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Distribution and movements of Atlantic bluefin tuna from electronic tagging

M. Lutcavage*, R.W. Brill, J. Porter***, P. Howey****, T. Rollins****, E. Murray, Jr.*, A. Mendillo*, M. Genovese* and W. Chaprales***

*New England Aquarium, Central Wharf, Boston, MA 02110, USA
**CEMR, Virginia Institute of Marine Science, Gloucester Pt., VA 23062, USA
***Department of Fisheries & Oceans, Government of Canada, Biological Station, 531 Brandy Cove Rd, St. Andrews NB E0G 2X0, Canada
****Microwave Telemetry, Inc., 10280 Old Columbia Rd, Ste 260, Columbia, MD 21046, USA

SUMMARY – Since 1997, fishery independent pop-up satellite tags have been used to identify the migration paths and behaviour of giant bluefin tuna released in New England and Canada. So far, all of the fish tagged in this region were in the central north Atlantic during their presumed spawning period, and 30-58% had tags that reported from the eastern management area. These results were compared with conventional tagging studies and bluefin tagging studies in other regions.

Key words: Atlantic bluefin tuna, pop-up satellite tags, migration.

RESUME – *"Distribution et mouvements du thon rouge atlantique déduits des marques électroniques". Depuis 1997, des marques satellitaires pop-up indépendantes des pêcheries ont été utilisées pour identifier les itinéraires de migration et le comportement des thons rouges géants relâchés en Nouvelle-Angleterre et au Canada. Jusqu'à présent, tous les poissons marqués dans cette région se trouvaient dans la partie centre nord de l'Atlantique pendant leur période présumée de reproduction, et 30-58% portaient des marques qui émettaient à partir de la région orientale de gestion. Ces résultats ont été comparés aux études à partir de marques conventionnelles et aux études de marquage du thon rouge dans d'autres régions.*

Mots-clés : *Thon rouge atlantique, marques satellitaires pop-up, migration.*

Since 1981, Atlantic bluefin tuna have been managed by ICCAT as two biological units separated by a management line at 45ºW. The biological basis of this management division is based on presumed separate and exclusive spawning grounds (in the Gulf of Mexico and the Mediterranean Sea), different ages of first reproduction, and an assumed low transfer rate (2-7% annually). Beginning in 1997, in an international collaboration between scientists and fishermen, our research group conducted electronic (satellite) tagging of spawning size class Atlantic bluefin tuna (ABFT) in New England and Canada (Lutcavage *et al*., 1999). The single point pop-up tags (PSAT), developed by Microwave Telemetry, Inc., and successfully tested and deployed on medium sized fish off North Carolina (Block *et al*., 1998) consist of a radio transmitter, environmental sensors, and a data logger that jettison from the fish after a predetermined release date. Data is relayed to orbiting satellites and distributed by Service Argos, Inc. to researchers via the internet. The goals of our program were to determine the long-term movements, origins and behaviour of the giant AFBT assemblages found on the New England shelf in summer and fall. We initially targeted adult fish comprising spawning size classes (>200 cm SFL) and programmed the majority of PSAT's to detach from the fish over their presumed spawning period (April-July).

From 1998 onwards, several independent tagging studies in the US, Canada, and the Mediterranean utilized new PSAT tags, which shortly thereafter incorporated light sensing and full geolocation capabilities. All studies soon produced surprising results, including data returns from eastern Atlantic fish (De Metrio *et al.,* 1999). From 1997-2001, all successfully released tags from our ABFT program reported from the central Atlantic roughly between Bermuda and the Azores. Each year, from 30-58% of tags on New England fish reported from east of the 45°W. stock division line and none were in or near known spawning grounds in the Gulf of Mexico or Mediterranean Sea (Lutcavage *et al*., 1999, 2000). This raised the possibility that some ABFT spawn in warm waters of the central north Atlantic, along the edges of current boundary systems, a possibility raised by

previous investigators (e.g. Mowbry, 1952; Hamre, 1963; Suzuki, 1991; Suzuki and Ishizuka, 1991; Mather *et al.,* 1995), but deemed unlikely by others (reviewed in Bakun, 1996).

A separate tagging study on medium sized fish off North Carolina by Block and colleagues that utilized implanted archival tags and PSAT's produced similar findings. Their results from the North Carolina archival tagging (and elsewhere) provided additional information on longer term movements and behaviour (1-3.4 yrs; Block *et al.*, 2001). In 2001, data returned from several implanted archival tags from fish captured in the Mediterranean confirmed migration of fish (tagged in the western Atlantic) to the Mediterranean and back. However, Block and colleagues suggested that while ABFT may mix extensively on feeding grounds, they believed that they exhibit spawning site fidelity (to the Gulf of Mexico or Mediterranean), and may not spawn every year. In contrast, our ongoing studies on the energetic and reproductive status of adult ABFT in the Gulf of Maine so far do not support the hypothesis that mature ABFT are not annual spawners.

Despite divergent views on some aspects of bluefin behavior, new electronic tagging studies confirm the linkage between western Atlantic, eastern Atlantic and Mediterranean ABFT. Unfortunately, we are also left with great gaps in knowledge regarding their long term mixing rates, reproductive habits, Atlantic wide movements, and natal origins. In 2000, with others we established an international scientific steering committee to plan a series of cruises for biological sampling of ABFT in the central north Atlantic. Specific recommendations call for a multi-year study, with international participation by oceanographic research vessels, longline sampling vessels, and full financial support for oceanographic data collection and analysis of samples. Future goals of international ABFT research teams should include expansion of electronic and conventional tagging to all areas of the north Atlantic, and elucidation of crucial components of the bluefin tuna's life history.

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