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EVALUATE STATUS OF PACIFIC LAMPREY IN THE 
CLEARWATER RIVER DRAINAGE, IDAHO 

ANNUAL REPORT 
2003 

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ABSTRACT

Pacific lamprey *Lampetra tridentata* is a native Snake River basin species occupying a unique ecological niche. Recent decline of Pacific lamprey adult migrants to the Snake River drainage has focused attention on the species. Adult Pacific lamprey counted passing Ice Harbor Dam fishway averaged 18,158 during 1962-69 and 545 during 1993-2003. Human natural resource manipulations in the Snake, Clearwater, and Salmon River drainages have altered ecosystem habitat in the last 120 years, likely impacting the productive potential of Pacific lamprey habitat. Timber harvest, stream impoundment, road construction, grazing, mining, and community development have dominated habitat alteration in the Clearwater River system and Snake River migratory corridor. Hydroelectric projects in the Snake River corridor impact juvenile and larval Pacific lamprey outmigrants and returning adults. Juvenile and larval Pacific lamprey outmigrants potentially pass through turbines, turbine bypass/collection systems, and over spillway structures at the four lower Snake River hydroelectric dams. Clearwater River drainage hydroelectric facilities, including the Pacific Power and Light dam on the Clearwater River in Lewiston, Idaho, (1927-1972) Dworshak Dam on the North Fork Clearwater River (1972-present), and Harpster Dam on the South Fork Clearwater River (1910-1963), severely or completely restricted chinook salmon *Oncorhynchus tshawytscha* passage and altered or obstructed passage routes of outmigrating Pacific lamprey juveniles, larvae, and upstream adult migrants.

In 2003 Idaho Department of Fish and Game continued investigation into the status of Pacific lamprey populations in Idaho’s Clearwater River drainage and implemented initial foundational sampling in the Salmon River drainage. Trapping, electrofishing, and visual habitat assessment surveys were used to determine Pacific lamprey distribution, life history strategies, habitat requirements, and population abundance in the South Fork Clearwater River, Lochsa River, Selway River, Middle Fork Clearwater River, and lower Salmon River subbasins. Three-hundred forty-nine ammocoetes were captured electroshocking 63 sites in the South Fork Clearwater River, Lochsa River, Selway River, Middle Fork Clearwater River, and lower Salmon River subbasins. Three-hundred forty-nine ammocoetes were captured electroshocking 63 sites in the South Fork Clearwater River, Lochsa River, Selway River, Middle Fork Clearwater River, Clearwater River, Salmon River, and their tributaries in 2003. Presence-absence survey findings in 2003 augmented by 2000-2002 surveys consistently indicate Pacific lamprey ammocoetes and macrothalmia are not numerous or widely distributed. Pacific lamprey distribution was confined to the lower reaches of Red River below rkm 8.0, the South Fork Clearwater River, Lochsa River (Ginger Creek to mouth), Selway River (Bear Creek to mouth), Middle Fork Clearwater River, the Clearwater River (downstream to Potlatch River), and the mainstem Salmon River downstream of the S.F. Salmon River.
INTRODUCTION

The Pacific lamprey *Lampetra tridentata* is facing the same migratory hazards and habitat degradation as other anadromous fish species in Idaho. Because this fish is not recognized as a sport or game fish species, little attention has been given to its status. Records documenting Pacific lamprey presence historically in Idaho are rare. Gilbert and Evermann (1894) identified the upstream distribution limit in the Snake River near Shoshone Falls. Idaho Department of Fish and Game (IDFG) personnel captured Pacific lamprey ammocoetes in the Snake River Dam anadromous fish downstream migrant traps near Brownlee Dam (Bell 1959). The Pacific Power and Light Lewiston Dam monitored Pacific lamprey adult upstream passage in the 1958-1972 period, however records were inconsistent during 1962-1972.

