ANALYSE DES CRITERES DE CLASSEMENT DU THON ROUGE ET DE LA RAIE BOUCLEE DANS LA LISTE DES ESPECES MENACEES OU EN DECLIN DE LA CONVENTION OSPAR

Réponse de l'Ifremer à la saisine de la DPMA 17-12025 (en annexe) préparée par Pascal Lorance[1] et Tristan Rouyer[1]
Relecture : Alain Biseau[1]

[1] Les experts ayant réalisé l'expertise ont certifié l'absence de lien d'intérêts avec le demandeur et le sujet de l'expertise.

1. Thon rouge *Thunnus thynnus (*Linnae, 1758)

1.1 Éléments en soutien à la révision

La dernière évaluation du stock de thon rouge de l'Atlantique Est (CICTA,2017)[2] montre une hausse importante de la biomasse féconde depuis 2007 accompagnée d'une forte baisse de la mortalité par pêche.

L'augmentation de biomasse est importante mais cependant plus modérée et biologiquement plus vraisemblable que celle estimée lors de l'évaluation de 2014. En particulier, l'évaluation de 2017 a révisé à la baisse l'estimation des recrues après 2003 par rapport à l'estimation de 2014, ce qui est plus conforme avec ce qui est observé dans les captures.

Si la tendance à la hausse de la biomasse est incontestable, les valeurs absolues de biomasses estimées sont plus incertaines et l'estimation est différente lorsqu'une nouvelle année de données est incluse dans le modèle (biais rétrospectif).

Par ailleurs, les analyses réalisées à partir de modèles alternatifs montrent des résultats moins optimistes. Le SCRS a ainsi souligné les incertitudes importantes quant à l'estimation du recrutement et du niveau de biomasse des dernières années.

À la suite des travaux sur les captures historiques des madragues, il est connu que la productivité du stock peut évoluer de façon substantielle au cours du temps, même en l'absence de pêche intensive. Cette grande variabilité de productivité est observée dans les estimations du recrutement par le modèle de référence utilisé pour l'évaluation. Or, la valeur de la biomasse de référence B_{msy} (ici $BF_{0.1}$) est estimée sur la base d'un stock en équilibre et donc sur l'hypothèse de productivité constante. Celle-ci n'étant pas remplie ici, le groupe chargé de l'évaluation a donc décidé de ne pas comparer les estimations récentes de la biomasse avec une quelconque biomasse de référence e. Néanmoins, en utilisant les mêmes hypothèses de productivité qu'en 2014, la comparaison avec la biomasse de référence qui en découle montre que, pour deux scénarios de productivité sur trois, la biomasse actuelle est supérieure à la biomasse de référence, ce qui signifie que le stock n'est pas surexploité[3].

La mortalité par pêche est estimée en dessous de la valeur de $F_{0.1}$($F_{2012\text{-}2014}$ /$F_{0.1}$ =0.34) qui est considéré comme un proxy de F_{msy}. Le stock n'est donc plus surpêché.

[2] https://www.iccat.int/Documents/Meetings/Docs/2017_SCRS_REP_FRA.pdf

3 Il convient de noter que dans la sphère CIEM la biomasse de référence utilisée aujourd'hui (MSY-$B_{trigger}$) est en général estimée comme la moitié de la valeur de B_{msy}. Le CIEM considère donc un stock non surexploité lorsque sa biomasse est supérieure à la moitié de B_{msy}, quand l'ICCAT fait ce constat lorsque la biomasse est estimée supérieure à B_{msy}.

À la lumière de ces éléments, il est aujourd'hui possible de déclasser le thon rouge dans le cadre de la convention OSPAR.

1.2 Critères Texel/Faial

Importance Globale

La convention OSPAR qui ne concerne que l'Atlantique Nord-Est (zones CIEM II, III, IV et V) n'inclue donc pas la zone Méditerranéenne dans laquelle la majorité des captures ont lieu. L'Atlantique Nord-Est représente moins de 30% des captures du stock Est de thon rouge. Cependant, des flottilles importantes pour l'exploitation du thon rouge, comme les palangriers japonais, y effectuent une part substantielle de leurs captures. Depuis maintenant quelques années, le thon rouge est préférentiellement pêché par cette flottille au sud de L'Islande. D'autre part, des gros individus sont maintenant fréquemment observés dans les zones côtières à relativement hautes latitudes (e.g. Norvège, Suède), où ils se nourrissent de maquereaux et de harengs.

Le thon rouge est une espèce de poissons dits grands migrateurs, très mobiles, capables de traverser l'Atlantique en peu de temps. Les zones de reproduction connues et récurrentes pour le thon rouge de l'Est se situent en Méditerranée. La littérature mentionne aussi que le thon rouge pourrait aussi se reproduire dans certaines zones de l'Atlantique. Chaque année de grands mouvements de migration saisonniers amènent une grande partie des individus matures vers ces zones de reproduction, ce qui implique notamment l'entrée des thons de l'Atlantique vers la Méditerranée. Il est aussi connu que les jeunes individus de Méditerranée, par exemple dans le golfe du Lion, peuvent y rester toute l'année. Enfin, il est suspecté que la variation des conditions environnementales affecte ces patrons de migration.

Il est ainsi difficile d'établir le taux de résidence des individus à l'intérieur de l'aire OSPAR. Les données de marquage de thon rouge ne permettent pas d'apporter de réponse quantifiée quant au pourcentage de poissons du stock présents dans la zone.

