



HAL
open science

Scophthalmus maximus, Turbot

Bruno Chanet

► **To cite this version:**

| Bruno Chanet. Scophthalmus maximus, Turbot. IUCN. 2021. hal-04050831

HAL Id: hal-04050831

<https://hal.science/hal-04050831v1>

Submitted on 29 Mar 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

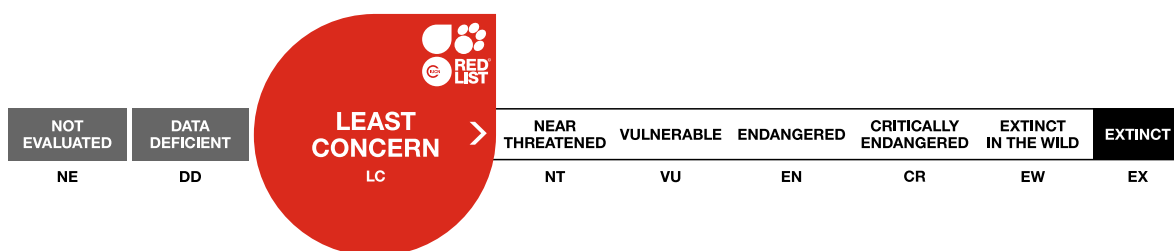
L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Copyright



Scophthalmus maximus, Turbot

Assessment by: Cardinale, M., Chanet, B., Martínez Portela, P., Munroe, T.A., Nimmegeers, S., Shlyakhov, V., Turan, C. & Vansteenbrugge, L.



[View on www.iucnredlist.org](http://www.iucnredlist.org)

Citation: Cardinale, M., Chanet, B., Martínez Portela, P., Munroe, T.A., Nimmegeers, S., Shlyakhov, V., Turan, C. & Vansteenbrugge, L. 2021. *Scophthalmus maximus*. *The IUCN Red List of Threatened Species* 2021: e.T198731A144939322. <https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T198731A144939322.en>

Copyright: © 2021 International Union for Conservation of Nature and Natural Resources

Reproduction of this publication for educational or other non-commercial purposes is authorized without prior written permission from the copyright holder provided the source is fully acknowledged.

Reproduction of this publication for resale, reposting or other commercial purposes is prohibited without prior written permission from the copyright holder. For further details see [Terms of Use](#).

The IUCN Red List of Threatened Species™ is produced and managed by the [IUCN Global Species Programme](#), the [IUCN Species Survival Commission \(SSC\)](#) and [The IUCN Red List Partnership](#). The IUCN Red List Partners are: [ABQ BioPark](#); [Arizona State University](#); [BirdLife International](#); [Botanic Gardens Conservation International](#); [Conservation International](#); [Missouri Botanical Garden](#); [NatureServe](#); [Re:wild](#); [Royal Botanic Gardens, Kew](#); [Sapienza University of Rome](#); [Texas A&M University](#); and [Zoological Society of London](#).

If you see any errors or have any questions or suggestions on what is shown in this document, please provide us with [feedback](#) so that we can correct or extend the information provided.

Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Actinopterygii	Pleuronectiformes	Scophthalmidae

Scientific Name: *Scophthalmus maximus* (Linnaeus, 1758)

Synonym(s):

- *Pleuronectes cyclops* Donovan, 1806
- *Pleuronectes maximus* Linnaeus, 1758
- *Pleuronectes turbot* Lacepède, 1802
- *Psetta maxima* (Linnaeus, 1758)
- *Rhombus aculeatus* Gottsche, 1835
- *Rhombus magnus* Minding, 1832
- *Rhombus maximus* (Linnaeus, 1758)
- *Rhombus stellosus* Bennett, 1835
- *Scophthalmus ponticus* Ninni, 1932

Regional Assessments:

- Europe
- Mediterranean

Common Name(s):

- English: Turbot, Britt
- French: Turbot
- Dutch; Flemish: Tarbot
- Turkish: Civili Kalkan

Taxonomic Notes:

The taxonomic history of this species is complicated in the Black Sea region (Parin *et al.* 2014). *Scophthalmus maeoticus* has been considered a junior synonym of *S. maximus* with uncertainty by some workers (Chanet 2003, Suzuki *et al.* 2004, Nielsen *et al.* 2004, Bailly and Chanet 2010). *Scophthalmus maeoticus* has also been considered as a subspecies of *S. maximus* by some (Parin *et al.* 2014), but both cytogenetic and population genetic data suggest that these two nominal species are part of the same species (Bouza *et al.* 1995, do Prado *et al.* 2018).

Currently, the subpopulation in the Black Sea is very likely isolated from other residual Mediterranean subpopulations due to the high temperature of the Mediterranean waters. A notable genetic differentiation has been reported in the subpopulation inhabiting the Black Sea, but this differentiation is similar to that of other residual subpopulations in the Mediterranean Sea (do Prado *et al.* 2018). This has prompted some authors (Turan *et al.* 2019) to claim that *S. maeoticus* and *S. maximus* are different species. A study by Firidin *et al.* (2020) that used mitochondrial DNA concluded that only *S. maximus* occurs in the Black Sea. Based on evidence provided in Firidin *et al.* (2020), it is concluded that *S. maeoticus* is a junior subjective synonym of *S. maximus* even if sampling conditions differed from those reported in Turan *et al.* (2019) (B. Chanet and T. Munroe pers. comm. 2020).

This species is still frequently referred to in the literature as *Psetta maxima*, but the proper generic

placement and nomenclature is *Scophthalmus maximus* (Bouza *et al.* 1995, Bailly and Chanet 2010). Different scientific names are used for this species in the coastal countries of the Black Sea. For example, in Russia, the name *S. maeoticus* is used, while in the Ukraine, both *S. maximus* and *Psetta maeoticus* are used. The region-level stock assessment conducted by the General Fisheries Commission for the Mediterranean (GFCM) primarily refers to this nominal species as *S. maximus* (V. Shlyakhov pers. comm. 2020).

