The Atlantic bluefin tuna

Everything you thought you knew.....

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For decades the scientific understanding of Atlantic Bluefin tuna was centred on a number of key pillars. These pillars informed stock assessments and quota decisions. From around 2016 some serious questions began to be raised about this 'received wisdom', topped off by a seminal research publication that questioned some fundamental assumptions about BFT spawning areas.

In 2020 ICCAT's scientific arm published its periodic assessment and advice. For the first time, ICCAT acknowledged that much of what they thought they knew about tuna was subject to questioning.

We first published this article commenting on that assessment in 2021 but with the 2022 assessment underway and a new report in coming months, we thought it would be useful to revisit it.

Who are 'we'?

The UK Bluefin Tuna Association is a not-for-profit membership organisation established by anglers, charter skippers and fishing organisations to represent anglers interests in relation to bluefin. Its mission is to campaign for a sustainable management strategy, to support research into their presence here, and to seek the establishment of a ***recreational catch and release fishery*** for them our waters.

The people behind the UKBFTA set up 'BFT UK' back in 2018 and engaged with government bodies, lobbying to have anglers voices heard. We gathered cross party political support and a seat at important policy making tables and meetings with senior UK Government officials including Fisheries Ministers.

We won, co-designed and delivered with DEFRA, CEFAS and other bodies the hugely successful English 2021 CatcH And Release Tagging ('CHART') programme. We have subsequently secured an expansion of the English programme in size and season length, and the establishment of CHART programmes in Wales and Northern Ireland in 2022.

We claim no monopoly on representing anglers and skippers interests, but believe we incorporate in our ranks the greatest combined expertise in the UK, on the science, regulations and fishing for bluefin, have a proven track record in working with political representatives, government departments, E-NGO's and other bodies to ensure that an evidence based approach is used in determining policy.

Turning Atlantic Bluefin tuna science on its head.....

In September 2020, the scientific research arm of ICCAT, the SCRS, published their 'Advice' paper as part of the Triennial stock assessment and quota discussion process.

The mixing between the two stocks, in particular from east to west, is acknowledged to be much greater than previously thought, and that the mixing occurs for reasons other than for foraging purposes.'

Within that report, research of the last 3-4 years revealed some of the most significant changes ever in their thinking about bluefin biology, migration and genetic make-up.

Some of those changes were not acknowledged or barely represented in the last Triennial report in 2017. They represent a seismic shift in our understanding of Atlantic bluefin.

ICCAT now openly acknowledge the existence of multiple spawning locations outside the two previously assumed to be the exclusive areas of reproduction.

They finally question the longstanding assumption that 'Western Atlantic bluefin' reach maturity at around 9 years old, 4 years later than bluefin of the Eastern/Atlantic/Mediterranean.

(The three points above were previously postulated in a key 2016 University of Massachusetts/NOAA paper).

Significantly, ICCAT reveal the existence of an additional 'intermediate genetic' group of ABFT, originating in the recently (2016) discovered Slope Sea spawning area off the US NE Seaboard.

These changes do have significant implications for our understanding of bluefin, their stock status and data modelling, and ultimately their stock-management.

In this article we will look at some of these changes in more detail, but first it is worth reminding ourselves of the fundamental premises that have for 30-40 years been the foundation of ABFT management, and are now being dismantled.

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A tale of two fishes....

The most fundamental premise was the 'two stock hypothesis'.

The received wisdom was that there was a small, 'Western Atlantic (WA) stock', and a much larger 'Eastern Atlantic/Mediterranean (EA/Med) stock', and that these two stocks were genetically distinct.

It was thought that some small degree of mixing between the two stocks occurred but this was assumed to be limited to migrations related to seasonal feeding patterns. For management purposes, a line was drawn at the 45 degree West meridian. Quota allocation and fishing areas were associated with either one of the zones.

Fundamental to this two stock hypothesis was the big assumption that the WA stock spawned exclusively in the Gulf of Mexico, and the EA/Med stock spawned only at various locations within the Mediterranean.

The final 'big assumption' was that the WA stock matured and began spawning at a much later age than that of the EA/Med, circa 9 years old versus 5 years old……

The first shots in a revolution.

