TROISIÈME RÉUNION DU GROUPE DE TRAVAIL DE GESTIONNAIRES DES PÊCHERIES ET D'HALIEUTES EN APPUI À L'ÉVALUATION DU STOCK DE THON ROUGE DE L'ATLANTIQUE OUEST

(Bilbao (Espagne), 25-26 juin 2015)

1. Ouverture de la réunion

Le Président de la Sous-commission 2, M. Masanori Miyahara (Japon), a ouvert la réunion et souhaité la bienvenue aux participants.

Le Secrétaire exécutif a présenté les CPC suivantes participant à la réunion : Canada, États-Unis, Ghana, Japon, Mexique, Nigeria, Sénégal, Union européenne et Uruguay.

En outre, les observateurs des organisations suivantes étaient présents: Ecology Action Center (EAC), Pew Charitable Trusts et the Ocean Foundation.

La liste des participants se trouve à l'**Appendice 2**.

2. Élection du Président

Les États-Unis ont nommé M. Masanori Miyahara (Japon) Président du Groupe de travail.

3. Adoption de l'ordre du jour et organisation des sessions

L'ordre du jour a été adopté sans modification et figure à l'**Appendice 1**.

4. Désignation du rapporteur

Mme Carolyn Doherty (États-Unis) a assumé les fonctions de rapporteur pour la réunion.

5. Examen des résultats de la deuxième réunion du Groupe de travail de gestionnaires des pêcheries et d'halieutes en appui à l'évaluation du stock de thon rouge de l'Atlantique Ouest

Le Président a rappelé le rapport du deuxième Groupe de travail de gestionnaires des pêcheries et d'halieutes en appui à l'évaluation du stock de thon rouge de l'Atlantique Ouest et a passé en revue les trois recommandations convenues par les CPC à cette réunion, tenue sur l'île du Prince Edouard (Canada), du 10 au 12 juillet 2014.

1) Pendant la période intersession, les scientifiques nationaux des CPC qui pêchent le thon rouge de l'Ouest travailleront conjointement pour explorer des domaines de collaboration, identifier les coûts et établir l'ordre de priorité des nouvelles propositions de recherche discutées à la présente réunion. Les résultats de ces travaux et les nouvelles propositions seront présentés au SCRS en septembre 2014 à des fins d'examen et d'évaluation. Dans le même temps, il a été reconnu que les CPC poursuivront les travaux déjà en cours (à savoir l'ampliation des prospections actuelles) et les nouveaux projets pour lesquels des fonds ont été garantis.

2) Les CPC collaboreront dans l'analyse des données de prise et d'effort non agrégées dans le but d'améliorer les indices d'abondance actuels du stock et de développer un indice unique d'abondance incorporant les données des diverses CPC. L'accès aux données sera partagé de manière à ne pas enfreindre les normes de confidentialité des données.

3) Les CPC poursuivront leurs efforts visant à améliorer la quantité et la qualité des données recueillies et déclarées, conformément aux recommandations du SCRS. Plus particulièrement, les CPC sont encouragées à fournir des informations sur les changements des pratiques de pêche et d'autres variables susceptibles d'influencer le taux de capture de manière à ce que ces facteurs soient incorporés dans les modèles de standardisation.

Le Canada, le Japon et les États-Unis ont fourni des mises à jour sur les activités de recherche en cours de réalisation en rapport avec ces trois recommandations.

Dr Gary D. Melvin (Canada) a fourni un aperçu général des efforts actuellement déployés au Canada dans sa présentation intitulée "Observations acoustiques in situ du thon rouge de l'Atlantique (*Thunnus thynnus*) avec un sonar multifaisceaux à haute résolution (**Appendice 3**). Sa présentation a décrit les récentes études sur le terrain destinées à déterminer la capacité et l'adaptabilité de l'emploi d'un sonar multifaisceaux à haute fréquence pour documenter, suivre et quantifier le thon rouge. Comme le Dr Melvin a expliqué, les résultats préliminaires de cette étude illustrent clairement que le thon rouge peut être détecté et suivi dans la trajectoire du sonar multifaisceaux. Les résultats de cette étude indiquent que l'utilisation d'un sonar multifaisceaux offre un potentiel intéressant permettant de suivre et de quantifier le thon rouge dans le cadre d'une étude indépendante sur la pêche à grande échelle.

Dr Melvin a poursuivi sa présentation sur les efforts déployés par le Canada en réalisant un exposé intitulé "Indice d'abondance acoustique pour le thon rouge dans la Baie des chaleurs" (**Appendice 4**). Il a évoqué la prospection acoustique actuellement en cours sur le hareng dans la zone de la Baie des chaleurs du golfe du St Laurent et visant à estimer l'abondance du thon rouge Le Canada est en train de ré-analyser ces jeux de données pour le thon rouge remontant à 1991 et a complété l'analyse de 2007 à 2013. Les analyses préliminaires sont positives et les travaux se poursuivront sur ces données et sur un indice d'abondance indépendant des pêcheries pour autant d'années que possible. Ces travaux seront présentés à la réunion de préparation des données au début de 2016, conformément aux protocoles requis pour l'introduction d'un nouvel indice d'abondance.

Dr Melvin a terminé sa présentation sur les efforts déployés par le Canada en réalisant un autre exposé intitulé "Projets scientifiques de la DFO sur le thon rouge au titre de 2015" (**Appendice 5**). Dr Melvin a indiqué que cinq projets financés par l'industrie ont été mis sur pied en 2015. Chacun de ces projets démarrera en août 2015 et abordera des questions spécifiques identifiées pour améliorer la saisie des données pour l'évaluation de 2016. Toutes les analyses de données seront achevées suffisamment à l'avance pour être disponibles à la réunion de préparation des données.

M. Haruo Tominaga (Japon) a expliqué qu'en l'absence d'un quota de thon rouge de l'Atlantique Ouest réservé pour la recherche, les activités de recherche proposées l'année dernière n'ont pas été réalisées par le Japon et ne pourront pas non plus être menées l'année prochaine.

Dr Craig Brown (États-Unis) a fourni un « Aperçu général des travaux actuellement en cours aux États-Unis dans le but d'améliorer les évaluations du stock de thon rouge de l'Ouest » (**Appendice 6**). Il a décrit une étude pilote visant à évaluer la possibilité de mettre au point un indice d'abondance pour des spécimens de thon roue de l'Ouest jeunes de l'année (YOY). Afin de déterminer la disponibilité, la distribution et les méthodes potentielles d'échantillonnage, un réseau de pêcheurs récréatifs volontaires et de capitaines de navires affrétés est en train de se développer le long de la côte du détroit de la Floride. Les essais de prélèvement des spécimens YOY de thon rouge de l'Ouest commenceront à l'été 2015.

Dr Brown a poursuivi sa présentation en expliquant qu'une étude pilote avait également démarrée dans le but de déterminer la possibilité de réaliser une analyse de similitude "close kin" qui pourrait déboucher sur des estimations directes de la biomasse du stock reproducteur de thon rouge de l'Ouest. Les travaux ont été lancés sur trois domaines de la recherche susceptibles d'améliorer l'indice larvaire existant du thon rouge de l'Ouest ou de déboucher sur la mise au point de nouveaux indices, dont : (1) en incorporant les estimations annuelles de l'âge et de la mortalité des larves recueillies dans différentes régions au sein du golfe du Mexique, ce qui devrait améliorer la standardisation des indices actuels du thon rouge de l'Ouest ; (2) en développant un nouvel indice des proies des larves, de la capacité de se nourrir et de croissance, ce qui pourrait améliorer la standardisation, à cet égard des travaux ont démarré sur des échantillons historiques archivés : et (3) en étendant les efforts d'échantillonnage exploratoire dans la mer des Caraïbes et l'ouest de l'Atlantique Nord dans le but de déterminer l'importance des d'autres zones de frai, à ce sujet un échantillonnage a été réalisé cette année au large de Cuba et du Mexique.

6. Examen des progrès accomplis concernant la combinaison des données brutes de prise et d'effort des flottilles individuelles dans un nouvel indice (ou dans de nouveaux indices) d'abondance pour le thon rouge de l'Atlantique Ouest

Le Président a lancé les débats sur les progrès de combiner des données brutes de prise/effort pour les flottilles individuelles dans un nouvel indice d'abondance pour le thon rouge de l'Ouest. Les discussions ont commencé avec un aperçu général de la collaboration entre le Canada et les États-Unis afin de combiner les données pour créer un indice de CPUE qui inclue l'information de toutes les flottilles palangrières et protège la confidentialité des données, comme discuté dans le SCRS/2015/032. Les Etats-Unis et le Canada examinent les moyens possibles pour fusionner leurs données de prise/effort non-agrégées respectives afin de créer un indice combiné. Ces travaux se poursuivront lors d'une réunion de travail qui sera tenue au Canada cet été à laquelle les États-Unis, le Japon et le Mexique sont invités à participer. Il a été décidé que ces travaux seront approfondis à la réunion des Parties qui se tiendra en marge de la prochaine réunion des groupes d'espèces du SCRS en septembre 2015 dans le but de développer un indice unique d'abondance incorporant les données des CPC avant la réunion de préparation des données de 2016.

En outre, les États-Unis et le Canada collaborent actuellement pour créer l'indice combiné pour la pêcherie de canne et moulinet.

Suite aux échanges d'informations qui ont eu lieu aux deux réunions antérieures du Groupe de travail, des discussions supplémentaires se sont tenues sur les processus de collecte des données pour la pêcherie récréative de canne et moulinet des États-Unis. En réponse à la demande du Japon, les États Unis ont expliqué brièvement leur processus visant à obtenir des informations de prise et d'effort précises auprès de cette pêcherie, y compris une exigence de déclaration directe assortie d'une prospection statistique scientifiquement validée, et ils ont proposé de fournir davantage d'information aux parties intéressées.