Importance Régionale

Parmi les zones importantes pour les jeunes thons rouges, le golfe de Gascogne est la zone la mieux connue pour l'Atlantique Est. Les jeunes individus pénètrent dans le golfe de Gascogne pour s'y nourrir en été, notamment de petits pélagiques (anchois). Les autres zones de nourricerie, le golfe du Lion, la mer Tyrrhénienne, l'Adriatique et la mer Égée, sont situées en Méditerranée. Le golfe de Gascogne occupe donc une place importante pour les jeunes thons rouges, mais n'abrite qu'une petite fraction de la population totale. Pour les adultes, la fraction est probablement encore plus basse car ceux-ci y sont moins fréquemment observés. La mobilité de l'espèce et la variabilité de l'occurrence des thons observés dans différentes zones au cours de l'histoire suggèrent que la majorité des régions de la zone OSPAR sont des zones de

passage ou de recherche de nourriture, qui ne sont pas récurrentes mais dépendent de la disponibilité en proies.

Rareté

Le thon rouge est observé sur une très large zone géographique. D'après les deux dernières évaluations de stock, le stock est estimé avoir atteint un haut niveau d'abondance pendant les années 70 et son abondance a fortement baissé dans les années 90 jusqu'aux années 2000. Selon ces mêmes sources, depuis la seconde moitié des années 2000 et l'implémentation d'un plan de restauration et des contrôles pour le faire respecter, l'abondance du stock est revenue à des niveaux comparables ou supérieurs à celle des années 70. En prenant en compte les incertitudes et les modèles alternatifs de la dernière évaluation de stock, cette tendance persiste, mais certaines hypothèses et certains modèles ne montrent pas une augmentation d'abondance aussi forte que celle retenue dans l'évaluation.

Les observations montrent que la répartition spatiale de l'espèce s'est agrandie. Dans le golfe du Lion où une campagne de survols est menée pour compter les bancs de thon rouge depuis les années 2000, le poisson occupe une zone plus large et s'est particulièrement rapproché des côtes. D'autre part, comme il l'a été indiqué ci-dessus des observations de thons rouges ont été réalisées dans des latitudes plus hautes. Étant donné la mobilité de l'espèce, ces changements de distribution spatiale ne sont probablement pas uniquement liés à une augmentation d'abondance (e.g. changement environnemental, distribution spatiale des proies…), mais ils sont néanmoins cohérents avec cette hypothèse.

En tenant compte des éléments exposés ci-dessus, le thon rouge n'est aujourd'hui pas rare dans l'aire OSPAR

Sensibilité

Le thon rouge a une croissance plus lente, une maturité plus tardive et un mode de reproduction qui le rendent plus vulnérable à la pression de pêche que les thons tropicaux. Son exploitation est réalisée sur les zones de reproduction pendant lesquelles le thon est regroupé. Les rendements sur cette zone et pendant cette période sont élevés. Le stock est donc sensible.

Cependant, depuis la mise en place du plan de reconstitution, l'exploitation des individus jeunes (<4.5 ans, 115cm, 30kg) est limitée. D'autre part en l'espace d'une dizaine d'années, l'abondance du stock est remontée substantiellement et est proche ou supérieure à celle des années 70. De plus, la mortalité par pêche est estimée compatible avec la prise maximale équilibrée (rendement maximal durable).

Espèce clé de voûte

La prédation du thon rouge peut probablement affecter l'abondance d'autres espèces. En effet, c'est un prédateur situé en haut du réseau trophique et capable de se nourrir de façon opportuniste sur une très large gamme de proies. Un changement de l'importance de la prédation du thon rouge lié à sa raréfaction [ou à l'augmentation de son abondance] pourrait donc potentiellement avoir un impact substantiel sur le fonctionnement de certains écosystèmes, en particulier ceux dans lesquels le thon peut passer beaucoup de temps.

Peu d'études se sont spécifiquement intéressées à ces aspects pour le thon rouge. Dans le golfe du Lion, où le thon peut séjourner toute l'année et se nourrit de petits pélagiques, une étude récente suggère que la prédation du thon n'aurait pas d'impact substantiel sur l'abondance des petits pélagiques (Van Beveren et al. 2017[4]).

Déclin

Selon l'évaluation de stock de 2017, ainsi que la précédente, et depuis la mise en place du plan de reconstitution de 2007 il n'est plus fait mention de déclin, mais bien d'augmentation de l'abondance et de la répartition spatiale, et de baisse de la mortalité par pêche. Néanmoins, une forte incertitude subsiste toujours quant à l'importance de l'augmentation ainsi que de sa vitesse. D'autre part, la concentration de l'activité de pêche des palangriers japonais conduit à poser la question de changements de répartition spatiale potentiels, e.g. concentration, qui pourraient affecter la tendance des indices d'abondance. Ces questions ne sont pas encore documentées de façon formelle.

Le niveau de recrutement (i.e. la productivité) du stock Est peut évoluer de façon substantielle au cours du temps et influence l'estimation de la biomasse de référence (B_{F01}). Cette incertitude a conduit le SCRS à ne pas se positionner par rapport à la biomasse de référence. Cependant, le SCRS a réalisé la comparaison avec la biomasse de référence sous les mêmes hypothèses de productivité qu'en 2014. Pour deux scénarios de productivité sur trois, l'analyse montre que la biomasse du stock est au-dessus de la biomasse de référence.

Le thon rouge qui n'était plus observé dans les hautes latitudes est de retour depuis plusieurs années. De gros individus sont maintenant fréquemment observés dans les zones côtières en Norvège, Suède et au Danemark, où ils se nourrissent de maquereaux et de harengs.

