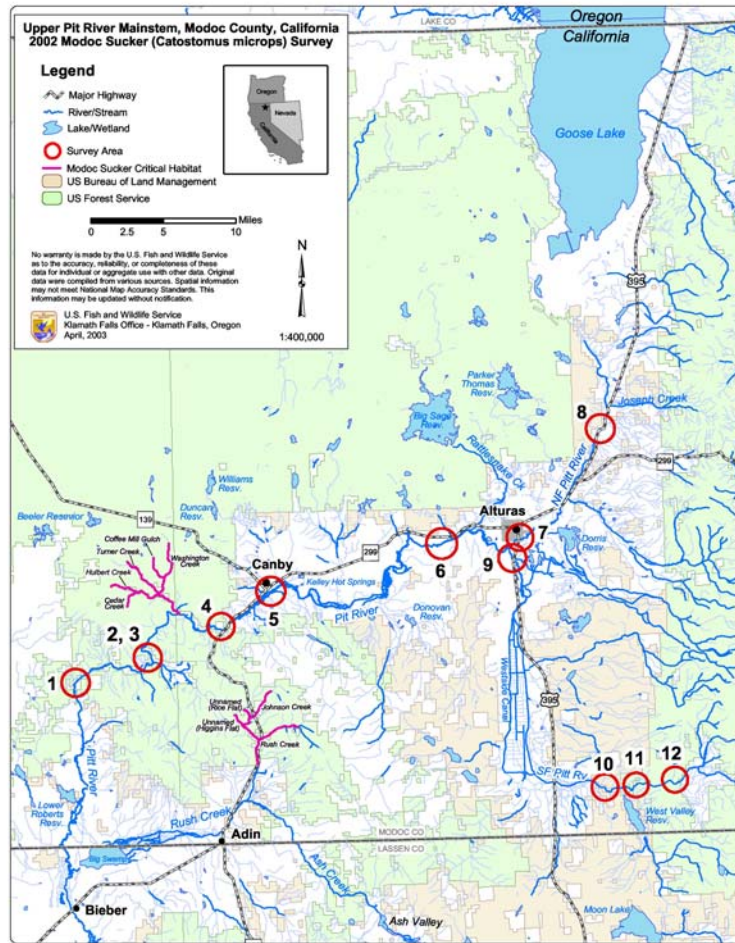


# MAINSTEM UPPER PIT RIVER FISH SURVEYS

**Including the North and South Fork Pit Rivers  
September 2002**



**Stewart B. Reid (principal author) - USFWS, Klamath Falls  
William Cowan and Stephanie Byers - USFWS, Reno**

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## **Abstract**

The 2002 Pit River fish surveys were intended to: 1) explore the possibility that unrecognized populations of the federally endangered Modoc sucker might be present in the mainstem rivers, and 2) provide a current fish survey that could be compared with historic collections in order to assess changes in the species composition of the mainstem Upper Pit River fish fauna over the last century (1898-2002). The results of the 2002 surveys will be incorporated into a current status review by the USFWS to determine whether the Modoc sucker has recovered to a point where downlisting or delisting under the Endangered Species Act is appropriate.

The surveys also provide a baseline and record of fish species composition at the various Upper Pit River sites monitored by the Pit River Watershed Alliance for water quality, habitat, and macroinvertebrate composition, and provide faunal information for assessing potential effects to aquatic resources as a result of water and fisheries management in the Pit drainage.

The results provided valuable information regarding the distribution of Modoc suckers in the upper Pit River Drainage. No indication of a resident population of Modoc suckers was found in the mainstem Pit River downstream of Alturas. However, the occurrence of Modoc sucker genetic markers in the Sacramento sucker population in the upper South Fork of the Pit River (above Likely) suggests that either a previously resident population of Modoc suckers has been genetically swamped and replaced by Sacramento suckers, or that an unrecognized source population of Modoc suckers occupies a tributary to the South Fork, well outside the previously known range of Modoc suckers in the Pit Drainage. The South Fork and possible tributary populations are the subject of an ongoing assessment by USFWS. The 2002 survey also demonstrated that the native fish fauna of the upper Pit River has remained relatively stable throughout the last century, and that exotic fishes form a relatively minor component of the fish community. Two exotic species, largemouth bass and channel catfish, caught during historical surveys from the 1960-70's, were notably absent in the 2002 survey.

## **Introduction**

The present project was undertaken primarily in order to explore the possibility that unrecognized populations of the federally endangered Modoc sucker, *Catostomus microps*, might be present in the mainstem river, as had been indicated by scattered individual suckers of uncertain identity caught during historic surveys of the Upper Pit River (Martin 1967, Cooper et al. 1978, Cooper 1983). This survey was also designed to provide survey information for various other local needs in the Upper Pit River, including: 1) a current fish survey that could be compared with historic collections in order to assess changes in the species composition of the mainstem Upper Pit River fish fauna over the last century, 2) faunal information for potential effects to aquatic resources as a result of water and fisheries management in the Pit drainage, and 3) a baseline and record of fish species composition at the various Upper Pit River sites monitored by the Pit River Watershed Alliance for water quality, habitat, and macroinvertebrate composition. These collections have also provided specimens and site-specific background on bioaccumulation of mercury for analysis of potential effects from the proposed ISOT hydrothermal project at Canby, as well as material for ongoing systematic and genetic studies of

various Pit River fishes (lampreys, tui chubs, and suckers), including Modoc suckers. However, these results are part of other projects and will not be specifically discussed in this report (contact S. Reid, USFWS Klamath Falls for further information).

The Pit River is the largest northern tributary of the Sacramento River and drains a large portion of northeastern California (Fig. 1; Pease 1965, Moyle and Daniels 1982). The headwaters of the Pit River lie in the Warner Mountains, forming the North Fork Pit, which is the now disjunct outlet of the Goose Lake Basin, and the South Fork Pit, which flow together just west of Alturas to form the mainstem Pit River. The Pit River then flows through broad, flat Warm Springs Valley to just below the town of Canby, where it enters the Adin Mountains. The river then increases its gradient and passes through the mountains until it emerges into Big Valley near Rose Canyon, about 15 miles north of Bieber. In Big Valley it takes on flow from Ash Creek and meanders across the valley to the Big Valley Mountains. There it enters the steep Pit River Canyon and flows to its confluence with the clear, spring-fed Fall River. After receiving the considerable flow of the Fall River, the Pit River continues through the canyon of the lower Pit to its historic confluence with the Sacramento River, now flooded beneath Shasta Reservoir. For the purposes of this survey, the Upper Pit River drainage includes the North Fork, South Fork and the mainstem Pit River thru Warm Springs Valley and the Adin Mountains to where it enters Big Valley.

The Modoc sucker is a relatively small sucker endemic to the Pit River drainage, including the Goose Lake sub-basin. Its currently recognized range is limited to two subdrainages of the Pit River (Turner and Ash Creek drainages) and certain tributaries to Goose Lake. The Modoc sucker was listed as endangered under the Endangered Species Act (ESA) in 1985 (USFWS 1985). At that time, the primary threats to the species were considered to be adverse habitat conditions, limited population size and distribution, and hybridization with the Sacramento sucker, which is also native to the Pit River.

The Modoc and Sacramento suckers are very similar in outward appearance when not spawning. The similarity in non-spawning coloration and external morphology have made it difficult to field identify specimens visually without the excessive handling necessary for counts of fin rays and scales. Prior to 2001, the Modoc sucker was generally characterized as having 79-89 lateral line scales and 10-11 dorsal rays, compared to 56-75 lateral line scales and 11-15 dorsal rays for the Sacramento sucker (Martin 1967, 1972; Moyle 1976a, Ford 1977, Cooper et al. 1978). Two authors used intermediate lateral line counts and slightly higher dorsal ray numbers (12 rays) to characterize presumptive "hybrids" between the two species (Cooper et al. 1978, Mills 1980, Cooper 1983). Recent analysis of a more extensive data set of several hundred Modoc and Sacramento suckers, and including additional characters, suggests that there is no morphological support for hybridization and that there is natural overlap in the meristic counts for the two species (Kettratad 2001). Kettratad found the actual meristic ranges for Modoc sucker to be 73-91 lateral line scales and 9-12 dorsal rays, somewhat overlapping Sacramento sucker. Recent ongoing genetic studies have also increased our understanding of hybridization between the two species (Wagman and Markle 2000, Dowling et al. unpub. data, Topinka et al. in prep.; contact S. Reid, USFWS Klamath Falls for further information), and species-specific genetic markers have been developed allowing an assessment of genetic interaction between the two species, as

well as identification of individuals containing predominant genes of either species (Topinka et al. in prep.).

The disjunct distribution of Modoc suckers in well-separated tributaries, the absence of physical barriers to their downstream movement into the river, and the historical difficulties in identification have led to speculation that a unrecognized resident population of Modoc suckers could exist in the mainstem Pit River. Martin (1967) identified a few specimens from the upper Pit with 76-79 lateral line scales, counts that are within the range for both sucker species, as Sacramento suckers. Cooper et al. also identified some specimens from the Pit River as "hybrids", based on character states shared by both Modoc and Sacramento suckers or thought to be intermediate (Cooper et al. 1978, Mills 1980, Cooper 1983). The primary goal of the present survey was to examine representative reaches of the upper Pit River for the presence of extant Modoc suckers and to examine the genetics of all suckers in the Pit River for evidence of historic gene flow between Sacramento and Modoc suckers.

### **Historic Collections From the Mainstem Pit River**

The mainstem of the Pit River has received little attention in fish surveys of the Upper Pit drainage. This is in part due to sampling constraints in the deeper river and to a focus on stream populations of specific fishes of interest to the various sampling projects.

In early September 1898, Cloudsley Rutter and his associates passed through the upper Pit drainage, collecting fish as part of a study of the natural history of young salmonids and the general distribution of fishes in the Sacramento-San Joaquin basin under the auspices of the U.S. Bureau of Fisheries (Rutter 1908).

In August 1904, J.O. Snyder, then professor of ichthyology at Stanford University, traveled through the upper Pit as part of a fish collecting expedition to the Oregon interior lakes, which he reported in his "Relationships of the Fish Fauna of the Lakes of Southeastern Oregon" (Snyder 1908). He collected in the North Fork Pit River, the mainstem Pit River, and in Rush Creek (tributary to Ash Creek).

