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# 2025 SLOPE SEA LARVAL BLUEFIN TUNA SAMPLING DESIGN, INITIAL CATCHES, AND POTENTIAL UTILITY OF THESE SAMPLES IN FURTHER RESEARCH

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*SUMMARY*

*The Slope Sea was sampled from 18-22 July 2025 with the specific objective of catching high numbers of bluefin tuna larvae for further study. A total of 69 plankton tows were made, with about half containing bluefin tuna larvae in an initial rapid shipboard analysis of samples. To date, limited plankton processing at the lab has already yielded thousands of bluefin tuna larvae. We anticipate these samples will be an important input into multiple studies of bluefin tuna population structure and life history. In particular, we discuss the longstanding questions on the nature of Slope Sea spawning that we anticipate being answered once these samples, and samples from future larval collections, are included in the western Atlantic bluefin tuna close-kin mark-recapture project.*

*RÉSUMÉ*

*La Slope Sea a été échantillonnée du 18 au 22 juillet 2025 dans l'objectif spécifique de capturer de grands nombres de larves de thon rouge pour une étude complémentaire. Au total, 69 prélèvements de plancton ont été effectués, dont environ la moitié contenait des larves de thon rouge lors d'une première analyse rapide des échantillons à bord du navire. À ce jour, le traitement limité du plancton en laboratoire a déjà permis de produire des milliers de larves de thon rouge. Nous prévoyons que ces échantillons constitueront une contribution importante à de nombreuses études sur la structure et le cycle vital de la population de thon rouge. En particulier, nous discutons des questions de longue date sur la nature du frai de la Slope Sea, auxquelles nous prévoyons de répondre une fois que ces échantillons, et les échantillons des futures collectes de larves, seront inclus dans le projet de marquage et récupération de marques apposées sur des spécimens de thon rouge de l'Atlantique Ouest étroitement apparentés.*

*RESUMEN*

*Se realizaron muestreos en el mar de Slope entre el 18 y el 22 de julio de 2025 con el objetivo específico de capturar un gran número de larvas de atún rojo para su posterior estudio. Se realizaron un total de 69 operaciones con redes de plancton, y aproximadamente la mitad de ellos contenían larvas de atún rojo, según un análisis rápido inicial de las muestras a bordo del buque. Hasta la fecha, el procesamiento limitado de plancton en el laboratorio ya ha producido miles de larvas de atún rojo. Prevemos que estas muestras serán una aportación importante para múltiples estudios sobre la estructura de la población y el ciclo vital del atún rojo. En concreto, analizamos las cuestiones que desde hace tiempo se plantean sobre la naturaleza del desove en aguas del mar Slope, que esperamos poder resolver una vez que estas muestras, junto con las muestras de futuras recolecciones de larvas, se incluyan en el proyecto de marcado y recaptura de individuos estrechamente emparentados de atún rojo del Atlántico occidental.*

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*KEYWORDS*

*Slope Sea; larvae; bluefin tuna; population structure; close-kin mark-recapture*

## 1. Introduction

Atlantic bluefin tuna spawning in the Slope Sea, between the northeast U.S. continental shelf and Gulf Stream, is well established. Archived plankton samples have revealed the presence of bluefin tuna larvae in the Slope Sea in 16 different years dating back to 1976 (Richardson *et al*. unpubl. data), with abundances comparable to the annual larval survey in the Gulf of America/Gulf of Mexico (Richardson *et al*. 2016a; Hernández *et al*. 2021). In addition, multiple reproductive (Goldstein *et al.* 2007; Heinisch *et al.* 2014) and electronic tagging studies (Lutcavage *et al.* 2013; Aalto *et al*. 2023) over decades support bluefin tuna spawning in the Slope Sea. What is less well established is the role of Slope Sea spawning in the population structure and life history of Atlantic bluefin tuna. Mather et al. (1995) put forward a hypothesis that Atlantic bluefin tuna have size-structured spawning grounds in the West Atlantic Ocean, with individuals switching from Slope Sea spawning early in life to Gulf of America/Gulf of Mexico spawning later in life. Alternatively, it has been suggested that Slope Sea spawners represent a unique third population, distinct from Gulf of America/Gulf of Mexico and Mediterranean Sea spawners, with the size structure of individuals spawning in the Slope Sea similar to individuals spawning in the Gulf of America/Gulf of Mexico (Aalto e*t al*. 2023). A third hypothesis is that Slope Sea spawners are "eastern" bluefin tuna, and that there is thus a unique Gulf of America/Gulf of Mexico population and a pan-Atlantic population made up of combined Slope Sea and Mediterranean Sea spawning fish. More complicated population structures with different types of intermixing among all spawning grounds have also been proposed (Díaz-Arce *et al.* 2024).

