The Sizewell C Project

SZC Co.'s Response to the Secretary of State's Request for Further Information dated 31 March 2022: Appendix 7 - Additional technical information to support Question 8.4 in relation to Environment Agency comments on assessment of sea bass

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APPENDIX 7: TECHNICAL INFORMATION TO SUPPORT THE SZC CO RESPONSE TO QUESTION 8.4 RELATING TO ENVIRONMENT AGENCY COMMENTS ON ASSESSMENT OF SEA BASS

CONTENTS

This Appendix contains further information to support the SZC Co written responses to questions raised by the Secretary of State for Business, Energy & Industrial Strategy ("the Secretary of State") in Information Request No. 2 question 8.4 pertaining to sea bass:

"The Applicant is invited to respond to the Environment Agency's concerns, in the Deadline 10 Submission - Comments on 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP10-187] and Deadline 7 Submission - Comments on additional reports submitted by the Applicant at Deadline 6 [REP7-133], in relation to the Sizewell C European Sea Bass Stock Assessment (Deadline 8 Submission - 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0) [REP8-131], which include:

1. *The scale of the stock assessment method;*
2. *Consideration of the most recent stock assessment and fishery advice;*
3. *The Applicant's parameters in consideration of Equivalent Adult Values (EAV) having not applied the Spawning Production Foregone (SPF) method, with provision of results for all years and scenarios; and*
4. *Evidence of a replenishment rate of 10% for sea bass."*

This Appendix specifically responds to the Secretary of State's invitation to address the above four points. Any additional unresolved comments in the Environment Agency's Deadline 7 Submission - Comments on additional reports submitted by the Applicant at Deadline 6 [REP7-133] are also addressed herein.

1.1 Scale of the stock assessment method

1.1.1 The Environment Agency, in its *Deadline 10 Submission - Comments on 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP10-187] state:*

"Issue: The stock assessment method does not address the EA concerns over the area of assessment. Using ICES stock assessment areas assumes an area for European seabass of 608,983 km^2.

Comment: Recent papers, including Stamp et al. (2021), identified juvenile and sub-adult movements to inform recovery strategies for high value fishery – European bass (Dicentrachus labrax) which shows high site fidelity of juvenile and sub-adult seabass.

Suggested solution: Need to provide an assessment at an appropriate local scale for European seabass that recognises the latest research into site fidelity and seabass movement and the likelihood of local populations that could be impacted by SZC".

1.1.1 SZC Co. does not agree with the Environment Agency's position in relation to the scale of assessment for effects of Sizewell C on the population of sea bass. The population comparator applied by SZC Co. is consistent with the most robust internationally accepted stock unit for sea bass. In the case of commercially targeted fish species such as sea bass, the stock units applied by SZC Co., as set out below, have been supported by the MMO.

1.1.2 To determine the population level effects of impingement on sea bass, SZC Co. has incorporated predicted impingement impacts with the full analytical International Council for Exploration of the Sea (ICES) stock assessment for the ICES stock area for 'Northern' sea bass. Sea bass is a migratory species, and the stock area covers the central & southern North Sea, Irish Sea, English Channel, Bristol Channel & Celtic Sea of ICES Divisions 4.b-c, 7.a, & 7.d-h (Figure 1). ICES role as the main international advisor on the status of fish populations in the North Atlantic, along with the safeguards and transparency of its advisory process, endorse that its assessments provide the best available and internationally reviewed evidence on the status of assessed stocks, including sea bass. To generate its advice, ICES assesses all the available evidence of the species of concern throughout its full life cycle including spawning migrations, larval dispersal, and patterns of recruitment.

1.1.3 It is a multistage international process with internal and external peer review that brings together experts in fish biology. Methods of assessments of each stock and its structure is considered by dedicated international

working groups which meet every 3-5 years at so-called 'Benchmarks'. During 'Benchmarks', available evidence on stock identity and biology is considered, including the stock unit used in the assessment. Considerations include the biology of the stock throughout its life cycle including spawning migrations, larval dispersal, and patterns of recruitment.

