2016 Chehalis Intensive Surveys in Off-Channel Habitat
2nd Progress Report - July 2016

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EXECUTIVE SUMMARY

The purpose of intensive surveys was to determine the seasonal patterns for stillwater-breeding amphibians and other Aquatic Species Restoration Plan (ASRP) non-salmonid target species in off-channel habitats in the mainstem Chehalis floodplain over a two-year period. We focused on six off-channel habitats selected across exotic predator abundance and hydroperiod gradients, the conditions thought to most influence the native aquatic biota in these habitats. This report updates the intensive survey effort through May 2016. This study, part of the larger effort addressing off-channel habitats, contributes directly and indirectly to the ASRP. Its goals are to contribute to identifying seasonal aquatic biota habitat utilization patterns in off-channel habitats in the Chehalis floodplain, to support the PEIS development process, to couple to inundation modeling intended to evaluate potential changes in off-channel habitats in the Chehalis floodplain as a consequence of flood control alternatives, and to help inform and prioritize restoration efforts in the Chehalis floodplain. We conducted this work with the generous permission of one public and nine private landowners: Tom Christin, Darryl Dick and Darlene Toland, Wayne Gray, Roy and Joyce Osborn, Andy and Linda Styger, Washington Department of Fish and Wildlife (WDFW) and Weyerhaeuser Natural Resources Company.

We have surveyed each site typically on two consecutive day intervals on an approximately monthly rotation beginning the first week of October 2015. We used a single overnight trap set using collapsible minnow traps, fyke nets and turtle traps coupled with dipnet surveys as the focal sampling methods. High water conditions required additional days to fully survey sites in a few circumstances. During either the 7th or 8th sampling round (April or May 2016), we also conducted one electrofish sampling effort at each site.

From October 2015 to May 2016, we sampled the six target sites through eight monthly rounds. At each site, we found 3-5 native stillwater-breeding amphibians from the suite of: Long-toed salamander (*Ambystoma macrodactylum*), Northern red-legged frog (*Rana aurora*), Northwestern salamander (*Ambystoma gracile*), Pacific treefrog (*Pseudacris regilla*), and Roughskin newt (*Taricha granulosa*). We also detected at least 3-8 native fish species at all but the upstream-most intensive site (Weyerhaeuser) from the suite of: Coho salmon (*Oncorhynchus kisutch*), lamprey (species unidentified), Largescale sucker (*Catostomus macrocheilus*), Northern pikeminnow (*Ptychocheilus oregonensis*), Olympic mudminnow (*Novumbra hubbsi*), Redside shiner (*Richardsonius balteatus*), sculpin (*Cottus* sp.), Speckled dace (*Rhinichthys osculus*), and Three-spine stickleback (*Gasterosteus aculeatus*). At the four most downstream located sites, we also detected the exotic American bullfrog (*Lithobates catesbeianus*), and at least 3-8 exotic fish species from the suite of: Black crappie (*Pomoxis*

nigromaculatus), Bluegill (*Lepomis macrochirus*), Brown bullhead (*Ameiurus nebulosus*), Common carp (*Cyprinus carpio*), Largemouth bass (*Micropterus salmoides*), Pumpkinseed (*Lepomis gibbosus*), Rock Bass (*Ambloplites rupestris*), Smallmouth bass (*Micropterus dolomieu*), and Yellow perch (*Perca flavescens*). Uncertainty in species numbers reflects unidentified lamprey, sculpin, and juvenile sunfishes, the genetic verification of which is pending.

Aquatic species composition among sites was variable, but several patterns were evident. Native amphibian breeding seasonal phenology resulted in the appearance of eggs in the 5th, 6th, and 7th (February-April) sampling rounds at all sites, consistent with the typical post-winter thaw oviposition of the native amphibian species suite. Both native and exotic fish species richness increased with increasing downstream position of the intensive sites, but that pattern was not evident with native amphibians. Also, two features suggest exotic amphibians and fishes affect native amphibians and fishes. First, an inverse relationship in the abundance indices of aquatic exotic versus aquatic native species exists. Second, for amphibians, evidence of recruitment (larval stages) following oviposition was limited or non-existent at sites with significant aquatic exotics. This was most evident at Osborn, the only intensive site where exotic species richness exceeded native species richness and where the abundance index of aquatic exotic species was approximately 50-fold that of native aquatic species; a less pronounced response was evident at less exotic loaded sites. However, recruitment failure of native amphibians was not universally attributable to exotics. In particular, at the fish and exotic free Weyerhaeuser site and the exotic fish-limited Christin site, recruitment failure of some native amphibians may reflect the dominance of the native Roughskin newts, a predator that focuses seasonally on amphibian eggs.

Intensive survey efforts summarized to date represents just over one third of the planned overall effort. The upcoming 31 December 2016 Progress Report will expand understanding of the seasonal patterns in Chehalis floodplain off-channel intensive sites through an entire year. We anticipate that recruitment failure among native amphibians at exotic richer sites, as currently evidenced by few or no larvae, will become clearer as the anticipated metamorphosis of larvae or lack thereof occurs when the June-July 2016 data are examined.

REPORT

Introduction

Intensive surveys were designed to identify ***seasonal*** changes in the aquatic biota of off-channel habitats in the mainstem Chehalis River floodplain that could not be obtained with the temporally restricted egg mass and extensive surveys in those habitats. The latter refers mainly to patterns of use by aquatic biota not present in those habitats year-round, such as selected life stages of stillwater-breeding amphibians (e.g., adult northern red-legged frogs [*Rana aurora*]) and fishes (e.g., juvenile Coho salmon [*Oncorhynchus kisutch*]). As a consequence, those surveys were focused on six off-channel habitats that were sampled at a monthly resolution. This report summarizes progress of the intensive survey efforts through May 2016.

Site Selection
We selected six sites (**Appendix Table 1**) from the 324-site pool of off-channel habitats spanning the entire floodplain of Chehalis mainstem from the proposed dam location (just above Pe Ell) to the 101 bridge in Aberdeen; this is the same pool of sites used to structure site selection for the egg mass and extensive surveys of floodplain off-channel habitats. We defined the mainstem floodplain as the FEMA-specified 100-year floodplain plus an additional 100 meters drawn perpendicular to that line.

We selected the six sites based on three criteria: 1) proximity to the proposed dam and reservoir; 2) connectedness to the Chehalis mainstem; and 3) relative abundance of exotic aquatic species. The first criterion reflected the need to have some sites with a greater likelihood of being influenced by proposed dam alternatives because a focus was to inform evaluation of those alternatives. The latter two criteria reflected a need to have some understanding of both the behavior of the aquatic biota in off-channel habitats that were more versus less connected to the mainstem and had a greater versus lesser loading of exotic aquatic species. Information on connectedness and exotic species relative abundance was based on data from a combination of egg mass and extensive surveys during the 2015 season as all six of the intensive survey sites had been surveyed during at least one of those efforts (all completed prior to 1 October 2015). Data upon which these sites were selected for the aforementioned three criteria are provided in **Table 1**.

		Selection Criteria			
				Exotic Aquatic Species	
	Site Name	Proximity (RM below Proposed Dam Site)	Connectedness to Chehalis Mainstem	Bullfrogs	Warmwater Fishes
1	007_Weyerhaeuser	Very Close (107.6 RM [172.8 RKm])	Never	None	None
2	004_Christin	Close (93.8 RM [150.6 RKm])	Limited Seasonally	None	Some
3	020_Styger_N	Moderately Close (76.6 RM [123.0 RKm])	Limited Seasonally	Some	None
4	068_Osborn	Moderately Close (76.6 RM [123.0 RKm])	Substantial Seasonally	Some	Many
5	025_Dick	Moderately Distant (44.3 RM [71.1 RKm])	Substantial Seasonally	Some	Some
6	086_Hoxit 2	Distant (36.5 RM [58.6 RKm])	Substantial Seasonally	Some	Some

Sampling

We sampled the six intensive survey sites on an approximately monthly rotation; **Table 2** shows the sampling dates for each site through the end of May 2016. We conducted all surveys with at least three people over a minimum two-day interval. We established 10 relatively evenly spaced transects at each site, at which we recorded vegetation composition, percent cover, water temperatures, deepest depth, visibility, wetted widths and distance between transects. Biotic surveys employed dipnets (25 dipnet samples/site), minnow traps (3 traps/transect; 30 total per site) and a minimum of one fyke and one turtle net. We placed all traps on the initial sampling day each month, left them in an overnight set, and retrieved them the next day, at which time we processed and released captured animals. Processing involved identifying, photographing and/or measuring species caught in traps, and recording their location and capture method. We also noted other relevant data (e.g., American beaver, bird or mammal activity or sign). Lastly, in the 7th - 8th round to date, we added electrofish sampling. We anticipate continuing to electrofish bimonthly, at every other visit.

Table 2. Survey dates for the six Extensive Survey effort Off-Channel Sites over the first eight surveys spanning October 2015-May 2016. Location details of the six sites are provided in **Appendix Table 1.**

Site Name		Survey Round							
		1st	2nd	3rd	4th	5th	6th	7th	8th
1	007_Weyerhaeuser	14-Oct	9-Nov	7-Dec	19-Jan	10-Feb	9-Mar	11-Apr	11-May
2	004_Christin	20-Oct	16-Nov	14-Dec	25-Jan	22-Feb	14-Mar	13-Apr	16-May
3	020_Styger_N	22-Oct	23-Nov	16-Dec	13-Jan	24-Feb	23-Mar	20-Apr	18-May
4	068_Osborn	26-Oct	30-Nov	27-Dec	27-Jan	29-Feb	28-Mar	25-Apr	25-May
5	025_Dick	2-Nov	2-Dec	5-Jan	8-Feb	2-Mar	29-Mar	27-Apr	23-May
6	086_Hoxit 2	6-Oct	4-Nov	21-Dec	11-Jan	1-Feb	7-Mar	5-Apr	2-May

In addition, we also conducted egg mass surveys on our normal survey dates in mid-January through the end of April. This involved a visual encounter survey (VES) for amphibian egg masses of the entire site (up to 1m water depth) and 50 additional dipnets. Each site had this separate survey done at least three times. Data from these surveys is combined with the data from the Intensive surveys when reporting results.

Results

We have sampled all six intensive sites through eight monthly rounds (**Table 2**). High water conditions in late November and December required minor shifts in the schedule, but these shifts only slightly altered our sampling timeline. Reduced visibility during the sixth sampling round (mostly March) resulted from rain during the surveys and increased turbidity due to elevated suspended material. The latter was particularly prominent at Christin and Weyerhaeuser. Site results are presented in order of their proximity to the proposed dam site in a downstream direction.

Weyerhaeuser, the site most proximate to the proposed dam (**Table 1**), is the only intensive site probably never connected to the Chehalis mainstem during high water. Sampling through the eighth round has not revealed either exotic vertebrates or native fish at this site. This pond, originally built to receive stormwater runoff from the adjacent Weyerhaeuser management facility, likely has a permanent hydroperiod; it retained water in late summer during the extreme drought year of 2015. Other than the aforementioned runoff pattern, one 1.8-km unnamed tributary flows through this pond via a stormwater conveyance ditch immediately south of the Weyerhaeuser facility. A mixed forest of Douglas-fir (*Pseudotsuga menziesii*), Red alder (*Alnus rubra*) and Western red cedar (*Thuja plicata*) surround most of this pond.

Aquatic vertebrates in this pond were exclusively native amphibians. Roughskin newts (*Taricha granulosa*) were the prominently dominant species (**Figure 1**). Though all native amphibians except newts[1] exhibited some reproduction in this pond, only Northwestern salamanders (*Ambystoma gracile*) showed much evidence of recruitment (see the March-May larval pattern in **Figure 1**). Long-toed salamander (*Ambystoma macrodactylum*) and Pacific treefrog (*Pseudacris regilla*) both very infrequently laid eggs in the Weyerhaeuser pond, whereas, though Northern red-legged frogs did deposit a fair number of eggs, we detected very few larvae as a result of this effort. We recorded a few larval Roughskin newts during the October-February interval. Except for newts, December numbers for all amphibian species were depressed. Adult newt numbers increased rather than declined during the winter period.

Electrofishing at Weyerhaeuser on 11 May 2016 (during the 8th sampling round) produced few amphibians (**Figure 2**). Electrofishing detected fewer individuals than non-electrofishing methods for three of the four amphibian species recorded. This was prominently evident for Northwestern salamander and Roughskin newt, where the numbers of individuals recorded were large (**Figure 2**). Numbers of Northern red-legged frogs were so small that any conclusion about differences between methods was uncertain. We recorded the same number of Pacific treefrogs with both method sets, but their numbers were also so few that any conclusions about the lack of differences is also uncertain.

[1] Newts lay single eggs concealed in soft aquatic vegetation and as a consequence, their oviposition patterns were impractical to track. However, based on the newt population patterns observed, it is likely that they successfully reproduce in this pond.

Figure 1. Time Series of Native Amphibian Life Stages for the Weyerhaeuser Intensive Site – includes all sampling except the 11 May 2016 electrofishing effort.

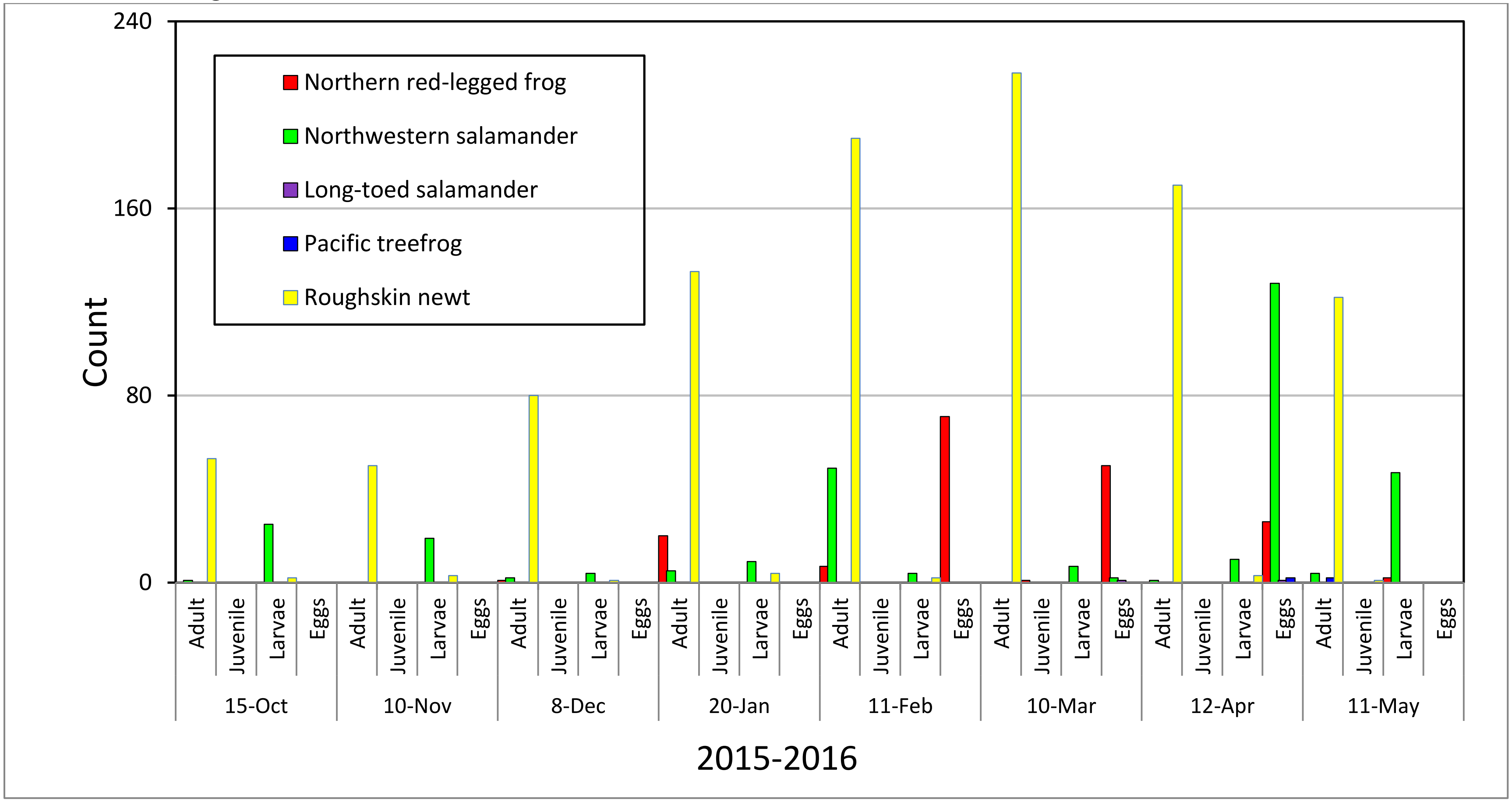
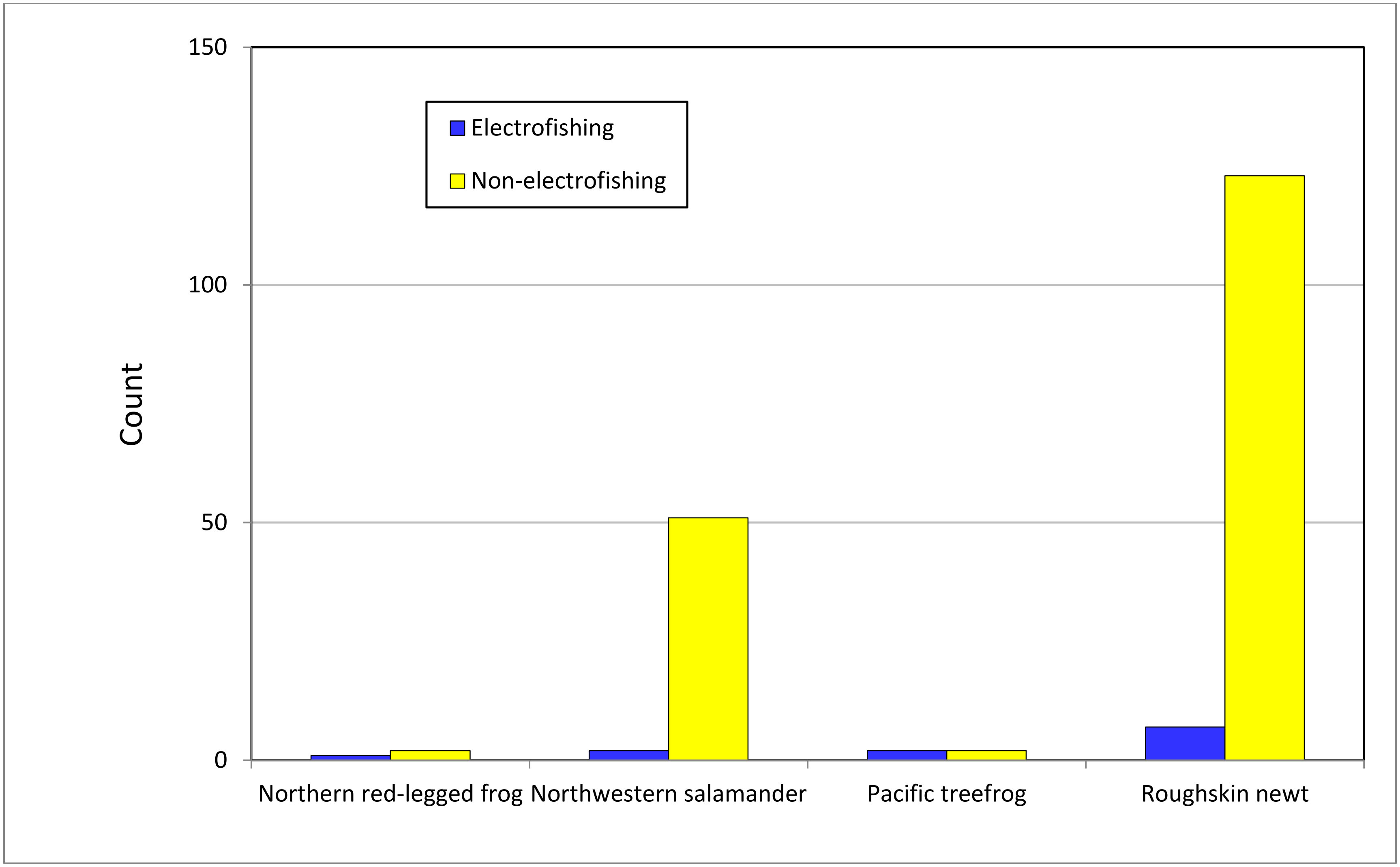


