Original: inglés

TERCERA REUNIÓN DEL GRUPO DE TRABAJO DE GESTORES Y CIENTÍFICOS PESQUEROS PARA RESPALDAR LA EVALUACIÓN DEL STOCK DE ATÚN ROJO DEL ATLÁNTICO OESTE
(Bilbao, España, 25-26 de junio de 2015)

1 Apertura de la reunión

El Sr. Masanori Miyahara (Japón), Presidente de la Subcomisión 2, inauguró la reunión y dio la bienvenida a Japón a los participantes.

El Secretario Ejecutivo presentó a las siguientes CPC que asistieron a la reunión: Canadá, Unión Europea, Japón, México, Nigeria, Senegal, Estados Unidos, Uruguay.

Además, estaban presentes los siguientes observadores: Ecology Action Center, Pew Charitable Trusts y The Ocean Foundation.

La lista de participantes se adjunta como **Apéndice 2**.

2 Elección del presidente

Estados Unidos nominó al Sr. Masanori Miyahara (Japón) como Presidente del Grupo de trabajo.

3 Adopción del orden del día y disposiciones para la reunión

El orden del día fue adoptado sin cambios y se adjunta como **Apéndice 1.**

4 Designación del relator

La Sra. Carolyn Doherty (Estados Unidos) fue designada relatora de la reunión.

5 Examen de los resultados de la 2ª Reunión del Grupo de trabajo de gestores y científicos pesqueros para respaldar la evaluación del stock de atún rojo del Atlántico oeste

El Presidente recordó el informe de la Segunda reunión del Grupo de trabajo de gestores y científicos pesqueros para respaldar la evaluación del stock de atún rojo del Atlántico oeste y examinó las tres recomendaciones acordadas por las CPC en dicha reunión, celebrada en la Isla del Príncipe Eduardo, Canadá, del 10 al 12 de julio de 2014.

1) En el periodo intersesiones, los científicos nacionales de las CPC que pescan atún rojo del oeste trabajarán conjuntamente para explorar áreas de colaboración, identificar costes y establecer prioridades para las nuevas propuestas de investigación desarrolladas en esta reunión. Los resultados de este trabajo y las nuevas propuestas se presentarán al SCRS en septiembre de 2014 con miras a su revisión y evaluación. Al mismo tiempo, se reconoció que las CPC procederán con el trabajo que ya se está llevando a cabo (por ejemplo, la ampliación de las prospecciones existentes) y con nuevos proyectos cuya financiación se haya asegurado.

2) Las CPC colaborarán para analizar los datos de captura y esfuerzo no agregados con el objetivo de mejorar los actuales índices de abundancia del stock y de desarrollar un único índice de abundancia incorporando los datos de varias CPC. El acceso a los datos se compartirá de una forma que no infrinja las normas de confidencialidad de los datos.

3) Las CPC continuarán sus esfuerzos para mejorar la calidad y la cantidad de los datos recopilados y comunicados, de forma coherente con las recomendaciones del SCRS. En particular, se anima a las

CPC a proporcionar información sobre cambios en los patrones de pesca y otras variables que puedan influir en la tasa de captura para que estos factores puedan ser incorporados en los modelos de estandarización.

Canadá, Japón y Estados Unidos proporcionaron actualizaciones sobre las diversas actividades de investigación pertinentes que están realizando en relación con estas tres recomendaciones.

El Dr. Gary Melvin (Canadá) presentó una visión general de los esfuerzos en curso de Canadá titulada "Observaciones acústicas in situ del atún rojo del Atlántico (*Thunnus thynnus*) con un sonar multi-haz de alta resolución" (**Apéndice 3**). Su presentación describía estudios de campo recientes para investigar la capacidad y la adaptabilidad de utilizar un sonar multi-haz de alta frecuencia para documentar, hacer un seguimiento y cuantificar el atún rojo. Como el Dr. Melvin describió los resultados preliminares del estudio demuestran claramente que el atún rojo puede detectarse y seguirse acústicamente dentro de la trayectoria del sonar multi-haz. Los resultados de este estudio indican que el uso del sonar multi-haz ofrece un buen potencial para el seguimiento y cuantificación del atún rojo en una prospección a gran escala independiente de la pesquería.

El Dr. Melvin continúo su exposición de los esfuerzos en curso de Canadá con una presentación denominada "Índice de abundancia acústico de atún rojo en la Bahía de Chaleur" (**Apéndice 4**). Describía el uso de una prospección acústica en curso del arenque del Atlántico en la zona de la Bahía de Chaleur del golfo de San Lorenzo para estimar la abundancia de atún rojo. Canadá está volviendo a analizar estos conjuntos de datos para el atún rojo remontándose hasta 1991 y ha finalizado el análisis de 2007-2013. Los análisis preliminares son positivos y se continuará trabajando en estos datos y en un índice de abundancia independiente de la pesquería para tantos años como sea posible. Este trabajo se presentará a la Reunión de preparación de datos a principios de 2016, tras los protocolos requeridos para la introducción de un nuevo índice de abundancia.

El Dr. Melvin finalizó su exposición de los esfuerzos en curso de Canadá con una presentación denominada "Proyectos de ciencia sobre atún rojo del DFO para 2015" (**Apéndice 5**). El Dr. Melvin indicó que, en 2015, se habían desarrollado cinco productos financiados por la industria. Cada uno de ellos empezará en agosto de 2015 y tratará temas específicos identificados para mejorar la introducción de datos para la evaluación de 2016. Todos los análisis de los datos se finalizarán a tiempo para que estén disponibles para la reunión de preparación de datos.

El Sr. Haruo Tominaga (Japón) explicó que, a falta de una cuota de atún rojo del Atlántico oeste reservada para la investigación, Japón no ha realizado los esfuerzos de investigación propuestos el año pasado, ni los podrá llevar a cabo el año próximo.

El Dr. Craig Brown (Estados Unidos) presentó una "Visión general del trabajo en curso que está llevando a cabo Estados Unidos para mejorar las evaluaciones de stock de atún rojo del oeste" (**Apéndice 6**). Describió un estudio piloto para evaluar la viabilidad de desarrollar un índice de abundancia de atunes rojos del oeste juveniles del año (YOY). Con el fin de determinar la disponibilidad, distribución y posibles métodos de muestreo, se está desarrollando una red de pescadores de recreo y capitanes de barcos de flete voluntarios a lo largo de la costa del estrecho de Florida. Los intentos para recopilar ejemplares de atún rojo del oeste YOY empezarán posteriormente este verano, 2015.

El Dr. Brown continuó su exposición con la perspectiva general de un estudio piloto concebido para investigar la viabilidad de llevar a cabo análisis close-kin que podrían conducir a estimaciones directas de la biomasa del stock reproductor de atún rojo del oeste y que ya se ha iniciado. Se ha iniciado el trabajo en tres campos de investigación que podrían mejorar el índice larval existente de atún rojo del oeste o conducir al desarrollo de nuevos índices, lo que incluye: (1) incorporar las estimaciones de edad y de mortalidad para las larvas recopiladas en diferentes regiones del golfo de México, que deberían mejorar la estandarización de los actuales índices de atún rojo del oeste; (2) obtención de un índice de presas de larvas, capacidad para alimentarse y crecimiento, que podría mejorar la estandarización y para el que se ha iniciado el trabajo en muestras históricas archivadas y (3) ampliar los esfuerzos de marcado exploratorios en el Caribe y el Atlántico noroccidental para determinar la importancia de zonas de desove alternativa, para lo que se han realizado actividades de marcado en aguas de Cuba y México este año.

6 Examen de los progresos realizados para combinar los datos brutos de captura/esfuerzo para las flotas individuales en un nuevo índice (o índices) de abundancia para el atún rojo del Atlántico oeste

El Presidente inició una discusión sobre los progresos alcanzados en la combinación de datos brutos de captura/esfuerzo para las flotas individuales en un nuevo índice de abundancia de atún rojo del oeste. La discusión se inició con una visión general de la colaboración entre Estados Unidos y Canadá para combinar datos con el fin de generar un índice de CPUE que incluya información sobre todas las flotas de palangre y proteja la confidencialidad de los datos, como se discute en el SCRS/2015/032. Estados Unidos y Canadá están examinando posibles formas de mezclar sus datos respectivos de captura/esfuerzo no agregados con el fin de crear un índice combinado. Este trabajo continuará en una reunión que se celebrará en Canadá este verano y a la que Estados Unidos, Japón y México están invitados a participar. Se acordó que este trabajo se avanzará en una reunión de las partes al margen de la próxima reunión del grupo de especies del SCRS de septiembre de 2015 con el objetivo de elaborar un índice de abundancia único que incorpore los datos de las CPC antes de la reunión de preparación de datos de 2016.

Además, Canadá y Estados Unidos están colaborando actualmente para elaborar el índice combinado para la pesquería de caña y carrete.

Siguiendo el previo intercambio de información en las dos reuniones anteriores del Grupo de trabajo, se produjo una discusión adicional sobre los procesos de recopilación de datos para la pesquería de caña y carrete de recreo de Estados Unidos. En respuesta a la pregunta de Japón, Estados Unidos explicó brevemente su proceso para asegurar información precisa de captura y esfuerzo de su pesquería, lo que incluye un requisito de comunicación directa, aumentado por una encuesta estadística científicamente validada, y se ofreció a proporcionar más información a las partes interesadas.

Japón y Estados Unidos continuarán el diálogo sobre este punto e informarán de los resultados a la Subcomisión 2.

7 Consideración del trabajo futuro

El Presidente recordó que en la última reunión de este Grupo de trabajo, todos los participantes reconocieron el valor de discutir juntos sobre este stock en particular. El Presidente reafirmó la importancia de este trabajo y solicitó a las CPC que consideraran los próximos pasos de este Grupo de trabajo.

Las CPC se mostraron de acuerdo en que este Grupo de trabajo había dio muy constructivo a la hora de avanzar en las actividades de investigación en colaboración entre las CPC y en que los esfuerzos de este grupo habían sido extremadamente positivo. Sin embargo, todas las Partes acordaron que este Grupo de trabajo no sería necesario en 2016 teniendo en cuenta la evaluación de stock pendiente y otros trabajos que se están llevando a cabo, aunque se instó a que el trabajo del Grupo en el periodo intersesiones continuara. Además, todas las partes se mostraron de acuerdo en que la posibilidad de que el Grupo de trabajo se reúna en una fecha posterior debería quedar abierta. El Grupo de trabajo, por tanto, recomienda que no se celebre ninguna reunión intersesiones en 2016 y que la Subcomisión 2 examine el progreso de los esfuerzos realizados en cuanto a investigación en su reunión de 2015 y considere celebrar una próxima reunión del Grupo de trabajo en 2017, si es necesario.

Las Partes discutieron también la actualización del análisis AIC llevado a cabo por el SCRS en 2014 para investigar el ajuste de los escenarios de alto y bajo reclutamiento a las estimaciones de la biomasa reproductora del stock y el reclutamiento. Canadá sugirió que el SCRS podría estudiar más a fondo este trabajo. El Presidente del SCRS confirmó que esto debería ser posible en la reunión del grupo de especies de septiembre de 2015.

8 Otros asuntos

No se debatieron otros asuntos.

9 Adopción del informe y clausura

El informe fue adoptado y la tercera reunión del Grupo de trabajo de gestores y científicos pesqueros para respaldar la evaluación del stock de atún rojo del oeste fue clausurada.