In 2016 a research paper published by highly regarded marine Biologists from the University of Massachusetts Boston, and the US Governments fisheries scientists, NOAA, threw a hand-grenade into these cosy assumptions. What had previously been whispered and inconclusively argued, was now a comprehensively researched argument, questioning decades of 'scientific wisdom'.

'We present unequivocal evidence that Atlantic bluefin tuna spawn in the Slope Sea, counter to the current assumption that the Gulf of Mexico and Mediterranean Sea are the exclusive spawning grounds. We also demonstrate that age at maturity of western bluefin tuna is currently overestimated, that this stock exhibits size-structured spawning migrations, and that migratory connections exist between western and eastern Atlantic spawning grounds.'

The Slope Sea is an area off the US North Eastern Seaboard, South of New England and East of the US Mid Atlantic States of Pennsylvania and New Jersey. As is often the case with such non-consensus thinking, these findings were met with derision by many who had developed and championed the previous assumptions.

Since 2016 however, the evidence supporting these theories has grown, and indeed subsequent research now supports the idea of other spawning sites across the North Atlantic in addition to the Slope Sea. The University of Massachusetts/NOAA paper however really marked the beginning of a revolution in the scientific communities thinking about Atlantic bluefin' biology, reproduction and distribution.

Multiple spawning sites.

The 2016 'Slope Sea' paper opened the debate on spawning locations, stock mixing and reproductive levels ('recruitment') that has reached a deafening level in the last few years.

Regarding the existence of other spawning locations, it is now widely accepted that there are more Atlantic Bluefin spawning locations across the North Atlantic. ICCAT are now acknowledging this but argue that more data is required before they can consider incorporating such fundamental changes into their assessments.

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SCRS 2020 Advice:

'Evidence indicates that spawning (occurs) in other areas, for example the vicinity of the Slope Sea off the Northeast USA and more recently the Cantabrian Sea, though the persistence and importance of these other areas as spawning grounds remain to be determined.' Larval samples gathered in the Bay of Biscay had previously included those of Atlantic Bluefin, in conditions indicating they could NOT have been transported there from the Mediterranean.

These Bay of Biscay larval samples represent a potentially significant discovery that will be the subject of much research in coming years. Initial reports from multiple satellite tagging programs in Ireland, the UK, Denmark and Sweden since 2017 are underlining the potential significance of this area. Those studies are also suggesting other 'areas of interest', with regard to possible spawning locations, including the Canary Islands.

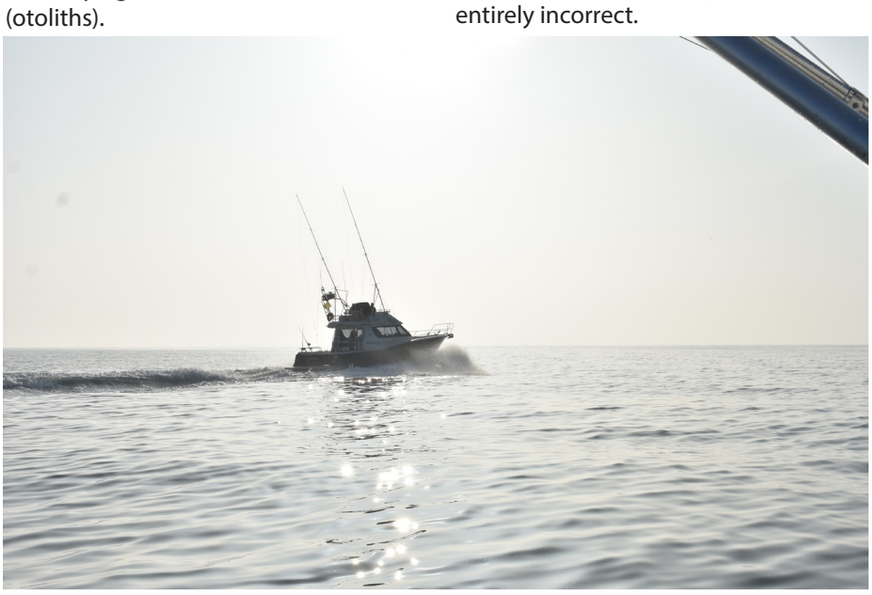
One last point re spawning locations is raised in the '2020 SCRS Advice' when the authors talk about some of the new, high-tech chemical analysis they are carrying out on bluefin ear bones (otoliths).