One of the major impediments to understanding how Slope Sea spawning fits into the population structure and life history of Atlantic bluefin tuna is the limited number of biological samples, including larvae, from the region. The majority of larvae have been collected on marine mammal surveys with limited plankton sampling conducted once every 3-5 years. These larval collections have been analyzed in various studies (Hernández *et al*. 2021), including studies of population genetics (Rodríguez-Ezpeleta *et al*. 2019; Díaz-Arce *et al*. 2024). However, the number of properly preserved (e.g. ethanol fixed) larvae from a range of stations has been insufficient to meet all needs.

In 2025, NOAA funded two projects to collect biological samples from bluefin tuna in the Slope Sea during the spawning season. The first sampling, with lead-PI Dr. Molly Lutcavage, was a 14-day commercial fishing trip on a contracted longline vessel. The second research cruise, described here, included 5-days of dedicated larval sampling on the NOAA Ship *Pisces*. The primary goal of the larval sampling was to support the ongoing close-kin mark-recapture project, with the secondary goal of obtaining larvae for additional studies of bluefin tuna population genetics and early life history.

The purpose of this paper is to document the larval sampling methods, the station data, and to provide very preliminary information on the bluefin larval sample availability. We then discuss some of the questions to be addressed by the incorporation of these Slope Sea larval samples into the close-kin mark-recapture framework. Finally, we describe protocols for sharing larval samples with outside researchers that are intended to maintain the independence of these groups' scientific inquiries, while optimizing synergy among the various research projects.

## 2. Methods

The NOAA ship *Pisces* departed Norfolk, Virginia on 15 July 2025 and returned to Newport, Rhode Island on 23 July 2025. All plankton sampling occurred in the Slope Sea, between the northeast U.S. continental shelf and the Gulf Stream. The first 3 days of the cruise (15-17 July 2025) were reserved for a mandated Operational Readiness Training for the ship's crew (including two test plankton tows) and the last day was the transit return to port. Plankton sampling thus occurred from 18-22 July 2025, which is about one week after the estimated date of peak larval bluefin tuna occurrence in the region (**Table 1**; **Figure 1**).

Sampling was designed to support the ongoing close-kin mark-recapture (CKMR) project. The objective of the plankton sampling for CKMR is to maximize the number of unique parents of the larval bluefin tuna in the collection. We thus sought to maximize our larval catch while also trying to reduce sibship within the catch by sampling a broad spatial domain. Strategies for maximizing catch included choosing a gear and tow protocol targeted for bluefin tuna larvae, rapid shipboard sorting of samples to evaluate catch, repeated resampling of high abundance locations, and evaluations of satellite sea surface temperature imagery and underway temperature and salinity data to inform sampling locations. Previous work in the Gulf of America/Gulf of Mexico provides estimates of the levels of sibship in patches of bluefin tuna larvae (McDowell *et al.* 2022; SCRS/2025/070). That work informed our decisions on when to move on from resampling a location. We also factored in knowledge that: 1) smaller larvae within a patch will likely have higher sibship, 2) higher abundance tows will likely have more unique parents for a given number of larvae, and 3) for a given larval abundance and size-structure, sibship levels within a patch may be lower in the Slope Sea if adults are smaller and spawn fewer eggs per individual than larger size adults spawning in the Gulf of America/Gulf of Mexico.

All plankton sampling followed the standard protocol used in the Mediterranean Sea (Anonymous 2023) and in some targeted sampling in the Gulf of America/Gulf of Mexico (Gerard *et al.* 2022). This methodology, described at the 2023 ICCAT GBYP workshop on Atlantic bluefin tuna larval indices, has not been previously used in the Slope Sea. We used a steel 90-cm bongo frame with 505 µm mesh nets, a 45-kg depressor weight and a Sea-Bird Electronics SBE Model 19+V2 profiling CTD attached above the frame (**Figure 2A**). Target tow times were approximately 10 min. with a maximum sampling depth of 20 m. The typical tow profile was two descents and ascents of the net (i.e. a "W shaped" tow profile). Of note, we used a zipoff 250 µm mesh cod-end bag, which differed from previous work that maintained the 505 µm mesh in the cod end. Both plankton samples (i.e. left and right net) were preserved immediately in 95% ethanol, and a partial sort was performed at-sea under the microscope to rapidly evaluate larval bluefin tuna abundance. No formal attempt was made to estimate the proportion of each sample sorted shipboard. Individual bluefin tuna removed at sea were preserved in 2 ml tubes in ethanol and placed in the freezer.