Apéndice 1

ORDEN DEL DÍA

1. Apertura de la reunión
2. Elección del presidente
3. Adopción del orden del día y disposiciones para la reunión
4. Designación del relator
5. Examen de los resultados de la 2ª Reunión del Grupo de trabajo de gestores y científicos pesqueros para respaldar la evaluación del stock de atún rojo del Atlántico oeste
6. Examen de los progresos realizados para combinar los datos brutos de captura/esfuerzo para las flotas individuales en un nuevo índice (o índices) de abundancia para el atún rojo del Atlántico oeste
7. Consideración del trabajo futuro
8. Otros asuntos
9. Adopción del informe y clausura

Apéndice 2

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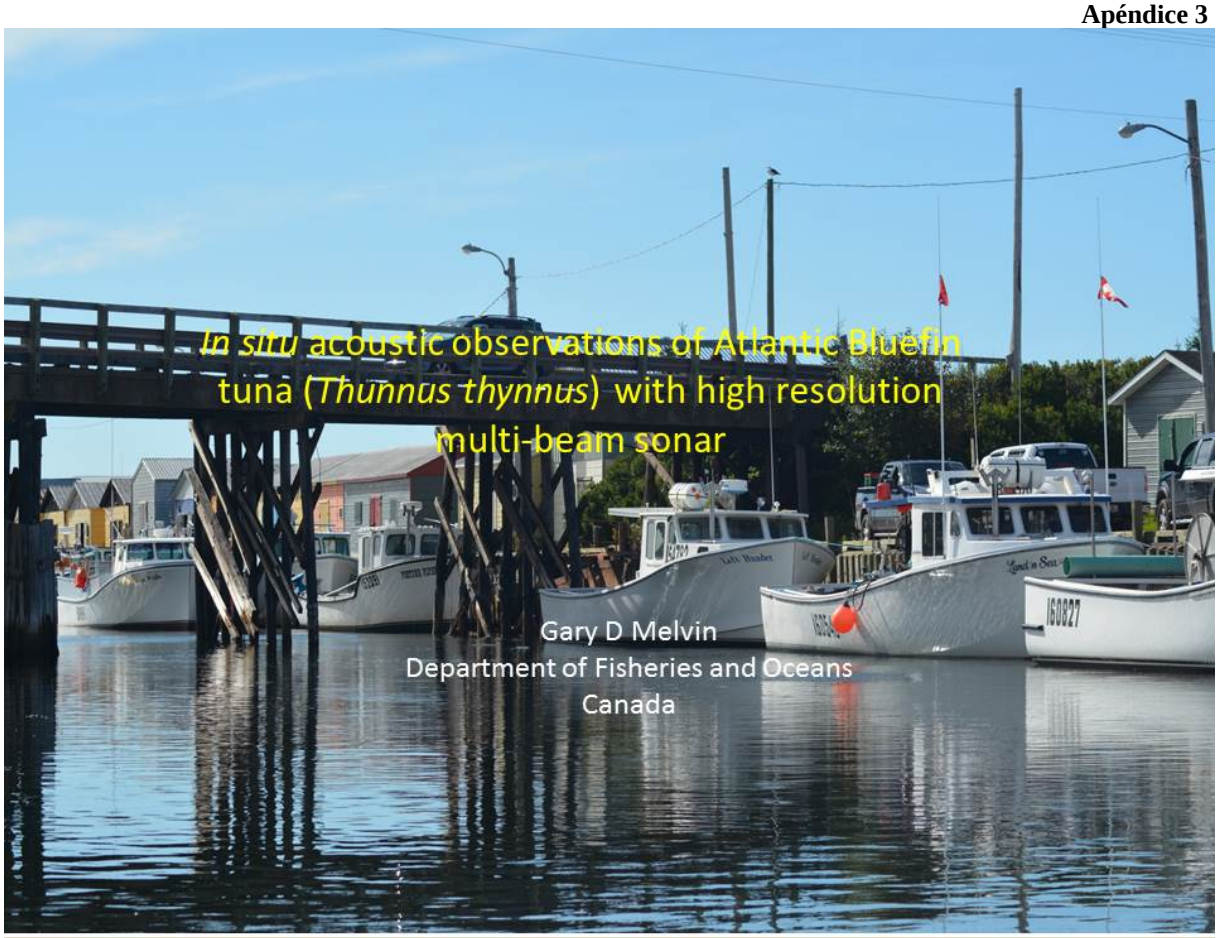
Apéndice 3



Background

- Most ICCAT Analytical Assessments are tuned with CPUE indices – bias and changing fishing patterns
- Recent concern about the representativeness of some CPUE indices of abundance for both eastern and western BFT stocks.
- Recommendation by SCRS for the development of Fishery Independent Indices.
- WG of Fisheries Managers and Scientists (July 2014) identified several proposals for new indices, and improvement of existing indices, by Canada, Japan, and the USA.
- One of Canada's 2 Proposals involved a full scale acoustic- trolling survey in the Gulf of St Lawrence.

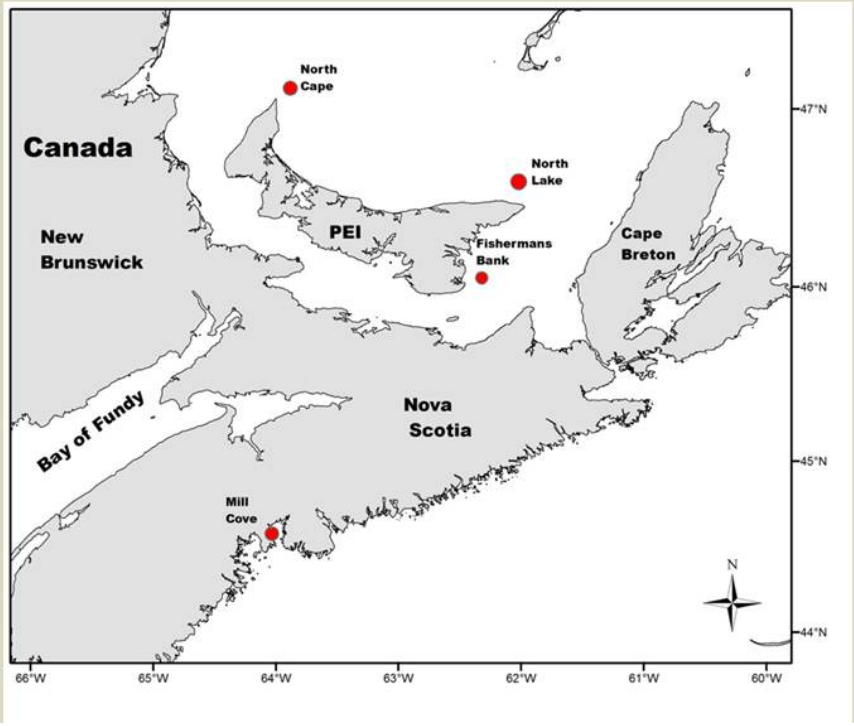
Field Study Objectives

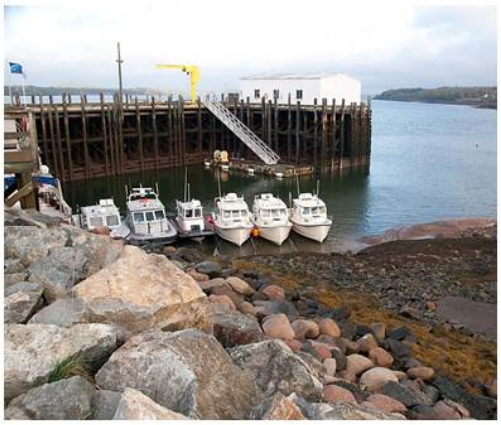
- Proof of Concept:
  - To evaluate the ability of acoustic technology to detect, observe, and quantify Bluefin tuna on the fishing grounds.
  - To investigate appropriate system configurations under different environmental and sea states (Tilt angle, vertical beam width, etc).
  - To investigate the operational limitations of the technology and approach to be considered in the final survey design.

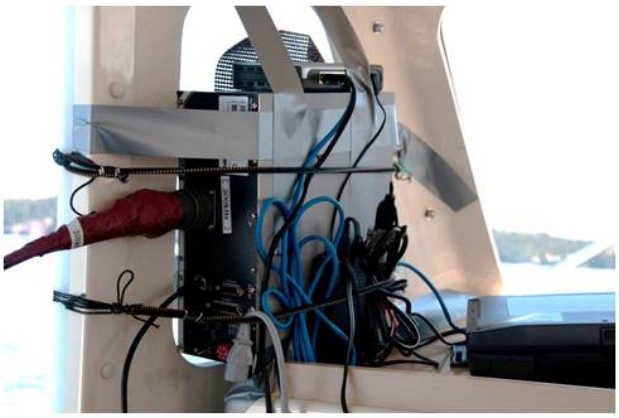
Study area and Equipment

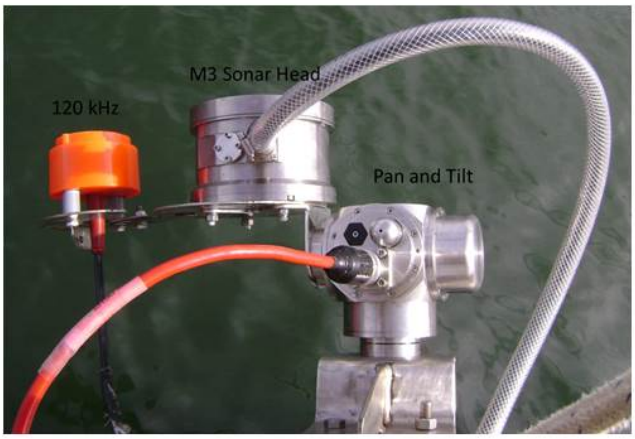
- Acoustic Recording undertaken at:
  - North Cape PEI - local and among herring fleet
  - East Point, PEI - local and among Rec fishing vessels.
  - Fishermans Bank, PEI, - local and among Rec fishing vessels.
  - A BFT Pen in St Margaret's Bay, Nova Scotia
- Equipment:
  - 24' Rossborough boat
  - Simrad EK 60 split beam (200kHz) scientific echosounder
    - 1 ping/sec
  - Simrad EK 60 split beam (120kHz) scientific echosounder
    - 1 ping/sec
  - Mesotech M3 multi-beam sonar (500kHz) 120° swath
    - ~ 5 pings/sec at 50m setting
- Survey Design
  - Ad hoc searches with a few transect in some areas.