Figure 2. Comparison of 11 May 2016 effort between electrofish and non-electrofish sampling (i.e., dip net, collapsible minnow trap and fyke net sampling combined) for different fish at the Weyerhaeuser intensive site.



Christin, the intensive site next most proximate to the proposed dam (**Table 1**), is largely separated from the Chehalis mainstem by the berm for the old railroad grade now part of the Willapa Hills Trail system. At least one culvert connects the Christin off-channel wetland to the mainstem through this berm, but that culvert appears partly debris obstructed, so this may affect changes in water levels in this wetland during high water events. Three drainages also feed this wetland from upslope, and two of these have year-round water input. The Christin site is largely surrounded by riparian forest dominated by Big-leaf maple (*Acer macrophylum*) through a fenced pasture that approaches the northwest margin. Four of the five native amphibian species found in the Weyerhaeuser pond were also present in the Christin wetland (**Figure 3**); only Pacific treefrog was not recorded at Christin. Also similar to the Weyerhaeuser pond, some adult newts were observed at every sampling round, though in much lesser numbers than in the Weyerhaeuser pond (compare **Figures 1** and **3**). Further similar to the Weyerhaeuser pond, all amphibians except newts (see footnote 1) showed evidence of reproduction. However, both Long-toed and Northwestern salamanders showed no evidence of recruitment (i.e., larvae); and Northern red-legged frogs exhibited very little evidence of recruitment. Moreover, unlike the Weyerhaeuser pond, we recorded no larval newts during the October-February interval. We also found amphibian numbers generally depressed in the November-January interval.

We also recorded at least nine fish species in the Christin wetland, five native species (**Figure 4**) and at least four exotic species (**Figure 5**). Based on non-electrofish sampling, we recorded exotic fish species (n = 38) over twice as frequently as native fishes (n = 14; compare **Figures 4** and **5**). All exotic fishes were centrarchids, including Bluegill (*Lepomis macrochirus*), Largemouth bass (*Micropterus salmoides*), Pumpkinseed (*Lepomis gibbosus*), and Rock bass (*Ambloplites rupestris*). Of exotic fishes, Largemouth bass was the most frequently recorded (**Figure 5**). The seven individuals of unknown sunfishes (**Figure 5**), all juveniles, are likely Bluegill or Pumpkinseed, but we cannot exclude a possible third sunfish species. Species verification of these juveniles based on genetic evaluation of their sampled tissues is pending.

Electrofishing done during the 8th sampling round (17 May 2016) gave a somewhat different result, recording almost three times as many native fishes as exotic fishes (**Figure 6**). Though electrofishing was uniformly more successfully than non-electrofish sampling for the six fish taxa recorded on 17 May (**Figure 6**), we did not record any taxa with electrofishing that had not already been recorded with non-electrofishing methods on other dates. However, on the 17 May date, we recorded five of the six fish taxa found only with electrofishing, and the sixth taxon, the unknown sunfishes (all juveniles), was recorded more frequently with electrofishing than with non-electrofish sampling in a 5-to-3 ratio (**Figure 6**). Notably, the electrofishing effort did not record any amphibians.

Figure 3. Time Series of Native Amphibian Life Stages for the Christin Intensive Site – includes all sampling except the 17 May 2016 electrofishing effort which captured no amphibians.

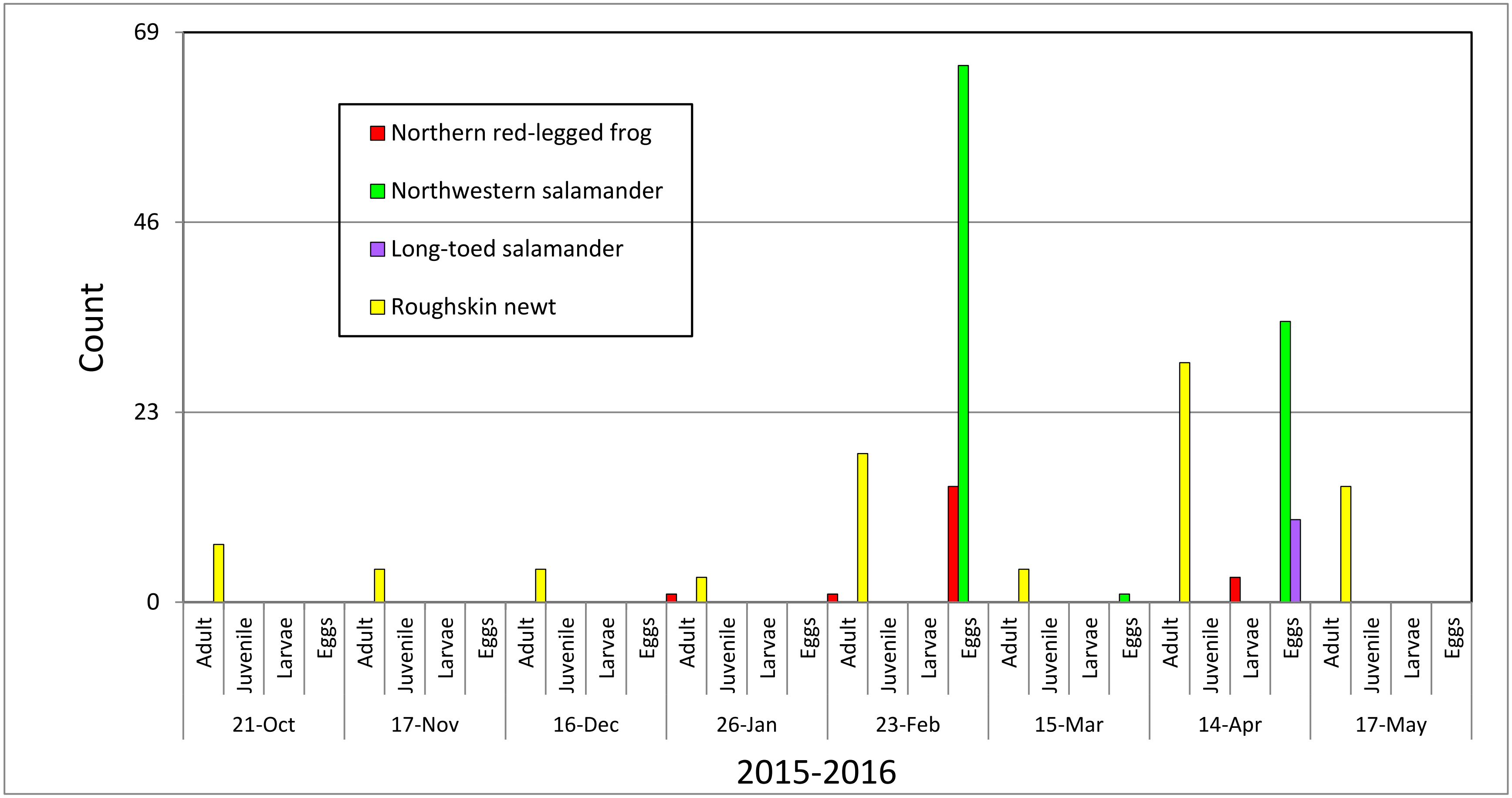


Figure 4. Time Series of Native Fishes for the Christin Intensive Site – includes all sampling except the 17 May 2016 electrofishing effort.

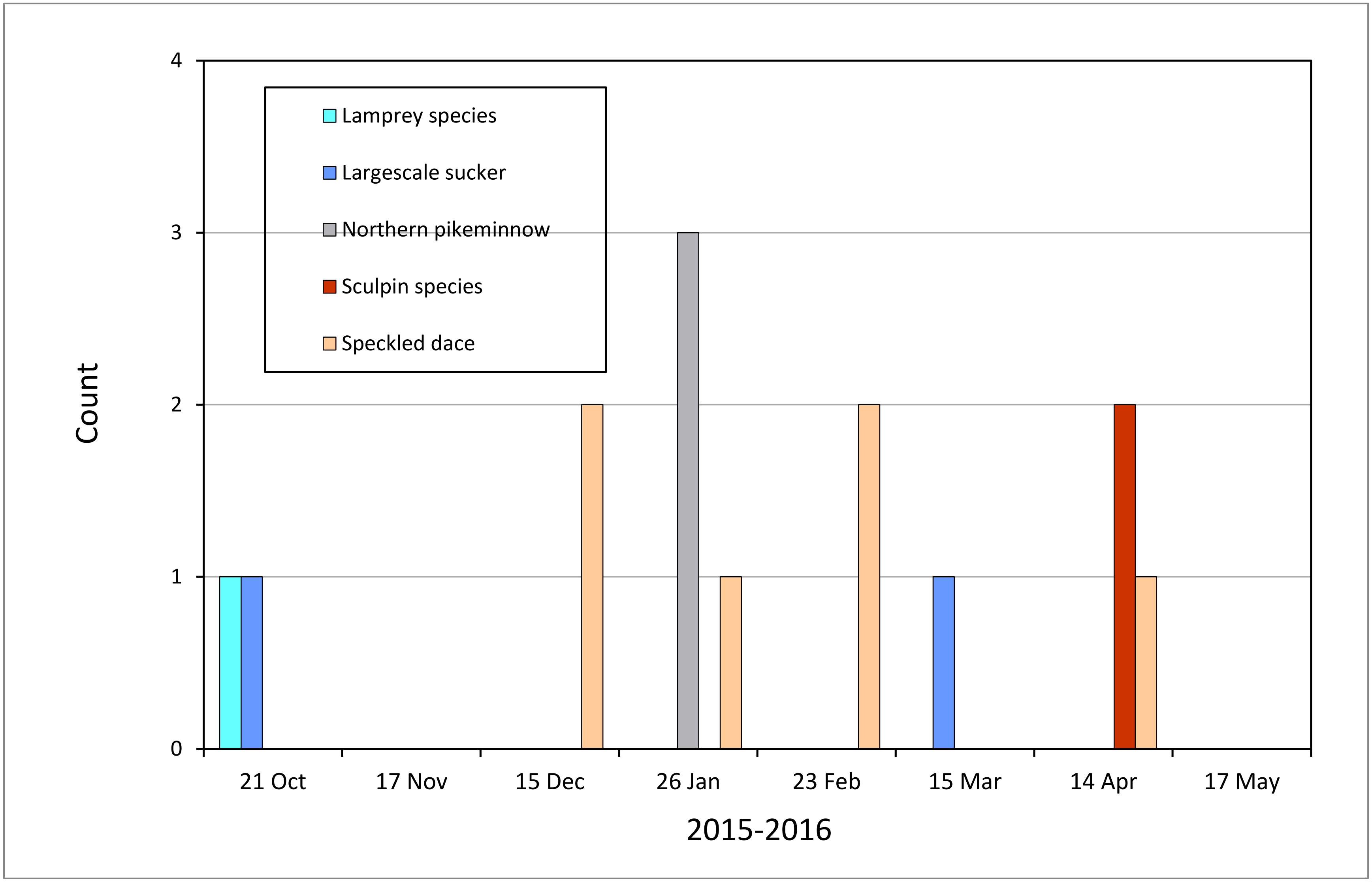


Figure 5. Time Series of Exotic Fishes for the Christin Intensive Site – includes all sampling except the 17 May 2016 electrofishing effort.

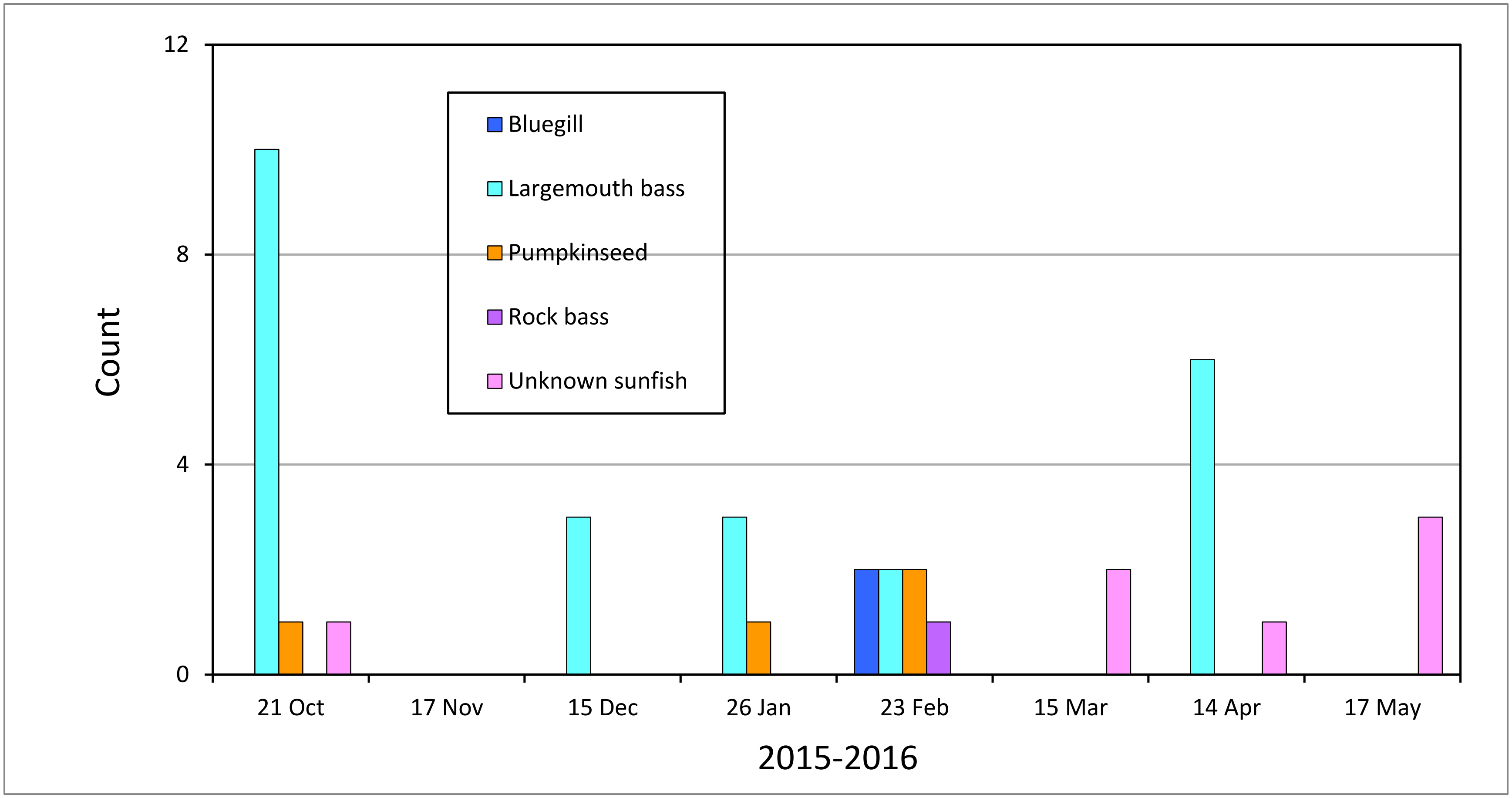
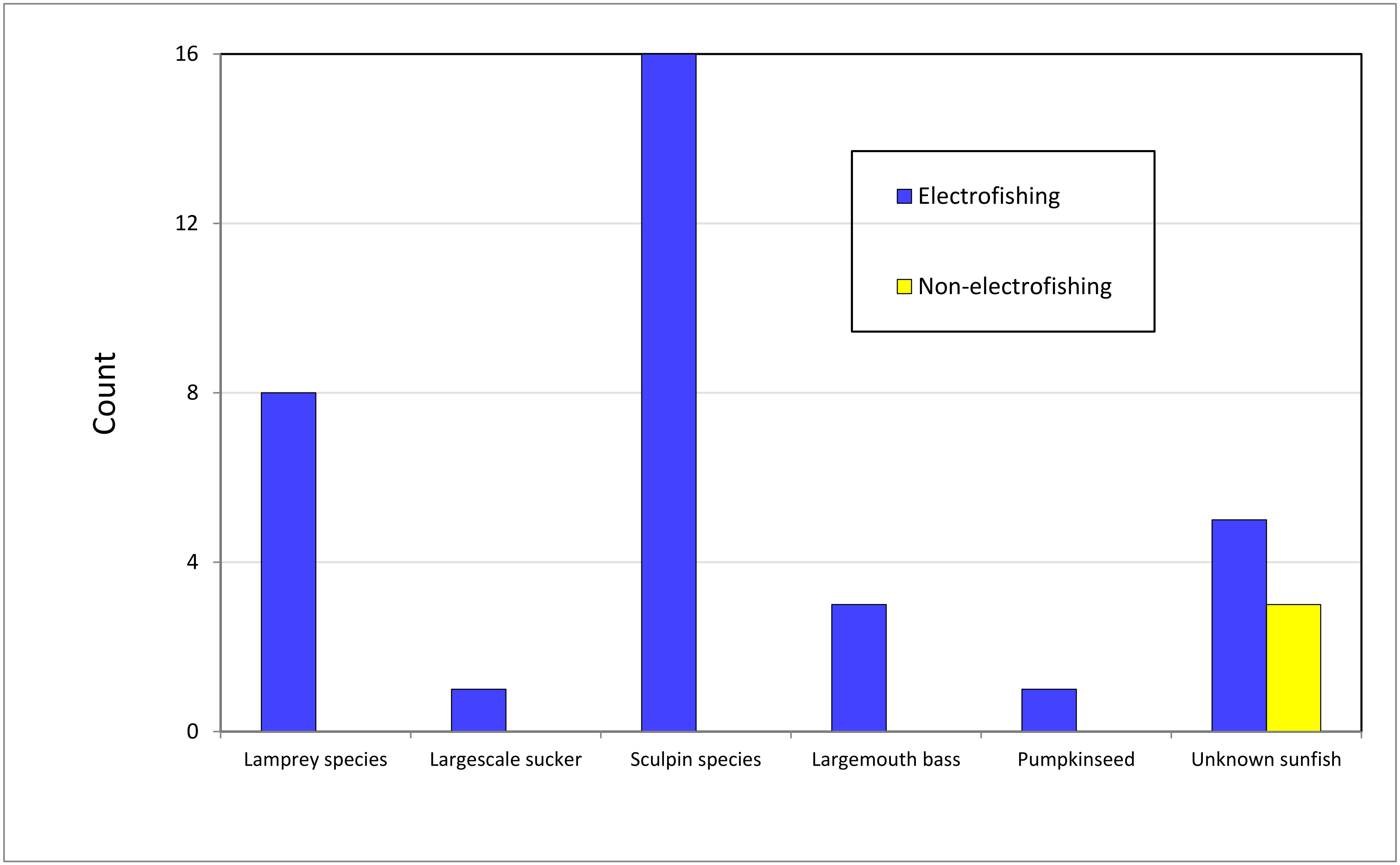