Sampling moved from west to east across the Slope Sea and eventually reached the edge of a Warm Core Ring at about 67° W (**Figure 1**). At the first station, sampled on 18 July 2025, a high number of ≈3 mm bluefin tuna larvae were caught. This location was resampled a total of 10 times over a 10-hour period. At a location sampled on 19 July, high numbers of scombrid yolk-sac larvae were sampled and a total of 3 stations were sampled at this location. Species-level identification of these yolk sac larvae has not been finalized. One location, which did not have high larval abundances in the net, was resampled on 20 July during the drifting light trap deployment (next paragraph). Two other locations were resampled during the cruise based on the results of the initial rapid sort.

On 20 July 2025 we tested the use of a drifting light trap for sampling bluefin tuna larvae (**Figure 2B**). The motivation for this work was twofold: 1) the desire to have a passive sampler that is readily deployed from smaller vessels, and 2) the desire to catch >10 mm bluefin tuna (late-stage larvae/early juveniles), which readily avoid plankton nets. The drifting light trap combined two well tested pieces of equipment. We used the low-cost drifters available through the Gulf of Maine Lobster Foundation (https://www.gomlf.org/drifters/). These surface drifters provide GPS signals at 5-min. intervals allowing near real-time tracking of locations. Below the drifters we attached a mesh light trap, common in coral reef fish studies (Sponaugle *et al.* 2005; Shulzitski *et al.* 2016). A long rope with two buoys was then attached to the drifter to allow the gear to be retrieved with a grappling hook. We tested both a white light and a blue light in the two light traps we deployed.

## 3. Results

Bluefin tuna larvae were found in about half of the 69 tows during the partial shipboard sorting of samples. Sample sorting in the lab is expected to increase the proportion of samples positive for bluefin tuna larvae. High counts of larvae were obtained during the 10 tows resampled at the first station (37.66° N; 73.00° W). Initial larval counts from the full processing of one of two paired nets at stations 3, 6, 9 and 12 in this patch were 880, 681, 556, and 521 respectively for a total of 2638 bluefin larvae from the 4 nets. Samples from the other 16 nets sampled in this patch remain unprocessed as of 11 September 2025. A large majority of these larvae were in the 3 mm size range, though some larger (≈6 mm) individuals were sampled. Station 18 (37.74° N; 71.78 °W) also had a high count of larvae (402 in one net) (**Figure 2C**), but was not recognized shipboard as a high abundance station. Stations 23-25 (38.75° N; 71.05° W) contained high numbers of yolk sac scombrid larvae that may or may not be bluefin tuna. The yolk sac larval stage of some scombrid species remains undescribed or poorly described. At this time, we consider it important to use genetics to confirm morphological identifications of any yolk sac scombrid larvae. A successful blind test of morphological identification criteria for the yolk sac stage of the dominant scombrid species

in the region is a clear research need (Anonymous 2023). Sampling at stations in the northeastern area of the sampling domain had a consistent presence of larger bluefin tuna larvae, but in sorting so far, individual nets have produced ≤20 larvae per sample.

Two light traps were deployed simultaneously for about 4 hours. These light traps were deployed a couple of minutes and 30-80 m apart off the starboard stern of the vessel. At some point during the period of their deployment they became tangled and were retrieved together. Catches in the light traps included 9 juvenile *Auxis* sp. ≈30-60 mm standard length, as well as two individuals (23 and 34 mm standard length) tentatively identified as juvenile *Thunnus* sp. (**Figure 2D**). Further analysis (genetics, osteology) is required to evaluate the species-level identifications of these juveniles. One morphologically identified bluefin larva 9.2 mm was also caught. Weather conditions and the short duration of the cruise prevented the planned further evaluation of the light traps.

## 4. Discussion

### *4.1 Bluefin catch levels and plankton gear performance*

An estimated total count of larvae for the cruise will not be available until mid-2026. All processing to date has focused on one of the two samples (i.e. Net 1 of 2) collected during each tow and only about 13% of the stations have had a sample fully sorted in the lab (as of 11 Sept 2025). The remainder of samples were partially sorted at sea. Despite the limited sample processing done to date, it is reasonable to conclude that the 2025 Slope Sea cruise will result in the highest larval bluefin tuna catch numbers for any cruise to date in the western Atlantic and adjacent basins.

