



# Morphological abnormality in thornback ray *Raja clavata* in the Irish Sea

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**Abstract** A free-swimming thornback ray *Raja clavata* specimen demonstrating significant morphological abnormality is reported, captured by beam trawl in the Irish Sea off north Wales, UK. The anterior sections of both pectoral fins were separated from the head section for a length of approximately 140 mm extending from the rostrum tip to a point posterior of the spiracles, along with abnormal morphology of the gill slits. This phenomenon has been observed elsewhere but is the first documented example of this abnormality in the eastern Irish Sea, despite widespread targeting of the species across the region by commercial and recreational fishers. Possible causes and consequences of the observed abnormality are discussed.

**Keywords** Deformity · Morphological abnormality · Thornback ray · Rajidae

Despite widespread monitoring and sampling by researchers, there are relatively few reports of morphological abnormalities in free-swimming, mature elasmobranchs, although numerous examples exist of embryo abnormalities (Bensam 1964; Mancini et al. 2006; Driggers et al. 2012; Guida et al. 2014). Moore

(2015) therefore suggested that the majority of these embryonic abnormalities might be fatal beyond birth. The few documented examples of morphological abnormalities in adults largely include albinism and other atypical colouration (Capapé et al. 2018; Lara-Mendoza and Guerra-Jimenez 2020), missing or additional fins (Taniuchi and Yanagisawa 1987; Williams 1935; Ellis 2005; Antoni et al. 2012; Moore 2015), deformed skeletons (Hoenig and Walsh 1983; Heupel et al. 1999; Thorburn and Morgan 2004) and other physical deformities to the body (Ramírez-Amaro et al. 2013; Moore 2015; Capape et al. 2015; Capapé et al. 2018). The causes of such occurrences in adults remain poorly understood, and further reporting can help understand both the causes and implications of such abnormalities (Heupel et al. 1999).

The thornback ray *Raja clavata* Linnaeus, 1758, is the dominant skate (Rajidae) species in inshore waters around Britain and Ireland (MarLIN 2021), where it is targeted by commercial and recreational fishers, in mixed demersal trawls, fixed nets and by rod and line (Quintana 2018). The species is present along the coast of the eastern Atlantic from the Strait of Gibraltar to Scandinavia (Quero et al. 2003), throughout the Mediterranean (Golani et al. 2006) and has been recorded off South Africa (Smith and Heemstra 1986), Mauritania (Maurin and Bonnet 1970), Morocco (Lloris and Rucabado 1998) and in the Black Sea (Bilecenoglu et al. 2014). The species is listed as near threatened by the International Union for the Conservation of Nature (IUCN 2021).