In the mid-20<sup>th</sup> century few collections were made from the upper Pit drainage, and they were primarily by individual ichthyologists passing through the area, rather than drainage-wide surveys. Our information for those collections is derived from museum collections and field notes by the collectors. Examination of museum records for institutions likely to contain material from northern California (see Methods) resulted in only four sets of collections from the mainstem upper Pit River, including the North and South Forks. Murphy and Riddell (July 1940), Hubbs et al. (July 1942) and Miller et al. (July 1963) all made various collections from the South Fork Pit as they passed through. Hubbs (August 1934) also made a collection from the North Fork Pit on the way from Surprise Valley to Goose Lake, and Murphy (July 1940) made a collection from a slough tributary to the North Fork, just east of Alturas. Miller (August 1961) made a single collection from the mainstem Pit River below Canby at the Highway 395 bridge. Their field notes and museum collections are at the University of Michigan. Both Hubbs and Miller made various additional collections from tributaries of the Pit as well, but these are not

comparable with the present mainstem survey. All of these collections were made with small seines, typically 12-15 ft long with ¼" mesh; Miller used a 30 ft seine for some of his collection at the Canby bridge.

In 1973-74 Moyle et al. made extensive collections throughout the Pit River drainage (primarily July to early September 1974 in the mainstem Pit River, 23-24 July in the South Fork, and 4-5 September in the North Fork), the distributional results of which were summarized and reported in Moyle and Daniels (1982). In 1978 (August), Cooper et al. surveyed the mainstem Pit River and its tributaries from Turner Creek down to Juniper Creek (Big Valley), as part of an assessment on impacts of the proposed Allen Camp Dam Project (Cooper et al. 1978, Cooper 1983). Moyle et al. primarily sampled with a backpack electroshocker or small seines, and they assessed the sampling of the mainstem Pit River as often inadequate due to deeper water depths and/or swift currents, as well as limited time (Moyle and Daniels 1982). Cooper et al. used an electroshocker floated on a johnboat, which was guided by waders in relatively shallow water of less than 1 m (Cooper et al. 1978). There have been no recorded fish surveys of the upper Pit River that we are aware of since 1978.

## **Methods**

Fish collections for this survey were made at twelve sites from September 10-18, 2002 (see map: Fig. 1; Table 1; and Appendix A for site details). All sampling was done with various pulse D.C. electroshockers and dipnets, including: a gas-powered electroshocker (Smith-Root model GPP 5.0) mounted on either an inflatable 6-man boat (for deeper water) or on a small pontoon raft (where wading was feasible), or backpack units (Smith-Root model Type 7 and/or Dirigo model 850B) in smaller, shallower river reaches. Each unit was accompanied by a netting crew of typically 2-3 people using ¼" mesh long-handled dip nets. Each site was sampled sufficiently to ensure that all representative habitat was included and that the crew was not encountering additional species. Reaches were not isolated by nets and no attempt was made to specifically quantify abundance.

Fish collected were identified to species, measured and counted by a shore crew, including S. Reid, then generally released (see below). Length measurements were of Standard Length (SL) or Total Length (TL; lampreys only) in millimeters. Dorsal fin ray counts were made on all suckers, and non-lethal fin clips for genetic analysis were taken from all or a representative sample of the suckers collected at each site, including any sucker with 11 or fewer rays. Voucher specimens were collected of suckers, smaller minnows of uncertain identity (identified in the lab), and lampreys. Environmental variables recorded for each site included: water depth, temperature, conductivity, visibility, and flow conditions.

The genetic analysis that these specimens were included in is part of a larger ongoing study by Univ. California Davis and USFWS, and the present results should be considered preliminary; discussion of methodology will be deferred to the report of that study (Topinka et al. in prep.; contact S. Reid, USFWS Klamath Falls, for further information).

Principal crew members included: Stewart Reid (USFWS, Klamath Falls); William Cowan, Stephanie Byers, Jesse Rivera, Alvin Duncan and Charles McCoy (USFWS, Reno).

Examination of museum records for institutions likely to contain historical specimens from northern California included: Univ. Washington, Oregon State Univ., Humboldt State Univ., U.C. Davis, Calif. Acad. Sci., L.A. Mus. Nat. Hist., Univ. Nevada, U.S. Natl. Mus., Am. Mus. Nat. Hist., and Univ. Michigan.

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- Site 1 :** Rose Canyon
    - Pit River, near confluence with Rose Canyon, at bridge on Shaw Ranch.
  - Site 2 :** Stone Coal Pool
    - Pit River, lg. pool at Stone Coal Creek confluence, just downstream of Road 85.
  - Site 3 :** Stone Coal Rapids
    - Pit River, rapids just upstream of Stone Coal Creek, at County Road 85 bridge.
  - Site 4 :** Hwy. 139 Bridge
    - Pit River, Hwy. 139 bridge public access, about 4 miles downstream of Canby.
  - Site 5 :** Canby
    - Pit River at County Road 54 bridge, ½ mile south of Canby.
  - Site 6 :** Clark's Ranch
    - mainstem Pit River about 5 miles west of Alturas.
  - Site 7 :** Alturas
    - North Fork Pit River in Alturas, behind River Center.
  - Site 8 :** North Fork Pit River
    - North Fork Pit River, at Thoms Creek, 1.4 miles downstream of Joseph Creek.
  - Site 9 :** Talbot Ranch
    - South Fork Pit River, about 1 mile south of Alturas.
  - Site 10 :** South Fork Bridge
    - South Fork Pit River, at bridge 1 mile downstream of West Valley Creek.
  - Site 11 :** South Fork Diversion
    - South Fork Pit River, above irrigation diversion upstream of West Valley Creek.
  - Site 12 :** Jess Valley
    - South Fork Pit River, outlet of Jess Valley, downstream of Jess Valley Bridge.
  - Site X :** Kelley Warm Springs
    - mainstem Pit River at outlet of Kelley Hot Springs channel (no collection made).
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**Table 1.** Survey sites from the 2002 Upper Pit River surveys (see Map, Fig. 1). Site information, habitat conditions and sampling methods are detailed in Appendix A: Survey Sites.



## **Results**

Fish collections were made at twelve sites from September 10-18, 2002 (see map: Fig. 1; site details: App. A). A total of over 1750 fish, representing fourteen species, were examined (Table 2-3). Length frequencies are shown in Appendix B. A summary of distribution, abundance and sampling considerations, where appropriate, for each species is provided below under Species Accounts. Historical comparisons with earlier collections (Tables 4-7) are also discussed below within the species accounts.

An attempt was made to sample in the Pit River at the outflow of Kelly Hot Springs channel (10-11 Sept.); however, when waded prior to sampling (water depth about 1m), there was no flow, the channel was choked with submerged aquatic plants, aquatic bugs (eg. dytiscid beetles) were abundant in the open water, suggesting an absence of fish, and multiple sweeps with a handnet caught no fish (see Appendix B: Site X, p. 38).

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**NATIVE SPECIES:**

Petromyzonidae	
Pit brook lamprey	<i>Lampetra lethophaga</i>
Salmonidae	
Redband/rainbow trout	<i>Onchorhynchus mykiss</i>
Cyprinidae	
Sacramento pikeminnow	<i>Ptychocheilus grandis</i>
Hardhead	<i>Mylopharodon conocephalus</i>
Tui chub	<i>Siphateles thalasinus</i>
Speckled dace	<i>Rhinichthys osculus</i>
Pit Roach <sup>1</sup>	<i>Lavinia symmetricus</i>
Catostomidae	
Sacramento sucker	<i>Catostomus occidentalis</i>
Cottidae	
Pit sculpin	<i>Cottus pitensis</i>

**INTRODUCED SPECIES:**

Salmonidae	
Brown trout (introduced)	<i>Salmo trutta</i>
Cyprinidae	
Golden shiner (introduced)	<i>Notemigonus chrysoleucas</i>
Ictaluridae	
Channel Catfish (introduced) <sup>1</sup>	<i>Ictalurus punctatus</i>
Brown bullhead (introduced)	<i>Ameiurus nebulosus</i>
Centrarchidae	
Sacramento perch (introduced)	<i>Archoplites interruptus</i>
Largemouth bass (introduced) <sup>1</sup>	<i>Micropterus dolomieu</i>
Green sunfish (introduced)	<i>Lepomis cyanellus</i>
Bluegill (introduced)	<i>Lepomis macrochirus</i>

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<sup>1</sup> Found in historical fish collections from the study area (see Tables 4-7), but not encountered in this survey.

**Table 2.** Species recorded from the upper Pit River. Species recorded from historical collections are included for comparative purposes; not all were caught during the present survey.

<b>SAMPLING SITE:</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
<b><u>NATIVE SPECIES:</u></b>												
Petromyzonidae												
Pit brook lamprey	<b>9</b>	-	-	-	-	<b>1</b>	-	<b>11</b>	-	<b>4</b>	<b>29</b>	<b>17</b>
Salmonidae												
Redband/rainbow trout	-	-	-	-	-	-	-	-	-	<b>8</b>	<b>6</b>	-
Cyprinidae												
Sacramento pikeminnow	<b>46</b>	<b>&gt;22</b>	<b>47</b>	<b>69</b>	<b>11</b>	<b>39</b>	<b>73</b>	-	<b>3</b>	<b>17</b>	<b>6</b>	<b>15</b>
Hardhead	<b>9</b>	<b>9</b>	<b>13</b>	<b>26</b>	<b>15</b>	<b>13</b>	-	-	-	-	-	-
Tui chub	-	-	<b>1</b>	<b>1</b>	<b>6</b>	<b>27</b>	-	-	<b>1</b>	-	<b>2</b>	<b>10</b>
Speckled dace	-	-	-	-	-	-	-	<b>300</b>	-	-	-	<b>1</b>
Pit Roach <sup>1</sup>	-	-	-	-	-	-	-	-	-	-	-	-
Catostomidae												
Sacramento sucker	<b>116</b>	<b>22</b>	<b>47</b>	<b>91</b>	<b>50</b>	<b>98</b>	<b>76</b>	-	-	<b>62</b>	<b>10</b>	<b>27</b>
Cottidae												
Pit sculpin	-	-	-	-	-	-	-	-	-	<b>7</b>	<b>38</b>	<b>2</b>
<b><u>INTRODUCED SPECIES:</u></b>												
Salmonidae												
Brown trout	-	-	-	-	-	-	-	-	-	<b>2</b>	<b>7</b>	<b>1</b>
Cyprinidae												
Golden shiner	-	<b>1</b>	-	-	<b>3</b>	-	-	-	-	-	-	-
Ictaluridae												
Channel Catfish <sup>1</sup>	-	-	-	-	-	-	-	-	-	-	-	-
Brown bullhead	-	-	-	<b>5</b>	<b>16</b>	-	<b>4</b>	-	<b>8</b>	-	-	-
Centrarchidae												
Sacramento perch	-	-	-	-	-	<b>1</b>	<b>5</b>	-	<b>2</b>	<b>10</b>	-	-
Largemouth bass <sup>1</sup>	-	-	-	-	-	-	-	-	-	-	-	-
Green sunfish	<b>21</b>	<b>39</b>	-	<b>16</b>	<b>58</b>	<b>7</b>	<b>13</b>	-	<b>8</b>	-	-	-
Bluegill	-	<b>4</b>	-	-	-	<b>4</b>	-	-	-	-	-	-

<sup>1</sup>. Found in historical fish collections from the study area (see Tables 4-7), but not encountered in this survey.