The ecological interaction of Snake River Pacific lamprey populations and other riverine species is thought to contribute to Snake River basin overall aquatic productivity. Pacific lamprey ammocoetes provide Snake River basin white sturgeon *Acipenser transmontanus* with an important food source which potentially contributes to population productivity (Galbreath 1979). Pacific lamprey adults are a source of marine derived nutrients in the Snake River basin. Aquatic and avian predator utilization of ammocoetes and macrothalmia (Merrel 1958) potentially results in reduced predation impact to outmigrating juvenile salmon and steelhead trout *Oncorhynchus mykiss* in the lower Snake River migrational corridor. Pacific lamprey, chinook salmon *O. tshawytscha*, and summer steelhead trout, rear in Snake River basin stream habitats, however, the ecological relationship interactions of the three species in the basin are little known.

Habitat degradation in the Columbia and Snake River basins associated with mining, livestock grazing, stream channelization, logging, road construction, and urbanization in combination with hydroelectric impacts are implicated as the major factors contributing to Pacific lamprey declines (Close et al. 1995; Jackson et al. 1996; Jackson et al. 1997). Hydroelectric dam upstream passage ladders are difficult structures for Pacific lamprey upstream migrants to navigate (Vella et al. 1997).

Pacific lamprey ammocoetes (also termed as untransformed) are eyeless upon hatching and filter feed 4-7 years before undergoing transformation into macrothalmia. Transformation changes include formation of an oral disc and eyes among other morphological processes. Following transformation into macrothalmia, Pacific lamprey migrate to the ocean and parasitically feed on a wide range of marine aquatic organisms (Scott and Crossman 1973) for an estimated 1-2 years prior to returning to freshwater to spawn.

The Clearwater River drainage of north central Idaho is an important study area as both Pacific lamprey ammocoetes and macrothalmia have been captured in S.F. Clearwater River anadromous fish smolt traps since 1992. Understanding Pacific lamprey larval fish population composition, migrational behavior, and habitat needs will provide basic information to better manage Pacific lamprey. Without this knowledge, the opportunity for preservation of critical habitat may be lost. This project continues to augment our knowledge of Pacific lamprey and provide critical information to minimize future degradation of habitat.
PROJECT AREA

The Clearwater River drainage is located in north central Idaho and encompasses approximately 2.5 million hectares (Figure 1). The major tributaries include the Potlatch, S.F. Clearwater, N.F. Clearwater, M.F. Clearwater, Selway, and Lochsa rivers.

Hydroelectric dam construction in the Clearwater River drainage has impacted salmon, steelhead, and Pacific lamprey populations. The Pacific Power and Light Lewiston Dam, was constructed in 1927 at Clearwater River rkm 1.8. The dam was originally constructed with two upstream passage ladders, but obstructed steelhead trout passage somewhat and salmon passage severely. In the 1927-1940 period when the problem was detected and remedied, spring chinook salmon and fall chinook salmon populations were already reduced to remnant numbers and subsequently never recovered (White 1954). The impacts of the Lewiston Dam to Pacific lamprey macrothalmia and ammocoete downstream migrants and upstream migrating adults are unknown, however, counts documented the presence of adult fish (Figure 2). Dworshak Dam, constructed in 1972 on the North Fork Clearwater River (rkm 1.8) was constructed without an upstream passage ladder. Anadromous fish populations upstream of the project are now considered extirpated. Harpster Dam constructed in 1910 on the S.F. Clearwater River blocked anadromous fish upstream migration in the 1949-1963 period, however, impact variables directly relating to Pacific lamprey are unknown. Steelhead trout migration was possible, although limited, over the dam from 1935 to 1949. High flows destroyed the fishway in 1949 eliminating adult salmonid passage until the dam was removed in 1963. Adult Pacific lamprey passage may have occurred during this entire period as adult Pacific lamprey have the ability to climb above water surface levels (G. Starke, U.S. Army Corps of Engineers, personal communications). Pacific lamprey returns following removal of the dam have potentially provided recolonization stock for the S.F. Clearwater River drainage.

The land ownership of the Clearwater River basin is U. S. Forest Service, Bureau of Land Management, and other federal Lands (58.0%), State of Idaho (6.0%), Timber Company Land (8.0%), Nez Perce Tribe (4.0%), and Private (24.0%). Land use in the Clearwater River drainage is primarily agricultural or livestock pasture grazing in the lower and central basin and forestry related in the headwater reaches. Dredge mining predominantly occurred in the S.F. Clearwater River drainage.

