

SOUTH PACIFIC COMMISSION

TWENTIETH REGIONAL TECHNICAL MEETING ON FISHERIES

(Noumea, New Caledonia, 1 – 5 August 1988)

**Report on the International Symposium and Educational Workshop
on Fish Marking Techniques – Seattle, 27 June–1 July 1988**

by
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Introduction

With the increased subsistence and commercial exploitation of the marine resources of regional countries, information on stock size, migration patterns, distribution, recruitment and mortality rates are essential for the proper and sound management of these resources. While some information can be obtained from catch and effort data, all required information could, in principle, be obtained from the various marking and tagging techniques that are available.

Several marking and tagging techniques have been developed over the years and these include external tags and marks, internal tags and marks, electronic tags, and genetic and chemical marks. These methods have their own limitations and how well they perform in a particular situation will depend on the characteristics of the species and fishery being investigated, how the data are to be collected, what information is intended to be collected, and prevailing environmental conditions. All of these considerations need to be taken account of when determining the appropriate tagging technique in a given situation. Tagging programmes are expensive and must be thoroughly justified. If possible, cheaper methods should be considered, however the quality of information collected has to be considered as well.

Careful consideration and planning of a tagging programme is required for the selection of an appropriate marking or tagging technique that will achieve the objectives of the programme. How the data are to be collected, what number of fish would be tagged, what percentage error in estimated parameters is acceptable, and the use of appropriate tag recovery procedures needs to be considered. Manpower and financial constraints usually have a marked influence on the marking and tagging method selected.

Many of these aspects of tagging programmes were discussed at the recent Fish Marking Symposium, held in Seattle 27 June–1 July (Symposium Program and List of Participants in Annexe). This report summarises each of the symposium sessions, highlighting work that is of potential interest to Pacific Island countries in the region.

External tags and marks

An historical overview of the various external tags and marks as classified under this category was made. These methods include the use of chemicals to produce marks or tatoos on fish, distinctive morphometric and meristic characters in describing fish stocks, freeze branding with CO₂ to produce marks on fish, scale reading for stock separation, fin clipping and artificial tags.

In choosing a tagging method, both biological and ecological factors have to be considered as these will determine the success of the tagging or marking programme. The method used should not adversely affect the movement, feeding, growth or survival of the fish, and should not detract from its edibility.

Two tagging programmes discussed during the symposium which are of significance to the regional countries were the king mackerel tagging in the United States and an evaluation of an underwater tagging technique for demersal reef fish using modified dart tags.

The king mackerel tagging in the United States was carried out in the South Florida and Caribbean area. Results of this tagging programme showed that there were two substocks in the areas which migrated in a north-south direction due to temperature changes and spawning requirements. The fishermen were also found to be un-cooperative when low rewards were offered and commercial fishing closed. It was therefore considered that high rewards should be offered when fish prices increase.

The underwater tagging technique was carried out using T-bar anchor tags on anaesthetised fish. The anaesthetic was applied to fish in crevices underwater before tagging and the fish were found to recover very quickly.

Tagging experiments of this type would indicate the extent of home ranges of the fish, reef to reef movement and enable displacement experiments to be carried out. Reefs were periodically sampled for tagged fish using the same technique. Advantages of the method include a high recovery rate of tags, elimination of tagging mortality through avoidance of barotrauma, provides accurate location information, elimination of non-reporting, and allows for multiple recaptures. The disadvantage of the method is that it is limited to small areas.

Internal tags and marks

Internal extrinsic identification systems with an overview of implanted wire tags, otolith marks and the use of parasites was covered during this session.

It is desirable that external and internal tags should not react with outside media or the biological systems of the fish. Tags used should be retained for a long time and this can be achieved by using the proper tag and tagging technique. Parasites can be used as natural tags but there are many more variables to be considered.

Inducement of unique otolith banding patterns could be seen as a practical means to mark juvenile fish. Otolith layer patterns could be manipulated by thermal and feeding variations to juveniles in a hatchery. These juveniles are later released into rivers or sea and their contribution to a fishery, growth rate, etc.. assessed.

Parasite spores can be fed to juvenile fish and then used as a marker. Certain parasites are also area specific and these could be used to differentiate geographical stocks contributing to a fishery. Advantages of these biological markers include no fish handling, present throughout fish life cycle, stability over time, little effect on fish and easily identified.

Coded wire tags have been inserted into fish and crustaceans. Results of juvenile fish tagged with these coded wire tags showed successful results with tag insertions in the nape and cheek area. Tags have also been inserted into the abdominal cavity of fish. It was found that in general, tagged adult fish survive better than juveniles. Desirable features of these tags are that they are permanently detectable, durable and benign.

