# STANDARD OPERATING PROCEDURES FOR APPLICATION OF LAMPRICIDES IN THE GREAT LAKES FISHERY COMMISSION INTEGRATED MANAGEMENT OF SEA LAMPREY (*Petromyzon marinus*) CONTROL PROGRAM

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Last edited: March 2024

SLC 04-001.14

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## MANUAL CITATION

The following is an example of how to cite this document from the Journal of Great Lakes Research:

Barber, J., Van Kempen, T., 2024. Standard Operating Procedures for the Application of Lampricides in the Great Lakes Fishery Commission Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program

This manual is intended solely for the use of individuals and organizations involved in sea lamprey control in the Great Lakes, Finger Lakes, and Lake Champlain under the terms, conditions and procedures cited herein. All data contained in the manual are exclusive to the use and the restrictions and stipulations contained herein. The U.S. Fish and Wildlife Service makes no claim of suitability and assumes no liability for uses of the material contained herein for control of sea lampreys.

This manual does not endorse or recommend the use of the brand names of products or equipment cited herein.

## ADOPTION OF PROCEDURES

These Standard Operating Procedures for control of sea lampreys in the Great Lakes are adopted and will be implemented by all U.S. Fish and Wildlife Service and Fisheries and Oceans Canada Sea Lamprey Management personnel. The procedures include measures to assure conformance with all specifications and requirements for use.

This page serves to update the previous ADOPTION OF PROCEDURES

_____ Date_____

Jessica Barber
Field Supervisor
U.S. Fish and Wildlife Service

_____ Date_____

Tonia Van Kempen
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## Approval of Standard Operating Procedures

All standard operating procedures for the chemical control of sea lampreys require signatures of approval from the program Field Supervisor, U.S. Fish and Wildlife Service and/or Division Manager, Fisheries and Oceans Canada. Persons filling either of these positions assume the responsibility of approving all procedures. This page is provided to simplify the process of granting approval.

This page furnishes blanket approval of all standard operating procedures published in Document SLC 04-001.9 *Standard operating procedures for application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (Petromyzon marinus) control program* on the date of signing.

Approval is not furnished for procedures introduced, amended, or edited after date of signing. All subsequent additions and changes require signatures on an individual basis.

_____ Date_____

Jessica Barber
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_____ Date_____

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## DEFINITION OF TERMS

Definitions specific for lampricides

**Active Ingredient (A.I.)**

The element or compound in a chemical formulation that causes the desired activity or effect.

**Administrative Operating Procedure (AOP)**

A document that describes the standardized procedures for conducting administrative functions which support field operations.

**Analytical standard**

A commercially prepared grade of 3-trifluoromethyl-4-nitrophenol (TFM) or 2',5-dichloro-4'-nitrosalicylanalide (niclosamide) of high purity, usually 95% or greater. The analytical standard must be accompanied by a Certificate of Analysis from the manufacturer stating the purity.

**Bayluscide**

The 2-aminoethanol salt of niclosamide, also known as Bayer 73 or Clonitralid.

**Biological Survey**

A procedure whereby personnel survey the stream before, during or after a treatment in order to characterize and document fish activity or mortality.

**Boost**

See Maintenance application

**Certified applicator (Pesticide applicator in Canada)**

A person who is approved by state and/or provincial regulatory agencies to apply pesticide products. Certified applicators of lampricides are limited to personnel from United States Fish and Wildlife Service, Fisheries and Oceans Canada, and provincial and state fish and game employees.

**Emulsifiable concentrate**

A formulation that contains active ingredient, one or more petroleum-based solvents, and an agent that allows the formulation to be mixed with water to form an emulsion.

**Field standard**

A laboratory formulated TFM or niclosamide standard prepared in an appropriate solvent. Concentrations of TFM field standards are 0.0, 4.0, 8.0, and 12.0 mg/L (A.I.) in sodium tetraborate buffered deionized water. Niclosamide field standards are formulated at 100 mg/L (A.I.) in dimethylformamide.

**Instrument Operating Procedure (IOP)**

A document that describes the standardized procedures for calibrating, operating, and maintaining an instrument or device.

**Lampricid® (TFM) or TFM HP Sea Lamprey Larvicide**

The formulated sodium salt of 3-trifluoromethyl-4-nitrophenol.

**Lampricide block**

A continuous volume of stream discharge containing lampricide(s). The volume typically represents the discharge passing a site for about 12 hours.

**Lampricide prediction table**

Relates the toxicity of lampricides to the pH and alkalinity of stream water. The tables are produced from of a series of regressions conducted on data produced by laboratory toxicity tests. Prediction tables allow determination of lampricide concentrations used in stream treatments.

**Maintenance application**

An application of lampricide(s) into an existing lampricide block that is intended to maintain the effectiveness of the block; also termed a boost.

**Maximum Allowable Concentration (MAC)**

The concentration of lampricide(s) that produces 25 percent mortality of brown trout after a 9-hour exposure. This concentration is determined by prediction charts based on pH.

**Minimum Lethal Concentration (MLC)**

The concentration of lampricide(s) that produces 99.9 percent mortality of sea lamprey larvae after a 9-hour exposure. This concentration is determined by prediction charts based on pH and alkalinity or pretreatment on-site toxicity tests.

**Niclosamide**

The active ingredient (2',5-dichloro-4'-nitrosalicylanilide; also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxy-benzamide) in formulations of Bayluscide.

**Non-target organisms**

All organisms other than sea lampreys.

**National Pollutant Discharge Elimination System (NPDES)**

The permit program that controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

**Primary application**

The initial upstream application of lampricides to an infested stream. Maintenance applications are made into, and many supplemental applications are timed to blend with the lampricide block produced by this application.

**Restricted use pesticide**

A pesticide designated by the United States Environmental Protection Agency (USEPA)/Health Canada for use only by or under the direct supervision of certified applicators. The designation and additional regulatory restrictions are intended to prevent adverse effects on the environment or injury to the applicator.

**Sea lamprey larvae**

The immature, nonparasitic life stage of the sea lamprey (ammocoete).

**Standard Operating Procedure (SOP)**

A document used by personnel to perform procedures that are routine and standardized. An SOP helps to ensure the quality and integrity of data, provides a basis for uniformity and accountability, and offers a basis for training and guidance.

**Stream Maximum Allowable Concentration (SMAC)**

The concentration of lampricide(s) that may be applied to a stream without expectation of causing undue non-target mortality. This is the highest concentration allowed during treatment.

**Stream Minimum Lethal Concentration (SMLC)**

The minimum concentration of lampricide(s) needed under specific water chemistry conditions for effective treatment of a stream or tributary. SMLC values for a stream can vary both temporally and spatially; many SMLC values may be used to conduct a single treatment.

**Supplemental applications**

Supplemental applications of lampricides are conducted in backwaters and tributaries of streams undergoing treatment. Applications are made with liquid or bar formulations of TFM or granular formulation of Bayluscide. Supplemental applications are generally timed to merge with the lampricide block from the primary application.

**Technical Operating Procedure (TOP)**

A document which describes the standardized steps required and used to perform a specific technical task.

**TFM HP Sea Lamprey Larvicide**

See Lampricide®

**Toxicity test**

A test in which the lethal effects of lampricide(s) on target and non-target animals are assessed by exposing sea lamprey larvae and selected non-target species to a series of concentrations of lampricide(s). The lowest observed concentration that produces 100% sea lamprey mortality in an on-site toxicity test can be used as the SMLC.