**Table 3.** Catches by Site for fish caught during the 2002 survey of the upper Pit River. Species recorded from historical collections are included for comparative purposes; not all were caught during the present survey. Note that collections were not standardized by sampling effort and different species have different catchability, such that numbers caught may not reflect actual relative abundance.

Common Name	Rutter 1898 <sup>1</sup>	Snyder 1904 <sup>2</sup>	Miller 1961 <sup>3</sup>	Moyle & Daniels 1973-74 <sup>4</sup>	Cooper 1978 <sup>5</sup>	Present Survey 2002 <sup>6</sup>
Petromyzonidae						
Pit brook lamprey	-	-	-	-	X	X
Salmonidae						
Redband/rainbow trout	-	-	-	-	-	-
Brown trout (introduced)	-	-	-	-	-	-
Cyprinidae						
Sacramento pikeminnow	X	-	X	X	X	X
Hardhead	X	X	X	X	X	X
Tui chub	X	X	-	-	-	X
Speckled dace	? <sup>6</sup>	-	-	-	x <sup>7</sup>	-
Pit roach	-	-	x <sup>8</sup>	-	-	-
Golden shiner (introduced)	-	-	-	-	-	X
Catostomidae						
Sacramento sucker	X	X	X	X	X	X
Ictaluridae						
Channel catfish	-	-	-	-	X	-
Brown bullhead (introduced)	-	? <sup>9</sup>	X	X	X	X
Centrarchidae						
Sacramento perch (introduced)	-	-	-	-	-	X
Largemouth bass (introduced)	-	-	X	X	X	-
Green sunfish (introduced)	-	-	X	X	X	X
Bluegill (introduced)	-	-	X	X	X	X
Cottidae						
Pit sculpin	X	? <sup>10</sup>	X	X	X	-

1. Rutter (1908): Pit River, near Canby.

2. Snyder (1908): Pit River, near Canby.

3. Miller et al.(1961): Pit River, at bridge just S. of Canby (Field no. M61-69). From notes and collections at Univ. Michigan.

4. Moyle and Daniels (1982): Throughout upper Pit from Alturas to Rose Canyon.

3. Cooper et al. (1978, 1983): Pit River in canyon from Stone Coal Creek to Rose Canyon Creek (Stations 28, 45-48).

5. Sites 1- 7, Alturas to Rose Canyon.

6. Specimens not recorded at Nation Museum with remainder of Rutter's collections.

7. Single individual caught near mouth of Stone Coal Creek (Station 48, Cooper et al. 1978).

8. Single specimen collected by Miller (UMMZ 179599).

9. Possibly collected and not reported in Snyder (1908), considered an introduced species (noted in museum jar). Specimens collected by Snyder in the Smithsonian are in two lots, both with tags saying "Sta. 23, Pit River, Alturas" (NMNH 058200, 058213; one and two specimens, respectively; S. Reid Pers. Obs.). One could be from a different Pit River locality.

10. Apparently collected and not reported in Snyder (1908). Preserved specimen collected by Snyder at Canby in Smithsonian (NMNH 058207).

**Table 4.** Historical Comparisons - Mainstem Pit River. Species caught within the mainstem upper Pit River, from Alturas downstream to Rose Canyon, during principal historical fish collections and the present survey.

Common Name	Rutter 1898 <sup>1</sup>	Snyder 1904 <sup>2</sup>	Hubbs et al. 1934 <sup>3</sup>	Murphy & Riddell 1940 <sup>4</sup>	Moyle & Daniels 1973-74 <sup>5</sup>	Present Survey 2002 <sup>6</sup>
Petromyzonidae						
Pit brook lamprey	-	X	-	-	-	-
Salmonidae						
Redband/rainbow trout	X	X	-	-	-	-
Brown trout (introduced)	-	-	-	-	-	-
Cyprinidae						
Sacramento pikeminnow	X	X	X	-	X	X
Hardhead	X	X	X	-	-	-
Tui chub	-	X	X	X	-	-
Speckled dace	X	-	X	X	-	-
Pit roach	x <sup>7</sup>	-	X	-	-	-
Golden shiner (introduced)	-	-	-	-	-	-
Catostomidae						
Sacramento sucker	X	X	X	X	X	X
Ictaluridae						
Channel catfish	-	-	-	-	-	-
Brown bullhead (introduced)	-	X <sup>8</sup>	-	-	-	X
Centrarchidae						
Sacramento perch (introduced)	-	-	-	-	-	X
Largemouth bass (introduced)	-	-	-	-	X	-
Green sunfish (introduced)	-	-	-	-	X	X
Bluegill (introduced)	-	-	-	-	-	-
Cottidae						
Pit sculpin	-	-	X	-	X	-

1. Rutter (1908): North Fork Pit River near Alturas.

2. Snyder (1908): Pit River "near Alturas".

3. Hubbs et al. (1934): N. Fork Pit River, E. of Alturas (T42N R13E; Field no. M34-116). Apparently at junction of Hwys. 299/395, based on route, just upstream of Parker Creek. From notes and collections at Univ. of Michigan.

4. Murphy, G. and F. Riddell (1940): Slough just E. of Alturas, trib. to N. Fork Pit (Field Nos. G\*M40-47). From field notes and museum collections at Univ. of Michigan.

5. Moyle and Daniels (1982): Various sites in upper North Fork Pit River in the vicinity of, or below, Parker Creek.

6. Site 7: North Fork Pit, in town of Alturas.

7. The combined catch from the North Fork near Alturas and at the mouth of Joseph Creek was described by Rutter as "a few small specimens" (1908, p. 139). There are no specimens from either site collected by Rutter in the National Museum.

8. Collected and not reported in Snyder (1908), because they were assumed to be an introduced species (noted in museum jar). Specimens collected by Snyder in the Smithsonian are in two lots, both with tags saying "Sta. 23, Pit River, Alturas" (NMNH 058200, 058213; one and two specimens, respectively; S. Reid Pers. Obs.). One could be from a different Pit River locality.

**Table 5.** Historical Comparisons – North Fork Pit River (lower). Species caught in the lower North Fork of the Pit River, from the vicinity of Parker Creek down to the confluence with the South Fork just below Alturas.

Common Name	Rutter 1898 <sup>1</sup>	Snyder 1904 <sup>2</sup>	Moyle & Daniels 1973-74 <sup>3</sup>	Present Survey 2002 <sup>4</sup>
Petromyzonidae				
Pit brook lamprey	-	-	X	X
Salmonidae				
Redband/rainbow trout	X	-	X	-
Brown trout (introduced)	-	-	-	-
Cyprinidae				
Sacramento pikeminnow	X	-	X	-
Hardhead	-	-	-	-
Tui chub	-	-	-	-
Speckled dace	X	X	X	X
Pit roach	x <sup>5</sup>	-	-	-
Golden shiner (introduced)	-	-	-	-
Catostomidae				
Sacramento sucker	X	-	X	-
Ictaluridae				
Channel catfish	-	-	-	-
Brown bullhead (introduced)	-	-	-	-
Centrarchidae				
Sacramento perch (introduced)	-	-	-	-
Largemouth bass (introduced)	-	-	-	-
Green sunfish (introduced)	-	-	X	-
Bluegill (introduced)	-	-	-	-
Cottidae				
Pit sculpin	X	-	X	-

1. Rutter (1908): North Fork Pit River near mouth of Joseph Creek.

2. Snyder (1908): Pit River "near Joseph Creek".

3. Moyle and Daniels (1982): Various sites in the upper North Fork Pit River above Chimney Rock.

4. Site 8: North Fork Pit, just downstream of Joseph Creek.

5. The combined catch from the North Fork near Alturas and at the mouth of Joseph Creek was described by Rutter as "a few small specimens" (1908, p. 139). There are no specimens from either site collected by Rutter in the National Museum.

**Table 6.** Historical Comparisons – North Fork Pit River (upper). Species caught in the upper North Fork of the Pit River, during principal historical fish collections and the present survey.

Common Name	Rutter 1898 <sup>1</sup>	Murphy & Riddell 1940 <sup>2</sup>	Hubbs 1942 <sup>3</sup>	Miller 1963 <sup>4</sup>	Moyle & Daniels 1973-74 <sup>5</sup>	Present Survey 2002 <sup>6</sup>
Petromyzonidae						
Pit brook lamprey	X <sup>a</sup>	-	X	X	-	X
Salmonidae						
Redband/rainbow trout	X <sup>a</sup>	-	-	-	X	X
Brown trout (introduced)	-	-	-	-	X	X
Cyprinidae						
Sacramento pikeminnow	-	X	X	X	-	X
Hardhead	-	-	-	-	-	-
Tui chub	X <sup>a</sup>	X	X	-	-	X
Speckled dace	X <sup>a</sup>	X	X	-	-	X
Pit roach	-	X	X	X	-	-
Golden shiner (introduced)	-	-	-	-	-	-
Catostomidae						
Sacramento sucker	X <sup>a</sup>	X	X	X	-	X
Ictaluridae						
Channel catfish	-	-	-	-	-	-
Brown bullhead (introduced)	-	-	-	-	X	-
Centrarchidae						
Sacramento perch (introduced)	-	-	-	-	-	-
Largemouth bass (introduced)	-	-	-	-	-	-
Green sunfish (introduced)	-	-	-	-	-	-
Bluegill (introduced)	-	-	-	-	-	-
Cottidae						
Pit sculpin	X <sup>b</sup>	-	X	X	X	X

1. Rutter (1908): South Fork Pit River at: a) South Fork Post Office (Likely) and b) Jess Valley.

2. Murphy, G. and F. Riddell (1940): S. Fork Pit from Likely to 5 mi upstream of Likely (Field Nos. G\*M40-43 to 46).  
From field notes and museum collections at Univ. of Michigan.