Location of Acoustic sampling sites in Eastern Canada

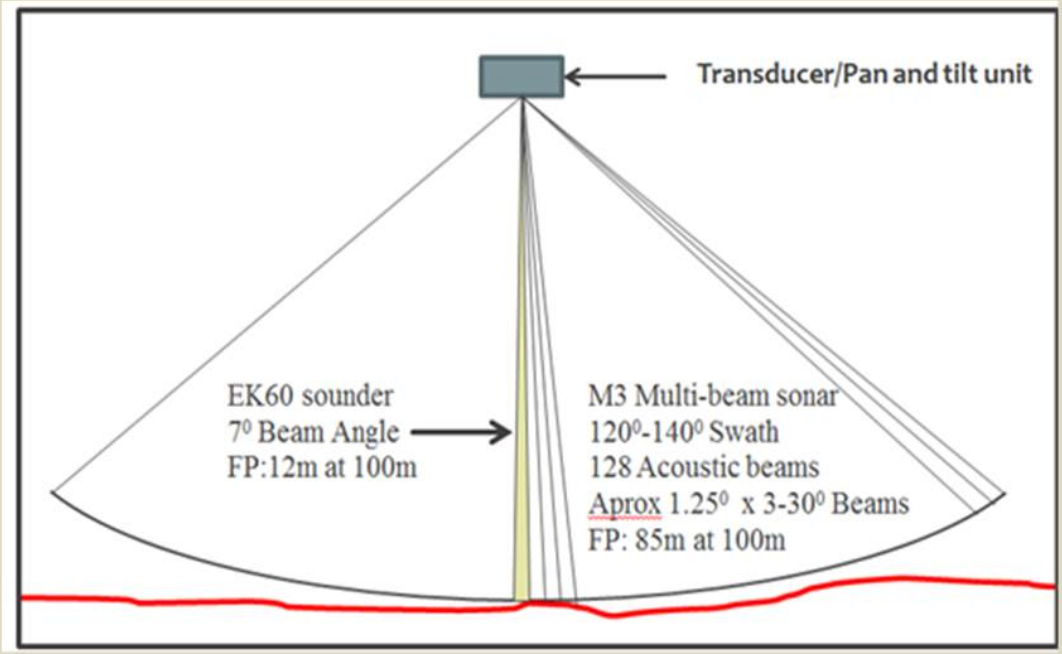






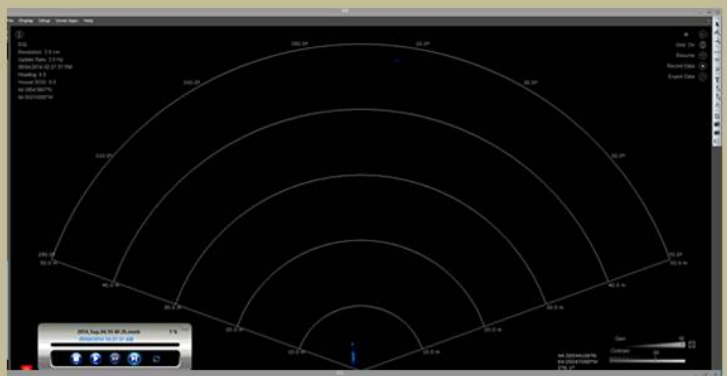


Comparison of EK60 echosounder and M3 multibeam sonar beam patterms

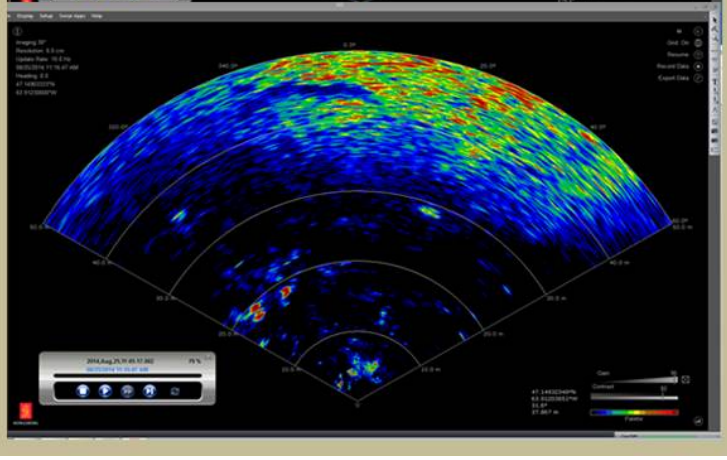


Observations in Shallow (<50) verse deeper water and rough and calm seas

M3 – Single ping >60m depth, and no wind/no swell

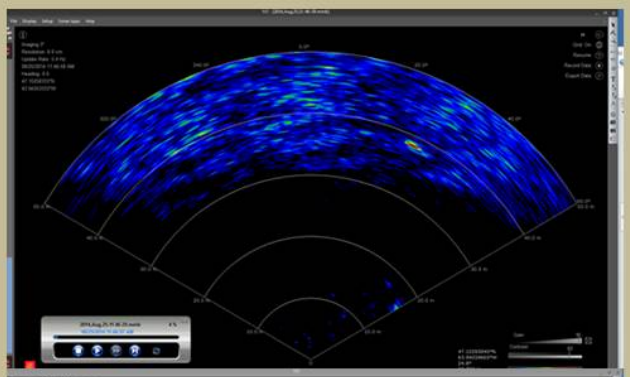


M3 – Single Ping, 20-25m depth, and 20 knot winds

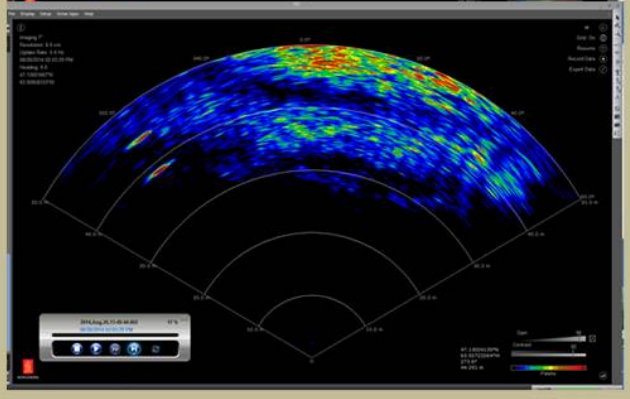


Observations of 1 and 2 BFT

M3 – Single Ping,
- Range 50m
- Shallow water,
-- One BFT

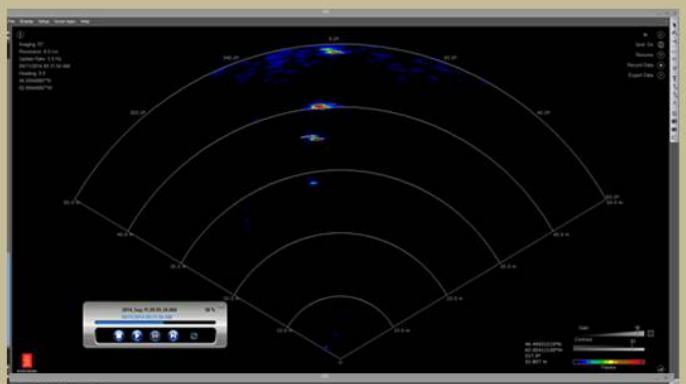


M3 – Single Ping,
- Range 50m
- Shallow water,
-- Two BFT

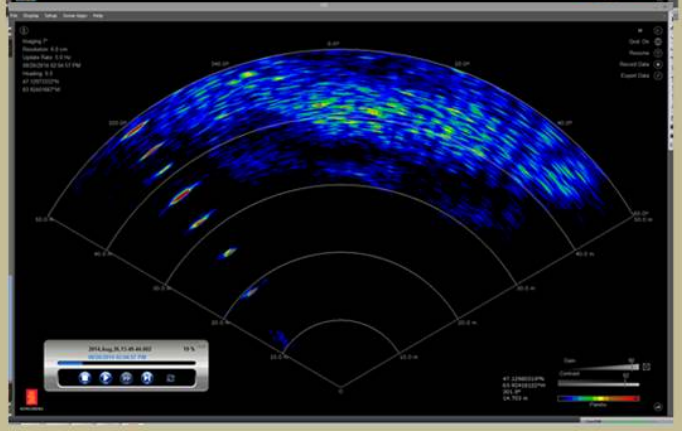


Observations of Multiple BFT

M3 – Single Ping,
- Range 50m
- Shallow water,
- 4 of 16 BFT



M3 – Single Ping,
- Range 50m
- Shallow water,
- 8 of 21 BFT



Aggregation of bluefin tuna near a commercial herring gillnetter

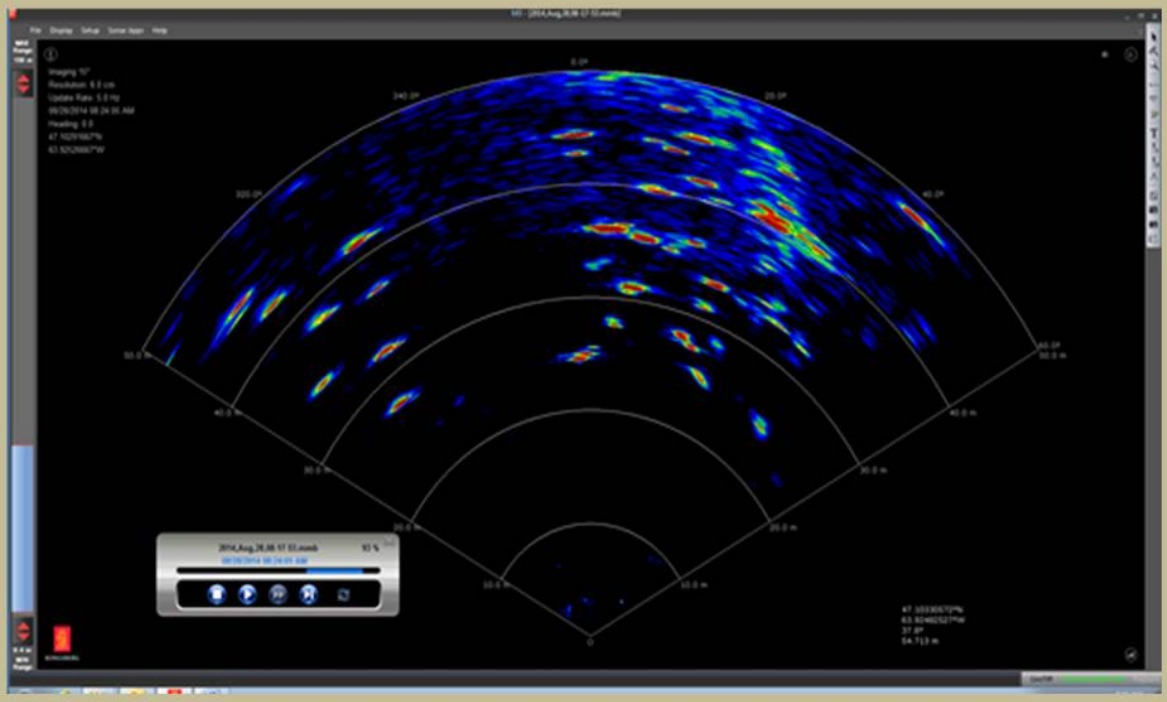
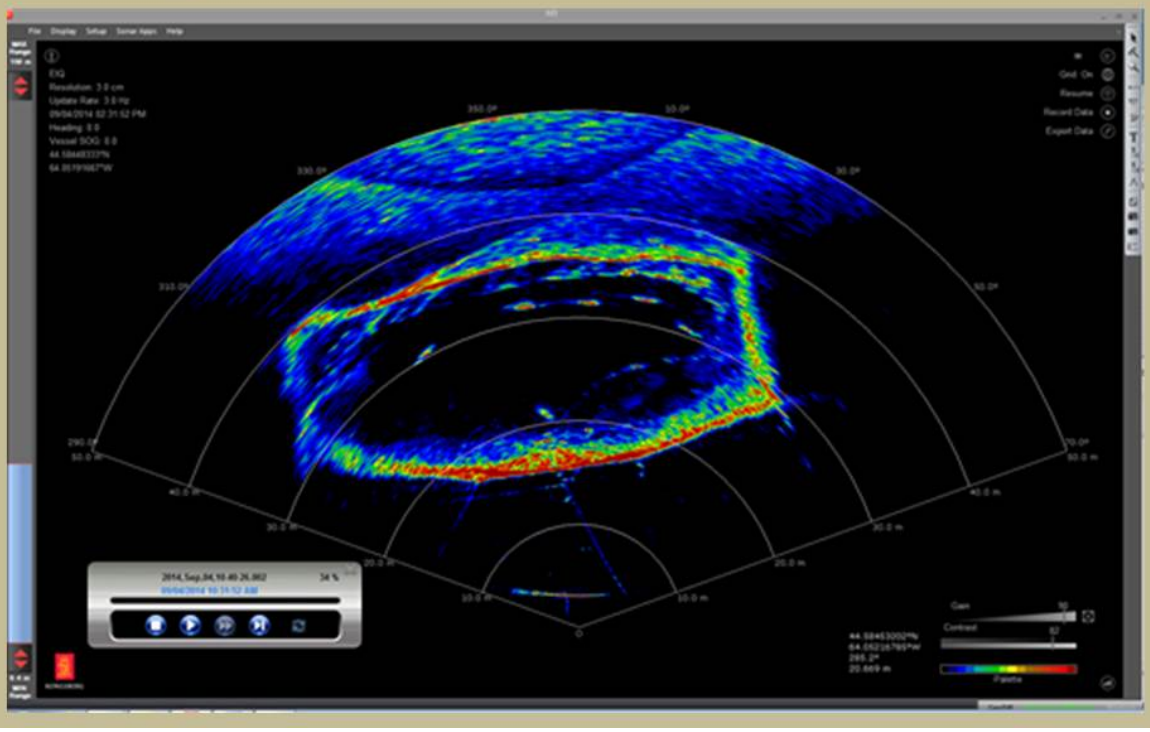


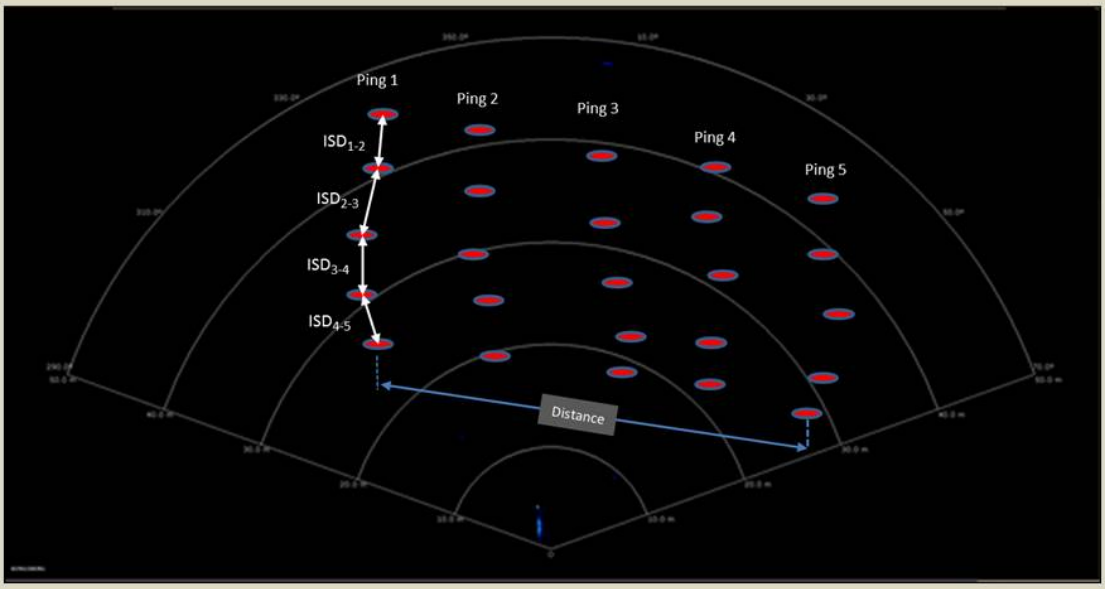
Image of bluefin tuna in the Mill Cove pen in St Margarets Bay, Nova Scotia, September 4, 2014.