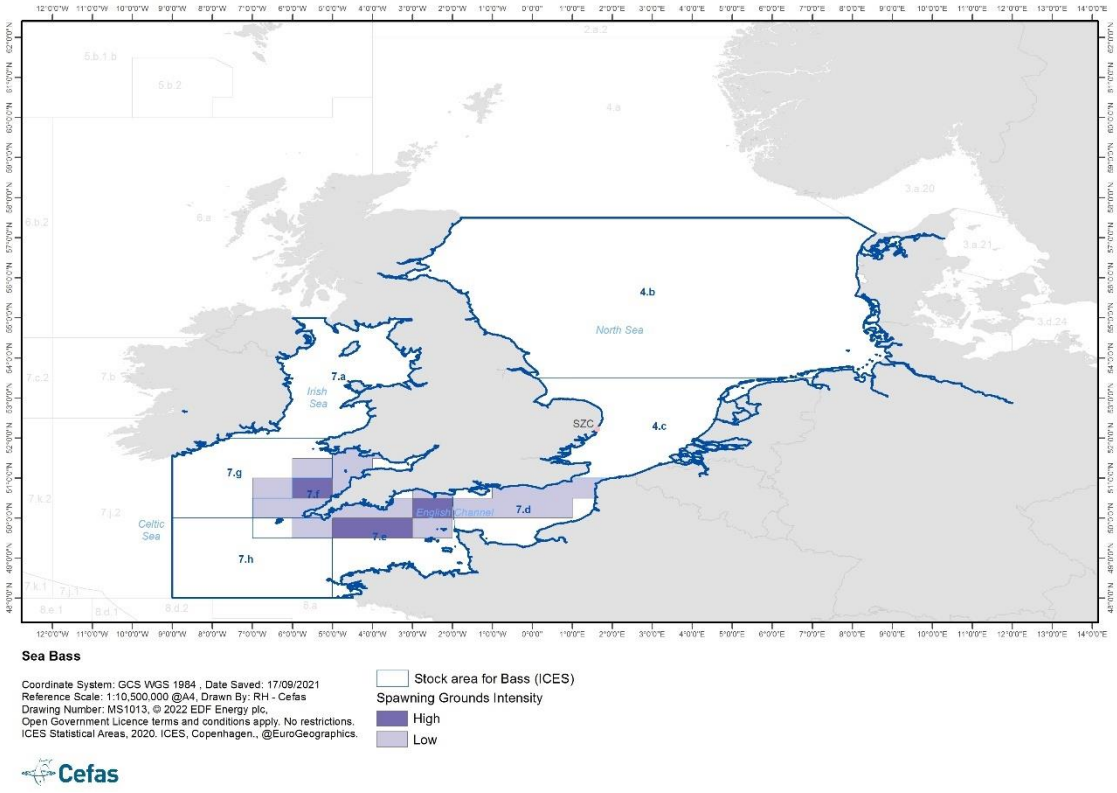

Figure 1. ICES stock area for sea bass showing established spawning grounds relative to Sizewell C. Known spawning areas are shown, but investigations of the distribution of sea bass eggs have been limited to the northern areas of the English Channel and to the eastern Celtic Sea, so spawning may occur in other offshore areas.

1.1.4 The connectivity of the sea bass population occurs at the stage of migratory juvenile and adult fish but also with passive redistribution of eggs and larvae with oceanic currents. Following spawning, eggs and larvae may be carried on ocean currents for 10s or 100s of km for over 30 days or more. Dispersal is driven by the influence of wind on residual ocean currents and water temperature resulting in interannual variation (Beraud *et al.,* 2018[1]). The eggs and larvae will intermingle in different ways in different seasons and years, and consistent spatial differentiation between larvae from different

[1] Beraud, C., van der Molen, J., Armstrong, M., Hunter, E., Fonseca, L., Hyder, K. 2018. The influence of oceanographic conditions and larval behaviour on settlement success - the European sea bass *Dicentrarchus labrax* (L.). ICES Journal of Marine Science, 75(2), 455-470.

individuals or groups within the same spawning population will not be consistently maintained.

1.1.5 The Environment Agency, in its Deadline 7 Submission - Comments on additional reports submitted by the Applicant at Deadline 6 [REP7-133] state:

"Evidence provided to HPC inquiry showed modelled seabass recruitment from different parts of the ICES area. Contribution of major western spawning grounds to North Sea was relatively small, which supports 'splitting' the stock in terms of assessing impacts. See evidence provided in Figure 6 in Beraud et. al., (2018)… Additional information on seabass population is presented but this doesn't include all the information presented at HPC inquiry (larval drift modelling, which showed little contribution of western areas to North Sea seabass doesn't seem to be referenced). Selected tracks[2] show two seabass tagged off SZC going to English Channel, but also shows two tagged in channel/Irish Sea never going to North Sea."

1.1.6 SZC Co. does not agree with the Environment Agency's interpretation of the results in Beraud *et al.,* (2018). The model was developed to better understand the factors affecting sea bass settlement on nursery grounds. Larval settlement of sea bass in the southern North Sea would primarily result from sea bass spawning in the southern North Sea (4c) and the eastern English Channel (7d) (Figure 1). In strong recruitment years there was greater connectivity between areas, with weak connectivity between the southern North Sea (4c) and the Irish Sea (7a). The capacity for long distance dispersal albeit contingent on interannual variability causes some interconnection between ICES Divisions throughout the range of this stock. Indeed, Beraud et al (2018) conclude that there is *"considerable potential for genetic mixing because of larval dispersal leading to weak stock differentiation"* (Beraud *et al.,* 2018).

1.1.7 The evidence described by the Environment Agency that was provided as part of the Hinkley Point C Inquiry in June 2021 relating to an appeal against the Environment Agency's non-determination of an application to vary an environmental permit, included latest tagging data which shows wide scale migratory behaviour of some individuals. Four selected tracks from the Cefas C-Bass project are provided in (Figure 2) to illustrate the distances of migratory movements and mixing of adult sea bass from different areas. For example, one individual (blue track in Figure 2) migrated from its capture location in Lowestoft (4c) across the English Channel to known

[2] Figure 8 of Deadline 6 Submission - 6.14 Environmental Statement Addendum - Volume 3: Environmental Statement Addendum Appendices - Chapter 2 - Main Development Site - Appendix 2.17.A - Marine Ecology and Fisheries - Revision 2.0 [REP6-016]. The same figure is reproduced herein to ease (Figure 2).

spawning areas off the southwest coast in divisions 7g and 7f before returning to 4c.

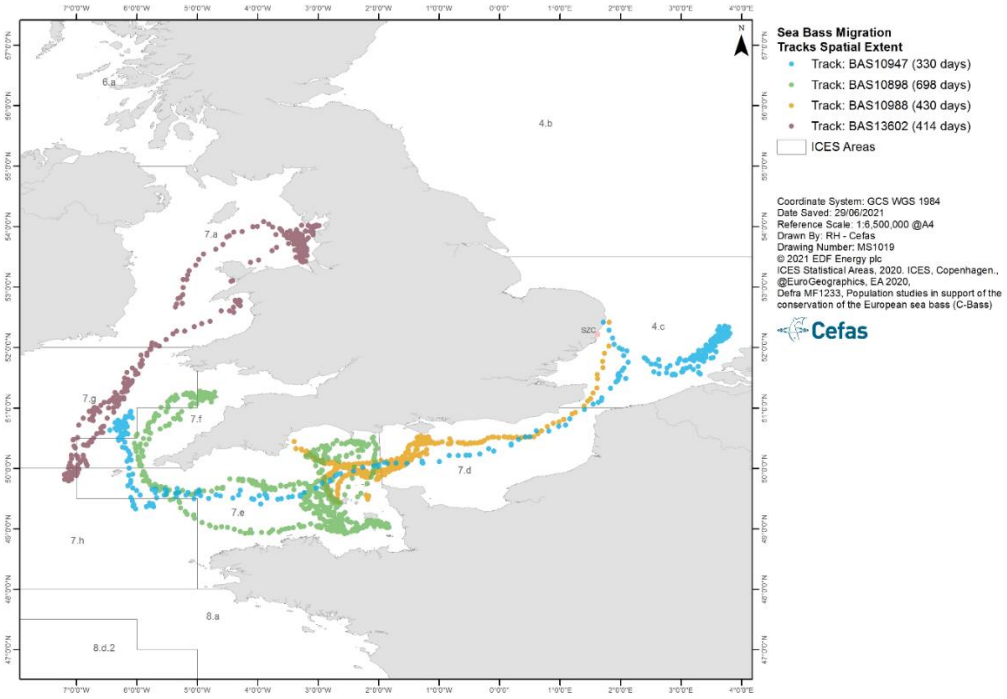

Figure 2. Selected tracks from four adult sea bass illustrating the potential for long distance migration to spawning grounds.