**Wettable powder**

A powdered formulation of a relatively insoluble pesticide in which the active ingredient is combined with an inert carrier and with a wetting or dispersing agent; a wettable powder forms a suspension rather than a true solution in water.

**Working standard**

A dilution of the niclosamide field standard to a suitable concentration for on-site analyses of niclosamide concentrations during stream treatments and toxicity tests.

## LIST OF ACRONYMS

| | |
|---|---|
| AI | Active Ingredient |
| AOP | Administrative Operating Procedure |
| ATV/ORUV | All-Terrain Vehicle/Off Road Utility Vehicle |
| CDL | Commercial Driver's License |
| CPR | Cardio-Pulmonary Resuscitation |
| DMF | Dimethylformamide |
| DFO | Fisheries and Oceans Canada previously Department of Fisheries and Oceans |
| DOT | Department of Transportation (U.S.) |
| DO | Dissolved Oxygen |
| DVIR | Driver Vehicle Inspection Report |
| EC | Emulsifiable Concentrate |
| ES | Ecological Services |
| ESTR | Empirical Stream Treatment Ranking |
| FERC | Federal Energy Regulatory Commission |
| FIFRA | Federal Insecticide, Fungicide, and Rodenticide Act |
| GLFC | Great Lakes Fishery Commission |
| HBBS | Hammond Bay Biological Station |
| HPLC | High Performance Liquid Chromatograph(y) |
| IOP | Instrument Operating Procedure |
| LBS | Ludington Biological Station |
| LC | Lethal Concentration |
| LCFWMC | Lake Champlain Fish and Wildlife Management Cooperative |

List of Acronyms (continued)

| | |
|---|---|
| MBS | Marquette Biological Station |
| MDEQ | Michigan Department of Environmental Quality |
| MAC | Maximum Allowable Concentration |
| MLC | Minimum Lethal Concentration |
| MSDS/SDS | Material Safety Data Sheet/Safety Data Sheet |
| NCTC | National Conservation Training Center |
| NPDES | National Pollutant Discharge Elimination System |
| NYSDEC | New York State Department of Environmental Conservation |
| OMNR | Ontario Ministry of Natural Resources and Forestry |
| OMOE | Ontario Ministry of Environment and Climate Change |
| PEAS | Pollution Emergency Alerting System |
| PPE | Personal Protective Equipment |
| SLCC | Sea Lamprey Control Centre |
| SLCP | Sea Lamprey Control Program |
| SMAC | Stream Maximum Allowable Concentration |
| SMLC | Stream Minimum Lethal Concentration |
| SOP | Standard Operating Procedure |
| TFM | 3-trifluoromethyl-4-nitrophenol; Lamprecid® |
| TOP | Technical Operating Procedure |
| UMESC | Upper Midwest Environmental Sciences Center |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| WHMIS | Workplace Hazardous Materials Information System |

List of Acronyms (continued)

| | |
|---|---|
| WP | Wettable Powder |

## PREFACE

The Great Lakes Fishery Commission was established by the CONVENTION ON GREAT LAKES FISHERIES BETWEEN THE UNITED STATES OF AMERICA AND CANADA, in 1955 (Appendix A). Article IV section d states that one of the duties of the Great Lakes Fishery Commission is "to formulate and implement a comprehensive program for the purpose of eradicating or minimizing the sea lamprey populations in the Convention Area". Article V section b states that the Commission may "take measures and install devices in the Convention Area and the tributaries thereof for lamprey control". The Great Lakes Fishery Act of 1956 (Public Law 557-84th Congress, Chapter 358-2d Session, S.3524, 16 U.S.C. 931-939C) provides the enabling legislation in the United States (Appendix A). The United States Fish and Wildlife Service (USFWS) and Fisheries and Oceans Canada (DFO) conduct a sea lamprey control program as partners of the Great Lakes Fishery Commission (GLFC) by Memorandum of Agreement with the Commission as specified in the Convention. All sea lamprey control actions taken by the partners for the Commission are pursuant to the Great Lakes Fishery Act of 1956 and Great Lakes Fisheries Convention Act. 1955, c.34, s.1.

## SCOPE

This document describes the standard operating procedures for application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (*Petromyzon marinus*) control program. The procedures described pertain to the chemical control and assessment of sea lampreys in the United States and Canada.

The list of technical operating procedures (TOPs) and appendices immediately following this paragraph as well as subsection *II. Lampricide Application Procedures* in the procedural section of this document are considered prescriptive and must be followed pursuant to the application of the lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (*Petromyzon marinus*) control program. Procedures not specifically listed, and the remainder of this document are considered advisory and not prescriptive in nature.

Prescriptive procedures:

| | |
|---|---|
| TOP:012 | Procedures for the Application of TFM |
| TOP:013A | Procedures for Application of Bayluscide 20% Emulsifiable Concentrate |
| TOP:014 | Procedures for Supplemental Application of TFM |
| TOP:015 | Procedures for Supplemental Application of Bar Formulation of TFM |
| TOP:017 | Procedures for Application of Bayluscide 3.2% Granular Sea Lamprey Larvicide |
| TOP:017A | Procedure for large-scale Applications of Bayluscide 3.2% Granular Sea Lamprey Larvicide |
| TOP:018 | Procedures for Conducting Spectrophotometric Analysis for TFM in Stream Water |
| TOP:021 | Procedures for Conducting Liquid Chromatographic Analysis for Bayluscide Active Ingredient (Niclosamide) |

Appendix I Lampricide Prediction Charts
Appendix J Lampricide Application Calculations

## INTRODUCTION

### I. Biology

The sea lamprey is a primitive eel-like fish distinguished from other fish by its lack of paired fins and jaws. The sea lamprey, closely related to the primitive hagfish, is an anadromous species endemic to the Atlantic Ocean. Most of the life of the sea lamprey is spent as a larva burrowed in the sediment of freshwater streams. In this life stage the animal is not harmful to other fish and feeds by filtering food from stream water. The sea lamprey may remain in the larval stage from 3 to more than 17 years before metamorphosing into the parasitic (predatory) stage. The parasitic-phase lamprey feeds by attaching to fish and rasping deep wounds from which blood, body fluids, and flesh are drawn. The results of such attacks are often fatal for the host fish.

### II. History

The sea lamprey was first reported in Lake Erie in 1921. They rapidly spread throughout the upper Great Lakes and were well established by the 1940s. By 1950, lake trout (*Salvelinus namaycush*), a primary prey species, were nearly extirpated in lakes Michigan and Huron.

Early attempts to control sea lampreys began in the 1950s with the installation of mechanical traps and electrical weirs in spawning streams, but these measures were largely unsuccessful. No effective control was accomplished until the advent of a chemical control program in 1958.

A search for an effective lampricide began in the 1950s. After toxicological screening of nearly 6000 chemicals, two classes of compounds emerged as likely candidates, halogenated nitrophenols and salicylanilides. From these classes of compounds two lampricides, TFM (3-trifluoromethyl-4-nitrophenol) and Bayluscide (2',5-dichloro-4'-nitrosalicylanilide) were developed and have been used successfully for the control of larval sea lampreys in the Great Lakes basin.

TFM and Bayluscide were registered as restricted use pesticides in 1960. Both lampricides were successfully reregistered in 1997 in the U.S. and in Canada.

### III. Lampricide Formulations

Lampricide formulations are registered by the USFWS as restricted use pesticides in both the United States and Canada. Use of these products is limited to certified applicators of the USFWS, DFO, and provincial and state fish and game employees. Pesticide labels (Appendix E) have been issued that define use practices in their respective countries.