Data Collection

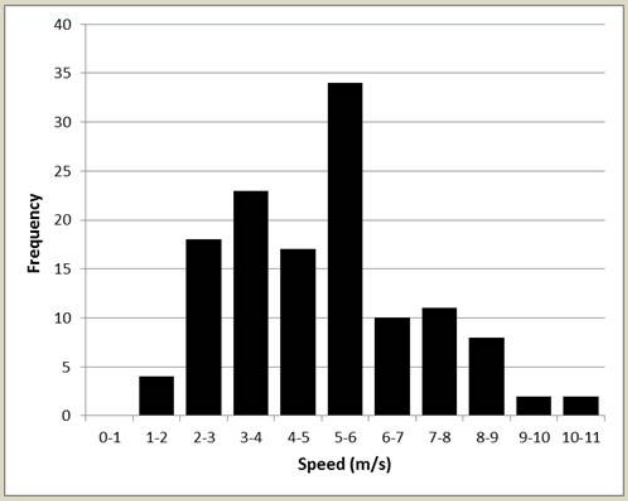
- Data Extractable for individual targets
  - Date, time, and vessel position
  - Position of individual targets in multi-beam swath.
    - Latitude and longitude
    - Angle and Range from sonar head
- Estimated Variables
  - Swimming speed within the sonar swath
  - Inter-spatial distance between adjacent BFT
  - Size of each target

Schematic of 5 ping overlay on a swath image illustrating the inter-spatial and swimming distance.



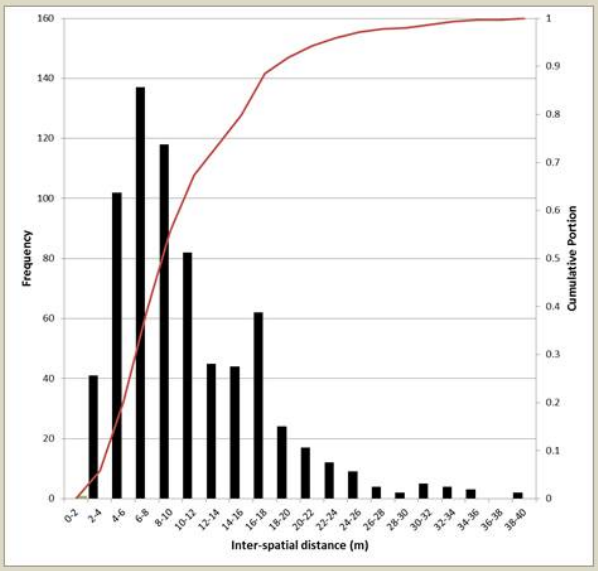
Swimming Speed

	Individuals	Groups
Number	26	104
Mean (m/s)	3.65	4.14
Std Dev	2.22	2.07
Min	0.86	0.54
Max	8.87	10.98



Inter-spatial Distance

Groups of Tuna	24
Observations	713
Mean (m)	8.94
Std	6.20
CV %	69.28
min	0.56
max	38.27



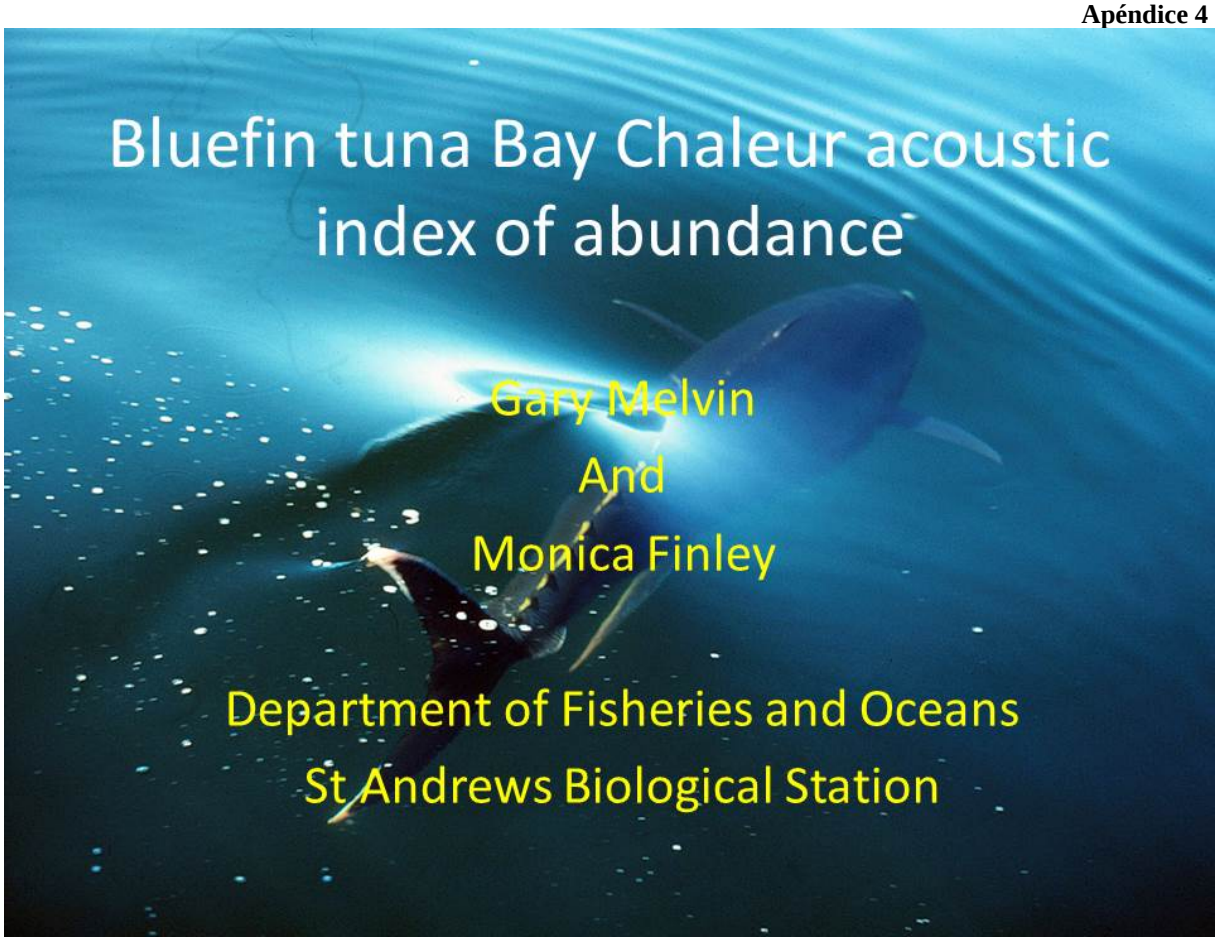
Other Acoustic Observations

- Horizontal EK60 (200kHz) TS
- Vertical EK60 (120 kHz) TS (-34 to -14dB)
- Acoustic observations of:
  - Pilot Whales
  - Minke Whales
  - Sunfish (Mola mola)
  - Seals
  - Diving Birds
  - Gillnets with fish.
- BFT appear different from the above.

Summary

- The M3 Sonar can detect, monitor, enumerate, and track BFT in open water, thus a candidate tool for development of a new fishery independent BFT index of abundance.
- Functional Range of M3 is dependent upon water depth and surface sea conditions.
  - Shallow water (20-30m) limited to 35-45 m.
  - Deep water >50m full operational range (>100m).
- During calm seas tilt angle of 0 can be attained, but must be increased with increasing sea state (max 20knots).
- 7 degree appears to good general tilt angle. Pan and tilt to finesse during surveying
- Vertical beam with of 7 and 15 degrees optimal in this study.
- Stability of transducer is vessel size dependent. A larger boat would improve acoustic detection.

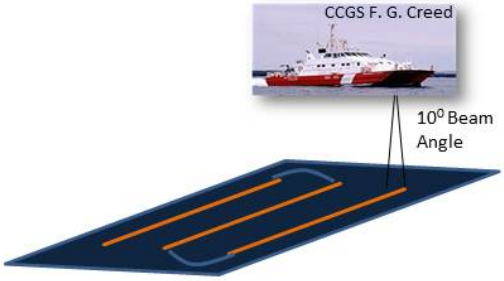
Apéndice 4

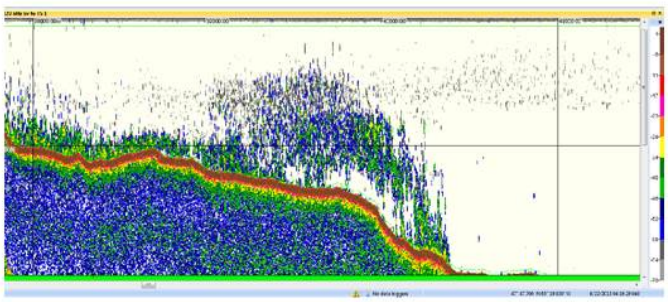


Gulf Region Bluefin Tuna Abundance Index

Background

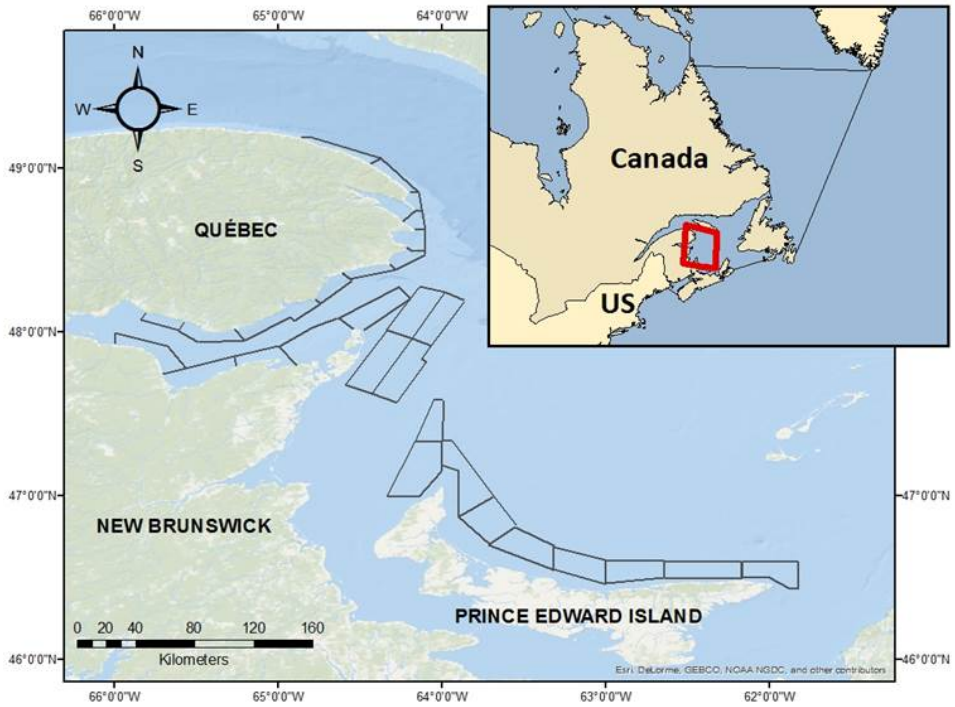
- The fall herring acoustic survey in the Southern Gulf has been conducted since 1991.
- The sampling design includes random (within strata) parallel transects with a hull-mounted single beam (120 KHz) transducer, using a Femto DE9320 digital echosounder. (LeBlanc *et al*. 2012)
- Survey has been conducted during the same period of time by the same vessel using the same equipment since it began.
- HDPS editing software uses a destructive approach and removes all backscatter not associated with the target species.
- Tuna were observed over the years but not available for quantification in the final analysis.





