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A Prospectus and Plan of Action for Herring Stock Identification

Using Parasite Tags

by

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INTRODUCTION

One of the persistent needs in herring research in the western North Atlantic is proper understanding of the stock structure and the nature of seasonal intermixing of stocks. A number of approaches - morphometrics and meristics, age and growth, tagging, and biological indicators (bio-chemistry and parasites) - have provided some information, but much remains to be learned.

Of the available methods, further exploration of parasite tags seems at present to be most likely to produce short-term information of use to stock management. This prospectus concerns a field and statistical examination of parasite frequencies in the stocks of herring of direct interest to the United States and Canada, exploiting insights gained from earlier work. The core of the proposal involves characterization of three spawning populations - Georges Bank, Southwestern Gulf of Maine and Nova Scotia - using encysted larval parasites (and possibly other parasites) as independent variables, followed by subsequent attempts to determine seasonal stock intermixing using frequencies of the same variables.

Critical ingredients are competent parasitological examination of samples, careful statistical design, and timely statistically-sound analyses of results. This prospectus contains a rationale and plan of action for a joint United States-Canada study of at least two years duration, the first and exploratory phase of which would begin in Autumn 1981, and the second and more quantitative phase in Summer 1982. Principal early emphasis will be placed on adequate parasitological characterization of spawning populations at the time of spawning, with subsequent samples drawn from as many geographic locations as possible - and at various times of the year.

HYPOTHESES TO BE TESTED

- 1) Herring stocks at the time of spawning are recognizable by statistically significant differences in prevalences of specific encysted larval parasites.
- 2) Examination of parasite prevalences and prevalence ratios in samples of adult herring taken at non-spawning periods should provide information on the spawning stock(s) from which the samples were drawn.

SOME BIOLOGICAL UNCERTAINTIES WHICH SHOULD BE ADDRESSED

The parasites

- 1) When are infections acquired (how early in the life history)?
- 2) What is the rate of acquisition (and loss) of parasites during adult life?
- 3) Do parasites cause differential mortality?
- 4) Are there seasonal and/or geographic differences in rate of acquisition of parasites?

The hosts

- 1) Is there adequate evidence that juveniles do not perform long migrations?
- 2) Spawning aggregations of herring often include substantial numbers of non-spawners; do parasite frequencies in non-spawners differ from those of ripe and running fish?

ACTION PLAN

An action plan for this prospectus includes three principal components: statistical design, parasitological examination, and statistical analysis of data obtained:

1. Statistical Design

The study must have careful initial scrutiny by statisticians, and a preliminary modeling effort should include consideration of the following:

- A) variability in parasite frequencies in individual samples from a single location, and size, number, and frequency of samples to be obtained from spawning and non-spawning populations;

- B) desired locations of sampling, and methods of obtaining samples (fishery dependent or not);
- C) desired length of study;
- D) necessary information to accompany parasitological data (length, gonad condition, etc.).

2. Parasitological Examination

The two larval parasites which should serve as the core of this study must receive scrutiny and taxonomic attention from trained parasitologists. The nematodes are members of the subfamily Anisakinae, and are identifiable as larvae. Most will be genus Anisakis, but some very small representation of other genera should be anticipated. Similarly with the cestode of the order Trypanorhyncha. Most will be members of the genus Grillotia, but some small representation of other genera may be present. Spines on the eversible proboscides of larvae enable precise identification.

The parasites of choice are recognizable by gross examination of the viscera, but should be checked microscopically. Frozen samples may be used, but proboscide eversion of the larval cestodes is of course not possible with such samples. The larvae are encysted, and persist long after liver and other soft tissues have degenerated.

During the exploratory phase of the study, a search will be made for additional parasites - including blood parasites, liver parasites, and gonad parasites - which could augment the two above named larval worms and could become part of the final protocol.

A significant problem may be in sampling the Georges Bank-Nantucket Shoals spawning population, since no fishery has existed for several years. A special effort, and possibly a special cruise, should be directed to this end in autumn of 1981.