Le Japon et les États-Unis poursuivront le dialogue sur ce point et informeront la Sous-commission 2 des résultats.

7. Examen des travaux futurs

Le Président a rappelé qu'à la dernière réunion de ce Groupe de travail, tous les participants ont reconnu la valeur de discuter ensemble de ce stock particulier. Le Président a réitéré l'importance de ces travaux et a demandé aux CPC d'envisager les prochaines étapes de ce Groupe de travail WBFT.

Les CPC ont convenu que ce Groupe de travail avait été très constructif pour faire avancer les activités de recherche collaborative entre les CPC et que les efforts de ce groupe avaient été extrêmement positifs. Nonobstant, toutes les Parties ont reconnu qu'il ne serait pas nécessaire que ce Groupe de travail se réunisse en 2016 compte tenu de l'évaluation du stock en suspens et d'autres travaux en cours de réalisation, mais elles ont encouragé la poursuite des travaux de ce groupe durant la période intersession. En outre, toutes les Parties ont convenu que la possibilité que le Groupe de travail se réunisse à une date ultérieure devrait rester ouverte. Le Groupe de travail recommande donc qu'aucune réunion intersession ne soit tenue en 2016 et que la Sous-commission 2 examine l'état d'avancement des activités de recherche à sa réunion de 2015 et envisage de tenir la prochaine réunion du Groupe de travail en 2017, si nécessaire.

Les Parties ont également discuté de la mise à jour de l'analyse AIC réalisée par le SCRS en 2014 afin de déterminer l'ajustement des scénarios de fort et de faible recrutement aux estimations de la biomasse du stock reproducteur et du recrutement. Le Canada a suggéré que ces travaux soient examinés plus avant par le SCRS. Le Président du SCRS a confirmé que cela devrait être possible à la réunion des groupes d'espèces en septembre 2015.

8. Autres questions

Aucune autre question n'a été discutée.

9. Adoption du rapport et clôture.

Le rapport a été adopté et la troisième réunion du Groupe de travail de gestionnaires des pêcheries et d'halieutes en appui à l'évaluation du stock de thon rouge de l'Atlantique Ouest a été levée.

Appendice 1

ORDRE DU JOUR

1. Ouverture de la réunion
2. Élection du Président
3. Adoption de l’ordre du jour et organisation des sessions
4. Désignation du rapporteur
5. Examen des résultats de la deuxième réunion du Groupe de travail de gestionnaires des pêcheries et d’halieutes en appui à l’évaluation du stock de thon rouge de l’Atlantique Ouest
6. Examen des progrès accomplis concernant la combinaison des données brutes de prise et d'effort des flottilles individuelles dans un nouvel indice (ou dans de nouveaux indices) d'abondance pour le thon rouge de l’Atlantique Ouest
7. Examen des travaux futurs
8. Autres questions
9. Adoption du rapport et clôture

Appendice 2

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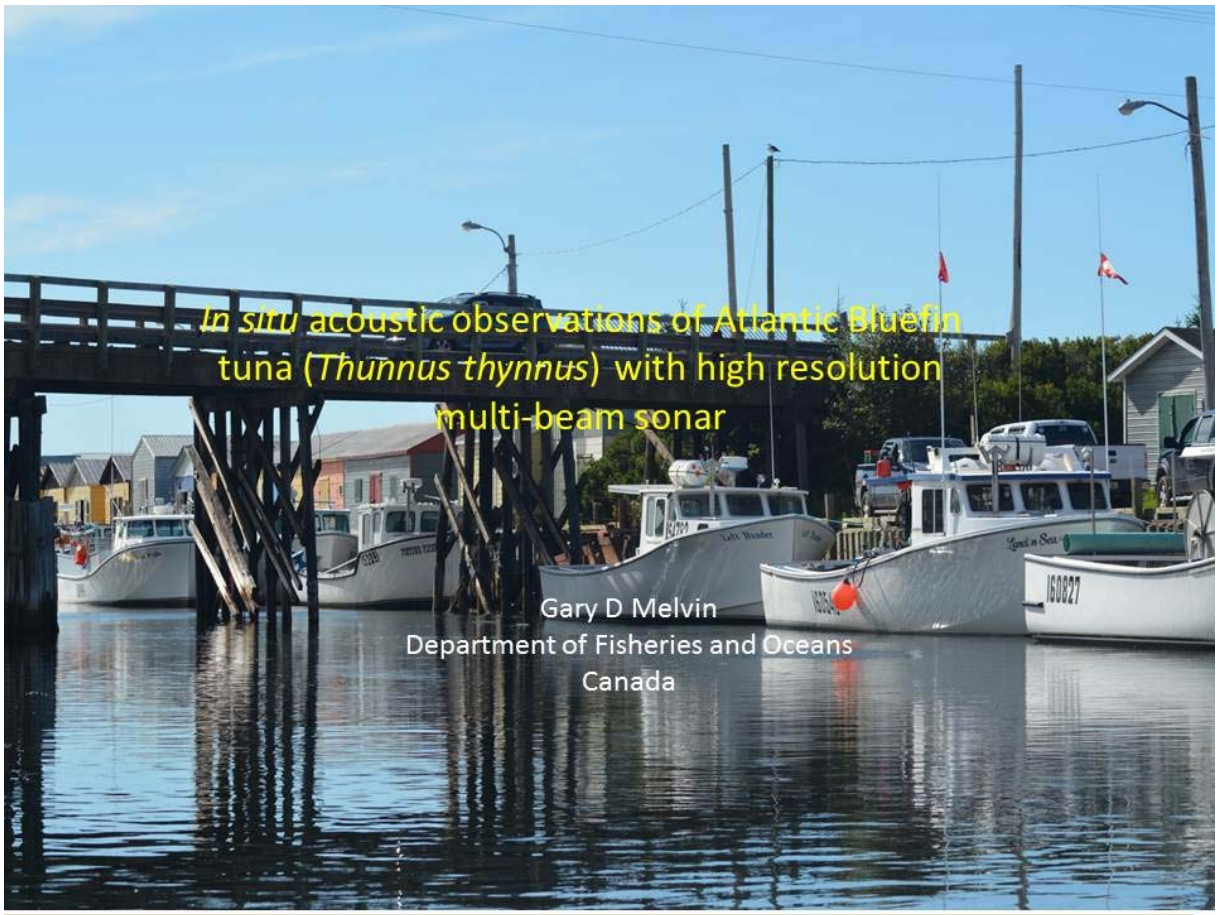


Background

- 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.

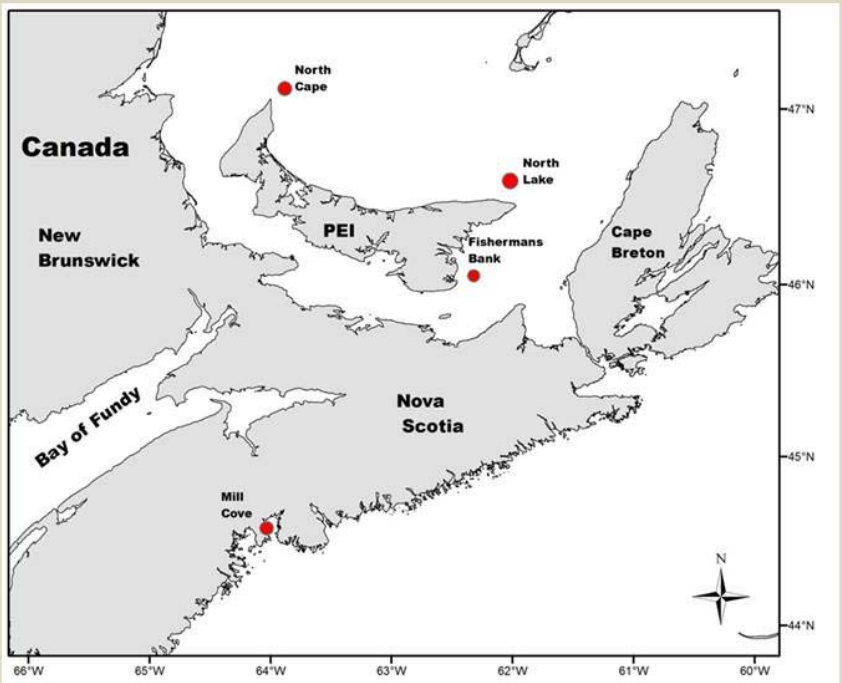
Field Study Objectives

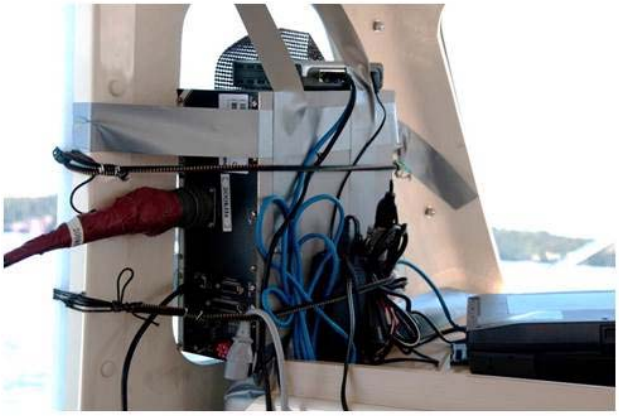
- Proof of Concept:
  - To evaluate the ability of acoustic technology to detect, observe, and quantify Bluefin tuna on the fishing grounds.
  - To investigate appropriate system configurations under different environmental and sea states (Tilt angle, vertical beam width, etc).
  - To investigate the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

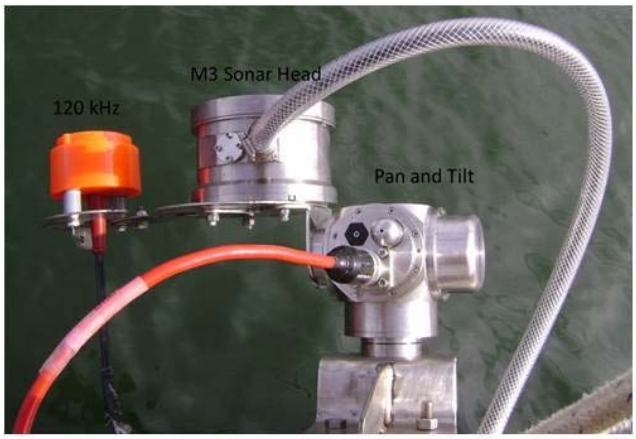
Study area and Equipment

- 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.