Electronic tags

Electronic tags are unique and have been used in the study of fish and crab movement. These tags fall into two groups, active and passive. Active electronic tags include ultrasonic transmitters and radio transmitters which send out signals through the water and are picked

up by a microphone and an antenna, respectively. Passive electronic tags on the other hand, are energised by an external source (a scanner) and the tag identification is read and recorded by a computer, or printed by a printer, or both, as a back-up measure.

The passive integrated transponder (PIT) tag has been used in monitoring systems for hydro-electric dams and fish hatcheries for restocking to find peak migration times for fish and for identification of two different species of fish. This shows its applicability in a mixed species fishery.

These tags did not show adverse effects on growth, behaviour, survival and spawning of the fish. Due to high costs, only relatively valuable fish are usually tagged in this way.

Telemetry studies with ultrasonic and radio transmitters have been used to study fish behaviour, especially range movement, survival of fish passing through turbines and spillways at dams, demersal fish movement and nearshore king crab movement in winter and in response to dredging of the seabed. This information on movement can be used for management purposes such as extending areas of protection.

In fish, the transmitters were either surgically or orally inserted, while in the king crab, the transmitter was attached to the carapace.

Depth and water temperature affect transmission of signals. Results of radio transmissions at different depths showed that low frequency radio signals were suitable for deep waters and high frequencies for shallow waters.

Ultrasonic transmitters have been used to study home range movements of demersal rockfish. The transmitter was attached externally with a Peterson tag. The study showed that fish tagged and released at the same spot didn't move at all, while fish tagged and released elsewhere moved back to their original place after some time of travelling.

Genetics

Specific genes that are characteristic of a population are identified for use in genetic marking. Population genetics is usually used rather than individual gene types. Gene markers are passed from generation to generation and are permanent markers for a population.

The genetic variability of fish is based on protein molecular structure, in how the amino acids are positioned on the protein molecule chain, thereby giving different changes for different

molecules. Generally, DNA is extracted from a fish sample such as liver, kidney, egg, gill or dermal tissue from the cheek of the fish through centrifusion. The DNA sample obtained is then treated with a restriction enzyme which is site specific in reaction. Fragments of DNA are then put on an electrophoresis gel system, which uses a small electric current. The pattern formations from the sample are then compared with baseline information on alleles is used.

Genetic markers have been used in enhancement projects to monitor returns which usually consist of fish from the hatchery releases and from the wild. Fin clipping is also used as a double check measure. Generation overlap would also occur in these returns and aging is also necessary. areDNA finger-printing can also be used in fish identification and parental contribution to offspring.

There are several different types of markers available for future use; these include nuclear DNA, ribosomal DNA and mitochondrial DNA.

In instances where there is mixing of stocks and variability is observed within and between stocks, mitochondrial DNA is normally used as this evolves quickly and therefore changes can be detected quickly.

In a large scale multiagency genetic stock identification (GSI) programme, fisheries estimates must be comparable and therefore standardisation is required. Techniques and results must be repeatable and data sharing must take place. A data management and testing system is needed here and a GSI baseline created.

Chemical marks

Inorganic chemical marks used on fish include dyes and stains, tetracycline, calcein and rare earth elements. These are introduced by the emersion of eggs, fry or juveniles into a solution, injection of juveniles and adults, feeding of fry, juvenile and adults, and introduced naturally or from pollutant sources. These marks can be detected visually, with ultra-violet light, fluometric methods with dye laser, electron microscopes, neutron activation analysis, atomic absorption spectroscopy, or X-ray.

Results with the use of calcein as a fluorescent marker in fish ~~hard~~ parts has shown better results than tetracycline marking. Calcein combines with calcium in a chemical reaction and therefore improves the fluorescent mark. Mortality problems have been observed with the use of tetracycline and tetracycline marks may not always be clearly visible. No fish mortality has been observed with the use of calcein. The main utility of these methods is for validation of aging techniques.

Rare earth elements have been screened for chemical marking of hatchery fish. Survival, growth, uptake and behaviour were used to judge the goodness of an element. The rare elements are taken up by fish through food and water across the gills and epithelium. Better results were obtained when elements were introduced at later ages.

Fatty acids as analysed by chromatography have been used to distinguish between different populations of herring close to the Norwegian coast. Fatty acids are not variable within a population but they are between populations. Polar lipids which are genetically controlled were used in the test and not neutral lipids which are controlled by feeding. This method is cheap, simple and fast, and separation between populations has been good.

Microchemical analysis of fish hard parts for reconstructing habitat use has been tested. Hard parts of fish such as scales, otoliths, bones and teeth incorporate trace elements from water over time. Laser-based techniques are used to discriminate fresh fish species from saltwater species. The technique can also be used to determine the history exposure to pollutants.

