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A REVIEW OF CATCHES OF LARVAL BLUEFIN TUNA FROM THE ATLANTIC AND GULF OF MEXICO

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SUMMARY

This is a summary of information on spawning areas and larvae abundance for Atlantic bluefin tuna. The paper reviews catches of bluefin tuna by U.S. and Cuban scientists from the 1970s to the present. The distribution of catches indicates two spawning areas, one in the Gulf of Mexico, and the other in the Gulf of Guinea and off Sierra Leone. Larvae abundance in the Gulf of Mexico has decreased markedly since the mid-1970s. Abundance appears as likely related to changes in larvae survival as to the size of the spawning stock.

RÉSUMÉ

Ce document présente un résumé des informations dont on dispose sur les zones de frai et sur l'abondance larvaire du thon rouge de l'Atlantique. Les captures de thon rouge des Etats-Unis et de Cuba sont examinées entre les années 70 et aujourd'hui. La distribution des captures indique la présence de deux zones de frai: dans le Golfe du Mexique et dans le Golfe de Guinée (au large de Sierra Leone). L'abondance larvaire dans le Golfe du Mexique a diminué fortement depuis le milieu des années 70. Il semble que l'abondance soit autant liée aux changements observés dans les taux de survie larvaire qu'à la taille du stock reproducteur.

RESUMEN

Este es un resumen de la información sobre áreas de desove y abundancia de larvas de atún rojo atlántico. El documento examina las capturas de atún rojo efectuadas por los científicos estadounidenses y cubanos desde los años 70 hasta la actualidad. La distribución de las capturas indica dos áreas de desove, una en el Golfo de México, y otra en el Golfo de Guinea y frente a Sierra Leona. La abundancia de larvas en el Golfo de México ha decrecido de forma significativa desde mediados de los años 70. La abundancia aparece como probablemente relacionada a cambios en las tasas de supervivencia de las larvas así como a la talla del stock reproductor.

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Spawning areas

In recent years the SCRS has conducted assessments on Atlantic bluefin tuna as though two stocks exist with a limited amount of mixing. The SCRS considers the stocks separated by a line dividing the Atlantic roughly in half. The two stocks are assumed to have separate spawning areas: the Gulf of Mexico/Florida Strait for the western stock, and the Mediterranean Sea, chiefly the west part around the Balearic Islands and the Tyrrhenian Sea for the east Atlantic and Mediterranean stock (ICCAT 1995).

The available information shows such a division of spawning grounds is not this simple, at least in the east. If the occurrence of larvae (bluefin less than 12 mm) is used as an indication of a spawning area, then bluefin are known to spawn, or have spawned in the recent past, throughout the Mediterranean and into the Black Sea (See Mather *et* al, 1995 p68 ff. for a discussion). In addition, 11 bluefin larvae have been identified from plankton tows taken in the equatorial Atlantic (Table 1). The sampling protocol was 10 minute surface tows using a 1-meter net of unstated mesh size. Five bluefin larvae were taken in March and five more in August in the Gulf of Guinea during two 1964 cruises. One bluefin larva was taken in February off Sierra Leone during the 1965 cruise. (Richards *et al* 1969a and b, and Richards *et al* 1970).

Cruise	Sta No	Date	Lat.	Long.	Time	Number & Size	Larvae /100^2m
3	159	8/3/64	2°28'W	6°01'N	2257	3-3.2 mm	0.51
3	177	16/3/64	3°35'W	5°42'N	2251	1-3.7 mm	0.17
3	197	24/8/64	3°00'W	0°00'N	1933	1-2.7 mm	0.31
4	40	8/8/64	3°03'W	5°58'N	0706	3-3.7 mm, 1-4.2mm	0.80
4	43	8/8/64	3°51'W	6°01'N	1422	1-3.7 mm	0.23
5	128	24/2/65	5°32'W	13°54'N	0927	1-2.7 mm	0.13

Table 1. Bluefin tuna larvae collected in 1964 and 1965: R/V Geronimo cruises 3, 4 and 5.

Although few in number, these east Atlantic larvae are of interest because they are evidence that bluefin spawn outside the areas considered by the SCRS as defining the two putative stocks. Larvae density is low, but comparable to that found in the Gulf of Mexico in recent years (Scott and Turner, 1995). Mather *et al* (1995, p79) speculate that these cruises may have missed the time of peak spawning. ICCAT scientists have recommended the present bluefin larvae survey areas be extended in the Gulf of Mexico and in the Mediterranean. Perhaps through an oversight, no such recommendation has been made for the equatorial region off Africa, (ICCAT 1996).

The situation in the west appears to be more certain in that no bluefin larvae have been collected from any areas other than the Gulf of Mexico and off the east coast of Florida. However, there has been little effort expended on icthyoplankton surveys outside these areas except to the north where tuna in general are less likely to spawn.

Larvae Abundance

Collections for the East Atlantic, Mediterranean and Black Sea have been sporadic, and unsystematic in types of nets and tows. None-the-less sufficient material has been collected to indicate seasonality of spawning (June and July in the western part and July into September for the south east and into the Black Sea. If spawning off Africa follows the same general seasonal pattern, the collection cruise did not coincide with the late spring to early summer peak .