1.1.8 The residency and site fidelity of some life stages of sea bass is well known, and especially in the case of juvenile sea bass which use inshore nursery areas for the first few years of life. Adult bass that mix on spawning grounds may also return to separate and identifiable summer feeding areas. However, there is wider mixing over the course of the life cycle that accounts for the scale of the population recognised by ICES. Indeed, having reviewed available evidence, the latest ICES Benchmark Workshop on Sea Bass (ICES, 2018[3]) stated (emphasis added):

"The sea bass inhabiting the Atlantic Ocean show a remarkable homogenous genetic structure although homing based on mark–recapture data suggests some level of population structure. Off the Strait of Gibraltar (9.a) there is evidence of introgression by the Mediterranean group. Sea bass inhabiting the areas Northern (4.b&c, 7.a,d–h) and Biscay (8.a&b) represent genetically one population unit. The current management in two

[3] ICES. 2018. Report of the Benchmark Workshop on Seabass (WKBASS), 20–24 February 2017 and 21–23 February 2018, Copenhagen, Denmark. ICES CM 2018/ACOM:44. 287 pp.

stocks (Northern and Biscay) can be considered ***a conservative and correct measure****".*

1.1.9 **Conclusion:** When determining the appropriate scale of assessment, the full life history of species must be considered. SZC Co. contends that the ICES stock areas are the most robust application of the evidence for determining population units for commercially harvested data-rich species, such as sea bass.

1.1.10 The MMO agrees with the approach adopted by SZC Co. and have stated this during the Public Examination *(Deadline 2 Submission - Written Representation) [REP2-140]*, emphasis added:

"In relation to the scale of assessment, the MMO notes that the Applicant continues to justify the use of the International Council for Exploration of the Sea ("ICES") stock areas as using the best available evidence. ***The MMO concludes that the use of ICES stock areas for commercial fish species represents the current best scientific evidence available. There is currently no robust information that would support use of more local stock areas in the assessment."***

1.1.11 Further detailed responses to Environment Agency and Natural England comments on the stock area of sea bass including the latest evidence in relation to the scale of assessment were provided during the Examination:

- **Section 2.10** of *Deadline 6 Submission - 6.14 Environmental Statement Addendum - Volume 3: Environmental Statement Addendum Appendices - Chapter 2 - Main Development Site - Appendix 2.17.A - Marine Ecology and Fisheries - Revision 2.0 [REP6-016],* and;
- **Appendix K: Supplementary Response to Natural England's Written Representations** in *Deadline 5 Submission - 9.54 SZC Co. Comments on Submissions from Earlier Deadlines (Deadlines 2-4) Appendices - Revision 1* [REP5-120].

1.2 Stock assessment and fishery advice

1.2.1 The Environment Agency, in its *Deadline 10 Submission - Comments on 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP10-187] state:*

"Issue: Years of stock assessment versus health of seabass fishery.

Comment: The stock assessment has included years 1985-2020 however it has not taken into account the most recent stock assessment and fisheries advice which shows that the stock is currently below safe limits.

Suggested solution: The analysis needs to include the current state in the assessment and the assumption of a 50 year lifetime on the plant acting on a stock that is currently at the lowest safe limits".

1.2.2 The sea bass stock has fluctuated over time between 1985 and 2020 (Figure 3). A decline from 2010 onwards brought about a series of management measures, including the prohibition of pelagic trawls and gillnets during the first six months of the year, bag limits for recreational fishing, and an increase in the minimum conservation reference size (MCRS) to 42 cm. The stock SSB fell to its lowest point below B_{lim} (the biomass limit reference point, below which there is a high risk that recruitment will be impaired) in 2018. Management measures implemented since 2015 have resulted in the SSB showing signs of recovery, increasing above B_{lim}, although SSB remains below pre-2010 levels. As a consequence, the SSB advice for total removals increased in 2022 to 2,216 tonnes (ICES, 2021[4]).

1.2.3 Consequently, accounting for the slight improvement in sea bass stock status since 2020 would not change the conclusions. The assessment provided is sufficient to demonstrate that effects of impingement are insignificant in relation to the effects of fishing and recruitment that are the main drivers of trends in spawning population size.

1.2.4 It is also worth noting that Bass Nursery Areas (BNAs) are established by Statutory Instruments[5] that have been created to protect aggregations of juvenile sea bass. Thermal uplifts created by direct cooled power stations increase the survival of juvenile sea bass during winter and BNAs were created at the former Bradwell, Blythe, Fawley and Kingsnorth power stations. A review of potential inshore nursery areas proposed 48 amendments to existing BNAs in England and Wales including 39 new BNAs, and the proposed removal of the BNAs that no longer benefit from warm water outflows due to the decommissioning of power stations (Hyder et al., 2018). At the time of writing there has been no change in status of the UK BNAs.

1.2.5 **Conclusion:** Fisheries management measures as provided in ICES stock advice are inherently included within the data supporting stock assessments. The ICES advisory process is open and transparent, regularly 'benchmarked' to review and assimilates new knowledge, and generates independent, peer reviewed advice based upon the work of the international science community. Therefore, by applying the ICES sea bass

[4] ICES. 2021. Sea bass (*Dicentrarchus labrax*) in Divisions 4.b-c, 7.a, and 7.d-h (central and southern North Sea, Irish Sea, English Channel, Bristol Channel, and Celtic Sea). In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, bss.27.4bc7ad-h. https://doi.org/10.17895/ices.advice.7733.