Assessment Information

Red List Category & Criteria: Least Concern [ver 3.1](#)

Year Published: 2021

Date Assessed: December 7, 2020

Justification:

This widely distributed, demersal species has an estimated generation length of 9 years. It is valued in commercial demersal fisheries through much of its range. Biomass in the North Sea stock, which represents the center of its global abundance, has been increasing over the past 14 years, or since 2005, and compared to three generations ago (around 1993), biomass is now higher. The Skagerrak/Kattegat stock, which is partly connected to the North Sea stock, is data-limited, but exploitable biomass has remained above the biomass sustainability target. Stocks further south are also depleted due to overfishing, including near extirpation off the coast of Spain. The status of the Baltic Sea and Iberian Peninsula stocks are poorly understood due to limited data availability. It is naturally scarce in the Mediterranean Sea. Conservation measures are in place in European waters to regulate fishing and monitor the status of stocks.

It is formally managed as a single stock across the Black Sea, but there are biological differences between Turbot in the northern and southern parts that support the need for a multi-area stock assessment model tailored by a spatial management. Spawning stock biomass (SSB) peaked in 1978, and then steeply declined to the mid-1980s due to overexploitation. Over the past three generations (since about 1993), SSB has remained at a low level compared to historical biomass, but has been relatively stable and even increasing slightly since 2013. According to the region-wide stock assessment, the population is overexploited and fishing mortality is above F_{MSY} . Several improvements in fishing regulations have occurred and a region-wide management plan and research programme are in development. However, deficiencies remain in preventing and tracking illegal fishing and enforcing fishing regulation/management.

Turbot is globally listed as Least Concern with the recommendation to conduct research on the declines in abundance and to improve fisheries management in parts of its range where it has declined. Suggested improvements needed to sustain the positive biomass trend in the Black Sea should be implemented, including improving catch and effort records and maintaining fleet capacity at the recommended level.

Geographic Range

Range Description:

This species is distributed in the eastern Atlantic from southern Iceland and Norway south to Cape Bojador in Western Sahara, including Great Britain and western Ireland, and in the Baltic Sea except Bothnian Bay (Munroe and Chanet 2016). In the Mediterranean Sea, it occurs in the western and central basins, including the Adriatic Sea (Arneri *et al.* 2001), Hellenic Seas (Papaconstantinou 1988) and the Gulf of Lion (Carlier *et al.* 2007). It also occurs in the Sea of Marmara, the Black Sea and the Sea of Azov (Nielsen 1986, Artüz 1999, do Prado *et al.* 2018, Balykin *et al.* 2019). The depth range is 0-140 metres (Ivanov and Beverton 1985, van der Hammen *et al.* 2013). In the Black Sea, it mostly occurs between 14-90 m (STECF 2011, Shlyahov *et al.* 2017).

Country Occurrence:

Native, Extant (resident): Albania; Belgium; Bulgaria; Croatia; Cyprus; Denmark; Estonia; Faroe Islands; Finland; France; Georgia; Germany; Gibraltar; Greece; Guernsey; Iceland; Ireland; Italy; Jersey; Latvia; Lithuania; Malta; Monaco; Montenegro; Netherlands; Norway; Poland; Portugal; Romania; Russian Federation; Slovenia; Spain; Sweden; Turkey; Ukraine; United Kingdom

FAO Marine Fishing Areas:

Native: Atlantic - northeast

Native: Atlantic - eastern central

Native: Mediterranean and Black Sea

Distribution Map

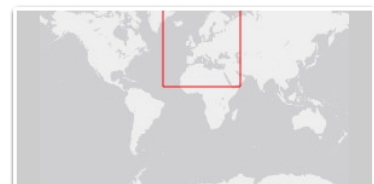
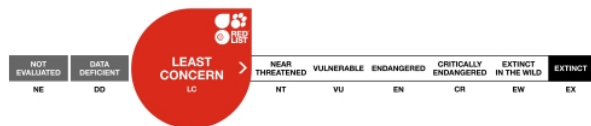


Legend

EXTANT (RESIDENT)

Compiled by:

IUCN Marine Biodiversity Unit/GMSA 2020



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.



Population

A genetics study conducted on fish collected throughout its range (including the Black Sea) reported separation between those from the Black Sea and Adriatic as well as between individuals from between the Atlantic Ocean and Baltic Sea. Some additional, but more subtle, differences were also detected in fishes from within the Baltic, as well as those from the Atlantic with fish from Norway separating from those taken off Spain (do Prado *et al.* 2018). Also, the Baltic subpopulation is clearly differentiated from the subpopulation inhabiting the North East Atlantic (Vandamme *et al.* 2020). Some subpopulations also differ in their adaptation to local temperature and oxygen availability (Andersen *et al.* 2020). This species is similar to that of Brill, *Scophthalmus rhombus*, and hybridization has been documented between the two species (Maroso *et al.* 2018).

Atlantic: The low genetic differentiation between the Atlantic subpopulations indicates relatively high gene flow (do Prado *et al.* 2018). At least four stocks are identified in the Atlantic: the North Sea, the Skagerrak/Kattegat, the Baltic Sea, and that of the Iberian Peninsula/Bay of Biscay. The North Sea stock has the highest abundance and represents the center of global abundance for this species (M. Cardinale and P. Martinez pers. comm. 2020).

This species has been exploited in the North Sea (Subarea 4) since the 1950s, and from 1975 onwards, the Netherlands has taken most of the landings (~50-60%). Over the past decade, fishing effort by the Dutch beam trawl fleet has decreased significantly, landings per unit effort were stable, and the abundance of this species likely increased. Overall effort by beam trawl fleets in the North Sea declined significantly since 1995. Total and spawning stock biomass (SSB) has been estimated for the years 1981-2020. Total biomass declined by 55% from 1984 to 1998, was stable at a low level to 2006, and has been increasing since then. SSB declined by 79% from 1981 to 1996 as fishing mortality increased, was stable at a low level until 2005, and has been increasing since then. Over the past three generations (since 1993), both total and spawning biomass were at higher levels in 2020 as compared to those of 1993. Fishing mortality has decreased since the mid-1990s and has been just below the sustainability target since 2012. Spawning stock biomass has been above the sustainability target since 2013. The proportion of immature individuals in the catch has been high, but the occurrence of larger individuals in the catches has increased in recent years. The discard rate is poorly understood for the years prior to 2002, and this introduces some uncertainty to the stock assessment. Historical data on recruitment are also unreliable, but available estimates indicate it has varied over time with no clear trend apparent. Recruitment has been stable or above average in recent years. Scientific surveys used for the stock assessment have a low internal consistency especially for fishes of older ages leading to a low ability to track cohorts over time, which negatively impacts the reliability of abundance estimates. Dutch scientists and fishers have initiated an industry survey that could give a more appropriate index as input for the assessment in the future (when five years of data are available) (ICES WGNSSK 2019; 2020). Catches of this species in fisheries operating in Icelandic waters have been increasing in the recent decade. Abundance may be increasing due to environmental changes in the region, including warming of the waters in this region, that are more favourable for this species. Genetics studies indicate the Icelandic and Norwegian subpopulations are relatively well-connected (Imsland *et al.* 2014).