The S.F. Clearwater River drains 300,440 hectares. The upper S.F. Clearwater River watershed has several large meadow complexes with low stream gradients and fine substrates. The mid and lower S.F. Clearwater River reaches are predominantly canyon confined and boulder substrate dominated. The current land ownership of the S.F. Clearwater River watershed is federal (70%), private (28%), Nez Perce Tribe (0.9%), and State of Idaho (0.7%). Extensive mining from the 1860's to the mid-1900's occurred in four S.F. Clearwater River tributaries, Crooked River, Red River, American River, and Newsome Creek.
Figure 1. General location of Pacific lamprey studies in Idaho, 2003.
Figure 2. Pacific lamprey adult upstream passage, Lewiston Dam 1950-1972, Clearwater River drainage, ID.

OBJECTIVES

Objective 1. Determine life history characteristics of Pacific lamprey ammocoetes and macrothalmia in the S.F. Clearwater River drainage.

Objective 2. Determine habitat requirements of Pacific lamprey throughout the Clearwater River drainage.

Objective 3. Determine distribution of Pacific lamprey in Clearwater River drainage.

Objective 4. Determine feasibility of enhancing population in Clearwater River drainage.
METHODS

Electroshocking techniques with an ABP-2 electrofisher were used to capture fish in stream channels. Presence-absence surveys were completed in the Red River, S.F. Clearwater River, Selway River, Lochsa River, Potlatch River, M.F. of the Clearwater River, lower Salmon River, and their selected tributaries (Figure 1). Presence-absence sampling was initially conducted in the S.F. Clearwater River drainage in 2001. Presence-absence sampling was implemented in the M.F. Clearwater River, Lochsa River, Potlatch River, and Selway River subbasins in 2002 and 2003. Sites were selected based on previous work identifying suitable Pacific lamprey stream habitat characteristics (Table 1). In 2003 extended surveys were utilized to identify Pacific lamprey distribution in tributaries and reaches of the Lochsa river, Selway River, M.F. Clearwater River, and tributaries not sampled in 2002.

Determination of habitat usage was focused in the Red River drainage. We segmented Red River into one-kilometer sections from its mouth upstream to the uppermost bridge crossing (rkm 41). We prioritized Red River habitat sampling locations based on random selection of kilometer section and then sampled the first 100 meters of each selected section. The habitat in each of the sampled sections was classified as to type (Table 1). The first riffle, pool, glide, etc., was electroshocked from its downstream boundary upstream without repeating sampling in identical habitat types. Water depth, water velocity, substrate composition, and canopy cover were measured and recorded at the site of individual captures. Habitat classification and stream substrate assessment methodologies utilized in habitat utilization surveys were implemented in the 2001-2003 Clearwater River drainage presence-absence surveys.

Three downstream migrant traps currently operated by Idaho Department of Fish and Game in the S.F. Clearwater River drainage were used to monitor Pacific lamprey downstream movements. The Crooked River scoop trap (rkm 1.0) was replaced with a 1.50 m rotary screen trap in 2002. It was operated from April 4 to October 31 in 2003. A 1.50 m diameter rotary screen trap on American River (rkm 3.0) was operated from April 12 to October 31. Another 1.50 m diameter rotary screen trap on Red River (rkm 5.0) was operated from April 10 to October 31. Nez Perce Tribal Fisheries (NPTF) operates a 1.50 m rotary screen trap at rkm 21.0 on Lolo Creek and another at rkm 0.1 on Newsome Creek. The Lolo Creek trap is operated 12 months annually, weather permitting. The duration of Newsome Creek trap operations is predominantly in the March to October period annually. Trapping records for the 1994-2003 period were obtained from Nez Perce Tribe biologists (Sprague and Johnson, NPTF 2003) and assessed to determine ammocoete and macrothalmia downstream migrant magnitude and timing in the Lolo and Newsome Creek drainages.

With the exception of fish captured in rotary screen or scoop traps, all captured Pacific lamprey ammocoetes and macrothalmia were anesthetized, and total lengths and body weights measured. Individuals were then recovered in fresh water and released near the site of capture. Outmigrant estimates at traps were made using trap area-fished methods (Beamish and Levings 1991).