Our gear (90-cm bongo; 505-µm mesh nets) and tow protocol (10 min; 1.5-2 kts; a 20-m max depth) is used on an ongoing basis in the Mediterranean Sea and in previous work in the Gulf of America/Gulf of Mexico. We chose this protocol to follow the recommendations of the ICCAT bluefin tuna larval workshop (Anonymous 2023). One difference in our gear was the use of a 250-µm mesh cod end bag, which may have increased the retention of smaller larvae. In comparison to the standard protocol for NOAA surveys (60 cm bongo; 333-µm mesh; 200 m depth; 20-40 min tow), the protocol we followed samples 10-15 fold the volume of water in the upper 20 m of the water column where larval bluefin tuna occur. In theory catch numbers are expected to increase by a similar factor to the increase in volume. Unfortunately, due to the truncated cruise schedule we did not conduct any paired gear comparisons to measure actual catch rate differences between gear types. We are thus cautious in our comparisons of larval abundances to previous work, but do note that a few stations contained among the highest standardized abundances (larvae/10 $m^2$) of bluefin tuna larvae sampled in the West Atlantic over the past half-century. For future work, we are particularly interested in evaluating the impact of using a finer-mesh cod-end bag, as the high catch rates of yolk sac scombrid larvae (which have yet to be identified to species) exceeded our expectations given the use of a 505-µm mesh in the body of the net.

The light trap deployments were extremely limited but were successful at sampling larger scombrids. While a majority of these individuals were *Auxis* sp., two were *Thunnus* sp., and an addition 9.2 mm individual was morphologically identified as a bluefin tuna. Most plankton net tows only catch scombrids <8 mm. Within the West Atlantic young-of-the-year bluefin tuna >20 cm have been caught using hook and line in late summer and early fall, but observations have been very limited despite targeted efforts. The 1-6 cm size classes of scombrids caught in the light trap are extremely uncommon in most sampling in the West Atlantic. More specifically, this size class was not caught in the plankton net tows done at any point during the cruise. The validation of an approach to capturing >8 mm larvae and early juveniles would enable new lines of research on the early life history of scombrid species, including bluefin tuna, and would provide individuals for the CKMR project that likely have very low sibship levels. Importantly, all deployment, and retrieval of this gear was done by hand (i.e., a winch was not required) and could be readily implemented on nearly any size vessel. The cost of this gear was also low. This approach warrants further testing.

### *4.2 Utility of samples in the Close Kin Mark Recapture project*

The cruise was primarily motivated by a desire to integrate larval samples from the Slope Sea into the western Atlantic bluefin tuna close-kin mark-recapture project. Since 2016, sampling in the Gulf of America/Gulf of Mexico provided ≈4000 larvae to the CKMR project. This number of larvae is sufficient to provide a reasonably precise population estimate when combined with the scale of sampling in the fishery (1000-3000/year; >10,000 fish total). The 2025 Slope Sea larval sampling will exceed all the Gulf sampling in terms of the number of larvae

collected. However, the actual utility of this sampling in the broader CKMR project will be determined by the number of unique parents that spawned these larvae, which is currently unknown.

Aside from the role in refining population size estimates, the integration of the Slope Sea larvae into the close-kin mark-recapture project will provide an independent approach to addressing many of the persistent questions about Slope Sea spawning. Existing observations from tagging and prior reproductive studies have been used to generate alternate hypotheses about the role of the Slope Sea spawning ground in bluefin tuna life history (e.g. Richardson *et al.* 2016a; Aalto *et al.* 2023). These alternate hypotheses in turn can be used to predict the observations we expect to see from the inclusion of Slope Sea individuals in the CKMR study, prior to any samples being submitted for analysis. Below we lay out some of the predicted results of this work (i.e. preregistration in terminology of Nosek *et al*. 2018).

The size-structured spawning ground hypothesis proposes Slope Sea spawners will be on average substantially smaller than Gulf of America/Gulf of Mexico spawners (Mather *et al*. 1995; Goldstein *et al*. 2007; Heinisch *et al.* 2014; Richardson *et al.* 2016a). Alternatively, Aalto *et al.* (2023) proposed that there is little difference in the size classes of fish using the two spawning areas. With the current CKMR data, the average size of an adult bluefin tuna matched to a Gulf of America/Gulf of Mexico larvae is 250 cm, generally in line with expectations from previous studies. As Slope Sea larvae from 2025 are matched to adult bluefin tuna from the fishery it will be possible to resolve differences or similarities in the size structure of the two spawning grounds. Current sampling for CKMR in the West Atlantic is focused on commercial size fish (>185 cm), though efforts are being made to increase sampling of smaller fish caught in the recreational fishery. Regardless of these sampling dynamics, the size-structured spawning ground hypothesis predicts significant differences between the two spawning grounds in the average size and minimum size of bluefin tuna matched to larvae. These differences should be apparent even after just one year of sampling in the Slope Sea, given the rates of parent-offspring pairs observed in the study, provided the stock composition is similar.