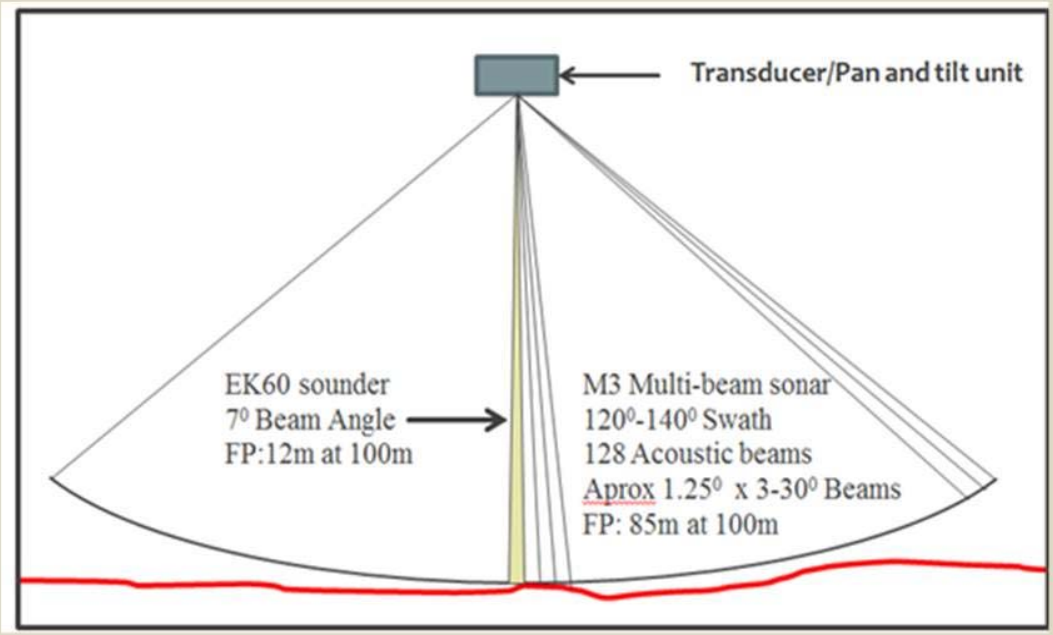
Location of Acoustic sampling sites in Eastern Canada