[5] The Bass (Specified Areas) (Prohibition of Fishing) (Variation) Order 1999. Available here: https://www.legislation.gov.uk/uksi/1999/75/made

stock assessment the best available method, based on robust data, has been use for the Sizewell C EIA.

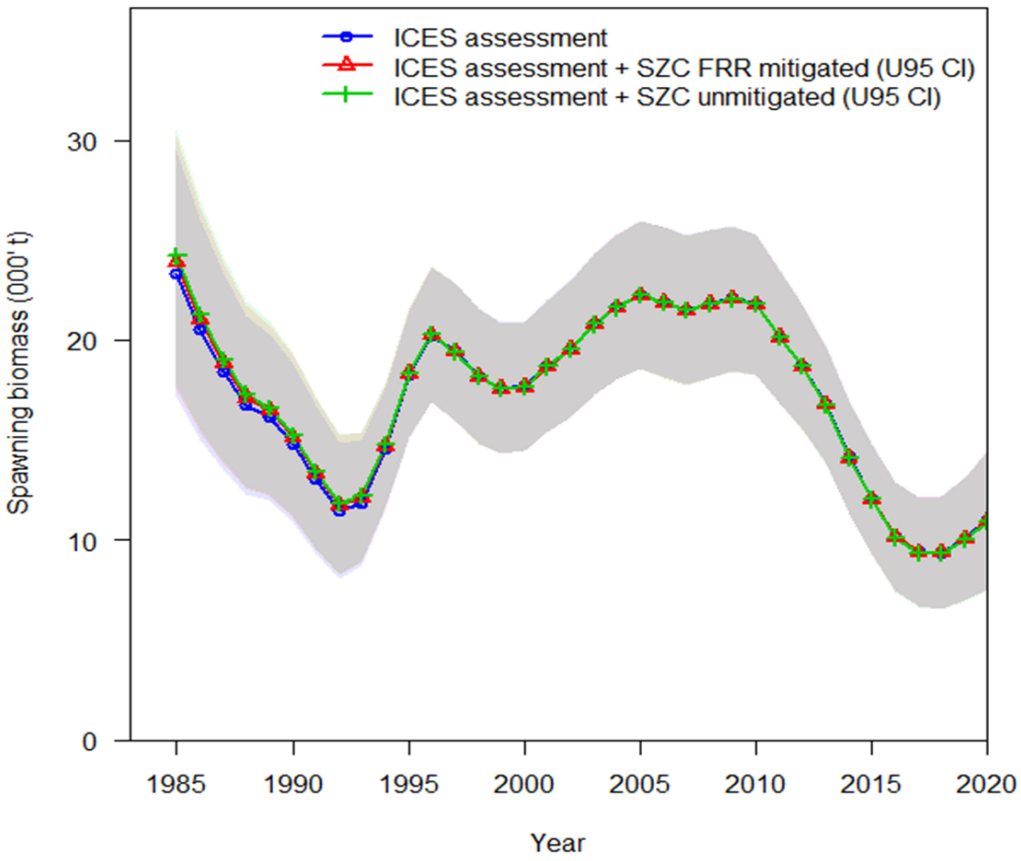

Figure 3. Trends in the spawning stock biomass (SSB x1,000 tonnes) for sea bass estimated in the core ICES and reruns of that assessment with SZC impingement incorporated. Estimated 95% confidence intervals of the SSB assessment for all three scenarios are indicated by shading.

1.2.6 ICES stock assessments are designed to inform fisheries management using forward projection of SSB from available data sources and hindcasting. There is no way of confidently forecasting stock assessments long into the future to account for impingement mortality, as suggested by the Environment Agency. This is because the data are not available to validate the models and in the case of Sizewell C, the scale of effect is dwarfed by the degree of uncertainties in prevailing environmental conditions and future fishing pressure acting on the stock 50 years into the future. Therefore, to determine the long-term effects of Sizewell C on the sea bass stock impingement, estimated losses were added every year starting in 1985 to the existing 35-year model simulation, which is informed

by an established data series over the period 1985-2020. A number of model runs were undertaken with and without the addition of impingement mortality included in the core ICES model run. The scenarios included runs with Fish Recovery and Return (FRR) mitigation (mean and upper 95% confidence intervals of annual impingement (U95)) and an extreme scenario of unmitigated impingement (mean and U95). Impingement had no discernible effects on the population trends and only very minor effects on absolute SSB. In the extreme scenario simulating upper 95% confidence intervals of unmitigated impingement losses each year, for 35 years (Figure), differences in stock SSB resulting from the operation of Sizewell C compared to the ICES core assessment range between 0.00% of SSB to -0.50% between 2009-2017.

1.2.7 Crucially, when the additional mortality of Sizewell C was included in the model run, even under the most extreme scenario the increase in SSB in 2019 and 2020 following the lowest levels in 2018 was unhindered (Figure). This period represents the most sensitive period of recovery from levels below B_{lim}.

1.2.8 Whilst the stock assessment does not provide a forward projection of 50 years into the future from 2020, there is an analogous period in the early 1990s when SSB fell from over 20,000 tonnes to 11,500 tonnes in 1992. The population recovered in the mid-1990s and achieved a period of high biomass between the mid-1990s and 2010 driven by above average recruitment. Again, the addition of extreme impingement losses did not influence the recovery of the stock during this potentially sensitive period (Figure 3). These results provide a convincing demonstration that, once SZC is operating, the size of the adult sea bass population will increase and decrease at the same times, and at almost identical rates, to those expected without impingement. This is because the environment and fishing mortality are the overriding drivers of sea bass abundance.

1.2.9 The Environment Agency also commented at *Deadline 10 Submission - Comments on 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP10-187] that:*

"Issue: This table[6] only presents the results for a short subset of the assessment period but does show that in two years, the SZC impingement has actually resulted in an increase in SSB.

Comment: This is very counter-intuitive and does not make sense that an additional pressure would increase biomass. This is especially problematic when it occurs in the more recent years when the SSB is already at or below

[6] Table 2 of Deadline 8 Submission - 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP8-131].

the biological safe limit below which there is a high risk that recruitment will be impaired.