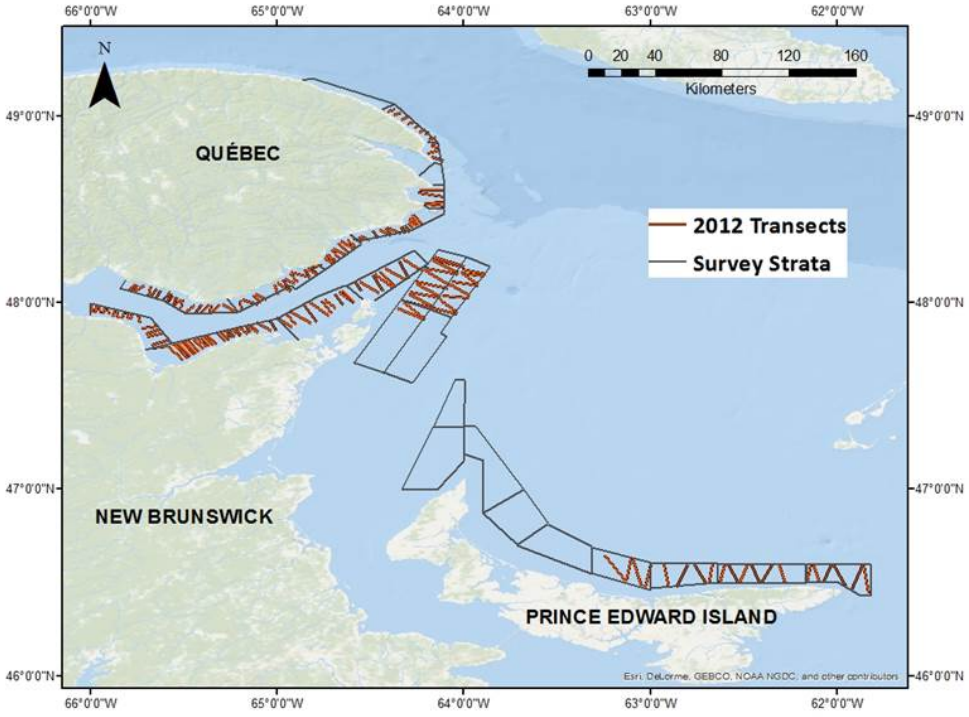
NAFO Division 4T Acoustic Survey

A fall acoustic survey of herring concentrations in the Southern Gulf, Canada has been conducted since 1991.



The acoustic biomass index contributes to the stock assessment of 4T herring.

Survey Transects 2012



Transect length ranges between ~2.5 and 18.4 km, average 7.7 km (2012).

In 2012 the total transect distance covered was 1, 289 km.

Available Data

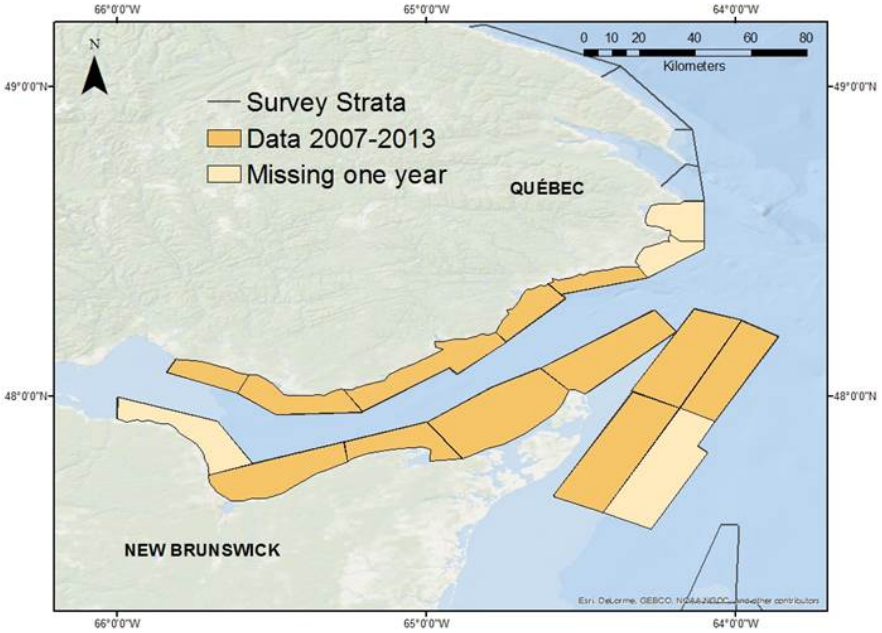
24 years of acoustic survey data available.

PEI has been surveyed 17 of the 24 years.

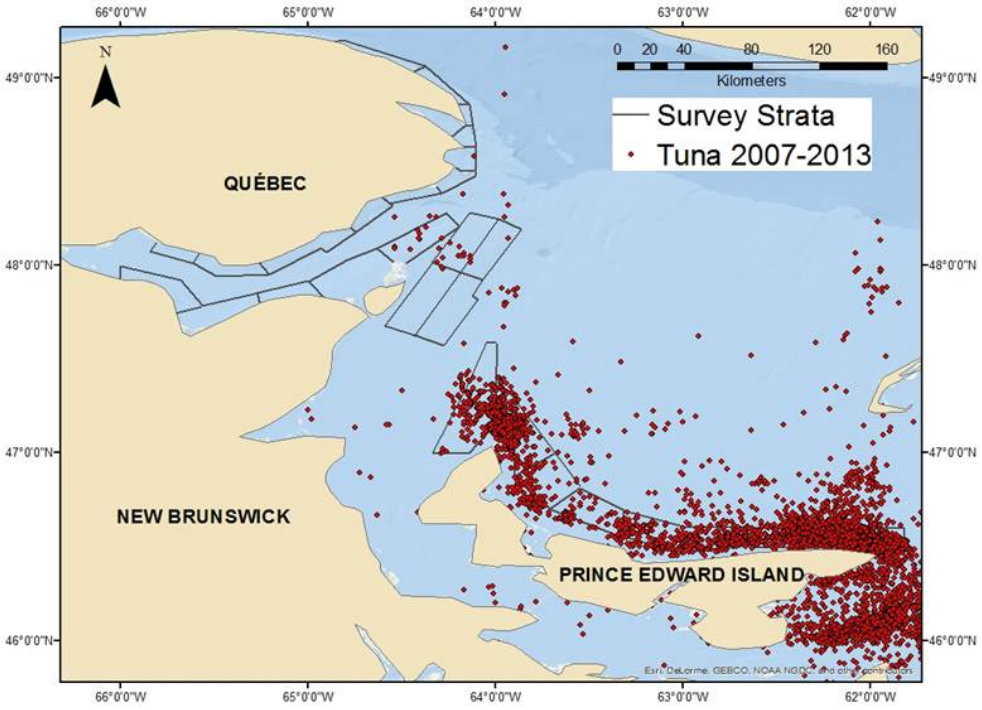
To date:

2007-2013 data have been re-edited and processed for BFT.

16 strata have been consistently sampled.



Commercial Landing Locations of BFT



PEI Coverage:

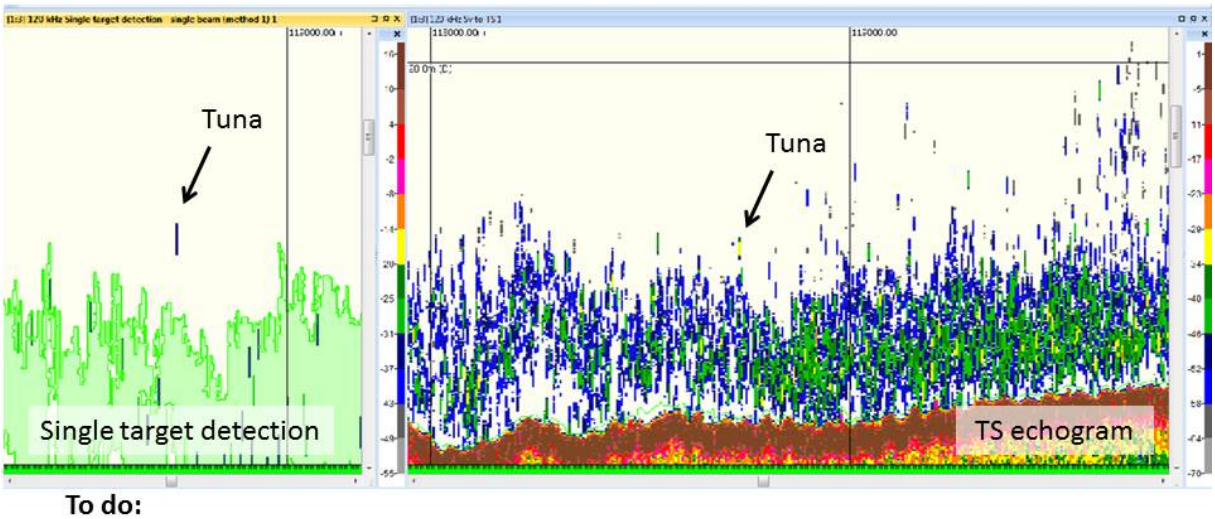
24 year of Surveying
17 years some PEI Strata
Many years of incomplete coverage
Final analysis will look at PEI coverage

Year	PEI Survey	Year	PEI Survey	Year	PEI Survey
1991	n/a	1999	Y	2007	Y
1992	n/a	2000	Y	2008	Y
1993	Y	2001	Y	2009	Y
1994	n/a	2002	Y	2010	Y
1995	Y	2003	Y	2011	n/a
1996	Y	2004	Y	2012	Y
1997	Y	2005	Y	2013	n/a
1998	n/a	2006	Y	2014	n/a

Acoustic Estimation of Gulf Region Bluefin Tuna Abundance

Did we find tuna in the Raw? **Yes**

- 377 identified single targets in 2012 and 279 in 2013 (preliminary, note- PEI was not surveyed in 2013)



To do:

Analyze multiple years and compare acoustic abundance estimate (# tuna/km^2) to the current CPUE index.

Steps

- Quality Control
- Identify TS range of observed bluefin from previous acoustic work.
- Finesse single target detection algorithm
- Identify BFT from all transects
- Enumerate the number observed per transect
- Stratum area weighted estimates to account for inter-year variability.

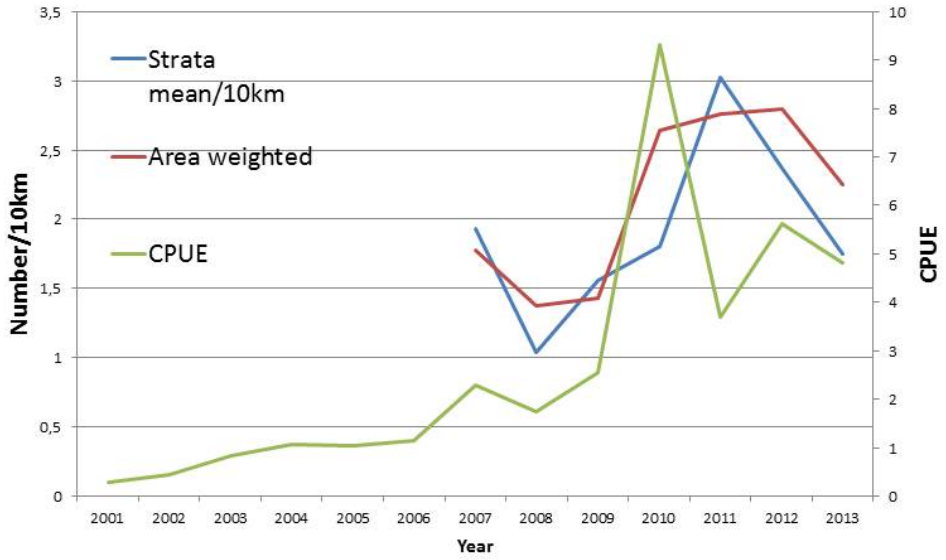
Tuna like Single Target Identification

Table: Parameters for single target detection

Parameter	Value selected
Minimum TS value	-35 dB
Maximum TS value	-16 dB
Pulse length determination level	6 dB
Minimum normalized pulse length	0.50
Maximum normalized pulse length	1.80

- A school detection algorithm was used to detect and remove targets within schools.
- Single targets above 2.5 meters from the surface and below 1 m from the bottom (best bottom candidate in Echoview) were removed.
- Remaining single targets that meet the above criteria were individually assessed.

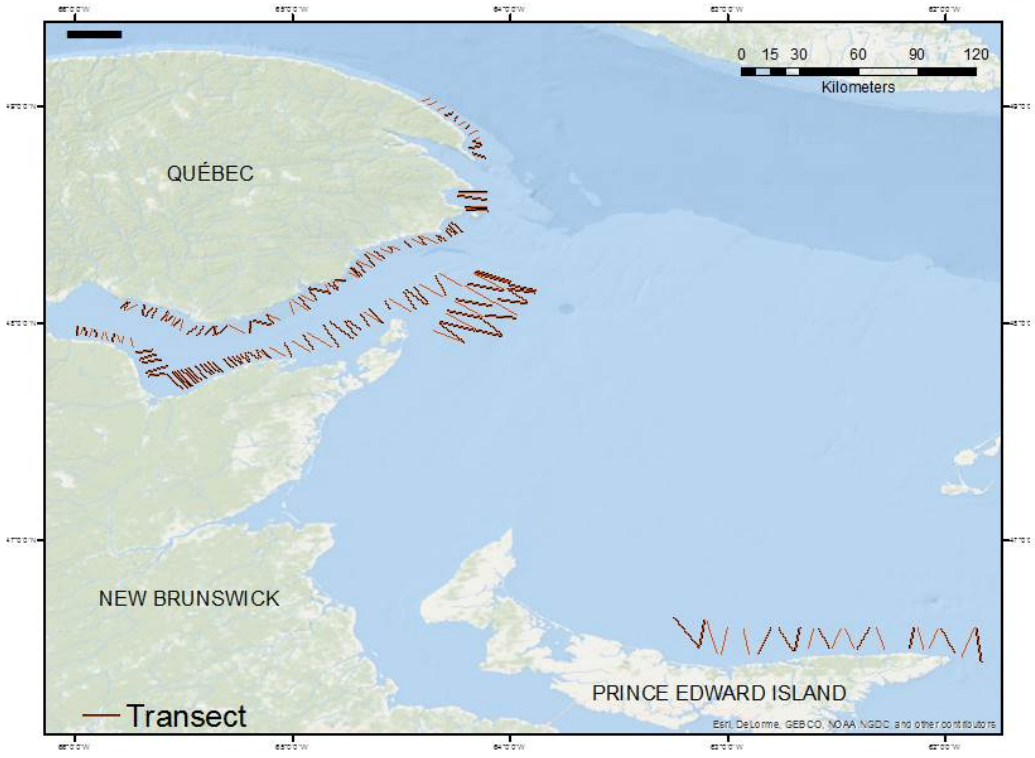
Preliminary Results



Summary

- BFT #/10km appears to follow a similar trajectory as the CPUE, without the extreme inter-annual variation.
- There is a significant increase, but not unrealistic, in the index in 2010 that remains high until 2013 when it decreases some.
- Anticipated data analysis (including variance) from 2001 to 2014 to be presented at the 2015 SCRS meeting.