The Skagerrak and Kattegat stock (Subarea 3a) is data-limited, and this results in higher levels of uncertainty in this stock assessment. It was recently determined that part of this stock actually belongs to the North Sea stock. Based on the available data, it is suspected that the stock is not overexploited

and exploitable biomass has remained above the biomass sustainability target. Total annual landings declined by 67% from the early 1990s to the early 2010s and then have increased in recent years. Fishing mortality has declined since the early 2000s. Fishery independent scientific surveys conducted in this area poorly cover this species, and the available survey indices show no clear trends (ICES WGNSSK 2020). A reconstructed time series of biomass by Cardinale *et al.* (2009) for Turbot in the Kattegat-Skagerrak estimated a decline of 86% from 1925 to 2007 and near extirpation of the northern component of the stock.

In the Baltic Sea (ICES Subdivisions 22-32), this species is most common in the southern and western parts up to the Åland Sea. Denmark and Germany are the main fishing countries in the western Baltic, while Poland, Russia and Sweden are the main fishing countries in the eastern Baltic. Landings increased from 1965 to a peak in 1996 and then declined thereafter by about 79% to 2014. Fishing effort slightly fluctuated or decreased since the 1990s. Recommended total catch limits by ICES have been historically exceeded. The lack of data on discard rate as well as relatively poor coverage of this species by scientific surveys introduces uncertainty to the understanding of stock status, and as a result, this stock is considered to be data-limited (ICES 2019).

No effort information is available for recent years for fish harvested from off the Iberian Peninsula or from the Bay of Biscay. In Portugal, catch per unit effort increased from 1992 to a peak in 2005 and then subsequently declined to 2011 (Teixeira *et al.* 2009, C. Teixeira pers. comm. 2013). Landings of Turbot from off northwest Spain have declined dramatically and are currently only about 10 tons per year. This represents a considerably much smaller portion of the global landings compared to those taken in the North Sea where thousands of tons are landed annually. Overfishing has caused the southern stocks of this species to be depleted, including near extirpation of this species from off the coast of Spain (P. Martinez pers. comm. 2020). No stock assessment is conducted for this area (M. Cardinale pers. comm. 2020).

Mediterranean Sea: This species is naturally scarce in the Mediterranean compared to the North Atlantic and it exists there primarily in relict subpopulations in the Gulf of Lion and in the northern Adriatic Sea (do Prado *et al.* 2018). No stock assessment is conducted for Turbot from this area (M. Cardinale pers. comm. 2020).

Black Sea: Results from genetics analyses by Firidin *et al.* (2020) appear to support the existence of two biological units in the Black Sea with one component in the north and another in the south, but with some exchange occurring between them. Most scientists from Russia, Bulgaria, Romania and the Ukraine consider the subpopulation of this species in the southern part of the Black Sea (at least in waters off Turkey) to differ greatly in maturation, growth rate, and maximum age compared to those parameters of individuals from the northern Black Sea subpopulation. Based on two molecular markers, *S. maximus* can be divided into genetically separated subpopulations within the Black Sea and the Marmara Sea. Microsatellite and mtDNA markers indicated there are restricted gene flows between these populations, which indicate ongoing processes of genetic differentiation (Turan *et al.* 2019). Based on the available area of shelf (to 100 m depth), about 50% of the natural abundance lies within Ukrainian and Russian waters, 15% in Turkish waters, and 35% in waters of the remaining countries (V. Shlyakhov pers. comm. 2020).

Formally, this species is managed as a single stock across the Black Sea (GFCM 2019), although localized

subpopulations do exist (Giragosov and Khanaychenko 2012) and there remains the need to account for those units in spatially resolved stock assessment models (M. Cardinale pers. comm. 2020). It is exploited by all six countries along the Black Sea coast, including Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine. Annual catch in Georgia is minimal compared to that of the other countries, while the Russian annual catch currently constitutes about 50% of the total catch (GFCM 2019). Fishing pressure is higher in the southern Black Sea in Turkish waters compared to that occurring in the northern part (Hulak *et al.* 2019).

Targeted fishing for this species began in the Black Sea prior to 1950 and high exploitation caused steep declines in abundance to occur from the late 1970s to the mid-1980s. Spawning stock biomass (SSB) peaked in 1978 at around 18,000 t, steeply declined in the early 1980s, and reached a historic low of about 1,400 t in 1991, which represents a 92% decline over a 13-year period. From the mid-1990s to 2018, or over the past three generations (25 years), annual SSB has remained at a low level fluctuating somewhat between 2,000-3,500 t, well-below historical biomass. Overall, fishing mortality has been mostly declining since 2001, but fishing mortality continues to exceed the target sustainability limit (F_{MSY}). The extent of illegal fishing is not known, but is suspected to continue at substantial levels, and deficiencies also occur in fishery management/regulation enforcement (GFCM 2019).

Turkey: According to genetics studies conducted on Turbot from Turkish waters, the subpopulation in the eastern Black Sea should be considered a separate stock from the western Black Sea and the Sea of Marmara subpopulations, which appear to have some level of connectivity between these latter two subpopulations (Karan and Turan 2020). This species is common in the Sea of Marmara (Artüz 1999). From 1964-1992, the majority (72%) of the total Black Sea catch of this species was taken in Turkish waters (Prodanov *et al.* 1997, Karan *et al.* 2016). Turbot are overfished in Turkish waters. The number of vessels targeting turbot (fishing effort) has been increasing in Turkish waters since about 2004 (V. Shlyakhov pers. comm. 2020). Total catch was 2,035 t in 1996 (Güneş and Şahin 2012) and catches averaged 2,800 t from 1985 to 2000 (Zengin and Düzgüneş 2003) before declining by 92% from 2,700 t in 2000 to 221 t in 2016 (Bilgin and Köse 2018). The occurrence of large individuals in the catch has also declined over time due to overfishing (Samsun *et al.* 2007). The high fishing pressure in Turkish waters may have also contributed to low genetic diversity observed subpopulations among Turbot occurring in this area (Karan and Turan 2020).