Suggested solution: The results for all years and scenarios aren't shown as clearly so are difficult to assess. But, it does highlight an apparent problem with the method when additional mortality has the opposite effect on the SSB values".

1.2.10 Stock assessment has rarely been used to assess impingement effects because the data requirements are far greater than those of Equivalent Adult Value (EAV) methods. The application of a full analytical stock assessment undertaken by SZC Co. therefore represents a considerable advancement to the EAV approach or indeed the EAV- Spawning Production Foregone (SPF) extension and has been undertaken to provide the greatest level of confidence in the conclusions.

1.2.11 As described above, in the extreme scenario SSB with the additional station the mortality was 0.00% to 0.50% lower than the core ICES run over the period 2009-2019. In the mitigated scenario there were instances where stock SSB was greater with the addition of station mortality resulting in losses of predominantly juvenile sea bass impinged at Sizewell. This does not suggest a problem with the method but simply that impingement losses are within the parameter-variability of the model and the stock is not sensitive to the losses of predominantly juvenile sea bass at the scale predicted to be caused by Sizewell C.

1.2.12 The Environment Agency has requested results for all years and scenarios. Details of absolute SSB under the model runs with and without additional impingement mortality and fishing mortality for all years (1985-2020) and for all scenarios was provided in Appendix A of *Deadline 8 Submission - 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP8-131].*

1.2.13 **Conclusion:** The stock assessment demonstrated no clear changes in population trends and only minor changes in absolute SSB. In essence, this means that the size of the spawning population would increase and decrease at the same times and at an almost identical rate whether the additional impingement from Sizewell C was occurring or not throughout the 35-year simulation. From this, SZC Co. have concluded that Sizewell C impingement mortality would not have any long-term effects on the dynamics of the adult sea bass population and that environmental variation and fishing will remain the overriding drivers of population dynamics.

1.3 Equivalent Adult Values and Spawning Production Foregone

1.3.1 The Environment Agency, in its *Deadline 10 Submission - Comments on 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP10-187]* state:

"Issue: This section[7] starts by stating that "sea bass is a long-lived, repeat spawning species." It also states that "fishing mortality is targeted at the 4-15 year old fish".

Comment: The applicant's EAV method does not take the repeat spawning of the adult seabass into consideration. If the ICES data shows the fishery is targeting fish up to 15 years old, then it is apparent that repeat spawning is occurring in this species and should be accounted for.

Suggested solution: Please use the EA EAV method to the seabass impingement assessment".

1.3.2 Before addressing the EA comment, it is emphasised that the EAV-only method is a relatively simple and precautionary method to assess the risks posed by impingement for the wide range of species for which comprehensive biological data are not available. In the case of sea bass, a full analytical stock assessment was also available and was applied. As noted in Section 1.2 this demonstrates that the sea bass spawning population would increase and decrease at the same times and at almost identical rates regardless of whether the additional impingement from Sizewell C was occurring or not. This assessment, and therefore the conclusion from the assessment, is not influenced by the EAV approaches as implemented by Cefas or the EA.

1.3.3 SZC Co. does not agree with the Environment Agency's position for reasons which have been set out before the Examination and are summarised below. In short, the Environment Agency's position is fundamentally misconceived. It can be noted that the MMO's position aligns with that of SZC Co.

1.3.4 In the context of the Sizewell C Examination, a Technical Note was prepared for the Examining Authority outlining the SZC Co. position regarding EAV. Following comments from Natural England[8] and the Environment Agency[9] an explanatory note was produced:

[7] Executive Summary of Deadline 8 Submission - 9.110 Sizewell C European Sea Bass Stock Assessment - Revision 1.0 [REP8-131].

[8] Natural England Deadline 7 Submission - Comments on submissions from earlier deadlines and subsequent written submissions to ISH1 to ISH6 and appendices [*REP7-143*].

[9] Environment Agency Deadline 7 Submission Comments on reports contained within Comments on Earlier Submissions and Subsequent Written Submissions to ISH1- ISH6 [*REP7-128*].

- **Appendix F: Technical Note on EAV and stock size** of *Deadline 6 Submission - 9.63 Comments at Deadline 6 on Submission from Earlier Submissions and Subsequent Written Submissions to ISH1-ISH6 -* [*REP6-024*].
- **Appendix I: Response to Natural England and Environment Agency Comments on SZC Technical Note on EAV and stock size** of *Deadline 8 Submission - 9.99 Comments on Earlier Deadlines and Subsequent Written Submissions to CAH1 and ISH8-ISH10 - Appendices Part 1 - Revision 1.0 -* [*REP8-119*].

1.3.5 EAV factors are used to convert an annual rate of loss due to impingement of predominantly juvenile sea bass into an annual rate of loss of fish that are maturing and joining the spawning population. The EAV-only method involves a forward projection of annual impingement mortalities, accounting for natural mortality, to give an equivalent annual rate of loss of mature fish. It is a straightforward adjustment to reflect the likelihood of impinged fish reaching maturity and contributing to the spawning population.

1.3.6 The EAV-only method converts an annual rate of impingement to an annual rate of loss of adult fish and can therefore be compared to annual fishing mortality rates or point (annual) estimates of the spawning stock biomass (SSB).

1.3.7 The EAV-only method is inherently precautionary for long-lived, repeat spawning species such as sea bass because:

- Fishing mortality has not been included when calculating the EAV. This means EAV numbers for first time spawners are overestimated. By assuming no fishing mortality before maturity, the EAV assessment overestimates the chance of survival to maturity and is therefore precautionary, particularly for species such as cod, whiting and sea bass.
- The method converts the calculated number of first-time spawners lost into an annual loss of biomass which is compared to the SSB. The conversion is achieved by multiplying the number of first-time spawners by the mean weight of fish in the spawning population. As older fish in the spawning population are larger and more fecund than first time spawners this considerably upweights losses. This has been considered an appropriately conservative step. To illustrate the degree of precaution, we can consider the alternative approach. If the weight of first-time spawning sea bass were applied, rather than the mean weight from the spawning population, the calculated loss of biomass each year reduces by >40%, with a reciprocal reduction in the population level effect.