Acoustic Survey 2012



Apéndice 5

DFO Bluefin Tuna Science Projects for 2015

2015 New BFT Projects

- For 2015, five projects have been developed that address specific issues identified to improve data input for the 2016 assessment.
- Projects are industry funded.
- Project are schedules to commence around August 1, 2015.
- All projects are to be completed before the 2016 data prep meeting

1) Review and revise the SW Nova Bluefin tuna index of abundance.

- Uncertainty related to effort actually directed at bluefin tuna during a fishing trip for some vessels.
- Effort and by-catch of Big Eye tuna has been increasing since the early 2000's.
- The project will define a series of criteria to identify the proportion of a standard trip devoted to Bluefin tuna.
  - through consultations with the industry and a review of individual log books.
- Work has already commenced.

Project 1 – SWNS BFT Index

Objectives are to:

- Determine protocols for identifying from vessel log books those trips which may not reflect the effort devoted to Bluefin tuna;
- Examine and adjust fishing effort of affected trips, and
- Revise the Bluefin tuna index of abundance for southwest Nova Scotia fleet.

Expected Completion:

- December 31, 2015 or earlier

2) Sampling Program Support

- Continuation and expansion of field sampling program
- collections throughout the Atlantic Provinces during the fishing season
- Technical support for processing and cataloguing

Project 2 – Field Sampling Support

- Objectives are to:
  - Coordinate the collection of bluefin tuna heads and biological data associated with landed fish.
  - Provide training in the removal of otoliths and collection of a tissue sample for genetic studies.
  - Collect and process the otoliths and tissue samples from fishing ports throughout the Atlantic Provinces and Quebec required for a variety of studies.
  - Preserve and catalogue all material collected.
- Completion Date:
  - Annual - December 31, 2015

3) Review of Gulf of St. Lawrence Bluefin tuna index of abundance

- Gulf of St Lawrence Bluefin tuna index is one of the key indices of abundance used in the 2014 stock assessment and has a strong influence on the stock status.
- Concerns were expressed regarding the representativeness of the index due to management and fishing pattern changes.
- suggestions to split the index into two time periods to try and account for the abrupt increase in 2010.
- Investigate if these changes can be accounted for through standardization and consultations with industry

Project 3 - GoSL Index

Objectives:

- Determine protocols for identifying from vessel log books those trips which may not reflect the effort devoted to bluefin tuna;
- Examine and adjust fishing effort of affected trips, and
- Revise the bluefin tuna index of abundance for the Gulf of St Lawrence.

Completion Date:

- March 31, 2016

Project 4 - PSAT Tagging study

- PSAT studies have been initiated to investigate the movement, distribution and origin of Atlantic Bluefin tuna.
- Project currently underway to report all Canadian tags in a format consistent with the SCRS requests.
- BFT expanding range (i.e., Newfoundland, Bay Chaleur). With apparent increase in abundance it is important to have a good understanding on how these fish are moving.
- Propose to release 20 new PSAT focusing on release locations not previously targeted.

Project 4 - PSAT Tagging study

- Objectives:
  - Coordinate with the fishing industry the locations from which tagging will be conducted.
  - To tag 20 Bluefin tuna throughout the Atlantic Provinces and possibly Quebec based on availability.
  - Monitor and report on the movement of BFT as the tags are released and data transmited.
  - Prepare a final report on the distribution and movement of tagged fish.
- Completion Date:
  - March 31, 2016

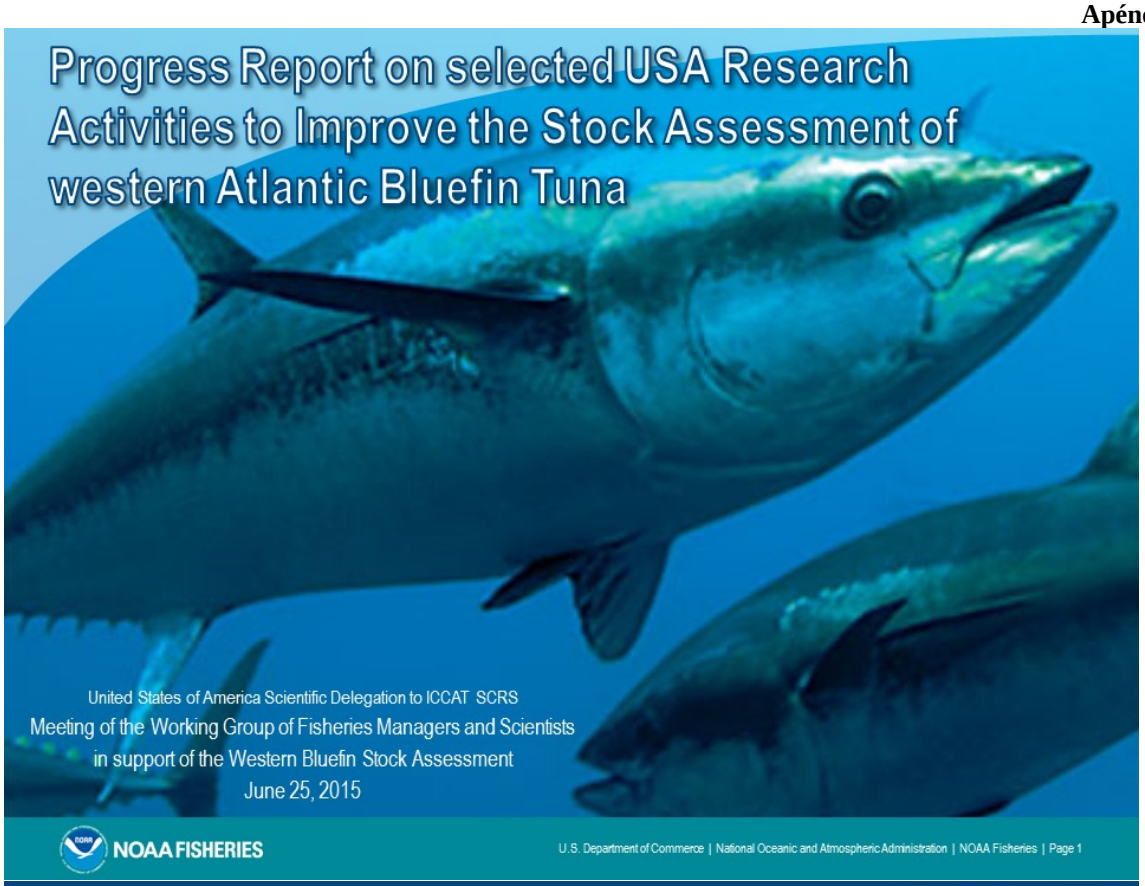
Project 5- ICCAT Tagging Program

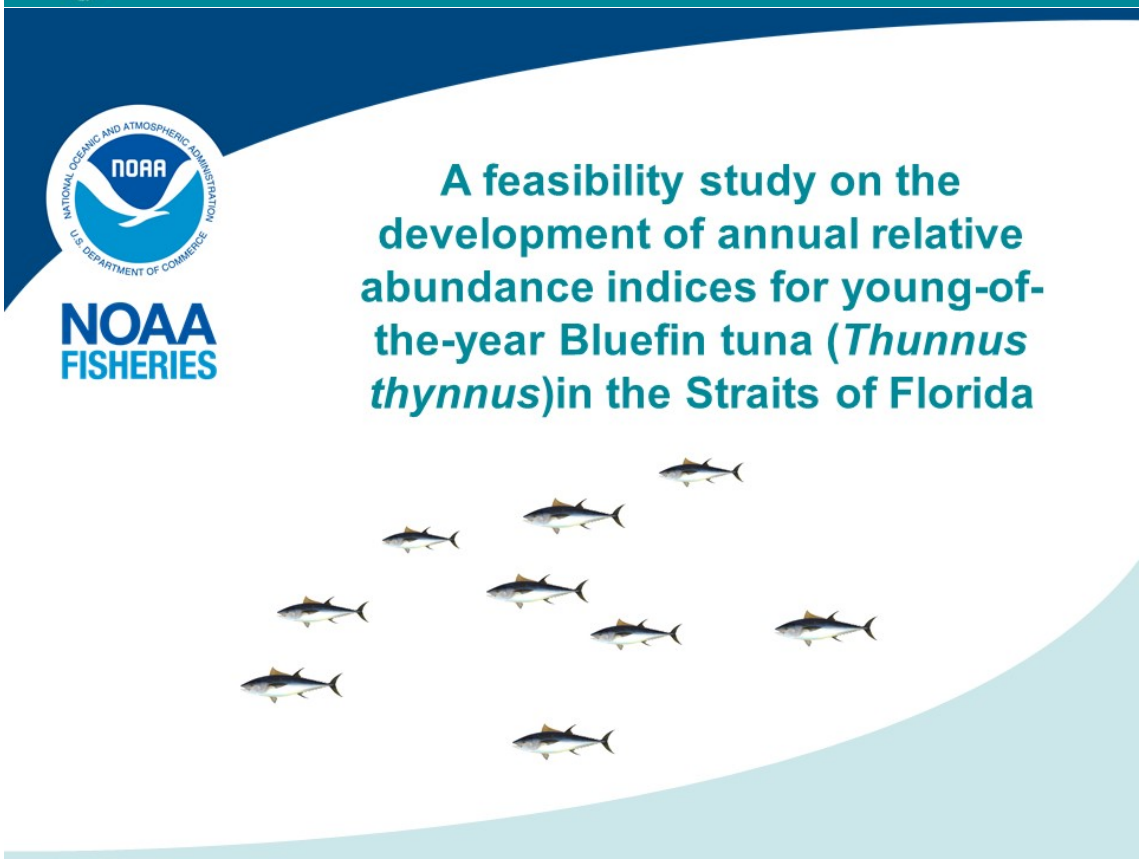
- GBYP program has established a voluntary tagging program with the fishing industry to tag and release bluefin tuna.
- ICCAT provides the conventional tags and reporting forms to the industry.
- Industry tag the bluefin tuna – fleets throughout Atlantic Canada engaged to undertake tuna