Figure 6. Comparison of 17 May 2016 effort between electrofish and non-electrofish sampling (i.e., dip net, collapsible minnow trap and fyke net sampling combined) for different fish at the Christin intensive site.



The next two intensive sites, Osborn and Styger, are located nearly the same distance downstream from the proposed dam (**Table 1**). However, Osborn is located on the north bank of Chehalis River floodplain, whereas Styger is located on its south bank. We address Osborn first.

The Osborn intensive site is a classic horseshoe-shape oxbow imbedded within a pasture and plowed field landscape. Within that landscape, most of its margin is lined with herbaceous and shrubby vegetation; only a few tree-sized Douglas-fir, Big-leaf maple, and Oregon ash (*Fraxinus latifolia*) were scattered along its margin. That herbaceous/shrubby margin is no more than 10 meters wide, edging the pastures or plowed fields of the surrounding landscape. The Osborn oxbow was seasonally connected with the Chehalis River mainstem at high water in each year of our observations (2015-2016), but became disconnected for over half the year annually during low flow, appearing to maintain a permanent hydrology. Most of the Osborn oxbow is steep-sided and has slowly graded shallowing only on its ends and in one small side arm.[2] Osborn differed from all the other intensive sites by having the most limited evidence of native amphibian reproduction, seven eggs masses or packets collectively laid by three species (**Figure 7**). In contrast, we recorded >100 American bullfrog (*Lithobates catesbeianus*) life stages at Osborn, mostly as larvae (**Figure 8**). Based on non-electrofishing methods, we also recorded a modest number of observations (n = 32) of at least three native fish species, mostly Northern pikeminnow (*Ptychocheilus oregonensis*) and sculpins (*Cottus* sp.; **Figure 9**). In contrast, we recorded seven times as many observations of exotic fishes (n = 243; **Figure 10**), representing at least six species, but Brown bullhead (*Ameiurus nebulosus*) were numerically dominant (n = 200; **Figure 10**). Similar to the Christin site, we found two juvenile sunfishes that could not be visually identified (**Figure 10**); these may be Bluegill or Pumpkinseed, but a possible third sunfish species cannot be excluded; species verification of these juveniles based on genetic evaluation of their sampled tissues is pending. We conducted electrofish sampling at Osborn during the 7th round of sampling on 26 April 2016. For the six fish taxa that could be compared, electrofishing was uniformly better than non-electrofishing methods for all taxa except sculpins, for which it was precisely the reverse (**Figure 11**). As with the Christin site, we did not retrieve any amphibians with electrofish sampling.

In many respects, the Styger intensive site is the opposite of Osborn. In particular, Styger is topographically complex. Though Styger has a permanent hydroperiod and is fed at least partially by decades-old drain tiles from adjacent fields, its seasonal variation appears substantial. In the extreme drought year of 2015, Styger came close to drying. However, Styger's regular seasonal spring connection with the Chehalis mainstem at high water appears to last longer than at Osborn. Styger is imbedded in a landscape that is a mosaic of agricultural fields and riparian forest. Black cottonwoods (*Populus trichocarpa*) and Big-leaf maple dominate the

[2] The small side of the Osborn oxbow, located on its north side, appears excavated.

Figure 7. Time Series of Native Amphibian Life Stages for the Osborn Intensive Site – includes all sampling except the electrofishing portion of the 26 Apr 2016 date.

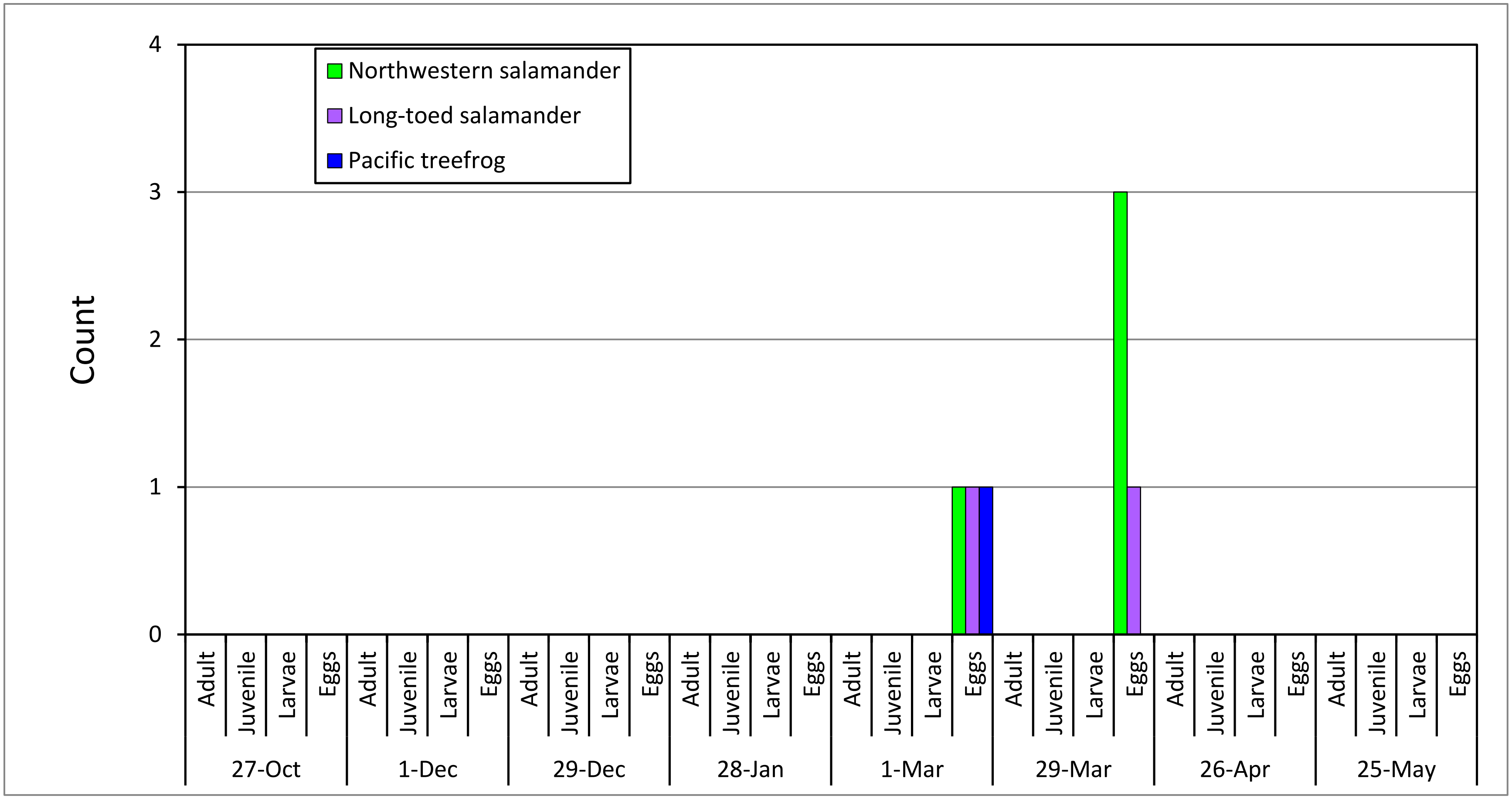


Figure 8. Time Series of American Bullfrog Life Stages for the Osborn Intensive Site – includes all sampling except the electrofishing portion of the 26 Apr 2016 date.

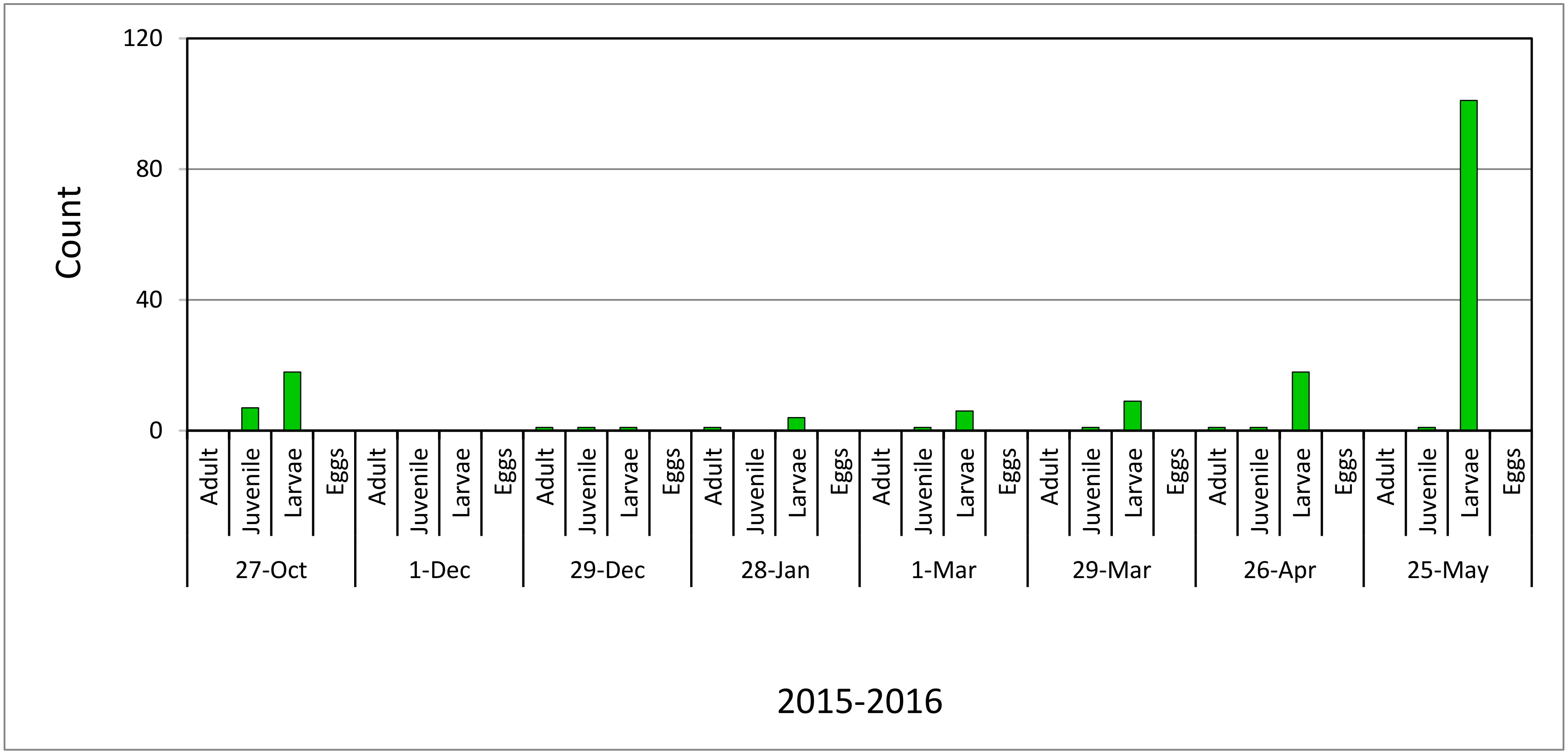


Figure 9. Time Series of Native Fish Life Stages for the Osborn Intensive Site – includes all sampling except the electrofishing portion of the 26 Apr 2016 date. One native fish species, Largescale sucker (*Catostomus macrocheilus*), recorded as only two individuals during electrofishing is not shown here; see **Figure 10** for those data.

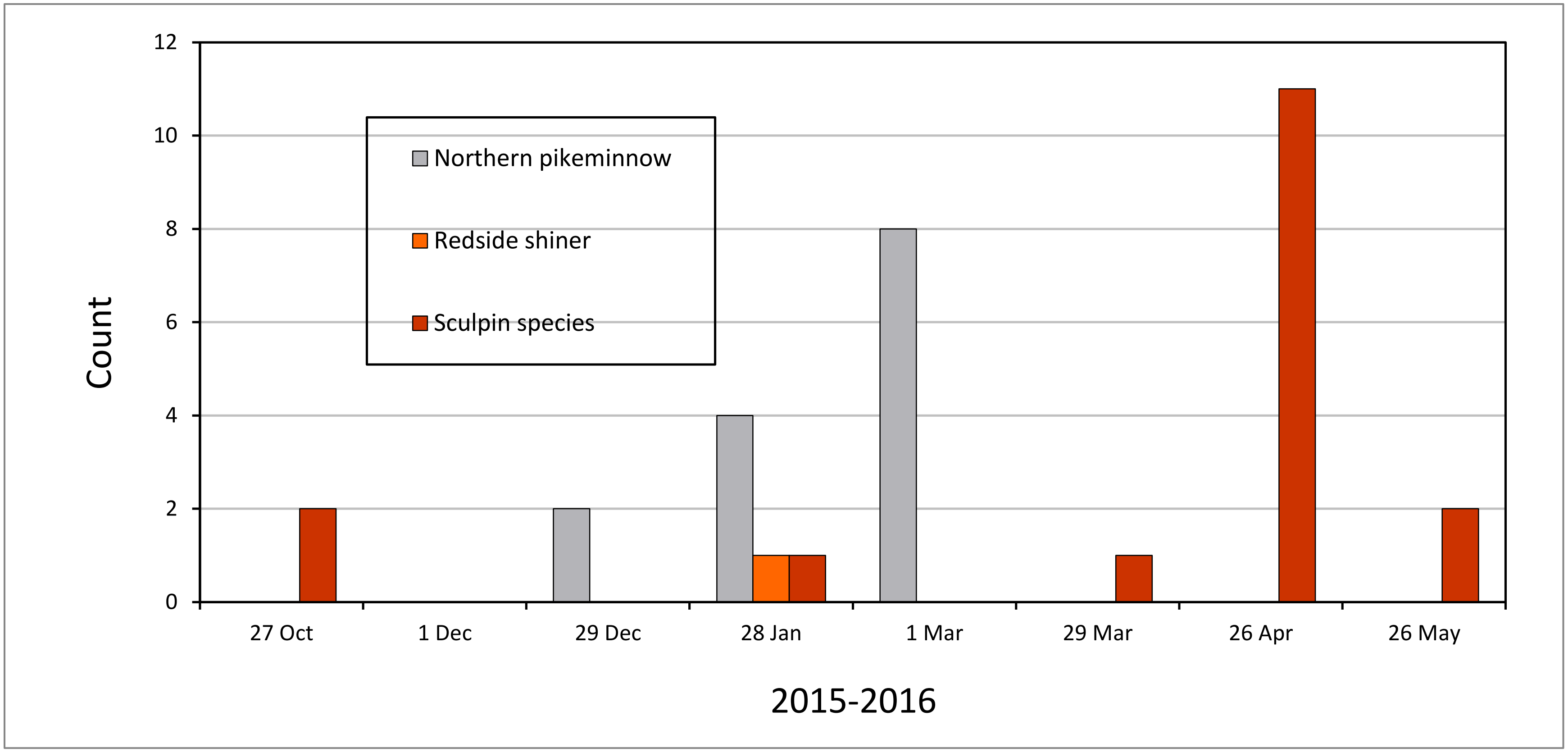


Figure 10. Time Series of Exotic Fish Life Stages for the Osborn Intensive Site – includes all sampling except the electrofishing portion of the 26 Apr 2016 date.