4Van Beveren Elisabeth, Fromentin Jean-Marc, Bonhommeau Sylvain, Nieblas Anne-Elise, Metral Luisa, Brisset Blandine, Jusup Marko, Bauer Robert Klaus, Brosset Pablo, Saraux Claire (2017). Prey predator interactions in the face of management regulations: changes in Mediterranean small pelagics are not due to increased tuna predation . Canadian Journal Of Fisheries And Aquatic Sciences , 74(9), 1422-1430 . Publisher's official version : http://doi.org/10.1139/cjfas-2016-0152 , Open Access version : http://archimer.ifremer.fr/doc/00371/48215/

Autres éléments à prendre en compte

D'après la dernière évaluation de stock, le stock de thon rouge de l'Est est aujourd'hui dans un statut nettement amélioré. La mise en place de la réglementation sur la limitation de l'effort de pêche des jeunes individus (<30kg et 115cm), le suivi des recommandations scientifiques de la CICTA ainsi que le contrôle de l'exploitation pour empêcher les captures illégales ont mené à la mise en place de conditions favorables à une exploitation durable associée à un retour rapide de la ressource.

Cependant, le bon état actuel du stock pourrait être remis en cause si les captures totales dépassent les captures autorisées (un retour des captures illégales, notamment sur les jeunes individus, pourrait être la conséquence d'une augmentation de l'effort consécutive à l'augmentation du TAC en 2020). Le maintien du contrôle des captures est une des clés du succès présent et à venir.

Une autre source d'incertitude sur le devenir du stock réside dans la variabilité du niveau de productivité du stock; en effet, il est particulièrement difficile d'ajuster le niveau de capture au niveau de productivité du stock quand celui-ci est fluctuant. Par conséquent des captures soutenables pour un niveau de productivité donné peuvent ne plus l'être dans le cas d'un changement du niveau de productivité. Il convient donc de rester prudent et d'étudier tous les signes de changement de productivité du stock afin de pouvoir y adapter le niveau de capture. Dans le cas du thon rouge, la capture des jeunes individus étant réglementée, il est mal aisé de détecter ces changements de productivité rapidement, soulignant le besoin de modifications graduelles des possibilités de pêche permettant de mesurer leurs effets.

2. Raie bouclée *Raja clavata* (Linnaeus, 1758)

Nomination
Thornback ray *Raja clavata* (Linnaeus, 1758)

Reason for review

New available information lead to reconsider the former conclusions for some criteria: first, a larger proportion of the total meta-population occurs in the OSPAR region, although the qualification of the species under this criterion is still uncertain; second, the sensitivity of the species appears to be more less straightforward than previously thought, as the species is now considered to have some, but limited, resistance to overfishing, and a good resilience (i.e. it declines under fishing pressure but recovers faster than previously thought when the fishing pressure is relaxed). More importantly, trends in stock size indicators from surveys in 5 out of 7 stocks assessed by ICES show significant abundance increases in the last ten years or more, implying that the species no longer qualifies to the criterion "Decline". Therefore, it is recommended to 'delist' the thornback ray. Furthermore, it should also be considered that the fisheries management, although at the level of skates and rays altogether, is now suitable to further rebuild populations and in all case, to quickly react if any reversal of the increasing trends would be observed.

Species distribution

Definition for habitat mapping (only habitats)

N/A report for species delisting

Geographical extent

OSPAR Regions: I, II, III, IV, V
Biogeographic Zones: South Iceland-Faeroe Shelf, West Norwegian subprovince, Skagerrak subprovince, Boreal, Boreal-Lusitanean, Lusitanean-Boreal, Warm Lusitanean subprovince, Cool Lusitanean subprovince, Azores subprovince (Macaronesian province).

Region & Biogeographic zones specified for decline and/or threat

In the case report for listing, regions II and III were specified for listing with limited mention to other regions. Here, the current knowledge of population in all OSPAR regions is reviewed.
Raja clavata inhabits mud, sand, shingle, gravel and rocky areas on the shelf and upper slope in the Northeast Atlantic and Mediterranean, also entering the Baltic and Black Seas, to West Africa and The Azores. Southern African records are now considered to represented misidentifications of the closely related biscuit skate, *Raja straeleni*, distributed in southern Africa

(Pasolini *et al.*, 2011), whereas individuals attributed to *Raja maderensis* from the Azores and seamounts located further south of the Azores by 30 to 35°N and to the north of Madeira did not display sufficient genetic sequence difference to support that *R. maderensis* and *R clavata* are two distinct species but may constitute part of a genetically diverging population (Ball *et al.*, 2016).

R. clavata is most abundant in coastal areas at 10–60 m depth (shallower in cold temperate waters, deeper in warmer waters), commonly recorded to 100 m, and occasionally to at least 300 m in the OSPAR area, and deeper in the Mediterranean Sea (Masuti and Moranta, 2003; Valls *et al.*, 2011). Estuaries and large shallow bays are important spring/summer spawning and feeding areas (Ellis *et al.*, 2005a; Hunter *et al.*, 2006).

Application of Texel-Faial criteria

Global importance

The centre of distribution of *Raja clavata* is in the North Sea, Celtic and Iberian Seas, covering three ICES ecoregions (greater North Sea, Celtic Seas and Bay of Biscay and Iberian Coast) and three OSPAR regions (II, III and IV). The species is also the main Batoid species in Azorean waters (OSPAR region V).