3. Hubbs, C.H. et al (1942): S. Fork Pit, at Likely (Field No. H42-64).  
From field notes and museum collections at Univ. of Michigan.

4. Miller, R.R. et al (1963): S. Fork Pit, 3.6 mi upstream of Likely (Field No. RRM63-22).  
From field notes and museum collections at Univ. of Michigan.

5. Moyle and Daniels (1982): South Fork Pit River at Likely and Jess Valley.

6. 2002 survey: Sites 10- 12, S. Fork Pit from about 5 mi upstream of Likely to Jess Valley.

**Table 7.** Historical Comparisons – South Fork of the Pit River. Species caught within the upper South Fork of the Pit River, from Likely to Jess Valley bridge, during principal historical fish collections and the present survey.

## Species Accounts

Sacramento sucker: Sacramento suckers were the most common species encountered and were abundant at most sites. The only sites without suckers were the small, higher gradient section of the upper North Fork (Site 8) and the Talbot Ranch (Site 9) on the lower South Fork just south of Alturas, which had apparently been nearly dry a few weeks earlier. Juveniles (<200mm) were caught at all sites, including the South Fork (App. B-9). Adults were caught in all deeper pool sites on the mainstem Pit (Sites 1-2 and 4-6), with highest abundance at the two sites in Warm Springs Valley, Canby and Clark's Ranch (Sites 5-6), and the Highway 395 bridge (Site 4).

Sacramento suckers have generally been caught by all surveys at all sites. However, they were not caught from the upper North Fork in 2002, and they were apparently not caught by Moyle and Daniels in the upper South Fork in 1974.

Examination of dorsal ray counts (Table 8) and preliminary genetic analysis of suckers from all sites provided no indication that a resident population of Modoc suckers was present in the mainstem Pit River (Topinka et al. in prep). With the exception of a single individual (from Site 2, at Stone Coal Creek) which exhibited one of five Modoc genetic markers, all suckers from the mainstem Pit and vicinity of Alturas had all three Sacramento markers and no Modoc markers. Three individuals from the cascade reach above Stone Coal Creek (Site 3) had some meristic characters generally within the ranges for both Modoc and Sacramento suckers, with 11 dorsal rays and lateral line counts of 78, 79 and 83. However, they had post-weberian vertebral counts of 43-45, which are outside the range for Modoc suckers (40-42) and within the range of Sacramento sucker (43-46) based on recent studies (Kettratad 2001; Reid, unpub. data). They also showed none of the five Modoc sucker genetic markers currently available (Topinka et al. in prep).

However, suckers from the upper South Fork sites (Sites 10-12) contained relatively high frequencies of Modoc markers along with at least two of three Sacramento markers. Five of 34 individuals were missing a single Sacramento marker (Sac 3). The occurrence of Modoc sucker genetic markers in the South Fork of the Pit River suggests that either a previously resident population has been genetically swamped and replaced by Sacramento suckers, or that an extant source population of Modoc suckers occupies a tributary to the South Fork (or a reach upstream of the 2002 sampling). The South Fork population is the subject of an ongoing assessment to clarify its phenotypic and genetic character and to survey for possible source populations of Modoc suckers in tributaries to the South Fork (contact S. Reid, USFWS Klamath Falls, for further information).

	<u>Fish Examined ( # )</u>												
	<u>Site:</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>
<b>Dorsal Rays</b>													
<b>10</b>	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>11</b>	1	2	7	5	6	7	2	-	-	4	-	4	
<b>12</b>	11	16	45	22	37	54	24	-	-	31	1	5	
<b>13</b>	-	3	5	3	7	14	4	-	-	3	-	2	
<b>Total:</b>	12	21	57	30	50	75	30	0	0	38	1	11	

**Table 8.** Dorsal fin ray counts in Sacramento suckers caught at the twelve sampling sites.

Pit brook lamprey: Pit brook lamprey, the only lamprey currently known from the upper Pit River (excluding Goose sub-basin), were caught in the deeper mainstem Pit River as well as in the more stream-like reaches of the North and South Forks. Both adults and ammocoetes (larvae) were collected together, except at Clark's Ranch on the Pit (Site 6), where only a single adult was caught. A sucker (112mm SL) with an apparent lamprey wound (approx. 8mm diameter) was caught at the Highway 395 bridge (Site 4); this is the first possible evidence of parasitic behavior in a lamprey from the upper Pit River.

Lampreys are often missed or underestimated during electroshocking surveys, especially in turbid water, due to their relatively small size, cryptic brown coloration, tendency to burrow in the substrate, and ability to wriggle through net mesh (S. Reid, pers. obs.). Therefore, their absence at any site is not particularly informative. The presence of lampreys in both the North and South Forks, as well as at mainstem Pit River sites during the present survey, suggests that they probably occur throughout the drainage, and their scattered occurrence in historical collections is probably not indicative of variability in their range.

Redband/rainbow trout: Trout exhibiting both native redband coloration (intense color and parr marks retained into maturity) and potential hatchery rainbow trout (indefinite parr marks and pale pink lateral stripe) were caught only in two of the upper South Fork sites.

The absence of trout in the present surveys was consistent with historical collections made during July-September in the mainstem Pit, as well as summer surveys in the vicinity of Alturas since 1904. Both Rutter (1908) and Snyder (1908) caught trout in the immediate vicinity of Alturas circa 1900 (1898 and 1904, respectively). Although both Rutter (in 1898) and Moyle and Daniels (in 1974) caught trout in the upper North Fork, habitat conditions during the 2002 North Fork sampling, which included very low flows and shallow, warm water, probably excluded trout from the area; although potential refugial areas may have been present in the cooler mouths of nearby Thoms and Joseph Creeks. The 2002 catches of trout in the upper South Fork were consistent with Moyle and Daniels collection in the early 1970's. The

collections from 1940-1963, which did not encounter trout, were from the lower reaches of the stream, in the vicinity of Likely.

Brown trout (introduced): Brown trout were caught only in the three upper South Fork sites (Sites 10-12). Similarly, in their Pit River collections, Moyle and Daniels caught brown trout only in the upper South Fork. Brown trout have been in the upper Pit drainage since about the 1930's (Moyle and Daniels 1982).

Sacramento pikeminnow: Pikeminnow were abundant at most sites, except the small, higher gradient section of the upper North Fork (Site 8; none caught) and the Talbot Ranch (Site 9; 3 juveniles) on the lower South Fork just south of Alturas, which had apparently been nearly dry a few weeks earlier. The observed length frequencies suggest a young of the year (YOY) size-class centered near 60mm, which was present at all sites except the upper North Fork (App. B-4). Larger juveniles and subadults (100 – 220mm) were present at most sites, but adults (220-400mm) were caught at only two sites in Warm Springs Valley, Canby and Clark's Ranch (Sites 5-6). Both sites contained large deep pools with relatively low flow and gradient.

With few exceptions, pikeminnow have been collected consistently throughout the mainstem and vicinity of Alturas. Their absence from the upper North Fork in the 2002 surveys and absence from the upper South Fork in the 1973-74 surveys are perhaps notable. However, these differences may be due to local site conditions at the specific times of the surveys or collecting methodologies, and they should not be necessarily taken to indicate complete absence within those streams.

Hardhead: Hardhead of all size-classes were caught only in the mainstem Pit River (App. B-5), and individuals over 200mm, presumably adults, were caught only at the two sites in Warm Springs Valley, Canby and Clark's Ranch (Sites 5-6).

Hardhead have been caught consistently in surveys sampling larger pools of the mainstem Pit River. Their presence in the early surveys in the vicinity of Alturas, probably represent changes in habitat post-channelization of the North Fork through Alturas and/or differences in specific collection sites for the different surveys. Larger pool habitat is still present during the summer in the vicinity of Parker Creek and the Hwy. 395 crossing to Lakeview, but it was not sampled in 2002. Moyles and Daniels (1982) did report hardhead from the mouth of Parker Creek in 1974, though not from their lower North Fork Pit River sites.

Tui chub: Tui chubs were generally not a substantial part of the catch and were absent or represented by only 1-2 individuals at most sites. However, higher catches occurred in two areas: at the two sites in Warm Springs Valley, Canby and Clark's Ranch (Sites 5-6), and at the entrance to Jess Valley on the South Fork (Site 12). Most chubs caught appeared to represent a YOY size-class (centered near 50mm) and year-one class (centered near 100mm). The largest chub was collected at Canby and measured 180mm (App. B-6).

Tui chubs were collected in 2002 from most reaches where they had been collected historically, with the exception of the vicinity of Alturas. Habitat conditions at the 2002 site (in the constructed channel at Alturas), were extremely shallow without large pool habitat similar to

other sites with tui chubs. Therefore it is not surprising that none were caught; selection of a deeper water site just upstream of town might have produced chubs, as it did for Hubbs and Murphy in the 1934 and 1940 surveys, respectively.

Speckled dace: Dace were absent in the mainstem Pit River, and only occurred in the uppermost sites of the North and South Forks. They were abundant only at the upper North Fork site (Site 8), where they were the only fish besides lampreys in the sample; one individual was caught at the entrance to Jess Valley on the South Fork (Site 12).

Dace were caught only in the shallower stream reaches (upper North and South Forks) in the 2002 surveys, which is generally consistent with earlier surveys. Some earlier surveys also contained catches in the vicinity of Alturas. Whether these catches were due to habitat conditions or site specific differences can not be assessed. While Rutter (1908) reported dace from the Pit River at Canby in his report, there are no specimens from this locality in the National Museum, which contains the remainder of his specimens. Cooper et al. (1978) caught a single dace in the Pit River, near the mouth of Stone Coal Creek.

Pit roach : Pit roach were not caught from the mainstem Pit or the North and South Forks during the 2002 surveys. A single specimen was caught by Miller at the Canby bridge in 1961, and otherwise Pit roach were caught in very low numbers by Rutter ("a few small specimens"; 1908, p. 139) and Hubbs (19 specimens) in the North Fork. Roach were also caught historically in the South Fork near Likely, a reach which was not sampled in 2002.

Golden shiner (introduced): Golden shiner, an introduced species frequently used for bait, was rarely encountered. A single individual was caught at the Stone Coal confluence pool (Site 2) and three were caught at Canby (Site 5). Moyle and Daniels (1982) reported golden shiners to be common in the Big Valley section of the Pit River (downstream of the 2002 survey area), but in the upper Pit Drainage caught the species only in low numbers from Rattlesnake Creek (downstream of Big Sage Reservoir).