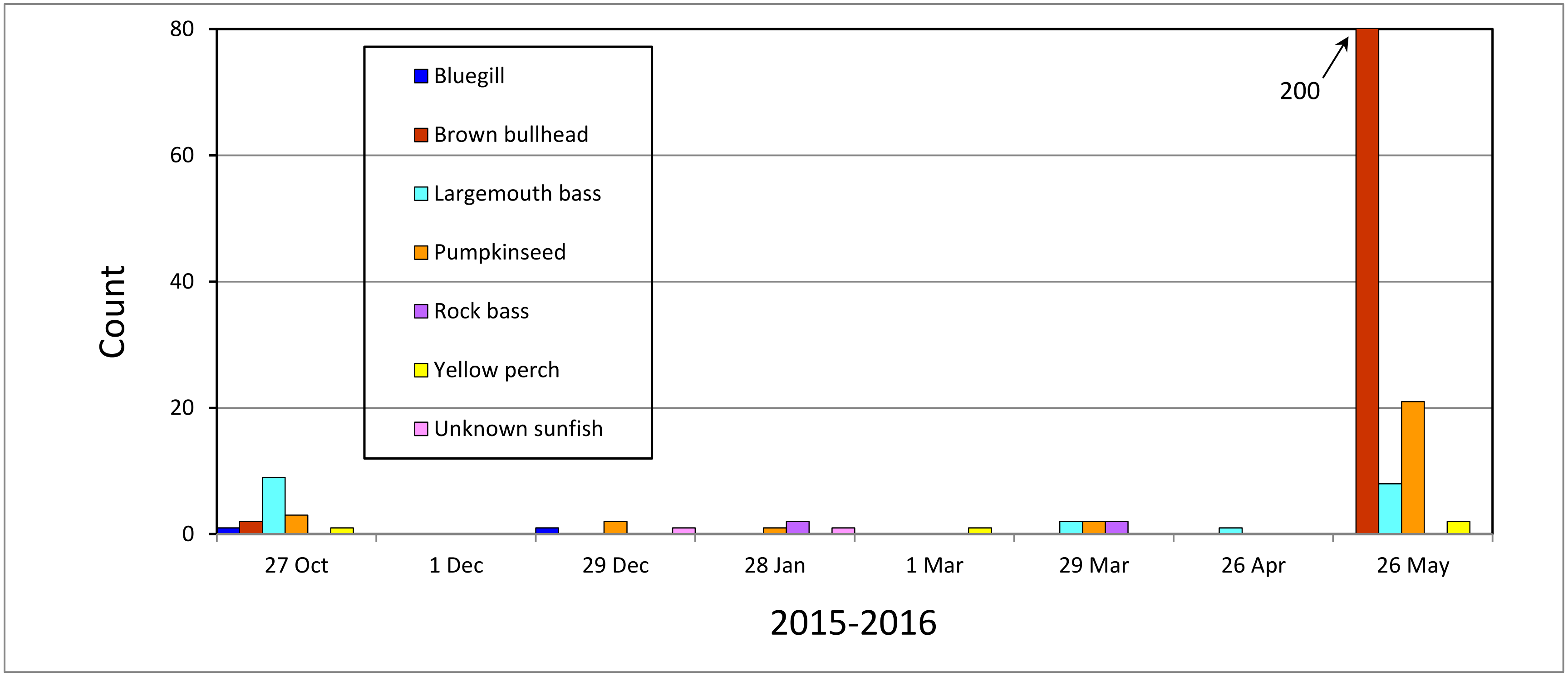
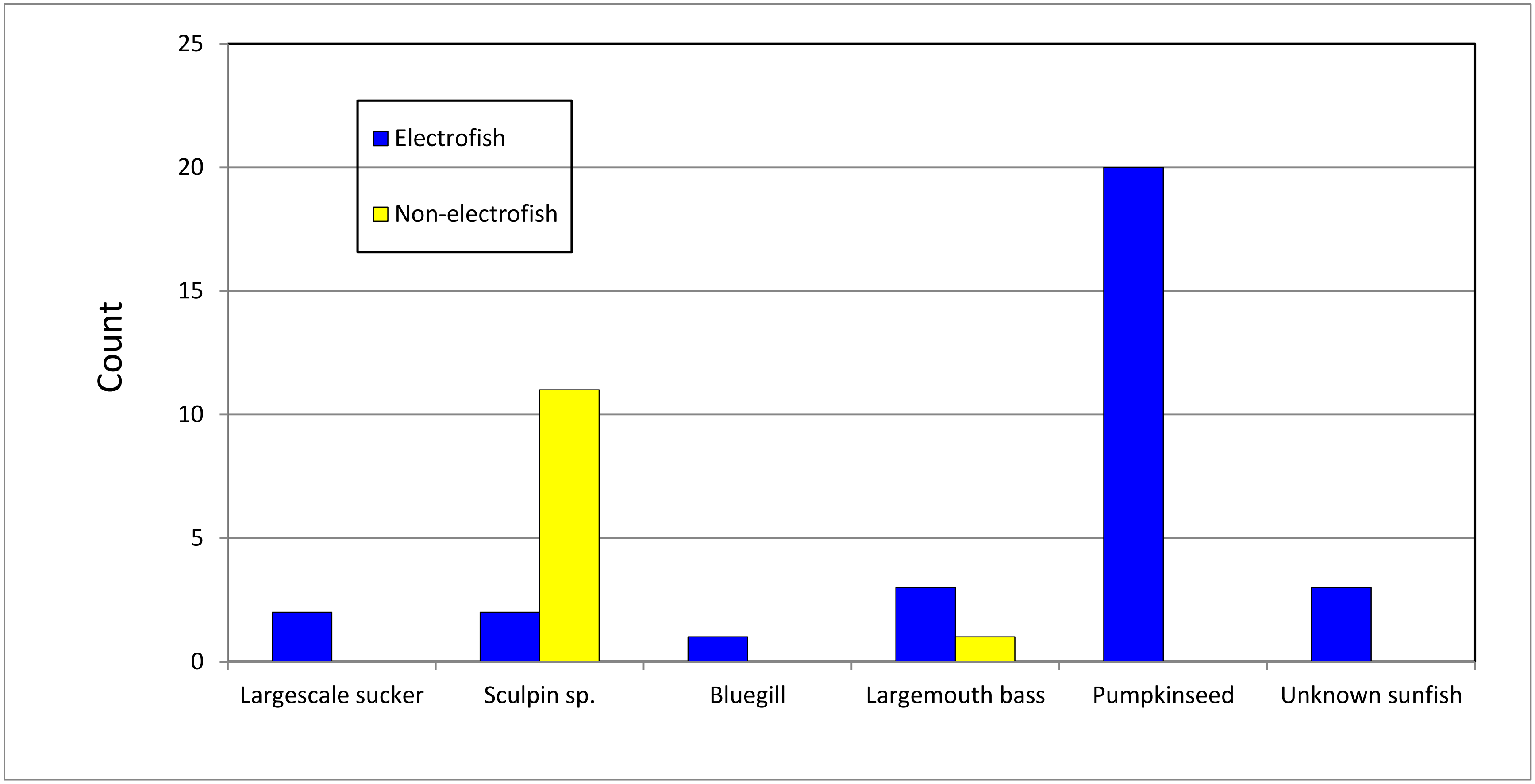


Figure 11. Comparison of 26 April 2016 effort between electrofish and non-electrofish sampling (i.e., dip net, collapsible minnow trap and fyke net sampling combined) for different fishes at the Osborn intensive site.



riparian forest. We recorded all five native amphibians at Styger that we documented at the Weyerhaeuser site (compare **Figures 12** and **Figure 1**). However, native amphibians at Styger differed from the assemblage at Weyerhaeuser in two important ways: first, Roughskin newts were infrequent (7 observation overall: 3 adults and 4 larvae); and second, all native amphibians showed evidence of modest to high levels of recruitment (**Figure 12**). We made a modest number (n = 38) of observations of American bullfrogs at Styger (**Figure 13**) but found no exotic fishes. In contrast, native fishes, especially Three-spined stickleback (*Gasterosteus aculeatus*) were seasonally abundant at Styger (**Figure 14**). Non-electrofishing methods were generally more effective for the fish and amphibian taxa at this site, the sole exception being Pacific treefrogs, for which electrofishing appeared to perform slightly better (**Figure 15**).

Dick, the fifth intensive site, is a crescent-shaped oxbow located on the southwest bank of the Chehalis River somewhat downstream of the confluence with the Black River (**Table 1**). The Dick site is largely surrounded by a broad band of riparian forest dominated by Big-leaf maple, Black cottonwood, and Oregon ash; outside this band is a mosaic of agriculture and more riparian forest. The Dick site appears to have a permanent hydroperiod and a regular seasonal hydrological connection with the Chehalis mainstem. We recorded all five native amphibian species at Dick that we found at Styger and Weyerhaeuser (compare **Figure 16** to **Figures 12** and **1**). Similar to Styger, Roughskin newts were infrequent and recruitment of native amphibians seemed more substantial; however, unlike Styger, Long-toed salamander was a less important part of the native amphibian assemblage (compare **Figures 16** and **12**). Dick was also similar to Styger in possessing modest numbers of American bullfrog life stages (compare **Figures 17** and **13**). However, based on non-electrofishing methods, Dick diverged from Styger in its high species richness of both native (**Figure 18**) and exotic fishes (**Figure 19**). In particular, Dick harbored at least eight native fish taxa, though Three-spine stickleback was numerically dominant (**Figure 18**). Dick also harbored at least six exotic fish species, though with the exception of Largemouth bass, for which large numbers of juveniles were recorded, remaining exotic fishes were found in more modest numbers (**Figure 19**).

Based on information from the 7th round (28 April) electrofishing effort, electrofishing detected one species, Bluegill, not found with non-electrofishing methods (**Figure 20**). Further, electrofishing performed better than non-electrofishing methods for at least four centrarchid taxa as well as for Largescale sucker and Yellow perch (*Perca flavescens*), but performed more poorly than non-electrofishing methods for American bullfrog, Northern red-legged frog and lamprey (**Figure 20**).

The last site, Hoxit 2, was the downstream-most intensive site (**Table 1**). A Washington Department of Fish and Wildlife-managed site, Hoxit 2’s hydrology may be partially influenced by an adjacent wetland containing a small dam that helps maintain its aquatic footprint. The culvert in this dam has a water control structure, and its water level is drawn down seasonally

Figure 12. Time Series of Native Amphibian Life Stages for the Styger Intensive Site – includes all sampling except the 1st (23 October 2015) date, and the electrofishing portion of the 19 May 2016 date, neither of which captured any native amphibians.

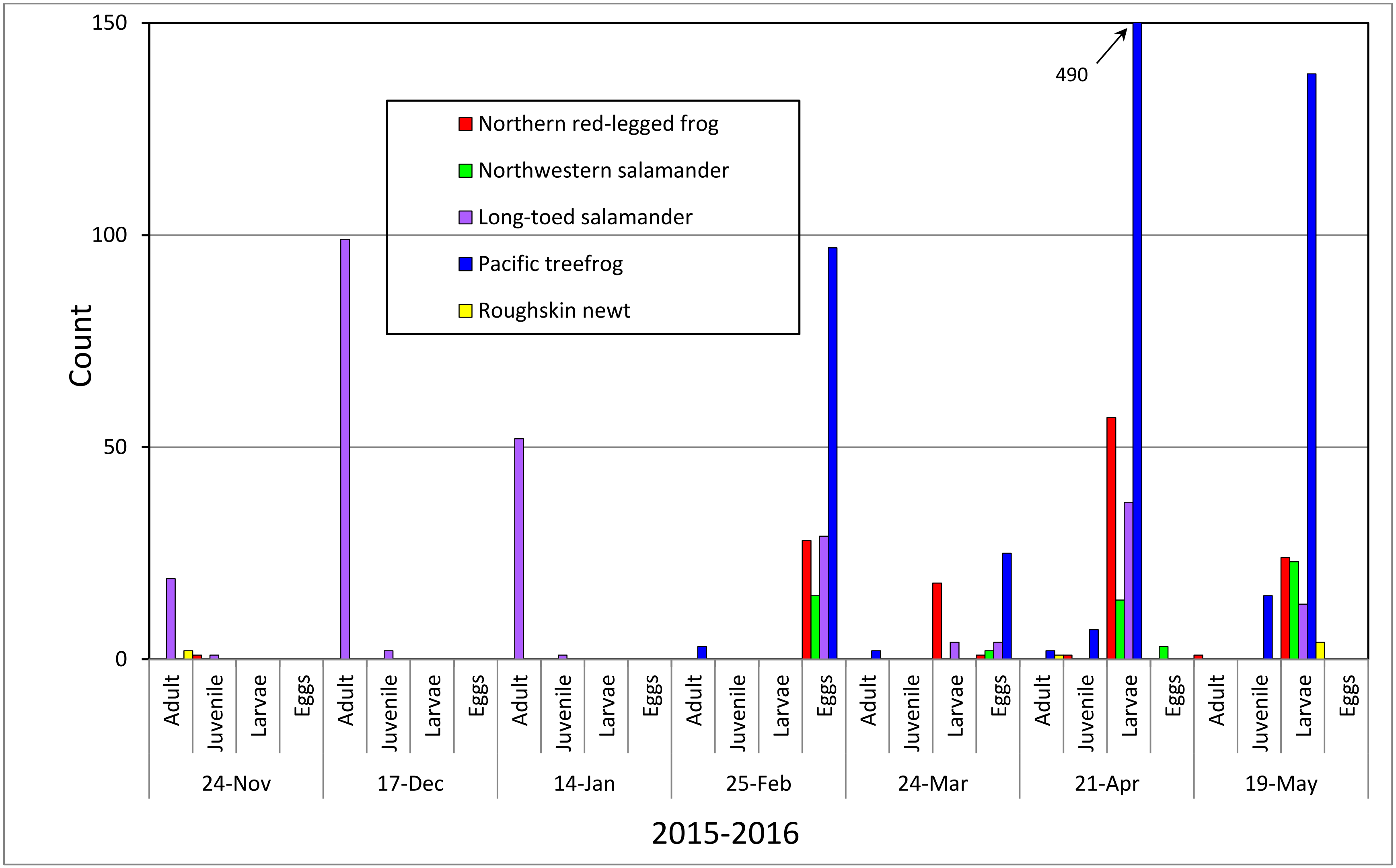


Figure 13. Time Series of American bullfrog Life Stages for the Styger Intensive Site – includes all sampling except the 1st (23 October 2015) date, and the electrofishing portion of the 19 May 2016 date, neither of which captured any American bullfrogs.

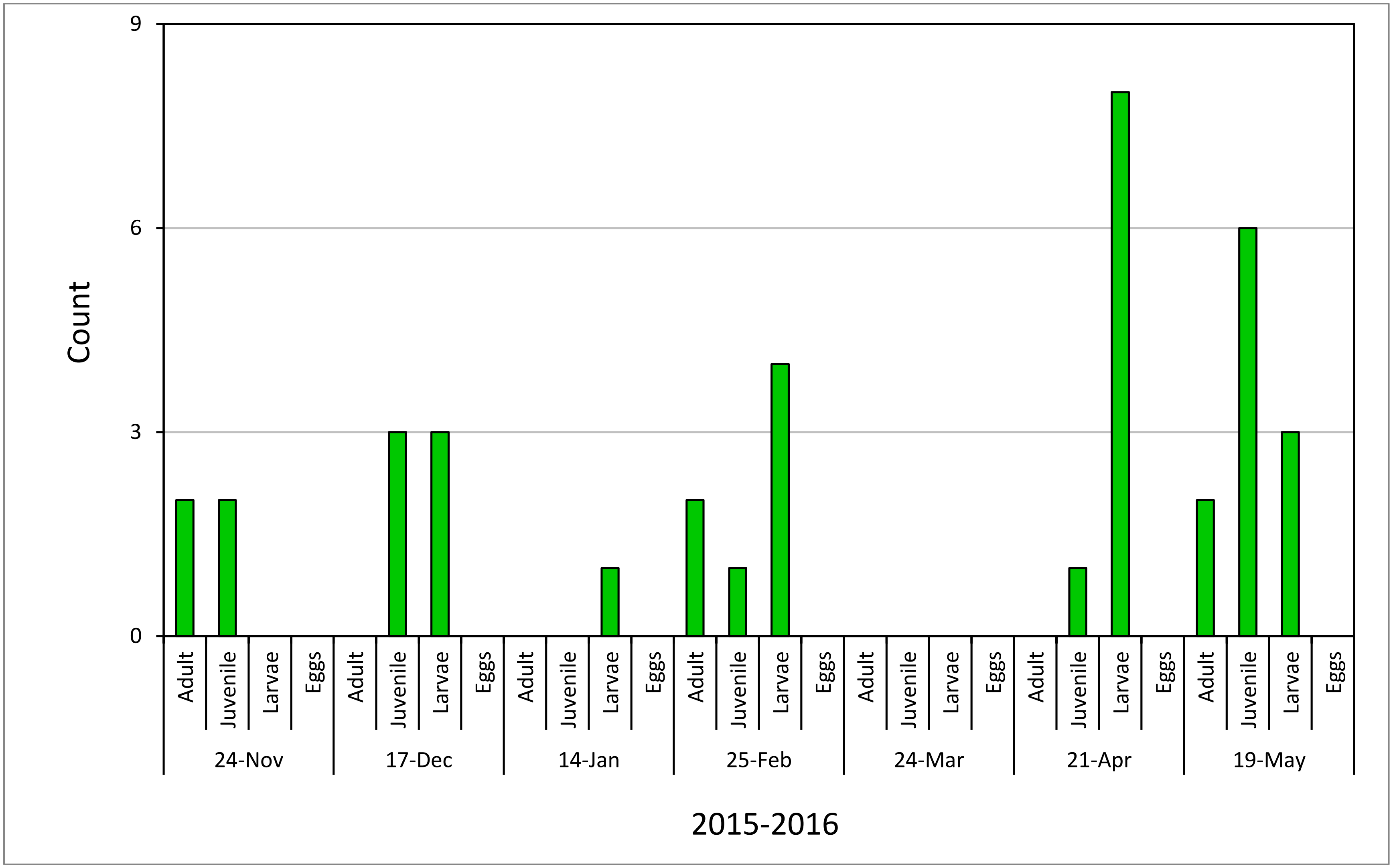


Figure 14. Time Series of Native Fishes for the Styger Intensive Site – includes all sampling except the 1st (23 October 2015) date, at which time no native fishes were captured, and the electrofishing portion of the 19 May 2016 date.