Pacific lamprey ammocoete and macrothalmia collection and passage information at Lower Granite Dam was obtained from the Washington Department of Fish and Wildlife personnel to determine the magnitude and timing of Pacific lamprey downstream migration. Mortality samples of macrothalmia and ammocoetes were collected to obtain genetic material and assess the general size of ammocoetes and macrothalmia captured.
Table 1. Habitat unit and substrate classification for sampling sites in the Clearwater River and Salmon River drainages, ID, 2000-2003.

<table>
<thead>
<tr>
<th>Habitat Units</th>
<th>I.D.</th>
<th>Substrate Classification</th>
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</thead>
<tbody>
<tr>
<td>Falls</td>
<td>FLL</td>
<td>Substrate Type (mm)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Large Boulder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 512</td>
</tr>
<tr>
<td>Cascades</td>
<td>CAS</td>
<td>Small Boulder</td>
</tr>
<tr>
<td></td>
<td></td>
<td>256-512</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cobble</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64-256</td>
</tr>
<tr>
<td>Rapids</td>
<td>RTT</td>
<td>Coarse Gravel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-64</td>
</tr>
<tr>
<td>Typical</td>
<td>RBB</td>
<td>Fine Gravel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-8</td>
</tr>
<tr>
<td>Boulders</td>
<td>RBD</td>
<td>Course Sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.5-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fine Sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.062-0.50</td>
</tr>
<tr>
<td>Riffles</td>
<td>RIF</td>
<td>Silt/Organic</td>
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<td></td>
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<td>0.004-0.062</td>
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<tr>
<td>Alcove</td>
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Development of a management plan to maintain or enhance existing Pacific lamprey population will be focused on translocation of pre-spawn adults from downstream Columbia River locations and supplementation with hatchery spawned ammocoetes into suitable habitat. As part of determining if these actions are feasible, disease and genetic concerns were addressed.

RESULTS

As in 2000-2002, no Pacific lamprey ammocoetes or macrothalmia were captured in the Crooked River or American River rotary screen traps in 2003. Ten ammocoetes and one macrothalmia were captured in the Red River rotary screen trap, but no length or weight measurements were obtained. Based on trap-area fished, a total of 70 ammocoetes and seven macrothalmia were estimated to have migrated past the Red River trap in 2003.

Pacific lamprey distribution in the Clearwater River drainage was limited to lower 7.5 km of Red River, the S.F. Clearwater River, Selway River (Selway Lodge to mouth), Lochsa River (Ginger Creek to mouth), M.F. Clearwater River, and the Clearwater River (Figure 3). No Pacific lamprey were captured in the Selway River above Selway Lodge, Selway River tributaries, Lochsa River tributaries, M.F. Clearwater River tributaries, or Potlatch River.
Figure 3. Location of Pacific lamprey investigations in the Clearwater River drainage, ID, 2000-2003. Circles indicate general sample locations with closed circles indicating sites of Pacific lamprey ammocoete observations.
A total of 65 Pacific lamprey ammocoetes were captured by electroshocking in Red River (Table 2). Pacific lamprey ammocoetes were found in seven sections of Red River from the mouth upstream to rkm 7.5. No Pacific lamprey ammocoetes or macrophthalmia were captured in Red River sample sites above rkm 7.5. The largest Pacific lamprey ammocoete captured electroshocking in the Red River drainage in 2003 was 161 mm TL and the smallest measured 113 mm TL (Figure 4).

Individuals were mostly found inhabiting sand and silt substrates in calm water sites adjacent to overhanging riparian canopy cover or in low velocity pockets behind boulders. Pacific lamprey ammocoetes were captured in water depths ranging from 0.1 – 1.0 m, however, they were predominantly captured in depths <0.60 m.

No marked Pacific lamprey ammocoetes were recaptured in 2003 in Red River reaches with marked Pacific lamprey from previous years’ surveys.

