**Pacific and River Lamprey –DRAFT**

**BDCP Logic Chains for Covered Fish Species**

***Note to Reviewers:***

*The following presents a draft set of straw BDCP biological objectives for steelhead. Per the recommendations of the independent science review panel, the objectives have been structured to address specific stressors as identified in existing documents such as existing recovery plans, biological opinions, and/or DRERIP life history conceptual models. A standardized table is used for each objective to provide specificity regarding the objective. Terms used in the table such as “Indicator” and “Attribute” are defined in Attachment 1. Additional components of the logic chain such as expected outcomes, conservation measures, and monitoring metrics are not presented herein. However, portions of the objective table are specifically intended to provide information relevant for these additional components. Efforts to link specific species objectives to broader natural community objectives and ecosystem objectives will be conducted once the species objectives have been reviewed and finalized.*

***Disclaimers:***

1. *Some of the objectives presented herein are hypothetical. These objectives are introduced to stimulate further discussion.*
2. *The Global Goals and Global Objectives presented below are not BDCP goals and objectives. BDCP will contribute to the achievement of these global goals and objectives.*

**Table of Contents**

[Global Goal 1](#_Toc275521364)

[Global Objectives 1](#_Toc275521365)

[Stressors/Limiting Factors 2](#_Toc275521366)

[Stressor #1: Passage Impediments/Barriers 3](#_Toc275521367)

[Stressor #2: Habitat Loss and Modification 4](#_Toc275521368)

[Stressor #3: Predation by Non-Native Species 5](#_Toc275521369)

[Stressor #4: Flow Alterations 6](#_Toc275521370)

[Stressor #5: Entrainment 7](#_Toc275521371)

[Stressor #6: Water Quality (Toxics and Temperature) 8](#_Toc275521372)

[Stressor #7: Dredging. 9](#_Toc275521373)

[References 10](#_Toc275521374)

[Attachment 1: Objective Worksheet 11](#_Toc275521375)

# Global Goal

Maintain and restore river lamprey (*Lampetra* *ayresii*) and Pacific lamprey (*Lampetra tridentate*) population distribution and abundance to higher levels than present (CALFED 2000. FWS 2009).

# Global Objectives

Implement actions known to benefit lampreys, to minimize threats to their existence, and improve understanding of them in order to recover their abundance and distribution (FWS 2009).

Stressors/Limiting Factors

The following stressors/limiting factors were adapted from the United States Fish and Wildlife Service (FWS) Draft Conservation Plan for Pacific Lamprey (2009).

|  |  |  |
| --- | --- | --- |
| ***ID*** | ***Stressor*** | ***Summary Description*** |
| **Stressors Addressed by BDCP** | | |
| **1** | Passage impediments/barriers. | Factors that reduce or eliminate access to key habitats necessary to complete all or some components of life history stages. |
| **2** | Habitat Loss and Modification | Changes in the extent, access to, and or quality of key natural habitats for specific life history stages. |
| **3** | Predation by non-native species | Competition, predation, or alteration of habitat characteristics from non-native invasive species. |
| **4** | Flow alterations | Rapid changes in flows and water levels affecting rearing habitat and outmigration success. |
| **5** | Water quality (toxics and temperature). | Water quality conditions affecting migration, growth rate, and reproductive success. |
| **6** | Dredging | Effects associated with physical disturbances of substrates from dredging activities used for rearing. |
| **Stressors Not Addressed by BDCP** | | |
| **7** | Disease | Disease may influence lamprey health with effects on reproduction and survival. |
| **8** | Ocean conditions | Reductions in the availability of host/food species may be affecting lamprey survival and growth. |

### Stressor #1: Passage Impediments/Barriers

Artificial barriers can impede upstream migrations by adult lampreys and downstream movement of ammocoetes and macropthalmia (FWS 2009). Many fish ladders, traditional spill gates and culverts do not effectively pass lampreys (FWS 2009). Pacific lamprey populations persist for only a few years above impassable barriers before dying out (FWS 2009).

**BDCP Objective #1**

Identify impediments/barriers to upstream adult passage and implement lamprey specific passage and protection measures.

