

RESEARCH PROPOSAL TO IMPROVE STOCK ABUNDANCE INDICES FOR WESTERN STOCK OF ATLANTIC BLUEFIN TUNA

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SUMMARY

Stock assessment for western stock of Atlantic bluefin tuna has to rely on a set of abundance indices. Each component of the present set of indices should be improved. New indices should be added for some part of life stage that lacking index at present. We propose four components of the set of indices (1) starting longline research in Gulf of Mexico for spawning fish, (2) starting research for young-of-the-year fish as recruitment monitoring, (3) improvement of Rod & Reel data collection in USA, and (4) starting fishery independent research which lasts for several months in Gulf of St. Lawrence Canada.

RÉSUMÉ

L'évaluation du stock occidental de thon rouge de l'Atlantique dépend d'un ensemble d'indices d'abondance. Chaque élément de l'ensemble d'indices actuel devrait être amélioré. Il conviendrait d'ajouter de nouveaux indices pour une partie du cycle vital qui manque d'indice à l'heure actuelle. Nous proposons quatre éléments du jeu d'indices (1) en démarrant la recherche palangrière dans le golfe du Mexique pour les poissons reproducteurs ; (2) en démarrant la recherche pour les juvéniles de l'année (YOY) comme suivi de recrutement ; (3) en améliorant la collecte des données de la pêche à la canne et moulinet aux Etats-Unis ; et (4) en démarrant la recherche indépendante des pêcheries qui dure plusieurs mois dans le Golfe du Saint-Laurent, Canada.

RESUMEN

La evaluación de stock para el stock de atún rojo del Atlántico occidental tiene que basarse en un conjunto de índices de abundancia. Debería mejorarse cada elemento del actual conjunto de índices. Deberían añadirse nuevos índices para algunas partes del ciclo vital para las que actualmente no se han desarrollado índices. Proponemos cuatro elementos del conjunto de índices: (1) iniciar trabajos de investigación sobre reproductores en el Golfo de México, (2) iniciar trabajos de investigación de jóvenes del año para realizar un seguimiento del reclutamiento, (3) mejorar la recopilación de datos de la pesquería de caña y carrete de Estados Unidos y (4) iniciar actividades de investigación independientes de la pesquerías que tengan una duración de varios meses en el golfo de San Lorenzo, Canadá.

KEYWORDS

Atlantic bluefin tuna, Longline, Research indices, Rod and reel, Western stock

Stock assessment and fishery management need reliable stock abundance indices. In ICCAT, both western and eastern stocks of Atlantic bluefin tuna lack highly reliable abundance indices because there are no major fishery which covers a large part of its distribution and a large part of its life history. Fishery independent scientific research is not yet carried out in a large scale for a long period.

In the western stock of bluefin tuna, a set of indices comprised of six indices are used for stock assessment (**Figure 1** and **Table 1**). As a whole, the set covers wide geographical range from Gulf of Mexico to the central Atlantic through Canadian waters including Gulf of St. Lawrence and wide range of life history from larvae to spawning fish. All the indices have relatively long period of time, more than 20 years. However, every index has insufficient points, such as small number of data, possibly including migrant from the east stock, and regulation change resulted in change of fishing operational pattern that should be correct the index. Some indices show contradictory trend each other; age 8+ in US Rod and Reel decreased from 1995 but CPUEs of Japanese longline and Canadian fishery in southwest Nova Scotia or Gulf of St. Lawrence were increased or stable. There are some parts of life stage that are not yet monitored due to selectivity of fishery.

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Each component of the present set of indices should be continued and improved. New indices should be added for some part of life stage that lacking index at present. Particularly, we propose three components of the set of indices as follows, which are practical measure and expect the set to be much more reliable.

1) Longline research in Gulf of Mexico for spawning fish

Bluefin tuna in Gulf of Mexico (GOM) is important for stock indices of adult fish as well as for investigate spawning ecology. The index is considered to be for fish of western origin only. Present index in GOM is derived from longline fishing targeting for other species, such as yellowfin and bigeye tunas, and swordfish, which make bluefin tuna as by-catch. Then, the index is based only on a small number of bluefin tuna caught which would cause a large variance in result.