3. Statistical Analysis of Data

Initial characterization of spawning populations should establish statistical significance of different parasite frequencies (a conclusion based on results of earlier studies). Subsequent sampling of migrating populations should disclose evidence of intermixing, by area and season; this will be the meaningful statistical treatment - to make estimates of the maximum/minimum intermixing of populations to explain observed frequencies.

It is possible that observed frequencies will lead to hypotheses explaining seasonal movements of all spawning populations, and the proportions in which they are removed by fisheries on non-spawning aggregations.

TIMETABLE

August 1981

Initial discussions with key participants (Sindermann).

Collect and examine spawning fish on Nova Scotia coast (McLattery).

September 1981

Collect and examine spawning fish from Maine coast (Chenoweth).

Continue collection and examination of spawning fish from Nova Scotia (McLattery).

Prepare experimental design and carry out preliminary sensitivity analysis (Sissenwine and Pennington).

Develop detailed protocols for examination of samples for parasites (Sindermann, McLattery).

October 1981

Continue collections of spawning fish from Maine coast and begin southern Gulf of Maine collections (Jeffries, Isles of Shoals, etc.).

Three-day exploratory herring cruise to Nantucket Shoals-Georges Bank (Lux). This is optional, depending on vessel availability and possibility of collections by Polish research vessel.

November 1981 - July 1982

Samples of opportunity - entire coast, especially such locations as Chedabucto Bay, Block Island Sound, Long Island Sound, Virginia coast, etc.

By June 1982, make decisions about the precise suite of parasites to be examined, and about final sampling pattern and examination protocol.

August 1982

Collect and examine spawning fish at Grand Manan and on the Nova Scotia coast, according to quantitative plan.

September 1982

Collect and examine spawning fish from Georges Bank and the Maine coast according to quantitative plan.

October 1982

Collect and examine spawning fish from southern Gulf of Maine (Jeffries, Isles of Shoals), according to quantitative plan.

November 1982 - July 1983

Collect and examine non-spawning herring from as many locations and fisheries as possible, emphasizing sites where herring are taken annually.

July 1983

Begin initial statistical analysis of results.

August 1983

Prepare draft document summarizing findings.

Make decisions about extent and nature of future examinations.

PERSONNEL

- 1) Canadian parasitological examinations will be done by Sharon McLattery, a graduate student at the University of New Brunswick, supported by the St. Andrews Biological Laboratory. Miss McLattery began her study at St. Andrews earlier in the year. She has been examining and will continue to examine samples of spawning fish from Trinity Ledges, Lurcher Shoals, and the Nova Scotia coast from Yarmouth to Halifax. Intercalibration of examination methods will be assured by periodic joint examination of samples with U.S. participants.
- 2) Sampling for spawning fish on the Maine coast and at coastal spawning sites north of Cape Cod will be made by Lew Lozier, Maine Department of Marine Resources, and examination of samples obtained will be carried out by Jean Chenoweth, Maine Department of Marine Resources.
- 3) Sampling for spawning fish in the Nantucket Shoals-Georges Bank area will be carried out on a special cruise in early October. Sample collection and examination will be carried out by a designated Northeast Fisheries Center staff member. Subsequent sampling in the area will be conducted as part of the joint U.S.-Polish effort; samples from this source will be frozen for later examination.
- 4) Samples from south of Cape Cod will be obtained by NMFS port samplers and examined by the designated NEFC staff member. These will depend on contacts with local fishermen - for Block Island Sound, Long Island, Raritan Bay, and Chesapeake Bay.

5) Initial statistical design and sensitivity analyses will be conducted by a team of quantitative biologists from NEFC (including V. Anthony, M. Sissenwine, and M. Pennington). Later statistical examination of data will be the joint responsibility of United States and Canadian participants. General coordination and oversight, and international interactions will be the responsibility of C. Sindermann, H. C. Boyar, and D. Iles.