The "Restricted Use" designation restricts a product, or its uses, to use by a certified pesticide applicator or under the direct supervision of a certified applicator. Pesticide applicators must adhere to all label requirements and follow all precautionary statements. Among these stipulations are the following: lampricides are to be handled and applied only by trained personnel; local, state, and provincial fish and game agencies must be notified before use; municipalities which use stream water as a potential source of drinking water must be notified 24 hours prior to treatment; agricultural irrigators must be informed 24 hours in advance of a treatment that they must turn off irrigation systems for a 24 hour period during and after treatment; pretreatment surveys must be conducted to determine larvae populations; on-site water chemistry analyses must be conducted to determine the minimum concentration of lampricide required to kill larval sea lampreys and the maximum concentration that can be used without causing undue non-target mortality; concentrations of lampricide in the water must be monitored by colorimetric analysis, or High Performance Liquid Chromatography (HPLC); and specified personal safety precautions must be followed.

A. TFM

The chemical compound 3-trifluoromethyl-4-nitrophenol also known as α,α,α-Trifluoro-4-nitro-m-cresol (TFM) is a halogenated mononitrophenol with the molecular formula $C_7H_4F_3NO_3$, and a molecular weight of 207.1. TFM has a pKa of 6.07 $\pm$ 0.03, and exhibits a maximum absorbance at 395 nm (for the phenolate ion) and 295 nm (for the unionized form).

1. Analytical Standard

This is a purified form and distributed by Sigma-Aldrich, St. Louis, Missouri. It is a light yellow crystalline substance with a purity of 99 percent active ingredient. The concentrations of TFM field standards used during lampricide applications are verified against a TFM analytical standard.

2. TFM (TOP:012)

TFM is produced as a liquid formulation of the sodium salt that contains about 33 percent active ingredient (free cresol) with the remainder primarily isopropanol and water. TFM (common names; Lampricide Sea Lamprey Larvicide, Sea Lamprey Larvicide Lamprecid®, TFM HP Sea Lamprey Larvicide) is produced under USEPA registration number 6704-45, and Health Canada Pest Control Products numbers 21124 and 11763. TFM is manufactured by Iofina Chemical, Inc., 1025 Mary Laidley Drive, Covington, Kentucky 41017; and by Weylchem (Deutschland) GmbH, 65933 Frankfurt/Main, Germany (distributed by Weylchem (America) Inc., 3411 Silverside Road, Wilmington, Delaware 19810). This formulation is highly water soluble and is packaged in 5-gallon (U.S.) plastic containers.

3. TFM Bar (TOP:015)

TFM bars are a water-soluble solid formulation containing about 23 percent active ingredient embedded in an inert chemical matrix. TFM bars are manufactured by Iofina Chemical Inc., 1025 Mary Laidley Drive, Covington, Kentucky 41017, under USEPA registration number 6704-86, and Health Canada Pest Control Products number 22610. The bars are used to treat small tributaries. The water solubility of the matrix is formulated so dissolution occurs at a controlled rate in flowing water. TFM is released with the concentration controlled primarily by the number of bars applied to the tributary. TFM bars are individually packaged and weigh about 0.9 kilograms (kg) each.

B. Bayluscide

The ethanolamine salt of 2',5-dichloro-4'-nitrosalicylanilide (Bayluscide) also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1) is registered as a molluscicide and as a sea lamprey larvicide. This compound with a molecular weight of 388.1 exhibits a maximum light absorbance at 330 nm. Bayluscide is only marginally soluble in water; 230 $\pm$ 50 mg/L at 25 °C at pH > 7. At pH < 7 Bayluscide is practically insoluble. Other common and trade names include Bay 73, Bayer 73, Bayer 2353, and Clonitralid.

1. Analytical Standard

Niclosamide (2',5-dichloro-4'-nitrosalicylanilide; also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide) the active ingredient of Bayluscide, is manufactured by Sigma-Aldrich, St. Louis, Missouri. The Bayluscide field standards are formulated with niclosamide.

2. Analytical Grade Bayluscide (Bayluscide technical)

Bay 73 technical (the ethanolamine salt of 2',5-dichloro-4'-nitrosalicylanilide also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1)) is manufactured in the Republic of China, by Anhui Topsun Pharmaceutical Inc. under contract to Bayer Germany who supplies the material under the names Bayer 2353 or Clonitralid. This technical product contains 96 - 100 percent active ingredient (81 – 84 percent niclosamide). This technical product registered under USEPA registration number 6704-88, and Health Canada Pest Control Products number 25561 is used in the manufacture of Bayluscide 70% Wettable Powder (WP), Bayluscide 3.2% Granular Sea Lamprey Larvicide, and Bayluscide 20% Emulsifiable Concentrate (EC).

3. Bayluscide 3.2% Granular Sea Lamprey Larvicide (TOP:17A)

Bayluscide 3.2% granular formulation contains 3.2% of the ethanolamine salt of niclosamide (5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1)), and is manufactured by Coating Place Inc., Verona, Wisconsin, under USEPA registration number 6704-91 and Health Canada Pest Control Products number 25563. This granular formulation is used to survey for and to control sea lamprey larvae in the Great Lakes, Finger Lakes, and Lake Champlain basins. It is applied at a rate of 5 pounds active ingredient per surface acre of water (5.6 kg active ingredient/hectare), and is packaged in plastic pails that contain 50 pounds (22.7 kg) of formulated product each.

4. Bayluscide 20% EC (TOP:013A)

Bayluscide 20% EC contains 20-21% of the ethanolamine salt of niclosamide (5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1)), approximately 18% niclosamide, and is manufactured by Coating Place, Verona, Wisconsin. This product is assigned the USEPA registration number 6704-92 and Health Canada Pest Control Products number 27407. During certain stream applications Bayluscide 20% EC is used as an additive with TFM to reduce the amounts of TFM used, and to protect populations of burrowing mayflies. Bayluscide 20% EC is applied directly to the stream water in combination with TFM at a weight ratio (active ingredient) of two percent or less. Analysis for the purpose of maintaining desired concentrations is accomplished by HPLC. Bayluscide 20% EC is packaged in 1- and 5-liter plastic containers.

The successful chemical control of sea lampreys has allowed reestablishment of a robust sport and commercial fishery in the Great Lakes. This document describes in detail the standard operating procedures used for chemical control of the sea lamprey.

## PROCEDURES

I. Administrative Procedures

Selected administrative procedures followed by the partners in conducting lampricide treatment functions are described in the Administrative Operating Procedures (AOPs).

A. Personnel

1. Organizational Structure

The Sea Lamprey Control Program (SLCP) is administered by the GLFC, Ann Arbor, Michigan. The partners operate from facilities located at Sault Ste. Marie, Ontario; Ludington, Michigan; and Marquette, Michigan. The

Lake Champlain Fish and Wildlife Management Cooperative (LCFWMC) operates independently as a partner in sea lamprey control.

The organizational structure of the partners is depicted in Appendix B. The Larval Assessment Team identifies streams containing sea lamprey and generates population estimates. The Lampricide Control Team reduces in-stream populations of sea lamprey larvae by periodic application of lampricides in the states and provinces bordering the Great Lakes basin. Responsibilities for application of lampricides are divided geographically among the three facilities.