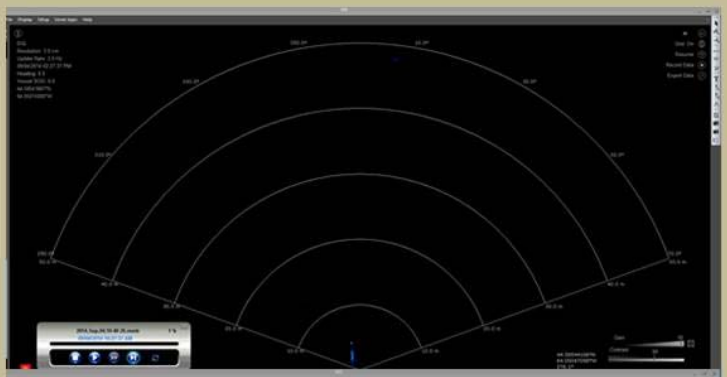


Comparison of EK60 echosounder and M3 multibeam sonar beam patterms

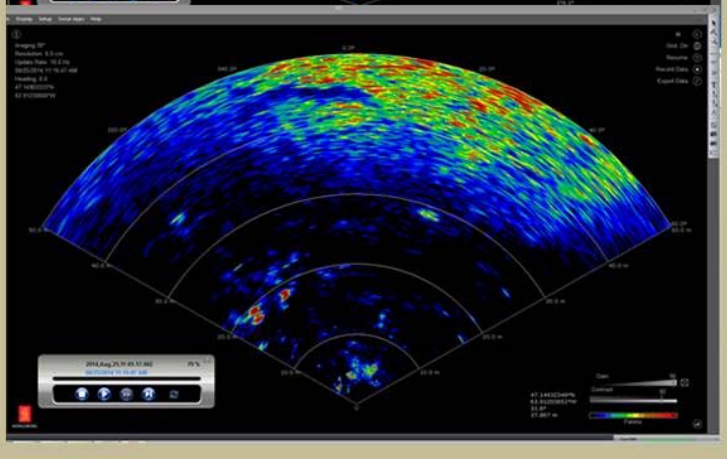


Observations in Shallow (<50) verse deeper water and rough and calm seas

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

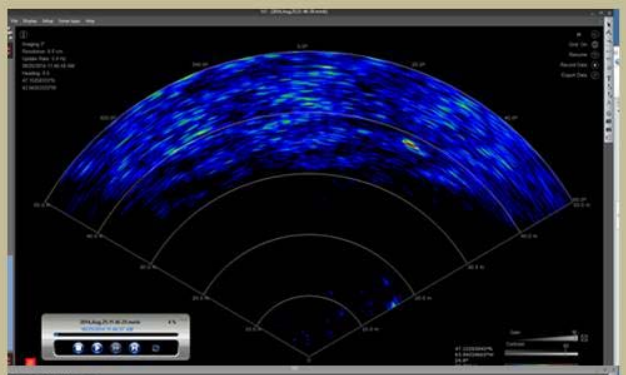


M3 – Single Ping, 20-25m depth, and 20 knot winds

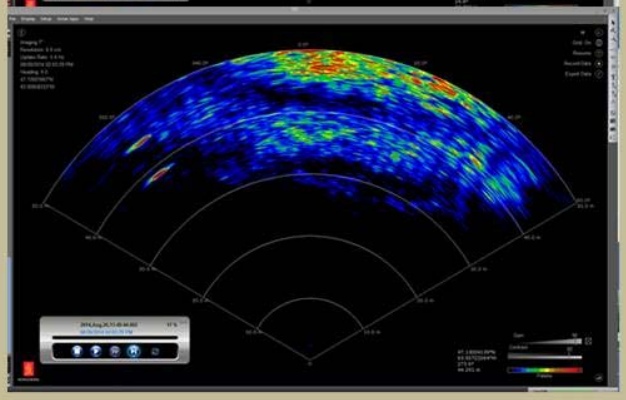


Observations of 1 and 2 BFT

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

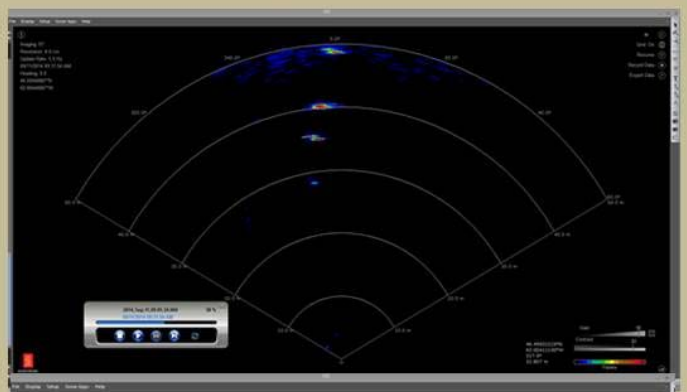


M3 – Single Ping,
- Range 50m
- Shallow water,
- Two BFT

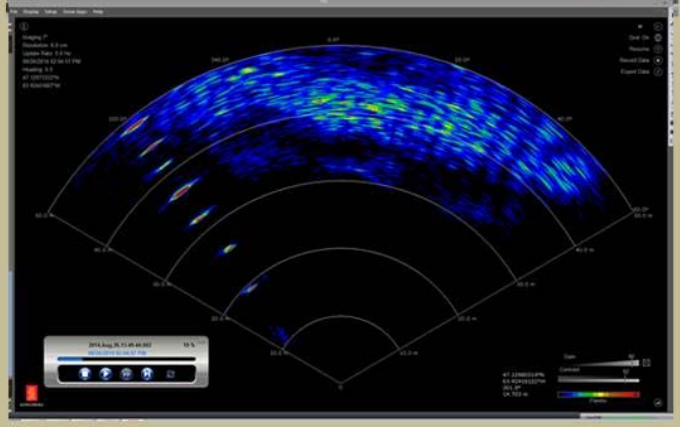


Observations of Multiple BFT

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

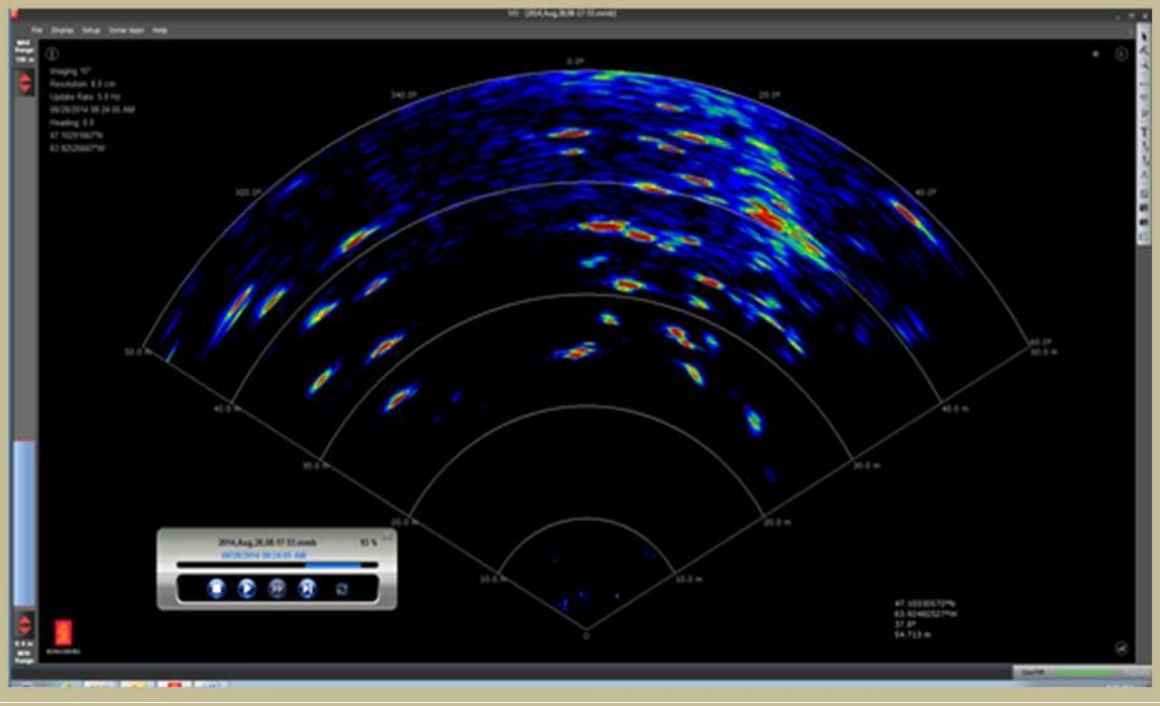
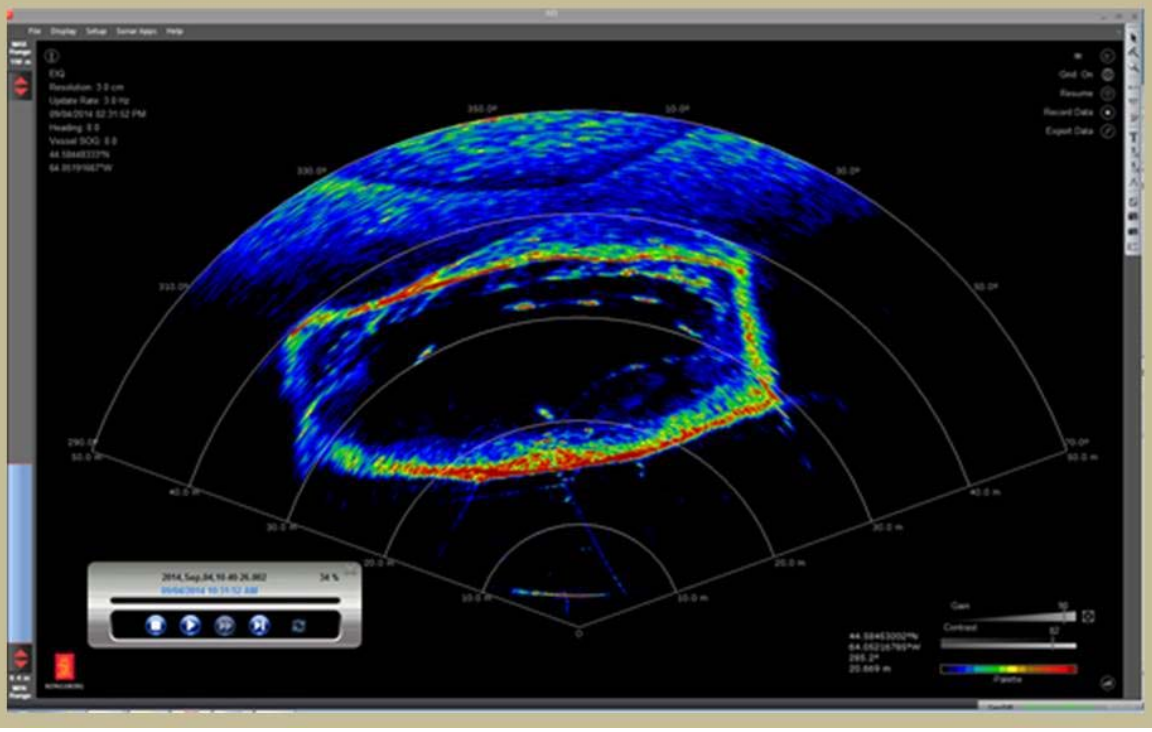


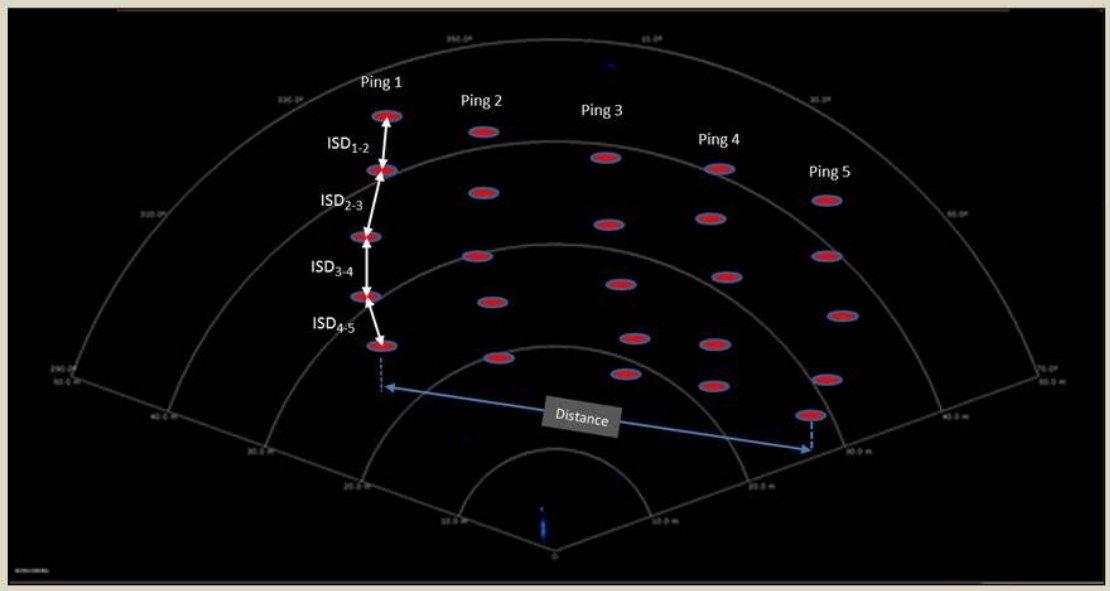
Image of bluefin tuna in the Mill Cove pen in St Margarets Bay, Nova Scotia, September 4, 2014.



Data Collection

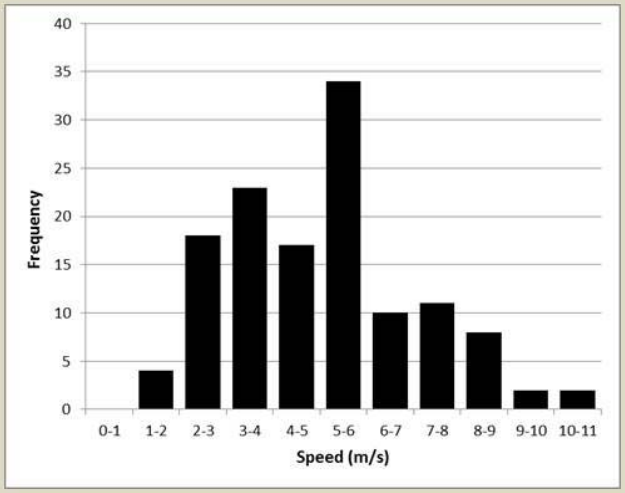
- Data Extractable for individual targets
  - Date, time, and vessel position
  - Position of individual targets in multi-beam swath.
    - Latitude and longitude
    - Angle and Range from sonar head
- Estimated Variables
  - Swimming speed within the sonar swath
  - Inter-spatial distance between adjacent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