Ukraine: Increasing salinity due to damming of rivers has contributed to the recent expansion of this species into the Sea of Azov (Balykin *et al.* 2019). Stock assessments have been difficult to conduct for this species in Ukraine due to a lapse in scientific survey work, lack of reliable fishing effort data, and the large-scale IUU fishing (Shlyakhov 2014). This species is overexploited in the northwestern Black Sea off Ukraine. Biomass has been estimated for the years 2002-2018. From 2002 to about 2007/2008, biomass increased gradually then declined to a low in 2014 of 1,010 tons, and has increased somewhat since then. Since 2016, some signs of recovery have occurred, including high recruitment, increasing catch per unit effort and increasing proportions of larger individuals in the catch. The exploitation rate remains high, but has been decreasing in recent years. Improved restrictions on bottom fishing have contributed to this reduction in effort (Hulak *et al.* 2019).

Russia: According to a genetics study, connectivity between the Black Sea and Sea of Azov subpopulations is low (Bessonova and Nebesikhina 2019). In the Crimean Peninsula region, biomass increased slightly between the period of 1992-1995 to 1996-2007 and was relatively stable through the

2000s, but the stock remained at levels approximately 50% lower than the biomass estimates of the 1970s. Catch per unit effort (CPUE) data are available for the years 2000-2018. CPUE and biomass declined by 60% from 2000 to 2001, but over the past 19 years since 2001, have been relatively stable. Fisheries catches increased from 2000 to 2009, but declined from 2010 to 2013, likely due to overexploitation by illegal, unreported and unregulated (IUU) fishing. Improvements in deterring IUU fishing caused a reduction in effort in 2014-2015, but in 2016-2018, fishing effort in general doubled. The most recent stock assessment concluded that overfishing did not occur during the period from 2000 to 2018. Biomass was projected to decline from 2019 to 2023, but is expected to remain above the sustainable biomass target (Shliakhov *et al.* 2019).

Romania and Bulgaria: According to fishery independent scientific surveys, this species has been increasing in abundance in Romanian waters since about 2015 (Hulak *et al.* 2019). The relative biomass of this species has been declining since 2008 in Bulgarian waters despite the introduction of fishing regulations (Hubenova *et al.* 2015). From 2003-2013, biomass in both countries declined by about 70% from 2008 to 2013 (STECF 2014).

Current Population Trend: Decreasing

Habitat and Ecology (see Appendix for additional information)

This demersal species occurs on sandy, rocky or mixed bottoms and commonly occurs in brackish waters. Adults tolerate cooler water temperatures than do juveniles (ICES 2013). Young juveniles utilize shallow, sandy, inshore habitats for nursery grounds (Niță *et al.* 2011, Støttrup *et al.* 2019). Adults migrate seasonally to spawn in relatively shallow waters at depths of 10 to 15 m, have high spawning site fidelity, and generally do not undertake extensive movements, with 95% of individuals moving less than 30 km from the spawning site. Larval dispersal is relatively low (ICES 2013). In the Black Sea, spawning occurs between 20-60 m depth and adults move to deeper waters outside the spawning season (Güneş and Şahin 2012, Shlyahov *et al.* 2017). Juveniles and adults migrate towards the coast in spring and move to deeper waters (>30 m) in winter (Florin 2005). The maximum total length is 106 cm (Shlyakhov 2014), but individuals typically occur to 40-60 cm (Munroe and Chanet 2016). The length-weight relationship is reported in Silva *et al.* (2013).

In the North Sea, this species reaches full maturity at 4 years of age and natural mortality is 0.2 (WGNSSK 2019). In the Black Sea, it reaches sexual maturity between 3-4 years of age and estimated natural mortality is 0.19 (GFCM 2019). In the Baltic Sea, females mature at 20 cm and 4 years. Off western Sweden, females mature at about 30 cm. In the Mediterranean, female length at maturity is 50 cm (Tsikliras and Stergiou 2014). In Turkish waters, females and males reach maturity at 2 years (Eryilmaz and Dalyan 2015). In Bulgarian waters, age at first maturity is 3 years (Prodanov and Mikhailov 2003). In Romanian waters, age at first maturity occurs at 2-3 years (STECF 2014). Off the Crimean Peninsula and off Ukraine, females reach maturity at about 3 to 4 years (Shlyakhov 2014, Shlyahov *et al.* 2017, Shliakhov *et al.* 2019). Maximum reported age data are as follows: 18 years in the Adriatic Sea (Arneri *et al.* 2001), 13 years in the North Sea, 19 years off Iceland (Imsland *et al.* 2014), 15 years off the Crimean Peninsula (Shlyakhov 2014, Shlyahov *et al.* 2017, Shliakhov *et al.* 2019), and 23 years off Romania (Cărăușu 1952 as cited in Niță *et al.* 2011). When applying the following equation recommended by the IUCN Red List methods: $1/\text{adult mortality} + \text{age of first reproduction}$, the generation length is estimated at approximately 9 years.

Systems: Marine

Use and Trade

This highly esteemed food fish is taken in industrial, artisanal and recreational fisheries. It is also important in the aquaculture industry (Munroe and Chanet 2016). It is frequently taken as bycatch in several fisheries (beam trawls, seines, trammel nets, longlines, gillnets and otter trawls), especially those targeting Sole and Plaice (Frimodt 1995). In the North Sea, this is a valued bycatch species taken in beam trawls, gillnets, otter trawls and static gear. In the Skagerrak and Kattegat, this species is only taken as bycatch and is a popular recreational target (WGNSSK 2019).

This is one of the most valuable commercial species, and often the most highly valued, in the Black Sea (Yıldız and Karakulak 2017). It is taken in gillnet, otter trawl and bottom trawl fisheries and retained as bycatch in purse seines and long lines (Prodanov *et al.* 1997, Zengin and Düzgüneş 2003, GFCM 2019). An aquaculture industry is in development in Turkey and Russia to supply commercial markets as well as for wild stock enhancement (Boyko and Ruzhinskaya 2019, Karan and Turan 2020).

