

ST. MARGARET'S BAY BLUEFIN RESEARCH PROGRAMME, A PROGRESS REPORT

by

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SUMMARY

A unique International Bluefin Research Program is described in conjunction with the operation (and rationale) of the St. Margaret's Bay bluefin impoundment fishery, on which it is based. In addition to the collection of basic biological and morphometric data, the research projects included: a study of feeding behaviour, ultrasonic monitoring of physiological and physical parameters, sexing via hormonal analysis, nutritional studies, contaminant analyses and underwater photographic projects.

RESUME

Le présent document décrit un programme unique de recherche internationale sur le thon rouge, en rapport avec le fonctionnement (et la raison d'être) de l'élevage de thon rouge dans la Baie de Sainte-Marguerite sur lequel il se fonde. Outre le recueil de données biologiques et morphologiques de base, les programmes de recherche comprenaient: étude du comportement alimentaire, contrôle par ultra-sons des paramètres physiques et physiologiques, détermination du sexe par analyses hormonales, étude des processus nutritifs, analyse des agents contaminants et photographie sous-marine.

RESUMEN

Describe un programa único e internacional de investigación sobre el atún, en relación con el funcionamiento (y objetivos) de la estabulación de atunes en la Bahía de St. Margaret, en la cual está basado. Además de la colección de datos básicos biológicos y morfométricos, los proyectos de investigación incluyen: un estudio de hábitos alimenticios, control ultrasónico de parámetros fisiológicos y físicos, determinación del sexo por análisis hormonal, estudios de nutrición, análisis de contaminantes y proyectos de fotografía submarina.

INTRODUCTION

The concept of fattening giant bluefin tuna within impounding nets was first considered in St. Margaret's Bay in 1937. The operation proved to be practical but was not a financial success. However, the current Japanese demand for high quality "Sashimi" has considerably altered the circumstances. The bluefin impoundments are attached directly to mackerel traps, an historic fishery within the Bay. The bluefin constitute an important by-catch; from two experimental impoundments in 1975 and nine in 1976, the fishery doubled this year to eighteen impoundments holding a total of 717 giant bluefin (291 metric tons).

The St. Margaret's Bay operation offers a unique opportunity for research on this, the largest of the Scombroids. Under the auspices of the St. Andrews Biological Station, which has the responsibility for large pelagic research on the Atlantic Coast of Canada, an international program was initiated in 1977. National and foreign scientists from government, university, and private laboratories were invited to participate. With the cooperation of Janel Fisheries and its Japanese associates, an additional impoundment containing thirteen giant bluefin was specifically established for research purposes.

The St. Margaret's Bay operations did not close in 1977 until November 6th, the date for the removal of the remaining fish. Many of the research projects, therefore, were still in progress at the time of the ICCAT conference.

RESEARCH PROGRAM

The 1977 St. Margaret's Bay program consisted of eight major projects which are briefly described below:

1. Basic Biological and Morphological Data Collection

St. Andrews Biological Station
Fisheries and Marine Service
St. Andrews, N.B.

Round and dressed weights were recorded for all bluefin landed within the Bay. Other data collected at the time of processing, for approximately 20% of the catch, included fork length (both straight and flank), girth and depth measurements, sex determination, and otoliths.

2. Feeding Behaviour

St. Andrews Biological Station & Woods Hole Oceanographic
Fisheries and Marine Service Institution
St. Andrews, N.B. Woods Hole, Mass.

The food preference, diurnal and seasonal variations in food intake, digestion rates, growth efficiencies and general feeding behaviour of thirteen experimental fish were assessed over a two-month period. The results, reflecting the aquacultural nature of the fishery, are reported in a preliminary form in a separate paper.

3. Ultrasonic Monitoring

St. Andrews Biological Station & University of New Brunswick
Fisheries and Marine Service Fredericton, N.B.
University of Guelph & Woods Hole Oceanographic
Guelph, Ontario Institution
Woods Hole, Mass.

Bluefin were tagged with small ultrasonic transmitters which sent such information as body temperature, swimming depth, and ambient water temperature to shore-based receivers. Tuna, unlike most fish which are

poikilothermic, can maintain their body temperatures considerably higher than their surroundings. How and why this is done is of considerable interest and importance to fish physiologists. The thermal tolerance of these animals, specifically to cold water conditions, was also assessed for both physiological and commercial reasons. In the latter case, the longer the bluefin can be impounded in the fall of the year, the higher the potential price on the Japanese market. At the time of writing, the water was isothermal at approximately 8°C, with an expectation of bluefin mortality at 6-7°C, based on the 1976 experience. At that time the temperature differential between the stomach and the surrounding water would have been approximately 17-20°C.