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



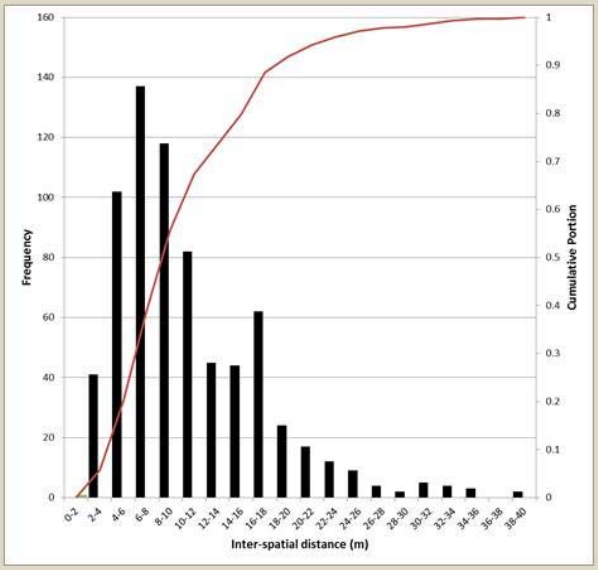
Swimming Speed

	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



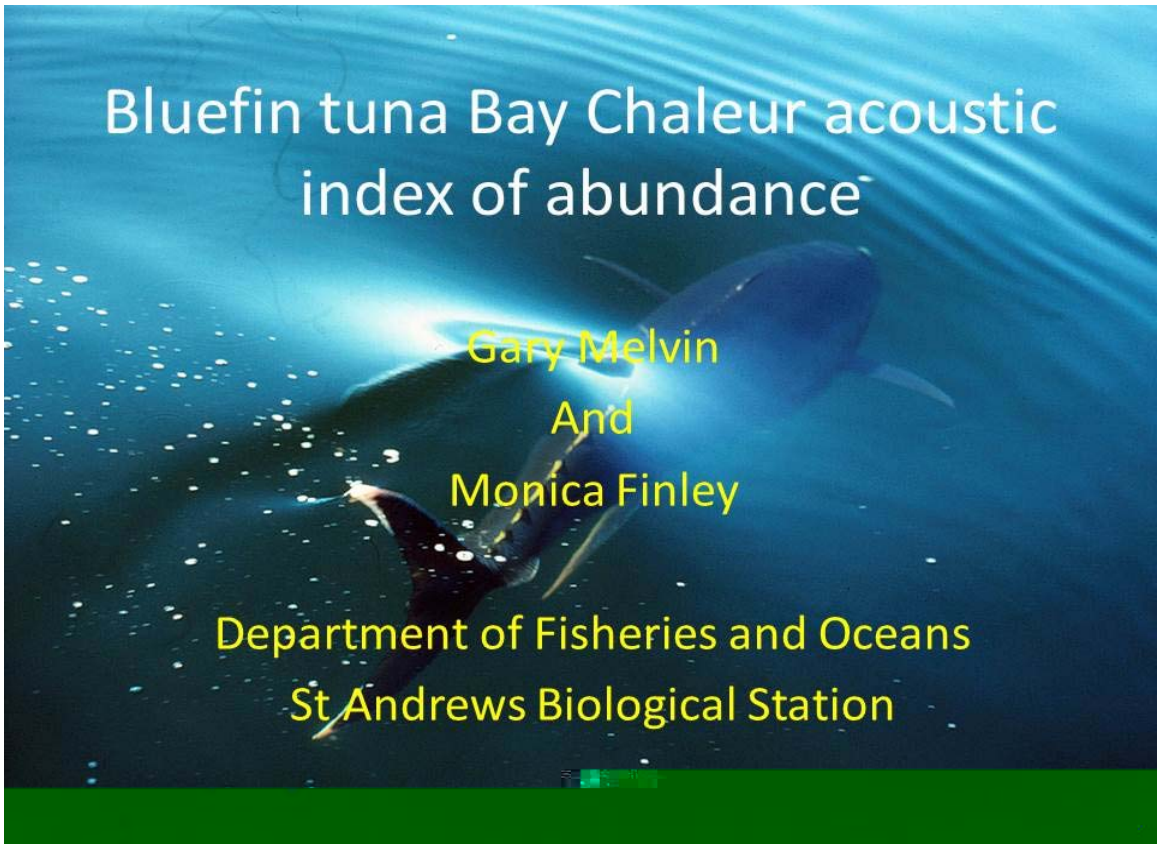
Other Acoustic Observations

- 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.

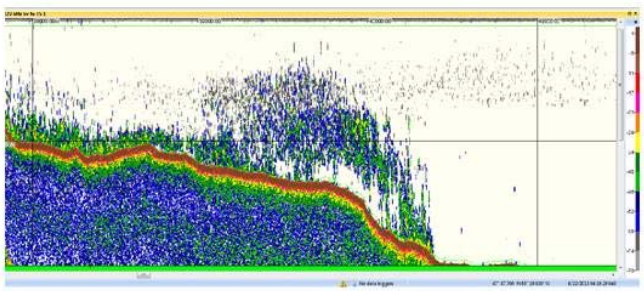
Appendice 4

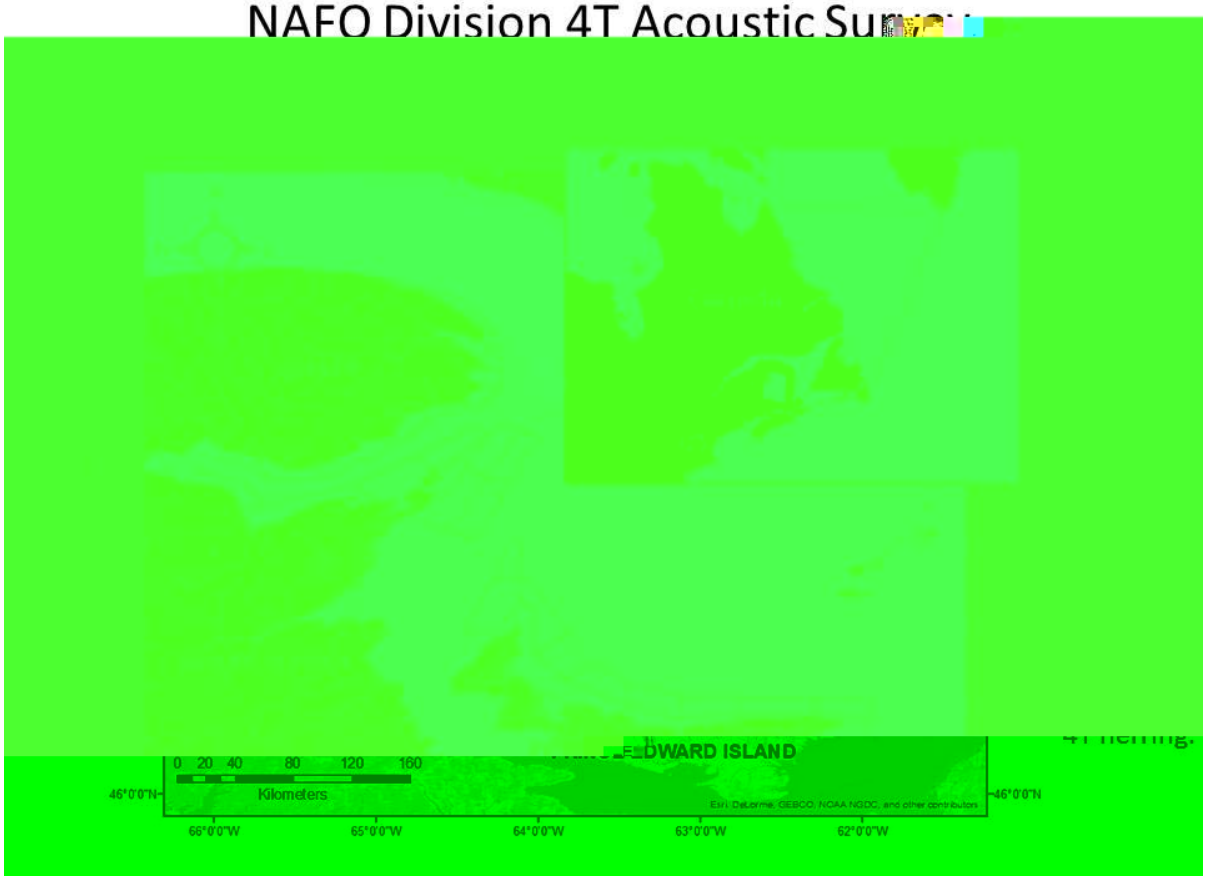


Gulf Region Bluefin Tuna Abundance Index

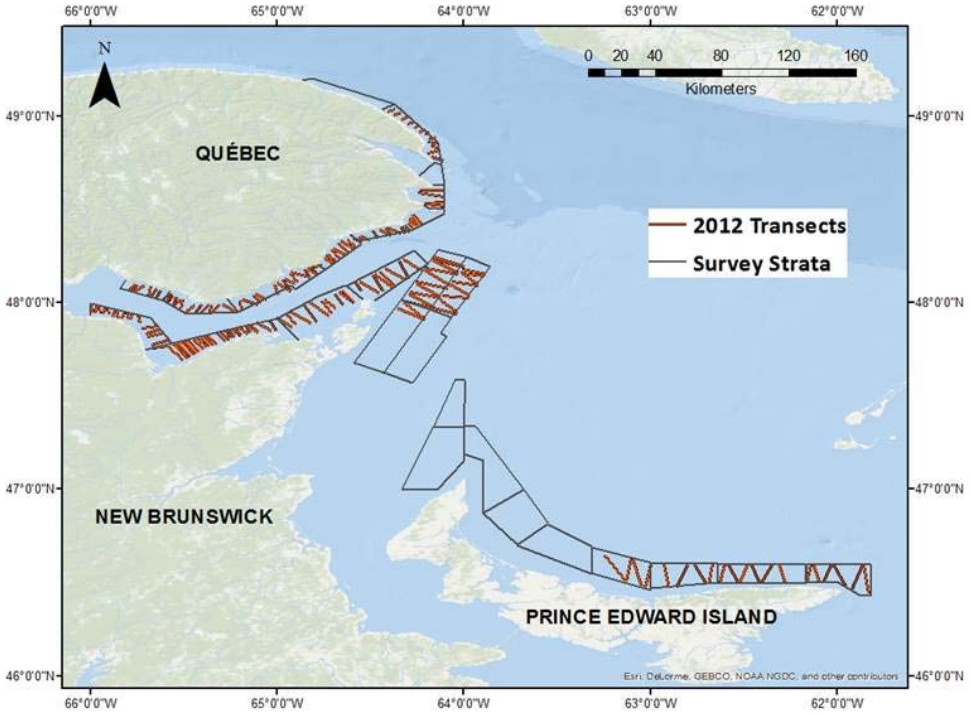
Background

- 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.