The aquaculture industry for this species began in European countries, but China is now the largest producer of farmed Turbot in the world (Xu *et al.* 2020).

Threats (see Appendix for additional information)

Overexploitation is a major threat to this species in parts of its range. Take of large females, or sex-ratio skewing (Florin *et al.* 2013), and exploitation of individuals on spawning sites contributes to the documented, large population declines observed in Turbot. This species has relatively low larval dispersal, strong spawning site fidelity, and limited adult migration; intrinsic characteristics that render this species to have a higher susceptibility to overfishing. The western Black Sea is heavily industrialised, including iron-steel factories, and waste discharge into the nearshore waters may impact this species (Karan and Turan 2020).

Conservation Actions (see Appendix for additional information)

Atlantic and Mediterranean: The International Council for the Exploration of the Sea (ICES) has provided advice for conserving the status of the North Sea stock since 2012. European fisheries that take this species are regulated with total allowable catch limits, closed fishing area, some minimum size limits and gear restrictions for the demersal fishing fleets. Improvements are needed in the following areas for increasing the North Sea stock: scientific survey coverage of this species, collection of landings per unit effort data for countries that utilize this stock besides the Netherlands, and increased ageing of fishes discarded. The Skagerrak and Kattegat stock assessment could also be improved with the expansion of scientific surveys, collection of age and length data for fishes harvested, filling of gaps in Swedish landings data, and further studies on stock structure (ICES WGNSSK 2020). Fishing for this species is prohibited during the spawning season in the southern Baltic Sea and a Swedish marine reserve in the Baltic Sea proper also provides some refuge from fishing activity (Florin *et al.* 2013). Some of the aquaculture production in Europe has also been used to supplement wild populations in several localities in the Atlantic (do Prado *et al.* 2018). Landings of this species in the Iberian Peninsula and Bay of Biscay are very scarce and efforts should be made to increase the abundance of this species in this area.

This species was regionally assessed as Near Threatened in the Mediterranean in 2008 and regionally assessed as Vulnerable in Europe in 2013.

Black Sea: Fishing regulations for this species in the Black Sea include minimum size limits, seasonal closures, gear restrictions and total allowable catch limits. Additional measures have been implemented since 2016 to deter IUU fishing, enforce quotas, promote stock rebuilding and support sustainable fishing. IUU fishing has been reduced in some parts, but it remains an active and poorly tracked problem. Data available to the stock assessment process has improved in recent years after deficiencies were identified in past stock assessments. A multiannual management plan is now in development. Recent recommendations include improving fishing regulation enforcement, vessel permitting requirements, and recording of catch and effort as well as maintaining fishing fleet capacity at the recommended level. Efforts are also underway to propose a research programme that includes establishment of a region-wide scientific survey (GFCM 2019).

Bottom trawling is prohibited in the eastern part of the Black Sea but remains an important fishing method in the western part, particularly in Turkish waters (Prodanov *et al.* 1997, Yıldız and Karakulak 2017). Bottom trawling and dredging have been prohibited in Bulgarian waters since 1984, a size limit is in place, gillnets are under a mesh size restriction, and a closed fishing period during the spawning season and catch quotas are also in place (Hubenova *et al.* 2015). Similar measures are in place in Ukrainian waters (Shlyakhov 2014). There is a closed fishing season during the spawning season in waters off Turkey, Romania and Bulgaria (STECF 2014). Improvements in fisheries management, including measures to reduce fishing pressure and bottom trawl gear regulation, are needed in Turkish waters (Yıldız and Karakulak 2017, Karan and Turan 2020).

No single binding fisheries agreement across all Black Sea countries exists. The General Fisheries Commission for the Mediterranean (GFCM) regulates this fishery in Turkey, Bulgaria and Romania as 'Contracting Parties', Georgia and Ukraine are 'Cooperating Non-Contracting Parties' and Russia regulates its fishery separately as a 'non-Contracting Party'. Russian conservation measures include catch limits and gear restrictions. Improvements needed in fisheries management for this resource in the Black Sea include increasing survey work, calibration of ageing methods, delineation of stock units, and standardization of analyses of fishing effort data (Shliakhov *et al.* 2019).

Credits

Assessor(s):	Cardinale, M., Chanet, B., Martínez Portela, P., Munroe, T.A., Nimmegeers, S., Shlyakhov, V., Turan, C. & Vansteenbrugge, L.
Reviewer(s):	Linardich, C.
Facilitator(s) and Compiler(s):	Linardich, C.

