Survey design

Station allocation

Much of the seabed is not flat or of soft sediment type (figure 2a) and thus not trawlable (see figure 2b). Within trawlable areas the availability of fish varies as does a trawl's ability to capture fish due to various technical, biological and environmental factors. Not every fish in the path of a trawl therefore will be captured and sampling design in IBTS surveys is underpinned by a strong emphasis on standardised sampling trawls and procedures. This helps ensure that changes in annual abundance seen in the catch data reflect a relative change in population abundance rather than a change in the trawl's ability to sample the population.

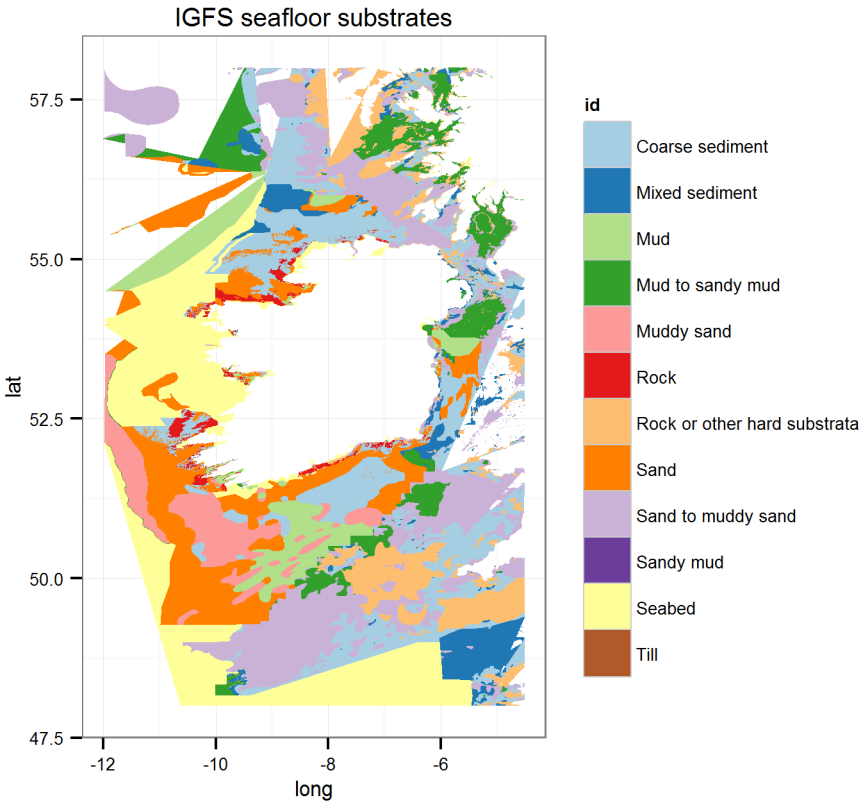

Fig. 2a Map of seafloor substrates around Ireland, based on collated seafloor habitat data as compiled by MESH Atlantic (see www.meshatlantic.eu)

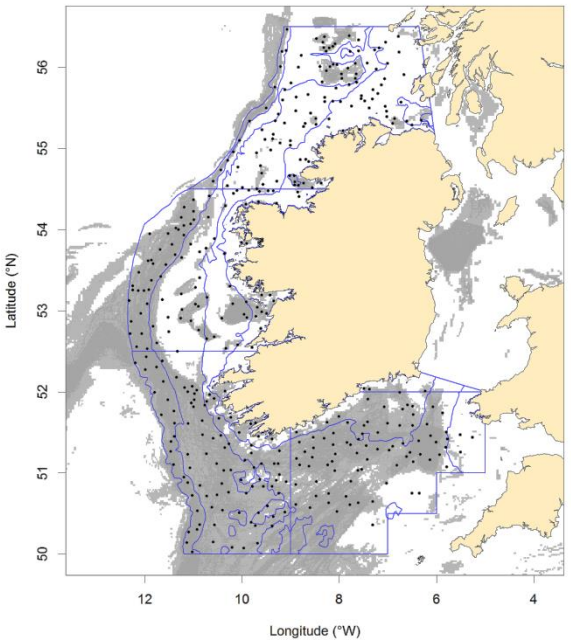

Fig. 2b Map of IGFS historic haul positions (black circles) in relation to commercial otter trawl activity (grey shaded area). Darker shading equates to higher commercial fishing intensity whilst little or no commercial activity can broadly be interpreted as challenging ground for demersal trawling.