Ninety-eight Pacific lamprey ammocoetes were sampled in the S.F. Clearwater River in 2003 (Table 2). The largest ammocoete measured 155 mm TL while the smallest measured 95 mm TL (Figure 5). Sixty-eight ammocoetes were captured in the Selway River and 70 in the Lochsa River in 2003 (Table 2) (Figures 6 and 7). The largest ammocoete (161 mm TL) captured in the Clearwater River drainage in 2003 was captured in the Red River (Figure 4) and the smallest was captured in the Lochsa River (18 mm TL) (Figure 7).


<table>
<thead>
<tr>
<th>Lamprey Captured</th>
<th>Total Area Fished m²</th>
<th>Total Time Fished (Min)</th>
<th>Lamprey/100 m²</th>
<th>C.P.U.E. (Lamprey/Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Red River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>16.0</td>
<td>16.2</td>
<td>406.3</td>
<td>4.60</td>
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<tr>
<td><strong>S.F. Clearwater River</strong></td>
<td></td>
<td></td>
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<tr>
<td>98</td>
<td>15.0</td>
<td>13.6</td>
<td>653.3</td>
<td>7.20</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>163</td>
<td>31.0</td>
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**2002-2003**

<table>
<thead>
<tr>
<th>Lamprey Captured</th>
<th>Total Area Fished m²</th>
<th>Total Time Fished (Min)</th>
<th>Lamprey/100 m²</th>
<th>C.P.U.E. (Lamprey/Min)</th>
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<td><strong>Selway River</strong></td>
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</tr>
<tr>
<td>68</td>
<td>22.0</td>
<td>19.2</td>
<td>309.0</td>
<td>3.05</td>
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<tr>
<td><strong>Lochsa River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(3 sites)</td>
<td>70</td>
<td>12</td>
<td>555.5</td>
<td>6.33</td>
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<tr>
<td><strong>Totals</strong></td>
<td>178</td>
<td>44.0</td>
<td>--</td>
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</tr>
</tbody>
</table>
Figure 4. Length frequencies of Pacific lamprey ammocoetes captured by electroshocking in Red River, ID 2000-2003.
Figure 5. Length frequencies of Pacific lamprey captured by electroshocking in the S.F. Clearwater River, ID 2000-2003.
Figure 6. Total length frequency of Pacific lamprey ammocoetes (N=61, 2002; N=60, 2003) captured electroshocking in the Selway River, ID, 2002-2003.

Figure 7. Total length frequency of Pacific lamprey ammocoetes (N=50, 2002; N=60, 2003) captured electroshocking in the Lochsa River, ID, 2002-2003.
NPTF rotary screen trap (rkm 21.0) operations in the Lolo Creek drainage captured 496 Pacific lamprey ammocoetes and macrothalmia 1994-2003 (Figure 8). Downstream movement of ammocoetes and macrothalmia annually was similar in timing to Red River (54.2% Jan 1 to May 31), however, a greater proportion of Lolo Creek ammocoetes and macrothalmia migrate downstream in the September – November period compared to Red River. The percentage of Pacific lamprey macrothalmia captured in Lolo Creek rotary screen trap increased annually in the 1994-2001 period (Figure 9). Assessment of the average weights of length classes of Pacific lamprey ammocoetes captured in the Lolo Creek and Red River drainages suggests Lolo Creek ammocoete weights for a particular length class exceed those in Red River (Figure 10). Eight ammocoetes were captured in the Newsome Creek rotary screen trap (rkm 0.10) 1998-2003 with one ammocoete captured in 2002 and none in 2003.

A total of nine ammocoetes were captured in the Salmon River subbasin while sampling 17 locations in the mainstem and tributaries from three rkm’s upstream of the South Fork Salmon River (rkm 217.2) downstream to the mouth. Lengths were not obtained for the majority of the ammocoetes captured, however, two ammocoetes less than 100 mm total length were captured in the mainstem downstream of the Little Salmon River confluence (rkm 133.9). No ammocoetes were captured or observed in selected tributaries, White Bird Creek, Eagle Creek, Slate Creek, Rapid River, Hazard Creek, Hard Creek, and Boulder Creek.

Pacific lamprey juvenile and larval passage information obtained from Washington Department of Fish and Wildlife at Lower Granite Dam in 1996-2003 supports information pertaining to spring chinook and steelhead trout and indicates that downstream movements of migrating ammocoetes and macrothalmia are linked to increased springtime flows (Figure 11).