The proportion of the global population distributed out of the OSPAR region is unknown as there are not quantitative estimates of the abundance or biomass of any (sub-) population within and outside of the OSPAR region. It is uncertain whether populations located in the Mediterranean Sea, along the Atlantic African coast, around Islands and on offshore Seamounts to the South of the OSPAR area constitute more of less of 25% of the global population, making it difficult to categorize this species in terms of global importance under the Texel-Faial criteria. Nevertheless, it is most likely that at least half of the global population occurs in the OSPAR Maritime Area and the OSPAR area comprises several genetically distinct stocks. Therefore, when applying the Texel-Faial criteria the relevance of the species to OSPAR is high and its global importance cannot be ruled out.

Regional importance

No region within the OSPAR area is of particular importance to the thornback ray under the Texel-Faial criteria. Nevertheless, it is important to note that this species is comprised of several distinct genetic stocks which have centres of distribution and areas of essential habitat within the OSPAR Area, including the Thames Estuary and Southeast English Channel (Walker and Hislop,1998; Martin *et al.,* 2010). In recent years ICES has considered seven stock units of thornback ray in the Northeast Atlantic, all of which fully distributed within the OSPAR area. These seven stock units include a multi species one for all "rays and skates in Azores grounds and north of Azores", where the most abundant species according to surveys and fisheries landings is, by far, the thornback ray.

Rarity

The thornback ray is not rare. It is widespread in the OSPAR area, and occurs at rather high densities in some areas. For example, in the eastern English Channel it was the 6th species in term of stratified biomass estimated from the French Channel Ground Fish Survey over years 2014 to 2017. The species is the main Batoid species in the southern North Sea, Eastern Channel, Irish Sea and Bristol Channel (Ellis *et al.,* 2005, Martin *et al.*, 2010). Numbers by populations or ICES stock units are unknown but are not presumed to be small. Although a modelling approach for the French part of the Bay of Biscay estimated a severe long-term decline, the current biomass was estimated to 1900 t, with a large confidence interval, (Marandel *et al.*, 2016) which might correspond to not less than one million individuals. Current abundances of several other populations are presumed much larger (Marandel, in press).

Sensitivity

The thornback ray is sensitive to very sensitive in relation to its slow growth rate and moderate fecundity (Walker and Hislop, 1998) which imply moderate biological productivity of populations. It is a large species, reaching at least 105 cm in total length for a total weight of 8 kg or more. Available estimates of maximum age from annuli in vertebrae or dermal thorns range from 10 to 15 years (Holden, 1972; Ryland and Ajayi, 1984; Serra-Pereira *et al.*, 2008; Kadri *et al.*, 2014). Fish larger than 100 cm are rare in current populations (see e.g. McCully *et al.*, 2012). Data on size distribution in the past are scarce. However, an historic study reported disk width (DW) up to 86 cm, corresponding to total length (TL) of 123-124 cm (Stevens, 1934). From figures in the same study, females over 80 cm DW (115 cm TL) represented 9% of mature females. Females reach sexual maturity at 70-80 cm (McCully *et al.*, 2012). The species is oviparous, but has relatively low fecundity, estimated available studies reporting 100-150 eggs per annum (Holden, 1971, 1975; Ryland and Ajayi, 1984; Serra-Pereira *et al.,* 2011) with observations in captivity yielding smaller number (Ellis and Shackley, 1995). Nevertheless, as rays lay large eggs protected by a capsule, the survival of eggs to one year old juveniles is higher than in teleost. In a simulation study fecundity assumptions of 48 to 150 eggs were made with corresponding survival to age 1 of 0.01 to 0.036 to generate a stable thornback ray population (Marandel etal., in press). Under these assumptions, designed to cover the plausible range, a mature female would produce 0.5 to 5 year old offspring per year. The species occurs on various seabed and habitats types so that its distribution is not particularly concentrated in small areas (see e.g. the contrast between the spread of *R. clavata* and the aggregation of *Scyliorhinus stellari*s in Martin *et al.,* 2012).

Recent data suggest that the assessment of the species sensitivity is challenging. On the one hand, its disappearance from large areas of the North Sea in the second half of the 20th century clearly reflects the low resistance of the species, which makes it susceptible to overexploitation when fishing pressure is high (Dulvy and Reynolds, 2002). On the other hand, recent and fast increases in abundance in some areas, in particular the Eastern English Channel (see below) suggests that the resilience, i.e. the ability to recover when human impact is relaxed, may be

higher than previously thought. This ability to quickly recover is also reflected by the increases in rays landings after wars (Letaconnoux, 1948; Walker and Hislop, 1998; Heessen, 2003).

This species is not sensitive to moderate eutrophication.

Keystone species

There is no information that the thornback ray or otherwise ray species would have a controlling influence on benthic, fish or any other marine community. The thornback ray feeds primarily on benthic decapods (Ebert and Bizzarro, 2007) and could therefore have some controlling influence on those. However, the species displays a diversified diet and dietary overlaps with other rays, sharks and other fishes (Holden and Tucker, 1974; Serrano *et al.*, 2003; Farias *et al.*, 2006; Demirhan *et al.*, 2007) which makes it unlikely that it is a keystone species. Furthermore, the diet varies with depth and areas with a possibly higher contribution of fish in Azorean waters and the Mediterranean Sea (Morato *et al.*, 2001; Demirhan *et al.*, 2007; Kadri *et al.*, 2014)

Decline

Patterns of decline in *Raja clavata* vary across the OSPAR Maritime Area, where this is one of the most important species of skate and ray in commercial fisheries. Trends in landings could not be used to assess the stock trends since thornback rays historic landings were difficult to determine in most areas, skates and rays landings being rarely species-specific before the mid-2000s. Although misidentification could still be a problem, landings data for recent years are more reliable thanks to the obligation to report landings species-by-species since 2009. ICES reconstructed species-specific landings series back to 2005. However, owing to the fixation of TACs for skates and rays in OSPAR regions II-IV since 2009, and decreasing trends in fishing effort (see below), trends in landings are unlikely to track populations trends. Therefore, ICES assessments are based upon trends in fishery-independent surveys. In the most recent ICES assessments, five out of the seven stock units had a stock size indicator increasing for 10 years or more, for one (OSPAR region V) there was no long-term trend but strong variations and a low level in recent year and for the last ICES had no recent information on abundance or exploitation. The following paragraphs review historic declines and recent trends in OSPAR Regions.