Research by longline that targeting for bluefin tuna is valuable. By using several vessels, it covers whole spawning season and areas. The result provide not only index of adult fish but also correction factors to the present index in GOM in terms of spatio-temporal distribution of bluefin tuna. In addition, gonad for spawning study can be collected from the fish caught. Furthermore, the length data of bluefin tuna caught is derived and provide data to examine the age and size at maturity, which is under debate for the western stock in ICCAT, at least for fish in GOM.

Start of this survey is practical and the result useful for stock assessment will be obtained soon. Longline fishing has already existed in GOM by US fishery. Japanese longliners are also being a candidate to operate. The longline operation and its catch should be monitored by on-board scientific observers. The research should be designed in scientifically, but fishermen knowledge is quite important especially to determine the location of longline set.

2) Research for young-of-the-year fish as recruitment monitoring

There is no index of young-of-the-year (YOY) bluefin tuna, i.e. 20-50 cm in body length, at present. YOY index is useful because YOY has already passed through larval stage, which has severe mortality rate with highly variability under fluctuating environmental conditions, then has relatively high correlation with recruitment stock of fishery, and it provide managers warning of the stock states a few years earlier than at present. In addition, because YOY of bluefin tuna are distributed in coastal areas than in older ages, it is easier to do research than doing in high-seas and it may provide information from whole the cohort which will disperse in wider area along with getting older. It is also a strong merit that YOY would be comprised solely with western origin fish, which can be evaluated if samples were collected.

It is not well known where YOY distributed because there is no fishery for it in USA. It would be distributed in coastal areas of GOM and east coast of USA between July and December. Any sampling gears are possible but tuna trolling in Japanese style is proposed here as one candidate. Various commercial trolling gears for small Pacific bluefin tuna have been developed in Japan. There are some gears used for 20-30 cm fish and others for 40-50 cm fish.

Fishery independent trolling transect surveys have already conducted by Japan for southern bluefin tuna and Pacific bluefin tuna. Trolling survey for southern bluefin tuna has been carried out since 1996 and modified in 2006 and continued at present (Itoh *et al.* 2012). It is operated in the southern coastal area (across continental shelf edge) of Western Australia for 18 days in January-February every year by a chartered Australian fishing boat 18 m in length with 8 lines of Japanese style trolling. The number of schools detected as catching per transected distance is used as recruitment index. While the survey have been aimed to detect warning sign of recruitment failure or provide information of recruitment level in low resolution, the derived index is in good agreement to the recruitment level estimated from the operating model (**Figure 2**). The survey is endorsed by CCSBT and its index is used as one of important key index of recruitment for southern bluefin tuna assessment in CCSBT (Anon. 2012). Fishery independent trolling survey for Pacific bluefin tuna started in 2008 has been carried out in Tosa bay for 20-30 cm fish by two boats (Kai *et al.* 2012).

Because it is new index for Atlantic bluefin tuna, several years are necessary to find any trend of recruitment abundance change useful for stock assessment. There is little information of YOY distribution from fishery, probably it is necessary for three years for feasibility, additional two years to establish the index and further additional three years (in total seven years) to produce useful index with trend. However, YOY is valuable as biological sample so that the survey can contribute largely to ICCAT from the first year. Length frequency of YOY, coupled with some otolith daily increment analysis, provide range of spawning season from different point of view from spawners or larvae as well as degree of contribution of any part of spawning season to the whole recruitment stock (Itoh 2009).

3) Rod & Reel data in USA

Catch rates of Rod & Reel off the east coast of USA is important information for young (age 2 to 8 or more) bluefin tuna. It has several advantages such as it last for 20 years, it provide index by age and it is the only one source of index for the young age. It is based on information collected through telephone interview for sampled boats at present. Because the number of fish caught was small, it seems that it includes only a small part of catch and effort of recreational fishing.

It is expected to be improved largely by collecting data from whole of the Rod & Reel fishermen. Report by submitted document would be convenient way in work force and speed of procedure. Note the importance of collect effort data for zero- catch. Because it seems promising that some additional work improve stock assessment immediately, urgent strengthening of the system is effective.

The fish for Rod & Reel is comprised with both western and eastern origin fish. Therefore, it is necessary to distinguish the two origin fish based on sufficient number of otoliths collected. Biological sampling and routine analysis program should also be established.