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

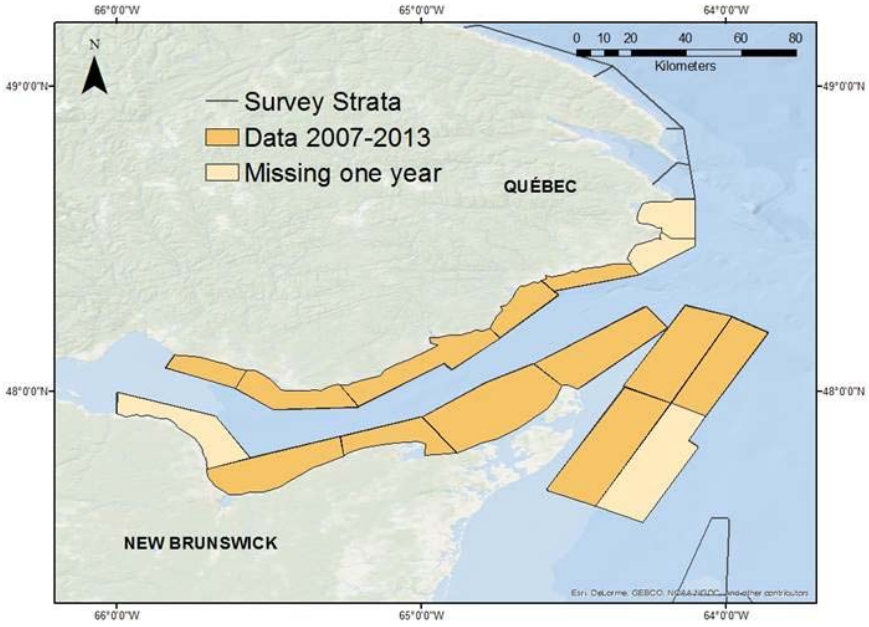
24 years of acoustic survey data available.

PEI has been surveyed 17 of the 24 years.

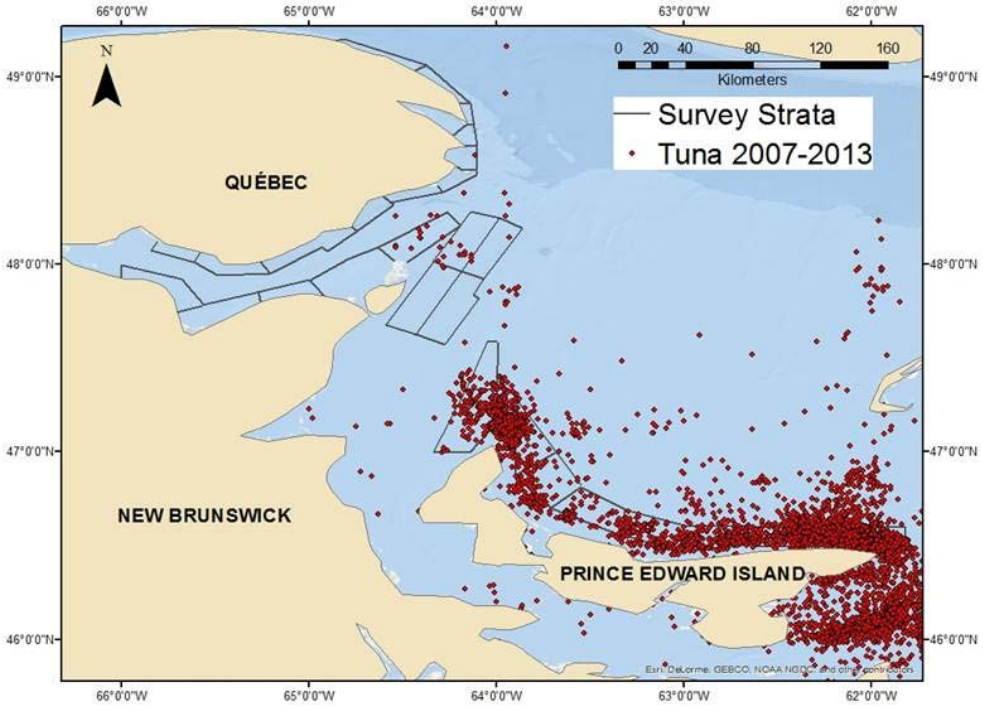
To date:

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

ge

Many years of incomplete covera

rage

Final analysis will look at PEI cove

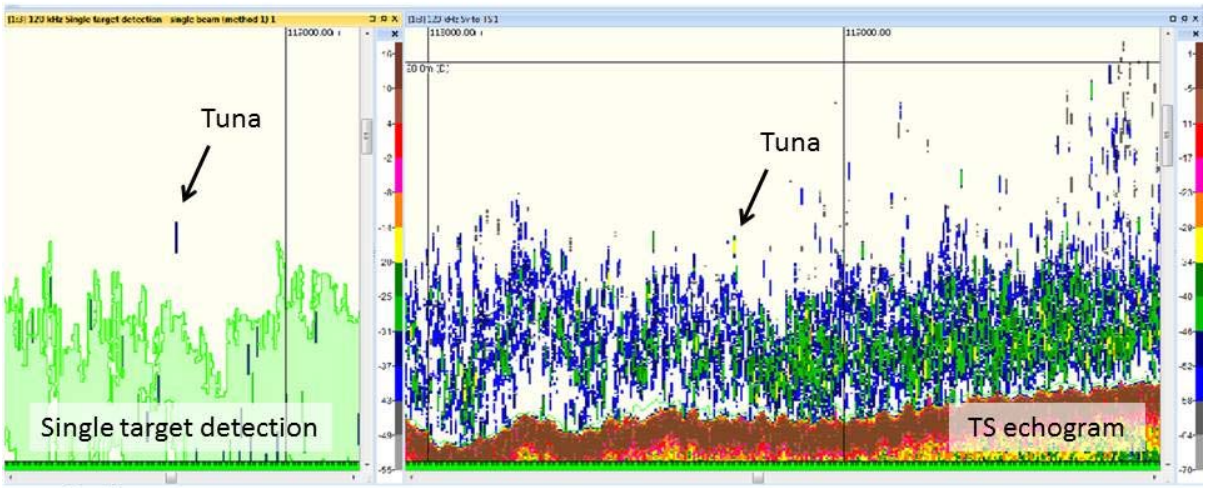
PEI Survey	Year	PEI Survey
Y	2007	Y
Y	2008	Y
Y	2009	Y
Y	2010	Y
Y	2011	n/a
Y	2012	Y
Y	2013	n/a
Y	2014	n/a

Year	PEI Survey	Year
1991	n/a	1999
1992	n/a	2000
1993	Y	2001
1994	n/a	2002
1995	Y	2003
1996	Y	2004
1997	Y	2005
1998	n/a	2006

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.

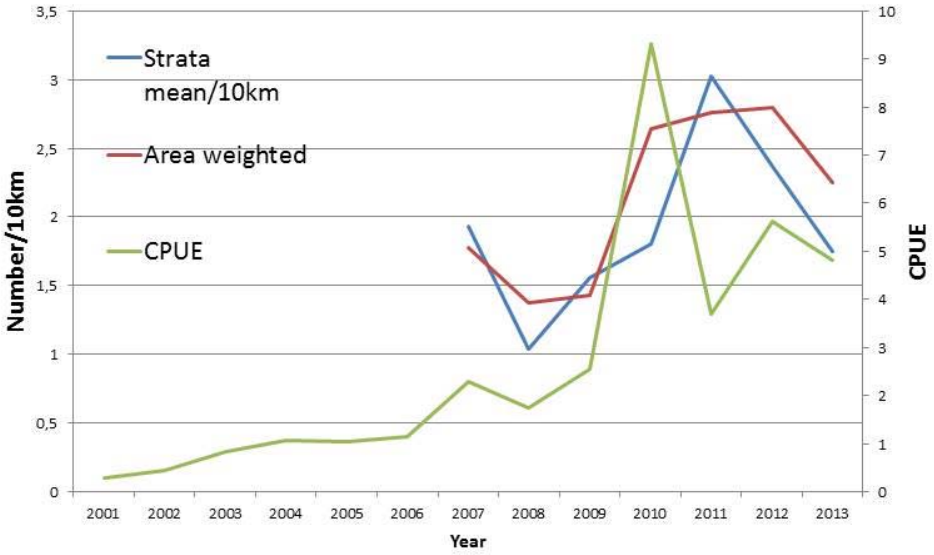
Tuna like Single Target Identification

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.

