RE-ASSESSMENT EUROPEAN EEL/2020 /RED LIST IUCN

JUSTIFICATION
Anguilla anguilla exhibits facultative catadromy (Tsukamoto et al. 1998, Tzeng et al. 2000, Tesch 2003), has multiple life stages, and is semelparous (Tesch 2003) and is panmictic across a continental spatial scale (Als et al. 2011, Pujolar et al. 2014b); these life history traits and characteristics made application of the IUCN Red List criteria challenging. Anguillids are often referred to as 'freshwater eels', however, it is known that they can exhibit inter-habitat migration and that a proportion may stay in estuaries, lagoons and coastal waters, rarely, if ever, entering freshwater.

The IUCN Red List criteria prioritise indices of mature animals at their breeding area. In the absence of such data for the eel, the criteria would be applied to silver eels starting their spawning migration (in the case of European Eels, leaving 'continental' waters), as these represent the maximum estimate of (pre-) spawning stock biomass, but such data sets for migrating silver eel are low in number, spatially limited and only recent (most only since 2010). The index data best representing the geographic range of A. anguilla, over adequate time scales to apply the Red List criteria, relate to glass eels, but the relationships between recruitment, yellow eel populations, silver eel escapement and spawner stock biomass are poorly understood (Westerberg et al. 2018). While there are hypotheses that certain regions may have greater importance for the spawning stock (e.g. Dekker, 2004, Kettle et al. 2011), evidence is lacking to support such hypotheses and to deviate from the common view that the European Eel is a panmictic species, i.e. all individuals come from a single spawning stock. As such, escapement from a specific river/country/region will not be directly reflected in subsequent recruitment as this relies on the spawning stock as a whole, irrespective of escapement location. Furthermore, it is most precautionary to assume that each and every part of the continental distribution area potentially contributes to the reproductive process, or that each part may be the key part (Dekker 1999). Therefore, the IUCN Red List criteria have to be applied to an amalgamation of multiple life stages, which provides the most comprehensive estimate.

Yellow and silver eel data for A. anguilla have an uneven geographical spread and do not fully represent the stock across its range. Nevertheless, a cursory analysis of these data found that over three generation lengths (39 years; see Habitat and Ecology), the mean decline in yellow and silver eels was found to be greater than 50% (see Population). Both analyses on yellow and silver eels indicated declines within the range of Endangered (EN) category. Compounding these declines in escapement of maturing eels, are strong correlations between recruit series from sites over the range showing substantial declines during the period of the last three generations (Bornarel et al. 2018). The ICES recruitment index is 98.6% lower in the 'North Sea' series, and 94% lower in the 'Elsewhere' series, compared to the 1960–1979 reference level (ICES 2019a). It is noted, however, that the most recent statistical analyses conducted on these recruitment data have shown the trend from 2011–2019 has increased significantly from zero (ICES 2019a). Due to the period of time eels spend feeding and growing prior to silvering and migrating to spawn, the numbers of silver eels may continue to decline, reflecting past declines in recruitment.

Sampling for leptocephali in the Sargasso Sea was undertaken in 2011, and results compared with previous sampling across the same area occurring in 1983 and 1985 (Hanel et al. 2014). The reduction in catch rate was 89% between 1983 and 2011, and 64% between 1985 and 2011 (Hanel et al. 2014). This observation indicates a decrease in the abundance of leptocephali occurring in the Sargasso breeding grounds over this time period, suggesting a lower abundance of spawners, higher egg and/or larval mortality and/or a reduction in

spawning success. Thus, data on leptocephali and recruits to continental waters indicate declines within the range of Critically Endangered (CR).

A suite of threats have been implicated in the decline of European Eel recruitment and stock: barriers to migration – including damage by hydropower turbines and pumps; climate change and/or changes in oceanic currents; disease and parasites (particularly Anguillicola crassus); exploitation of glass, yellow and silver eels; changing hydrology; habitat loss; pollutants; and predation. The significance of these threats individually or synergistically may vary across spatial range of the eel. Further research is required to fully quantify and understand the complexities of individual and combined threats.

