39. Elasmobranch critical egg-laying habitat

Figure A10.39.1. Examples of elasmobranch egg cases collected from Broadstrand, Co. Cork. From the top to bottom row: bull huss Scyliorhinus stellaris (four examples), spotted ray Raja montagui (two examples), lesser spotted catshark Scyliorhinus canicula (13 examples) and thornback ray Raja clavata (63 examples). Photo by Danielle Orrell.

Background

Ireland's waters are home to 71 elasmobranch species, from small shark species, to the world's largest skate species (Clarke et al., 2016). Of these, 39 species are oviparous and reproductive females lay sessile egg cases or 'mermaids purses' every year, or every other year (Clarke et al., 2016). Typically each egg case contains a single embryo (Ebert et al., 2007). The number of eggs laid per reproductive female varies between species. For example, small-spotted catsharks (*Scyliorhinus canicula)* or 'dogfish' are thought to lay up to 240 eggs (Capape et al., 2014) in shallow (e.g. among macroalgae; Ragonese et al., 2013; Koehler et al., 2018) and deepwater habitats (e.g. among black corals at 180-210 m depth; Cau et al., 2015). In contrast, the flapper skate *Dipturus intermedius* is thought to lay <40 egg cases annually (Du Buit, 1977) on rocky or broken ground, with recent research from Scotland suggesting viable habitats in >20 m of water (Phillips et al., 2021). Once laid in preferred habitats, egg cases mature for an estimated 3-18 months before the animal emerges from the spent case (Shark Trust, 2009; Benjamins et al., 2021). During this maturation phase the egg cases are vulnerable to anthropogenic pressures and predation as they remain sessile, and anchored to the seabed (Lucifora and Garcia, 2004; Serra-Pereira et al., 2014).

Elasmobranch egg case morphology is diverse. For example, small-spotted catshark (*S. canicula*) and bull huss (*S. stellaris*) egg cases have tendrils on the anterior and posterior ends, which is thought to facilitate attachment to macroalgae and other structures (Gordan et al., 2016). In contrast, skate egg cases are typically rectangular in shape and have a horn extending from each corner, which is thought to help secure them between rocks or in the substrate (Hoff, 2008; Love et al., 2008). These diverse features make it possible to identify the species from which the egg case came. Consequently, confirmed distribution and habitat use of elasmobranch species is possible from *in-situ* egg cases, greatly increasing our knowledge of a species. Additionally, it is possible to predict the distribution and habitat use of stranded (washed onto shore) egg cases, however backmodelling to find the true lay location is necessary given potential drift (Phillips et al., 2021).

Elasmobranch egg cases have been recorded in variety of habitats such as, sandy continental slopes, among soft corals, rocky substrate, muddy sand, and cold-water seeps (Breder & Rosen, 1966; Hoff, 2008; Hoff, 2010; Treude et al., 2011; Cau et al., 2015; Dodd et al., 2022). Information regarding egg-laying habitats appears to be somewhat site- and species-specific. For example, thornback ray *R. clavata* egg cases have been recorded at depths of 220-298 m in the Mediterranean Sea (Başusta, 2019), whereas this species is reported to lay eggs in 'shallow' areas with juveniles found in <30 m depth (Ebert & Stehmann, 2013). This highlights a challenge when searching for egg-laying habitats as the same species may deposit egg cases in different habitats depending on geographic location. Identification of egg-laying habitats is important for spatial protection of this vulnerable life stage, as evidenced in recent literature and the recommendation of including egg-laying sites as critical habitats in Important Shark and Ray Areas for conservation planning (Ellis et al., 2024; Régnier et al. 2024).

The systematic identification of egg-laying areas is poor in northern Europe (Ellis et al., 2024), but recent research by Ellis et al. (2024) has highlighted spatial areas of interest around the British Isles and collected relevant data surrounding important life history traits such as total lengths of vulnerable life stages (12 skate species including assessing the 'common skate complex' as one of those species). It is thought that, based on site fidelity, a large number of mature females, early (recently hatched) and mid stage juveniles are good proxies to identify spawning areas (or egg case areas; Ellis et al., 2024). It is possible to identify these life history stages from total length measurements taken from fisheries data, meaning important areas for vulnerable species could be identified without actual egg case records (Ellis et al., 2024). However, identification of early stage juvenile areas to highlight potential egg-laying habitats is perhaps not a suitable proxy for all egg-laying species, given differences in space use and dispersal, again highlighting species-specific differences. For example, egg case location data did not match early stage juvenile location data in Scottish waters of the thornback ray, although this may be a consequence of available habitat in that area (Ellis et al., 2024), and spatially segregated egg-laying sites and nursery areas are known in some deep-water skate species (Hoff, 2016; Love et al., 2008; Treude et al., 2011).