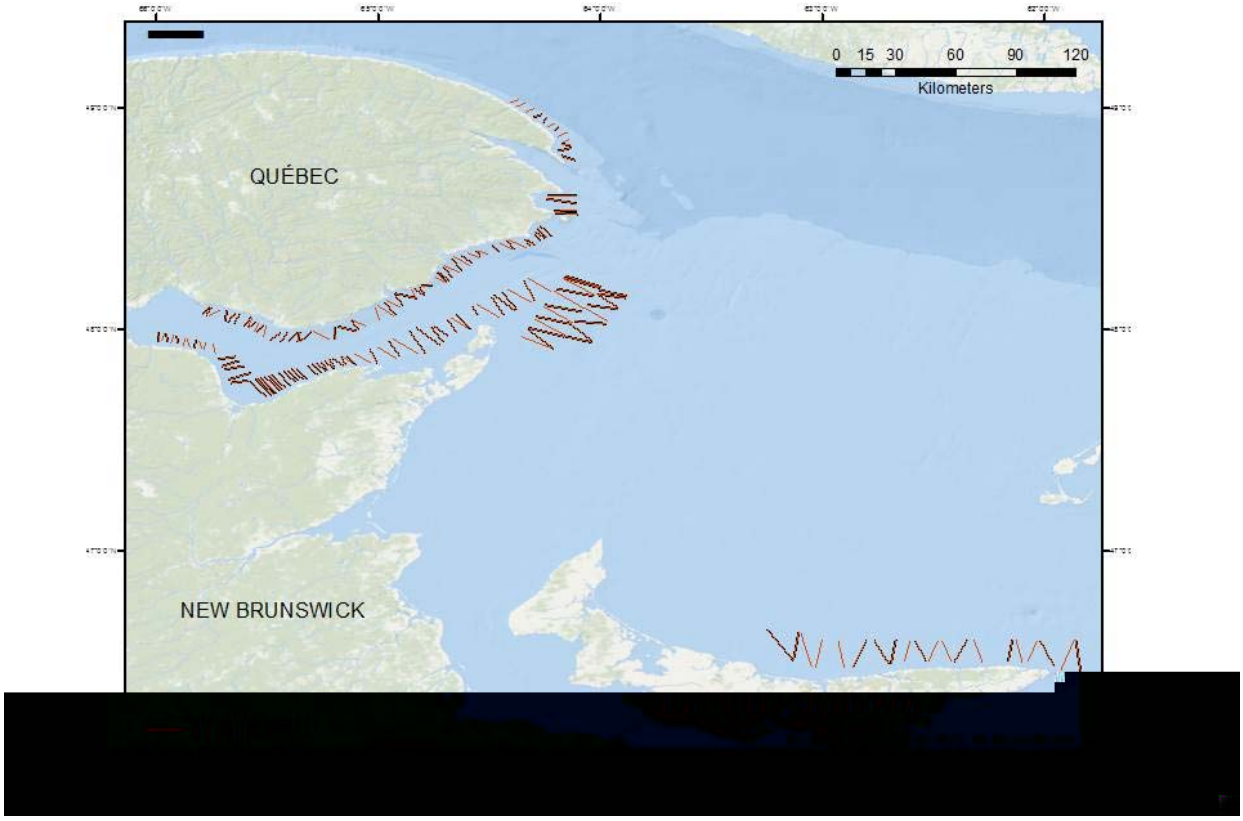
Preliminary Results



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



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

Appendice 6

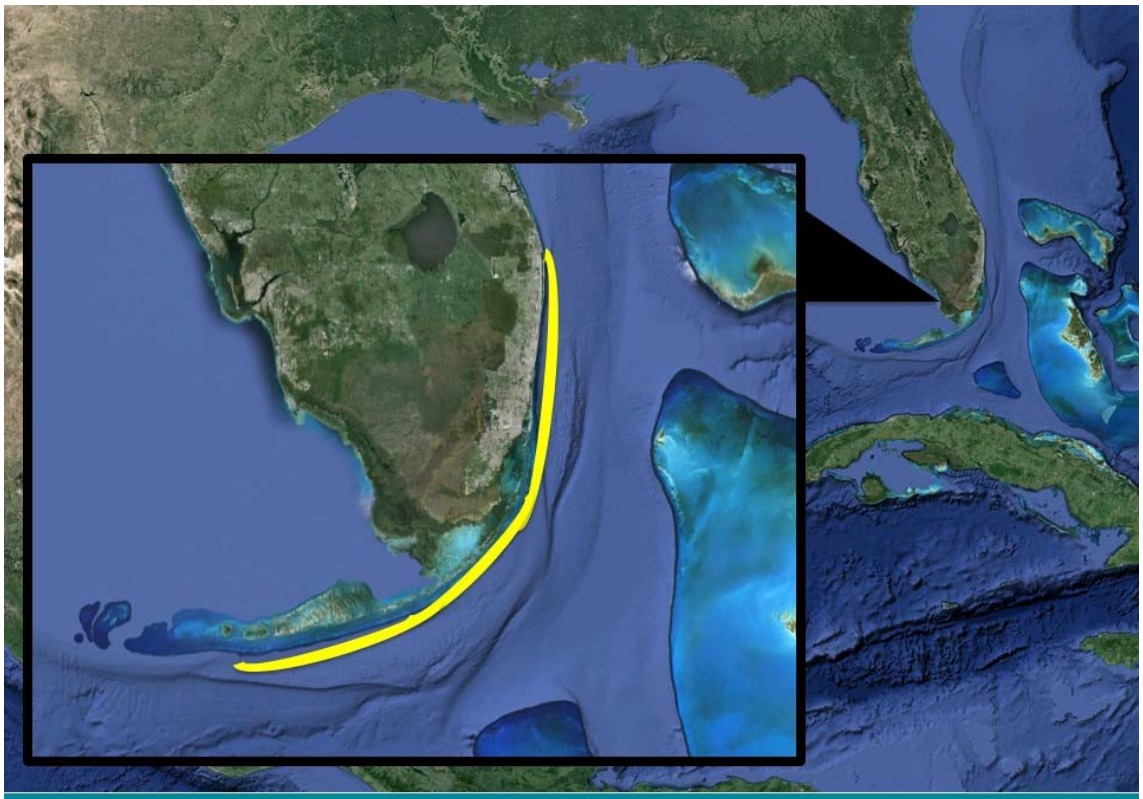
Progress Report on selected USA Research Activities to Improve the Stock Assessment of western Atlantic Bluefin Tuna

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

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 FISHERIES

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.

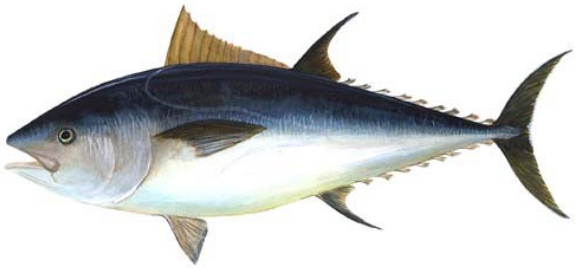
Blackfin 19-25 gillrakers

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

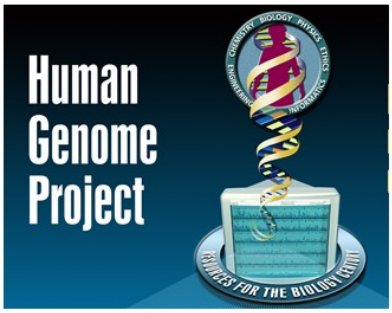
Human genome project has changed the game for molecular DNA technology and analysis

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

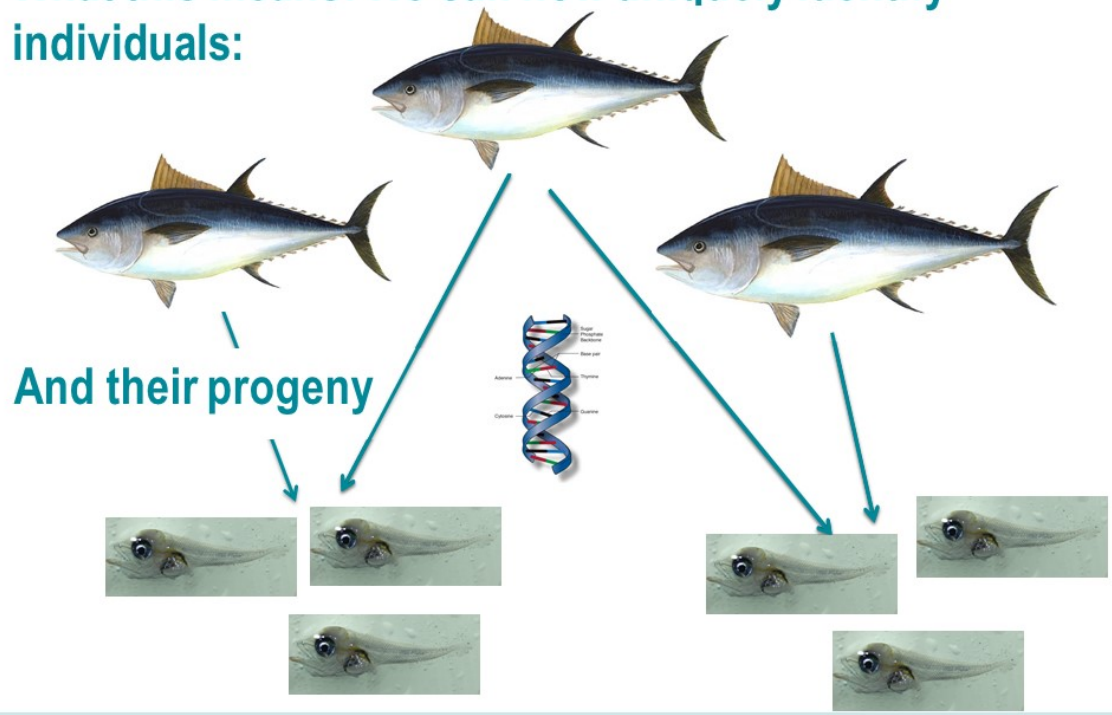
1000s of DNA markers can be sequenced rapidly and cheaply to identify individuals.

It is time to apply these methods to fisheries problems



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

What this means: We can now uniquely identify individuals:

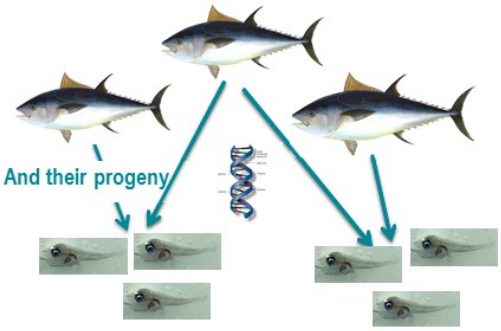


NOAA FISHERIES

Larval pictures from Katherine Dale, NMFS

Close-Kin Analysis

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



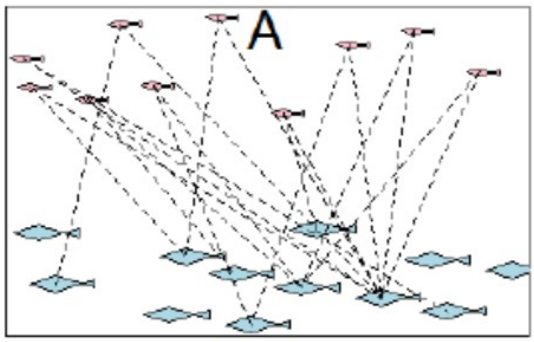
Similar to a mark-recapture experiment

Successfully applied to

- Minke whales
- Southern Bluefin tuna

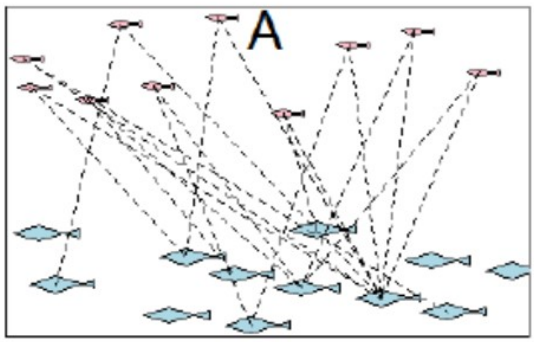
NOAA FISHERIES

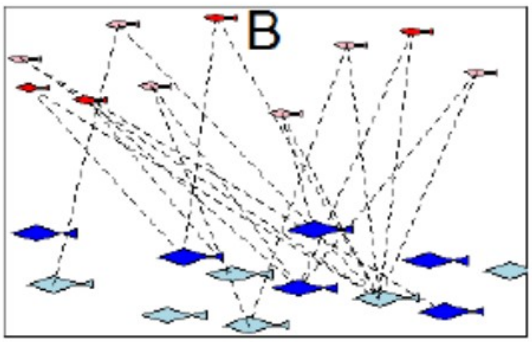
Close-Kin Analysis (Bravington et al. 2013)