Eel Management Plans (EMPs) have been developed in European Union Member States after implementation of the EU Council Regulation No 1100/2007 relating to the recovery of the European Eel (EU 2007). The Regulation set the objective of each EMP to be to "reduce anthropogenic mortalities so as to permit with high probability the escapement to the sea of at least 40 % of the silver eel biomass relative to the best estimate of escapement that would have existed if no anthropogenic influences had impacted the stock" (EU 2007), and that EMPs would be prepared with the purpose of achieving this objective in the long term.

A number of management measures are being implemented in line with EMPs, including control of fisheries, bypassing turbines and pumps, easing of barriers and restocking - transfer of eel from one watershed to another. Quantifying the effects of these measures on silver eel escapement biomass is complicated in many cases because (i) measures are not implemented in isolation, making it difficult to identify individual contributions, and (ii) measures affecting earlier life stages will take years to influence silver eels, and ultimately spawning stock. There remains a great deal of debate as to whether restocking benefits the eel spawning stock and thus enhances future recruitment. Regulations and management actions currently focus on increasing escapement from continental waters, although these do not take account of eel condition or quality (Belpaire et al. 2019).

A recent evaluation of the implementation of the Eel Regulation sought to assess the measures established for the protection and sustainable use of the European Eel stock, as well as the contribution of EMPs to promoting recovery (European Commission 2019, 2020a). It was concluded that the Regulation has been important in catalysing activity towards the recovery of the European Eel and remains a relevant document (European Commission 2020b). However, despite progress, the eel remains in a critical condition and recovery could take decades, and further ambition is required (European Commission 2020b).

Although the Eel Regulation (1100/2007) only applies to EU Member States, efforts are being pursued to non-EU countries to develop and implement management plans and conservation measures. The GFCM are currently in the process of negotiating a regional Eel Management Plan (SAC 2018). The last working group on the management of European eel (WGMEASURES-EEL) occurred on the 16–17th April 2019, where priorities for a regional research programme on eels was discussed, which included drafting an agreed workplan, with a method to launch and implement the programme (SAC 2019). A number of other range states have implemented management measures and/or developed national eel management plans (Musing et al. 2018).

In 2007, A. anguilla was listed in Appendix II of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) due to concerns over the impact of international trade on this species (this listing came into force in March 2009). In 2010, the EU's Scientific Review Group (SRG) concluded it was not possible to perform a Non-Detriment Finding (NDF) for this species (Musing et al. 2018). Exports out of, and imports into, the European Union (EU), have since ceased due to ongoing concerns over the decline in recruitment and stocks. However, trade continues within the EU and from non-EU countries

within its range to other non-EU countries. In 2014, Anguilla anguilla was also listed in Appendix II of the Convention on Migratory Species (CMS).

The limited understanding of the complex relationship between recruitment, growth phase, and escapement makes it difficult to determine how declines in one will affect the other. However, it has been concluded that low recruitment will very likely ultimately translate, though not linearly, to reduced future escapement for, at least one generation length (13 years; see Habitat and Ecology). Further, since there is a short time period (~two years) between spawning and subsequent glass eel abundance, low recruitment has been proposed to be indicative of low breeding stock. As such it was deemed appropriate to assign A. anguilla a Critically Endangered (CR) listing under current observations and future projected reductions of mature individuals (A2bd+4bd).

This category status remains unchanged from the previous assessment. Ultimately the CR category accounts for a proportional decline in population over a continental scale and this species has undergone a substantial decline over the last three generations. Although implementation of management measures has shown improvement, there is still concern over the effectiveness of EMPs to generate recovery to historic reference state within an appropriate timeframe, in the context of multiple threats (European Commission 2020). Continued, and ideally increased, effort will be essential in promoting recovery. A drive to fill data gaps – particularly in relation to the southern range of this species – would allow a more spatially comprehensive assessment in the future.

Assessment of this species was carried out during a workshop held at the Zoological Society of London from the 5th–9th November 2018.