

A MARK-RECAPTURE EXPERIMENT ON BLUEFIN TUNA (*THUNNUS THYNNUS* L.)
FROM THE BROWNS-GEORGES BANKS REGION OF THE CANADIAN ATLANTIC

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SUMMARY

A mark-recapture study on bluefin tuna (*Thunnus thynnus* L.) was initiated in August 1990 in the Browns-Georges bank region of the Canadian Atlantic. The study was a joint project of the Southwest Nova Tuna Association and the Department of Fisheries and Oceans Canada (Scotia-Fundy Region). Data from the tagging intervals were applied to the stochastic model of Seber and Jolly for an estimate of stock size during the commercial fishing period (28 August-31 October 1990). Sixty-two bluefin tuna were double tagged and released during the experiment. No fish had been recaptured as of 15 October 1990. Information on migratory behavior, tag retention and susceptibility to recapture for marked fish is anticipated from the study.

RESUME

Une étude sur le marquage-recapture du thon rouge (*Thunnus thynnus* L.) a démarré en août 1990 dans la région canadienne de l'Atlantique de Browns Georges Bank. Cette étude a été un projet conjoint entre la "Southwest Nova Tuna Association" et le "Department of Fisheries and Oceans Canada" (Scotia-Fundy Region). Les données provenant du marquage ont été appliquées au modèle stochastique de Seber et Jolly pour estimer la taille du stock durant la période de pêche commerciale (28 août-31 octobre 1990). Soixante-deux thons rouges ont été marqués en double et relâchés au cours de cette expérience. Au 15 octobre 1990, aucun poisson n'avait été recapturé. A partir de cette étude, on s'attend à obtenir des informations sur le comportement migratoire, la rétention des marques et la susceptibilité de recapture des poissons marqués.

RESUMEN

En agosto de 1990 se inició un estudio sobre marcado-recaptura de atún rojo (*Thunnus thynnus* L.) en la región de Browns-Georges en el Atlántico canadiense. El estudio constituyó un proyecto conjunto de "Southwest Nova Tuna Association" y el "Department of Fisheries and Oceans Canada" (Scotia-Fundy Region). Se aplicaron datos de los intervalos de marcado al modelo estocástico de Seber y Jolly para hacer una estimación del tamaño del stock durante el período de pesca comercial (28 agosto - 31 octubre). Se colocaron marcas por duplicado y se liberaron sesenta y dos ejemplares de atún rojo. Al quince de octubre de 1990, no se había recapturado ningún individuo. Del estudio se anticipa información sobre el comportamiento migratorio, retención de marcas y susceptibilidad para recapturar peces marcados.

INTRODUCTION

Population or stock size estimates for bluefin tuna (*Thunnus thynnus*) have previously been calculated on the basis of catch-at-age data collected during commercial fisheries. Virtual and sequential population analyses have been the primary methods employed for these data, particularly for Atlantic bluefin (see Doubleday 1984; Parrack 1981; Conser 1989; Anon. 1990). Although tagging studies have been undertaken for a long time to collect biological information on growth and migratory behaviour (e.g. Beckett 1970), they have only recently been used to assess bluefin tuna stocks (Majkowski et al. 1984; Hearn and Majkowski 1987). Most have not attempted to determine size of an examined stock, but concentrated on its characteristics, primarily annual recruitment, exploitation rates and fishing mortality. There have been no attempts to calculate a population size of bluefin tuna using standard mark-recapture experiments during directed tagging studies, despite their proven efficiency in providing dependable estimates (c.f. Ricker 1975). In particular, population size estimates from an analysis using multiple census, stochastic models have proven the most reliable as they consider the significant effects of recruitment and survival (Bailey 1951; Pollock et al. 1990). Ideally, a bluefin tuna population to be estimated by these methods should be biologically autonomous, be relatively restricted to a small geographical area for a predictable period of time, and should be subject to a high level of commercial fishing (or sampling) pressure to ensure adequate marking and recapture rates. Unfortunately, few populations of bluefin tuna exhibit all of these characteristics.

A fishery for bluefin tuna has recently developed off the southwest coast of Nova Scotia (Clay et al. 1990). It differs from the historical fishery in this area (Hurley and Iles 1980) as the fish are smaller and located further offshore. The aggregation which is the subject of the fishery exhibits the primary characteristics which make it a likely candidate for a mark-recapture study. This fishery has operated for only a few years and little is known of the stock characteristics of the fish. The bluefin tuna in the fishery are assumed to be a distinct aggregation, exhibiting a consistently similar average length (220.22 cm) between individuals (probably originating from only a few year-classes), appearing annually for a short period in early fall and returning to the same small geographical area each season. The fishing effort and catch rate for this stock are currently at a high level (1916 landed fish in 1989). Considering these characteristics, it was assumed that a reliable estimate of the size of this stock of bluefin tuna could be obtained using a multiple census, mark-recapture experiment. Consequently, in August 1990, a tagging study conducted jointly by government and industry was begun with the objective of determining stock size and characteristics and to obtain

information on growth, migratory behaviour and susceptibility to recapture. This paper reports on the preliminary results of this study.