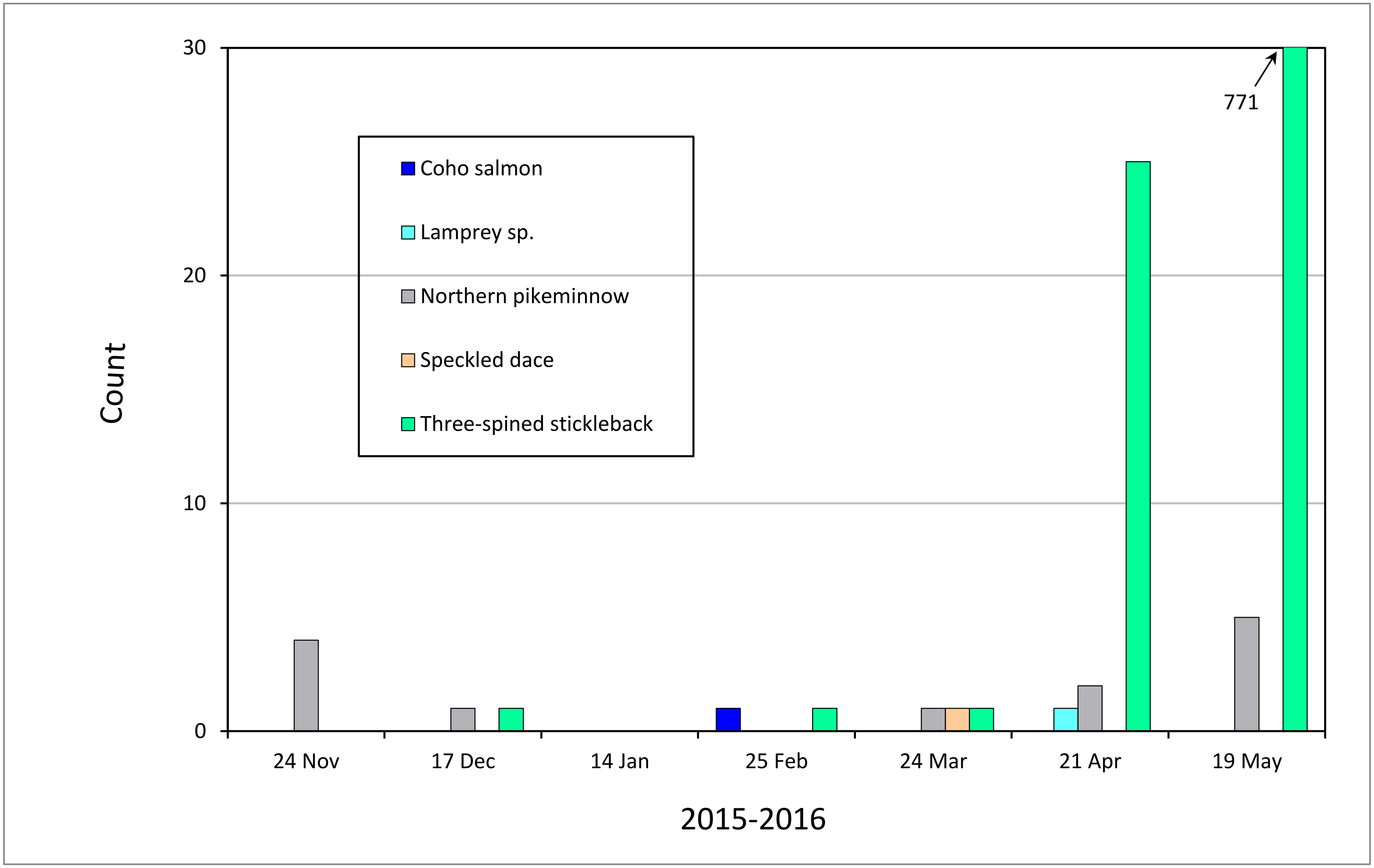


Figure 15. Comparison of 19 May 2016 effort between electrofish and non-electrofish sampling (i.e., dip net, collapsible minnow trap and fyke net sampling combined) for different amphibians and fishes at the Styger intensive site. Six larvae of an unidentified species of mole salamander that could have been either Long-toed salamander or Northwestern salamander are not shown.

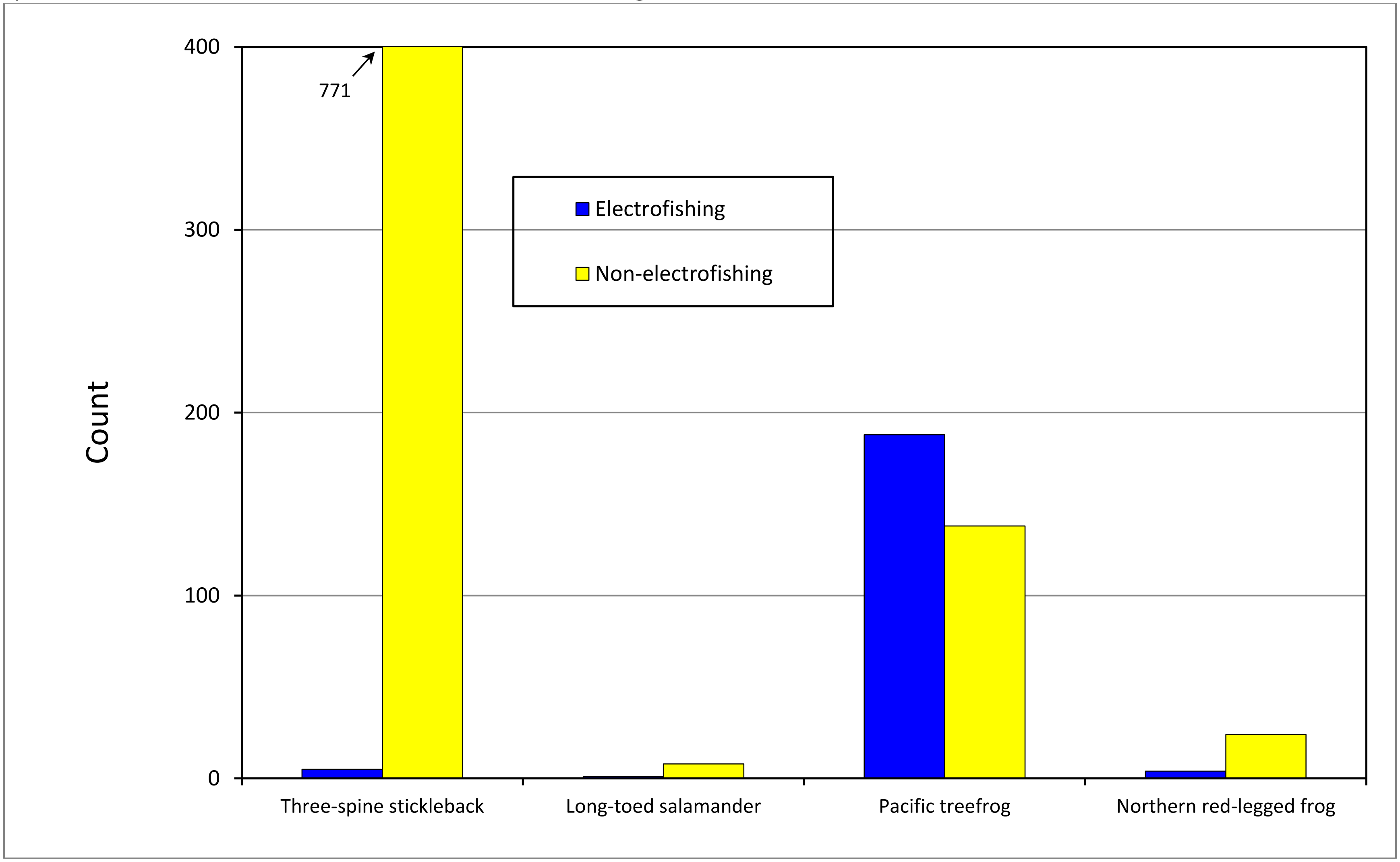


Figure 16. Time Series of Native Amphibian Life Stages for the Dick Intensive Site – includes all sampling except the 1st (3 November 2015) date, at which time no amphibians were recorded, and the electrofishing portion of the 28 Apr 2016 date.

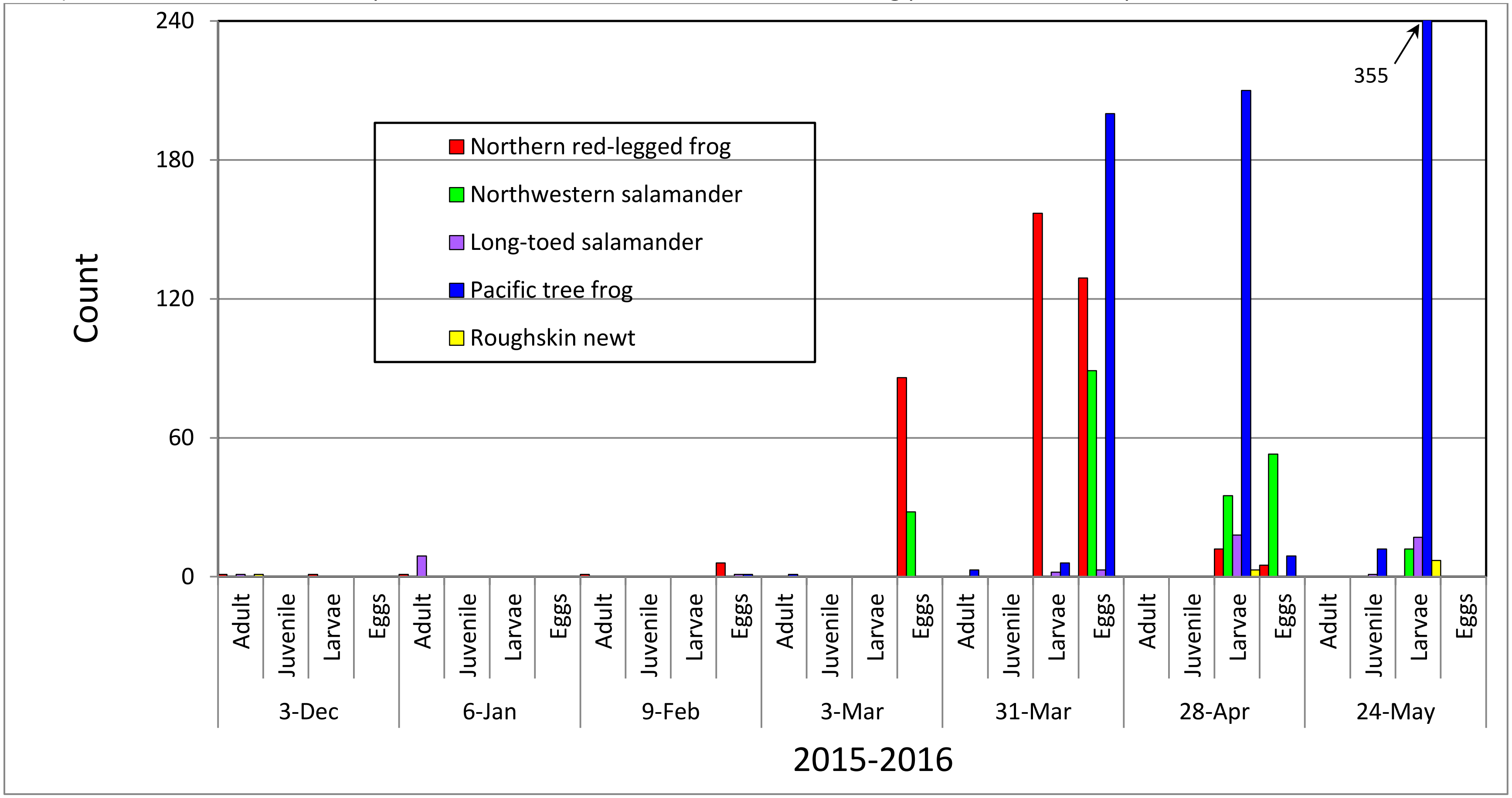


Figure 17. Time Series of American bullfrog Life Stages for the Dick Intensive Site – includes all sampling except the 1st (3 November 2015) date, at which time no American bullfrogs were recorded, and the electrofishing portion of the 28 Apr 2016 date.

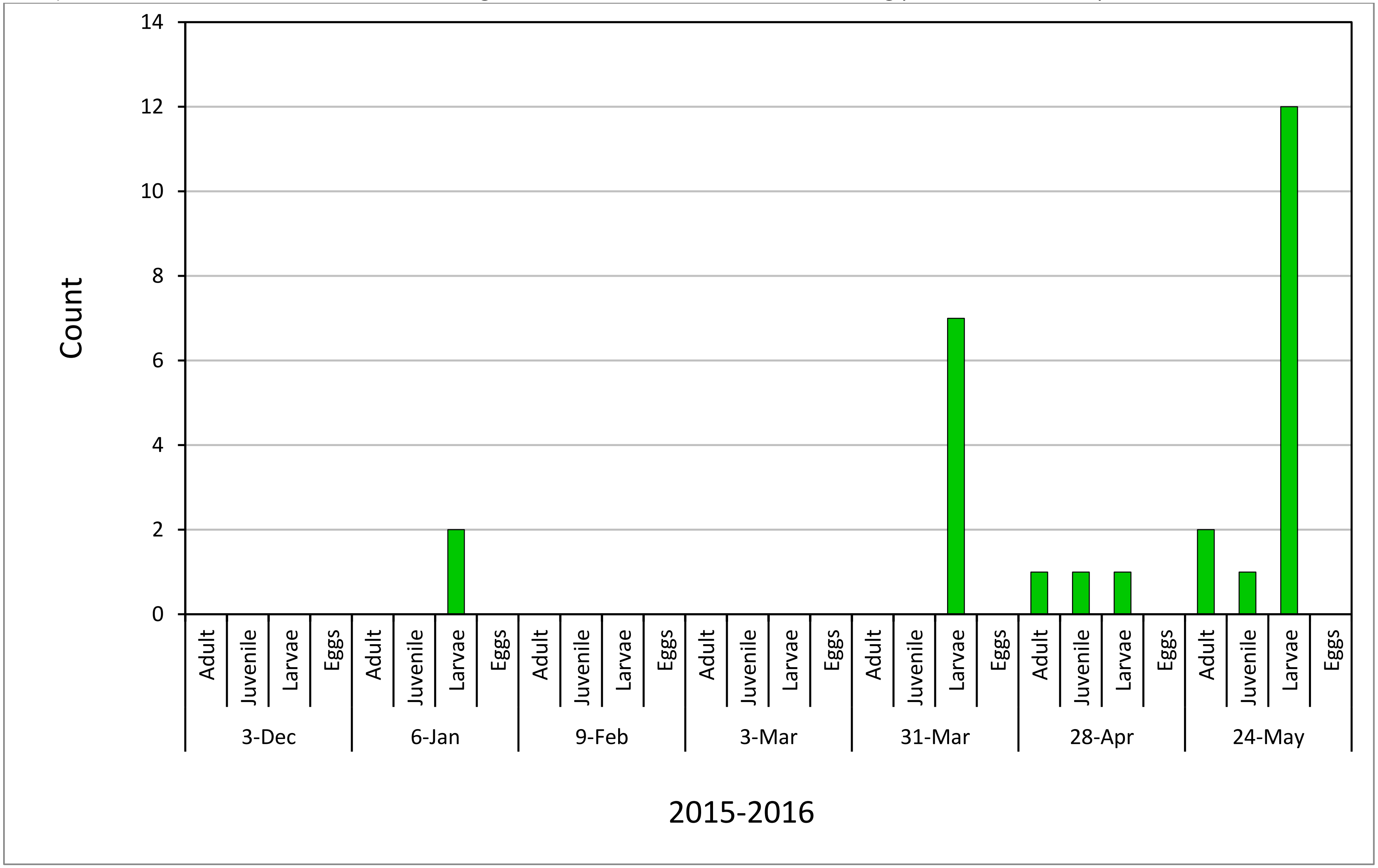


Figure 18. Time Series of Native Fish Life Stages for the Dick Intensive Site – includes all sampling except the electrofishing portion of the 28 Apr 2016 date.