Information pertaining to Pacific lamprey disease issues is limited, however, some disease samples have been collected by the U.S. Fish and Wildlife Service (Lower Columbia River Fish Health Laboratory) in the 1990-2003 period. Samples currently processed indicate Pacific lamprey are capable of contracting furunculosis *Aeromonas salmonicida*. The U.S. Fish and Wildlife Service along with the University of California at Davis, the Hatfield Marine Science Center (Newport, OR), and the Nanaimo British Columbia laboratories were contacted in 2003 and their findings and biological opinions supported the U.S. Fish and Wildlife work.

In the event lamprey populations decline to the point reintroduction is necessary, the potential sources for Pacific lamprey adults to support adult translocation and hatchery supplementation programs will depend on the genetic compatibility of downstream sources in relation to existing Idaho’s populations. Limited information is presently available regarding Pacific lamprey genetics. To address the questions of compatibility, this project will begin focusing on the genetics issues in 2004-2005.
Figure 8. Pacific lamprey captured (N=496) in NPTF rotary screen trap Lolo Creek (rkm 21.0) 1994-2003, Clearwater River drainage, ID (Sprague and Johnson 2003).

Figure 9. Pacific lamprey downstream migrant percentage transformed, NPTF rotary screen trap (rkm 21.0), 1994-2003, Clearwater River drainage, ID, (Sprague and Johnson 2003).
Figure 10. Pacific lamprey ammocoete and macrothalmia length grouping and average weight, Red River (RR) and Lolo Creek, Clearwater River drainage, ID, (Lolo Creek, Sprague and Johnson NPT 2003).

Figure 11. Pacific lamprey ammocoete and macrothalmia adjusted bypass/collection count and Snake River flows, Lower Granite Dam, WA, 1998.
DISCUSSION

Presence-absence sampling in 2000-2003 in the S.F. Clearwater River basin firmly indicates distribution of Pacific lamprey in the basin is restricted to the mainstem S.F. Clearwater River and the lower Red River. Suitable habitat remains in the upper Red River, American River, and Crooked River, but Pacific lamprey ammocoetes and macrothalmia were not found. Despite presence-absence work in the Newsome Creek subbasin in 2001 no Pacific lamprey were captured, and NPTF rotary screen trapping clearly indicates remnants of Pacific lamprey populations in the stream are nearing the final stages of decline. Pacific lamprey ammocoete distribution in the Selway River and Lochsa River drainages was limited to mainstem reaches. Hammond (1979) captured Pacific lamprey ammocoetes in the mainstem Potlatch River upstream of Kendrick, ID, and the East Fork of the Potlatch River. In 2002 Pacific lamprey presence-absence sampling in mainstem Potlatch River, Bear Creek, and the East Fork Potlatch River failed to produce lamprey.

During 2000-2003, no Pacific lamprey ammocoetes or macrothalmia were captured in the Crooked River or American River rotary screen traps. In 2002 one-hundred twenty-five Pacific lamprey ammocoetes and 20 macrothalmia were captured in the Red River rotary screen trap compared to 10 ammocoetes and one macrothalmia in 2003. Based on trap-area fished, a total of 70 ammocoetes and seven macrothalmia were estimated to have migrated past the Red River trap in 2003, compared to 875 ammocoetes and 140 macrothalmia in 2002, 307 ammocoetes and seven macrothalmia in 2001, and 175 ammocoetes and 14 macrothalmia in 2000.

A total of 679 (154, 186, 274, and 65) Pacific lamprey ammocoetes was captured by electroshocking in Red River in 2000-2003. One macrothalmia was captured in Red River presence-absence surveys in September 2001. In 2000-2003 no Pacific lamprey ammocoetes or macrothalmia were captured in Red River sample sites at rkm’s 8.0, 9.0, or 10.0, and locations sampled in upper Red River. The largest Pacific lamprey ammocoete captured electroshocking in the Red River drainage in 2000-2003 was 166 mm TL in 2000 and the smallest Pacific lamprey ammocoete captured measured 72 mm TL in 2001 (Figure 4).