Design programmes – contribution and analysis

Selection of an appropriate tagging and marking method will have a large bearing on the success of the project. The design of the tag and clear, formulated objectives are also important for the success of the project. Fundamental notions of tagging and marking is to study the population and population parameters such as survival rate, which could be obtained from a release/recapture method. An appropriate model should be developed for the survival experiment to reduce bias, and replicates are needed for the release/recapture method. A t-statistic is usually used here to determine the required number of replicates. The success of a project will also depend on sample size (the larger the sample size the better the results), harvest intensity and the reporting of tags. An awareness factor with regards to the tagging project should be included in the model. In a tag-recapture project, statistical, logistical and financial considerations are very important for its success. The acceptable level of error has to be determined initially by the person carrying out the experiment.

In all tagging and marking projects attention to data quality at both release and recovery is crucial. Tape recording of the tagging and marking procedure and all associated information is a good practice.

In a fishery where several nations are harvesting the same fish stock, data sharing is important, and some standardisation of sampling methods and data processing is essential. The data collected should be validated by agencies in one country before being passed on to another country.

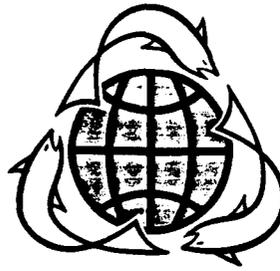
Large-scale marking programmes

Presentations were also made on some large scale fishery tagging programmes and these included snapper tagging in New Zealand, history of the ICCAT tagging programmes, Australian cooperative gamefish tagging programmes 1973–1987, and 60 years of tagging Pacific halibut.

Acknowledgements

I am indebted to FAO/UNDP for meeting my financial expenditures to the International Symposium in Seattle and to the Research Co-ordinator of the FFA for his kind assistance in making the necessary arrangements for my trip.

Annex



**INTERNATIONAL SYMPOSIUM
AND EDUCATIONAL WORKSHOP ON
FISH-MARKING TECHNIQUES**

PROGRAM

27 June – 1 July 1988

**University of Washington
Seattle, Washington, USA**

Sponsored by

American Fisheries Society
U.S. Fish and Wildlife Service
Sport Fish Restoration Program

Supported by

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**Special thanks to BioSonics, Inc., Floy Tag & Mfg., Inc., and
Northwest Marine Technology, Inc. for their support in putting
on this conference.**

Conference Overview Schedule

27 June, Monday

- 6:00-8:30 pm Registration and Welcome Reception
Light buffet and hosted wine and beer sponsored by BioSonics, Inc., Floy Tag & Manufacturing, Inc., and Northwest Marine Technology Inc.
"HUB" Student Union Building East Ballroom
- 6:00-8:30 pm Equipment and Manufacturers Exhibits
"HUB" Student Union Building East Ballroom

28 June, Tuesday

- 7:00-8:30 am Breakfast Haggitt Hall Cafeteria
- 8:00 am Registration
Kane Hall Room 120
- 9:00 am-5:00 pm Exhibits "HUB" East Ballroom
- 9:00-11:00 am Conference Opening
- 11:00-12:00 am **Session 1: Overview**
- 12:00-1:30 pm Lunch "HUB" West Ballroom
Exhibits "HUB" East Ballroom
- 1:30-4:45 pm **Session 2: External Tags**
- 6:15 pm Board boat for cruise to Kiana Lodge Banquet
Marine Sciences Dock on Portage Bay (see campus map for directions)
- 11:00 pm Return to Marine Sciences Dock

29 June, Wednesday

- 7:00-8:30 am Breakfast Haggitt Hall Cafeteria
- 8:30 am-12:05 pm **Session 3: Internal Tags and Marks**
Kane Hall Room 120
- 9:00 am-6:30 pm Exhibits "HUB" East Ballroom
- 12:05-1:30 pm Lunch "HUB" West Ballroom
Exhibits "HUB" East Ballroom
- 1:30-4:45 pm **Session 4: Electronic Tags**
Kane Hall 120
- 4:45-6:30 pm Poster Session and Exhibits
Wine, Beer and light hors d'oeuvres
"HUB" East Ballroom

30 June, Thursday

- 7:00-8:30 am Breakfast Haggett Hall Cafeteria
- 8:30 am-12:20 pm **Session 5: Genetic Marks**
Kane Hall Room 120
- 9:00 am-6:30 pm Exhibits "HUB" East Ballroom
- 12:20-2:00 pm Lunch "HUB" West Ballroom
Exhibits "HUB" East Ballroom
- 2:00-4:40 pm **Session 6: Chemical Marks**
Kane Hall Room 120
- 4:45-6:30 pm Poster Session and Exhibits
Wine, beer and light hors d'oeuvres
"HUB" East Ballroom
- 7:30 pm Busses depart from Haggett Hall for Seattle Aquarium
Banquet
- 10:00 pm Busses depart Seattle Aquarium for return to Haggett Hall