Rationale for spatial protection in the southern Celtic Sea

Elasmobranch critically egg-laying habitats were nominated for inclusion with particular reference to supporting the recruitment of Threatened oviparous elasmobranchs (species nominated on our potential features list including, blonde ray *R. brachyura*, blue skate *D. batis,* blue pygmy skate *Neoraja caerulea*, bull-huss *S. stellaris*, cuckoo ray *Leucoraja naevus*, Flapper skate *D. Intermedius*, ghost catshark *Apristurus manis*, Kreft's skate *Malacoraja kreffti*, large-eyed rabbitfish *Hydrolagus mirabilis*, lesser spotted catshark *S. canicula,* long-nosed skate *D. oxyrinchus*, Norwegian skate *D. nidarosiensis*, rabbitfish *Chimaera monstrosa*, shagreen ray *Leucoraja fullonica*, small-eyed ray *R. microocellata*, smalleye catshark *Apristurus microps*, starry skate *Amblyraja radiata*, straightnose rabbitfish *Rhinochimaera atlantica*, thornback ray *R. clavata* and the undulate skate *R. undulata*). At present, there is no spatial protection for elasmobranch critical egg-laying habitats in Irish waters. Currently three eNGOs actively collect egg case sighting records; these include Marine Dimensions (Purse Search Ireland Project), the Shark Trust (The Great Eggcase Hunt) and The Ray Project. These eNGOs have recorded 12 species (*Amblyraja radiata, Rostroraja alba, S. canicula, D. batis, D. intermedius, L. naevus, R. brachyura, R. clavata, R. microocellata, R. montagui, R. undulata and S. stellaris*) to date, but it is likely that, in total, 39 oviparous elasmobranchs could lay in Irish waters (estimation based on species present in Irish waters and identified in Clarke et al., 2016).

Based on current knowledge, elasmobranch egg-laying areas are amenable to spatial protection. Egg cases remain sessile on the seabed for several months long periods of time as the animal matures inside the case, making this life stage vulnerable to pressures associated with extraction and disturbance (Lucifora & Garcia, 2004; Serra-Pereira et al., 2014). Elsewhere, spatial protection of egg case nursery areas has benefited elasmobranchs that exhibit high site-fidelity and philopatry to egg lay areas (Régnier et al., 2024).