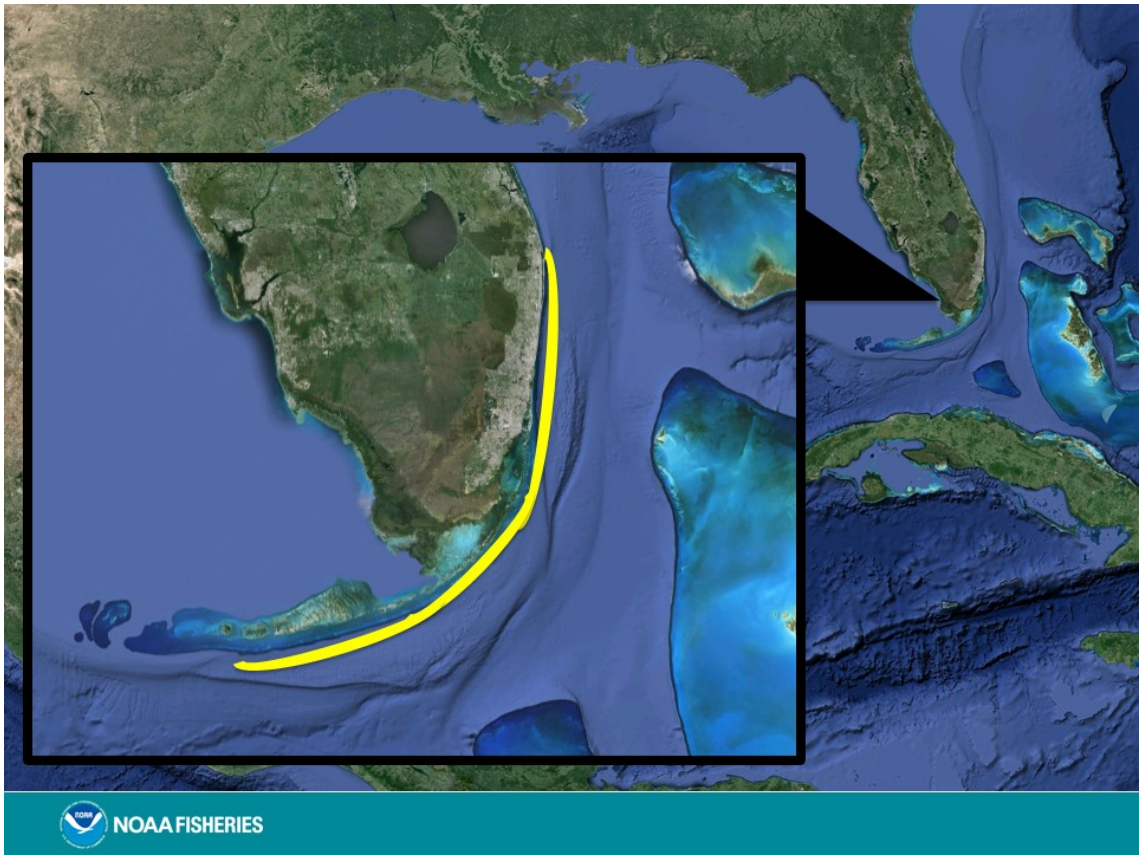
Project 5- ICCAT Tagging Program

- Objectives
  - Collaborate with the industry to mark bluefin tuna released alive with conventional tags.
  - Promote the tagging of released bluefin tuna with conventional tags provided by ICCAT and in support of GBYP.
- Completion Date:
  - March 21, 2016, but subject to renewal annually

Apéndice 6


Progress Report on selected USA Research Activities to Improve the Stock Assessment of western Atlantic Bluefin Tuna
United States of America Scientific Delegation to ICCAT SCRS
Meeting of the Working Group of Fisheries Managers and Scientists in support of the Western Bluefin Stock Assessment
June 25, 2015
NOAA FISHERIES
U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 1


NOAA
FISHERIES
A feasibility study on the development of annual relative abundance indices for young-of-the-year Bluefin tuna (*Thunnus thynnus*)in the Straits of Florida



NOAA scientists have been meeting with recreational fishermen and charter boat captains to explain the study, and provide training in how to identify young-of-the-year bluefin tuna. A number of these fishermen have agreed to participate in the voluntary network of samplers along the Florida Straits.

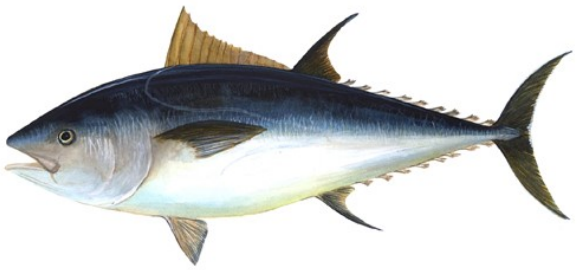
Blackfin 19-25 gillrakers

Bluefin 34-43 gillrakers

NOAA scientists have also conducted some initial field testing of the gear provided by Japanese scientists.

NOAA FISHERIES

Developing a genomic approach Bluefin tuna assessment



Background

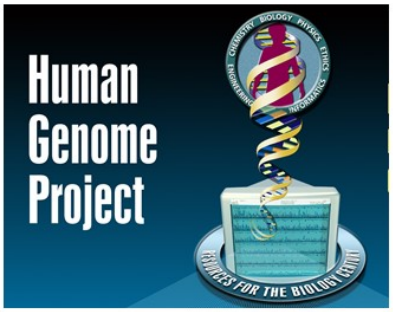
Human genome project has changed the game for molecular DNA technology and analysis

Newly-developed, next-generation DNA techniques have dramatically increased power of genetic methods

New economy of human genome project has vastly decreased analytical costs, now comparable to or cheaper than many traditional sampling methods

1000s of DNA markers can be sequenced rapidly and cheaply to identify individuals.

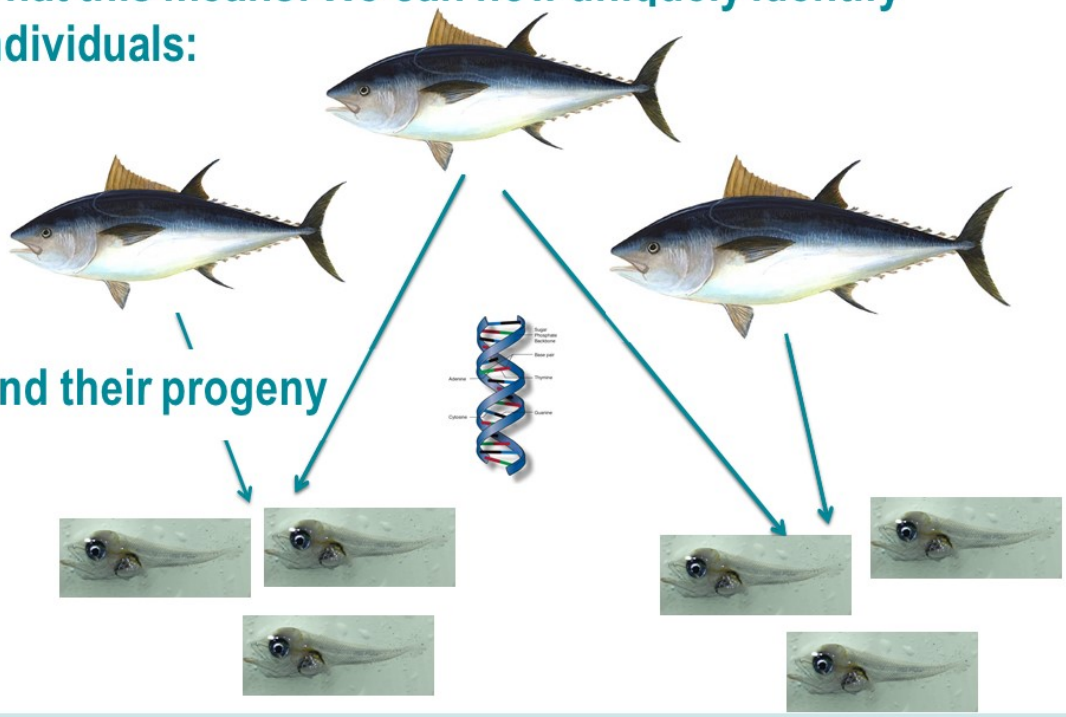
It is time to apply these methods to fisheries problems



Courtesy: National Human Genome Research Institute and Smithsonian National Museum of Natural History

NOAA FISHERIES

What this means: We can now uniquely identify individuals:



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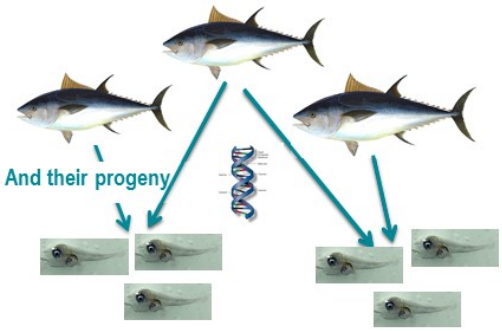
Larval pictures from Katherine Dale, NMFS

Close-Kin Analysis

By counting number of parent-offspring pairs, we can estimate number of parents



Similar to a mark-recapture experiment

Successfully applied to

- Minke whales
- Southern Bluefin tuna

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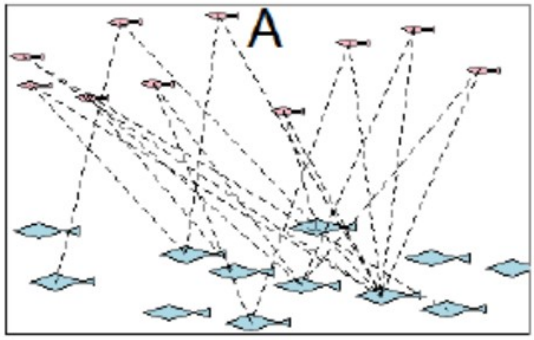
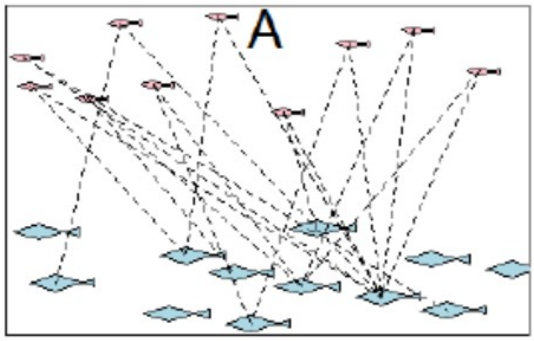
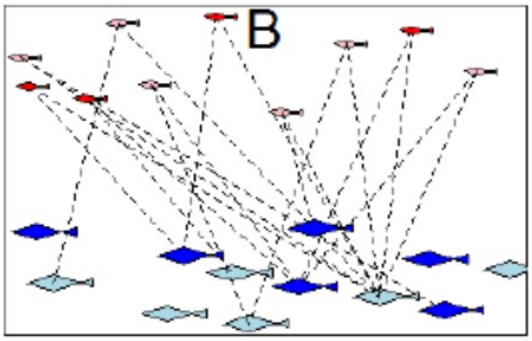
Close-Kin Analysis (Bravington et al. 2013)



A. Each juvenile 'tags' its parent's DNA marker

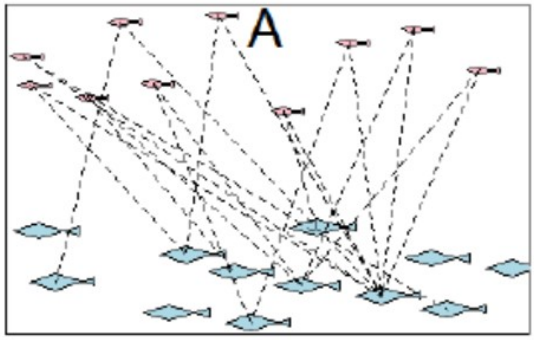
Close-Kin Analysis (Bravington et al. 2013)

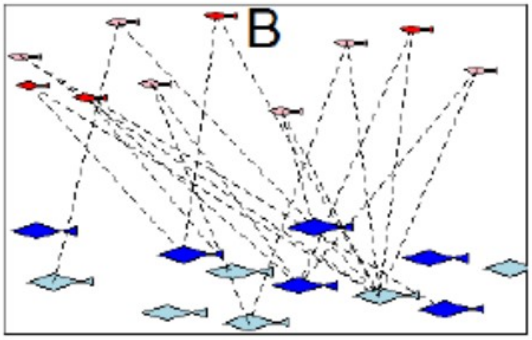




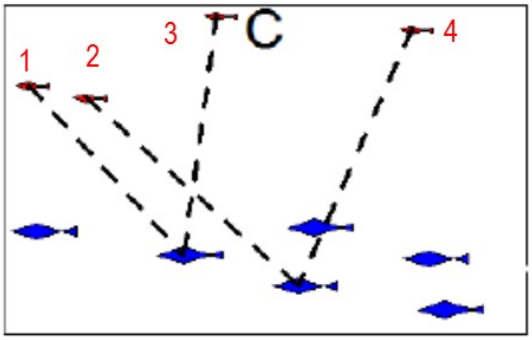
B. Sample some fraction of adults and juveniles, obtain genotypes

Close-Kin Analysis (Bravington et al. 2013)

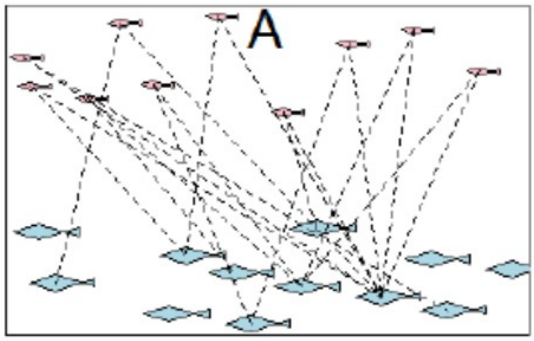


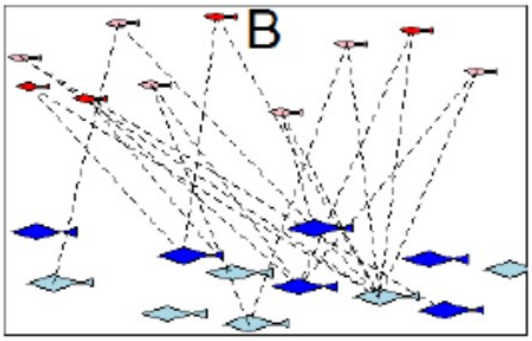


C. Genetically identify matches, i.e. number of parent/offspring pairs; here there are 4



Close-Kin Analysis (Bravington et al. 2013)