'In addition, for the first time the high-precision secondary ion mass spectrometry (SIMS) was used, with the aim of providing high resolution estimates of oxygen stable isotopes along otolith growth transects. Examination of the relative patterns between individuals indicated substantial variability in environmental histories during the first few months of life. The results support the hypothesis that some individuals are retained within homogenous water masses during early life, while others are exposed to wide variation in water chemistry.'

This appears to suggest that there are quite significant differences between the habitat conditions encountered by recently spawned fish, underlining the existence of multiple, environmentally varied spawning locations. If so, this might also question some of the assumptions about the environmental requirements for a successful spawning locale…?

Late developers, or not?

Similarly, the previously assumed but counterintuitive difference in bluefin sexual maturity between 'Western' and 'Eastern' fish is increasingly seen as not entirely incorrect.



What now seems more likely is that older fish were spawning in the GoM, whilst younger fish were spawning in locations further North along the US Eastern seaboard, with the Slope Sea being of particular significance.

ICCAT have yet to fully accept this but the '2020 SCRS Advice' stated: 'Currently, the Committee assumes for assessment purposes that eastern Atlantic and Mediterranean bluefin tuna contributes fully to spawning at age 5.

There are also indications that some young individuals (of age 5) of unknown origin caught in the West Atlantic are mature, but there is considerable uncertainty with regards to their contribution to the western stock spawning.

Therefore, the Committee has considered two spawning schedules for the western stock; one identical to that used for the East and one with peak spawning at age 15.'

Changes in the assumed age of maturity influence estimates of recruitment, and the vulnerability of the stock. So these are significant acknowledgments that several foundations of the long-held scientific assumptions are no longer 'gospel'….

If 'this stock exhibits size-structured spawning migrations,' as UMass/NOAA proposed in 2016, then why is that the case? Why are older fish the dominant cohorts in the GoM?

Has it always been this way, or is it a recent development linked to factors such as environmental/habitat change? The 'genetic coding' that drives spawning site fidelity (fish returning to their 'point of origin'), takes time to work itself out of a stock.

Is this a process which will ultimately see the GoM replaced as a spawning location completely? These are key questions yet to be fully answered.

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Stock mixing.

The dogma for 40 years was that the two ABFT stocks exhibited spawning site fidelity and only intermingled on a limited scale via cross Atlantic seasonal (Autumnal) migrations to fatten up after spawning.

There has been evidence for decades of cross Atlantic migrations, with the presence of 'Western fish' in the East and vice versa, (Ireland's 2003/4 tagging programs were an eye opener with regard to this). However, the 'meet and eat' theory remained the sole explanation for this mixing amongst the consensus.

Satellite tracks that didn't confirm a return to 'home spawning grounds' each spring, and Genetic analysis that didn't clearly identify fish as being from one distinct 'stock' or another were dismissed as, 'errors', 'outliers', or 'skip spawners' (some scientists believe that bluefin may skip spawning in some years).

However...

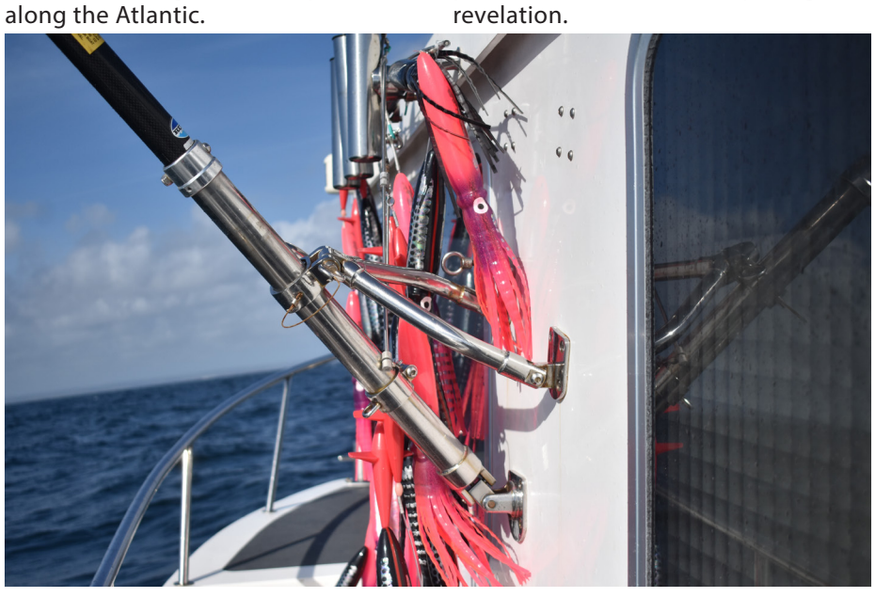
The 2020 SCRS Advice confirmed a shift at last in this thinking:

'…..more in-depth analyses have shown that the population dynamics of ABFT are more complex than a pure homing behaviour to the two main spawning grounds (the Mediterranean and the Gulf of Mexico), with feeding aggregates mixing in the Atlantic'…… The results of genetic and integrated analyses show that BFT present more complex population dynamics than previously thought…..'

The 'more in-depth analyses ' included genetic and environmentally linked research (otolith microchemistry, new carbon and oxygen stable isotope analyses), which is revealing not only much greater rates of mixing of the stocks in their travels, but the extent to which the 'Mediterranean genetic profile' is appearing in the Western Atlantic.

'Possible evidence of trans-Atlantic migration of adult fish was also recorded in some otolith chemistry profiles.' >2400 samples)… 'from feeding aggregations, including 470 newly genotyped samples, completing the mixing map of the Gulf of Mexico and Mediterranean genetic components along the Atlantic.

Indeed, the Mediterranean genetic profile was majoritarian at every sampled location except for Nova Scotia and Newfoundland.' In other words, 'Eastern' fish actually appeared to be making up the majority of bluefin encountered in the sampling of fish in most of their Western Atlantic locations.
It is already known that the EA/Med stock comprises over 90% of the global stock, but the extent of their presence in the WA is a surprising revelation.



Assignments using the new genetic-informed baseline produced higher assignment rates than those calculated using the original location-informed baseline, both analyses confirming high mixing in Western locations.'

'Besides, when using the genetic-informed baseline, lower proportions of unassigned samples were obtained.

The addition of the newly genotyped samples completing the mixing map along the North Atlantic Ocean confirmed previously observed patterns, revealing strong mixing of eastern and western genetic origin individuals in the west Atlantic.

(It may however be a least partly explained by further revelations about the genetic composition of the stock... see below).
One further interesting output from the satellite tagging of 'EA/Med Bluefin' raised further questions though about these migrations.

Satellite tag tracks of relatively young 'Eastern' Bluefin have showed them visiting the Slope sea during the spawning season.

Little explanation was forthcoming from the traditionalists as to whether this was a form of 'grand tour' amongst recently matured bluefin, or possibly something more fundamental? 'Sex tourism?!'

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All in the genes…

The 2020 SCRS Advice not only acknowledged increasing evidence of multiple spawning sites, and much greater stock mixing than previously believed, but that the fundamental premise of just two distinct Western and Eastern Genetic stocks is also wrong….

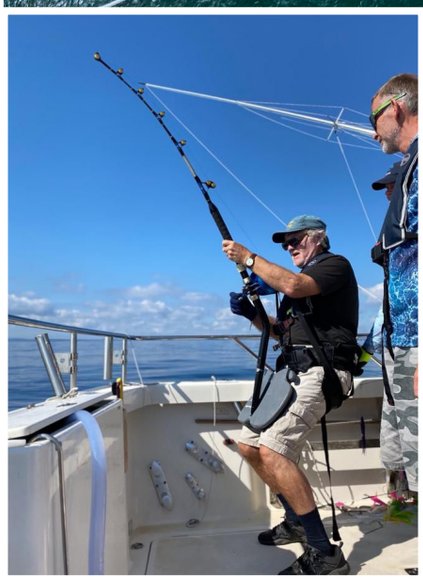
They report that 'more in-depth analyses ' of the genetics of bluefin revealed: 'First, individuals with Mediterranean genetic background are found within the Gulf of Mexico and, second, the Slope Sea constitutes a genetically intermediate population,which might explain why some individuals cannot be assigned to either population and why some Gulf of Mexico individuals are assigned to the Mediterranean Sea.'

'In addition, the contribution of the individuals born in the Slope Sea to each of the two main stocks is not clear as there is no way to differentiate them genetically.'

'Regarding the population structure of Atlantic bluefin tuna, gene-flow from the Mediterranean Sea into the Gulf of Mexico, most likely through the Slope Sea, was confirmed analyzing RAD-seq data from 535 individuals.