MATERIALS AND METHODS

The study was conducted within a geographical area which has been the site of the most intensive fishing effort for bluefin tuna off southwest Nova Scotia (see Fig. 1). This area lies roughly between the northeast portion of Georges Bank and the southeast edge of Browns Bank off the Scotian Shelf (42°04'N; 65°35'W) (Fig. 1). Bluefin tuna were captured and tagged from

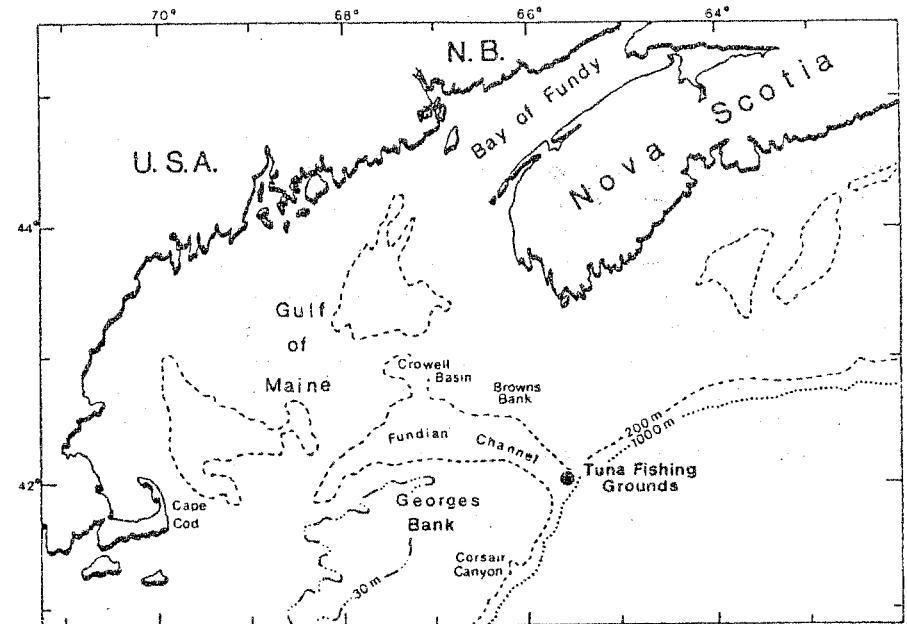


Fig. 1. Location of southwest Nova Scotia bluefin tuna fishery and site of mark-recapture experiment.

a 40' commercial fishing vessel using the handline gear characteristic of the fishery. This "tended line" gear consisted of 600-800 m of 1.25-cm diameter braided line (spooled within a large tub) to which a 8- to 10-m monofilament leader of 400-lb test breaking strength was connected. A size 8/0 galvanized hook attached to the leader was baited with a whole herring (*Clupea harengus* L.) and then suspended with a float between 3 and 15 m below the boat. Tuna were initially attracted to the boat by "chumming" with quantities of whole and halved herring which had been previously frozen. In several cases, tuna were seen within 10 m of the boat and the hooked bait presented to individual fish. After hooking a fish, a period of approximately 30 min was required to play the fish by hand and bring it close enough to the boat for tagging. Each tuna captured was marked with two tags to estimate the rate of tag retention (Porter, in prep.). After bringing the fish alongside the boat, its length and weight were roughly estimated and two tags were inserted simultaneously in the musculature at the base of the second dorsal fin. The leader was then severed as close to the hook as possible, and the fish released. All fish were marked with sequentially numbered yellow spaghetti tags provided with stainless steel anchor points. The tags used during each tagging interval were distinguished by applying different colours of fluorescent paint to the exposed ends.

The tagging study was initiated on 6 August 1990, 22 days prior to the start of the commercial fishery. For purposes of the experiment, the study period was divided into three intervals comprised of weekly or bi-weekly tagging trips. Initial and subsequent experimental design were based on the stochastic model of Seber and Jolly (see Ricker 1975). Data recorded during the tagging intervals were applied to the model for estimates of the size of the bluefin tuna stock present during the commercial fishing period. Data from landed fish (number and length of individuals caught) were also collected during the study period (28 August-31 October 1990) as part of the stock census.

RESULTS

Three tagging intervals were incorporated into the experiment. They were as follows: 1) 23 August-10 September, 2) 11-23 September, 3) 24 September-31 October. Forty tuna were tagged in period one, 22 in period two and no fish have yet been tagged in the last interval. No recaptures have as yet been reported of fish tagged during the first two intervals.

Mean fork length of 8 landed tuna was 220.2 cm (range 190.1-233.68). To date (15 October), 1471 fish have been landed during the fishery in southwest Nova Scotia, which has involved approximately 100 licensed fishermen.

DISCUSSION

The experiment to calculate stock size is proceeding as intended, although the number of tuna tagged and released is considerably less than originally anticipated. We had hoped to tag at least 50 fish during each interval, but several factors have conspired to reduce catches. Chief among these was adverse weather conditions, with a general lack of tuna early in the study as an additional detriment. Although we have not succeeded in marking a large number of tuna as yet, the experiment should be successful given an adequate number of recaptures.

The tagging procedure employed during the study appears to be successful. Tagged tuna appeared to swim away strongly after release.

The characteristics which made the southwest Nova Scotia bluefin tuna stock suitable for estimation by a mark-recapture experiment have been evident in the course of this study. The tuna frequented the same confined area as in previous years, during the expected time period. Fishing effort has been operating at peak levels (equal to or greater than in previous years) and estimates of susceptibility to recapture should be forthcoming from the study. It is intended to incorporate data collected during this year's (1990) study in a mark-recapture experiment conducted over a consecutive 2-year period (1990-91).

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