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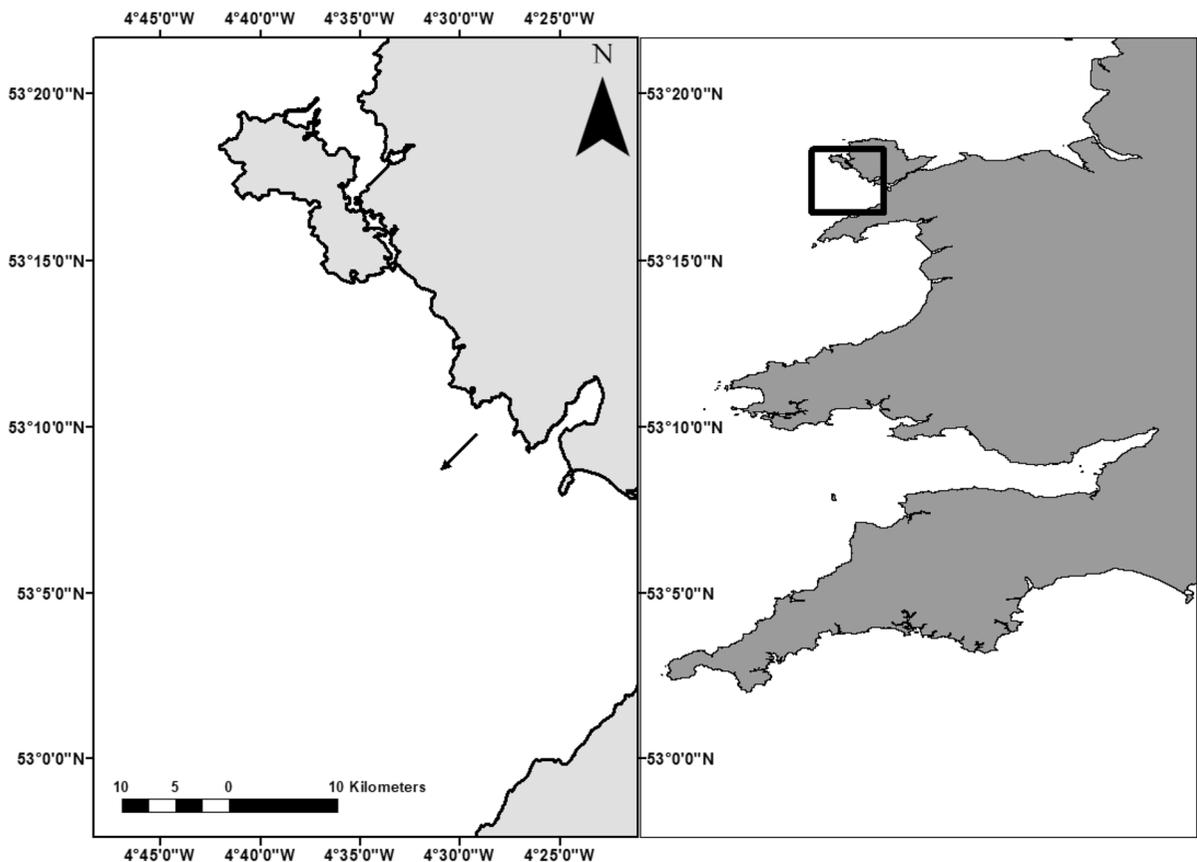
On 28th August 2020, a thornback ray specimen weighing 1.45 kg was captured in Caernarfon Bay, north Wales, UK (53°09'47" N, 4°29'10" W) with a 4-m beam trawl from the RV Prince Madog, at 19–22 m depth and approximately 7 km offshore, as part of an elasmobranch population monitoring survey across the region (Fig. 1). Dissection of this specimen was not possible. Based on the total length of the individual (Table 1) and the length of the claspers (Fig. 2), the specimen was identified as a male approaching sexual maturity (ICES 2009). The specimen showed a clear symmetrical separation of the anterior sections of the pectoral fins from the head (Fig. 2a). This separation extended from the snout and periorbital region, reaching posterior of the spiracles to the gill slits (Fig. 2a), to a length of approximately 140 mm. The gill slits also showed abnormalities relative to those usually observed in the species, with only 2–3 visible on each side as opposed to the usual

**Table 1** Morphometric measurements of the thornback ray specimen with significant morphological deformities

Measurement	Length (mm)
Total length	600
Disc width	425
Clasper length	86
Pectoral edge	200

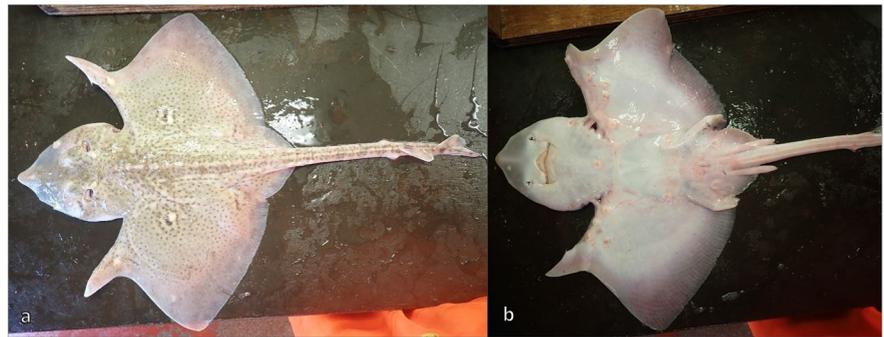
five, and those gill openings present appearing much larger than in usual specimens (Figs. 2b and 3). The anterior-most of the right-hand gill slits was notably located at the intersection of the wing and the head section (Figs. 2b, 3 and 4). No sign of physical injury or scarring was evident.