2. Lampricide Control Team Structure

Responsibilities for conducting lampricide treatments are shared by treatment supervisors of the Lampricide Control Teams. The USFWS employs a Chemist who provides analytical support to all partners in the program. Remaining field personnel are support staff.

a. Treatment Supervisor – Supervisory Fish Biologist and Fish Biologist (USFWS) or Aquatic Science Biologist III (DFO)

The treatment supervisors are responsible for the operation and direction of the lampricide control crew including planning, directing, and overseeing all aspects of lampricide treatment.

b. Chemist

The Chemist is responsible for adapting available analytical techniques for conducting water chemistry measurements and measurements of concentrations of lampricides metered into streams. The Chemist maintains a procedural manual of chemical analysis techniques and conducts a variety of investigations.

c. Technical Support Personnel –Technicians

Technical support personnel provide direct support and perform the duties necessary to conduct a lampricide treatment. These persons conduct pre-application measurements, conduct toxicity tests, apply lampricides, and carry out other essential tasks related to the program.

B. Quality Assurance

The purposes of Quality Assurance (AOP:001) are to (1) provide guidance on how applications of lampricides are conducted and (2) ensure that facilities, equipment, personnel, methods, practices, records, and controls conform with standards provided through the Federal Insecticide, Fungicide, and Rodenticide

Act (FIFRA) and Pest Control Products Act and enforced by the USEPA and Health Canada.

This manual is a digest of procedures used throughout the SLCP in the U.S. and Canada. Assuring that procedures outlined in this manual are current and accurate is a vital function of Quality Assurance. Methods used to update procedures are outlined in AOP:002.

1. Training

a. Administrative Orientation

Administrative orientation applies to all new personnel who enter on duty as full-time, part-time, temporary, or seasonal employees of the partners. This procedure ensures that new employees become familiar with all regulatory and physical aspects of the workplace.

b. Equipment

All employees are trained in proper use of all equipment needed to perform their jobs. This annual training occurs prior to or during the field season according to procedures outlined in AOP:004. Records of training are maintained.

c. Instrumentation and Operating Procedures

Personnel are trained annually in instrumentation and analytical procedures used routinely in sea lamprey control operations to determine lampricide concentrations and stream water chemistry AOP:004. Training is provided in the use of these instruments and techniques to assure the accuracy and precision of the data collected.

d. Quality Assurance

The Quality Assurance program (AOP:001) for sea lamprey control field operations includes formal training (AOP:004). The training process emphasizes three areas of quality assurance: operator training, demonstration of abilities, and testing of abilities. The Quality Assurance program is reviewed annually.

e. Pesticide Applicator Certification

Federal law regulating pesticides as covered under FIFRA and Pest

Control Products Act regulations provides states and provinces the authority to certify applicators, register pesticides, and design programs to meet local needs. The lampricides used in SLCP are restricted use pesticides and use of these chemicals requires pesticide applicator certification. Certification is a continuing process, and recertification is conducted according to provincial and state guidelines.

2. Safety

a. Cardio-Pulmonary Resuscitation (CPR)/First Aid

Certification training in CPR and First Aid is provided to all new employees (AOP:004). Permanent and returning personnel must be currently certified in CPR and in First Aid.

b. Water Safety/Boat Safety

All personnel who operate watercraft receive training and certification in water safety (AOP:004). Subjects include the proper use of boats and motors, waterway navigation and rights-of-way, emergency procedures, and avoidance of low head dams and other navigation hazards.

c. Electrofishing

Each member of a USFWS electrofishing crew must have completed an electrofishing safety training course and crew leaders must be certified by the USFWS National Conservation Training Center (NCTC) in electrofishing. Electrofishing activities are conducted following procedures specified in the USFWS Safety Manual section 24AM13 and AOP:004.

d. Vehicles, All-Terrain Vehicles/Off Road Utility Vehicles (ATV/ORUV), and Heavy Equipment

Personnel are thoroughly trained in the operation of all vehicles and heavy equipment that they are required to operate (AOP:004). Driver certification and vehicle inspection requirements follow guidelines mandated by appropriate regulatory agencies.

Vehicles are thoroughly inspected on an annual basis to ensure safety. All vehicles are equipped with safety equipment that may include a fire extinguisher, first aid kit, chemical spill kits, and hazard warning devices.

New USFWS personnel must complete a certified course in

defensive driving.

Personnel frequently tow trailers. State and provincial laws require specific licensing for drivers of some truck and trailer combinations. Personnel who tow trailers are provided with practical training by experienced drivers annually.

All personnel who use ATV/ORUVs in remote locations to transport personnel and equipment are instructed and certified in the proper operation of these vehicles. ATV/ORUV drivers are required to wear specified safety equipment.

Heavy equipment training is provided to selected personnel. Forklift operators (USFWS and DFO) must be certified.

e. Material Hazard Communication

The Hazard Communication Program (USFWS) and Workplace Hazardous Materials Information System (DFO) keep employees apprised of the hazardous properties of chemicals to which they are exposed and of appropriate safety measures. Training emphasizes identification and properties of hazardous chemicals, health hazards associated with exposures, procedures to protect against hazards, procedures for controlling spills and leaks, and safe disposal methods. Current Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS) are available in the station laboratories, shops, warehouses, laboratory trailers, and in a digital database for reference by employees.

f. Handling of Pesticides

(1) Storage

Lampricides are stored in a cool, dry place within a locked facility according to USEPA and Ontario Ministry of Environment (OMOE) guidelines. TFM and Bayluscide are stored in original containers and in a manner consistent with regulations to prevent cross contamination with other substances. Appropriate safety equipment is provided to all personnel working in storage areas.

(2) Spills

Lampricides are handled in a manner that prevents spillage. Accidental spills of lampricides are managed according to stipulations of the Pesticide Spill Plan (Appendix D), pesticide label (Appendix E), and SDS (Appendix F).

(3) Pesticide Disposal

The procedures for disposal of lampricides follow federal, state, and provincial regulations. Pesticide containers are triple rinsed (or equivalent) before disposal. Rinsate from the containers is incorporated into the stream treatment.

(4) Pesticide Container Disposal

Empty lampricide containers are rendered unsuitable for further use and disposed or recycled consistent with requirements of federal, state, and provincial regulations.

(5) Inventory

Logs are maintained at the storage facility and in the administrative section to record delivery and removal of pesticides. Information required on the log includes the employee's name, date, and the amount by batch of pesticide entering or leaving the facility. A record of each pesticide application also is maintained. This record includes the location, date, time, amount applied, batch number, application rate, and name of the applicator.

A record is maintained of amounts of lampricides applied during each application and of the total amount applied during each treatment. These records are part of the procedure used to maintain an inventory of lampricide stocks available to the program (AOP:006).

(6) Transport

TFM and Bayluscide are transported in a variety of vehicles according to federal, state, and provincial regulations (Appendix R). Weight capacities for individual trucks are not exceeded. Proper precautions are taken to evenly distribute and secure loads. Transport vehicles also carry absorbent materials (spill kits) in case of accidental spills.

(7) Protection of Workers

Personnel working with TFM and Bayluscide are trained to apply pesticides in a safe manner, in accordance with requirements stipulated on the pesticide labels (Appendix E), and SDS (Appendix F), Standard Operating Procedures,

and applicable federal, state, and provincial laws. Protective equipment specified on the pesticide labels and SDS is worn by all personnel working with lampricides. Emergency eyewash and soap are available at each application site.