July 1, Friday

- 7:00-8:30 am Breakfast Haggett Hall Cafeteria
- 8:30 am-12:00 pm **Session 7: Design, Program Contribution and Analysis**
Kane Hall 120
- 9:00 am-1:30 pm Exhibits "HUB" East Ballroom
- 12:00-1:30 pm Lunch "HUB" West Ballroom
Exhibits "HUB" East Ballroom
- 1:30-2:50 pm **Session 7 continued**
- 2:50-4:35 pm **Session 8: Large-Scale Tagging Programs**
Kane Hall 120
- 4:35-4:50 pm Conference Conclusion

Conference Opening,

Tuesday, June 28

Kane Hall 120

9:00-9:15 am	Welcome Dr. Nick Parker Program Chair
9:15-9:30 am	Welcome Dr. Robert R. Stickney Director, School of Fisheries, University of Washington
9:30-9:45 am	Welcome State and city representatives
9:45-10:15 am	Keynote address Dr. Dayton L. Alverson Director, Natural Resources Consultants Seattle, Washington
10:15-10:45 am	Keynote Speaker Value of Marking and Tagging in Fisheries Management Dr. Carl Walters Department of Zoology University of British Columbia Vancouver, British Columbia, Canada
10:45-11:00 am	Break

Session 1: Overview

Chair: Doug Jester

11:00-11:10	Statement of Purpose Doug Jester
11:15-11:30 am	American Fisheries Society and the Wallop-Breaux Bill Dr. Stan Moberly President, American Fisheries Society
11:30-12:00 am	Dr. Robert C. Francis Director, Fisheries Research Institute University of Washington Seattle, Washington

Session 2: External Tags and Marks

Chair: Eric Prince

Kane Hall 120

1:30-1:45 pm	An historical review of marine and freshwater external tags and marks, <i>G.A. McFarlane, R. Wydoski, E.D. Prince</i>
1:45-2:00 pm	Summary of king mackerel tagging in the Southeast United States, mark-recapture techniques and factors influencing tag returns, <i>W.A. Fable</i>
2:00-2:15 pm	Evaluation of long-term tags for the snow crab <i>Chionecetes oophilus</i> , <i>G.V. Hurley, R.W. Elner, D.M. Taylor, R.F.J. Bailey</i>
2:15-2:30 pm	Guidelines for application of sprayed fluorescent pigment to trout, <i>M.E. McAfee, C. Sealing</i> ✕
2:30-2:45 pm	Freeze branding with CO ₂ —an effective, easy-to-use field method to mark fish, <i>M.D. Bryant, C.A. Dolloff, P.E. Porter, B.E. Wright</i>
2:45-3:00 pm	Break
3:00-3:15 pm	An evaluation of morphometric and meristic characters vs. truss networks for describing Pacific herring stocks, <i>J.B. Schweigert</i>
3:15-3:30 pm	Cold branding techniques for estimates of Atlantic salmon parr densities, <i>A.E. Knight</i> ✕
3:30-3:45 pm	A description and evaluation of an underwater tagging technique for demersal reef fish using modified dart tags, <i>K. Matthews, R.H. Reavis</i>
3:45-4:00 pm	A tattoo ink marking method for batch identification of fishes, <i>J.C. Laufle, L. Johnson, C.L. Monk</i>
4:00-4:15 pm	A ten-year overview of the use of fluorescent pigment on cutthroat trout in Bear Lake, Utah, <i>B.R. Nelson</i>
4:15-4:30 pm	Hydrostatic nylon dart and internal anchor tags in red drum, <i>E.J. Gutherz, G.A. Rohr, R.V. Minton</i>
4:30-4:45 pm	Problems in stock separation analysis using scale patterns due to regeneration, <i>C.M. Knudsen</i>