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| --- | --- |
| **Relation to Global Objective** | Elimination of passage barriers will have positive effects on:   * Abundance * Productivity * Spatial distribution |
| **Indicator** | Immigration success |
| **Location** | BDCP Planning Area |
| **Attribute** | * Immigration rate * Immigration success |
| **Quantity or State** | Increase immigration rate/success by \_\_%. |
| **Time Frame** | Within 10 years of permit issuance. |

### Stressor #2: Habitat Loss and Modification

Confining flood flows in reservoirs and between levees has caused the loss of natural hydrologic and geomorphic processes (NMFS 2009). Habitat for fish and wildlife has been lost or severely degraded as a result of loss of natural processes (USACE and Reclamation Board 1999; USDI *et al.* 1999). Channelization of Delta waterways has altered significant areas of channel margin habitat. Many age classes of ammocoetes in stream substrates can be affected by channel alterations by reducing or eliminating areas for spawning and ammocoete rearing (FWS 2009).

**BDCP Objective #2.**

Restore and/or enhance lamprey rearing habitat.

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| --- | --- |
| **Relation to Global Objective** | Enhancing rearing habitats will improve the productivity of lampreys. |
| **Indicator** | Channel margin riparian habitat |
| **Locations** | * Steamboat and Sutter sloughs * San Joaquin River (between Vernalis and Mossdale) |
| **Attribute** | Extent and quality of riparian and channel margin habitat |
| **Quantity or State** | Create and/or enhance \_\_\_ miles of channel margin habitat. |
| **Time Frame** | Within \_\_\_ years of permit issuance. |

### Stressor #3: Predation by Non-Native Species

Nonnative fishes such as bass, sunfish, walleye, striped bass, and catfish, among others prey upon lampreys (FWS 2009). Modification of natural channel margins and riparian habitats, colonization of non-native SAV and FAV, as well as artificial instream structures may change the natural predator-prey dynamics favoring predators (NMFS 2009).

**BDCP Objective #3**

Reduce predation of lamprey by non-native predators.

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| --- | --- |
| **Relation to Global Objective** | Reducing predation of lampreys by non-native predators will increase the abundance and productivity. |
| **Indicator** | Predation |
| **Location** | BDCP Planning Area |
| **Attribute** | Predation rates |
| **Quantity or State** | Reduce predation rates by \_\_% from pre-permit levels. |
| **Time Frame** | Non-native lamprey predator population targets will be achieved within \_\_\_years of permit issuance. |

### Stressor #4: Flow Alterations

Fluctuations in reservoir and stream water levels, irrigation diversions, and stream dewatering can strand ammocoetes in the substrate (FWS 2009). A single event can have a significant effect on a local lamprey population (FWS 2009). Restoration efforts targeting other species, such as Pacific salmonids (channel reconstruction projects), can result in rapid and sometimes extensive dewatering of existing channels and negatively impact lamprey populations (Luzier et. al. 2009).

Downstream movement of juvenile lampreys happen year round (Luzier et. al. 2009). Due to poor swimming ability movement is probably driven by flow conditions and velocities (Moursund 2002). Juvenile lamprey travel time is related to water particle travel time, increases in freshet flows will likely reduce lamprey travel time (Nez Perce et. al., 2008). Thus, managing flows to a peaking hydrograph will benefit juvenile lamprey as well as juvenile salmon (Nez Perce et. al., 2008).

**BDCP Objective #4**

1. Reduce stranding of lamprey ammocoetes.
2. Maintain flow conditions that facilitate outmigration of juvenile lampreys.

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| **Relation to Global Objective** | Reducing stranding occurrences of lamprey ammocoetes and facilitating outmigration of juvenile lamprey will:   * Increase productivity; * Increase abundance. |
| **Indicator** | In Delta hydrodynamics. |
| **Location** | BDCP Planning Area |
| **Attribute** | Flows and Hydrodynamics   * River flow * Net flows * Gate and diversion operations |
| **Quantity or State** | Provide flow conditions to eliminate the risk of lamprey ammocoete stranding and facilitate outmigration of juveniles in all water year types. |
| **Time Frame** | TBD |

### Stressor #5: Entrainment

Downstream migrating macropthalmia may be entrained in water diversions or turbine intakes and due to their size and weak swimming ability, they are often impinged on the diversion and intake screens resulting in injury or death (FWS 2009).

**BDCP Objective #5**

Reduce entrainment and impingement of lamprey.