Brown bullhead (introduced): Brown bullheads were caught in relatively low numbers from the Hwy. 395 bridge (Site 4) on the mainstem Pit to the Talbot Ranch (Site 9) on the lower South Fork just south of Alturas. Most were smaller juveniles (<100mm), with only a few adults (140-200mm) caught (App. B-10).

Brown bullheads were introduced to California in 1874, and were caught from the mainstem Pit by Snyder in 1904 (Dill and Cordone 1997). They have not been caught in the upper North Fork, probably due to its rocky stream habitat.

Sacramento perch (introduced): Sacramento Perch, a species native to the Sacramento Valley, occurred only as small numbers of juveniles (29-69mm), with the largest catch (10) in the South Fork (Site 10), just below the outlet of West Valley Reservoir (App. B-11).

Sacramento perch were apparently introduced to West Valley Reservoir (tributary to the South Fork Pit) in 1972 (Moyle and Daniels 1982). There are no records from the mainstem Pit or North and South Forks in the historical surveys. The juveniles encountered in the 2002 surveys

may be waifs from this population, and the lack of adults in any collections suggest that the species is not established as a reproducing population in the mainstem Pit or North and South Forks.

Green sunfish (introduced): Green sunfish were generally caught throughout the mainstem Pit, lower North Fork and lower South Fork in low-energy reaches. The only mainstem site where green sunfish were not caught was in the high-energy cascade reach (Site 3) immediately above the Stone Coal confluence pool (Site 2), where they were relatively abundant. They were also absent from the upper reaches of the North and South Forks. While small green sunfish were moderately abundant at some sites and were the most abundant exotic species encountered, they never represented a large component of the biomass, since they were generally young juveniles (<50mm) and rarely exceeded 100mm (App. B-12).

Green sunfish were first recorded in fish surveys by Miller in 1961 (Pit River at Canby bridge) and have been recorded from the mainstem Pit and vicinity of Alturas in all subsequent surveys. Moyle and Daniels also caught them in the North Fork Pit, but they were not encountered at the single 2002 site. The species seems to be broadly present throughout the lower elevations of the upper Pit Drainage (Moyle and Daniels 1982, Reid pers. obs.).

Bluegill (introduced): Bluegill were caught at only two sites: the Stone Coal confluence pool (Site 2) and Clark's Ranch (Site 6). Each site had only four, relatively small (63-110mm) individuals apiece (App. B-13).

Bluegill were first recorded in fish surveys by Miller in 1961 (Pit River at Canby bridge) and have been recorded, in at least low numbers, from the mainstem Pit in all subsequent surveys. They have not been recorded from other sections of the North or South Fork, but may be present.

Pit sculpin: Pit sculpin were caught only in the three relatively high gradient upper South Fork sites (Sites 10-12). In historical collections, Pit sculpin have been recorded from throughout the upper Pit system. The absence of sculpin from the 2002 mainstem Pit River collections may be due, in part, to sampling artifacts. Sculpin are cryptically colored and are often missed by netters following electroshockers in turbid streams, while they are trapped in seines regardless of visibility. Sculpin were observed in the mainstem Pit River just upstream of Stone Coal Creek in late summer 2001 (Reid pers. obs.), so they were probably missed during the 2002 collections, rather than absent.

## **Conclusions**

The 2002 Pit River fish surveys were intended to: 1) explore the possibility that unrecognized populations of the federally endangered Modoc sucker might be present in the mainstem rivers, and 2) provide a current fish survey that could be compared with historic collections in order to assess changes in the species composition of the mainstem Upper Pit River fish fauna over the last century (1898-2002). The results of the 2002 surveys will be incorporated into a current status review by the USFWS to determine whether the Modoc sucker has recovered to a point where downlisting or delisting under the Endangered Species Act is appropriate.

The surveys also provide a baseline and record of fish species composition at the various Upper Pit River sites monitored by the Pit River Watershed Alliance for water quality, habitat, and macroinvertebrate composition, and provide faunal information for assessing potential effects to aquatic resources as a result of water and fisheries management in the Pit drainage. These survey results will be provided to the Pit River Watershed Alliance for incorporation into its ongoing assessment of watershed conditions and needs.

The present survey provided valuable information regarding the distribution of Modoc suckers and faunal characteristics of the mainstem upper Pit River, the North and the South Forks over the last century, including:

- 1) The 2002 survey found no indication of a resident population of Modoc suckers in the mainstem Pit River downstream of Alturas.
- 2) The occurrence of Modoc sucker genetic markers in the Sacramento sucker population in the upper South Fork of the Pit River (above Likely) suggests that either a previously resident population of Modoc suckers has been genetically swamped and replaced by Sacramento suckers, or that an unrecognized source population of Modoc suckers occupies a tributary to the South Fork (or a reach upstream of the 2002 sampling) well outside the previously known range of Modoc suckers in the Pit Drainage. The South Fork population is the subject of an ongoing assessment to clarify its phenotypic and genetic character and to survey for possible source populations of Modoc suckers in tributaries to the South Fork (contact S. Reid, USFWS Klamath Falls, for further information).
- 3) The native fish fauna of the upper Pit River has remained relatively stable throughout the last century at the sites surveyed. Possible exceptions include the summer distribution of redband trout in the North Fork, from Alturas upstream, and the localized exclusion of, or reduction in, fishes in river reaches subject to dewatering and/or stagnation.
- 4) Exotic fishes formed a relatively minor component of the fish communities at the sites surveyed. The most consistently present exotic species were green sunfish and brown bullheads in the mainstem Pit and vicinity of Alturas, and brown trout in the upper South Fork. All three species have been present in the drainage for at least seventy years.
- 5) Two exotic species, largemouth bass and channel catfish, were caught during historical surveys from the 1960-70's but were notably absent in the 2002 survey. The decline and disappearance of bass and channel catfish was supported by numerous comments by local residents and fishermen during the 2002 survey.

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**Appendix A: Survey Sites - Sampling Methods and Habitat Notes**



**Site 1:** Location: Rose Canyon - Pit River, confl. Rose Canyon, at Shaw Ranch bridge.  
Township: T 41N R 7E Sec 35 (Modoc Co.)  
Date: 12 Sept. 2002, 1030-1400 hrs.  
Depth sampled: 0.1 - 2.0 m in pools, max depth ca 2.0 m under bridge  
Visibility: ca. 0.3 m  
Water temp.: 16.6 °C  
Conductivity: 226µmhos/cm  
Shocker time: Raft shocker in pools = 1158 secs (377, 781 secs)  
Backpack shocker in riffles = not recorded  
Notes: Moderate flow<sup>1</sup>.

<sup>1</sup>: Current was characterized as 1) "weak", if water was flowing but hardly noticeable, 2) "moderate", if there was noticeable flow, but it was not strong enough to affect waders in the water, and 3) "strong", if the current resulted in notably turbulent flow and/or was difficult to wade against, control raft, or net fish.



**Site 2:** Location: Stone Coal Pool - Pit River, large pool at confluence with Stone Coal Creek, just below County Road 85 bridge  
Township: T 41N R 8E Sec 27 (Modoc Co.)  
Date: 13 Sept. 2002, 0900-1230 hrs.  
Depth sampled: ca. 1.0 - 5.0 m  
Visibility: ca. 2.0 m  
Water temp.: 15.2 °C at surface, 14.0 °C at 3.2 m  
Conductivity: 220µmhos/cm at surface, 215µmhos/cm at 3.2 m  
Shocker time: Raft shocker = 2462 secs (1155, 1307 secs); Backpack = 30 mins  
Notes: Large pool at confluence sampled with boat shocker, about 30m of shallow riffles below pool sampled by backpack. Small YOY pikeminnow (< 50 mm) were common in riffles, one larger (120 mm), also caught four small suckers (< 10 cm, all with 12 DR) in riffles.



**Site 3:** Location: Stone Coal Rapids - Pit River, rapids reach just above confluence  
Stone Coal Creek, at County Road 85 bridge  
Township: T 41N R 8E Sec 27 (Modoc Co.)  
Date: 12 Sept. 2002, 1450-1900 hrs.  
Depth sampled: ca. 0.5 - 2.0 m  
Visibility: ca. 2.0 m  
Water temp.: 21.9 °C  
Conductivity: 241  $\mu\text{mhos/cm}$   
Shocker time: Total time (backpack shocker) = not recorded  
Notes: Rapids reach, large rock and cobble pools with short rapids between.



**Site 4:** Location: Hwy. 139 Bridge - Pit River, just downstream of Hwy. 139 bridge at public access, about four miles down from Canby.  
Township: T 41N R 9E Sec 9 (Modoc Co.)  
Date: 17 Sept. 2002, 0915-1015 hrs.  
Depth sampled: ca. 0.5 - 1.3 m  
Visibility: ca. 1.0 m  
Water temp.: 16.5 °C  
Conductivity: 241  $\mu$ mhos/cm  
Shocker time: Total time (boat shocker on raft, single pass) = 1423 secs  
Notes: Slight flow. Sampled rocky bottom, deeper pool, vegetated shorelines and aquatic vegetation.



**Site 5:** Location: Canby - Pit River at County Road 54 bridge (Modoc Co.)  
 Township: boundary of T 42N R 9E Sec 36/ T 42N R 10E Sec 31  
 Date: 10 Sept. 2002, 0800-1575 hrs.  
 Depth sampled: 0.6 - 3.2 m  
 Visibility: ca. 1.0 m  
 Water temp.: 15.3 °C  
 Conductivity: 147µmhos/cm  
 Settings: Pass 1: High, 30 pd, 50%  
 Pass 2-5: High, 30 pd, 100% - relocated anodes shallower (1.5 m) bow  
 Shocker time: Boat shocker = 8109+ secs ("short", 2188, 1412, 1734, 2775 secs.)  
 Notes: Moderate flow. Three Sacramento suckers (372, 375, 385 mm SL )  
 and three pikeminnow (370, 385, 390 mm SL) frozen for tissue  
 analysis of mercury. Proposed outfall site for ISOT hydrothermal.



**Site 6:** Location: Clark's Ranch - Pit River ca. 5 miles west of Alturas  
Township: T 42N R 11E Sec 13-14 (Modoc Co.)  
Date: 11 Sept. 2002, 1000-1445 hrs.  
Depth sampled: 0.3 - 1.7 m, mostly < 0.8 m  
Visibility: < 1.0 m  
Water temp.: 15.2 °C  
Conductivity: 209µmhos/cm  
Shocker time: Boat shocker = 4418 secs (2051, 1345, 1022 secs)  
Notes: Moderate flow. Three pikeminnow (340, 350, 400 mm SL) frozen for tissue analysis of mercury concentrations.