The identification of half-siblings among years can allow for direct and clear evidence of both spawning site fidelity and individuals switching spawning grounds. Importantly, most hypotheses about the role of the Slope Sea spawning ground predict a high level of spawning site-fidelity. An individual that spawns for 6 years in the Slope Sea, switches spawning grounds, and then spawns for 6 years in the Gulf of America/Gulf of Mexico, will only have one year-to-year period of spawning ground switching and 10 year-to-year periods of fidelity to a spawning ground. The differences among hypotheses about spawning in the West Atlantic is whether year-to-year spawning site fidelity is absolute. Hypotheses that propose the Slope Sea is a completely different population from the Gulf of America/Gulf of Mexico assume absolute spawning site fidelity and predict no cross-spawning ground half siblings. The size structured spawning ground hypothesis predicts that these half siblings across spawning grounds will occur and that their frequency will increase with time up until a certain point (i.e. a higher probability of 2025 Slope Sea:2028 Gulf half siblings than 2025 Slope Sea:2026 Gulf half siblings). Obviously, the ability to detect these half-siblings is dependent on maintaining successful larval sampling programs in future years in both spawning grounds.

Richardson *et al*. (2016a) and Hernández *et al*. (2021) laid out the lines of evidence for characterizing the Slope Sea as a major spawning ground. In contrast a common statement in the literature is that there are "two major spawning grounds, the Mediterranean Sea and the Gulf of America/Gulf of Mexico," with the implication being that the Slope Sea is a minor spawning ground. If we assume there is some level of spawning site fidelity (see discussion above), the frequency of within spawning ground half sibling matches can be used to estimate the relative magnitude of spawning in each area. As an example, if two isolated spawning grounds share the same size structure of spawners and life history characteristics (growth, mortality), the spawning ground with a higher number of spawners will have a lower probability of cross-cohort half-sibling matches. The calculations are more complicated if spawning is size-structured, as the frequency of half sibling matches are based on the number of individuals spawning and their respective reproductive output and not total fish biomass. However, the basic principle remains that if the Slope Sea is a minor spawning ground then half sibling matches between years will be expected to occur at a high rate.

The final important question that will be addressed by integrating these larval samples into the close-kin mark-recapture project, and other studies, is: "How do Slope Sea individuals fit within the currently used frameworks of population assignment (typically Med-like and Gulf-like)?". These results can come directly through the genetic analysis of larvae or indirectly through the analysis of adults (e.g. otolith isotopes, genetics) matched to the larvae. It is beyond the scope of this paper to present a thorough discussion of this topic, and there are already some data available on Slope Sea larval genetics (Rodríguez-Ezpeleta *et al*. 2019; Díaz-Arce *et al*. 2024). However, one prediction of the size-structured spawning ground hypothesis is that Gulf of America/Gulf of Mexico spawners also spawned at an earlier age in the Slope Sea. If this is true, then the full distribution of

population assignments (or PCA scores etc.) from Gulf samples should also be represented in the Slope Sea samples. Notably, the reverse of all Slope Sea assignments being represented in the Gulf would not be predicted if there is size-structured spawning in the West Atlantic plus some additional mixing with eastern fish in the Slope Sea.

As should be obvious, many of the benefits of integrating the Slope Sea larvae into the CKMR projects will only be realized if larval sampling in both the Slope Sea and Gulf is sustained and successful in future years. A Slope Sea larval cruise is currently scheduled to occur in late-June 2026. The Gulf of America/Gulf of Mexico sampling of bluefin tuna larvae for CKMR occurs on the SEAMAP survey, which has been maintained for decades.

### *4.3 Sample availability*

We recognize that larval samples from the Slope Sea are a critical component of certain studies of bluefin population structure, and we encourage researchers to request and analyze these samples. Sample sharing agreements have been drafted that are intended to provide outside groups with the material and data they need while not interfering with the scope or independence of the science. At the same time, additional insights can be gained when results from multiple techniques are united, particularly when the analyses are run on replicate samples from the same fish. How data from these samples are managed, eventually made public, and openly discussed in a collaborative environment will affect whether these additional insights are realized.