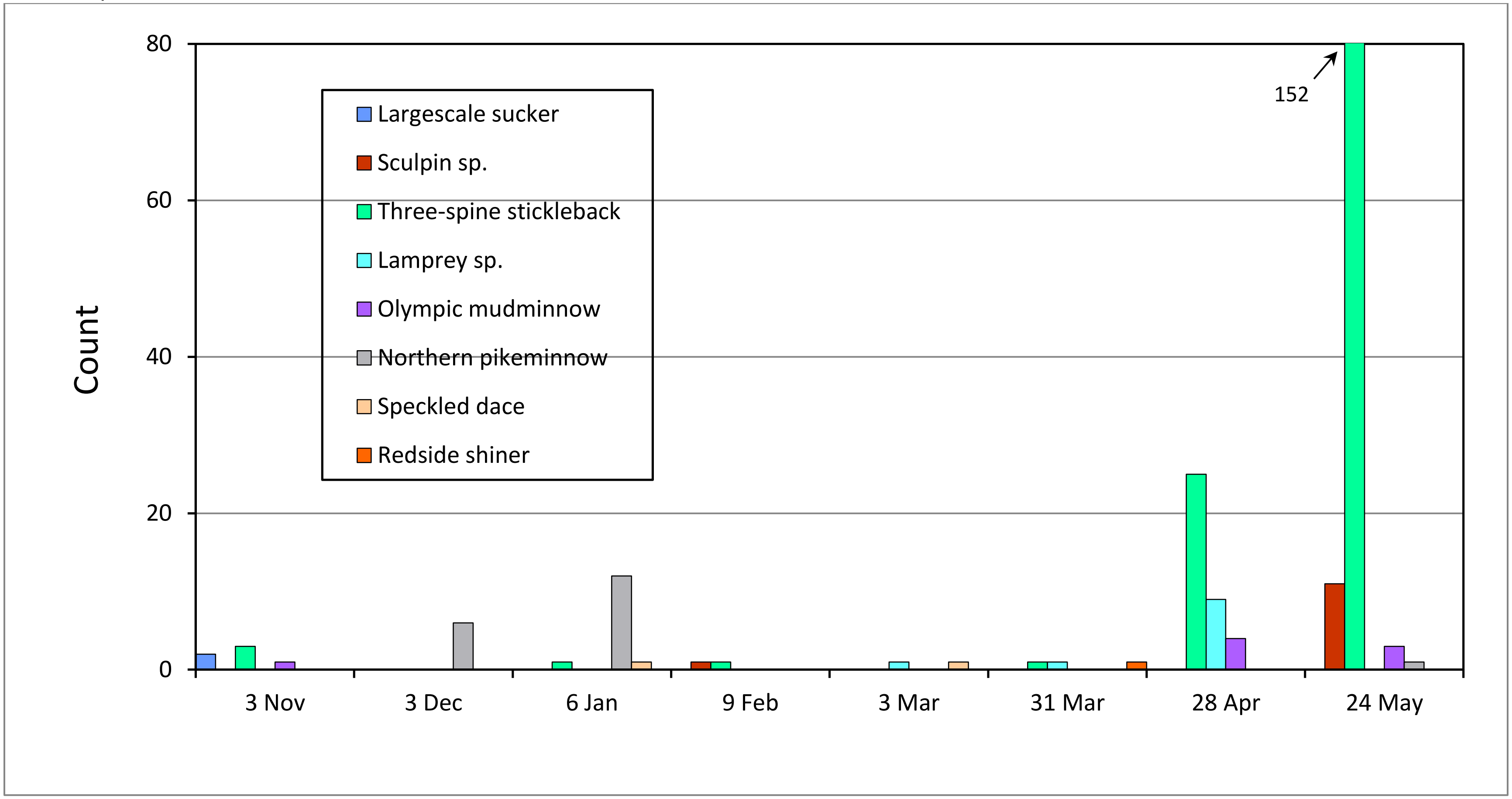


Figure 19. Time Series of Exotic Fish Life Stages for the Dick Intensive Site – includes all sampling except the electrofishing portion of the 28 Apr 2016 date. One species, bluegill, caught exclusively with electrofishing is not shown; Bluegill data are shown on Figure 19.

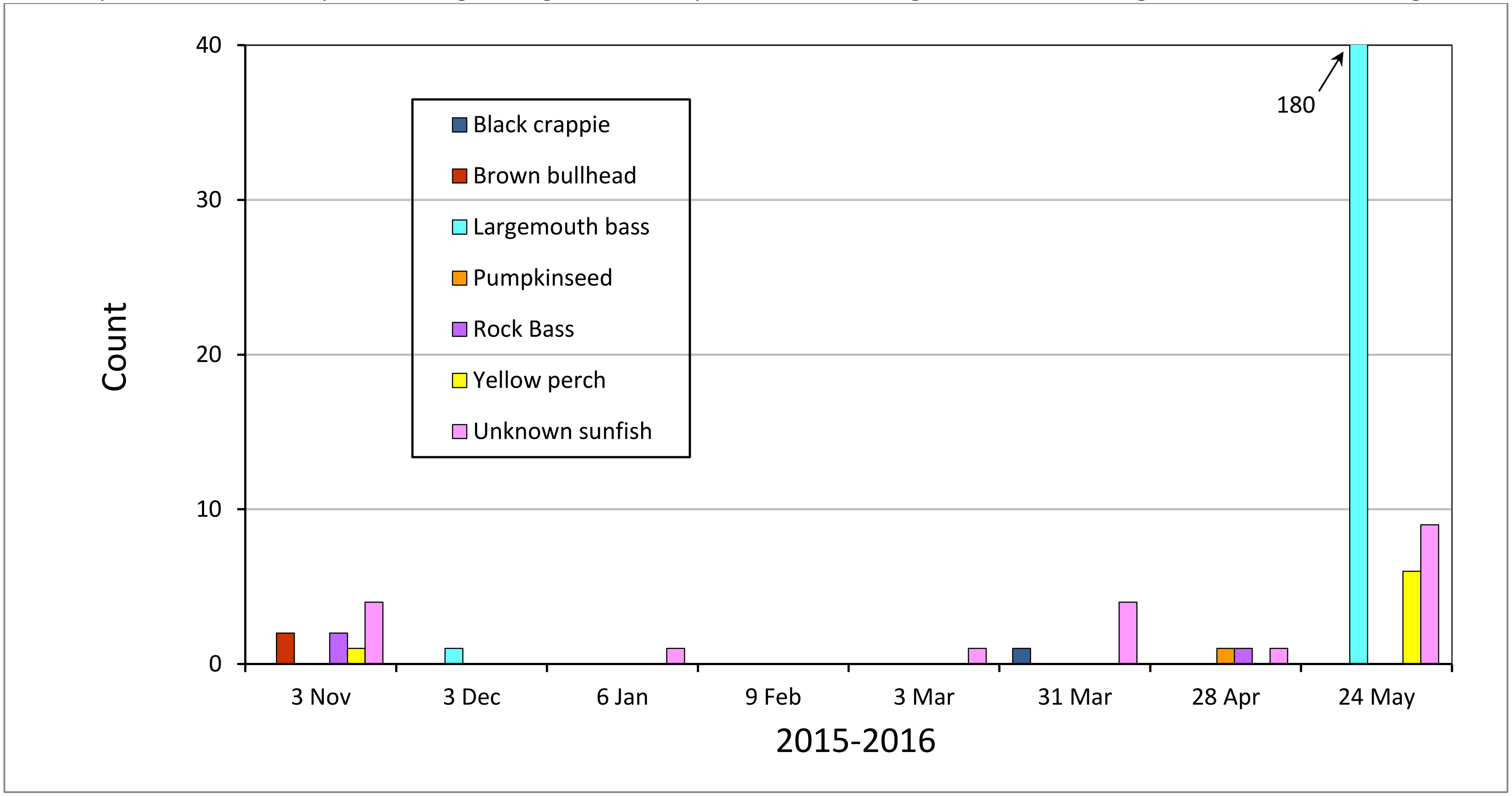
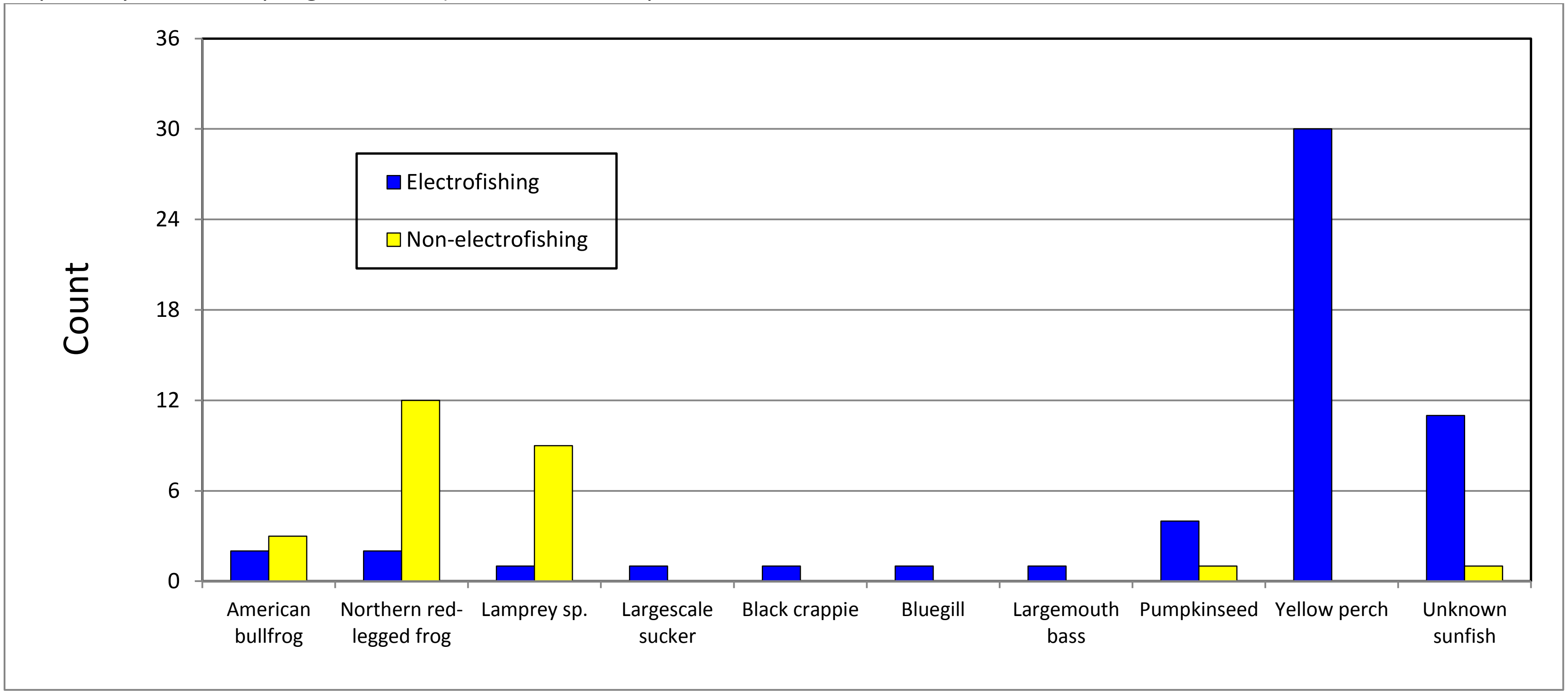


Figure 20. Comparison of 28 April 2016 effort between electrofish and non-electrofish sampling (i.e., dip net, collapsible minnow trap and fyke net sampling combined) for different amphibians and fishes at the Dick intensive site.



to a smaller pool in part to enable haying of adjacent pasture on its west side and in part to maintain vegetated waterfowl habitat within the aquatic footprint. The outflow below Hoxit 2 has a direct connection to the Chehalis River mainstem, albeit through a relic beaver dam that is not actively maintained by beavers and during seasonal high water in most years, the entire area inundates. We recorded the same four native amphibian species at Hoxit 2 that were found at the Christin intensive site (compare **Figure 21** to **Figure 3**), all except Pacific treefrog. Unlike Christin, however, Hoxit 2 appears to experience modest native amphibian recruitment and newts are infrequent. Most amphibian egg masses at Hoxit 2 were observed in an arm of the pond that is seasonal and somewhat isolated by berms. We also observed modest numbers (n = 63) of American bullfrogs at Hoxit 2 (**Figure 22**). Based on non-electrofishing methods, Hoxit 2 also had the highest fish species richness of any of the intensive sites, both for native fishes (at least seven taxa; **Figure 23**) and exotic fishes (at least nine taxa; **Figure 24**). Among native fishes, Northern pikeminnow was dominant (**Figure 23**); among exotic fishes, unknown sunfishes were dominant (**Figure 24**).

Electrofishing data from the 8th round (3 May 2016) revealed that centrarchid fish taxa were more successfully collected with electrofishing than with non-electrofishing methods. However, two native fishes (Northern pikeminnow and Three-spine stickleback) and American bullfrogs were collected more successfully with non-electrofishing methods during the same survey (**Figure 25**).

Figure 21. Time Series of Native Amphibian Life Stages for the Hoxit 2 Intensive Site – includes all sampling except the electrofishing portion of the 3 May 2016 date.

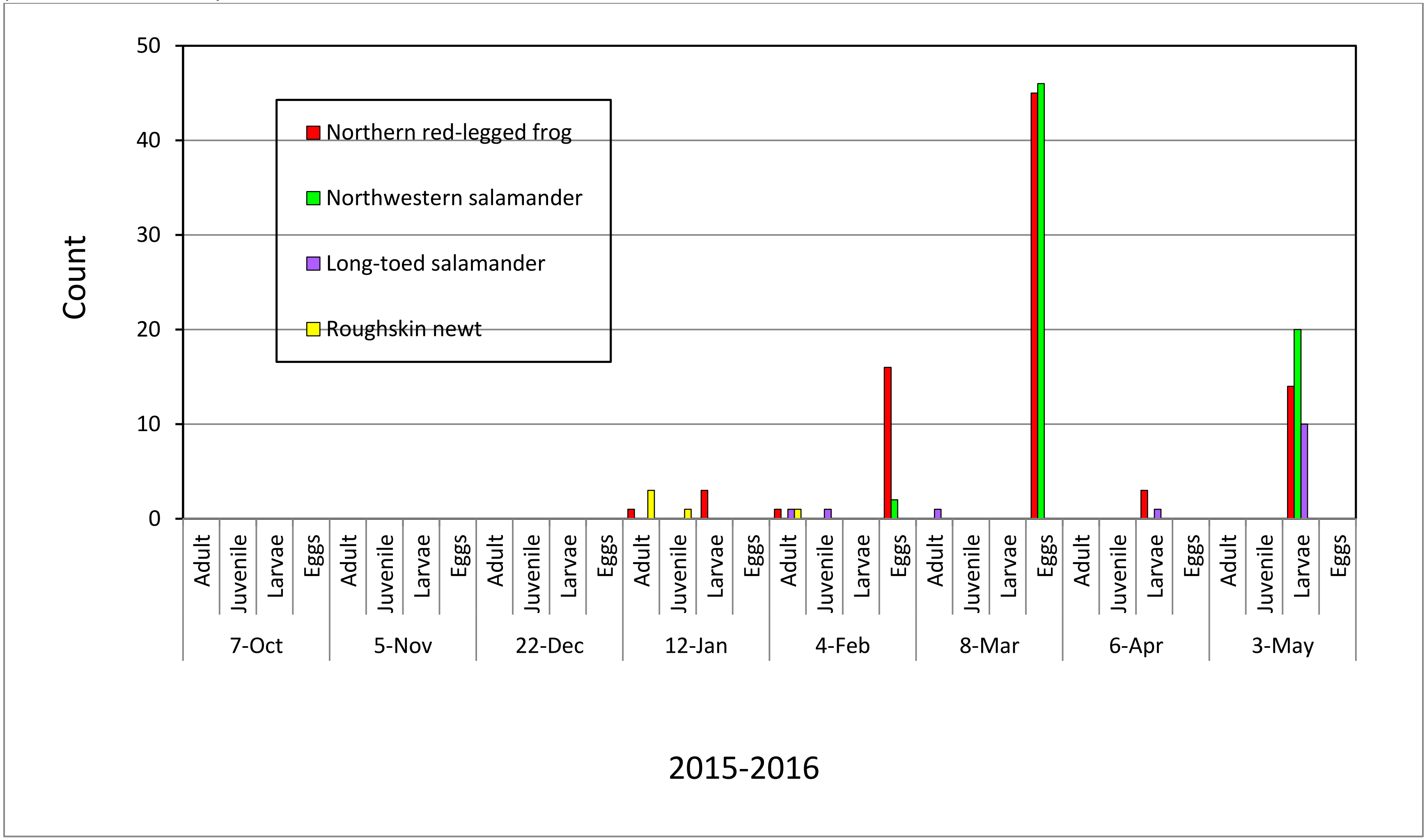


Figure 22. Time Series of American bullfrog Life Stages for the Hoxit 2 Intensive Site – includes all sampling except the electrofishing portion of the 3 May 2016 date.

