Executive summary

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This first Northeast Region Fish Mark-recapture Workshop was held in response to a need identified by NOAA Fisheries, Northeast Regional Science Center during the winter of 2003. It was felt that cooperative tagging programs in the northeast, which focus on a number of commercially important species, would benefit from a meeting aimed at reviewing the theory and analytical details of the modeling and analysis options currently available to tagging data. The aim of the workshop was as follows:

Goal: • Provide a forum for reviewing the capabilities and limitations of available mark-recapture models in the context of ongoing or future tagging activities in the Northeast.

Objectives: • Review state-of-the-art models available for testing mark-recapture project hypotheses.
• Review and critique three current mark-recapture projects in the Northeast (Atlantic cod, black sea bass and yellowtail founder) and provide advice on experimental design, field protocols, model selection, database development and ancillary parameters.

The Gulf of Maine Research Institute (GMRI) was contracted to coordinate and facilitate this meeting in collaboration with the NEFSC. Planning began in August, 2004 when an organizing committee was formed to determine the core elements of this workshop, including which tagging programs should be featured, what the attendee focus should be and what structure the workshop should follow. The workshop was developed over a two-month period.

The tagging programs presented were selected for their status as cooperative research programs (involving both science and industry) in the Northeast Region; these programs ranged in longevity from ~40 years (e.g. shark tagging) to programs which are still in their planning stages (e.g. Atlantic haddock). The three key programs (Atlantic cod, yellowtail flounder, black sea bass) were identified for their common characteristics of being large-scale programs with sufficient data to present, while also being young enough that design and modeling suggestions arising from this workshop could still be implemented where necessary.

The workshop took place over the course of three days. Day One comprised of presentations of each tagging program with discussion and feedback offered within each presentation. The invited keynote speakers, Dr. John Hoenig (Virginia Institute of Marine Science) and Dr. Alistair Hobday (CSIRO Marine, Hobart, Tasmania, Australia), presented on Day Two, providing a review of the options for modeling and simulation of tagging data, in addition to some practicalities regarding tag study design. Day Three focused on reviewing the three key programs in light of the feedback offered, followed by an in depth discussion of the overarching issues which were considered applicable to most tagging programs; this discussion was led by the workshop Chairman, Dr. Paul Rago (Northeast Fisheries Science Center, Woods Hole, Massachusetts).

Feedback both during and since the workshop has confirmed that this 3-day working meeting provided an excellent and much needed opportunity for exchange of ideas and sharing of experiences between programs. The format of this workshop facilitated some open, energetic and productive discussions, through which attendees were able to collectively consider the ways in which each program could be improved and strengthened in future months. Consideration should

be given to the establishment of an ongoing working group to review progress by specific programs, develop and/or apply analytical methods for analysis of tagging data and evaluate incorporation of tagging data into stock assessments.

These workshop proceedings collate and document the core information on which the workshop was based (see Tagging program fact sheets); the detailed critiques and reviews for each tagging program presented (see Workshop discussions); the overarching issues identified (see Overarching issues); and the reviews provided by the two keynote speakers (see Keynote speaker reviews). From these proceedings, it is evident that the workshop aims were well met.

Summary of Overarching issues

Certain key regional needs were identified for tagging programs operating along the Northeastern seaboard; these are discussed in depth within the section on Overarching issues, but a brief summary of these is provided here:

Reporting rates
- Reporting rates need to be maximized.
- Heterogeneity in reporting rates leads to mis-specified models and imprecise parameters. Identification of heterogeneity is necessary and reduction of such variations is highly desirable.
- A review of rewarding techniques and options (e.g. cash rewards, sentimental rewards and lotteries) was recommended.
- Failure to reward returns over a long period of time has a detrimental effect on returns for other/future programs.
- Consideration of a central clearing house for rewarding returns.