Aside from these significant deformities, the specimen had no other unusual morphological features, markings or colouration and was in good

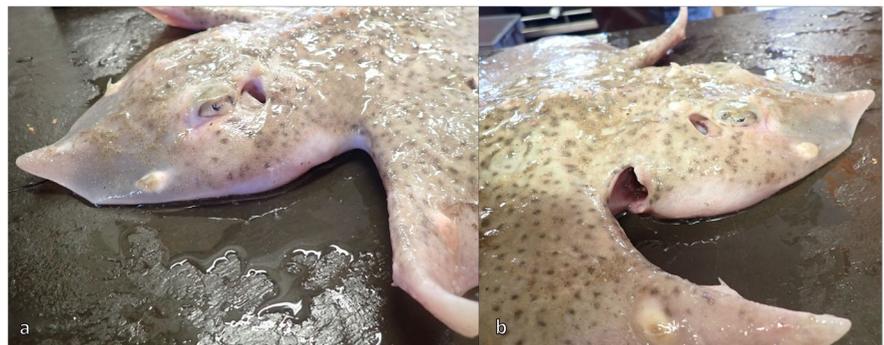


**Fig. 1** Catch location (black arrow) of the deformed thornback ray *Raja clavata* in Caernarfon Bay, northwest Wales, UK. The location in relation to the wider UK is indicated on the right of the figure

**Fig. 2** Dorsal (a) and ventral (b) view of abnormal thornback skate *R. clavata* captured in Caernarfon Bay, Wales, in August 2020, demonstrating the significant non-adherence of the pectoral fin from the head section



**Fig. 3** Close-up images of the dorsal head region of the abnormal *R. clavata* specimen captured in Caernarfon Bay, Wales, in August 2020, indicating the enlarged gill slit on the right-hand side at the point of adherence with the head



**Fig. 4** Ventral views of the head and anterior pectoral regions of the abnormal *R. clavata* specimen captured in Caernarfon Bay, Wales, in August 2020

condition. The individual was tagged with a Floy® disc identification tag prior to release from the survey vessel. Apparently approaching sexual maturity and at 600 mm  $L_T$ , it appears the observed deformities had not caused physical impairment or interference with normal biological processes for the specimen, which demonstrated strong vitality and low levels of physical injury after capture in the trawl.

The most frequently reported physical abnormalities in elasmobranchs are usually loss or damage

to the fins or tail (Templeman 1965; Mnasri et al. 2009; Orlov 2011; Moore 2015; Capapé et al. 2018), although non-adherence of the pectoral fins to the head has been occasionally observed in batoid species elsewhere, with observations dating back to the 1800s, although available information suggests not usually to the extent observed in the present specimen (Bureau 1890; Gudger and Goffin 1933). Other examples of anterior notches or separation in the pectoral fins of batoids exist in the

literature, to varying degrees (Johnstone 1906; Sæmundsson 1909; Gudger and Goffin 1933; Ribeiro-Prado et al. 2008), and for *R. clavata* in particular (Vaillant 1908; Williamson 1909; Legendre 1936; De Buit 1964; Jardas and Homen 1977), although documented cases of the phenomenon are of single specimens and the frequency at the population level remains unknown. As far as we are aware, however, this is the first recorded observation of this phenomenon from Welsh waters and the eastern Irish Sea.

Whilst other rostral deformities may occur due to the effects of physical injury, such as through ghost fishing (Akyol and Aydin 2018), parasites or disease (Heupel et al. 1999; Moore 2015), it has been suggested that pectoral non-adherence is due to the failure of pectoral fins to fuse together in front of the head in early embryonic development, during which the pectoral fins are separate, before fusing in medium-term embryos and forming the complete body disc in late development (Bigelow and Schroeder 1953). It would therefore appear that the reduced number of gill slits in the specimen is likely due to this developmental abnormality and non-adherence.

Nakamura et al. (2015) showed that the genetic mechanisms behind batoid fin development differ between the anterior and posterior sections; thus, the observed deformity to the posterior pectoral section in our specimen may be due to disruption to the genetic pathways that determine anterior pectoral development and fusion with the head. Such disruption may be through natural genetic variation or through pollutant exposure (Boldrini and Pereira 1987; Tomassi 1985). The water quality across the area of capture is known to be high, however, with low levels of pathogens and pollutants (Natural Resources Wales 2019). Whilst not collected in this study, the genetic analysis of tissue samples from specimens that demonstrate this abnormality may allow a better understanding of the causal factors and of the longer-term implications of the condition to the individual.

The deformities reported here have been observed in the species elsewhere, but there are no records in the literature of pectoral non-adherence in thornback ray in the eastern Irish Sea or in Welsh waters specifically. This therefore represents the first recorded observation of the phenomenon in the region despite the widespread targeting of the species by commercial and recreational fishers.

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**Data availability** No further data than that presented in this manuscript are available.

#### Declarations

**Ethics approval** This work received ethical approval from Bangor University's Animal Welfare and Ethical Review Body.

**Conflict of interest** The author declares no competing interests.

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