### *4.4 Conclusions*

There were numerous calls for directed larval and longline cruises to the Slope Sea subsequent to the 2016 publication documenting the collection of larval bluefin tuna in the region *(e.g. Richardson et al. 2016b; Walter et al*. 2016). Both cruises were finally implemented in 2025 and both matched or exceeded targets in terms of collecting and sampling bluefin tuna. The longline and larval cruises were specifically designed to complement each other. The samples and data collected will support the implementation of multiple approaches to addressing prominent questions about bluefin tuna life history, spawning and population structure. Over the next few years, we anticipate that this sampling effort will help advance our understanding of bluefin tuna throughout the Atlantic.

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**Table 1.** Sampling locations and times. Stations with bluefin identified during a partial shipboard sort are noted with a +. Preliminary bluefin tuna larval counts are provided from the full sample sort at the lab (as of 11 Sept. 2025). Blank cells indicate no laboratory processing has occurred.

| Station | Date (GMT) | Latitude | Longitude | Net 1 BFT | Net 2 BFT | Note |
|---|---|---|---|---|---|---|
| 1 | 7/16/2025 19:04 | 36.82 | -74.03 | | | Test Tow: Net deployment issue- pulled in early to retow |
| 2 | 7/16/2025 19:23 | 36.81 | -74.04 | | | Test tow |
| 3 | 7/18/2025 3:56 | 37.65 | -73.01 | 880 | | Patch 1 |
| 4 | 7/18/2025 5:08 | 37.65 | -73.02 | + | | Patch 1 |
| 5 | 7/18/2025 5:59 | 37.64 | -73.01 | + | | Patch 1 |
| 6 | 7/18/2025 7:17 | 37.66 | -73.00 | 681 | | Patch 1 |
| 7 | 7/18/2025 7:59 | 37.66 | -73.00 | + | | Patch 1 |
| 8 | 7/18/2025 9:02 | 37.67 | -73.00 | + | | Patch 1 |
| 9 | 7/18/2025 10:14 | 37.65 | -73.00 | 556 | | Patch 1 |
| 10 | 7/18/2025 12:04 | 37.65 | -73.01 | + | | Patch 1 |
| 11 | 7/18/2025 13:04 | 37.66 | -73.00 | + | | Patch 1 |
| 12 | 7/18/2025 13:44 | 37.66 | -73.00 | 521 | | Patch 1 |
| 13 | 7/18/2025 16:28 | 37.41 | -72.75 | + | | |
| 14 | 7/18/2025 18:18 | 37.36 | -72.51 | | | Net deployment issue- pulled in early to retow |
| 15 | 7/18/2025 18:35 | 37.36 | -72.51 | | | |
| 16 | 7/18/2025 20:22 | 37.30 | -72.24 | | | |
| 17 | 7/18/2025 22:34 | 37.49 | -71.88 | | | |
| 18 | 7/19/2025 0:33 | 37.74 | -71.78 | 402 | | |
| 19 | 7/19/2025 2:58 | 37.99 | -71.66 | | | |
| 20 | 7/19/2025 5:46 | 38.25 | -71.54 | + | | |
| 21 | 7/19/2025 8:19 | 38.51 | -71.42 | | | |
| 22 | 7/19/2025 10:53 | 38.75 | -71.30 | | | |