Experimental design
- Tagging programs should aim to maximize the efficiency of the resources used and their ability to test specific hypotheses.
- Two particular tag release strategies were identified:
    1) Release tags in proportion to fishing effort;
    2) Release tags in proportion to relative abundance.
- Total cost of information from tags: the cost of the tag can be relatively minor compared to the costs of release, rewards and database management/maintenance – this point is particularly valid when considering double-tagging proportions for a study.
- Use of mission-appropriate tags: specific movement hypotheses may be more efficiently tested using a few expensive tags (e.g. electronic tags) than a large number of conventional tags.

Database design and implementation
- Database design has important implications for data entry and efficient data retrieval.
- Databases need to be versatile to current and future unidentified needs.
- The Northeast Regional Cod Tagging Program's database was judged to be the most advanced, and a potential model for other programs, and in particular was proposed as a possible cost-effective model for bridging between regional programs.
- Crucial elements of a tagging database were considered to be quality assurance and quality control (QA/QC), data visualization and data export functions for specialized software.

- The database is recognized as the primary tool for the tag reward program, and thus needs to be capable of providing timely feedback to those reporting tags and analysts.

Data analysis & model building

- Specialized analytical models and visualization tools are needed.
- Such tools should be sufficiently general to support differences between programs, e.g. differences in program design and analytical needs.
- A multi-disciplinary approach is recommended: e.g. approaches taken by oceanography and wildlife management may be of value.
- The high priority data analysis and model building needs identified were:
  - The development of appropriate analysis tools;
  - The development of diagnostic methods for validation of model assumptions and fit.
- There is a role for GIS in the visualization of tagging data.
- Historical tagging data or simulated data could be used in model development.
- There is a need to develop procedural approaches and analytical methods for incorporating tagging information into stock assessment analysis.

Archiving information and data access

- Long-term utility of tagging datasets is evident: raw data are needed, rather than just data summaries.
- Long-term storage and availability of data is needed.
- Attempts should be made to recover historical tagging data and make this information accessible.
- A standard regional data-sharing policy is needed; this should reflect professional ethics and courtesies for scientists, without constraining timely access to data for management use.
- There is an overall need for transparency, cooperation and critical review to facilitate:
  - Performance improvements of all tagging programs;
  - Justification for continued public funding of adaptive tagging programs, focused on management needs.

Workshop deliverables

In addition to program-specific needs and overarching regional needs, throughout the workshop specific points and deliverables were proposed. These can be summarized as follows:

- **Workshop proceedings:** Produce proceedings to document this first Northeast Mark-recapture Workshop and provide useful reference material for consideration by future tagging initiatives and management meetings.
- **Long-term commitment to tagging studies:** The success of any tagging program is highly dependent on achieving high reporting rates; these are in turn dependent on the appropriate outreach efforts being made by each tagging program. For the region as a whole, tagging efforts would benefit from a long-term commitment by funding bodies to support the necessary outreach needs, e.g. a region-wide capacity to support long-term reward of tag returns. It was further recommended that researchers and funding bodies see the longevity of a tagging study as being 3-10 years, depending on the aims of the study.

- **Creation of a central clearing house:** Consideration should be paid to the potential value of establishing a central clearing house for long-term: 1) rewarding of tag returns for multiple programs, and 2) database management and maintenance on a region-wide, multi-program scale.

- **Undertake a review of tag-reward programs:** This could focus in particular on assessing the efficiency of different reward options for their achievement of high return rates and quality information. A review of tag return lottery procedures should be included in this review.

- **Experimental design:** Investments in development of appropriate experimental designs are valuable for identifying attainable objectives and estimable parameters, defining feasible deployment strategies, evaluating the relative cost of tag information and selecting mission-appropriate tags.

- **Program goals and data limitations:** It is important to identify and define the limitations of each program at the outset. This should prevent disappointment upon subsequent presentation of the results to both the scientific and fishing communities.