1.3.8 The SPF extension (the 'EA EAV method') seeks to account for the potential for species, such as sea bass, to spawn multiple times. In so doing, the Environment Agency argues that the SPF extension provides a more realistic reflection of the long-term impacts of the station. The SPF extension necessarily generates a higher predicted rate than the EAV-only method because the SPF impact is a summation of impacts over more than one year i.e., repeat spawning.

1.3.1 Since the SPF extension does not generate an estimate of an annual rate of loss of spawners from the spawning population, it cannot be compared to annual estimates of fishing mortality or SSB. It is misleading and inappropriate to relate results of a multi-year analysis to effect thresholds (baseline) that were defined based on a single years rate of loss. The SPF method as asserted by the Environment Agency is therefore not considered fit for purpose for determining the impacts of Sizewell C on sea bass populations.

1.3.2 The SZC Co. position is shared by the MMO. In its review of the EAV approaches used in the Environmental Statement, the MMO concludes:

"The MMO consider the core method [EAV-only method in comparison with the EAV-SPF] *is the better in that the end-point age is more likely to be reflective of reality in the context of currently fished seas, and because the MMO consider the extension method, while very precautionary, has conceptual challenges for EAV>1 and problems for comparing to SSB. The MMO is comfortable that all due efforts have been made to secure data at an appropriate scale."* [RR-0744]

1.3.3 The mean annual effects of impingement by Sizewell C are predicted to be 0.87% of SSB. To address MMO and Environment Agency comments, a full sensitivity analysis of the assessment was undertaken regarding uncertainties in the operational performance of the proposed fish mitigation measures and sampling techniques used to derive entrapment predictions. The sensitivity analysis also accounted for natural fluctuations in SSB *(Deadline 10 Submission - 9.67 Quantifying Uncertainty in Entrapment Predictions for Sizewell C) [REP10-135].* The uncertainty analysis demonstrated a mean annual loss of 0.99% of SSB (95% confidence intervals L95 0.40% - U95 1.85%).

1.3.4 In addition to the inherent precaution of the EAV-only approach, these estimates are again considered to be precautionary because sea bass are not uniformly distributed within the Greater Sizewell Bay with densities inshore of the Sizewell-Dunwich Bank, where the Sizewell B intakes are located, higher than offshore where the Sizewell C intakes would be

located. This suggests that impingement predictions scaled-up from Sizewell B may overestimate Sizewell C sea bass impingement.

1.3.5 **Conclusion:** SZC Co. is confident in the precautionary nature of EAV-only based risk assessment, which has demonstrated that the predicted effects of Sizewell C would have no significant bearing on the population abundance of sea bass. This conclusion has been supported by the application of a full analytical ICES stock assessment which is independent of the EAV-only calculation and provides the most robust evidence available.

1.4 Replenishment rates

1.4.1 Responses provided above relate to assessments of population level effects and parameters used to derive population assessments for sea bass. The request for further information regarding replenishment rates relates to the assessment of local depletion in the Greater Sizewell Bay (GSB), see Section 3 of *Deadline 6 Submission - 6.14 Environmental Statement Addendum - Volume 3: Environmental Statement Addendum Appendices - Chapter 2 - Main Development Site - Appendix 2.17.A - Marine Ecology and Fisheries - Revision 2.0) [REP6-016], hereafter "SPP103.Rev5 [REP6-016][10]".*

1.4.2 The local depletion assessment is independent of the population level effects assessment and focuses on the smallest spatial scale, i.e., that of the GSB. It is not a population assessment, rather it estimates the reduction in fish density local to the proposed development in comparison with a situation without a power station operating (i.e., without either Sizewell C or Sizewell B operating). The local effects assessment was designed as a simple conceptual framework and is primarily suited to consider aspects such as depletion of fish as prey resources for designated HRA species, particularly piscivorous birds at the scale of the GSB. The local depletion assessment should not be conflated with the population assessment which considers absolute losses relative to a population comparator. The two approaches and what they seek to achieve, would only be comparable if the relevant population scale for a given species was limited to the GSB. This is not the case for any of the assessed species.

1.4.3 It is not feasible to parameterise the complexities of fish dynamics and behaviour in an open coastal environment that accurately represents diurnal, seasonal and life-history changes in distribution and abundance for each of the species at Sizewell. Therefore, the simple conceptual model necessarily makes a series of assumptions that have been clearly defined.

[10] BEEMS Scientific Position Paper SPP103 Consideration of potential effects on selected fish stocks at Sizewell (Rev.5).

1.4.4 At its basis, the local effects assessment is a volumetric calculation of abstraction relative to processes of replenishment into / out of the GSB from the wider area (e.g., in terms of immigration/emigration of fish species). As such, the replenishment rate is an important parameter. Quantifying immigration and emigration rates for a range of species in an open coastal site is simply not feasible. In the absence of empirical species-specific data, the local effects assessment applied a 10% replenishment rate of fish within the GSB per day. This is based upon conservative water exchange rates for the GSB. In an open coastal system with no geomorphic features to limit exchange rates, water exchange is anticipated to be approximately 20% per day at east coast locations (Environment Agency, 2011[11]).

1.4.5 The primary objective of the local depletion assessment was to determine the potential for localised reductions in prey availability of designated sea birds. During the breeding season, little terns feed their chicks on a range of prey items including fish and crustaceans, young-of-the-year clupeids (sprat and herring) have been shown to be important prey resources for little terns. Fish behaviour is more complex than simple water exchange, however, based on the tidal exchange rates a starting position of 10% per day for small pelagic species was considered to be an appropriately precautionary assumption. The sensitivity of the local assessment to replenishment rates ranging from 1% to 25% of fish per day was considered in SPP103.v5 [REP6-016] and the report along with the conceptual calculation was provided to the Environment Agency to allow for complete transparency.

1.4.6 The Environment Agency commenting on SPP103.v5 [REP6-016] questioned the applicability of the 10% replenishment rate for both sea bass and smelt *(Deadline 7 Submission - Comments on additional reports submitted by the Applicant at Deadline 6) [REP7-133]*:

"Issue: The seabass local depletion assumes a replenishment rate of 10% but what evidence is there that seabass are moving around at this rate?