Session 3: Internal Tags and Marks

Chair: Roy Heidinger

Kane Hall 120

8:30-8:50 am	Internal extrinsic identification systems: overview of implanted wire tags, otolith marks, and parasites, R.M. Buckley, H.L. Blankenship, F. Haw, P.K. Bergman
8:50-9:10 am	Inducement of unique otolith banding patterns as a practical means to mass mark juvenile Pacific salmon, E.C. Volk, S.L. Schroder, K.L. Fresh
9:10-9:30 am	Mass marking of otoliths of lake trout sac fry by temperature manipulation, R.A. Bergstedt, R.L. Eshenroder, C. Bowen II, J.G. Seelye, J.C. Locke
9:30-9:50 am	Use of the brain parasite <i>Myxobolus neurobius</i> in separating mixed stocks of sockeye salmon, A. Moles, P. Rounds, C. Kondzela
9:50-10:10 am	Coded wire tag loss from chinook and coho salmon, H.L. Blankenship
10:10-10:25 am	Break
10:25-10:45 am	Performance of half-length coded wire tags in a pink salmon hatchery marking program, L. Peltz, J. Miller
10:45-11:05 am	Evaluation of inserting coded microwire tags in legs of small juvenile American lobsters, J.S. Krouse, G.E. Nutting
11:05-11:25 am	Coded wire tag retention by, and tagging mortality of, striped bass reared at the Hudson River hatchery, D.J. Dunning, Q.E. Ross, B.R. Friedman, K.L. Marcellus
11:25-11:45 am	Evaluation and marking techniques for juvenile and adult white sturgeons reared in captivity, C.E. Bordner, S.I. Doroshov, D.E. Hinton, R.E. Pipkin, R.B. Fridley, F. Haw
11:45-12:05 pm	Head mold design for coded wire tagging of selected spiny-rayed fingerling fishes, S.B. Cook, W.T. Davin, R.C. Heidinger
	1st alternate Otolith marking, E.B. Brothers
	2nd alternate Effects of trapping and coded wire tagging on coho salmon smolts, H.L. Blankenship, P.R. Hanratty
	3rd alternate Retention rates of half-length coded wire tags implanted in emergent pink salmon, W.M. Kaill, K. Rawson, T. Joyce

Session 4: Electronic Tags

Chair: Al Giorgi

Kane Hall 120

1:30-1:45 pm	A passive integrated transponder tag for fish, <i>E.F. Prentice, T.A. Flagg, C.S. McCutcheon</i>
1:45-2:00 pm	PIT tag monitoring systems for hydroelectric dams and fish hatcheries, <i>E.F. Prentice, C.S. McCutcheon, D.F. Brastow</i>
2:00-2:15 pm	Use of PIT tags for identification of striped bass <i>Morone saxatilis</i> and red drum <i>Sciaenops ocellata</i> broodstock, <i>W.E. Jenkins, T.I.J. Smith</i>
2:15-2:30 pm	Relative success of telemetry studies in Michigan, <i>J.S. Diana, D.F. Clapp, E.M. Hay-Chmielewski, G. Schnicke, D. Siler, W. Ziegler, R.D. Clark, Jr.</i>
2:30-2:45 pm	Break
2:45-3:00 pm	Effects of dummy ultrasonic transmitters on juvenile coho salmon, <i>M.L. Moser, A.F. Olson, T.P. Quinn</i>
3:00-3:15 pm	Use of radio telemetry to estimate survival of sauger passing through turbines and spillways at dams, <i>F.W. Olson, E.S. Kuehl, K.W. Burton, J.S. Sigg</i>
3:15-3:30 pm	Use of radio telemetry for studying salmon in glacial rivers, <i>J.H. Eiler</i>
3:30-3:45 pm	The application of ultrasonic transmitters to demersal rockfish movement research on shallow rocky reefs in Puget Sound, Washington, <i>K.R. Matthews, T.P. Quinn, B.S. Miller</i>
3:45-4:00 pm	Surgical implantation of dummy ultrasonic transmitters in juvenile chinook salmon using stainless steel sutures, <i>D. Mortensen</i>
4:00-4:15 pm	Monitoring the nearshore movement of red king crab under sea ice with ultrasonic tags, <i>P.C. Rusanowski, E.L. Smith, M. Cochran</i>
	1st alternate A pulse coded radio tag system for fish identification, <i>L. Stuehrenberg, A. Giorgi, C. Bartlett</i>
4:15-4:30 pm	Questions and answers