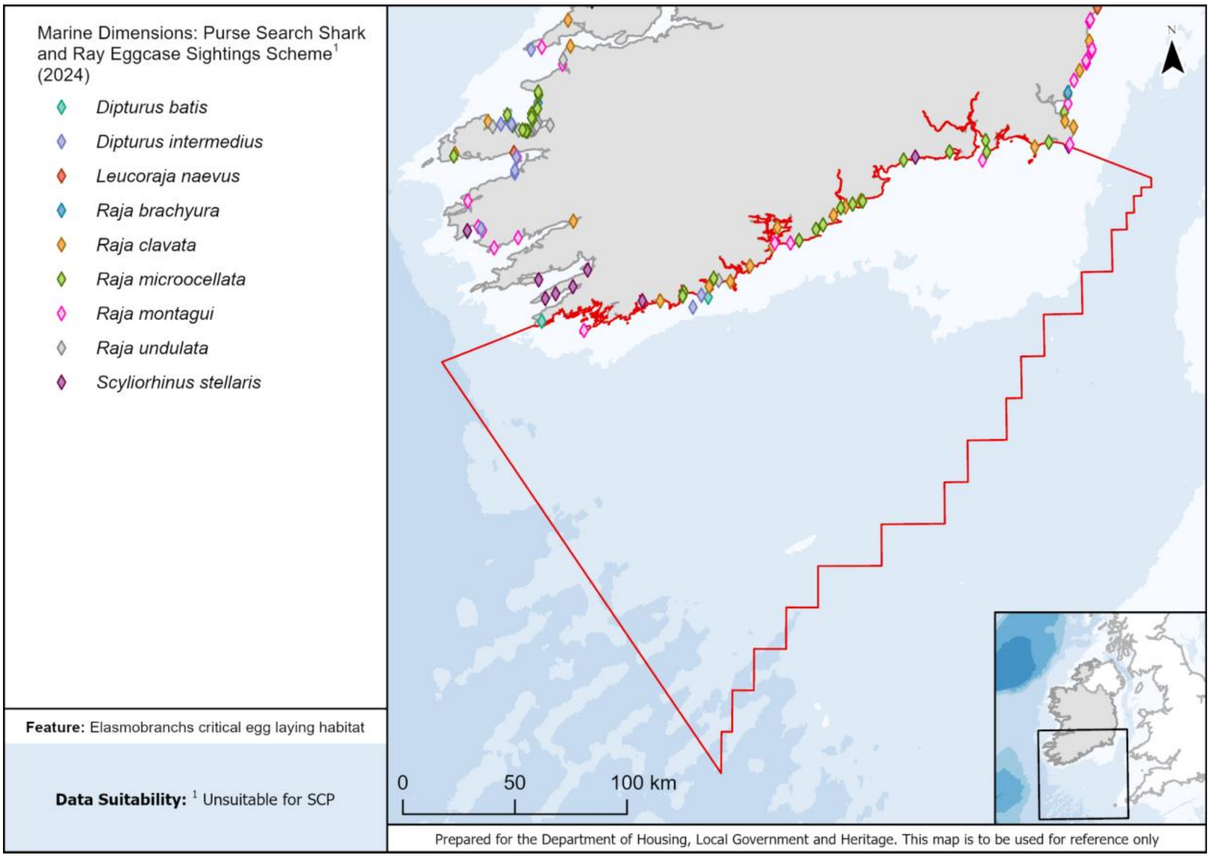

Figure A10.39.2. Distribution of egg cases in the focal area dating from 2007-2024. Red solid line denotes our area of interest. Egg case records within our study area were available for the following species, with counts of egg cases shown in parentheses; *D. batis* (2), *D. intermedius* (2), *R. brachyura* (3), *R. clavata* (357), *R. microocellata* (28), *R. montagui* (37), *R. undulata* (8), *S. canicula* (662) and *S. stellaris* (69). Purse Search Ireland and Marine Dimensions data received from National Biodiversity Data Centre spans 2007-2018 and data received directly from Marine Dimensions spans 2022-2024.

Rationale for exclusion of this feature in the southern Celtic Sea

To investigate whether the south coastline of Ireland forms a critical egg-lay habitat for elasmobranchs, preliminary investigations involved (1) an initial review of published literature on egg laying of the focal species found in the study area (preferred lay substrate and depth) (2) discussions with other experts on potential hotspots in the study area (based on local knowledge of reproductive females, in-situ egg cases, or ex-situ egg case sightings), (3) a review of the accessible egg case stranding data (which included seven species; blonde *R. brachyura*, bull huss *S. stellaris*, flapper skate *D. intermedius*, small-eyed ray *R. microocellata*, spotted ray *R. montagui*, thornback ray *R. clavata*, undulate ray *Raja undulata*) retrieved from Purse Search Ireland and Marine Dimensions via the National Biodiversity Data Centre (Figure A10.39.2). This allowed experts to assess the confidence in the literature regarding reproductive behaviours, and the quantity of data available for prioritisation analyses.

In total, 1,168 egg case records were retrieved for the seven aforementioned species (spanning 2007 - 2024). Records were primarily *ex-situ* and owing to time-constraints could not be mapped to a specific area, nor could existing literature or data be used to readily identify the appropriate neighbouring habitat given variations in local oceanographic conditions, potential egg case drift distances and, for some species, a lack of specific associated lay habitats and depth. Ex-situ egg case stranding data were also perceived to be potentially biassed to popular accessible beaches rather than reflective of their true distribution.

However, available data for early stage juvenile blue skate and mature female flapper skate data were appropriate for prioritisation analysis due to their known ecology (discussed above and in Appendix 10) and conservation status; these species anyway were included as separate species (Features 2 and 5; Table 3.1.1 Main report) because of their Threatened status, and the juvenile and mature female (respectively) records provided data on life stages amenable to spatial protection.

Data sources available

Data sources that were available to the MPA Advisory Group, and the quality / suitability of those data for conservation prioritization analyses (See Table 3.2.1 Main Report), are shown in Figure A10.39.2. The data were not considered suitable for conservation prioritization analyses.

Further research needs

The review process of accessible data revealed large gaps in the literature relating to preferred species-specific egg laying habitats (e.g., substrate, flow rate, and other environmental conditions) of elasmobranch species in both global and Irish waters. Additionally, while egg case records were available from community science records, the limited spatial and temporal coverage (associated with sporadic volunteer effort), and the unknown ‘true’ lay location (records are of spent egg cases washed to shore) affected the ability to use this dataset in spatial analysis. Future research should support existing work in this space through supporting existing national engagement. For example, financially supporting the eNGO Marine Dimensions (currently volunteer led) to coordinate and systematically conduct shore-based surveys through community science initiatives. Pairing underwater video and diver surveys to identify preferred lay habitats with systematic data collection from shoreline surveys, opportunistic bycatch during commercial fishing, and existing scientific surveys, could in turn inform back-modelling of egg case records to find true lay locations. Although a sensitivity analysis was not conducted herein, the sensitivity of egg cases to pressures associated with all sectors is, for the most part, poorly described for each species in the published literature. For example, there are unknown effects of turbidity changes, siltation and electromagnetic fields to most egg-laying species' development and survival. However, there are many pressures (e.g., substrate penetration and removal) to which many species' egg-cases will clearly be highly sensitive.

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