SEA LAMPREY CONTROL BOARD RESEARCH PRIORITIES

The Sea Lamprey Control Board has identified these research priorities as critical research needs to understand and improve the control of sea lamprey in the Great Lakes. Investigators are encouraged to use this list to develop research ideas. The research priorities addressed by a proposal are considered during proposal evaluation.

Note: This is an unranked list of research needs.

Larval Assessment (*updated October 2025)*

1. **Where is the natal origin of an adult sea lamprey?**
    - The Larval Assessment Task Force is interested in determining which specific stream, channel, or lentic area an adult sea lamprey lived in as a larva. This has long been a top priority for the Sea Lamprey Control Program as indicated by the references below and would inform future research and control efforts.
    - See: Lochet et al 2014, Waldman et al 2008, Howe et al 2008, Mateus et al 2021
2. **How are biotic and abiotic factors influencing the survival and growth of larval sea lamprey?**
    - Broadly, the Larval Assessment Task Force is interested in understanding population dynamics of larval sea lamprey and how environmental factors contribute to larval production, growth, and survival. These factors could be biotic (density, predation, food availability) and/or abiotic (water quality, stream substrate, seasonal effects, and extreme weather).
    - Several key focus areas include:
        - Understanding how changing environmental conditions will affect survival and growth of larval sea lamprey.
        - Understanding why control of larval sea lamprey in Lake Superior streams has not resulted in the same reduction of adult sea lamprey as observed in other lakes.
        - Understanding the environmental conditions that bring about a mismatch in spawning run size and larval densities. In particular, the Humber River (Lake Ontario) provides an interesting study system, as it supports a large spawning run, however, reproduction has been extremely low or nonexistent.

- Understanding survival and growth of lentic populations of larval sea lamprey, see Johnson et al 2016.

3. **What techniques can be used for improved assessment of larval sea lamprey density and habitat?**

- Accurate density estimates and habitat quantification are essential for calculating the stream populations of larval sea lamprey used in determining control efforts. The Larval Assessment Task Force is interested in novel techniques or improvements to existing techniques that could be used at sites with low population densities or at sites that are hard to access. Currently, the Sea Lamprey Control Program uses electrofishing and granular Bayluscide for larval assessment.

- The Sea Lamprey Control Program is also interested in techniques for estimating available larval lamprey habitat. Currently, habitat quantification requires labor intensive transect and flow measurements, see LATF 2016, Slade et al 2003. The Program is looking for more efficient methods.

Lampricides *(updated October 2024)*

1. **What factors impact lampricide treatment effectiveness and contribute to the survival of sea lamprey larvae following a lampricide treatment (i.e., residuals)?**
   - Identifying sources of larvae that survive or avoid exposure to lampricide treatments (also known as residuals), in both lentic and lotic lampricide treatments (TFM, TFM/niclosamide, granular Bayluscide), remains a critical knowledge gap for the Sea Lamprey Control Program.
   - An improved understanding of how biological and environmental factors contribute to residuals would inform treatment supervisors on how to achieve more effective lampricide treatments. Factors could include larval sea lamprey behavior (such as escapement), water quality (pH, temperature, alkalinity), and seasonal effects and climate change, as it relates to treatment efficacy.
   - While no evidence of lampricide resistance has been detected, it is critical for the program to understand the possible physiological mechanisms of resistance for both TFM and niclosamide. Further research on the development of tools to efficiently screen for resistant individuals using bioassays or molecular approaches is also needed.
     - See: Dunlop et al. 2021
   - See Mcdonald and Kolar 2007, Sullivan et al 2021; Hlina et al. 2017; Schueller et al. 2024

2. **What novel lampricides can be developed for effective sea lamprey control?**
   - The control program is keenly interested in developing novel lampricide formulations that maintain or improve treatment efficacy and selectivity. New lampricides need to be environmentally compatible and have the potential to meet regulatory standards in both U.S. and Canada.
   - Research on how unique physiological, ecological, and biological vulnerabilities of sea lamprey could be exploited to develop new lampricides is strongly encouraged.
   - See Wilkie et al. 2019, Birceanu et al. 2021, Borowiec et al. 2021.