Session 5: Genetics

Chair: Gary Winans

Kane Hall 120

8:30-8:40 am	An overview of genetic marking, <i>G. Winans</i>
8:40-9:00 am	Genetic marking of a population of Alaskan pink salmon with an evaluation of the mark and marking process, <i>S. Lane, A.J. McGregor, S.G. Taylor, A.J. Gharrett</i>
9:00-9:20 am	Genetic marking of a stock of chinm salmon: evaluation of adult returns and a review of future applications, <i>L.W. Seeb, J.E. Seeb, R.L. Allen, W.K. Hershberger</i>
9:20-9:40 am	An evaluation of gametic disequilibrium analysis as a means of identifying mixtures of salmon populations, <i>R.S. Waples, P.E. Smouse</i>
9:40-10:00 am	A large-scale, multiagency genetic stock identification program—making it work, <i>J.B. Shaklee, S. Phelps</i>
10:00-10:20 am	Break
10:20-10:40 am	Comparison of stock discrimination for Pacific herring based on electrophoretic and mitochondrial DNA analysis, <i>J. Schweigert, R. Withler</i>
10:40-11:00 am	Mitochondrial variability in brook trout <i>Salvelinus fontinalis</i> from the eastern United States, <i>J.M. Quattro, R.P. Morgan II, R.W. Chapman</i>
11:00-11:20 am	Restriction endonuclease analysis of mitochondrial DNA of striped bass, <i>I.I. Wirgin, P. Silverstein, J. Grossfield</i>
11:20-11:40 am	Genetic marks detected by immunogenetic methods, <i>W.C. Davis, R.A. Larsen</i>
11:40-12:00 am	Genetic marking of fish using variability in chromosomes and nuclear DNA, <i>R.B. Phillips, P.E. Ihssen</i>
12:00-12:20 pm	DNA fingerprinting in fishes: a new generation of genetic markers, <i>M.Castelli, J.C. Phillipart, G. Vassart, M. Georges</i>
	1st alternate A technique for determining DNA variation from blood samples of walleye <i>Stizostedion vitreum</i> , <i>N. Billington, P.D.N. Herbert</i>

Session 6: Chemical Marks

Chair: Nick Parker

Kane Hall 120

2:00-2:20 pm	Inorganic chemical marks induced in fish, <i>R.J. Muncy, N.C. Parker, H.A. Poston</i>
2:20-2:40 pm	The use of calcein as a fluorescent marker in fish hard parts, <i>D. Beckman, C.A. Wilson, F. Lorica, J.M. Dean</i>
2:40-3:00 pm	Screening of elements for the chemical marking of hatchery salmon, <i>S.B. Yamada, T.J. Mulligan</i>
3:00-3:20 pm	Break
3:20-3:40 pm	Field verification of daily growth increments on the otoliths of juvenile cunner <i>Tautoglabrus adspersus</i> , <i>T. Gleason, C. Recksiek</i>
3:40-4:00 pm	Distinguishing between different populations of herring <i>Clupea harengus</i> of chemistry, <i>O. Grahl-Nielsen, K.A. Ulvund</i>
4:00-4:20 pm	Current and future analytical techniques at the FBI forensic science laboratory, <i>L.D. Lasswell</i>
4:20-4:40 pm	Microchemical analysis of fish hard parts for reconstructing habitat use: practice and promise, <i>C.C. Coutant</i>

Session 7: Design, Program Contribution, and Analysis

Chair: Doug Jester

Kane Hall 120

8:30-8:50 am	Design of survival experiments using marked animals: a case study, <i>E. Rextad, K.P. Burnham, D.R. Anderson</i>
8:50-9:10 am	The use of tag-recovery information in migration and movement studies, <i>C.J. Schwarz, A.N. Arnason</i>
9:10-9:30 am	Determining movement patterns in marine organisms: a comparison of methods using penaeid shrimp, <i>P.F. Sheridan, R.G. Castro Melendez</i>
9:30-9:50 am	Use of coded-wire tags to estimate aggregate stock composition of salmon catches in multiple mixed stock fisheries, <i>L.D. Shaul, J.E. Clark</i>
9:50-10:10 am	Jeopardized estimates of the contribution of marked, propagated Pacific salmon to the sportfishery of the Strait of Georgia, BC, due to awareness factor variability, <i>R.V. Palermo</i>
10:10-10:30 am	Break
10:30-10:50 am	Comparison of two methods for replicating coded-wire tag studies, <i>E.A. Perry, H.L. Blankenship, R.V. Palermo</i>
10:50-11:10 am	Parametric bootstrap confidence intervals for estimates of fisheries contribution in salmon marking studies, <i>H.J. Geiger</i>
11:10-11:30 am	Variance estimation of contribution rate estimates based on sample recoveries of coded-wire tagged fish, <i>K.B. Newman</i>
11:30-11:50 am	Sample size determination for mark-recapture experiments—Hudson River case study, <i>D.G. Heimbuch, D.J. Dunning, H. Wilson, Q.E. Ross</i>
12:00-1:30 pm	Lunch
1:30-1:50 pm	Random-sampling design to estimate hatchery contributions to fisheries, <i>R.R. Vreeland</i>
1:50-2:10 pm	Improved data quality in a tagging program through quality assurance and quality control, <i>P. Goeghegan, M.T. Mattson, D.J. Dunning, Q.E. Ross</i>
2:10-2:30 pm	Data organization and coding for a coast-wide mark recovery data system, <i>L. Lapi, M. Hamer, B. Johnson</i>
2:30-2:50 pm	Break