The minimum length of ammocoetes in the S.F. Clearwater River increased incrementally comparing 2000 (47 mm TL), 2001 (60 mm TL), 2002 (77 mm TL), and 2003 (95 mm TL) (Figure 5). In 2001 the number of reaches surveyed was increased in order to determine the downstream distribution of Pacific lamprey thereby resulting in nearly 300% more ammocoetes sampled as compared to 2000 work. However, the minimum total length of ammocoetes increased. In 2002-2003 sampling was restricted to locations considered preferred. An increase in the minimum length ammocoete captured over the study period, 2000-2003, reflects a lack of recruitment in the S.F. Clearwater River subbasin.

More Pacific lamprey ammocoetes were captured in the Clearwater River drainage (random and nonrandom presence-absence surveys) sampling lateral scour pool habitat than any other single habitat type (Table 3), however, no alcove habitat was sampled in 2001, 2002, or 2003 where the greatest density of 253.3/100 m² was found in 2000. Individuals were mostly found inhabiting sand and silt substrates in calm water sites adjacent to overhanging riparian canopy cover or in low velocity pockets behind boulders.
Table 3. Habitat locations of Pacific lamprey larvae in randomly sampled units in Red River, ID, 2000-2002.

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<th>Habitat Type</th>
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NPTF rotary screen trapping efforts in Lolo Creek suggest Pacific lamprey are currently present, however, the population composition of downstream migrant trapped Pacific lamprey indicates the percentage of macrothalmia increased consistently throughout the 1995-2001 period in the subbasin. Increasing macrothalmia percentages potentially reflect annual age incremental increase with limited recruitment. No Pacific lamprey were captured in 2003 with presence-absence sampling of 15 sites in Lolo Creek, Musselshell Creek, and Eldorado Creek. In 2003 NPTF captured one Pacific lamprey in the rotary screen trap at rkm 21.0.

Downstream migration of ammocoetes and macrothalmia in Red River occurs predominantly at night from mid-March to May 31, with a limited number captured in September and October (Figure 12). Out of the total (N=821) Pacific lamprey ammocoetes captured April 1 to October 31, 1993-2002 88% occurred between April 1 and May 31. In 1996 a total of 25 Pacific lamprey ammocoetes were captured in the March 13 to March 31 period, which is important information indicating an unknown portion of downstream migration occurs prior to the general April 1 – October 31 trapping period.
Figure 12. Pacific lamprey ammocoetes and macrothalmia captured April 1-October 31, 1993-2002 in Red River trap (rkm 5.0), ID.

Adult Pacific lamprey passage over lower Columbia and Snake River dams show a downward trend in abundance (Figures 13, 14, and 15). Pacific lamprey densities observed in 2000-2003 reflect overall low population numbers in the Clearwater River drainage. The number of spawning adults in the Clearwater River basin is suspected to have averaged fewer than 200 Pacific lamprey annually 1995-2003. The Clearwater River drainage estimated spawning adult escapement is based on Lower Granite dam passage of an average of less than 600 adults in the 1998-2003 period and assumption of even distribution of Pacific lamprey adults into the Grande Ronde, Imnaha, Salmon, and Clearwater Rivers with fewer than one-third of Clearwater River drainage spawners returning to the S.F. Clearwater River.

Pacific lamprey adults often migrate upstream in the night hours. Nighttime counts were completed at Lower Granite Dam 1995-2002 (Figure 15) and are considered critically strategic in conjunction with daylight counts to determine abundance of Pacific lamprey adult escapement into the Snake River upstream of the project.
Figure 13. Pacific lamprey adult upstream passage 1938-2003, Bonneville Dam, OR.

Figure 14. Pacific lamprey adult upstream passage 1962-2003, Ice Harbor Dam, WA.
Pacific lamprey persistence patterns in the Clearwater River drainage are, at best, difficult to analyze. Despite a severe declining trend in the Columbia River and Snake River basins (Figures 13, 14, and 15), Pacific lamprey remain in several Clearwater River drainage streams. The persistence of Pacific lamprey appears to be linked with high water quality in streams such as the Selway and Lochsa rivers (Dechert 2003, Gerhardt 1993). Streams with impaired water quality either do not support present populations as in Potlatch River or Lawyers Creek, or support declining populations such as found in the Lolo Creek and the S.F. Clearwater River drainage. However, excellent habitat quality cannot totally compensate for the limited numbers of lamprey passing Lower Granite Dam.

