NATAL HOMING BY GULF OF MEXICO ADULT ATLANTIC BLUEFIN TUNA, 1976-2012

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SUMMARY

Membership to natal population, Mediterranean Sea or Gulf of Mexico, was assigned for historical and recent samples of Gulf of Mexico collected during the past 35 years, 1978-2012. Maximum likelihood estimates of each sample's mixture were based on otolith stable isotope composition of $\delta^{18}O$ and $\delta^{13}C$. Gulf of Mexico spawners showed strong natal homing (100.0%±0.01 SD %) regardless of sampling period.

RÉSUMÉ

L'appartenance à une population natale, de la Méditerranée ou du golfe du Mexique, a été assignée à des échantillons historiques et récents du golfe du Mexique prélevés au cours de ces 35 dernières années, de 1978 à 2012. Les estimations de la vraisemblance maximale de chaque mélange de l'échantillon se sont basées sur la composition des otolithes en isotopes stables (O et C). Les reproducteurs du golfe du Mexique manifestent un fort retour vers les frayères (100,0%±0,01 SD %) indépendamment de la période d'échantillonnage.

RESUMEN

Se asignaron los miembros de población natal, mar Mediterráneo o golfo de México, en muestras históricas y recientes de reproductores del Golfo de México recogidas durante los 35 últimos años, 1978-2012. Las estimaciones de máxima verosimilitud de cada mezcla de muestras se basaron en la composición isotópica de otolitos estables $\delta^{18}O$ y $\delta^{13}C$. Los reproductores del golfo de México mostraron una fuerte conducta de retorno al lugar de nacimiento (100,0%±0,01 SD %) al margen del periodo de muestreo.

KEYWORDS

Otolith stable isotopes, Stock composition, Natal homing, Tuna fisheries, Thunnus thynnus

1. Introduction

To evaluate possible influences of historical fisheries on recruitment in the western population, landings data needs to be weighted by where individuals originated - either the Mediterranean Sea (Eastern Stock) or the Gulf of Mexico (Western Stock). Recent evidence from natural markers supports two populations of Atlantic bluefin tuna, both exhibiting high levels of natal homing to the two known spawning and nursery regions (Carlsson *et al*. 2007; Rooker *et al*. 2008; Dickhut *et al*. 2009). Here we provide estimates for natal homing by Atlantic bluefin tuna spawners collected in the Gulf of Mexico during two periods - 1978, and1997-2012 - based on otolith stable isotope stock composition analysis.

2. Methods

Otoliths collected from adults sampled in the Gulf of Mexico in 1978 (n=60) and 2009-2011 (n=142) were provided by the Southeast Fisheries Science Center. Samples of spawners collected during the period 1999-2007 (n=41) were previously reported upon by Rooker *et al*. (2008).

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Otoliths were prepared according to Schloesser *et al*. (2010). Otolith $\delta^{18}O$ and $\delta^{13}C$ in historical samples, year-classes prior to ~1990, must be corrected for the Suess Effect: historical changes to stable isotopes resulting from a multi-decadal enrichment of atmospheric CO_2. This was done according to the equation reported in Schloesser *et al*. (2009). Ages were estimated from curved fork length (CFL) according to the growth model reported by Restrepo *et al*. (2010).

Classification of the unknown sample mixtures to source populations was performed using a maximum likelihood estimation (MLE) method (HISEA: Millar 1990) aka finite mixture distribution (Prager and Shertzer 2005); using a new juvenile baseline. The baseline is largely a reanalysis of archived juvenile otoliths but also includes recent years' Mediterranean samples made available by GBYP partners. Juvenile otoliths (age =1 year; N=265) were drawn from eastern and western nurseries for the period 1998-2011 and were treated using the same approach (rastering thin sections) and analyzed by a single laboratory.

3. Results

Otolith stable isotope stock composition analysis supported natal homing by Gulf of Mexico spawning fish over the past five decades. The older and more recent samples, representing approximate year-classes 1958-1968 and 1987-1999, each comprised 100% Gulf of Mexico contributions (**Table 1; Figure 1**). For the more recent sample, a few individuals showed $\delta^{18}O$ levels that placed them within the baseline ellipse for the Mediterranean population, but had little influence on the overall classification rate.

4. Discussion

The results conform to expectations of natal homing by the western stock, with nil to minimal straying from the Mediterranean population.

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Table 1. Natal population mixture rates for Atlantic bluefin tuna sampled in Gulf of Mexico (adults) samples during the period 1978-2011. MED=Mediterranean population; GOMEX=Gulf of Mexico population; MLE=maximum likelihood estimate of population composition; SD=standard deviation.

Year-classes	Year(s) sampled	Sample	N	Population	MLE(%)	MLE SD
1958-1968	1978	Gulf of Mexico Adults	60	MED	0.0	~0.0
				GOMEX	100.0	
1987-1999	1999-2011	Gulf of Mexico Adults	183	MED	0.0	0.5
				GOMEX	100.0	

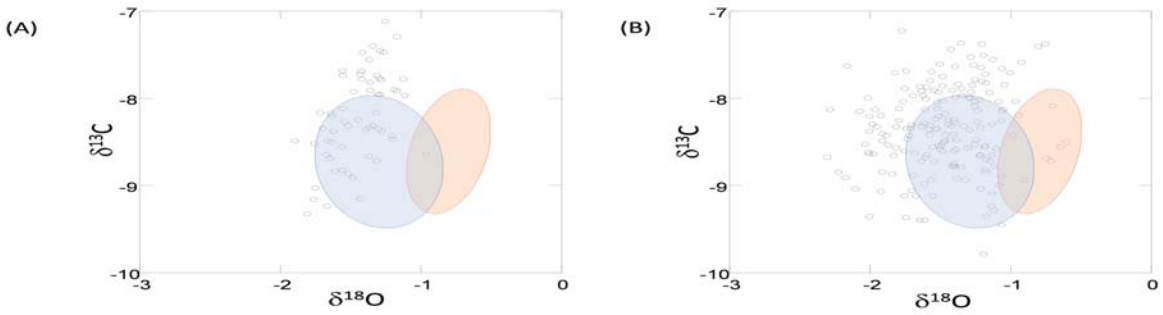

Figure 1. Stable isotope scatter plots for adult Atlantic bluefin tuna captured in the Gulf of Mexico during (A) 1978 and (B) 1999-2011. Sample ellipses (68%) for the juvenile baseline are shaded blue and red respectively for the Gulf of Mexico and Mediterranean populations.