4) CPUE of Gulf of St. Lawrence in Canada

Longline, tended line and rod and reel are operated in the Gulf of St. Lawrence (GSL). The index lasts for more than 20 years since 1981. The fishing season was quite short in Gulf of St. Lawrence (GSL) in 2009 and 2010 resulted in extremely high CPUE. In 2011, the season expanded by implementation of ITQ. Such an inconsistency of fishing pattern may change the relationship between CPUE and stock abundance as SCRS scientists had concerned.

It is effective to conduct a fishery independent research which can continue for several months using longline or other suitable gear. Derived results will be used to correct the fishery data and to establish independent index.

While it was shown that giant fish in GSL were western origin in the previously examined samples, it should be further examined. In addition, there were smaller size fish (90-135kg) in GSL in 2011 and 2012 (Hanke et al. 2012) which should be confirmed its origin. Therefore, it is necessary to distinguish the two origin fish based on sufficient number of otoliths collected. Biological sampling and routine analysis program should be established.

References

- Anon. 2012 Report of the 19th Annual meeting of the Commission. CCSBT, 1-4 Oct. 2012 in Takamatsu City, Japan.
- Cass-Calay, S. L. and Walter, J. F. 2012 Standardized catch rates of bluefin tuna from the United States pelagic longline fishery in the Gulf of Mexico during 1987 to 2011. SCRS/2012/160.
- Hanke, A. R., Andrushchenko, I., Neilson, J. D. and Whelan C. 2012 Indices of stock status obtained from the Canadian bluefin tuna fishery. SCRS/2012/118.
- Ingram, G.W. Jr 2012 Annual indices of bluefin tuna (*Thunnus thynnus*) spawning biomass in the Gulf of Mexico (1977-2011). SCRS/2012/159.
- Itoh, T. 2009. Contribution of different spawning seasons to the stock of Pacific bluefin tuna *Thunnus orientalis* estimated from otolith daily increments and catch-at-length data of age-0 fish.
- Itoh, T., Sakai, O., and Tokuda, D. 2012 Report of the piston-line trolling monitoring survey for the age-1 southern bluefin tuna recruitment index in 2011/2012. CCSBT-ESC/1208/33.
- Kai, M., Nakano, H., Okamoto, H., Minami, H., Oshima, K., Sato, K., Fujioka, K., Uosaki, K., YOkawa, K., Abe, O., Matsumoto, T., and Takeuchi Y. 2012. National report of Japan. ISC/12/PLENARY/08.
- Kimoto, A., Itoh, T., Sakai, O. and Miyake, M. 2012 Overview of the Japanese longline fishery for bluefin tuna in the Atlantic Ocean, up to 2011. SCRS/2012/130
- Kimoto, A., Itoh, T., Suzuki, Z. and Miyake, M. 2012 Updated standardized bluefin tuna CPUE from the Japanese longline fishery in the Atlantic up to the 2011 fishing year. SCRS/2012/131.
- Lauretta M.W. and Brown C.A. 2012 Updated standardized catch rates of bluefin tuna, *Thunnus thynnus*, from the rod and reel/handline fishery off the northeast United States during 1980-2011. SCRS/2012/158.

Table 1. Information of abundance indices of the western Atlantic bluefin tuna stock used at present.

<i>Name</i>	<i>Area</i>	<i>Method</i>	<i>Start</i>	<i>Provide country</i>	<i>Scale</i>	<i>Fish size</i>	<i>Possibility of mixing</i>	<i>References</i>
US LL	Gulf of Mexico	Longline CPUE (N / 1000 hooks)	1987	USA	1202 sets with 0.207 nominal CPUE in 2010	Spawning fish	west only	SCRS/2012/160
Larval index	Gulf of Mexico	Larval net sampling (N pre 100m ²)	1977	USA	37 stations and 49 larvae in 2011	larvae	west only	SCRS/2012/159
Rod & Reel	Northeast coast of USA	CPUE of recreational catch (N per hours)	1993	USA	In 2011, 260 boats with 1548 hours and 223 fish (66-114cm and 115-144cm fish) and 329 boats with 2605 hours and 30 fish(>177cm fish)	age 2-3, age 4-5, age 8+	west & east	SCRS/2012/158
Gulf of St. Lawrence	Gulf of St. Lawrence, Canada	CPUE of Rod & Reel and Tended line	1981	Canada	55,297 hours and 859 fish in 2006. 5,204 hours and 503 fish in 2011.	Large fish	west only	SCRS/2012/118
Southwest Nova Scotia	Southwest Nova Scotia, Canada	CPUE of Rod & Reel, Tended line and harpoon	1988	Canada	2,769 hours and 383 fish in 2011	Large fish	west & east	SCRS/2012/118
Japan LL	west of 45W	Longline CPUE (N / 1000 hooks)	1976	Japan	285 sets with 5.211 nominal CPUE in 2011	Large fish	west & east	SCRS/2012/130 SCRS/2012/131