It is unknown if the populations of Pacific lamprey in the Clearwater River drainage are in the initial stages of approaching a critical unrecoverable threshold, however, of the 133 sites sampled in the Clearwater River basin in 2002-2003, only 18 produced Pacific lamprey. Throughout the Clearwater River drainage, the 2003 distribution is likely an estimated 40% of the drainage area occupied in 1960. Information of 2000-2003 reflects population minimal numbers and distribution ranges restricted to the remaining preferred habitat in the entire Clearwater.

Basic life history, distribution, and remaining population status are urgently needed to increase understanding of this species and to further implement intensive management before populations decline to critical, unrecoverable threshold in Idaho.
ACKNOWLEDGEMENTS

This study was funded primarily by Bonneville Power Administration (Project Number 2000-028-00) with additional support from the Idaho Department of Fish and Game and the Bureau of Land Management.
LITERATURE CITED


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APPENDIX
Appendix A. Table 1. Pacific lamprey length, weight, and mark information from Red River, ID, 2003.

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Appenix A. Table 2. Pacific lamprey length, weight, and mark information for S.F. Clearwater River, ID, 2003.

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1 RCO-Right center orange
2 T-transformed; U-untransformed
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1. Mark
2. Phase
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1 RCO-Right center orange
2 T-transformed; U-untransformed
* Caught 7 lamprey, observed 23 additional lamprey, lengths were only estimated
Appendix A. Table 4. Pacific lamprey length, weight, and mark information for Lochsa River, ID, 2003.

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1. RCO – Right center orange
2. T – Transformed; U - Untransformed

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### Appendix A. Table 7. Pacific lamprey presence-absence surveys in S.F. Clearwater River drainage, ID, 2003.

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* 14/8 outside measured area, 15/6 outside measured area.
** 7 captured, 23 observed (unmeasured)


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*28/8 outside measured area
*32/11 outside measured area


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*13/6 outside measured area, 21/9 outside measured area

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Appendix A. Table 15. Pacific lamprey presence-absence surveys in Mainstem Salmon River drainage, ID, 2003.

<table>
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<th>TEMP (°C) / TIME</th>
<th>TIME (Min)</th>
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<th>DEPTH</th>
<th>SHADE</th>
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<td>1222</td>
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<td>3.5km av. Mackay Bar</td>
<td>15.0 C/1222 17.0 C/1222</td>
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<td>9/21/2003</td>
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<td>9/21/2003</td>
<td>1045</td>
<td>Ltl. Whitbrd.Crk.</td>
<td>10 m av. rd 642 clvt.</td>
<td>9.0 C/1045 5.0 C/1045</td>
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<td>1602</td>
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<td>9/22/2003</td>
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<td>0.3km blw. Wapshilla Crk.</td>
<td>17.0 C/1136 17.0 C/1136</td>
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<th>GRVL.</th>
<th>COBBLE</th>
<th>BLDR.</th>
<th>BLDR.</th>
<th>OTHER</th>
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<td>Lt. Whtbrd.Crk. 10 m abv. rd 642 clvt.</td>
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<td>25.0 7.0</td>
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<td>Salmon R.</td>
<td>Lucille Rec. Site</td>
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<tr>
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<td>30.2km up frm mouth.</td>
<td>5.0 7.0</td>
<td>17.0 39.0</td>
<td>19.0</td>
<td>18.0</td>
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### Appendix A. Table 17. Pacific lamprey presence-absence surveys in Little Salmon River drainage, ID, 2003.

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<th>TEMP (°C) / TIME</th>
<th>TIME (Min)</th>
<th>LAMPREY CAPTURED</th>
<th>DEPTH AVE.(m)</th>
<th>SHADE (%)</th>
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<td>1032</td>
<td>Bldr. Crk</td>
<td>2.5 km blw. Ant Basin Rd.</td>
<td>16.5 C/1032</td>
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