3. **What are the effects of lampricides on non-target organisms, including physiological effects to individuals as well as population level effects?**
    - Understanding how lampricides affect non-target organisms remains a key priority for the Sea Lamprey Control Program and Lampricide Control Task Force. Current species of concern to the Sea Lamprey Control Program include, but are not limited to, mudpuppies, native lamprey, native mussels, and any state/provincial or federally listed aquatic species.
    - Research that determines the underlying physiological mechanisms of toxicity and tolerance in species would be highly beneficial for better predicting how non-target species will respond and recover from lampricide exposure and would inform treatment protocols to minimize negative effects.
    - Information on population levels, pre- and post-treatment, would also be useful to the program (including modeling, genetics, etc.) Research in this area would lead to a better understanding of long-term and population level effects.
    - See Kaye 2021, Pratt et al. 2021.

Trapping *(updated October 2023)*

1. **What factors influence encounter rates for adult sea lamprey at traps and how can those factors be used to improve encounter and entrance into traps?**
    - Adult sea lamprey are captured using traps at migratory barriers for purpose of population assessment but encounter and entrances rates are unsatisfactory at many sites. Results would be used to improve or alter sea lamprey trap design and placement in barrier blocked streams where traps are used.
    - See McLaughlin et al. 2007, Miehls et al.2020.

2. **What biological, behavioral, and environmental factors or phenotypic traits be exploited to capture and remove downstream migrating sea lamprey?**
    - Currently, newly metamorphosed migratory sea lamprey are not targeted for control or assessment due to a lack of knowledge about behavior during downstream migration and a lack of effective means of capture for juveniles that typically migrate in fall and spring during periods of high flow and often high debris loads.
    - The task force is interested in information that will help with conception, design, and testing methods to effectively capture and remove downstream migrating juvenile sea lamprey.
    - See Evans et al. 2021v for review of current state of knowledge of downstream migratory life stage.

3. **What behaviors could be exploited, or methods/technologies could be used to enumerate or capture adult sea lamprey in large open river systems without barriers?**
    - Currently, adult sea lamprey are not targeted in large open river systems because capture success is low without migratory barriers to concentrate the lamprey and it thus is not cost-effective.
    - The SLCP is interested in innovative ideas to enumerate or capture adult sea lamprey in open river systems. Information that will help with conception, design and/or testing of new methods is also critical to the program needs.
    - See McLaughlin et al. 2007, Miehls et al.2020.

Barriers *(updated October 2023)*

1. **What factors influence connectivity decisions (barrier removal, construction, and modification), including social, cultural, economic, and biological factors?**
    - Often natural resource agencies struggle to reach mutual goals and objectives when balancing stream connectivity with invasive species management, specifically sea lamprey in the Great Lakes. While the economic costs of barrier removals are well known, other factors that impact the decision-making process are less understood, including social, cultural, and biological factors. These factors may vary temporally, spatially, and between stakeholders and managers. The SLCP aims to understand the decision process of barrier owners and other agencies when determining actions related to connectivity. This information will be used to inform SLCP investment and communication strategies when engaging partners in efforts to reach the best decision for overall stream health and invasive species management.
    - See Hrodey et al 2021, Walter et al 2021, Miehls et al.2020, and Bellmore et al 2019.

2. **What hydraulic and hydrologic characteristics of barrier/fishway designs most effectively facilitate passage needs, exploiting the natural behavior and motivation of sea lamprey and non-targets (native non-jumping species)?**

3. **What are the future effects of climate change (extreme weather events) and geomorphology changes on sea lamprey barrier efficacy?**
    - The SLCP is interested in understanding how climate change and associated variation in geomorphology will impact sea lamprey barrier effectiveness, as the influence of current and future stream geomorphic characteristics on sea lamprey barrier performance is not well understood. Research to address this question would focus on changes in physical river conditions and barrier stability associated with more frequent extreme weather events, as well as physiological and behavioral changes in adult sea lamprey.
    - The SLCP would benefit from the ability to predict barrier failures and sea lamprey escapements and identifying strategies or technologies to prevent or mitigate such events.

<u>FishLamp:</u>

1. What is the lethality of lamprey attacks on hosts (salmonines, burbot, coregonines) and what factors determine lethality?

2. How do sea lampreys locate, select, and attach to hosts (salmonines, burbot, coregonines) in the lake?

3. What is the relationship between localized larval sea lamprey production and the distribution of parasitic juveniles in the lake?

4. What proportion of recently metamorphosed sea lampreys survive to feed, and what proportion of parasitic juveniles survive to spawn?

<u>Other:</u>

1. What is the mechanism for the stock recruitment relationship and how is it influenced by adult and larval habitat?

2. How do adult sea lamprey distribute themselves to spawning habitat (from the lake to stream)?