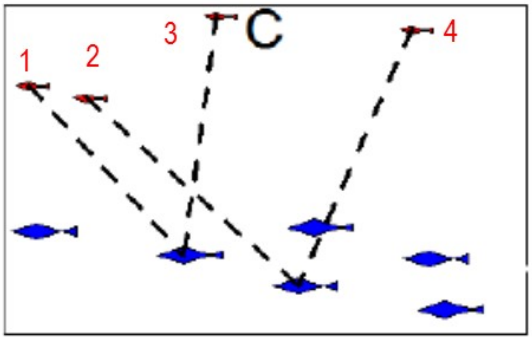




D. Estimate number of spawners:

$$\widehat{N} = 2 * J * A/POP$$

4 Juveniles sampled
6 adults sampled
4 POPs
$\widehat{N} = 2 * 4 * 6/4$ =12 *spawners*



Close-Kin Analysis: Study Design Overview

- **Spawner Marking**: Gulf of Mexico (GOM) Larval Sampling Program
  - Existing long-term monitoring survey since 1977
  - Stratified random sampling
  - Coverage across the northern Gulf of Mexico spawning grounds
- **Spawner Recapture**: Sampling of U.S., Canada, Japan, and Mexico Fisheries (and other international fisheries)
  - Marked individuals (GOM spawners) assumed to mix with unmarked population
  - Marked spawners recaptured in fisheries after the spawning period, outside of the GOM (does this represent a random sample of adults?)
  - Short duration between mark and recapture events, potentially negligible natural mortality

NOAA FISHERIES

Pilot Study underway – Objectives:

- Identify unique individuals using next-generation genomic sequencing following methods developed for Southern BFT
- Evaluate the feasibility of using GOM larvae to mark WBFT spawners
  - 500-1,500 individual larvae encountered yearly
  - Very clustered: few samples capture many larvae
  - Can we extract sufficient quality DNA from larval samples?
  - Unknown kinship (spawner genetic diversity) in larval samples
    - Does one plankton tow represent multiple spawner genomes or a single pair?
    - Has sufficient larval mixing occurred such that individual larvae represent a sample unit, i.e. unique spawner pairs?
- Feasibility of sampling fisheries for recaptures of genetically marked spawners
  - Can we identify stock origin of harvested fish? (i.e. East versus West Atlantic and remove positive N bias of recapturing mixed stocks)
  - Can we obtain representative samples from fisheries and meet the assumption of homogeneity in probability of recapture? (essential to obtain unbiased estimates of spawner absolute abundance using CKA)

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Potential Benefits

Pilot:

1) Application of next-generation genetic techniques for spawning stock abundance estimation – a different and more valuable result than just stock origin

2) Estimation of East vs West stock origin by genetic methods – useful as a stand-alone product for allocating catch compositions

Operational (Provided that pilot succeeds):

- a full close-kin analysis may provide an estimate of absolute number of spawners
- This could greatly reduce assessment uncertainty
- Or provide new basis for deriving quotas as a fraction of the spawning stock

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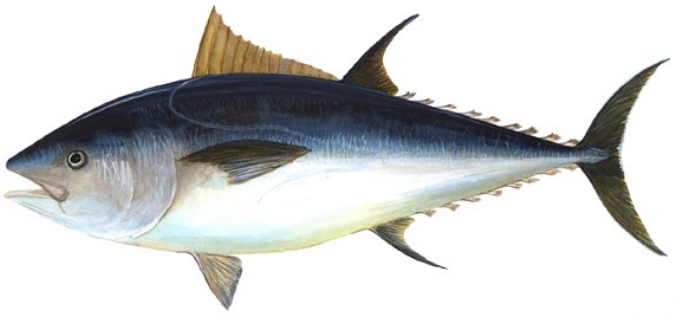
Developing new/improved fishery independent indices for western Atlantic Bluefin Tuna using larval collections



Potential improvements to existing indices

- Incorporate an adaptive sampling scheme based upon habitat models
- Expand depth-stratified sampling to define the vertical distribution of larvae
- Incorporating age and mortality estimates for larvae collected in different regions within the Gulf of Mexico

Potential new indices that might be developed:

- Develop an index of larval prey, feeding success and growth
- Initiate sampling for bluefin tuna eggs, to index of spawning stock biomass
- Extend exploratory sampling efforts in the Caribbean Sea and western North Atlantic to determine the significance of alternative spawning grounds

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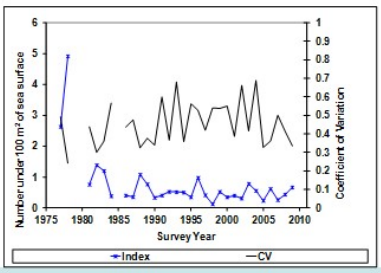
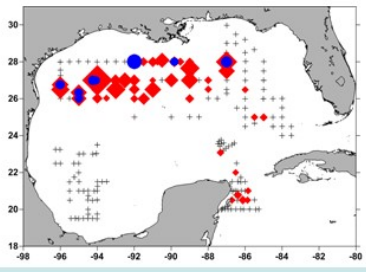
Past improvements to existing larval index: catch efficiencies

- *Issues*:
  - The larval index was zero-inflated, and didn't account for environmental conditions. This resulted in a high degree of uncertainty around index values
- *Solutions*:
  - We developed an environmentally-driven habitat model to predict conditions and locations where larvae would be expected
  - This model suggested that catchability of larvae was likely sub-optimal, so we introduced a new plankton sampling gear in 2010, which is much more efficient

Larval bluefin index (blue), and coefficient of variation (black)



Larval bluefin catches from bongo net (blue) and S-10 net (red) tows, 2010



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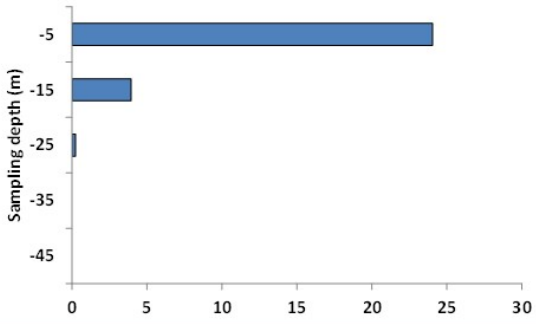
Potential future improvements to existing larval index: depth distributions

- *Issues*:
  - We have limited information on distributions of larvae by depth, and so catch efficiencies are still not well known
  - This contributes another potential source of error to the larval index
- *Solutions*:
  - We propose to increase use of depth-stratified opening/closing nets on annual cruises, in order to quantify the sampling efficiencies of all gears used
- *What we need*:
  - More ship time during the peak spawning season

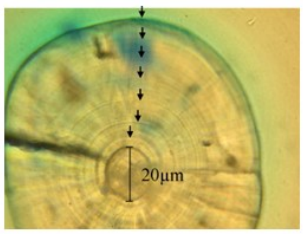
A MOCNESS opening and closing plankton sampling net

Preliminary data on larval depth distributions



Potential future improvements to existing larval index: larval aging

- *Issues*:
  - Estimates of age-at-length are required to standardize larval catches for the larval index
  - The current age-length curve was developed from larvae sampled off Miami more than 30 years ago
- *Solutions*:
  - New age curve was developed from samples taken in 2012. Curve will be updated using the 2013 and 2014 specimens.
  - We have begun to age larval bluefin from several cruises in the Gulf of Mexico in recent years
  - When sufficient samples have been processed, we will develop predictive models to define how environmental conditions affect growth, and how this varies among years
- *What we need:*
  - Resources for lab work, to dissect and age larvae



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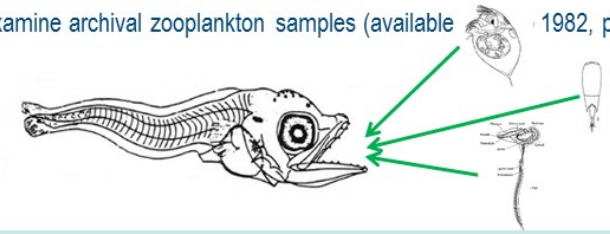
Potential development of new indices: feeding success and recruitment

- *Issues*:
  - Survival of larvae at very early life stages may exert a strong influence on recruitment variability
  - Planktonic feeding conditions are likely important, but little is known about larval bluefin feeding ecology
- *Solutions*:
  - We have begun to look at gut contents and feeding preferences of larvae from the Gulf of Mexico, in collaboration with WHOI, and this year we will examine archival plankton samples from past years to determine the abundance of these prey items.
  - Larval feeding success and prey fields will be compared among years with good vs. poor recruitment
  - When combined with estimates of larval growth rates, we can investigate how environmental conditions drive larval survival and recruitment, and how these might have varied in the past several decades
- *What we need:*
  - Resources for lab work, to dissect and process larvae
  - Resources to examine archival zooplankton samples (available 1982, possibly earlier)



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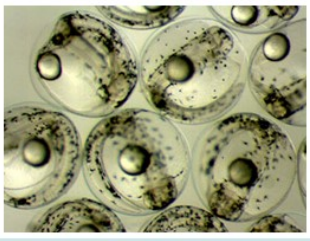
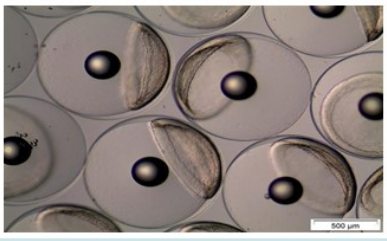
Potential development of new indices: egg production

- *Issues*:
  - Larval growth and mortality contributes to variability in larval abundances, which adds error to estimates of spawning stock biomass from the larval survey
- *Solutions*:
  - A daily egg production model (DEPM) provides a much more direct estimate of spawning biomass
  - This could be developed for bluefin tuna using genetic techniques to identify eggs
- *What we need:*
  - Resources for genetic analyses to identify eggs, which are already collected during annual surveys





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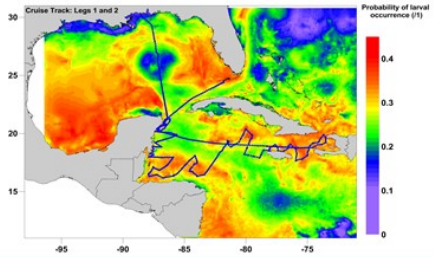
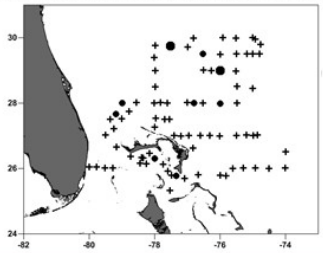
Potential development of new indices: alternate spawning grounds

- *Issues:*
  - Sampling for larval bluefin tuna has traditionally been concentrated in the northern Gulf of Mexico
  - Limited sampling in the southwest Gulf, western Caribbean, and north of the Bahamas has collected small numbers of larvae
  - However, the importance of this spawning activity to the western stock is not known
- *Solutions:*
  - Additional sampling efforts in potential spawning grounds with greater spatiotemporal coverage
  - Genetic analyses to compare relationships between larvae from inside vs. outside the Gulf of Mexico
  - Backtracking and development of individual Based Models (IBMs) using hydrodynamic models estimate spawning locations of larvae caught
- *What we need:*
  - More ship time in the southwestern Gulf of Mexico, western Caribbean and western central Atlantic
  - Resources to sort collected samples, and to analyze collected larvae genetically
  - Resources to complete IBM and larval backtracking analyses

Cruise track and sampling stations: Bluefin tuna cruise 2011



Larval bluefin tuna (black dots) collected north of the Bahamas, 2013



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Areas where progress has been made since 2014 meeting of this Working Group:

Potential improvements to existing indices currently underway:

- Incorporating age and mortality estimates for larvae collected in different regions within the Gulf of Mexico

  This work is underway

Potential new indices that might be developed:

- Develop an index of larval prey, feeding success and growth

  Study initiated on archived historical samples

- Extend exploratory sampling efforts in the Caribbean Sea and western North Atlantic to determine the significance of alternative spawning grounds

  Sampled off Cuba and Mexico this year. Funding has not yet been identified for expansion into the Atlantic. There is likely a need for a larger NOAA ship with increased endurance for this work.

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