| 23 | 7/19/2025 12:57 | 38.75 | -71.05 | ? | | Patch 2- Very high yolk sac larval counts-Need Genetic ID |
| 24 | 7/19/2025 13:46 | 38.75 | -71.05 | ? | | Patch 2- Very high yolk sac larval counts-Need Genetic ID |
| 25 | 7/19/2025 14:27 | 38.75 | -71.05 | ? | | Patch 2- Very high yolk sac larval counts-Need Genetic ID |
| 26 | 7/19/2025 16:09 | 38.75 | -70.80 | | | |
| 27 | 7/19/2025 18:43 | 38.61 | -70.60 | | | |
| 28 | 7/19/2025 20:41 | 38.48 | -70.41 | | | |
| 29 | 7/19/2025 22:43 | 38.33 | -70.20 | | | |
| 30 | 7/20/2025 0:37 | 38.19 | -70.00 | | | |
| 31 | 7/20/2025 2:35 | 38.05 | -69.80 | | | |
| 32 | 7/20/2025 3:58 | 37.98 | -69.72 | | | |
| 33 | 7/20/2025 5:01 | 37.98 | -69.73 | + | | Retows during light trap deployment |
| 34 | 7/20/2025 6:00 | 37.99 | -69.72 | | | Retows during light trap deployment |
| 35 | 7/20/2025 7:14 | 37.99 | -69.72 | | | Retows during light trap deployment |
| 36 | 7/20/2025 11:16 | 37.96 | -69.40 | | | |
| 37 | 7/20/2025 13:39 | 37.95 | -69.06 | 20 | | Patch 3 |
| 38 | 7/20/2025 14:30 | 37.95 | -69.05 | + | | Patch 3 |
| 39 | 7/20/2025 15:18 | 37.96 | -69.03 | + | | Patch 3 |
| 40 | 7/20/2025 16:26 | 37.96 | -69.03 | | | Patch 3 |
| 41 | 7/20/2025 16:58 | 37.96 | -69.03 | + | | Patch 3 |
| 42 | 7/20/2025 18:02 | 38.03 | -68.89 | | | |
| 43 | 7/20/2025 20:25 | 38.13 | -68.72 | | | |
| 44 | 7/20/2025 21:53 | 38.22 | -68.55 | | | |
| 45 | 7/20/2025 23:31 | 38.30 | -68.37 | + | | |
| 46 | 7/21/2025 1:17 | 38.43 | -68.37 | | | |
| 47 | 7/21/2025 2:59 | 38.60 | -68.37 | + | | |
| 48 | 7/21/2025 4:52 | 38.71 | -68.37 | | | |
| 49 | 7/21/2025 6:49 | 38.84 | -68.38 | | | |
| 50 | 7/21/2025 8:41 | 38.97 | -68.37 | | | |
| 51 | 7/21/2025 10:30 | 39.12 | -68.37 | + | | |
| 52 | 7/21/2025 12:14 | 39.24 | -68.36 | + | | |
| 53 | 7/21/2025 14:08 | 39.25 | -68.23 | | | |
| 54 | 7/21/2025 15:44 | 39.25 | -68.07 | | | |
| 55 | 7/21/2025 17:26 | 39.26 | -67.93 | 18 | | |
| 56 | 7/21/2025 18:17 | 39.26 | -67.93 | + | | Second Tow |
| 57 | 7/21/2025 18:52 | 39.25 | -67.92 | + | | |
| 58 | 7/21/2025 21:32 | 39.41 | -67.92 | + | | |
| 59 | 7/21/2025 23:07 | 39.54 | -67.92 | + | | |
| 60 | 7/22/2025 0:40 | 39.54 | -67.78 | + | | |
| 61 | 7/22/2025 2:16 | 39.55 | -67.62 | 9 | | |
| 62 | 7/22/2025 3:45 | 39.55 | -67.47 | + | | |
| 63 | 7/22/2025 5:19 | 39.55 | -67.31 | + | | |
| 64 | 7/22/2025 6:06 | 39.55 | -67.32 | + | | |
| 65 | 7/22/2025 7:40 | 39.55 | -67.17 | + | | |
| 66 | 7/22/2025 9:22 | 39.70 | -67.16 | | | |
| 67 | 7/22/2025 10:58 | 39.84 | -67.16 | | | |
| 68 | 7/22/2025 12:47 | 40.00 | -67.18 | | | |
| 69 | 7/22/2025 14:29 | 40.15 | -67.17 | + | | |