OSPAR Region II

During the 20th century *R. clavata* declined steeply in the North Sea, it vanished from the Dutch Wadden Sea in the 1950s and the distribution area restricted to the southwest of the North Sea by the end of the century (Walker and Heessen, 1996; Walker and Hislop, 1998; Heessen 2003). The long-term trend in other parts of Region II is less clear as there was less survey data. However, a local survey revealed a 20 to 100 fold decline in abundance at two coastal sites near Plymouth (UK) between periods 1913-22 and 2008-09 (McHugh *et al.*, 2011). No similar information exists for the Skagerrak and Kattegat.

In spite of the overall decline in the North Sea during the 20th century, remaining patches were reported in particular along the British coast (Walker and Hislop, 1998; Heessen 2003). A recent study based upon data from power stations from the English Channel to Scotland suggests that such patches of thornback ray persisted, although a number of other elasmobranchs disappeared from these coastal waters (Henderson, 2017). There is no study on recent distribution in the North Sea.

In the recent period, ICES estimated a stock size indicator based on the combination of four surveys for the stock in the North Sea, Skagerrak and Eastern Channel (i.e. OSPAR Region II excluding the western Channel, treated as a separated stock unit). This indicator, limited to years 1993-2016 for consistency of survey data, reflects a 5.6 fold biomass increase between the average for years 1993-2003 and 2013-16. This biomass indicator started increasing strongly around 2010 and the increase has been sustained since.

Thornback ray in the Western Channel is treated as a separated stock by ICES. There is only limited survey data in Lyme Bay (East of Plymouth). Trawl survey data in Lyme Bay indicated that the relative abundance of this species was stable or increasing over the period 1989–2011 (Burt *et al.*, 2013). While this survey no longer operates, it is expected that time-series data from recently initiated English and French surveys in this area will provide stock indicators in the near future.

OSPAR Region III

During the 20th century, reported landings of skates and rays (combined) have been highly variable, with an overall decline (ICES, 2017a). Reported landings were about 25 000 tonnes from the 1930s to the 1960s, then they declined to approximately 15 000 t in the mid-1970s and varied between 15 000 and 20 000 t in the 1980-90s before to display a steady decline in landings since 2000. The latter was, at least partly, due to the introduction of catch limits. Annual landings have been less than 10 000 t since 2009, in which year TAC was established. The contribution of thornback ray to this trend in unknown, but the species is the main commercial species in the inshore fishing grounds (e.g. eastern Irish Sea, Bristol Channel) and is thought to have been more abundant in the past (ICES, 2017a). Few published studies provide further insights: standardised survey catch rates in numbers in the northwest Irish Sea in 1989-97 were one third of those from 1901-07 (Rogers and Ellis, 2000). Commercial catch rate of skates and ray in the Irish Sea, where thornback is the main species showed an almost monotonous decline during 1950-1990 (Dulvy *et al.*, 2000). More recently, survey catch rates have decreased in the Celtic Sea (here ICES divisions 7,g,h,j) during 1987-2003 (Ellis *et al.,* 2005). In the Irish Sea, estimated trends were somewhat conflicting as beam trawl surveys showed stable survey catch rates over 1993-2003 where a consistent survey grid was used (Ellis *et al.*, 2005) while declining catch rates were estimated using data from 1988-1997 (Dulvy *et al.*, 2000). There is no data on long-term trend to the west of Scotland (ICES Subarea 6).

In recent years, ICES estimated biomass trends from surveys for the two stocks: (1) West of Scotland and (2) Irish Sea, Bristol Channel and North Celtic Sea. In other parts of region III corresponding to ICES divisions 7b,c,h,j,k the thornback ray occurs at lower density and no ICES assessment is available. For the west of Scotland the stock size indicator increased by a factor 5

from 2005 to 2013 then decreased in 2014-15. The level of this survey indicator in 2014-15 is still 1.8 times the average for year 2005-07. Additional information from this stock referred to by ICES (2017) include (1) the Scottish surveys in ICES Division 6.a in 1985-2010, which suggested a stable/increasing abundance trend but the data was not further updated and (2) an indicator of occurrence in French on-board observations of commercial fisheries in 2007-2016, which suggested no trend. For the Irish Sea, Bristol Channel and North Celtic Sea, the stock size indicator showed a 2.7 times increase between the early years of the time-series (1993-1996) and the most recent (2014-15).