C. Stream Selection, Scheduling, and Planning

1. Stream Selection Process

Streams are selected for treatment based on estimated treatment costs and benefits (AOP:014). This is done through the application of a computer model, the Empirical Stream Treatment Ranking (ESTR) program. The production of sea lamprey larvae within a stream is estimated by methods outlined in Appendix S. The cost of treatment is compared to the estimated number of large larvae (>100 mm) that would be eliminated through treatment. The resulting cost per large larva is ranked for streams throughout the Great Lakes basin. Fiscal limitations could determine the number of streams treated. Lake Champlain and Finger Lakes tributaries may be selected through the use of a modification of this process.

The selection of some streams is independent of the stream ranking system described above. Some streams are selected annually to limit recruitment to offshore areas and others on the basis of expert judgment. In addition, some streams are selected on the basis of other criteria: deferrals, geographical location, and scientific research.

2. Scheduling

The scheduling of stream treatments is influenced by many physical, chemical, biological, and sociological factors. A listing of sea lamprey producing streams and optimal treatment dates are listed in Appendix H. The process of scheduling lampricide treatments and factors considered in that process is outlined in Appendix U.

a. Physical

Streams are scheduled for treatment during periods in which applications are both efficacious and cost effective. Historical data are reviewed to provide a profile of optimal discharge at which a stream can be treated successfully. Insufficient stream discharge during a treatment can cause the lampricide block to weaken and be less effective, particularly in impoundments or river mouth areas. Streams in which low discharge presents a problem are usually treated soon after spring runoff. Lampricide treatments often are scheduled to utilize the ability of a water control structure to regulate water discharges.

Treatments of streams are scheduled to avoid extremely low water temperatures. The efficacy of lampricides is reduced at low water temperatures.

b. Chemical

The efficacy of lampricides is affected by water chemistry. Some streams are scheduled to avoid periods of increased water temperature and unsuitable water chemistry such as extremely high or fluctuating pH. Some streams are scheduled to avoid runoff from applications of agricultural fertilizers.

c. Biological

Streams are scheduled to reduce exposure of potentially susceptible species or certain life stages of non-target organisms such as lake sturgeons (*Acipenser fulvescens*), spawning suckers, and salmonids. Streams with large populations of burrowing mayflies may be scheduled to avoid exposing the animals to lampricides before emergence. The presence of an endangered, threatened, candidate species, or species of special concern results in special considerations that are outlined in treatment permits.

Treatments are scheduled to prevent production of transformed larvae. Certain early embryonic life stages of lampreys are not as susceptible to treatment concentrations of lampricides. In streams where young-of-the-year larvae drift into lentic areas, treatments usually are conducted annually after the larvae have reached a susceptible life stage.

d. Sociological

Public use of the stream during treatment does not present a known health hazard, but many persons do not wish to be exposed to lampricide (Appendix P). Stream treatments are scheduled to reduce potential exposure by avoiding public events.

3. Planning and Notification

After streams are selected for treatment and approved by the GLFC, lists are sent to state, provincial, tribal, and cooperating agencies that have local jurisdiction (AOP:007) for concurrence. The recipients review and comment on the list of streams. Comments and concerns are considered during scheduling.

a. USFWS

Preliminary lists of streams considered for treatment are provided to Federal, state, and tribal agencies each year. Concurrence of these lists is acquired from agencies in whose jurisdiction applications of lampricides are planned. County departments of public health are also notified. In addition, hydroelectric facilities and media receive notice of treatment plans.

b. DFO

A number of contacts are made prior to the treatment season. These include Ontario Ministry of Environment and Climate Change (OMOE), Ontario Ministry of Natural Resources and Forestry (OMNR), New York State Department of Environmental Conservation (NYSDEC), Parks Canada, Ontario Parks, conservation authorities, Health Canada, First Nations, hydroelectric power corporations, media, municipalities, cooperating industries, Canadian Border Services Agency, and U.S. Customs.

4. Reporting

The partners sign a Memorandum of Agreement with the GLFC annually. This document lists the streams that the partners plan to treat during the field season. The partners also furnish reports at the end of each treatment season to GLFC and each of the Lake Committees (AOP:007).

a. USFWS

The USFWS collects data on mortality of non-target species during lampricide applications. A report that summarizes these data is provided to all states that request this information. In addition, a report may be issued to the USEPA to comply with the USEPA June 16, 1998 ruling of section 6(a)(2) of FIFRA.

b. DFO

Annual reports of treatment activities are sent to OMOE, OMNR, and NYSDEC. In addition, DFO reports any non-target mortality above FIFRA section 6(a)(2) thresholds to the registrant (USFWS).

II. Lampricide Application Procedures

A. Pre-application

1. Offsite Preparations

a. Notifications

(1) Jurisdictional Agencies

Federal, state, provincial, and tribal agencies again receive notification prior to lampricide treatment. A confirmation of dates of treatment is made to each agency by telephone or email. The local municipal water utilities are contacted if community water supplies might be affected by the lampricide treatment. In these instances, monitoring of the water supply may be requested by state authorities and conducted by personnel from the U.S. Fish and Wildlife Service.

(2) Media

Local media may be contacted prior to the proposed date of application (AOP:007 and AOP:010). Further arrangements can be made for media contact in the field.

(3) Power Utilities (Hydro-dams)

Authorities that regulate discharge and operate power (hydro) dams are contacted prior to treatment if the discharge from a power dam must be regulated to supply a stable flow or a specific discharge during lampricide application. The Federal Energy Regulatory Commission (FERC) largely governs discharge in the U.S.

(4) Riparians

Riparian water users are notified of intent to treat a scheduled stream. Examples of these water users include industrial (paper companies), residential (potable water users), agricultural (irrigators), recreational (canoe liveries), and commercial interests (bait dealers). Permission to access private property is obtained in person, by telephone, or by written correspondence before treatment.

b. Review and Planning

(1) Historic Treatment Information

Past treatment information is reviewed to estimate: (1) personnel, (2) time frame of the proposed treatment, (3) formulations and quantities of lampricides required, and (4) special considerations unique to the watershed. Historical

lampricide flow times and time of passage dye studies can be used to predict starting times of future applications at various points on the streams.

(2) Larval Assessment Data

Larval assessment data are reviewed to determine the distribution and abundance of sea lamprey larvae. This information is used to assure that treatment will cover all areas of significant infestation of sea lampreys. A stream map showing access roads, application points, and land ownership is available to treatment supervisors as part of the assessment package.

(3) Preliminary Treatment Plan

A preliminary treatment plan is prepared after review of assessment and historical data. The plan consists of a tentative treatment date, the personnel assigned to each treatment, quantity and formulation of lampricides, vehicles and types of equipment needed, and schedule of pre-treatment toxicity tests.

2. Onsite Preparations

a. Contacts, Site Preparation, and Security

(1) Access Permission

Measures taken to secure access permission are initiated in the office and continue on site. Certain situations require additional contacts including change or addition of application sites, change of property ownership, or completion of efforts to acquire access permission. Property owners are briefed on the proposed activities to occur on their property.

(2) Coordination with Consumptive and Non-consumptive Water Users and Cooperators.

The initial arrangements to coordinate lampricide treatments with water users on the stream are made prior to arriving on site; specific details are worked out just prior to, or during the application. Local water users are informed of lampricide treatment details, including time of application. All known agricultural irrigators are notified of an impending treatment at least 24 hours prior to

application. Irrigators are advised of their obligation to turn off their irrigation systems for a 24-hour period during and following the arrival of the lampricide block. Recreational users such as canoe liveries, and households using the stream for potable water, are advised of lampricide treatment plans and remedial action. Hydro-electric dam operators are again contacted to ensure that stream discharge can be regulated. Frequently, the application of lampricides at hydro-electric sites requires access and use of the site buildings. This also needs to be coordinated with the dam operators.