Bibliography

- Andersen, Ø., Rubiolo, J.A., De Rosa, M.C. and Martinez, P. 2020. The hemoglobin Gly16β1Asp polymorphism in turbot (*Scophthalmus maximus*) is differentially distributed across European populations. *Fish Physiology and Biochemistry* 46(6): 2367-2376.
- Arneri, E., Colella, S. and Giannetti, G. 2001. Age determination and growth of turbot and brill in the Adriatic Sea: reversal of the seasonal pattern of otolith zone formation. *Journal of Applied Ichthyology* 17: 256-261.
- Artüz, M. 1999. Inventory of existing species and their habitats in the Bosphorus area. *Oceanata* 112(1): 552-564.
- Bailly, N. and Chanet, B. 2010. *Scophthalmus* Rafinesque, 1810: The valid generic name for the turbot, *S. maximus* (Linnaeus, 1758) [Pleuronectiformes: Scophthalmidae]. *Cybium* 34(3): 257-261.
- Balykin, P.A., Kutsyn, D.N. and Orlov, A.A. 2019. Changes in salinity and species composition of ichthyofauna in the Sea of Azov. *Oceanology* 59(3): 358-366.
- Bessonova, N.A., Nebesikhina, N.A. 2019. Assessment of genetic diversity of the Black Sea turbot *Scophthalmus maeoticus* population. In: Belousov, V.N. (ed.), *Proceedings of the Azov-Black Sea Branch of the Russian Federal Research Institute of Fisheries and Oceanography "VNIRO"*, pp. 40-46. AzNIIRKH, Rostov-on-Don.
- Bilgin, S. and Köse, O. 2018. Length-weight relationships (LWRs) of target fish turbot, *Scophthalmus maximus* (Pleuronectiformes: Scophthalmidae) and non-target fish thornback ray, *Raja clavata* (Rajiformes: Rajidae) caught by turbot gill net fishery in the Black Sea, Turkey. *Cahiers de Biologie Marine* 59: 615-622.
- Bouza, C., Sánchez, L. and Martínez, P. 1994. Karyotypic characterization of turbot (*Scophthalmus maximus*) with conventional, fluorochrome and restriction endonuclease-banding techniques. *Marine Biology* 120(4): 609-613.
- Boyko, N.E., Ruzhinskaya, L.P. 2019. Characterization of the functional state of the Black Sea turbot *Scophthalmus maeoticus maeoticus* at different periods of the reproductive cycle based on the research data from 2009-2017. In: Belousov, V.N. (ed.), *Proceedings of the Azov-Black Sea Branch of the Russian Federal Research Institute of Fisheries and Oceanography "VNIRO"*, pp. 31-39. AzNIIRKH, Rostov-on-Don.
- Cardinale, M., Linder, M., Bartolino, V., Maiorano, L., & Casini, M. 2009. Conservation value of historical data: reconstructing stock dynamics of turbot during the last century in the Kattegat-Skagerrak. *Marine Ecology Progress Series* 386: 197-206.
- Carlier, A., Riera, P., Amouroux, J.-M., Bodiou, J.-Y. and Gremare, A. 2007. Benthic trophic network in the Bay of Banyuls-sur-Mer (northwest Mediterranean, France): An assessment based on stable carbon and nitrogen isotopes analysis. *Estuarine Coastal and Shelf Science* 72: 1-15.
- Chanet, B. 2003. Interrelationships of scophthalmid fishes (Pleuronectiformes: Scophthalmidae). *Cybium* 27(4): 275-286.
- Chanet, B. and Branellec, A.L. 2008. Expliquer la biologie des espèces par leurs relations de parenté. Exemple des Scophthalmidae [Teleostéens : Pleuronectiformes]. *Bulletin de la Société des Sciences naturelles de l'Ouest de la France* 30(2): 81-89.
- Chanet, B., Quero, J., Vayne, J. 2003. Présence de deux Populations de targie naine, *Phrynorhombus norvegicus* (Pleuronectiformes : Scophthalmidae), dans les eaux ouest européennes. *Cybium* 27(3): 227-232.

do Prado, F.D., Vera, M., Hermida, M., Bouza, C., Pardo, B.G., Vilas, R., Blanco, A., Fernández, C., Maroso, F., Maes, G.E. and Turan, C. 2018. Parallel evolution and adaptation to environmental factors in a marine flatfish: Implications for fisheries and aquaculture management of the turbot (*Scophthalmus maximus*). *Evolutionary Applications* 11(8): 1322-1341.

Eryilmaz, L. and Dalyan, C. 2015. Age, growth, and reproductive biology of turbot, *Scophthalmus maximus* (Actinopterygii: Pleuronectiformes: Scophthalmidae) from the southwestern coasts of Black Sea, Turkey. *Acta Ichthyologica et Piscatoria* 45(2): 181-188.

Firidin, S., Ozturk, R.C., Alemdag, M., Eroglu, O., Terzi, Y., Kutlu, I., Duzgunes, Z.D., Cakmak, E. and Aydin, I. 2020. Population genetic structure of turbot (*Scophthalmus maximus* L., 1758) in the Black Sea. *Journal of Fish Biology* 97: 1154-1164.

Florin, A.-B. 2005. Flatfishes in the Baltic Sea 0 a review of biology and fishery with a focus in swedish conditions. *Fiskeriverket Informerar 2005*: 1-56.

Florin, A.B., Bergström, U., Ustups, D., Lundström, K. and Jonsson, P.R. 2013. Effects of a large northern European no-take zone on flatfish populations. *Journal of Fish Biology* 83(4): 939-962.

Frimodt, C. 1995. *Multilingual illustrated guide to the world's commercial coldwater fish*. Osney Mead, Oxford, England.

GFCM. 2019. Black Sea Turbot Stock Assessment. In: General Fisheries Commission for the Mediterranean Working Group on the Black Sea (ed.). European Union.

Giragosov, V. and Khanaychenko, A. 2012. The state-of-art of the Black Sea Turbot spawning population off Crimea (1998-2010). *Turkish Journal of Fisheries and Aquatic Sciences* 12(5): 377-383.

Güneş, E. and Şahin, T. 2012. Distribution and abundance of Turbot (*Psetta maxima*) in the Southeastern Black Sea. *Turkish Journal of Science Technology* 7(1): 19-30.

Heap, S.P. and Thorpe, J.P. 1987. A preliminary study of comparative growth rates in O-group malpigmented and normally pigmented turbot, *Scophthalmus maximus* (L.), and turbot-brill hybrids, *S. maximus* × *S. rhombus* (L.), at two temperatures. *Aquaculture* 60(3-4): 251-264.

Holt, E.W. 1895. Note on some supposed hybrids between the turbot and the brill. *Journal of the Marine Biological Association of the United Kingdom* 3(4): 292-299.

Hubenova, T., Zaikov, A., Ivanova, A., Trezyiski, D. and Kazakova-Gevesova, M. 2015. Size structure of the Turbot (*Psetta maxima maeotica*) landings from the North Bulgarian Black Sea Coast. VII International Conference "Water & Fish": 144-150.

Hulak, B.S., Leonchik, E.Y., Chashchin, A.K. 2019. The current state of the population of turbot *Psetta maxima* (Linnaeus, 1758) in the north-western part of the Black Sea. In: Novitsky, R.O., Gubanova, N.L., Guslista, M.O., Gorchanok, A.V., Kuliush, T. Yu. (ed.), *Modern problems of theoretical and practical ichthyology*, pp. 232. Dnipro, Ukraine.

ICES. 2013. Report of the ICES Advisory Committee 2013. ICES Advice 2012. Copenhagen, Denmark.

ICES. 2019. Stock Annex: Turbot (*Scophthalmus maximus*) in subdivisions 22–32 (Baltic Sea). International Council for the Exploration of the Seas Baltic Fisheries Assessment Working Group.

ICES WGNSSK. 2019. Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak. In: De Oliveira, J.A.A. (ed.), *ICES Scientific Reports 1:7*. International Council for the Exploration of the Seas.