OSPAR Region IV

Although the overall sign al is blurred by missing data for some countries and years, the long-term time series of skates and rays landings shows an overall decline since 1973 (ICES, 2017a) and landings in 2016 may have been between half and two third of those for 1973. Data from earlier years seem even less reliable and are not presented here. Like for region III, the contribution of the thornback ray to the overall decline is unknown, but the species is thought to have declined. ICES considers two stocks in (1) one in the Bay of Biscay and (2) one in Atlantic Iberian waters, and these covers the whole Region IV. In the last assessment of the Bay of Biscay stock carried out in 2016, the stock size indicator, based on the combination of two surveys covering the stock area, suggested a recent increase. In the Cantabrian Sea (ICES Division 8c) the survey biomass index showed a reliable overall increasing trend since 1983, the average for years 2012-16 being at least 4 times that of 1983-1999 (see figure 19.7a in ICES, 2017a). In ICES divisions 8abd, an indicator of occurrence of the species in commercial fishing hauls from French on-board observations in 2007-16 showed an increasing trend. For the Atlantic Iberian waters, the stock size indicator resulting from the combination of three surveys, showed a sustained increase since the late 1990s.

OSPAR Region V

Thornback ray is, by far, the main species in landings of skates and rays from this region. Like in other regions, until recent years, ray species were not reported separately. Landings of skates and rays from this region come mainly from artisanal fisheries operating in coastal waters of the Azores. Landings of about 40 t/years were reported from 1974 to the late 1980s and then increased to 120-140 t in recent years. Thornback ray is the first elasmobranch species caught in an annual longline surveys carried since 1994 out Azorean waters and covering all coastal waters and the major seamounts. The survey indicates no overall trends with catch rates in recent years being at low levels similar to those observed in 1997-2001, with higher abundance observed in the 2000s. The stock abundance indicator in the last year (2016) was slightly lower than the average for 2010-13 (no survey in 2014-15), leading ICES to recommend a reduction in catch (ICES, 2017b).

Out of the OSPAR region

The thornback ray is also widespread in the Mediterranean Sea, where it also declined in the 1980-90s (Aldebert *et al.*, 1997, Bertrand *et al.*, 2000). Recent (taken as last year posterior to 2008) trends were found for three area only (Gulf of Lion, Est Corsica and Sardinia) 2/3 were increasing, 1/3 stable (Marongui *et al.*, 2017, http://www.ifremer.fr/SIH-indices-campagnes/).

Relevant additional considerations

Compared to the case report from 2008, which led to not considering the OSPAR region as of global importance for the species, this is now considered uncertain. First, records of the species off southern Africa are now more clearly attributed to *R. stralaeni*. Second, although the species occurs throughout the Mediterranean Sea, the available shelf area at suitable depths is much smaller than in the OSPAR area. Third, although occurrences are confirmed, populations to the North of the OSPAR area and in the Baltic Sea are small compared to populations in the OSPAR area. In the Atlantic, the distribution of the species clearly extends in the central east Atlantic to the South of the boundary of the OSPAR region (36° North). But available data do not suggest the occurrence of large populations. However, this is still uncertain because the extension towards the South along the African coast is poorly known, survey data being limited and species-specific fisheries landings data being unreliable for rays in parts of the CECAF area.

In this report, historical information on abundance was reviewed and as far as possible reported consistently with current ICES stock units. In the case report from 2008 there was some mixture between actual abundance, biomass or occurrence data or estimates and relative estimates. The latter were removed from the present report because they could be misleading as some relative estimates were the proportion of thornback ray in all elasmobranchs, which could vary as a consequence of change in the abundance of other species.

Threat and link to human activities

The historic decline of thornback ray populations was due to fishing, both target and bycatch. In the light of knowledge accumulated since the 2008 case report, the threats description made to implement the listing of the species was fully right. The IUCN assessment as Near Threatened, was not changed after a new evaluation carried out in 2012. Since the listing as declining species in the OSPAR area, fishing has been regulated through the introduction of TACs for skates and rays in EU waters of all OSPAR regions (see below). In the northeast Atlantic, fishing effort, which was excessive for several decades, started reducing at the turn of the century with measurable effect on exploited stocks (Fernandes and Cook,. 2013; Gascuel *et al.,* 2016). This overall decline in fishing effort implies that fishing mortality of thornback ray populations from bycatch fisheries has been reduced, while TACs for skates and rays, introduced in 1999 in region II and 2009 elsewhere, are designed to control both bycatch and targeted fisheries.

Management considerations

Overall, in EU waters where the main thornback ray populations of the OSPAR area occur, the Common Fisheries Policy has been revised and now aims to "*ensure that exploitation of living marine biological resources restores and maintains populations of harvested species above levels which can produce the maximum sustainable yield* " in application of the Marine Strategy Framework Directive (MSFD), which provides that "*Populations of all commercially exploited fish and shellfish are within safe biological limits*".

Skates and rays are now subject to TAC management in EU waters. These TACs apply to European Union waters and, to European Union fishing vessels, in non-Union waters. Thornback ray is further subject to prohibition, i.e. "caught specimens shall not be harmed and shall be promptly released" in one part of the range where it has been rarefied namely the Skagerrak, ICES Division 3a. Although, TACs for skates and rays are not species-by-species, there is an obligation to report species separately, which has already allowed improving stock assessments (ICES, 2017a).

The increase in several thornback ray populations estimated by ICES assessments (see above) reflects the effect of both the overall reducing fishing pressure in the whole northeast Atlantic and the TAC management of skates and rays.

Further information

In the 2010s, TACs for skates and rays became constraining to fisheries, which have reacted by managing fishing opportunities. The management of limited fishing opportunities may include various measures taken by fishers' organizations such as limiting landings per trip and banning landings for smaller fish of lesser commercial value. For example in France, rays smaller than 45 cm total length have been banned to landings (JORF, 2017). As rays have been estimated to be amongst fish species that survival best to catching, depending on several factors including tow duration and fishing depth (Despelete *et al.*, 2014; Saygu and Deval, 2014; Morfin *et al.*, 2017; Knotek *et al.*, 2018) a, possibly high, fraction of these discards survive, implying a reduced fishing mortality.