(3) Identification and Preparation of Application and Analysis Sites

Sites used for the application and analysis of lampricides are determined by on-site inspection. Signs are placed at acceptable sites to inform the public of impending applications (AOP:010). Considerations include ease of access to the stream, quantity of lampricide required, logistical placement of equipment, vehicle use options, and personnel safety. Potential sites for analysis are selected at a sufficient distance downstream of the application site that ensures homogenous lampricide concentrations.

(4) Security and Storage of Equipment and Lampricides

Safe storage of equipment and lampricides is a primary concern (AOP:008). Specialized locked trailers protect application equipment from the elements and the public. Lampricides are stored in a manner to prevent unauthorized access. At times, arrangements are made with other organizations or agencies to obtain secure storage.

b. Determining Physical, Chemical, and Biological Characteristics of the Stream.

(1) Physical

(a) Stream Discharge

Stream discharge must be determined to accurately set application rates of lampricides. Stream discharge in free-flowing streams is constantly changing; portions of the watershed may respond independently to recent rainfall or to lack of rainfall. Point-in-time data at critical sites can be

obtained either from on-site measurements, permanent gauge sites, or from known discharges at hydro-electric facilities.

Stream discharge data are obtained at selected sites by crews physically measuring (gauging) the stream discharge (TOP:001). In some cases, stream discharge estimates are done on small volume streams (<2 cfs). Staff gauges are placed at all gauging sites to correlate discharge measurements with stream level.

(b) Flow Time Estimates

The time for water to flow between two points on a stream (flow time) is a function of stream discharge. Time of passage estimates are determined by applying fluorescent dyes (Rhodamine WT or Uranine) and monitoring the time of travel between selected sites in the watershed (TOP:002) or by using historic flow data obtained in prior treatments. Estimates of flow time are used to schedule and coordinate lampricide application and monitoring.

(c) Dye Dilution Studies

The objective of a dye dilution study is to estimate the dilution of lampricides during treatments (TOP:003). Several situations require dye dilution studies to estimate decrease of lampricide concentration. These include lack of historical data, unusually low stream discharge, significant presence of physical impairments to flow, and braided stream channels.

(2) Chemical

Total alkalinity, pH, and temperature of stream water are known to influence the efficacy of lampricides. Therefore, water chemistry data are collected by the deployment of water chemistry monitors (TOP:004) and by hand-sampling. In addition, concentrations of dissolved oxygen and ammonia may be measured, particularly in watersheds with a history of agricultural contamination.

(a) Total Alkalinity

The toxicity of lampricides has been correlated with

the total alkalinity of water. Lampricides are more toxic to sea lampreys in waters of low total alkalinity. To predict appropriate treatment concentrations, it is necessary to measure the total alkalinity of stream water at selected sites in the watershed as well as the pH. Total alkalinity measurements are conducted according to methods outlined in TOP:005.

(b) Water pH

Lampricides are ionizable phenols, so the apparent toxicity of the chemicals is greatest where the neutral form predominates (low pH). Therefore, measurement of pH is necessary to determine application rates (TOP:006).

Frequently, stream waters exhibit daily fluctuations in pH that result from photosynthesis and respiration by biota in the stream or in impounded waters draining into the stream. Presence of a daily pH cycle may influence treatment delivery. Measurements of pH are made at selected sites in a watershed to provide a record of stream water pH.

(c) Temperature

Stream water temperatures are recorded routinely, although they are not generally considered critical in planning lampricide applications. Application time may be extended at low water temperatures (2-5° C) when applying TFM; treatments are not as effective at stream temperatures less than 2° C. Bayluscide is not recommended for use if stream temperatures are less than 3° C. Treatments at higher temperature may result in increased non-target mortality.

Temperature is considered when measuring pH, dissolved oxygen concentration, and the concentration of ammonia in stream water. Measurements are made in °C with a thermometer or pH meter equipped with a temperature probe.

(d) Dissolved Oxygen

Dissolved oxygen concentrations are affected by

photosynthesis and respiration by the biota in the stream and may influence the general health and resistance of animals in a stream. Oxygen concentrations fluctuate to some extent in most streams; depressed concentrations of dissolved oxygen may affect treatment efficacy.

Treatment crews use oxygen meters to measure dissolved oxygen concentrations (TOP:008). Particular attention is paid to the measurement of concentrations of dissolved oxygen in waters downstream of impoundments, wastewater facilities, agricultural areas, areas of rooted aquatic macrophytes, and lentic areas. Low concentrations of dissolved oxygen may cause deferral of a lampricide treatment.

(e) Ammonia

Although concentrations of ammonia rarely reach a level considered a threat to non-target species, certain situations warrant monitoring. If the pH of stream water does not exceed about 8.3, especially in cool waters, the percent of toxic, un-ionized ammonia is usually too low to offer a significant additive toxic effect. Analyses are completed in areas with potentially high ammonia concentrations. These include areas of heavy agricultural use, areas downstream of feed lots or sanitation disposal facilities, and slow-moving stretches of stream with low dissolved oxygen concentrations. Ammonia nitrogen is quantified according to (TOP:009).

(3) Biological

(a) Toxicity Testing

Pretreatment toxicity tests may be conducted to verify the minimum lethal concentrations of lampricides required for effective treatment (TOP:010). Priority for conducting toxicity tests is given to streams being treated for the first time, streams with a history of non-target mortality, or streams with water quality that may affect the efficacy of lampricides. In situations of intense public interest or sensitive environmental concerns, or when certain species of concern are present, tests

may be conducted as a precautionary measure.

Results from toxicity tests are interpreted to provide estimated Minimum Lethal Concentrations (MLC) and LC25s (lethal concentrations producing 25% mortality) of non-target test organisms. The results are compared with values for corresponding pH and total alkalinity levels in lampricide prediction charts (Appendix I).

c. Planning Treatment Strategy

Analysis and interpretation of pretreatment data is used to develop a treatment strategy which includes setting lampricide concentrations, determining the timing of lampricide applications, and scheduling personnel and use of equipment.

(1) Setting Lampricide Concentrations

(a) MLC and SMLC

MLC is the concentration of lampricide that produces 99.9 percent mortality among sea lamprey larvae during a 9-hour exposure for a given water chemistry. However, in stream applications the MLC will vary because of changes in water chemistry that occur throughout the watershed. The SMLC is the lowest concentration of lampricides determined by the treatment supervisor to provide an effective treatment over the range of expected water chemistries in a treatment area. Water chemistry may vary widely throughout a stream system. Therefore, SMLC values vary temporally and spatially, and multiple SMLC values may be needed to conduct a single treatment.

The pH/alkalinity prediction charts (Appendix I), data collected during toxicity tests, and water chemistry determinations are used to set treatment SMLCs. In addition, adjustments for seasonal variations in toxicity may be made.

(b) MAC and SMAC

MAC is based on the brown trout LC25 value from the pH/alkalinity prediction chart (Appendix I). At concentrations approaching or exceeding MAC,

non-target mortality may occur with increasing frequency. The SMAC is determined before application of lampricides and is the estimated maximum concentration of lampricide that may be applied to a stream. Typically stream application concentrations range from 1.0 to 2.0 times the MLC and are below SMAC.

Similar to SMLCs, multiple SMACs may be necessary for a treatment. These values are set by the treatment supervisor after consideration of the stream pH and prediction charts (Appendix I), the non-target species present and their inherent sensitivity to lampricides, and the results of on-site toxicity tests. Endangered, threatened, or candidate species are afforded special consideration (TOP:011 and TOP:011B). An example of a species that is afforded special consideration is the lake sturgeon.