This acknowledgement of a genetically distinct, 'intermediate' stock of bluefin of Slope Sea origin goes even beyond what the 2016 UMass/NOAA paper postulated.

In conjunction with the evidence of much greater and more complex stock mixing, it raises significant questions about the validity of the 'two stock' management approach and the value of some of the modelling used in stock assessments.



And lastly….. The environment.

Another notable change is that for the first time, ICCAT also acknowledge that changing environmental factors may influence the distribution, abundance and even 'catchability' of bluefin across the North Atlantic.

'The reappearance of bluefin tuna in historical fishing areas (e.g. Norway and, more recently, the Black Sea) suggest that important changes in the spatial dynamics of bluefin tuna may also have resulted from interactions between biological factors, environmental variations and a reduction in fishing effort.'

They go on to recommend a change to incorporate such factors into the assessment and modelling processes going forward.

'Evaluate whether the current indices can be improved including through more explicit incorporation of environmental or ecosystem factors. Noting the potential role of ecosystem factors in affecting the interpretation of many indices, the Committee recommends that effort be directed towards both identifying environmental factors that affect catchability at basin and local scales and incorporating these factors in the index standardization or modelling…..'

'Habitat and environmental variables represent an important source of variability in existing indices of BFT relative abundance, the Committee recommends continued explorations of factors that may account for differential availability or catchability.'

Note that these are likely to be variables beyond just the man-made climate change factors, and incorporate the kind of long term climatic cycle changes such as the decades long cyclical shifts in various North Atlantic currents.

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Conclusion.

The '2020 SCRS Advice' publication has within it, some very significant, if belated acknowledgements of a major shift in our understanding of Atlantic Bluefin.

The UMass/NOAA paper in 2016 argued that the existence of more spawning sites, the real lower age of maturity of Western fish, and greater stock mixing REDUCED the vulnerability of ABFT to threats from overfishing and environmental shifts.

They argued that the stocks might be in better shape than the stock assessments were indicating, (even as those assessments were already indicating a marked recovery from the lows of 2005/2010 in response to comprehensive long term stock recovery plans). Those conclusions were the ones most subject to vitriolic rejection by some of the most extreme 'enviro-bullies'.

However, the 2020 SCRS Advice publication confirms that in the five years since that UMass/NOAA paper was published:

The existence of Multiple spawning sites across the North Atlantic is now widely acknowledged, including by ICCAT.

The apparent disparity between Western and Eastern fish's age of sexual maturity is now widely dismissed and even ICCAT are incorporating alternative assumptions into their stock modelling.

Much greater levels of stock mixing across the Atlantic than previously believed are being recorded via a variety of techniques.

The existence of an additional 'genetically intermediate' stock of fish originating in the Slope Sea is revealed, demolishing the idea of just two, distinct genetic pools.

The possible influence of environmental factors in the abundance and distribution of ABFT across the North Atlantic is acknowledged.

All of these have the potential to drive a major rethink in the assessment of the health of Atlantic Bluefin Tuna.

In the case of several of these factors, (multiple spawning sites, additional genetic mixing, the existence of a new 'genetically intermediate stock'), they are positive elements in boosting the resilience of the stock to various shocks, and are very constructive in terms of the outlook for ABFT.

Covid-19 limited the ability of ICCAT to incorporate this new thinking into the 2020 Stock assessments as plans to update models fell victim to cancelled meetings.

Only 'strict updates' took place based largely upon the same models as in 2017.

In 2021 ICCA continued its work in refining models as part of the new Management Strategy Evaluation and the stock assessment taking place through 2022 will benefit from that work. This should go some way to reducing some of the uncertainty about the precise extent of the recovery of the last 10 years. We should acknowledge the work that got us here, and will take us forward.

It may be undertaken by an army of very smart scientists, but also in many many cases, the data they utilised, is sourced from or with the help of recreational fishermen.

Citizen science is at the forefront of this explosion in our knowledge, and we should ensure that recreational fishermen continue to play a key role in this crucial work.

The UKBFTA is currently open to membership from licensed Charter vessels owner/operators and will open to individual members in early 2023.

You can find more details about us, our objectives and activities on our social media pages.

On Facebook: The UK Bluefin Tuna Association.

Website: www.ukbfta.co.uk
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