References

Aldebert, Y. (1997). "Demersal resources of the Gulf of Lions (NW Mediterranean). Impact of exploitation on fish diversity." Vie et Mileu 47(4): 275-284.

Ball, R. E., B. Serra-Pereira, J. Ellis, M. J. Genner, S. Iglesias, A. F. Johnson, C. S. Jones, R. Leslie, J. Lewis, S. Mariani, G. Menezes, F. Neat, L. R. Noble, D. W. Sims and A. M. Griffiths (2016). "Resolving taxonomic uncertainty in vulnerable elasmobranchs: are the Madeira skate (Raja maderensis) and the thornback ray (Raja clavata) distinct species?" Conservation Genetics 17(3): 565-576.

Bertrand J., L., Gil De Sola, C., Papakonstantinou, G., Relini and A., Souplet, (2000). Contribution on the distribution of Elasmobranchs in the Mediterranean (from the Medits surveys). Biologia Marina Mediterranea 7(1), 385-399.

Burt G.J., Ellis J.R., Harley B.F. and Kupschus S.. 2013. The FV Carhelmar beam trawl survey of the western English Channel (1989–2011): History of the survey, data availability and the distribution and relative abundance of fish and commercial shellfish. Sci. Ser. Tech. Rep., Cefas Lowestoft, 151: 139 pp.

Catchpole, T.L., Enever, R. and Doran, S. 2007. Programme 21. Bristol Channel Ray Survival. Fisheries Science Partnership 2007/2008. Cefas, Lowestoft, UK.

Demirhan, S. A., K. Seyhan and N. Basusta (2007). "Dietary overlap in spiny dogfish (Squalus acanthias) and thornback ray (Raja clavata) in the southeastern Black Sea." Ekoloji 16(62): 1-8.

Dulvy, N. K., J. D. Metcalfe, J. Glanville, M. G. Pawson and J. D. Reynolds (2000). "Fishery stability, local extinctions, and shifts in community structure in skates." Conservation Biology 14(1): 283-293.

Dulvy, N. K. and J. D. Reynolds (2002). "Predicting extinction vulnerability in skates." Conservation Biology 16(2): 440-450.

Ebert, D. A. and J. J. Bizzarro (2007). "Standardized diet compositions and trophic levels of skates (Chondrichthyes : Rajiformes : Rajoidei)." Environmental Biology of Fishes 80(2-3): 221-237.

Ellis, J. R., N. K. Dulvy, S. Jennings, M. Parker-Humphreys and S. I. Rogers (2005)a. "Assessing the status of demersal elasmobranchs in UK waters: a review." Journal of the Marine Biological Association of the UK 85(05): 1025-1047.

Ellis, J. R. and S. E. Shackley (1995). "Observations on egg-laying in the thornback ray." Journal of Fish Biology 46(5): 903-904.

Farias, I., I. Figueiredo, T. Moura, L. S. Gordo, A. Neves and B. Serra-Pereira (2006). "Diet comparison of four ray species (Raja clavata, Raja brachyura, Raja montagui and Leucoraja naevus) caught along the Portuguese continental shelf." Aquatic Living Resources 19(2): 105-114.

Fernandes, P. G. and R. M. Cook (2013). "Reversal of Fish Stock Decline in the Northeast Atlantic." Current Biology 23(15): 1432-1437.

Garofalo, G., M. Gristina, F. Fiorentino, F. C. Fulgosi, G. Norrito and G. Sinacori (2003). "Distributional pattern of rays (Pisces, Rajidae) in the Strait of Sicily in relation to fishing pressure." Hydrobiologia 503(1-3): 245-250.

Heessen, H. J. L. (Ed.) 2003. Development of elasmobranch assessments DELASS. Final report of DG Fish Study Contract 99/055, 605 pp.

Holden, M. J., D. W. Rout and C. N. Humphreys (1971). "The Rate of Egg Laying by Three Species of Ray." Journal Du Conseil 33(3): 335-339.

Holden, M. J. and R. N. Tucker (1974). "The food of Raja clavata Linnaeus 1758, Raja montagui Fowler 1910, Raja naevus Müller and Henle 1841 and Raja brachyura Lafont 1873 in British waters." ICES Journal of Marine Science 35(2): 189-193.

Holden, M. J. (1975). "The fecundity of Raja clavata in British waters." Journal Du Conseil 36(2): 110-118.

Holden, M. J. and R. N. Tucker (1974). "The food of Raja clavata Linnaeus 1758, Raja montagui Fowler 1910, Raja naevus Müller and Henle 1841 and Raja brachyura Lafont 1873 in British waters." ICES Journal of Marine Science 35(2): 189-193.

Hunter, E., F. Berry, A. A. Buckley, C. Stewart and J. D. Metcalfe (2006). "Seasonal migration of thornback rays and implications for closure management." Journal of Applied Ecology 43(4): 710-720.

ICES. 2017. Report of the Working Group on Elasmobranchs (2017), 31 May-7 June 2017, Lisbon, Portugal. ICES CM 2017/ACOM:16. 1018 pp.

ICES. 2017b. Rays and skates, mainly thornback ray (*Raja clavata*), in subareas 10 and 12 (Azores grounds and north of Azores), ICES Advice on fishing opportunities, catch, and effort Azores and Oceanic Northeast Atlantic Ecoregions (raj.27.1012), 6 October 2017. DOI: 10.17895/ices.pub.3191

JORF, 2017. Texte n° 6, Journal Officiel de la République Française, n°0073 of 26 march 2017. https://www.legifrance.gouv.fr/eli/arrete/2017/3/21/DEVM1707953A/jo/texte.