Comment: Evidence is needed to support the use of this figure.

Suggested solution: Provide evidence that supports the use of this figure".

1.4.7 The 10% replenishment rate for sea bass was an assumption based on the application of tidal exchange volumes. Whilst it is not possible to exactly quantify the replenishment rate, sea bass are mobile predatory species and impingement rates at Sizewell B are highly variable suggesting shoaling

[11] Environment Agency. 2011. Parameter values used in coastal dispersion modelling for radiological assessments. Report: SC060080/R3.

fish move along the coast resulting in pulses in impingement and have seasonal movements throughout the year.

1.4.8 In relation to smelt the Environment Agency commented in *(Deadline 7 Submission - Comments on additional reports submitted by the Applicant at Deadline 6) [REP7-133]*:

"Issue: Local depletion assumes replenishment rate of 10% for smelt. No evidence has been provided that supports this figure. This is not considered precautionary.

Comment: We acknowledge the efforts made to consider the potential effects on smelt populations of relevance to Sizewell. We note that with a predicted exchange rate of 1% of fish per day, local depletion in the Greater Sizewell Bay (GSB) and tidal excursion reaches 23% in this revised (rev 5) report. We note the applicant's comments on the caution required when applying a range of values to a conceptual model. The applicant has used an Anglian region SSB to account for concerns that the smelt stock may be more localised than previously acknowledge. Referenced in this report is the uncertainty analysis in SPP116 (Doc Ref. 9.67) which determined that the station is anticipated to result in losses of 0.51% of the estimated Anglian Region SSB with an upper 95% percentile estimate of 0.82%. We highlight the uncertainty that exists over what smelt movements are in this area and over the uncertainty as to what the level of immigration to the GSB from a wider stock (including a stock from The Thames to the Great Ouse) is. We therefore consider the use of the 10% exchange rate applied to smelt in table 7, which predicts a local depletion of 2.9% in the GSB + tidal excursion, as not appropriate or precautionary.

Suggested solution: Provide evidence to support the use of these figures. In the absence of any supporting evidence we require application of a more precautionary exchange rate".

1.4.9 As described above, the local depletion assessment and population level effects are not directly comparable assessments and results should be treated independently.

1.4.10 Impingement of smelt at Sizewell B is predominantly juvenile fish in the summer months. These juvenile fish likely originated from a number of river systems in the East Anglian Region and possibly beyond including the nearest river systems of the Alde & Ore, Deben, Orwell and Stour 25-42km to the south of Sizewell and the rivers Yare, Bure, Wensum and Waveney some 30-40km to the north. Movements of shoaling smelt along the East Anglian coast are likely to be driven by tidal processes and prey availability. As a pelagic species in an unconstrained coastal environment,

replenishment rates of 10%, half the daily water exchange was deemed a suitable starting position. Smelt replenishment rates of just 5% per day result in local depletion at the scale of the GSB and tidal excursion of approximately 5.8% compared to 2.9% with 10% replenishment[12]. Acoustic surveys of pelagic fish within the GSB have has shown a high degree of spatial and seasonal heterogeneity in biomass, however, there is no clear evidence of depletion caused by the existing Sizewell B station *(SPP103.Rev5 [REP6-016])*.

1.4.11 The Environment Agency notes that a replenishment rate of 1% results in 23% reductions in smelt within the local GSB and tidal excursion. However, this is a unrealistic scenario in an open system as the simple conceptual calculation assumes even distribution within each assessment cell (i.e., the unbounded GSB). Therefore, the 1% replenishment scenario assumes very low movement of fish at the cell boundary (GSB and wider Anglian coast / North Sea) while simultaneously maintaining equal distribution within the assessment cell. There is no evidence to support such an approach.

1.4.12 Smelt are not identified as a primary prey species for HRA designated birds feeding within the GSB. Equally, the river systems with spawning populations of smelt are located beyond the GSB where localised depletion is substantially reduced to less than 1% irrespective of the replenishment rate.

1.4.13 At the population level, the mean annual effect of entrapment by Sizewell C is predicted to be 0.57% (95% confidence intervals L95 0.33% - U95 0.92%) of the conservatively estimated Anglian Region SSB, based on Environment Agency landings data *(Deadline 10 Submission - 9.67 Quantifying Uncertainty in Entrapment Predictions for Sizewell C) [REP10-135]*. Losses of this magnitude are not predicted to cause significant population level effects. However, in Schedule 11 of the Deed of Obligation (*Deadline 10 Submission - 8.17/10.4 Deed of Obligation Engrossment Version - Front End of Plans*) *[REP10-075]* SZC Co. has committed to contribute funding to fund Eel and Migratory Fish Mitigation Measures. This is intended to include two fish pass systems to be constructed by the Environment Agency (one at Snape Maltings (River Alde) and one at Blythford Bridge (River Blyth)) to enhance upstream eel passage. The schemes would also benefit other diadromous fishes such as smelt.

[12] Section 3.5 of SPP103.v5 [REP6-016] provides further ecological interpretation of the conceptual results and information on the potential depletion at Sizewell.

1.5 Other outstanding comments from REP7-133

1.5.1 This section provides responses, or indicates where any outstanding comments from the Environment Agency (*Deadline 7 Submission - Comments on additional reports submitted by the Applicant at Deadline 6 [REP7-133]*) on Revision 5 of *Deadline 6 Submission - 6.14 Environmental Statement Addendum - Volume 3: Environmental Statement Addendum Appendices - Chapter 2 - Main Development Site - Appendix 2.17.A - Marine Ecology and Fisheries - Revision 2.0) [REP6-016], hereafter "SPP103.Rev5 [REP6-016]"* have been addressed.