FISHERY INDICATORS

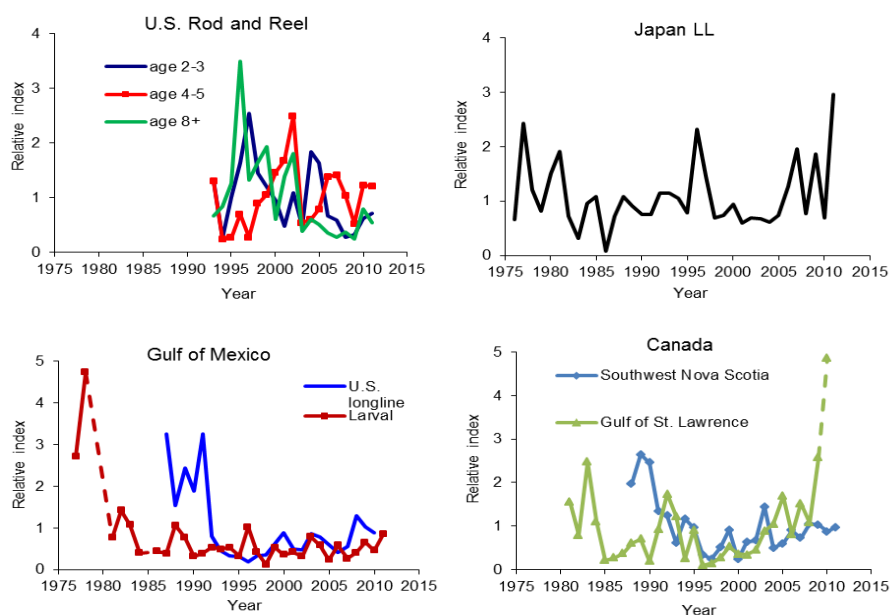


Figure 1. Abundance indices of the western Atlantic bluefin tuna stock used at present. From western stock chair presentation in 2012 SCRS.

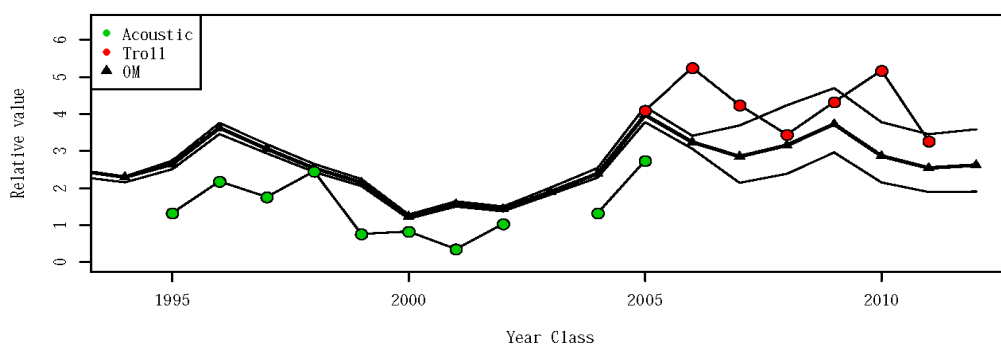


Figure 2. Trolling index of southern bluefin tuna by trolling survey. “Acoustic” is the trolling index using trolling catch data in the acoustic research survey for age-1 fish and “Troll” is the index from the trolling research survey for age-1 fish. “OM” is estimation of the recruitment by operating model used for stock assessment of southern bluefin tuna in CCSBT, with median and 25 and 75 percentiles.