Session 8: Large-Scale Marking Programs

Chair: Nick Parker

Kane Hall 120

2:50-3:05 pm	Fish marking techniques in New Zealand, <i>T. Murray</i>
3:05-3:20 pm	History of the ICCAT tagging program, <i>P.M. Miyake</i>
3:20-3:35 pm	Australian cooperative gamefish tagging program, 1973-1987: status and evaluation of tags, <i>J.G. Pepperell</i>
3:35-3:50 pm	Striped bass restoration along the Atlantic coast: A multi-state and federal cooperative hatchery and tagging program, <i>C.M. Wooley, N.C. Parker, B.M. Florence</i>
3:50-4:05	Regional overview of coded wire tagging of anadromous salmon and steelhead in northwest America, <i>J.K. Johnson</i>
4:05-4:20 pm	Sixty years of tagging Pacific halibut: a case study, <i>R.J. Trumble, I.R. McGregor, G. St. Pierre, D.A. McCaughran, S.H. Hoag</i>
4:20-4:35	History of a cooperative game fish tagging program in the Atlantic Ocean, Gulf of Mexico, and Caribbean Sea, <i>E.L. Scott, E.D. Prince, C.D. Goodyear</i>
	1st alternate Marine fish tagging in South Africa: 1934-1987, <i>R.P. van der Elst</i>
	2nd alternate The Fisheries Research Institute's High Seas Salmon Tag Recovery Program, <i>N.D. Davis, K.W. Meyers, C.K. Harris, R.V. Walker</i>
4:35-4:50 pm	Conference Conclusion

Poster Presentations

"HUB" East Ballroom

Wednesday, June 29,

4:45-6:30 pm

Thursday, June 30,

4:45-6:30 pm

Hosted wine, beer and light hors d'oeuvres

Some vital statistics from mark-recapture data on the brook stickleback in Delta Marsh, Lake Manitoba, *T.O. Acere*

Marking techniques and results in the Juan Fernandez lobster *Jasus frontalis* and shrimps *Rhynchocinetes typus* and *Cryphios caementarius*, *P.M. Arana*

Evaluation of the Finnish tagging programs with Carlin-tags in the Baltic Sea and in the inland lakes, *H. Auvinen*

Marking eels, M.L. Bianchini, R. Rossi, *P.W. Sorensen*

Tag retention, survival, and growth of fingerling red drums marked with coded wire tags, *B.W. Bumgardner, R.L. Colura, A.F. Maciorowski, G.C. Matlock*

Overview of mark-recapture to determine population size of blueblack herring in Santee River, South Carolina, *R.W. Christie, D.W. Cooke*

Tagging of marine fish in sub-zero air temperatures, *D. Clay*

Observations of external marking techniques on Atlantic salmon, *K.A. Coombs, G.W. Friars, J.K. Bailey, C.M. Herbinger*

The Fisheries Research Institute's High Seas Salmon Tag Recovery Program, *N.D. Davis, K.W. Meyers, C.K. Harris, R.V. Walker*

Angler utilization of black crappie and the effects of a reward-tag program at Jamesport Community Lake, Missouri, *S. Eder*

Sample size requirements and analysis of tag recoveries for paired releases of lake trout, *J.H. Elrod, A. Frank*

Description of PIT-tagging equipment, methods, and automated data entry station, *T.A. Flagg, C.S. McCutcheon, D.F. Brastow, D.C. Cross*

A rapid reward program for king mackerel tag recoveries in the Southern Gulf of Mexico, *B.D. Fortune*

Experimental designs for changing allele frequencies in a selected fish population, *A.J. Gharrett, J.E. Seeb*

Survival and growth rates for Texas spotted sea trout, *A.W. Green, L.W. McEachron, G.C. Matlock, E. Hegen*

Promotion of tag and release in Hawaii: "A Success Story," *D.B. Grobecker*

Effects of monetary rewards and jaw tag placement on angler reporting rates for walleye and smallmouth bass, *R.C. Haas*

Design, implementation, and analysis of a catfish tagging study on the St. Johns River, Florida, *M.M. Hale, J.E. Crumpton, D.J. Renfro*

Visible implanted fish tag, *F. Haw, P.K. Bergman, R.D. Fralick, R.M. Buckley, H.L. Blankenship*

Migration patterns of Atlantic salmon originated from different wild stocks and river releases of hatchery reared stocks in the Baltic Sea, *E. Ikonen*

Pit tagging wild and natural chinook salmon and steelhead trout parr in Idaho, *R.B. Kiefer*

The importance of matching tag and fish length—A New Zealand experience, *P.D. Kirk*