Section 2.1: Twaite Shad

1.5.2 Commenting on Section 2.1 of SPP103.Rev5 [REP6-016] in relation to the twaite shad population estimate in mainland European rivers, the Environment Agency requests clarification on where the uncertainty and confidence intervals in the population estimate would be reported. The population estimate of twaite shad in the River Elbe and Scheldt and the underlying uncertainty in the population estimates was calculated, and incorporated within the full uncertainty analysis (*Deadline 6 Submission - 9.67 Quantifying Uncertainty in Entrapment Predictions for Sizewell C - Revision 1.0 [REP6-028]* and revised following comments at *Deadline 10 Submission - 9.67 Quantifying Uncertainty in Entrapment Predictions for Sizewell C) [REP10-135].*

Section 2.10: Sea bass stock area and Swansea Bay Tidal Lagoon

1.5.3 Commenting on Section 2.10 of SPP103.Rev5 [REP6-016], the Environment Agency requests further information on the justification of the sea bass stock size noting the Swansea Bay Tidal Lagoon (SBTL) applied an assessment at the scale of the Bristol Channel.

"Issue: Bass stock size: Cefas sees no justification to reduce or deviate from ICES stock unit for bass, which is described as a "conservative and [the] correct measure".

Comment: We note that in the Swansea Bay Tidal Lagoon (SBTL) proposed power plan. In the fish impact assessment (CD 9.118[13]) produced of this project CEFAS used much smaller population sizes than that of the ICES stock unit. For bass the Bristol Channel was identified and used as the smallest discrete population for this species.

[13] CD9.118 Tidal Lagoon Swansea Bay. Alternative Fish Impact Assessment – Addendum 1. Monte Carlo Analysis of Alternative Draw Zone Models, June 2017. Submitted as CD9.118 of the Hinkley Point C Water Discharge Activity (WDA) Appeal Inquiry on the Permit Variation Application Relating to Acoustic Fish Deterrent. Documents can be found here: https://ea.sharefile.com/share/view/sfb86ac1978a14420862086325f233f9f/fo0eb3c3-a748-4816-be7c-c98a687d4955

Suggested solution: Please provide information why a population size of the Bristol Channel and not that of the current ICES stock unit was considered appropriate by CEFAS for bass for the fish impact assessment of SBTL proposed power station but CEFAS sees no justification to deviate from the ICES stock unit in the case of the SZC proposed power station."

1.5.4 SZC Co. responded to this comment and comments raised by the Environment Agency on the SBTL in the written submissions[14] following Issue Specific Hearing 10 in [REP10-157].

1.5.5 The SBTL applied a fundamentally different type of model approach than at Sizewell that did not define absolute population sizes. Rather the SBTL assessment was based on scale to determine the proportion of fish lost because of the development. The SBTL assessment states "*Starting Population: this value has no bearing on the outcome of the model as predicted mortalities are always taken as proportional to this Starting Population. A nominal value of 100,000 individuals is used for each species to visualize the operation of the models"*.

1.5.6 In the case of Sizewell C, the assessment is informed by eight years of impingement monitoring at the adjacent Sizewell B station. This allows for the generation of absolute numbers of fish lost (with associated confidence intervals and uncertainty analyses) that can be compared to absolute numbers within the population. As described in Section 1.1, the spatial scale of the ICES stock area is for management purposes with the population not evenly distributed across the ICES stock area. In the Sizewell C assessment, it is the population size rather than the spatial area of the management unit that the population exists within, which is of greater ecological relevance. The population comparator applied as the comparator for Sizewell C losses is as defined by ICES, following a multistage international process with internal and external peer review that brings together experts in fish biology to define stock units. The application of absolute losses relative to the population size within the ICES stock unit, represents the best interpretation of current evidence that considers the biology and ecology of the species over its full life history.

Table 1: Application of revised SSB and landings statistics

1.5.7 Table 1 of SPP103.Rev5 [REP6-016] relates to the relevant stock units, mean SSB and landing statistics between 2009-2017 for the key species at Sizewell. The Environment Agency commented that *"SSB and catch information had been updated for many species. e.g. For sprat estimated SSB decreased by 12.6%, for bass SSB decreased by 6.0%, SSB for plaice*

[14] Environment Agency Deadline 7 Submission - Post Hearing submissions including written submissions of oral case [REP7-131].

increased by 40%". The Environment Agency questioned whether TR406[15] would be revised based on the figures and requested the latest values be included in the update.

1.5.8 ICES keeps stock definitions under continuous review and adjusts these definitions when the weight of scientific evidence indicates that a change is appropriate. As additional landings data sources become available or models refined to improve fore/hindcasting of annual SSB, ICES updates their advice. Table 1 of SPP103.Rev5 [REP6-016] provided information on the latest ICES stock sizes and landings data for the period 2009-2017. Changes in SSB or landings and the directionality of change is provided thereby ensuring the most up-to-date data was incorporated into the assessments during the Sizewell C Examination. As stated in SPP103.Rev5 [REP6-016], the latest SSB and landings data used as comparators for the impingement effects was applied in impingement and entrainment effects. In addition to the application of mean SSB (or landings data), the uncertainty analysis used the variance in these parameters as part of the determination of effects (*Deadline 6 Submission - 9.67 Quantifying Uncertainty in Entrapment Predictions for Sizewell C - Revision 1.0 [REP6-028]* and revised following comments at *Deadline 10 Submission - 9.67 Quantifying Uncertainty in Entrapment Predictions for Sizewell C) [REP10-135].* BEEMS Technical Report TR406 will be updated (to Revision 8) and provided to the Environment Agency following the completion of the Examination and Permit Determination to collate updates and comments during the process. The data and results presented during the Examination reflect the final position of SZC Co.

Table 7: Depletion results

1.5.9 The Environment Agency has pointed to occasions where the percentage depletion quoted in the text and Table 7 of SPP103.Rev5 [REP6-016] do not match. We confirm that in the case of cod the % depletion ranges for the realistic best- and worst-case FRR mitigation efficiencies were incorrectly reported in the text. The values in Table 7 are correct (best case 6.4% - worst-case 11.5%). In the case of the epi-benthic species, the best-case FRR uncertainty ranges reported in the text are correct for Dover sole (2.2%) and plaice (1.8%).

[15] BEEMS Technical Report TR406 '*Impingement predictions based upon specific cooling water system design'* pdf pg. 66 of Additional Submission in relation to the Applicant's request for changes to the application and Additional Information - 6.14 Environmental Statement Addendum Volume 3: Environmental Statement Addendum Appendices Chapter 2 Main Development Site Appendices 2.17.A Marine Ecology [AS-238].