One of the ultrasonic projects (St. Andrews Biological Station and University of New Brunswick) was still in progress at the time of writing but is briefly reported in a separate paper. The other project (University of Guelph and Woods Hole Oceanographic Institution) is reported in rather more detail being based on early season data.

4. Ageing Studies

St. Andrews Biological Station
Fisheries and Marine Service
St. Andrews, N.B.

If the deposition of alternate opaque and hyaline zones in calcareous structures of bluefin is a regular annual occurrence, an adjacent pair can be correctly termed an annulus. This, theoretically, can be confirmed; the seasonality of zone formation can be tested by the introduction of tetracycline via the alimentary canal. The antibiotic is rapidly absorbed and deposited where active calcification is occurring at the time of assimilation. Subsequent analysis of otolith sections, for instance, have revealed a narrow ring under ultra-violet light, representing the deposition zone at the time of tetracycline assimilation.

Fish within the experimental pound were fed various quantities of tetracycline (4-40 grams/fish) in single or multiple doses from four to eight weeks prior to their death. Otoliths, etc., were collected in early November and are in the process of being analyzed. The results will be particularly pertinent in view of the controversy surrounding the ageing of the giant fish. Growth studies, so essential to the efficient management of any fish stock, require accurate size-at-age data.

The most current thoughts on this subject are contained in the proceedings of the "Atlantic Bluefin Tuna Ageing Workshop" (New York, March 28-31, 1977) presented elsewhere at this conference.

5. Nutritional Studies

Halifax Laboratory
Fisheries and Marine Service
Halifax, N.S.

The price of bluefin in Japan is based on the apparent fat content as well as on the colour and appearance of the flesh. These factors will all be affected by the quantity and quality of food the bluefin receive during their 2- to 3-month impoundment.

In this regard, preliminary work was carried out on the proximate analysis (lipid, protein, ash, and moisture) of food fishes, which include mackerel, herring, billfish, squid, gaspereau and whiting. The seasonal variation of food available can therefore be taken into account when planning feeding strategies. The rate of lipid accumulation in the muscle of the tuna was determined throughout the latter half of the bluefin season.

Food quality was also monitored in relation to rancidity, as high quality tuna can only be produced if the food organisms are fresh or have been properly stored. Rancidity may cause off-flavours as well as discolouration or edema in the tuna flesh.

The problem of insuring an optimum flesh colour is an important aspect of bluefin economics. Experimental food "sausages" containing various natural pigments (e.g. crushed lobster carapaces) were fed to the bluefin. The results are being assessed.

6. Sexing of Bluefin

Halifax Laboratory
Fisheries and Marine Service
Halifax, N.S.

The sexing of bluefin at the time of tagging and during impoundment experiments, without the fatal procedure of gonadectomy, has obvious biological advantages.

Attempts during the 1975/76 season to sex the animals by blood analyses (i.e. hematocrit and protein electrophoresis) proved to be unsuccessful.

However, the development of a rapid and sensitive radioimmunoassay (RIA) method of quantifying testosterone (T) and 11-ketotestosterone (11-kt) in fish plasma has permitted the sexing of a number of fish species. To date, 56 out of 60 bluefin samples have been sexed correctly (confirmed by gonad examination) using the RIA procedure where only 50-100 μ l of plasma were used.

7. Contaminant Analyses

St. Andrews Biological Station	&	Halifax Laboratory
Fisheries and Marine Service		Fisheries and Marine Service
St. Andrews, N.B.		Halifax, N.S.

Bluefin tissues have been analyzed primarily for their mercury content for a number of years. In addition, the levels of chlorinated hydrocarbon and PCB contamination are being determined.

8. Underwater Photography

Photographic projects were carried out by numerous institutions and individuals. The impounded bluefin, and in particular, the experimental fish, became relatively indifferent to the presence of scuba divers.

It is hoped that next year, the opportunities will be even greater and that a more intensive program, coordinated by the St. Andrews Biological Station, will be organized to involve both Canadian, Japanese, and U.S. scientists.

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