The movement of tagged crappie through reservoir flood control gates (Copan Lake, Oklahoma), *M. Knapp, L. Talent, O.E. Maughan*

Bias in stock separation analyses using scale patterns due to unequal scale regeneration rates between stocks, *C.M. Knudsen*

Mark-recapture design and estimation of abundance and migration: Rainbow trout in the glacially turbid Kenai River, Alaska, *R. Lafferty, T.J. Quinn II*

Magnetic tag detection efficiency in Hudson River striped bass, *M.T. Mattson, B.R. Friedman, D.J. Dunning*

Marking fish by scarring soft fin rays, *K.H. Mills*

Tagging and detection of magnetic Microwire tags in Atlantic herring, *J.A. Morrison*

Effects of dummy ultrasonic transmitters on juvenile coho salmon, *M.L. Moser, A.F. Olson, T.P. Quinn*

Electrical anesthesia for handling and tagging salmonids, *J. Orsi*

Tagging on pelagic fishes in Peru, uses and problems, *N. Pena, J. Zuzunaga*

Analysis of lobster *Homarus americanus* migrations through the multiple recapture of tagged individuals, *D.S. Pezzack, D.R. Duggan*

An evaluation of multiple mark-and-recapture techniques for estimating population size and mortality of large mouth bass, *W. Porak, W. Coleman, S. Crawford, J. Estes*

Tagging methods of king and Spanish mackerel in North Carolina, *L. Reed, J.D. Ward, T.D. Willis, T.C. Stiles*

The use of scale patterns and shape as discriminators between wild and hatchery striped bass stocks, *W.R. Ross*

Population, sizes, structures, and movements of brook trout and Atlantic salmon from Schnable mark-recapture in two Newfoundland lakes, *P.W. Ryan*

Washington Department of Fisheries' mobile tagging units— construction and operation, *G.C. Schurman, D.A. Thompson*

The study of population dynamics of *Cyprinus carpio* in ponds using parasites as biological tags, *R.N. Singhal*

Herring, a practical example of the need for replication in tagging studies, *W.T. Stobo*

Use of radiotracking in France for recent studies about the E.D.F. Fishways Program, *F. Travade, P. Bomassi, J.M. Bach, C. Brugel, P. Steinbach, J.F. Luquet, G. Pustelnik*

Genetic marking in fishes: an overview focusing on protein variation, *F.M. Utter, J.E. Seeb*

Marine fish tagging in South Africa: 1934-1987 Use of drifting live cars when tagging from commercial fishing gear, *R.P. van der Elst, J.C. Veffosse, J.J. Loesch*

Evaluation of pressure sensitive radio transmitters for monitoring depth selection by trout in lotic systems, *T.H. Williams, R.G. White*

Equipment and Manufacturers Exhibit

Chair: Stan Smith

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Advanced Telemetry Systems, Inc.

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470 First Ave North Box 398
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(Telemetry systems)

BioSonics, Inc.

Contact: Rae Jean Sielen
4520 Union Bay Place NE
Seattle, WA 98105
(PIT Tags, Hydroacoustics,
Optical Pattern Recognition)

Fisheagle Trading Co.

Contact: John Taylor
Little Faringdon Mill
Lechlade, Glos., England GL73QQ
(Tagging equipment)

Floy Tag and Manufacturing, Inc.

Contact: Margaret Anderson
4616 Union Bay Place NE
Seattle, WA 98105
(Original manufacturer of T-Bar, anchor,
dart and laminated tags for fish)

Hallprint Pty. Ltd.

Contact: Michael Hall
27 Jacobsen Crescent
Holden Hill, South Australia 5088
(Fish tags)

Ketchum Mfg. Sales Ltd.

Contact: Claude Lalonde
396 Berkley Ave
Ottawa, Ontario Canada K2A 2G6
(Fish tags)

Laughing Walrus

Contact: Susan Guerro
PO Box 4398
Bellingham, WA 98227
(Arts and Crafts)

Northwest Marine Technology, Inc.

Contact: Jan Kallshian
Shaw Island, WA 98286
(Tagging equipment/monitoring)

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INTERNATIONAL SYMPOSIUM AND EDUCATIONAL WORKSHOP ON
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International Symposium and
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PAGE: 2

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**Report on the International Symposium and Educational Workshop on Fish
Marking Techniques - Seattle, 27 June - 1 July 1988**

by

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ERRATUM

Page 4, Para 8, Last line _____ (with baseline information on alleles is used)

should read
(with baseline information on alleles used)

Page 5, Para 1, line 4 _____ (are DNA finger-printing can also be)

should read
(DNA finger-printing can also be)

Page 5, para 5, line 1 _____ (Inorganic chemical marks used on fish)

should read
(Inorganic and organic chemical marks used on fish)