Kadri, H., S. Marouani, M. N. Bradai and A. Bouain (2014). "Diet and feeding strategy of thornback ray, Raja clavata (Chondrichthyes: Rajidae) from the Gulf of Gabes (Tunisia-Central Mediterranean Sea)." Journal of the Marine Biological Association of the United Kingdom **94**(7): 1509-1516.

Letaconnoux, R. (1948). "Effets de la guerre sur la constitution des stocks de poissons." Rapports et Procès-Verbaux des Réunions du Conseil Permanent International pour l'Exploration de la Mer **122**(3): 55-62.

Marandel, F., P. Lorance and V. M. Trenkel (2016). "A Bayesian state-space model to estimate population biomass with catch and limited survey data: application to the thornback ray (Raja clavata) in the Bay of Biscay." Aquatic Living Resources 29(2).

Marandel, F., P. Lorance, M. Andrello, G. Charrier, S. Le Cam, S. Lehuta, and V. M. Trenkel. In press. Insights from genetic and demographic connectivity for the management of rays and skates (Canadian Journal of Fisheries and Aquatic Sciences).

Marongiu, M. F., C. Porcu, A. Bellodi, R. Cannas, A. Cau, D. Cuccu, A. Mulas and M. C. Follesa (2017). "Temporal dynamics of demersal chondrichthyan species in the central western Mediterranean Sea: The case study in Sardinia Island." Fisheries Research 193: 81-94.

Massuti, E. and J. Moranta (2003). "Demersal assemblages and depth distribution of elasmobranchs from the continental shelf and slope off the Balearic Islands (western Mediterranean)." ICES Journal of Marine Science 60(4): 753-766.

McCully, S. R., F. Scott and J. R. Ellis (2012). "Lengths at maturity and conversion factors for skates (Rajidae) around the British Isles, with an analysis of data in the literature." ICES Journal of Marine Science 69(10): 1812-1822.

Morfin, M., S. Mehault, H. P. Benoit and D. Kopp (2017). "Narrowing down the number of species requiring detailed study as candidates for the EU Common Fisheries Policy discard ban." Marine Policy 77: 23-29.

Knotek, R. J., D. B. Rudders, J. W. Mandelman, H. P. Benoit and J. A. Sulikowski (2018). "The survival of rajids discarded in the New England scallop dredge fisheries." Fisheries Research 198: 50-62.

McHugh, M., D. W. Sims, J. C. Partridge and M. J. Genner (2011). "A century later: Long-term change of an inshore temperate marine fish assemblage." Journal of Sea Research 65(2): 187-194.

Morato, T., E. Sola, M. P. Grós and G. Menezes (2003). "Diets of thornback ray (*Raja clavata*) and tope shark (*Galeorhinus galeus*) in the bottom longline fishery of the Azores, Northeastern Atlantic." Fish Bull. **101**: 590-602.

Pasolini, P., C. Ragazzini, Z. Zaccaro, A. Cariani, G. Ferrara, E. G. Gonzalez, M. Landi, I. Milano, M. Stagioni, I. Guarniero and F. Tinti (2011). "Quaternary geographical sibling speciation and population structuring in the Eastern Atlantic skates (suborder Rajoidea) Raja clavata and R. straeleni." Marine Biology 158(10): 2173-2186.

Ryland, J. S. and T. O. Ajayi (1984). "GROWTH AND POPULATION-DYNAMICS OF 3 RAJA SPECIES (BATOIDEI) IN CARMARTHEN BAY, BRITISH-ISLES." Journal Du Conseil 41(2): 111-120.

Saygu, I. and M. C. Deval (2014). "The Post-Release Survival of Two Skate Species Discarded by Bottom Trawl Fisheries in Antalya Bay, Eastern Mediterranean." Turkish Journal of Fisheries and Aquatic Sciences 14(4): 947-953.

Serrano, A., F. Velasco, I. Olaso and F. Sanchez (2003). "Macrobenthic crustaceans in the diet of demersal fish in the Bay of Biscay in relation to abundance in the environment." Sarsia 88(1): 36-48.

Serra-Pereira, B., I. Figueiredo, I. Farias, T. Moura and L. S. Gordo (2008). "Description of dermal denticles from the caudal region of Raja clavata and their use for the estimation of age and growth." ICES Journal of Marine Science 65(9): 1701-1709.

Serra-Pereira, B., I. Figueiredo and L. S. Gordo (2011). "Maturation of the Gonads and Reproductive Tracts of the Thornback Ray Raja clavata, with Comments on the Development of a Standardized Reproductive Terminology for Oviparous Elasmobranchs." Marine and Coastal Fisheries 3(1): 160-175.

Valls, M., A. Quetglas, F. Ordines and J. Moranta (2011). "Feeding ecology of demersal elasmobranchs from the shelf and slope off the Balearic Sea (western Mediterranean)." Scientia Marina 75(4): 633-639.

Walker, P. A. and H. J. L. Heessen (1996). "Long-term changes in ray populations in the North Sea." ICES Journal of Marine Science 53(6): 1085-1093.

Walker, P. A. and J. R. G. Hislop (1998). "Sensitive skates or resilient rays? Spatial and temporal shifts in ray species composition in the central and north-western North Sea between 1930 and the present day." ICES Journal of Marine Science 55(3): 392-402.