**Site 7:** Location: Alturas - North Fork Pit River, in Alturas, behind River Center.  
Township: T 42N R 12E Sec 14 (Modoc Co.)  
Date: 17 Sept. 2002, 1700-1830 hrs.  
Depth sampled: ca. 0.2 - 1.0 m  
Visibility: ca. 0.5 m  
Water temp.: 19.6 °C  
Conductivity: 472µmhos/cm  
Shocker time: Total time (backpack shocker) = 1307 secs  
Notes: Slight flow.



**Site 8:** Location: North Fork - North Fork Pit River, at confl. with Thoms Creek, 1.4 miles downstream of Joseph Creek.  
Township: T 43N R 13E Sec 1 (Modoc Co.)  
Date: 17 Sept. 2002, 1330-1515 hrs.  
Depth sampled: ca. 0.2 - 1.0 m  
Visibility: ca. 1.0 m  
Water temp.: 17.1 °C  
Conductivity: 270µmhos/cm  
Shocker time: Total time (backpack shocker) = 2442 secs  
Notes: Slight flow. Dace abundant. Lamprey also present, no other fish.

NO PHOTOS AVAILABLE

**Site 9:** Location: Talbot Ranch - S. Fork Pit River, ca. 1 mile south of Alturas  
Township: T 42N R 12E Sec 23 (Modoc Co.)  
Date: 11 Sept. 2002, 1630-1800 hrs.  
Depth sampled: 0.3 - 1.2 m, mostly ca 1.0 m  
Visibility: ca. 1.0 m  
Water temp.: 22.0 °C  
Conductivity: 410<sup>+</sup>µmhos/cm  
Shocker time: Total time = 1152 secs (boat shocker on raft)  
Notes: Slight flow. Site had been near dry two weeks earlier (pers. com. Mr. Talbot). Water depth 30-120 cm, dense aquatic vegetation and algae, water clear and red, bottom solid with sod or caliche.



**Site 10:** Location: South Fork Bridge - South Fork Pit River, at bridge one mile below confluence with West Valley Creek.  
Township: T 39N R 13E Sec 11 (Modoc Co.)  
Date: 18 Sept. 2002, 0800-0940 hrs.  
Depth sampled: ca. 0.5 - 1.5 m  
Visibility: ca. 0.2 m, turbid with West Valley Reservoir water  
Water temp.: 14.7 °C  
Conductivity: 139µmhos/cm  
Shocker time: Total time (boat shocker on raft) = 988 secs  
Notes: Strong current.



**Site 11:** Location: South Fork Diversion - South Fork Pit River, at irrigation diversion above confluence with West Valley Creek.  
Township: T 39N R 14E Sec 8 (Modoc Co.)  
Date: 18 Sept. 2002, 1155-1400 hrs.  
Depth sampled: ca. 0.3 - 1.5 m  
Visibility: ca. 1.0 m, red with Jess Valley water  
Water temp.: 13.4 °C  
Conductivity: 97µmhos/cm  
Shocker time: Total time (backpack shocker) = 1680 secs  
Notes: Moderate current.



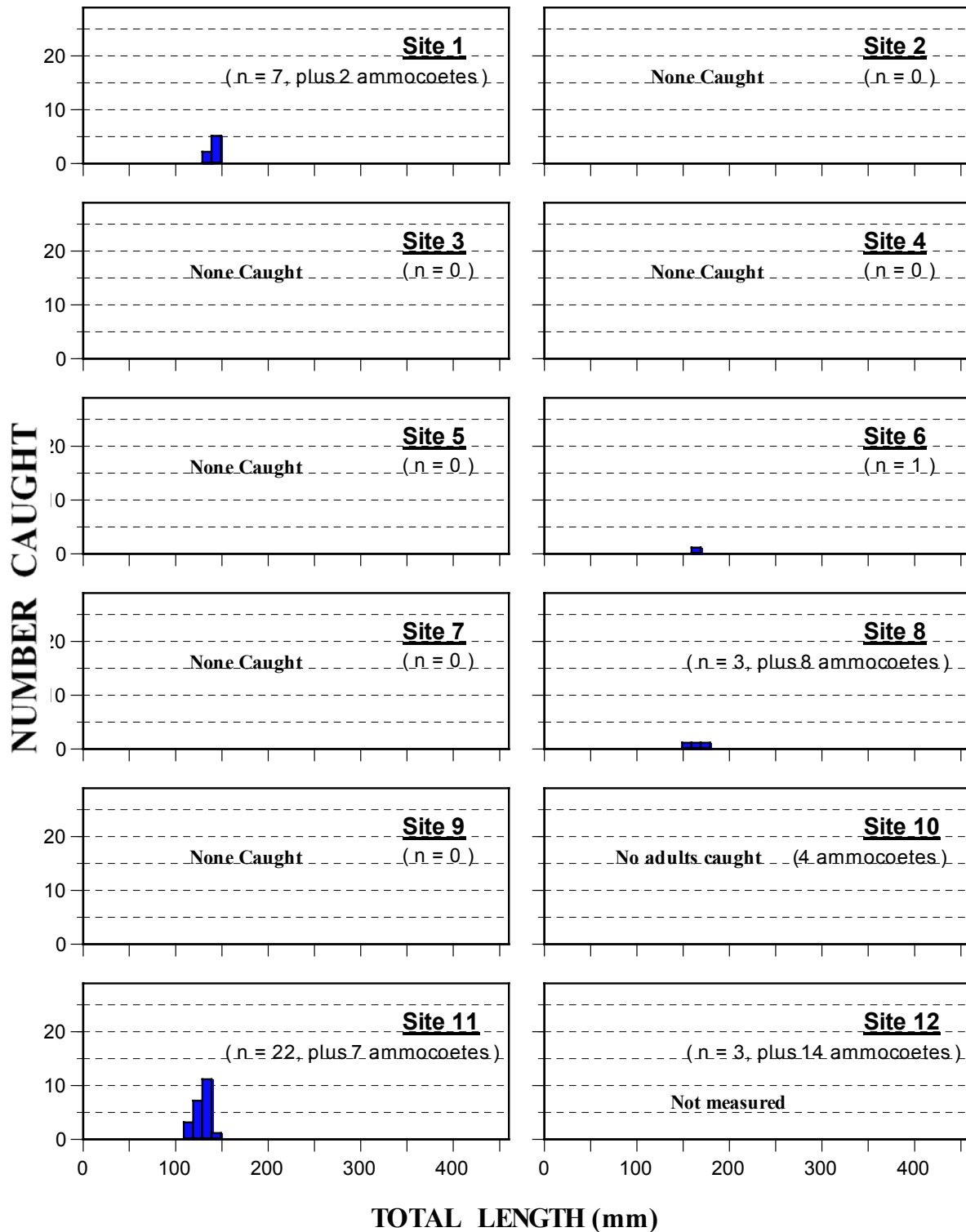
**Site 12:** Location: Jess Valley - South Fork Pit River, just below Jess Valley Bridge.  
Township: T 39N R 14E Sec 10/11 (Modoc Co.)  
Date: 18 Sept. 2002, 1430-1600 hrs.  
Depth sampled: ca. 0.3 - 1.5 m  
Visibility: ca. 1.0 m, red with Jess Valley water  
Water temp.: 15.9 °C  
Conductivity: 95µmhos/cm  
Shocker time: Total time (backpack shocker) = 1989 secs  
Notes: Moderate current. Relatively low gradient, silt and cinder bottom, with woody debris, branches and vegetation in water.



Site X - Pit River at Kelley Hot Springs outflow channel on September 10<sup>th</sup>, 2002 – not sampled. Water quality conditions and handnetting indicated the site did not contain many, if any, fish.

**Appendix B: Length Frequencies by Species**

# Pit Brook Lamprey (adults)



**Figure B-1. Pit Brook Lamprey** - Length Frequencies and numbers of all adults caught at the various sampling sites. For size distribution of ammocoetes see text (Results).

# Redband Trout

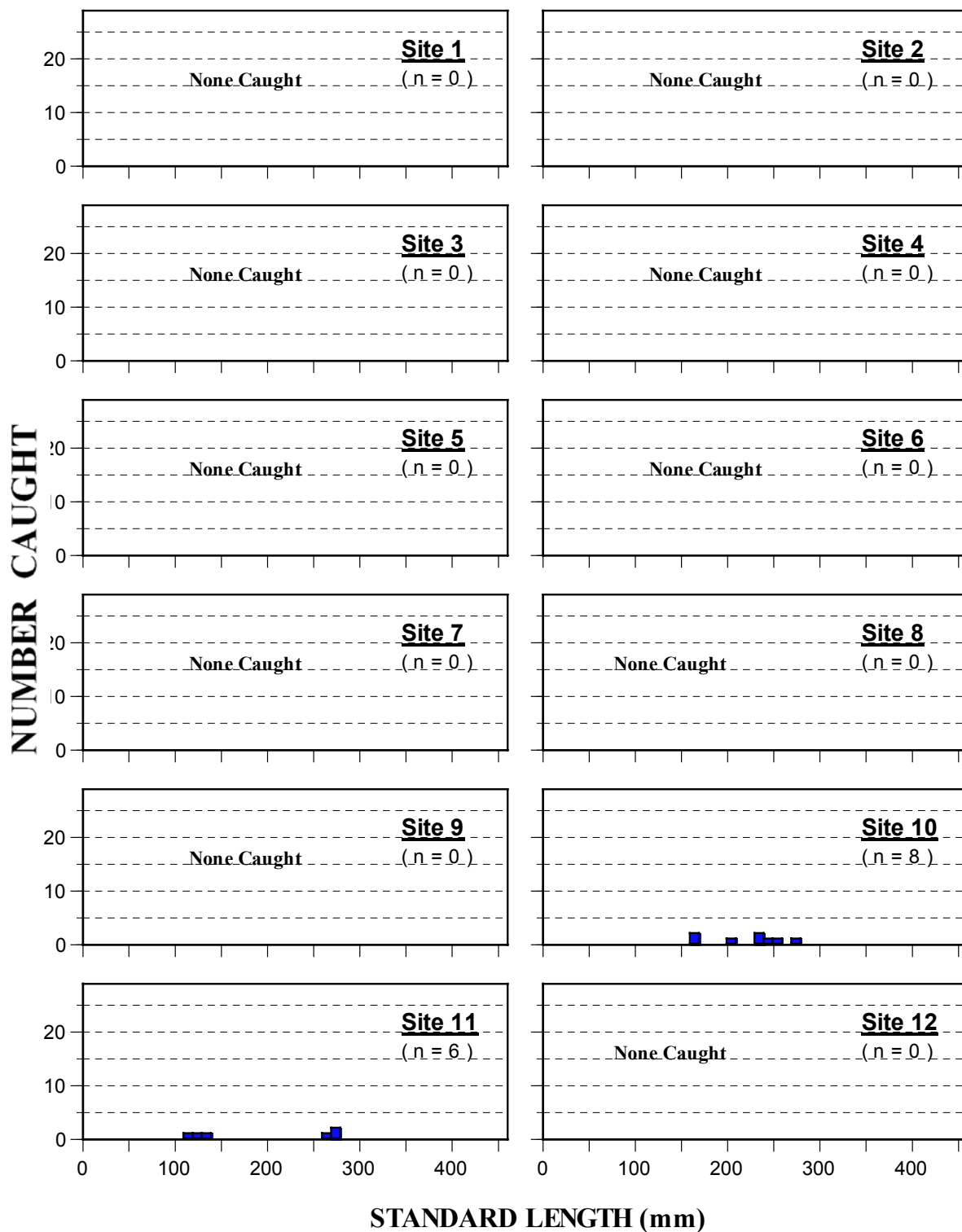


Figure B-2. Redband Trout - Length frequencies and specimens caught at the various sampling sites.