(c) Application Concentrations

Application concentrations are the concentrations of lampricides metered into the stream at specific sites. The object of the treatment is to maintain SMLC throughout the treatment area. Discharge, water chemistry, dye study data, and historical treatment information are used to set the application concentrations.

(2) Determining Length and Timing of Lampricide Applications

Application time is normally 12 hours, but may be adjusted to assure 9 hours or more of SMLC at downstream sites. Applications of 24 hours may be considered for streams with significant diurnal pH cycles, and blocks longer than 12 hours may be applied to counter seasonal variations in sensitivity of sea lampreys. Concentrations of lampricides decrease as the treatment block travels downstream. The concentration loss depends on changes in stream discharge, the distance traveled by the lampricide block, and stream morphology. Historical data at similar stream discharges can help to estimate the application period required.

Timing of applications is an important part of treatment planning. In single application treatments, timing is often based on convenience and applications begin during normal

working hours. As the complexity of the treatment increases, maintenance and supplemental applications are scheduled to assure the convergence of lampricide blocks and to maintain SMLC throughout the stream.

(3) Scheduling Personnel and Use of Equipment

Efficient use of manpower and equipment is necessary during stream treatments. Personnel are allocated to priority application and analysis duties until all duties are assigned. Generally, two shifts of application personnel are required for each site. In addition, analysis shifts are scheduled with all applications. When several applications take place concurrently, more than one person may be assigned per analysis shift. A treatment may be canceled if personnel shortages are critical.

(4) Projected Lampricide Needs

The quantity of lampricide needed at each application site can be projected by converting the application metering rate (Appendix J) to volume of lampricide applied per hour, then multiplying by the total hours of application. The total volume of lampricide then is divided by the volume of a TFM container to give the projected number of containers needed. Additional containers (20-25 percent of the projected total) usually are taken to the application site to allow for significant increases in application rates.

B. Application

After necessary preparations for treatment are completed, activities of field personnel shift to carrying out the treatment plan. Once applications begin, the focus of all activities is on maintaining lampricide concentrations between the SMLC and SMAC and assuring effective treatment in the stream.

1. Lampricide Applications

The locations and times of applications are set to effectively cover the treatment area. The types of applications and formulations used are tailored to effectively treat streams, backwaters, and lentic areas.

a. Primary and Maintenance Lampricide Applications

Primary and maintenance applications are made with TFM or a mixture of TFM and Bayluscide. The types of applications are differentiated by the locations at which they are conducted.

Primary applications are the initial applications on any infested tributary, whereas maintenance applications (boosts) are made into existing lampricide blocks. Maintenance applications are required to prevent the concentrations of lampricides from decreasing to less than SMLC, and to allow primary applications at lower concentrations. The procedures and equipment used differ with the type of application and formulation of lampricide applied (TOP:012, TOP:013).

b. Supplemental Applications

Supplemental applications are conducted in backwater areas and in low-discharge tributaries to eliminate lampreys and to prevent escape of lampreys from treatments in larger tributaries. Supplemental applications are made either with liquid or bar formulations of TFM or a combination of both, or with Bayluscide 3.2% Granular Sea Lamprey Larvicide.

(1) TFM

TFM liquid formulation is sprayed onto slow-moving waters and isolated backwaters that are not effectively treated by lampricides from primary and maintenance applications. Procedures for conducting spray applications of TFM liquid formulation are outlined in TOP:014.

(2) TFM Bar Formulation

Bars of TFM are applied to low-discharge, flowing tributaries when application of liquid TFM is not practical. Procedures for application and control of concentration are outlined in TOP:015.

(3) Bayluscide 3.2% Granular Sea Lamprey Larvicide

The granular formulation of Bayluscide is occasionally applied as a supplemental means of eliminating lampreys in limited areas where TFM liquid formulation may not be effective. Procedures for the application of Bayluscide 3.2% Granular Sea Lamprey Larvicide are described in TOP:017.

c. Primary Applications of Bayluscide 3.2% Granular Sea Lamprey Larvicide

Bayluscide granules are applied as a control measure in areas where standard application techniques and other formulations of

lampricide are not effective. Applications are conducted in lentic and lotic areas in the Great Lakes, Lake Champlain, and the Finger Lakes, vary in size, and may cover many acres (TOP:017 and TOP: 017A).

2. Analysis of Lampricides and Concentration Adjustments

The concentrations of lampricides in stream water are monitored from the time of application until the lampricide block passes through the treatment area. The methods of measuring concentrations of lampricide and controlling rates of application are termed "analysis" procedures.

a. Duties of Analysis Personnel

Selected personnel from each treatment crew are trained to measure the concentrations of lampricides in stream water and to assess the progress and efficacy of an ongoing treatment. These personnel, after sufficient experience, are given the responsibility of controlling the applications of lampricides during a treatment. The procedures followed by analysis personnel are outlined in TOP:018, and TOP:021. In addition to monitoring and controlling concentrations of lampricides, total alkalinity is measured at least once during each analysis shift and pH is recorded at regular intervals to provide a record of stream water chemistry. Sampling frequency may be increased if conditions warrant.

b. Monitoring Progress of Lampricide Block

The concentrations of lampricides are measured at application sites and monitoring sites throughout the length of a stream treatment. Monitoring activities assure that safe, effective concentrations of lampricides are maintained throughout targeted treatment areas. Samples of stream water are collected by hand or by automatic water samplers (TOP:022).

3. Adjustments to Treatment Plan

A treatment plan is a basic framework for applications of lampricides and supporting activities. Variables in nature and other unexpected complications usually produce the need for subtle to significant adjustments in the plan as a treatment progresses.

a. Unscheduled Maintenance Applications

Stream conditions may necessitate additional applications to compensate for unanticipated loss of concentrations of lampricide. These conditions include unexpected increases in stream discharge

due to rainfall or water releases from impoundments; failure to maintain desired concentrations of lampricide at primary application points; failure to effectively merge blocks of lampricide; stream/ground water exchange; unexpected increases in pH or alkalinity; and excessive losses of concentration in pools, riffles, marshes, braids, or ponds.

b. Adjustments to Timing of Applications

The starting times of applications often are adjusted in response to progress of a treatment. Adjustments may result from changes in time-of-flow due to variations in discharge; delays in starting upstream applications; and changes of arrival time, length, and concentration of the lampricide block.

c. Adjustments to Target Concentrations of Lampricides

Target concentrations of lampricides may be adjusted at application points. The changes may be made to compensate for variations in discharge, water chemistry, loss of concentration in the lampricide block, and unexpected mortality in non-target species.

d. Cancellation or Termination of Treatment

The decision to cancel or terminate a treatment may be made by the treatment supervisor or a shift supervisor. Reasons for canceling a treatment include extremely high or low discharge; water chemistry outside of the safe working range; presence of contaminants; excessive non-target mortality; equipment failure; unsafe working conditions; and serious conflicts with private, public, or government interests.