The IGFS uses a semi-random depth stratified survey design. Potentially any trawlable ground within the survey area therefore should be sampled at some point and avoids artificially stable catch rates from persistent local hot/cold spots. In as far as is practicable, a minimum of 10 nautical miles is maintained between hauls to avoid repeat sampling of the same fish assemblage.

Stations are stratified according to ICES divisions (management units) as well as depth bands, culminating in 15 strata in total (Figure 3). Depth boundaries are 0-80m, 81-120m, 121-200m, 201-600m corresponding to Coastal, Medium, Deep and Slope respectively. Haul allocation per strata is proportional to the area. In total 170 stations are allocated annually at random from historical survey tow positions. The database of potential survey tows is also continually expanded whenever possible with new information from commercial and research fishing activity as well as multibeam data, all of which provides the important additional random element to the design.

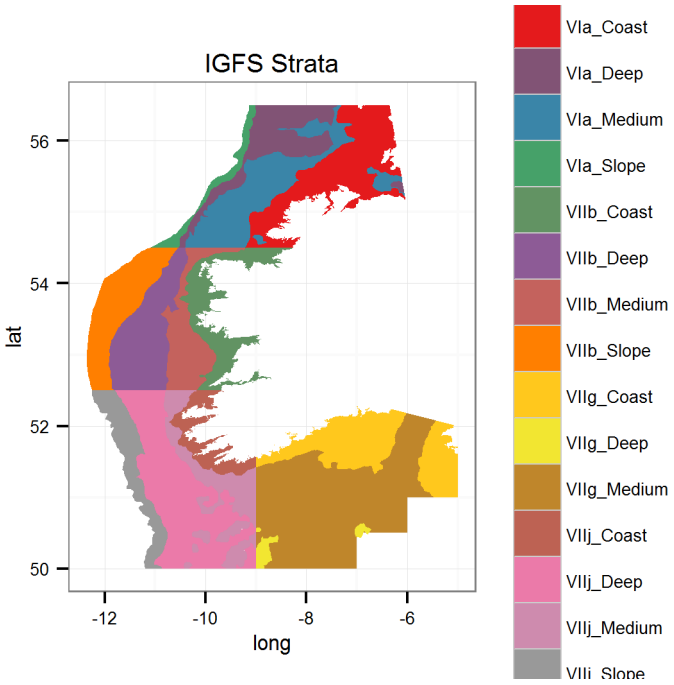

Fig. 3 Map of IGFS survey strata. Coastal strata = 0-80m; Medium strata = 81m-120m; Deep strata = 121m-200m; Slope strata = 201m-600m.

Sample allocation

Given that reproduction and recruitment of juveniles into the adult stock is seasonal in temperate waters, management of many commercially exploited fish stocks is based on numbers at age. Ageing fish is labour intensive relative to measuring lengths and therefore length frequency sampling carried out on survey is later allocated to age groups, where appropriate, based on smaller biological samples returned to the laboratory for ageing.

Up until 2007, targets for age samples were set on a length-stratified basis for each stratum. Generally this meant that no more than 5 individuals per 1cm size class per stratum would be sampled. However, this type of quota-sampling can introduce bias if the age structure within a stratum is not uniform. For example, it is possible that at a length of, say 20cm, 80% of fish are age 2 and 20% are age 3 on an inshore station, while on a station further offshore (within the same stratum) those proportions are 60% / 40%. With the old “quota-based" sampling, the samples are not equally spread out between hauls and this can be the source of bias. Therefore, sampling targets were set for each station (rather than each stratum) from 2008 onwards. In practice, this meant a sampling target of 1 fish per cm size class for each station. For species that have abundant catches of young fish that are likely to be all the same age, the size classes can be broadened, e.g. 1 fish per 5cm per station. For fish that are rare in the catches (e.g. cod), the targets will often be set to sample all fish, even if there are more than one per size class.