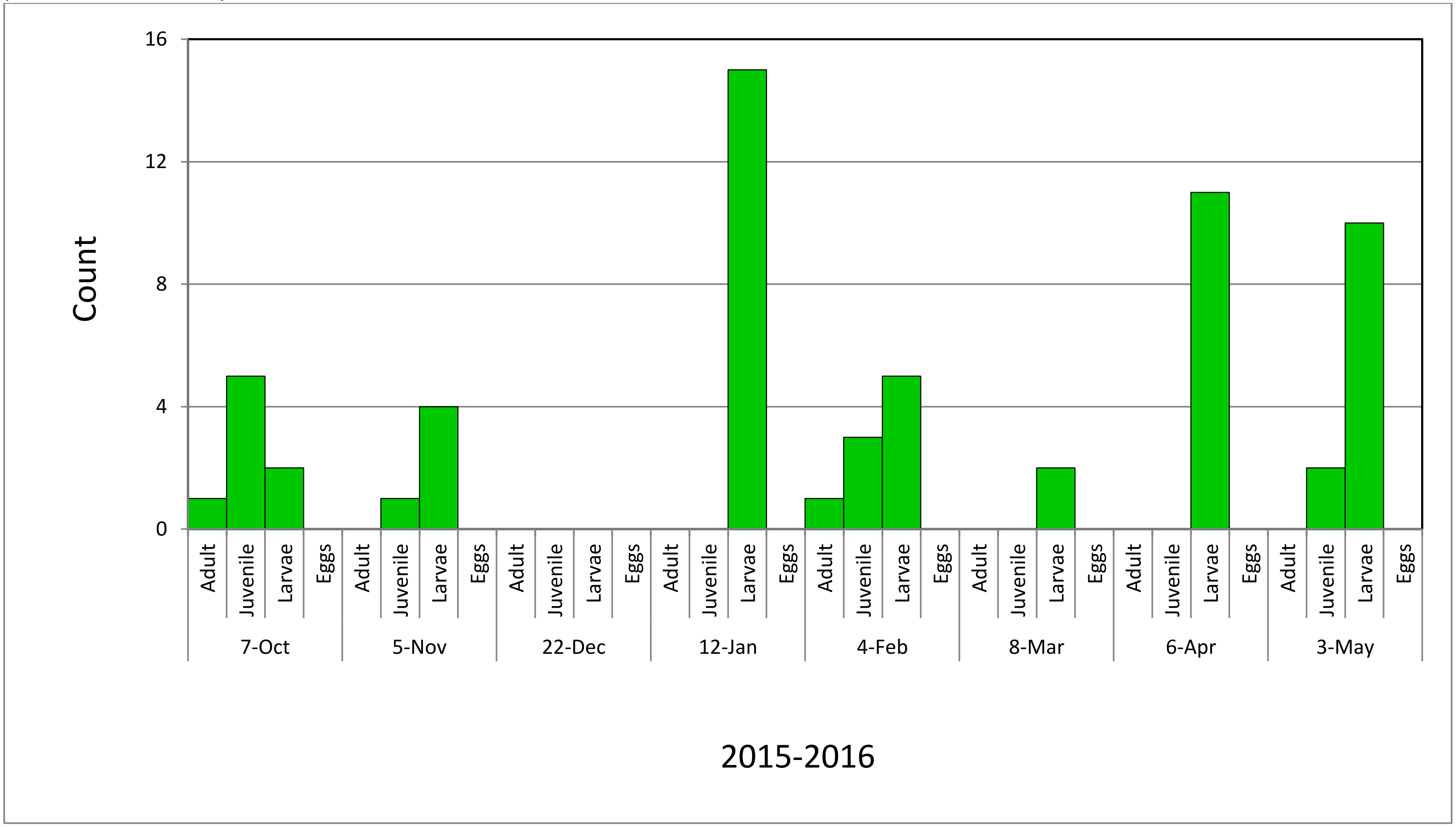


Figure 23. Time Series of Native Fish Life Stages for the Hoxit 2 Intensive Site – includes all sampling except the electrofishing portion of the 3 May 2016 date.

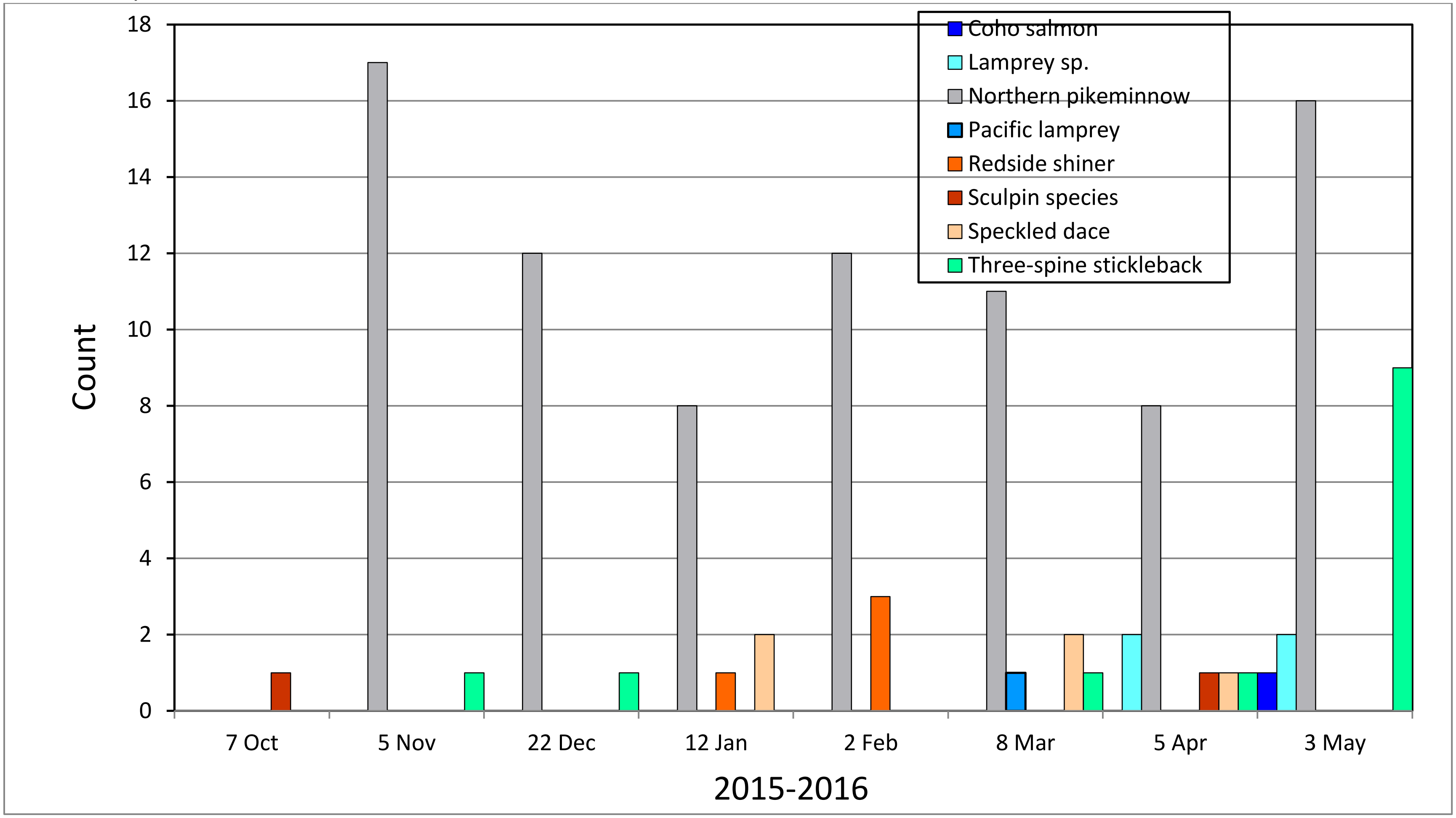


Figure 24. Time Series of Exotic Fish Life Stages for the Hoxit 2 Intensive Site – includes all sampling except the electrofishing portion of the 3 May 2016 date.

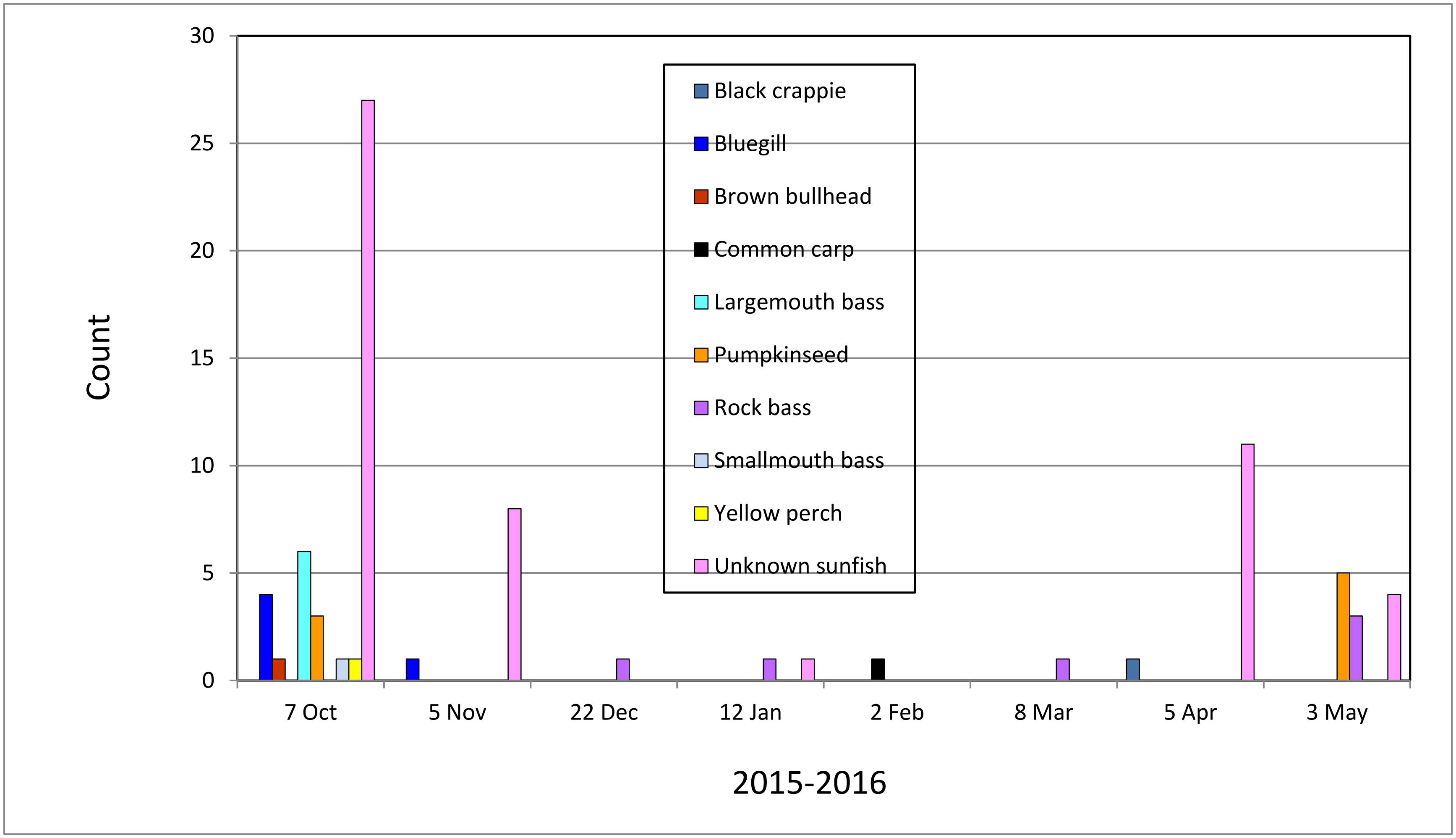
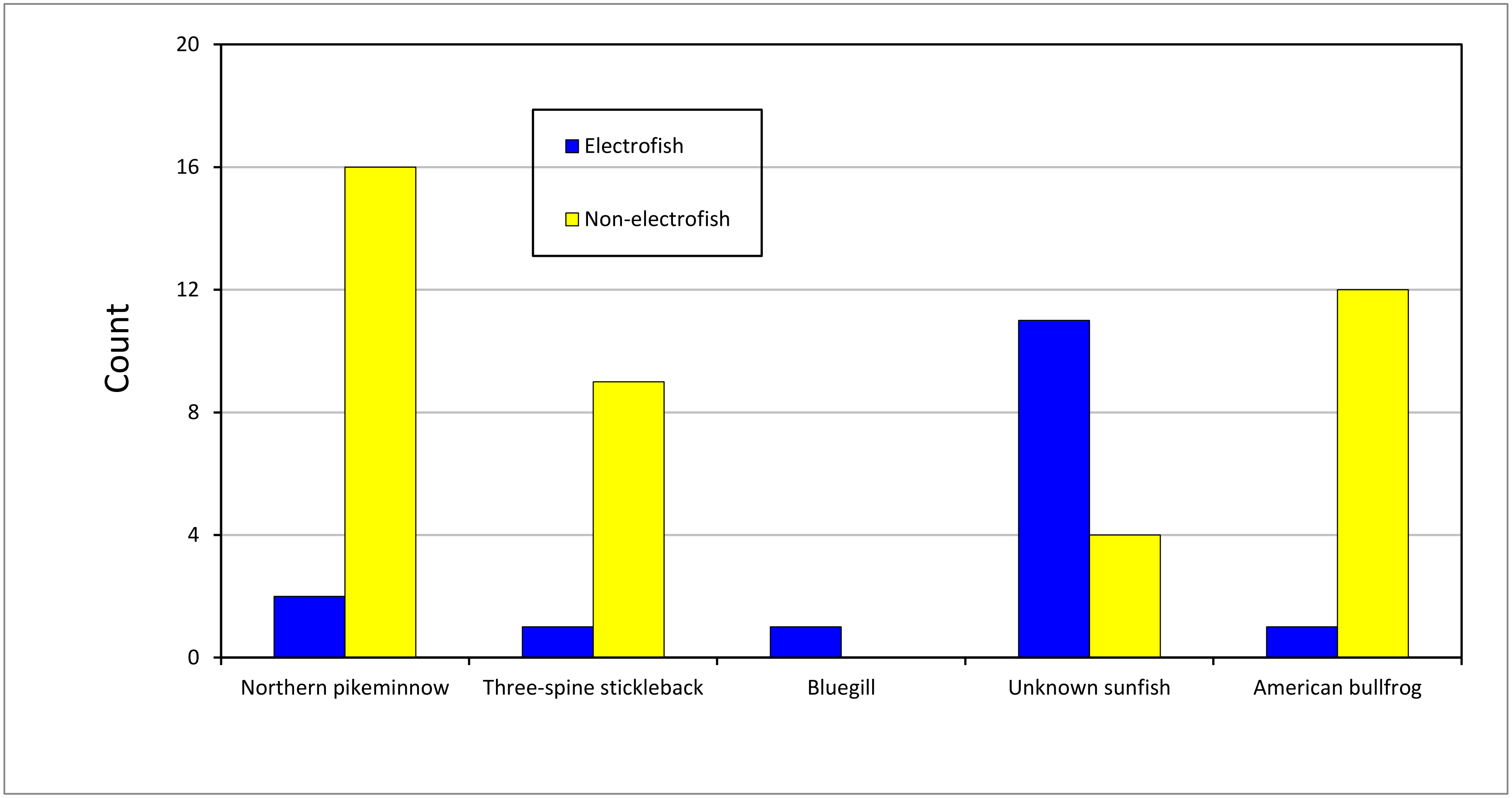


Figure 25. Comparison of 3 May 2016 Capture Success between Electrofish and Non-electrofish Sampling (dip net, collapsible minnow trap and fyke net sampling combined) for different amphibians and fishes at the Hoxit 2 intensive site.



Discussion

We found considerable variability across the intensive study sites in the aquatic biota. We collectively recorded five different native stillwater-breeding amphibian species at intensive study sites: Long-toed salamander, Northern red-legged frog, Northwestern salamander, Pacific treefrog, and Roughskin newt. Osborn had the fewest native amphibian species (n = 3), and Dick, Styger and Weyerhaeuser tied for the most (n = 5; **Table 3**). Only Long-toed salamander and Northwestern salamander were found at all sites, and native amphibian species richness showed no obvious trends with regard to floodplain position. We found only one exotic amphibian species at any of the six intensive study sites, the American bullfrog, with our observations at the four most downstream locations (**Table 3**).

Table 3. Summary of amphibian species composition across intensive study sites.

		Amphibian Species						
Site Name		Long-toed salamander	Northern red-legged frog	Northwestern salamander	Pacific treefrog	Roughskin newt	Native Amphibian Richness	American bullfrog
1	007_Weyerhaeuser	X	X	X	X	X	5	
2	004_Christin	X	X	X		X	4	
3	068_Osborn	X		X	X		3	X
4	020_Styger_N	X	X	X	X	X	5	X
5	025_Dick	X	X	X	X	X	5	X
6	086_Hoxit 2	X	X	X		X	4	X

We collectively recorded at least nine different native fish species at intensive study sites: Coho salmon, Lamprey (species undetermined), Largescale sucker, Northern pikeminnow, Olympic mudminnow, Redside shiner, Sculpin (species undetermined), Specked dace, and Three-spine stickleback (**Table 4**). Lamprey and sculpin may represent more than one species; genetic verification of species from collected tissue samples is pending. The Weyerhaeuser site lacked fish entirely. For the sites with native fish species, Osborn had the fewest (n = 3), and Dick and Hoxit 2 tied for the most (n = 8; **Table 4**). Northern pikeminnow was the only native fish species recorded at all five sites with fishes, and Olympic mudminnow was the only native fish species recorded at only one site (Dick) (**Table 4**). Except for Osborn, native fish species richness generally increased with downstream position (**Table 4**).

We collectively recorded at least nine different exotic fish species at four intensive study sites: Black crappie, Bluegill, Brown bullhead, Common carp, Largemouth bass, Pumpkinseed, Rock bass, Smallmouth bass, Yellow perch and unknown sunfishes (**Table 5**). Unknown sunfishes were juveniles that could not be visually identified to species; they may represent Bluegill or Pumpkinseed, but we cannot exclude the possibility that at least some of them represent another sunfish species not on the aforementioned list. As with the aforementioned lamprey and sculpin, genetic verification of species from collected tissue samples is pending.

Table 4. Summary of native fish species composition across intensive study sites.

Site Name		Native Fish Species									
		Coho salmon	Lamprey sp.	Largescale sucker	Northern pikeminnow	Olympic mudminnow	Redside shiner	Sculpin sp.	Speckled dace	Three-spine stickleback	Richness
1	007_Weyerhaeuser										0
2	004_Christin		X	X	X			X	X		5
3	068_Osborn				X		X	X			3
4	020_Styger_N	X	X		X				X	X	5
5	025_Dick		X	X	X	X	X	X	X	X	8
6	086_Hoxit 2	X	X	X	X		X	X	X	X	8

Table 5. Summary of exotic fish species composition across intensive study sites.

Site Name		Exotic Fish Species										
		Black crappie	luegill	rown bullhead	ommon carp	argemouth bass	umpkinseed	ock bass	mallmouth bass	ellow perch	nknown sunfishes	ichness
1	007_Weyerhaeuser											0
2	004_Christin		X			X	X	X			X	4
3	068_Osborn		X	X		X	X	X		X	X	6
4	020_Styger_N											0
5	025_Dick	X	X	X		X	X	X		X	X	7
6	086_Hoxit 2	X	X	X	X	X	X	X	X	X	X	9

Neither Styger or Weyerhaeuser had any exotic fish. Of the four sites with exotic fish species, Christin had the fewest (n = 4), and Hoxit 2 had the most (n = 9); with exotic fish species richness increasing with downstream position (**Table 5**). We recorded four centrarchid fishes (Bluegill, Largemouth bass, Pumpkinseed, and Rock Bass) at all four sites with exotic fish species present.