# Brown Trout

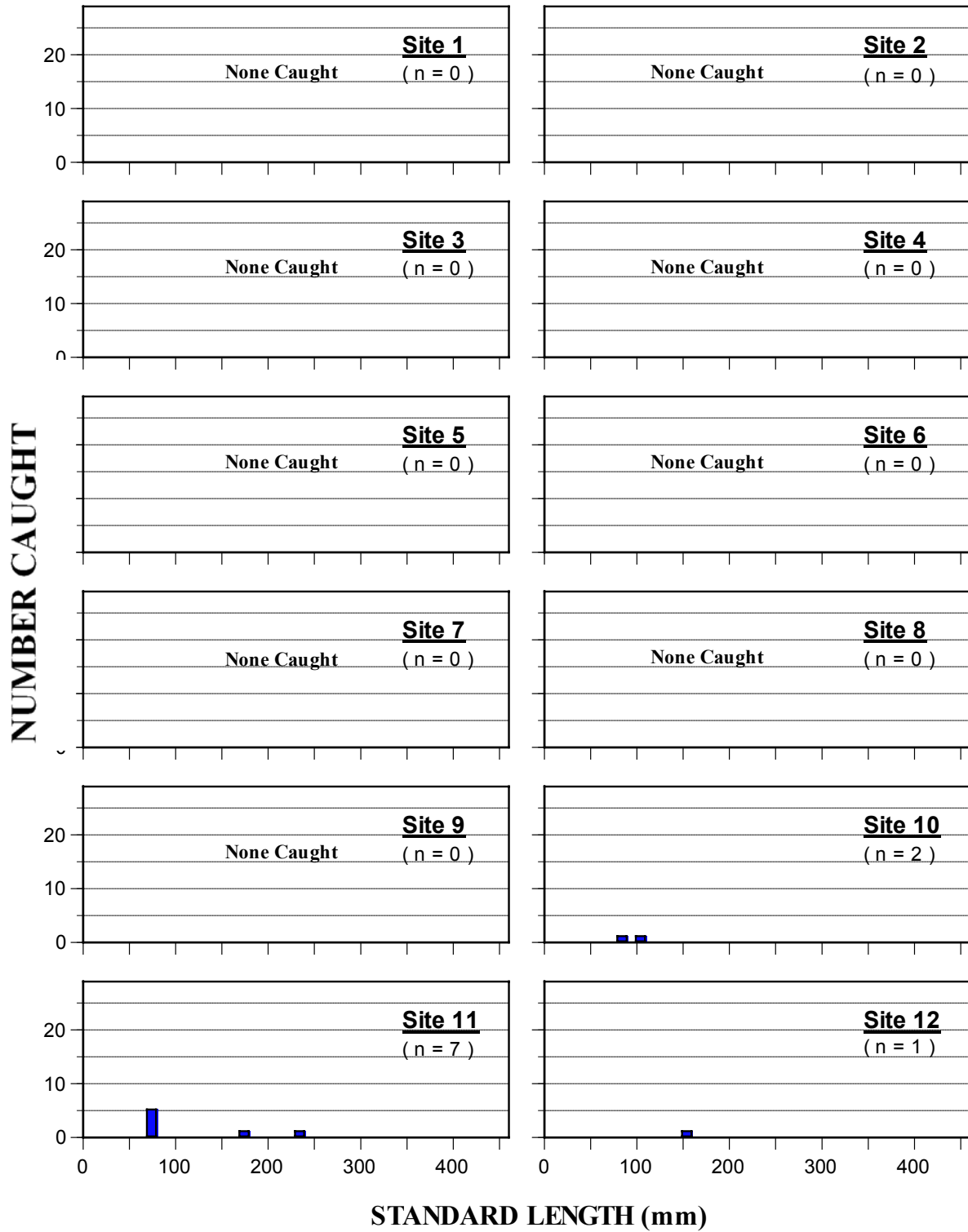


Figure B-3. Brown Trout - Length frequencies and specimens caught at the various sampling sites.

# Sacramento Pikeminnow

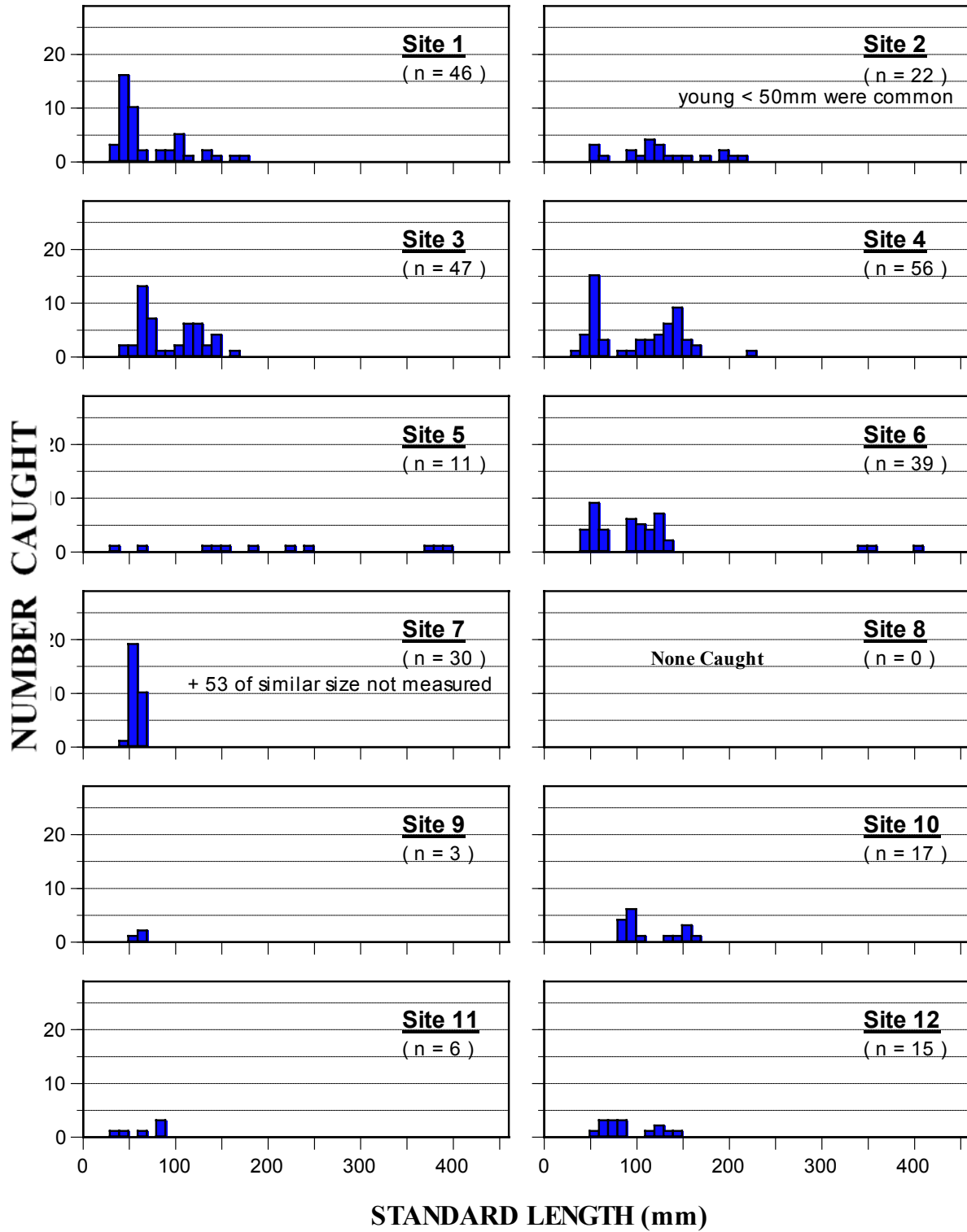


Figure B-4. Sacramento Pikeminnow - Length frequencies and specimens caught at the various sampling sites.