- **Future tagging workshops:** There is a need to conduct additional fish mark-recapture workshops in the future; this will enable researchers to make progress on the areas described in the "Overarching Issues" section of this proceedings. It would be particularly timely and appropriate to hold the next mark-recapture workshop ahead of the 2008 benchmark stock assessments for Northeast groundfish (e.g. cod, haddock and yellowtail flounder). A data-oriented workshop during 2006 could provide the forum for program partners and stock assessment personnel to analyze the tagging data together, for incorporation into the 2008 stock assessments; of note, 3-4 years of tag return data would have been accumulated by this time for Atlantic cod, yellowtail flounder and black sea bass.

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Cooperative tagging projects in the northeast include a variety of target species (Atlantic cod, yellowtail flounder, black sea bass, striped bass, Atlantic haddock, herring, halibut, pelagic and large coastal sharks, etc.) and program objectives (movement, mortality, growth and outreach). Several programs have been ongoing for many years, while others were developed more recently and are focused on answering questions of particular interest for groundfish management.

In the winter of 2003, NOAA Fisheries Northeast Fisheries Science Center (NEFSC) identified that all of these tagging programs would benefit from a review of the theory and analytical details of the state-of-the art models available for testing project hypotheses. This workshop was initiated to provide an opportunity for current tagging programs to develop timely feedback in terms of technical direction for project planning and mid-course correction on experimental design. The goal and objectives may be summarized as follows:

Goal: • To provide a forum for reviewing the capabilities and limitations of available mark-recapture models in the context of ongoing or future tagging activities in the Northeast.

Objectives: • Review state-of-the-art models available for testing mark-recapture project hypotheses.
     • Review and critique three current mark-recapture projects in the Northeast (Atlantic cod, black sea bass and yellowtail founder) and provide advice on experimental design, field protocols, model selection, database development and ancillary parameters.

The Gulf of Maine Research Institute (GMRI) was contracted to coordinate and facilitate this meeting in collaboration with the NEFSC. Planning began in August, 2004 when an organizing committee was formed to determine the core elements of this workshop, including which tagging programs should be featured, what the attendee focus should be and what the structure the workshop should follow. The workshop was developed over a two-month period.

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There was an international attendance at the workshop. Two keynote speakers were invited with expertise on various aspects of tagging programs, but with particular specializations in movement studies and integration of tagging data into stock assessment applications. In addition, each of the Northeast tagging programs was represented by its principle investigators and participants. The

keynote speakers were asked to provide guidance to each of the three key programs on experimental design, field protocol, database development and estimating ancillary parameters. The emphasis was on the practical aspects of tagging and designing a study to successfully meet objectives.

The format of the workshop (see Annex 3: Workshop outline and agenda) allowed for presentations and discussion panels on the technical aspects listed above, with prescriptive advice on how to structure tagging studies. Program overviews (see Fact sheets 1-8) were prepared by field analysts and program managers of the ongoing research tagging programs prior to the meeting. These provided an overview of each program's objectives, experimental design, methods used to date, anticipated uses of the resulting data, relationship to ongoing studies, and expected duration. The summaries were compiled and sent to the keynote speakers in advance of the meeting. Keynote speakers then oriented their initial presentations toward one or more of the key ongoing studies.

All presentations were delivered in a conversational format, allowing for clarifying questions and open discussions during the course of each. Program overviews of the key three species entailed a detailed presentation by the program manager, on program aims, program design, data management, results to date, lessons learned and ancillary studies identified. These provided sufficient information for experts to tailor their deliverance the following day to specific requirements of each key program. Shorter, less detailed program overviews were given for the additional tagging programs; their focus was geared toward program aims, lessons learned, things to do and things to avoid.

These proceedings provide a dissemination of the workshop's progression, and are structured as follows:

- Executive summary;
- Project description fact sheets – information distributed during the workshop;
- Workshop discussions – reviews by each PI on the key points made about their respective program, in addition to a section on more general Overarching issues;
- Keynote speaker reviews;
- Annexes (Workshop transcript, Bibliography, Outline and agenda, Keynote speaker background and Attendee contact details).