4. Supplemental Activities

Several peripheral activities may be conducted to support lampricide applications. These activities help assess and document treatment efficacy.

a. Biological Surveys

Biological surveys are routinely conducted during a treatment and after the lampricide block has passed in order to assess treatment effectiveness, verify sea lamprey distribution and age class structure where assessments are questionable, or document non-target mortality. Typically, staff walk a stream and collect organisms using scap nets (Fyke nets are not recommended). Non-

target organisms are identified to species and sea lampreys are counted and measured. Survey types and detailed procedures are contained in TOP:029.

b. Caged Animal Assays

Sea lamprey larvae and non-target animals may be placed in cages at selected sites within the treatment area and at an untreated control site to assess the safety and effectiveness of a treatment. Mortalities of each species are counted and recorded after passage of the lampricide block.

c. Data Processing

Field data are processed and summarized in a computer database. Some data are transcribed from forms to temporary files on computers in the field (TOP:024). All data are eventually entered into permanent files at stations in Marquette, Ludington, Sault Ste. Marie, and Essex Junction. These data are available for reports and for reference during future treatments. Methods of records management are outlined in AOP:011.

C. Post application

Post application procedures may include the collection of water samplers, measurement of lampricide concentrations in water samples, and the collection and analysis of samples of water from municipal water intakes. Biological observations including surveys of lamprey and non-target mortality may continue after the treatment, and the results of caged animal assays are tabulated. Clean-up procedures are completed at application sites, and equipment and empty lampricide containers are packed for transport. Disinfection of equipment is conducted according to TOP:028.

III. Public and Environmental Safety

The public and environmental safety program complies with the requirements of the lampricide labels (Appendix E) and SDS (Appendix F) in a practical and effective manner. The program also complies with additional restrictions and precautions to assure the safe use of lampricides.

A. Preliminary Measures - Notification

Government agencies and the public are notified of planned treatments through several avenues to allow adequate time for questions, comments, and revisions of the treatment schedule.

1. Government Agencies

Notification may be furnished to departments of Public Health and Natural Resources of each Federal, state, province, county, municipality, tribe, or First Nation in whose jurisdiction lampricide applications are planned. The preliminary notification occurs prior to the field season so each department can respond with approvals or specific requests. Agencies may be notified again before each application.

2. Media

Notices may be sent to newspapers and to radio and television stations in the treatment area. Examples of press releases are presented in Appendix L. Personnel may participate in interviews for radio and television stations and for newspapers. The interviews inform the public of treatment operations and make the public aware of the applications of lampricides.

3. Public Outreach

Informational programs on sea lamprey control are presented to numerous groups throughout the year. Presentations are made to sporting groups, service organizations, schools, and all interested parties. Thousands of individual contacts are made through this approach annually. The talks and accompanying videos detail all aspects of the program including details on lampricide safety (Appendix P).

B. Pretreatment Measures

Measures designed to ensure public and environmental safety during a treatment for sea lampreys begin before the application of lampricides. Procedures followed immediately before lampricide applications are outlined below.

1. Transport and Storage of Lampricides

Lampricides are transported from the storage facility to the base of operations in enclosed vehicles. All vehicles used to transport lampricides are supplied with a list of emergency telephone numbers and a contingency plan (Appendix D) that outlines emergency procedures to be used in case of an accidental spill. Also, each vehicle is supplied with a spill kit that contains chemically absorbent materials, and is equipped with a two-way radio to allow rapid communication if a problem occurs.

2. Riparian Contacts

Efforts are made to notify known irrigators and other riparian users of stream water of treatment schedules at least 24 hours in advance of treatment. Considerable time is spent locating irrigators. Lists of

irrigators are maintained to assure timely notification. Water users are advised not to take water from the stream while the lampricide block passes. Irrigators are advised of their obligation to cease irrigation for a 24-hour period during and following passage of the lampricide block. Progress of the lampricide block is closely monitored to verify estimates of time-of-passage and to allow notification of changes to irrigators.

3. Toxicity Testing

Toxicity tests may be conducted before stream treatments to assure that appropriate concentrations of lampricides are applied. Toxicity test procedures are described in TOP:010.

4. Setting Lampricide Concentrations

Treatment strategies devised by the Sea Lamprey Control Board's Lampricide Control Task Force require applying the least lampricide needed to effectively treat a stream. Applying the lowest effective concentration of lampricide minimizes effects on non-target organisms.

C. Treatment Measures

Attention to safety issues continues throughout all applications of lampricides. Specific measures taken during treatments are outlined below.

1. Treatment site

Contact by the public with concentrated lampricide is prevented by restricting access to application sites. Few lampricide containers are open at any time and open, empty containers are triple rinsed (or equivalent) and returned to the transport vehicle. All applications are conducted under direct supervision of a certified pesticide applicator.

Field personnel working on a stream are engaged in a high-profile activity that results in contact with the public. Personnel provide information on the use and safety of lampricides to hundreds of individuals each year through distribution of informational publications (Appendix P). A listing of standardized statements is provided as a training aid to assure that the public receives correct information in response to inquiries (Appendix T). If persons require more information, they are contacted by a treatment supervisor.

Protective equipment and safety procedures as described in the pesticide labels (Appendix E) and SDS (Appendix F) are provided to all applicators. Equipment includes chemical splash goggles, hip boots, rubber gloves,

and a chemical protection apron. Smoking, eating, and drinking are not permitted near open lampricide containers or when wearing contaminated protective clothing.

Personnel are prepared for accidental spills of lampricide and follow procedures in Appendix D. Any contamination is cleaned and disposed of according to label requirements.

2. Stream

Although in-stream concentrations of lampricides have been shown to pose no adverse health effects, treatment personnel inform people who inquire that a stream treatment is in progress and caution them about potential exposure. Warning signs (Appendix O) may be placed at known public access sites.

The lampricide block is closely monitored to assure that prescribed concentrations are maintained, and care is taken to monitor mortality of non-target organisms during each treatment. Applicators and analysis personnel routinely watch for signs of stress in non-target species (TOP:029). Indications of stress in non-target organisms may result in reevaluation of the treatment plan. Observations of mortality in non-target organisms may result in an immediate investigation (Appendix W Flowchart for Response to Fish Mortality Concurrent with Lampricide Treatment; TOP: 026).

3. Municipal Water Supplies

Municipal water supplies are monitored upon request for the presence of lampricides (TOP.023). Managers at municipal intakes without carbon filtration systems are notified immediately if lampricide is detected, so remedial actions can be initiated. Results of monitoring efforts are reported to supervisors of water treatment plants and state health authorities. Monitoring may be required after treatment of a stream or following the application of Bayluscide 3.2% Granular Sea Lamprey Larvicide in the vicinity of a municipal intake.

D. Post treatment Measures

Dissemination of information to assure public and environmental awareness continues throughout the year. Reports on treatment activities in each lake drainage are prepared for representatives of jurisdictional agencies bordering the Great Lakes, and other interested parties. Non-target surveys are conducted according to TOP:029. Information on effects of treatments to non-target organisms in Michigan and New York tributaries are detailed in an annual report to the Michigan Department of Environmental Quality (MDEQ) or NYSDEC. Information on effects of treatments on non-target organisms and lampricide use

in the province of Ontario is provided to the OMNR, OMOE. Reports of effects on non-target organisms are submitted to the USEPA in compliance with section 6(a)(2) of FIFRA (AOP:007).

Treatment records are kept for at least 2 years to comply with Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Section 11 and 26(c).

| Revision No. | Date | Person(s) Responsible | Description |
|---|---|---|---|
| 1.12 | 1/24/22 | Benson Solomon | Update MBS Address and all AOP, TOP, IOP #s, add citation section, FIFRA statement |
| 1.13 | 1.22/23 | Benson Solomon | Update relevant SOP numbers |
| 1.14 | 3/4/24 | Benson Solomon | Update members, update relevant SOPs, remove WP |
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