such research is necessary to inform any future decisions about whether or not to include meiofaunal assessment in monitoring programmes associated with marine aggregate extraction activities.

11) Sorne preliminary research has been conducted on the effects of extraction operations on fish resources and their trophic interactions with other components of the ecosystem. Future investigations should try to develop an understanding of the effects of marine aggregate extraction activities on both commercial and sensitive fish species in relation to changes in marine habitats. Such investigations should attempt to apply the relevance of such research to a wide range of environrnental conditions and dredging strategies.

12) WGEXT recornmends further development of approaches to risk assessment in connection with the extraction of marine sediments and the possible effects on the marine ecosystem. The completeness and utility of existing approaches need to be examined in detail, together with comparisons with risk-assessment methods employed in other sectors, such as the oil and gas industries.

13) A large number of studies have now been undertaken to determine the environrnental effects of marine aggregate extraction across ICES Member Countries. WGEXT emphasizes the need to establish the significance of such effects relative to natural fluctuations in the marine environrnent (including climate change) and changes caused by other anthropogenic activity. Such an appraisal of the concept of environrnental significance in relation to stakeholder perception is long overdue and must include an assessment of socio-economic factors.

14) Long-term investigations (over several years) on the recovery of fish resources and benthos should be undertaken to determine, in particular: (i) natural recovery of the structure and function of the biological community, and (ii) any persistent and long-term changes to fish resources and benthic community parameters within the context of natural, spatial, and temporal variability of reference environrnents.

15) There is a need for further research to assess the feasibility and cost-effectiveness of restoring sensitive marine habitats in areas where adverse, persistent, and long-term effects of marine aggregate extraction are evidento

Work to identify suitable indicators of the impacts of marine sand and gravel extraction should continue. Such indicators will need to satisfy the criteria as far as possible

(see *ICES Cooperative Research Report No.* 273; ICES, 2005), as well as attempting to achieve EcoQOs, including those already proposed by OSPAR.