Examining the aquatic biota collectively, we recorded at least 24 different amphibian and fish species across intensive study sites. The general increase in overall aquatic species richness with progressive downstream position reflects the parallel trends for native and exotic fish species richness previously noted. Exotic species contribution to the overall species richness of amphibians and fishes (ratio of exotic to native species [i.e., the number of exotic species divided by the number of native species]) varied from zero (Weyerhaeuser) to 1.17 (Osborn); Osborn was the only intensive study site where exotic species constituted more than half of the aquatic species richness total.

Table 5. Summary of overall aquatic species richness across intensive study sites.

Site		**Amphibian Species Richness**			**Fish Species Richness**			**Overall Aquatic Species Richness**		
		Native	**Exotic**	**Total s**	**Native**	**Exotic**	**Totals**	**Native**	**Exotic**	**Totals**
1	007_Weyerhae user	5	0	5	0	0	0	5	0	5
2	004_Christin	4	0	4	5	4	9	9	4	13
3	068_Osborn	3	1	4	3	6	9	6	7	13
4	020_Styger_N	5	1	6	5	0	5	10	1	11
5	025_Dick	5	1	6	8	7	15	13	8	21
6	086_Hoxit 2	4	1	5	8	9	17	12	10	22

We also found large variability across the intensive sites in relative abundance. Using an abundance index based on summing a species' life stages over each survey round and averaging these across the eight survey rounds, species-specific relative abundance indices for native amphibians varied from zero (several species at different sites) to as high as 129 (Roughskin newt at the Weyerhaeuser site; **Table 6**). This analysis reveals that though the Weyerhaeuser site had the highest mean abundance index (38.3), the Dick and Styger sites were also native amphibian productive (19.3-23.1). In contrast, the Christin, Hoxit 2, and Osborn sites all had low mean abundance indices for native amphibians (0.1-5.2). The American bullfrog abundance index was similarly variable across sites, ranging from a high of 21.8 at Osborn to zero at each of Christin and Weyerhaeuser. American bullfrog mean abundance index was inversely correlated with the mean abundance index for native amphibians across the six intensive sites (ρ = -0.754).

Table 6. Summary of amphibian species abundance indices across intensive study sites.

Site Name		Amphibian Species Abundance Index						
		Long-toed salamander	Northern red-legged frog	Northwestern salamander	Pacific treefrog	Roughskin newt	Mean Native Abundance Index	American bullfrog
1	007_Weyerhaeuser	0.3	22.3	39.6	0.5	129.0	38.3	0.0
2	004_Christin	0.9	2.4	12.5	0.0	10.4	5.2	0.0
3	068_Osborn	0.3	0.0	0.5	0.1	0.0	0.1	21.5
4	020_Styger_N	32.6	16.4	7.1	97.4	0.9	19.3	4.8
5	025_Dick	6.5	49.9	27.5	99.6	1.4	23.1	3.4
6	086_Hoxit 2	1.8	10.5	8.5	0.0	0.6	4.3	7.8

Relative abundance indices for native fishes also varied. Values ranged from zero (several species at several sites) to as high as 99.9 (Three-spine stickleback at the Styger site; **Table 7**). This analysis revealed that the Styger site had the highest mean abundance index for native fish species (11.3); Dick had a mean abundance index of slightly over one-quarter that value (3.3) and Hoxit 2 had an index around half the latter (**Table 7**). Dick and Styger were also notable due to their relatively high abundance indices for Three-spine stickleback, whereas Hoxit 2 was notably for its relatively high Northern pikeminnow abundance index.

Relative abundance indices for exotic fishes were also variable. Values ranged from zero (several species at several sites; **Table 8**) to as high as 25.3 (Brown bullhead at the Osborn site; **Table 8**). Notably, we did not record exotic fish species at Styger (**Table 8**), though it had the highest abundance index for native fish species (**Table 7**). This analysis also revealed that the Osborn site had the highest mean abundance index for exotic fishes (3.3) and Dick (2.7) was a relatively close second (**Table 8**).

Abundance indices for exotic versus native amphibians did not show the same relationship as the abundance indices for exotic and native fishes. As mentioned previously, the abundance index between native and exotic amphibians was inversely related (ρ = -0.754); this was not the pattern between native and exotic fishes (ρ = 112; see **Table 9**). However, combining the amphibian and fish abundance indices retained the inverse relationship diluted by the fish data (ρ = -0.657; see **Table 9**).

Native amphibian and fish recruitment patterns likely have different explanations across sites. At the apparently fishless Weyerhaeuser site, the dominance of predatory salamanders, especially Roughskin newt, is the likely reason for suppression of recruitment in Long-toed salamander, Northern red-legged frog, and Pacific treefrog. Post-metamorphic Roughskin newts are well known amphibian egg consumers (Chivers and Mizra. 2001, Kiesecker et al. 2002

Table 7. Summary of native fish species abundance indices across intensive study sites.

	Site Name	Native Fish Species Abundance Index									
		Coho salmon	Lamprey sp.	Largescale sucker	Northern pikeminnow	Olympic mudminnow	Redside shiner	Sculpin sp.	Speckled dace	Three-spine stickleback	Mean Abundance Index
1	007_Weyerhaeuser	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	004_Christin	0.0	0.1	0.3	0.4	0.0	0.0	0.3	0.8	0.0	0.2
3	068_Osborn	0.0	0.0	0.0	1.6	0.0	0.1	2.1	0.0	0.0	0.4
4	020_Styger_N	0.1	0.1	0.0	1.6	0.0	0.0	0.0	0.1	99.9	11.3
5	025_Dick	0.0	1.4	0.3	2.4	1.1	0.1	1.5	0.3	22.9	3.3
6	086_Hoxit 2	0.1	0.6	0.0	10.5	0.0	0.4	0.3	0.6	1.6	1.6

Table 8. Summary of exotic fish species abundance indices across intensive study sites.

	Site Name	Exotic Fish Species Abundance Index										
		Black crappie	Bluegill	Brown bullhead	Common carp	Largemouth bass	Pumpkinseed	Rock bass	Smallmouth bass	Yellow perch	Unknown sunfishes	Mean Abundance Index
1	007_Weyerhaeuser	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	004_Christin	0.0	0.3	0.0	0.0	3.0	0.5	0.1	0.0	0.0	0.9	0.5
3	068_Osborn	0.0	0.3	25.3	0.0	2.5	3.6	0.5	0.0	0.5	0.3	3.3
4	020_Styger_N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	025_Dick	0.1	0.0	0.3	0.0	22.6	0.1	0.4	0.3	0.9	2.5	2.7
6	086_Hoxit 2	0.1	0.6	0.1	0.1	0.8	1.0	0.8	0.1	0.1	6.4	1.0

Table 9. Overall summary of species abundance indices across intensive study sites.

Site Name		Amphibians		Fishes		Totals	
		Native	Exotic	Native	Exotic	Native	Exotic
1	007_Weyerhaeuser	38.3	0.0	0.0	0.0	38.3	0.0
2	004_Christin	5.2	0.0	0.2	0.5	5.4	0.5
3	068_Osborn	0.1	21.5	0.4	3.3	0.5	24.8
4	020_Styger_N	19.3	4.8	11.3	0.0	30.6	4.8
5	025_Dick	23.1	3.4	3.3	2.7	26.4	6.1
6	086_Hoxit 2	4.3	7.8	1.6	1.0	5.9	8.8

Lehman 2006), and all three of these amphibians deposit their eggs in soft jellies (Jones et al. 2005); making their deposited eggs highly accessible to post-metamorphic newts. In contrast, Northwestern salamanders possess the hardest jelly of any Pacific Northwest amphibian (Jones et al. 2005). Roughskin newts have been observed to excavate into this hard jelly to access eggs and developing embryos (M. Hayes, personal observation), but differential accessibility because of jelly hardness may explain why Northwestern salamanders were the only native amphibian with some larval recruitment. The fact that numbers of Roughskin newts were present in every sampling month (**Figure 1**) agrees with this hypothesis. Roughskin newts may also influence the extraordinarily low native amphibian recruitment at Christin because Christin was the only other intensive site where post-metamorphic newts were common and appeared in every month (**Figure 2**); exotic fishes were unlikely to be a substantial influence at Christin as it had a low absolute exotic fish index, which was the lowest exotic fish abundance index among intensive sites (**Table 9**).

Exotics may influence differential recruitment at the remaining four intensive sites, and exotic fishes appear to be more important than American bullfrogs in contributing to that pattern. Support for this hypothesis comes from Styger, which had the best native amphibian larvae recruitment across all sites with some fish present (**Figure 12**), but no exotic fishes, few newts (**Figure 12**), and modest bullfrog numbers (**Figure 13**). Further support comes from Osborn, the site for which native amphibians had the lowest species richness (**Table 5**), the lowest abundance index (**Table 9**), and the most limited native amphibian oviposition among intensive sites (compare **Figure 7** to **Figures 1, 3, 12, 16,** and **21**) as well as no evidence of native amphibian larval recruitment (**Figure 7**). However, Osborn was the only intensive site where richness of overall exotic aquatic species exceeded that of native species (**Table 5**) and also had the highest abundance indices among intensive sites for both exotic fishes and bullfrogs (**Table 9**). The remaining two sites (Dick and Hoxit 2) also seemed somewhat consistent with this pattern, displaying intermediate levels of both exotic abundance indices and recruitment among native amphibians, though other subtleties likely influence the details

Table 10. Summary of electrofishing (E) versus non-electrofishing (NE) results across intensive study sites for amphibians.

Site Name		Amphibian Species											
		Long-toed salamander		Northern red-legged frog		Northwestern Salamander		Pacific treefrog		Roughskin newt		American bullfrog	
		E	NE	E	NE	E	NE	E	NE	E	NE	E	NE
1	007_Weyerhaeuser	0	0	1	0	3	51	2	2	7	123	0	0
2	004_Christin	0	0	0	0	0	0	0	0	0	0	0	0
3	068_Osborn	0	0	0	0	0	0	0	0	0	0	0	0
4	020_Styger_N	1	8	4	24	0	0	188	138	0	0	0	0
5	025_Dick	0	0	2	12	0	0	0	0	0	0	2	3
6	086_Hoxit 2	0	0	0	0	0	0	0	0	0	0	1	12
Totals		1	8	6	36	3	51	188	138	7	123	3	15

Table 11. Summary of electrofishing (E) versus non-electrofishing (NE) results across intensive study sites for native fishes. Electrofishing results for the Weyerhaeuser are not included since no fishes were obtained with electrofishing at that site.

Site Name		Native Fish Species									
		Lamprey sp.		Largescale sucker		Northern pikeminnow		Sculpin sp.		Three-spine stickleback	
		E	NE	E	NE	E	NE	E	NE	E	NE
2	004_Christin	8	0	1	0	0	0	16	0	0	0
3	068_Osborn	0	0	2	0	0	0	2	11	0	0
4	020_Styger_N	0	0	0	0	0	0	0	0	5	771
5	025_Dick	1	9	1	0	0	0	0	0	0	0
6	086_Hoxit 2	0	0	0	0	2	16	0	0	1	9
Totals		9	9	4	0	2	16	18	11	5	771

Table 12. Summary of electrofishing (E) versus non-electrofishing (NE) results across intensive study sites for exotic fishes. Electrofishing results for the Weyerhaeuser and Styger are not included since no exotic fishes were obtained with electrofishing at those sites.

Site Name		Exotic Fish Species											
		Black crappie		Bluegill		Largemouth bass		Pumpkinseed		Yellow perch		Unknown sunfish	
		E	NE	E	NE	E	NE	E	NE	E	NE	E	NE
2	004_Christin	0	0	0	0	3	0	1	0	0	0	5	3
3	068_Osborn	0	0	1	0	3	1	20	0	0	0	3	0
5	025_Dick	1	0	1	0	1	0	4	1	30	0	11	1
6	086_Hoxit 2	0	0	1	0	0	0	0	0	0	0	11	4
	Totals	1	0	3	0	7	1	25	1	30	0	30	8

of these patterns. For example, both these sites have sections that become isolated and dry during the summer months; for Dick, the isolated sections seem to have more native amphibian adults, whereas for Hoxit 2, the isolated sections seem to have more native amphibian egg masses. Exotic-influenced recruitment patterns are in general agreement with published information indicating that exotics can suppress native aquatic species recruitment, and an influence from exotic fishes is more likely to have a greater impact than bullfrogs (Hayes and Jennings 1985, Adams 2000, Pearl et al. 2005). Moreover, the fact that four species of centrarchid fishes were present at all four sites where we suspect an exotic influence suggests that this species assemblage may be the important causal factor, a pattern that has been suggested elsewhere (Adams et al. 2003).

The addition of electrofishing to the sampling program suggests that it provides some advantage for the sampling of selected taxa. In particular, electrofishing provides no particular advantage for sampling amphibians with the possible exception of the Pacific treefrog, where the advantage is one of degree (**Table 10**). However, the latter being based on a single site would require confirmation of the pattern. In contrast, electrofishing appears to provide an advantage for the sampling of at least one native fish, the Largescale sucker, and may provide some advantage in the sampling of sculpins (**Table 11**). It is also worth noting that an electrofishing advantage may be site-specific, as which occurred with both lamprey and sculpin. More data are needed to determine the site-specific conditions where electrofishing may be advantageous to these two taxa. However, electrofishing seems clearly disadvantageous for the sampling of the native fishes, Northern pikeminnow and Three-spine stickleback. Finally, electrofishing appears to provide a clear advantage for the sampling of all exotic fish taxa that were compared (**Table 12**). In fact, all five exotic taxa would not have been detected in nine different instances if electrofishing had not been used. This pattern may be an underestimate because what the unknown sunfish category represents taxon wise is uncertain.

In summary, we sampled six Chehalis floodplain off-channel habitats with a suite of methods designed to detect both amphibians and fishes on a monthly rotation from October 2015 through May 2016. This effort revealed a variety of important patterns, which were:

1. Three to five different native stillwater amphibian species were detected at all six sites.
2. In all cases, the native stillwater amphibian species present comprised some combination of the following five species: Long-toed salamander, Northern red-legged frog, Northwestern salamander, Pacific treefrog, and Roughskin newt.
3. Two additional native stillwater breeding amphibians, the Oregon spotted frog and Western toad, with some possibility of occurring in Chehalis floodplain were not found.
4. One exotic amphibian, the American bullfrog, was found at four of the six sites.
5. The four sites at which American bullfrog were found are the more downstream in geographic position of the six sites. The two upstream-most sites do not appear to have American bullfrogs present.
6. The site most upstream in position and most disconnected from the floodplain, the Weyerhaeuser site, appears to be fishless.

7. With the exception of the Northwestern salamander, native amphibian recruitment (as reflected by larval stage numbers) appears to be extremely poor at the two upstream-most sites, the fishless Weyerhaeuser site, and Christin, which seems to have limited numbers of exotic fishes.
8. The recruitment limitation at the two upstream-most sites appears to reflect post-metamorphic Roughskin newts, renowned amphibian egg predators that seem much more abundant at these two sites than the remaining four sites.
9. At sites where we recorded fishes, we found at least 3-8 native fish species from the suite of native fishes that include: Coho salmon, lamprey (species not identified), Largescale sucker, Northern pikeminnow, Olympic mudminnow, Redside shiner, sculpin (species not identified), Speckled dace, and Three-spine stickleback; and 4-9 exotic species from the suite of exotic fishes that include: Black crappie, Bluegill, Brown bullhead, Common carp, Largemouth bass, Pumpkinseed, Rock bass, Smallmouth bass, and Yellow perch.
10. Native amphibian recruitment at the four downstream-most sites appears to be influenced by exotic fishes because a) the one site that lacks exotic fishes but has bullfrogs in modest numbers, Styger, has the best native amphibians recruitment; b) the one site with the highest exotic fish abundance index, Osborn, has the most limited amphibian recruitment; and c) the remaining two sites, Dick and Hoxit, with intermediate levels of exotic fishes have intermediate native amphibian recruitment levels.
11. All four sites with exotic fishes have at least a few of four exotic centrarchid fishes present: Bluegill, Largemouth bass, Pumpkinseed and Rock bass. With the exception of Osborn, which has Brown bullhead in abundance, these four centrarchid fishes may be responsible for the native amphibian recruitment pattern noted in 10.
12. Species richness of both native and exotic fishes generally increases with downstream position. Such a pattern is not evident for native amphibians.
13. Electrofishing was useful for the detection of exotic fishes and Largescale sucker, and may have some value for lamprey, Pacific treefrog, and sculpin.
14. The intensive study field effort will continue into 2017. We expect that remaining months will continue to confirm the patterns we suggest here. However, particularly important will be to determine whether: a) depressed recruitment in native amphibians observed as few or no larvae at Weyerhaeuser, Christin, and Osborn will translate into a depressed annual cohort of metamorphosing young amphibians; b) the absence of exotic fish at Styger represents a regular phenomenon or will actually change with coming wet-season conditions, a feature that electrofishing can help confirm; and c) new data will help confirm exotic fish control on native amphibian recruitment at Osborn, Dick, and Hoxit 2.

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Appendix Table 1. Locations of Off-Channel Sites for the Extensive Survey effort. Latitude and longitude (in decimal degrees) are from a relatively central point within each off-channel site.

Site Number & Name		Location		
		Chehalis River Segment	Latitude	Longitude
1	007_Weyerhaeuser	Elk Creek to Proposed Dam	46.550690	-123.304193
2	004_Christin	South Fork Chehalis River to Elk Creek	46.635691	-123.166147
3	068_Osborn	Newaukum River to South Fork Chehalis River	46.647589	-123.001875
4	020_Styger_N	Newaukum River to South Fork Chehalis River	46.644339	-122.997943
5	025_Dick	Porter Creek to Black River	46.826396	-123.257333
6	086_Hoxit 2	Porter Creek to Black River	46.911953	-123.302853