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| --- | --- |
| **Relation to Global Objective** | Reducing direct and indirect mortality associated with entrainment and salvage will have positive effects on:   * Abundance * Productivity |
| **Indicator** | Entrainment numbers and mortality rates. |
| **Location** | Power plants and water diversions within BDCP planning area. |
| **Attribute** | Entrainment rates   * Mortality * Occurrence |
| **Quantity or State** | * Entrainment rate ≤ \_\_% of total Pacific lamprey population. * Entrainment rate ≤ \_\_% of total River lamprey population. |
| **Time Frame** | Within \_\_\_ years of permit issuance and maintained annually thereafter. |

### Stressor #6: Water Quality (Toxics and Temperature)

Ammocoetes are relatively immobile in the stream substrates and tend to concentrate in areas that include many age classes making them susceptible to chemical spills or chemical treatment (rotenone) targeting other species (FWS 2009). They spend 3-7 years filter feeding and accumulate chemicals such as PCB’s, mercury and other heavy metals (FWS 2009). Accumulated toxins in the lower reaches of streams/rivers may affect ammocoetes because they are often found in these areas (FWS 2009).

Water temperatures of 72°F (22°C) may cause significant death or deformation of eggs or ammocoetes (FWS 2009).

**BDCP Objective #6**

Reduce levels of ammonia, organophosphate, pyrethroid pesticides and copper in the Delta to levels below the olfactory effect threshold.

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| **Relation to Global Objective** | Improvements in key water quality parameters will positively effect:   * Spatial extent of key life stages through the elimination of water quality barriers to migration. * Abundance * Productivity * Life history/genetic diversity maintenance (restoration) |
| **Indicator** | Water quality parameters. |
| **Location** | Key migratory corridors |
| **Attribute** | * Concentration (µg/L) of;   + ammonia,   + pyrethroids,   + copper,   + organophosphates |
| **Quantity or State**  **Time Frame** | TBD |

### Stressor #7: Dredging.

Many age classes of ammocoetes in stream substrates can be impacted by mining or dredging activities (FWS 2009).

**BDCP Objective #7**

Reduce impacts of dredging on lamprey ammocoetes.

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| **Relation to Global Objective** | Reductions in dredging impacts on lamprey ammocoetes will positively effect:   * Abundance * Productivity |
| **Indicator** | Direct mortality from dredging operations. |
| **Location** | BDCP Planning Area |
| **Attribute** | Dredging related mortality |
| **Quantity or State** | ???? |
| **Time Frame** | Within 10 years of permit issuance. |

# References

Luzier, C.W. and 7 co-authors. (2009). Proceedings of the Pacific Lamprey

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Moursund, R.A. (2002). Evaluation of the effects of extended length submersible bar screens at McNary Dam on migrating juvenile Pacific lamprey (*Lampetra tridentata*). Report to the Army Corps of Engineers. 31p.

Nez Perce, Umatilla, Yakama, and Warm Springs Tribes. (2008). Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin. Formal Draft. 68 pp.

United States Fish and Wildlife Service (FWS). (2009). Draft Outline of the Pacific Lamprey Conservation Plan. 10 pp. <http://www.fws.gov/pacific/fisheries/sp_habcon/lamprey/pdf/Pacific%20Lamprey%20Conservation%20Initiative%20ver%20060809.pdf>

FWS. (2010). Best Management Practices to Minimize Adverse Effects to Pacific Lamprey (*Entosphenus tridentatus*). 25 pp. <http://www.fws.gov/pacific/fisheries/sp_habcon/lamprey/pdf/Best%20Management%20Practices%20for%20Pacific%20Lamprey%20April%202010%20Version.pdf>

# Attachment 1: Objective Worksheet

|  |  |
| --- | --- |
| **Relation to Global Objective** | How will the stressor-level objective contribute to achieving the global objective? |
| **Indicator** | What will be measured?  Species, habitat, ecological process, physical condition… |
| **Location** | Where will it be achieved? |
| **Attribute** | What aspect of the indicator will be measured?  Population size, density, cover, presence/absence, reproductive rate… |
| **Quantity or State** | What measurable condition or change is expected?  Increase, decrease, maintain or limit negative impact?  *Quantity*: 500 individuals, 20% cover, 30% increase …  *Quality*: Weed-free, all life stages present, cover class 4… |
| **Time Frame** | When will this be achieved? |