ICES WGNSSK. 2020. Working Group on the Assessment of Demersal Stocks in the North Sea and

- Skagerrak. Girardin, R. and Miethe, T. (eds.), ICES Scientific Reports 2:61. International Council for the Exploration of the Seas.
- Imslund, A.K., Ólafsson, K., Skírnisdóttir, S., Gunnarsson, S., Oddgeirsson, M., Vandamme, S., Helyar, S.J., Skadal, J. and Folkvord, A. 2014. Life history of turbot in Icelandic waters: Intra-and inter-population genetic diversity and otolith tracking of environmental temperatures. *Fisheries Research* 155: 185-193.
- IUCN. 2021. The IUCN Red List of Threatened Species. Version 2021-2. Available at: www.iucnredlist.org. (Accessed: 04 September 2021).
- Ivanov, L. and Beverton, R. 1985. The fisheries resources of the Mediterranean. Part 2: Black Sea. *GFCM, Studies and Reviews No 60*, pp. 135. Food and Agriculture Organization of the United Nations.
- Karan, S. and Turan, C. 2020. Evaluation of molecular and phenotypic markers for phylogeographic analysis of the Black-Sea Turbot *Scophthalmus maeoticus* (Pallas, 1814) (Actinopterygii: Scophthalmidae). *Acta Zoologica Bulgarica* 72(1): 137-147.
- Karan, S., Doğdu, S.A., Uyan, A., Gürlek, M., Ergüden, D. and Turan, C. 2016. Microsatellite loci for Black Sea turbot *Scophthalmus maeoticus*. *Natural and Engineering Sciences* 1(3): 23-26.
- Kerby T.K., Cheung W.W.L., van Oosterhout C. and Engelhard G.H. 2013. Entering uncharted waters: Long-term dynamics of two data limited fish species, turbot and brill, in the North Sea. *Journal of Sea Research* 84: 87-95.
- Maroso, F., Casanova, A., do Prado, F.D., Bouza, C., Pardo, B.G., Blanco, A., Hermida, M., Fernández, C., Vera, M. and Martínez, P. 2018. Species identification of two closely exploited flatfish, turbot (*Scophthalmus maximus*) and brill (*Scophthalmus rhombus*), using a ddRADseq genomic approach. *Aquatic Conservation: Marine and Freshwater Ecosystems* 28(5): 1253-1260.
- Munroe, T.A. and Chanet, B. 2016. Scophthalmidae: Turbots, megrims, brills. In: Carpenter, K.E. and De Angelis, N. (eds), *The Living Marine Resources of the Eastern Central Atlantic*, pp. 800. FAO, Rome.
- Nielsen, E.E., Nielsen, P.H., Meldrup, D. and Hansen, M.M. 2004. Genetic population structure of turbot (*Scophthalmus maximus* L.) supports the presence of multiple hybrid zones for marine fishes in the transition zone between the Baltic Sea and the North Sea. *Mol. Ecol.* 13: 585-595.
- Nielsen, J.G. 1986. Scophthalmidae. In: Whitehead, P.J.P., Bauchot, M.-L., Hureau, J.-C., Nielsen, J., Tortonese, E. (ed.), *Fishes of the North-Eastern Atlantic and the Mediterranean*, pp. 1287-1293. UNESCO, Paris.
- Niță, V., Diaconescu, Ș., Zaharia, T., Maximov, V., Nicolae, C. and Micu, D. 2011. The characterization of the main habitat types populated by the Black Sea Turbot in its different stages of development. *Aquaculture, Aquarium, Conservation & Legislation Bioflux* 4(5): 552-570.
- Papaconstantinou, C. 1988. *Check-list of marine fishes of Greece*.
- Parin, N.V., Evseenko, S.A. and Vasili'eva, E.D. 2014. *Fishes of Russian Seas: Annotated Catalogue*. *Archives of the Zoological Museum of Moscow State University*. KLM Scientific Press, Moscow.
- Prado, F.D.D., Vera, M., Hermida, M., Blanco, A., Bouza, C., Maes, G.E., Volckaert, F.A., Martinez, P. and AquaTrace Consortium. 2018. Tracing the genetic impact of farmed turbot *Scophthalmus maximus* on wild populations. *Aquaculture Environment Interactions* 10: 447-463.
- Prodanov, K. and Mikhailov, K. 2003. Status of demersal fish along the Bulgarian Black Sea coasts. In: Öztürk B., Karakulak S. (ed.), *Workshop on Demersal Resources in the Black Sea and Azov Sea*, pp. 35-48. Istanbul.

Samsun, N., Kalayci, F., Samsun, O. 2007. Seasonal variation in length, weight, and sex distribution of Turbot (*Scophthalmus maeoticus* Pallas, 1811) in the Sinop Region (Black Sea) of Turkey. *Turkish Journal of Zoology* 31: 371-378.

Scientific, Technical and Economic Committee for Fisheries (STECF). 2011. Assessment of Black Sea Stocks. In: Daskalov, G. and Rätz, H. (eds), STECF-EWG-11-06. Publications Office of the European Union, Luxembourg:.

Shliakhov, V.A., Piatinskii, M.M., Shliakhova, O.V. 2019. Fishery and biological characteristics of the Black Sea turbot and the state of its stock in the waters adjacent to the Crimean Peninsula in 2000-2018. In: Belousov, V.N. (ed.), *Proceedings of the Azov-Black Sea Branch of the Russian Federal Research Institute of Fisheries and Oceanography "VNIRO"*, pp. 8-30. AzNIIRKH, Rostov-on-Don.

Shlyakhov, V. 2014. Fisheries and biological information and the stock assessment of turbot *Psetta maxima maeotica* (Pallas) in Ukrainian waters of the Black Sea. *Main results of complex research in the Azov and Black Seas Basin and the World Ocean*, pp. 24-45. YugNIRO, Kerch.

Shlyakhov, V.A., Shlyakhova, O.V., Nadolinskiy, V.P., Perevalov, O.A. 2017. Fishery and biological indices of Russian fisheries for the principal shared stocks of marine biological resources in the Black Sea in 2015-2016 and retrospectively. *Materials of the IX International Scientific and Practical Conference*: 1-15.

STECF. 2014. Black Sea Assessments (STECF-14-14). In: Scientific, Technical and Economic Committee for Fisheries (eds). Publications Office of the European Union, Luxembourg.