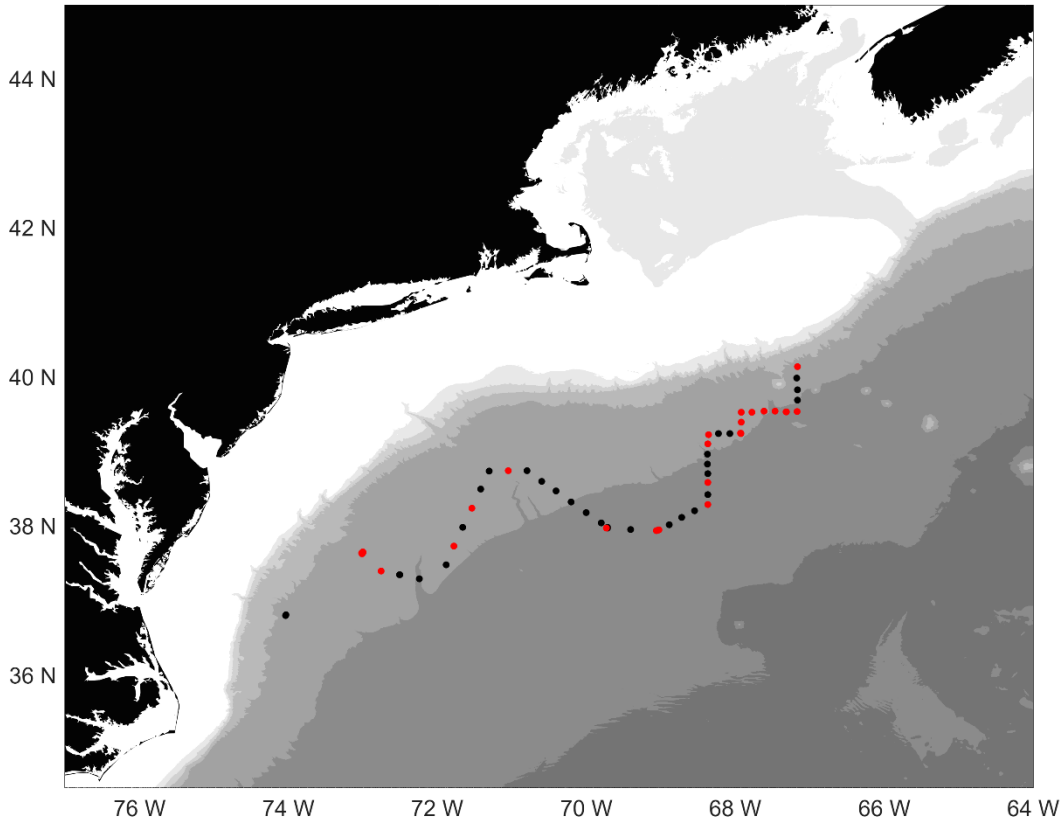


**Figure 1.** Map of the sampling area with sampling stations. Stations with catch of bluefin identified during a partial shipboard sort of the sample are plotted in red. A full accounting of positive stations will not be available until all samples are fully processed.

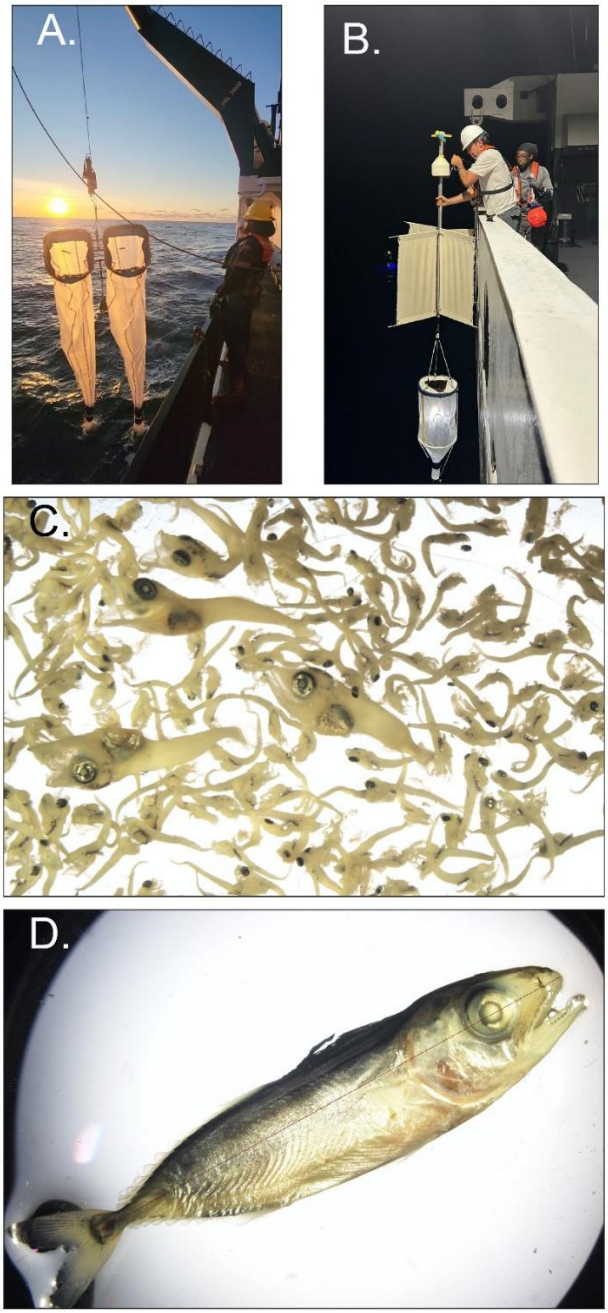


**Figure 2.** Sampling gear and catch on the 2025 Slope Sea survey. A) The 90-cm bongo frame was built following the design used in the Mediterranean Sea. B) The drifting light trap combined a surface drifter containing a GPS unit and strobe light with a mesh light trap below. C) Partial catch of bluefin larvae from the 90-cm bongo net deployment at station 18. Most individuals are ≈3 mm with some ≈6 mm individuals also present. D) 34 mm SL (red line) scombrid caught in the light trap. This individual currently has not been identified to species.