Although attempts are underway to calibrate collection protocols (ICCAT 1996), the use of diverse sampling methods and few quantified estimates of larvae density make it impossible to compare larvae abundance among the areas at present. The inclusion of larvae less than 3 mm standard length in some collections and uncertainties about identification add to the problem of quantifying larvae abundance in the Mediterranean.

The situation is better for the west where a degree of continuity in cruises provides a time series of samples that provide quasi-quantitative estimates of abundance for both larval and juvenile bluefin. These start with Cuban collections in 1973, 1974 and 1976 (Juarez, 1974, Juarez and Montolio, 1974, Juarez 1976) followed by US collections from 1977 to present (Scott and Turner, 1995).

There also exits data from a series of collections of small fish and juvenile fish including juvenile bluefin tuna found in bird vomit obtained in connection with tern banding in the Dry Tortugas Islands. The data are available in a broken series starting in the 1960's (Potthoff and Richards, 1970) and continuing to present (Browder *et* al, 1995).

The Cuban collections are interesting because of the large numbers of larvae (more than 1000/100^2m) obtained at some stations, with bluefin larvae accounting for 20-47% of all scombrid larvae collected. Since the other abundant scombrid in the collections was the frigate mackerel *Auxis thazard*, a species which according to Duclerc *et al* (1973) is impossible to distinguish from bluefin up to lengths of 5.0 mm, there is a chance that some of these larvae were misidentified.

In general, densities in the Cuban collection remained high through 1976. Density dropped by several orders of magnitude in 1977 when the US series begins and declines further recent years (Fig 1a). Estimates of juvenile abundance from the tern samples were made for he period 1960-67, and four years, 1976, and 1992-94. Occurrence of juvenile bluefin were higher during through 1976 than during the most recent years.

Discussion and Conclusions

The larvae abundance information from the US collections is used by the SCRS for tuning the VPA of the "western stock" of Atlantic bluefin tuna. In the past there has been discussion about the likely relation between larvae abundance and spawning biomass. Despite arguments to the contrary, the prevailing view has been that even though there are many reason to question the usefulness of the relation and index, none-the-less the index should contain some information about spawning biomass. The arguement continues that because the variance associated with this index is very large, the index is assumed to have very little effect on the tuning process so there is no harm in including this index in tuning the VPA even if the relationship is spurious. This reasoning holds when indices of abundance are weighted by the inverse of variance, but not when, as is sometimes the case, the VPA runs are made with all indices given equal weight. Also, this raises the question: If the weighting removes this index, what is the point of including it at all?

The second interpretation that could be given the larvae index is that it is more closely related to the number of recruits than to the spawning biomass. This is because the sources of mortality to eggs and larvae are several and highly variable. Much of the mortality due to predation, water conditions and early starvation occur before larvae become vulnerable to plankton nets. Thus the errors associated with looking back in time and relating larvae numbers to eggs produced and these in turn to spawning biomass are likely greater than going forward in time and relating larvae numbers to future recruitment, although the uncertainties associated with this procedure also are going to be very great. None-the-less, if a larvae index is going to be used in the tuning process, it might be as useful to use numbers of age-1 recruits rather than biomass of spawning females (Fig 1b).

Finally, the question of spawning in the east Atlantic needs to be considered. Information on seasonality is lacking, so it is impossible to guess how important this spawning area is compared to other areas. Further, there are no data to indicate spawning still occurs in the area. Richards (pers. comm.) suggests these larvae may have been produced by fish from the former Brazilian fishery. This area of fish was exploited heavily during the early 1960's, and was believed to have been greatly reduced in numbers by the time of the Geronimo surveys. However, questions remain:

Was this a separate spawning stock?

If so, does it still exist today?

How does, and did, this "stock" fit into the overall picture and into the business of assessing and managing the northern bluefin tuna stock(s) in the Atlantic and Mediterranean Sea?

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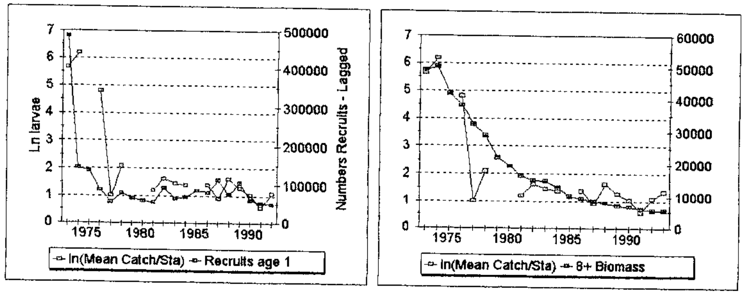

Fig 1a. Ln mean catch per station - larvae/100 sq. meter of surface.

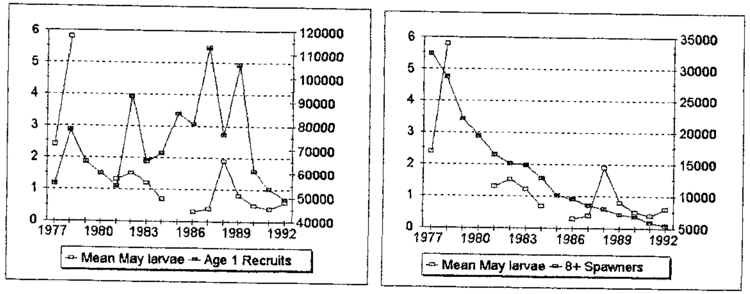

Fig.1b. Delta mean May catch per station - larvae/100 sq. meter of surface.