Støttrup, J.G., Kokkalis, A., Brown, E.J., Vastenhoud, B., Ferreira, S., Olsen, J., Dinesen, G.E. 2019. Essential Fish Habitats for commercially important marine species in the inner Danish waters. DTU Aqua-rapport, No. 338-2019. Technical University of Denmark.

Suzuki, N., Nishida, M., Yoseda, K., Üstündağ, C., Şahin, T. and Amaoka, K. 2004. Phylogeographic relationships within the Mediterranean turbot inferred by mitochondrial DNA haplotype variation. *Journal of Fish Biology* 65(2): 580-585.

Teixeira, C.M., Pinheiro, A. and Cabral, H.N. 2009. Feeding ecology, growth and sexual cycle of the sand sole, *Solea lascaris*, along the Portuguese coast. *Journal of the Marine Biological Association of the United Kingdom* 89: 621-627.

Tsikliras, A. and Stergiou, K. 2014. Size at maturity of Mediterranean marine fishes. *Reviews in Fish Biology and Fisheries* 24: 219-268.

Turan, C., Ivanova, P., Gürlek, M., Yağlıoğlu, D., Ergüden, D., Karan, S., Doğdu, S.A., Uyan, A., Öztürk, B., Nikolov, V. and Raykov, V. 2019. Phylogenetic relationships of turbot species (Scophthalmidae) inferred from the mitochondrial COIII gene and morphological characters. *NEsciences* 4: 28-41.

Vandamme, S., Raeymaekers, J.A., Maes, G.E., Cottenie, K., Calboli, F.C., Diopere, E. and Volckaert, F.A. 2020. Reconciling seascape genetics and fisheries science in three codistributed flatfishes. *Evolutionary Applications* 00: 1-17.

van der Hammen, T., Poos, J.J., van Overzee, H.M.J., Heessen, H.J.L., Magnusson, A., Rijnsdorp, A.D. 2013. Population ecology of turbot and brill: what can we learn from two rare flatfish species? . *Journal of Sea Research* 84.

Xu, X.W., Shao, C.W., Xu, H., Zhou, Q., You, F., Wang, N., Li, W.L., Li, M. and Chen, S.L. 2020. Draft genomes of female and male turbot *Scophthalmus maximus*. *Scientific Data* 7: 1-8.

Yıldız, T. and Karakulak, F.S. 2017. Discards in bottom-trawl fishery in the western Black Sea (Turkey). *Journal of Applied Ichthyology* 33(4): 689-698.

Zengin, M. and Düzgünes, E. 2003. Variations on the turbot (*Scophthalmus maeoticus*) stocks in the south-eastern Black Sea during the last decade and comments on fisheries management. In: Öztürk, B. and Karakulak, S. (eds). Turkish Marine Research Foundation, Istanbul, Turkey.

Citation

Cardinale, M., Chanet, B., Martínez Portela, P., Munroe, T.A., Nimmegeers, S., Shlyakhov, V., Turan, C. & Vansteenbrugge, L. 2021. *Scophthalmus maximus*. *The IUCN Red List of Threatened Species 2021*: e.T198731A144939322. <https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T198731A144939322.en>

Disclaimer

To make use of this information, please check the [Terms of Use](#).

External Resources

For [Supplementary Material](#), and for [Images and External Links to Additional Information](#), please see the Red List website.

Appendix

Habitats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Habitat	Season	Suitability	Major Importance?
9. Marine Neritic -> 9.3. Marine Neritic - Subtidal Loose Rock/pebble/gravel	Resident	Suitable	Yes
9. Marine Neritic -> 9.4. Marine Neritic - Subtidal Sandy	Resident	Suitable	Yes
9. Marine Neritic -> 9.10. Marine Neritic - Estuaries	Resident	Suitable	Yes

Use and Trade

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

End Use	Local	National	International
Food - human	Yes	Yes	No

Threats

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Threat	Timing	Scope	Severity	Impact Score
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.2. Intentional use: (large scale) [harvest]	Ongoing	Minority (50%)	Rapid declines	Medium impact: 6
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
5. Biological resource use -> 5.4. Fishing & harvesting aquatic resources -> 5.4.4. Unintentional effects: (large scale) [harvest]	Ongoing	Minority (50%)	Rapid declines	Medium impact: 6
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
9. Pollution -> 9.2. Industrial & military effluents -> 9.2.3. Type Unknown/Unrecorded	Ongoing	Minority (50%)	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		

Conservation Actions in Place

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Conservation Action in Place
In-place research and monitoring
Action Recovery Plan: Yes
Systematic monitoring scheme: Yes

Conservation Action in Place
In-place land/water protection
Occurs in at least one protected area: Yes
In-place species management
Harvest management plan: Yes

Conservation Actions Needed

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Conservation Action Needed
2. Land/water management -> 2.3. Habitat & natural process restoration
3. Species management -> 3.1. Species management -> 3.1.1. Harvest management
3. Species management -> 3.2. Species recovery
5. Law & policy -> 5.1. Legislation -> 5.1.1. International level
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.1. International level

Research Needed

(<http://www.iucnredlist.org/technical-documents/classification-schemes>)

Research Needed
1. Research -> 1.1. Taxonomy
1. Research -> 1.2. Population size, distribution & trends
2. Conservation Planning -> 2.1. Species Action/Recovery Plan
3. Monitoring -> 3.1. Population trends
3. Monitoring -> 3.2. Harvest level trends

Additional Data Fields

Distribution
Lower depth limit (m): 140
Upper depth limit (m): 0
Population
Population severely fragmented: Unknown
Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes

Habitats and Ecology
Generation Length (years): 9

The IUCN Red List Partnership



The IUCN Red List of Threatened Species™ is produced and managed by the [IUCN Global Species Programme](#), the [IUCN Species Survival Commission \(SSC\)](#) and [The IUCN Red List Partnership](#).

The IUCN Red List Partners are: [ABQ BioPark](#); [Arizona State University](#); [BirdLife International](#); [Botanic Gardens Conservation International](#); [Conservation International](#); [Missouri Botanical Garden](#); [NatureServe](#); [Re:wild](#); [Royal Botanic Gardens, Kew](#); [Sapienza University of Rome](#); [Texas A&M University](#); and [Zoological Society of London](#).