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

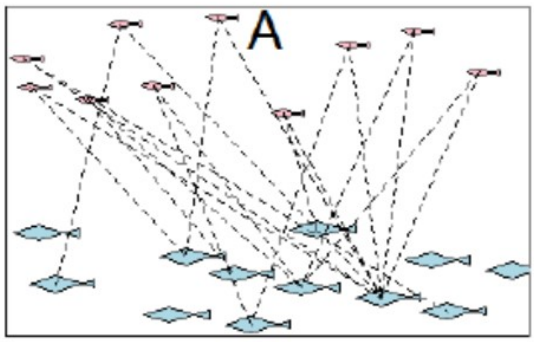
Close-Kin Analysis (Bravington et al. 2013)

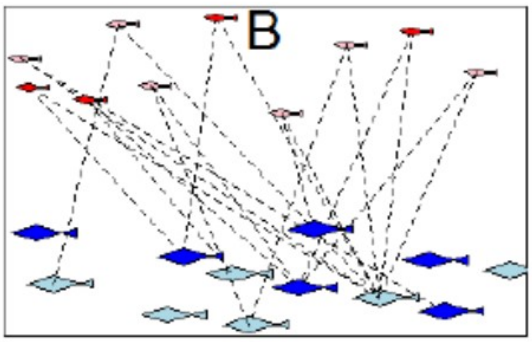




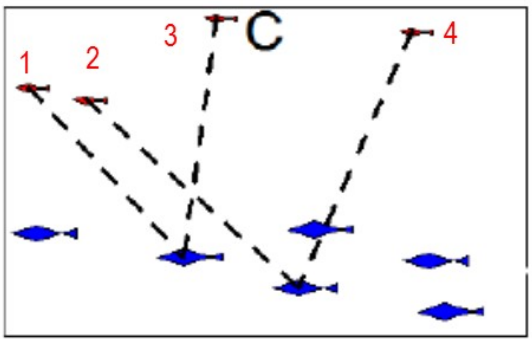
B. Sample some fraction of adults and juveniles, obtain genotypes

Close-Kin Analysis (Bravington et al. 2013)

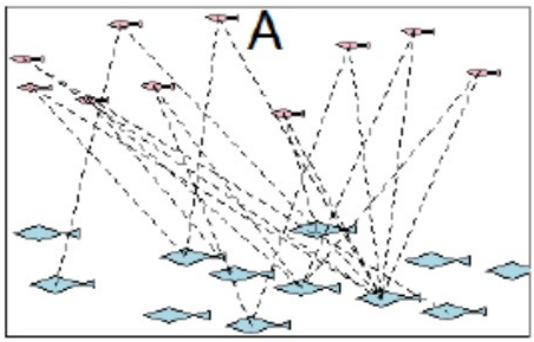


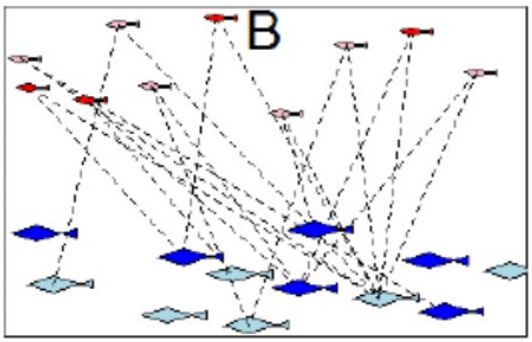


C. Genetically identify matches, i.e. number of parent/offspring pairs; here there are 4



Close-Kin Analysis (Bravington et al. 2013)





D. Estimate number of spawners:

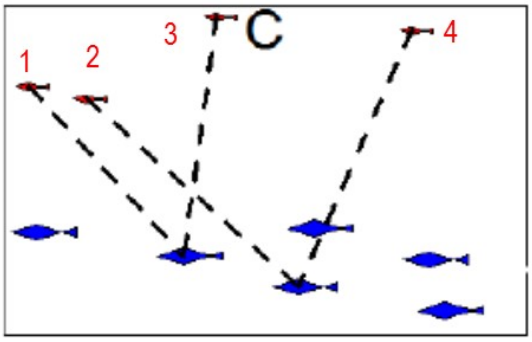
$$\widehat{N} = 2 * J * A/POP$$

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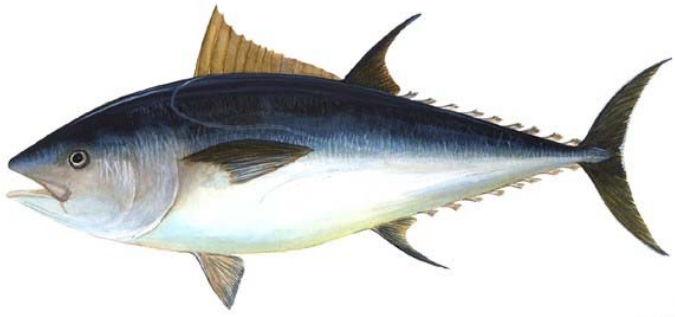
Developing new/improved fishery independent indices for western Atlantic Bluefin Tuna using larval collections



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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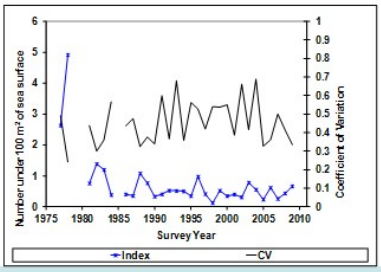
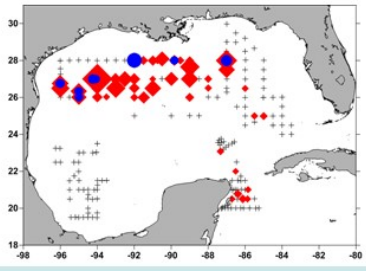
Past improvements to existing larval index: catch efficiencies

- *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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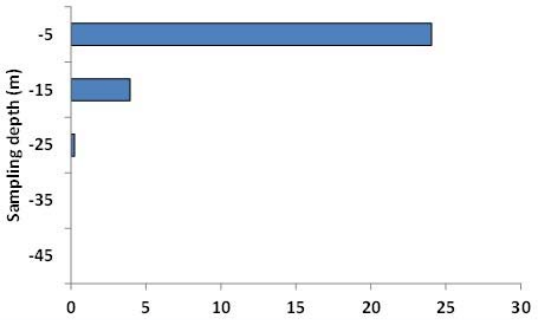
Potential future improvements to existing larval index: depth distributions

- *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

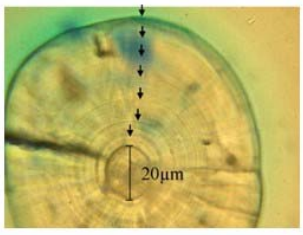
A MOCNESS opening and closing plankton sampling net

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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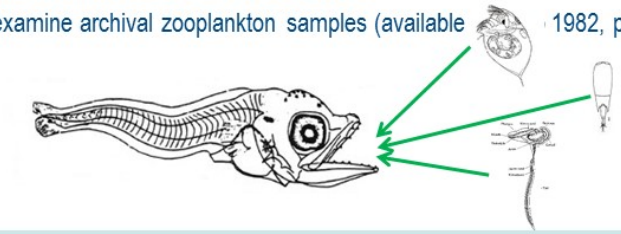
Potential development of new indices: feeding success and recruitment

- *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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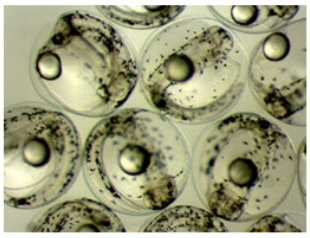
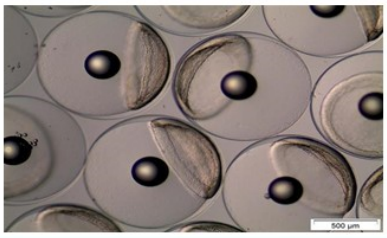
Potential development of new indices: egg production

- *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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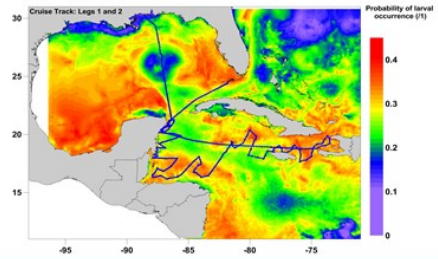
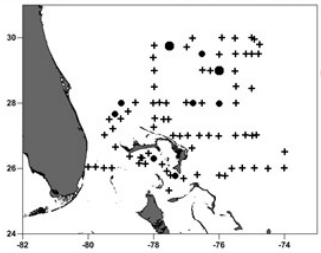
Potential development of new indices: alternate spawning grounds

- *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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