# Hardhead

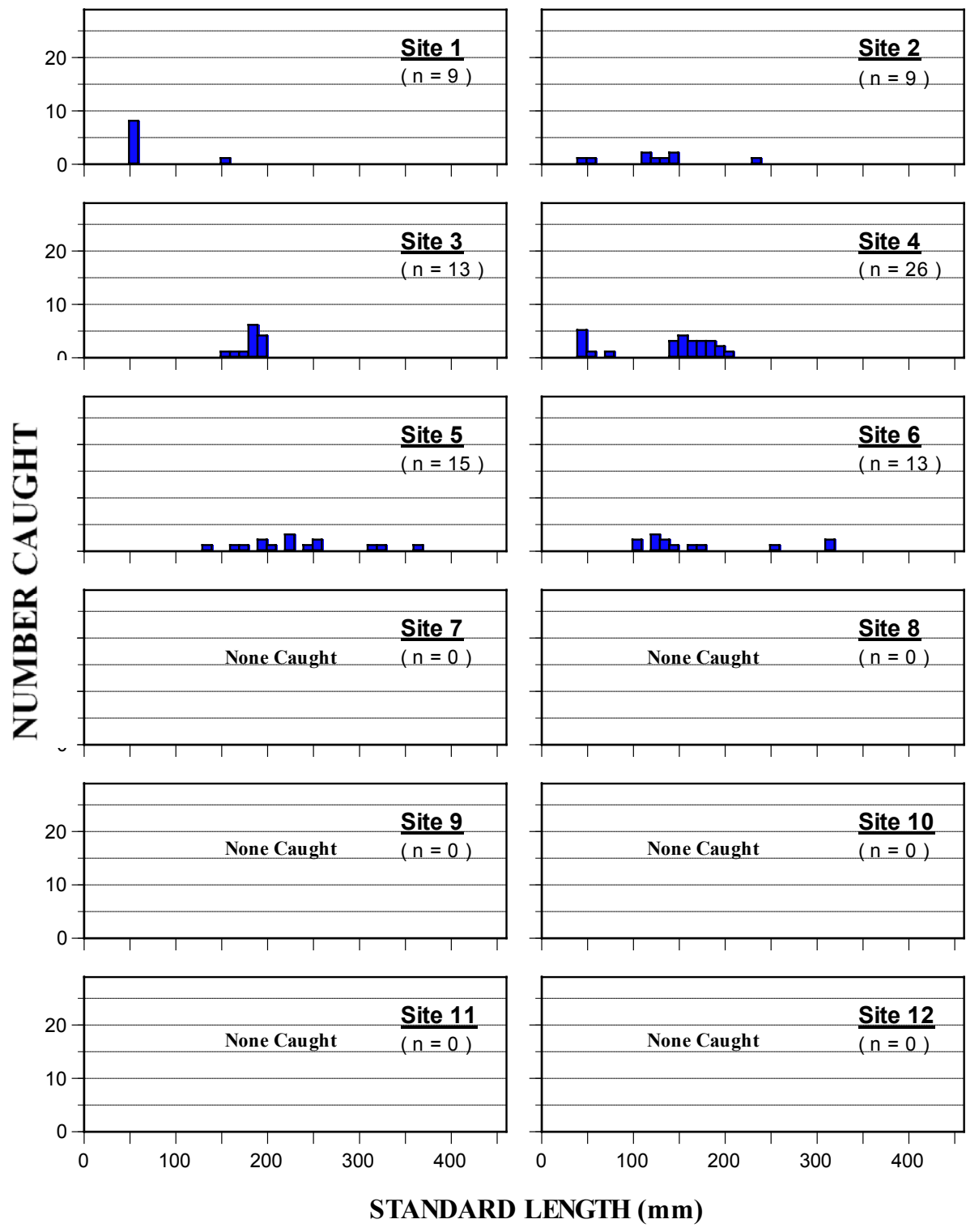


Figure B-5. Hardhead - Length frequencies and specimens caught at the various sampling sites.

# Tui Chub

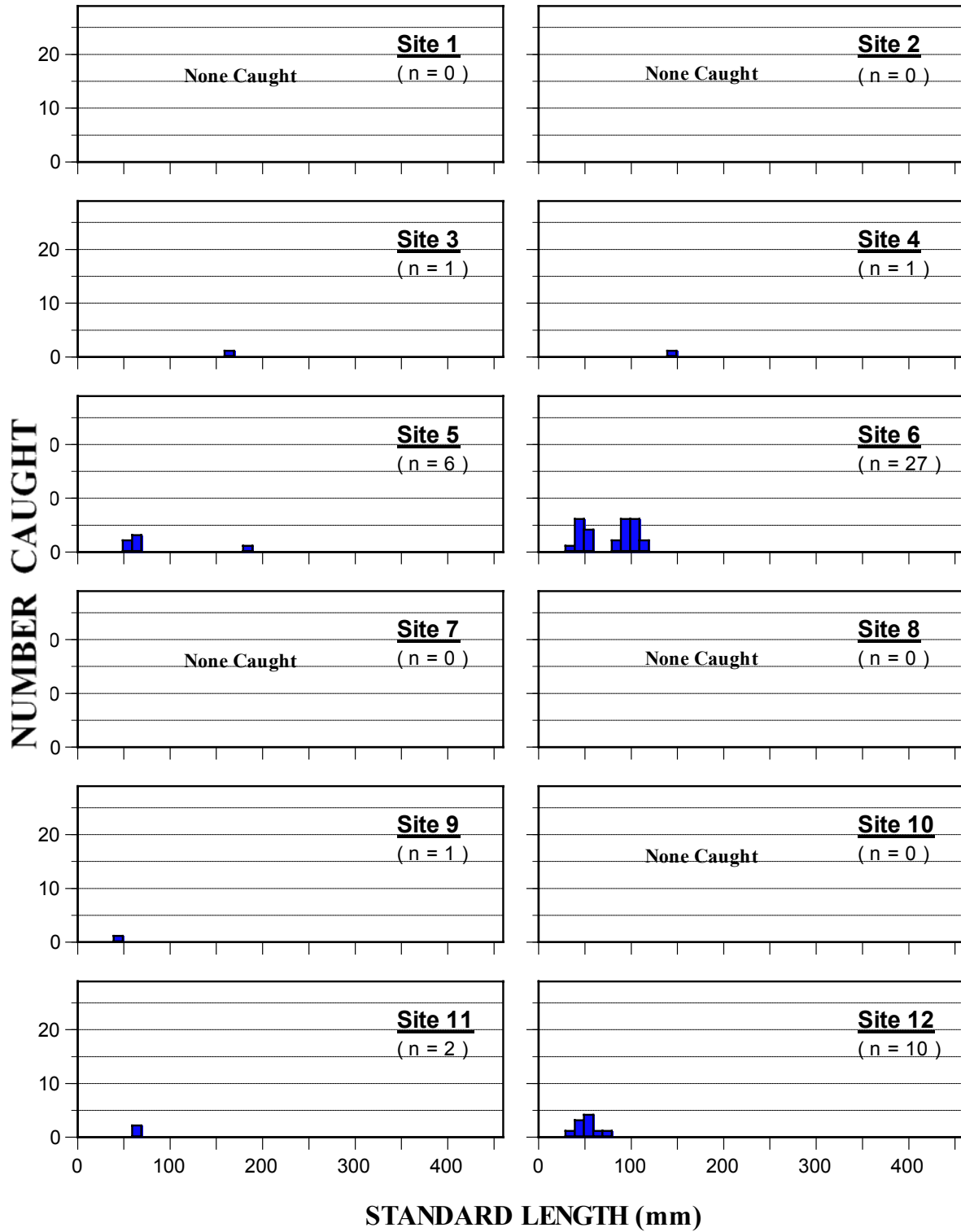


Figure B-6. Tui Chub - Length frequencies and specimens caught at the various sampling sites.

# Speckled Dace

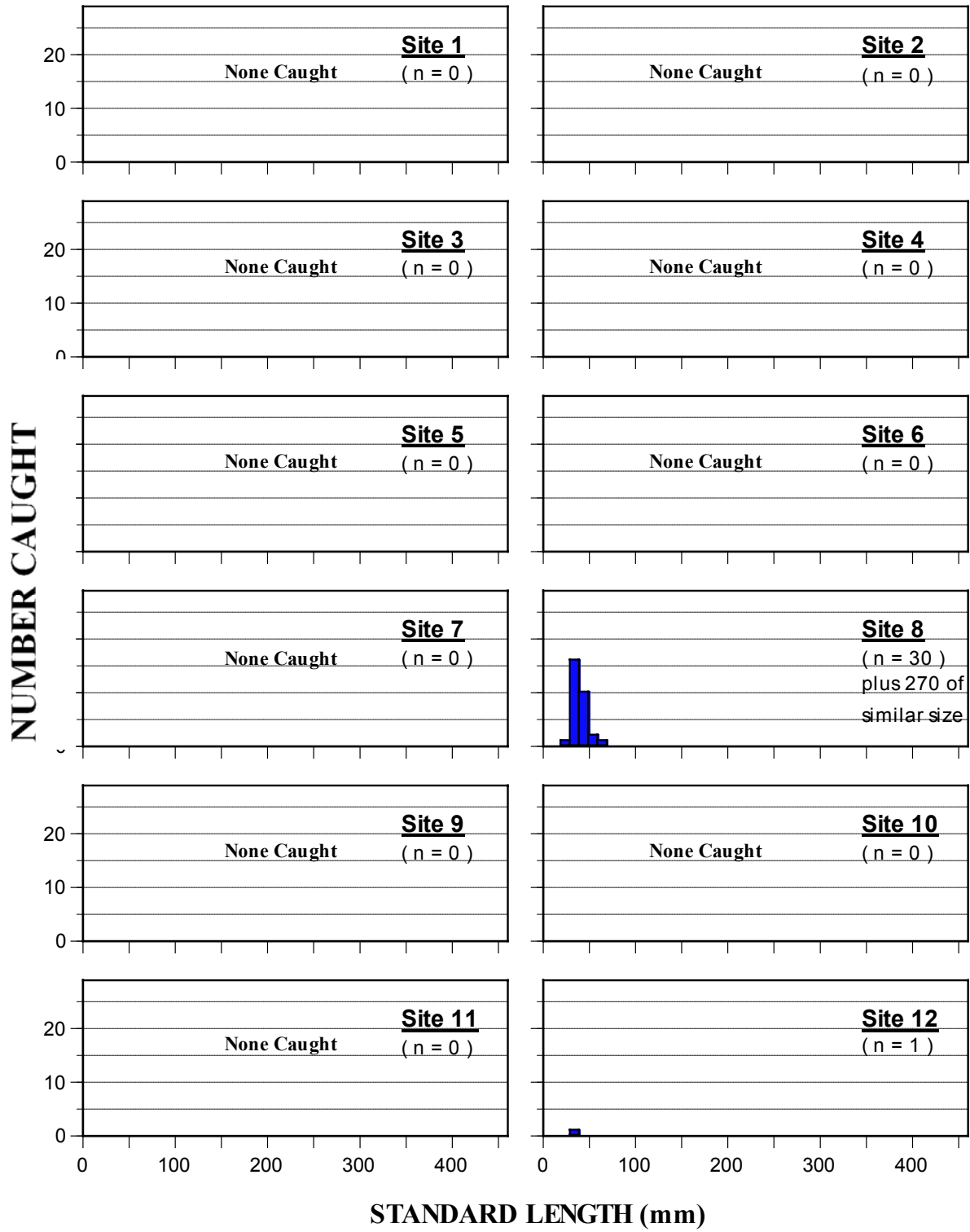


Figure B-7. Speckled Dace - Length frequencies and specimens caught at the various sampling sites.

# Golden Shiner

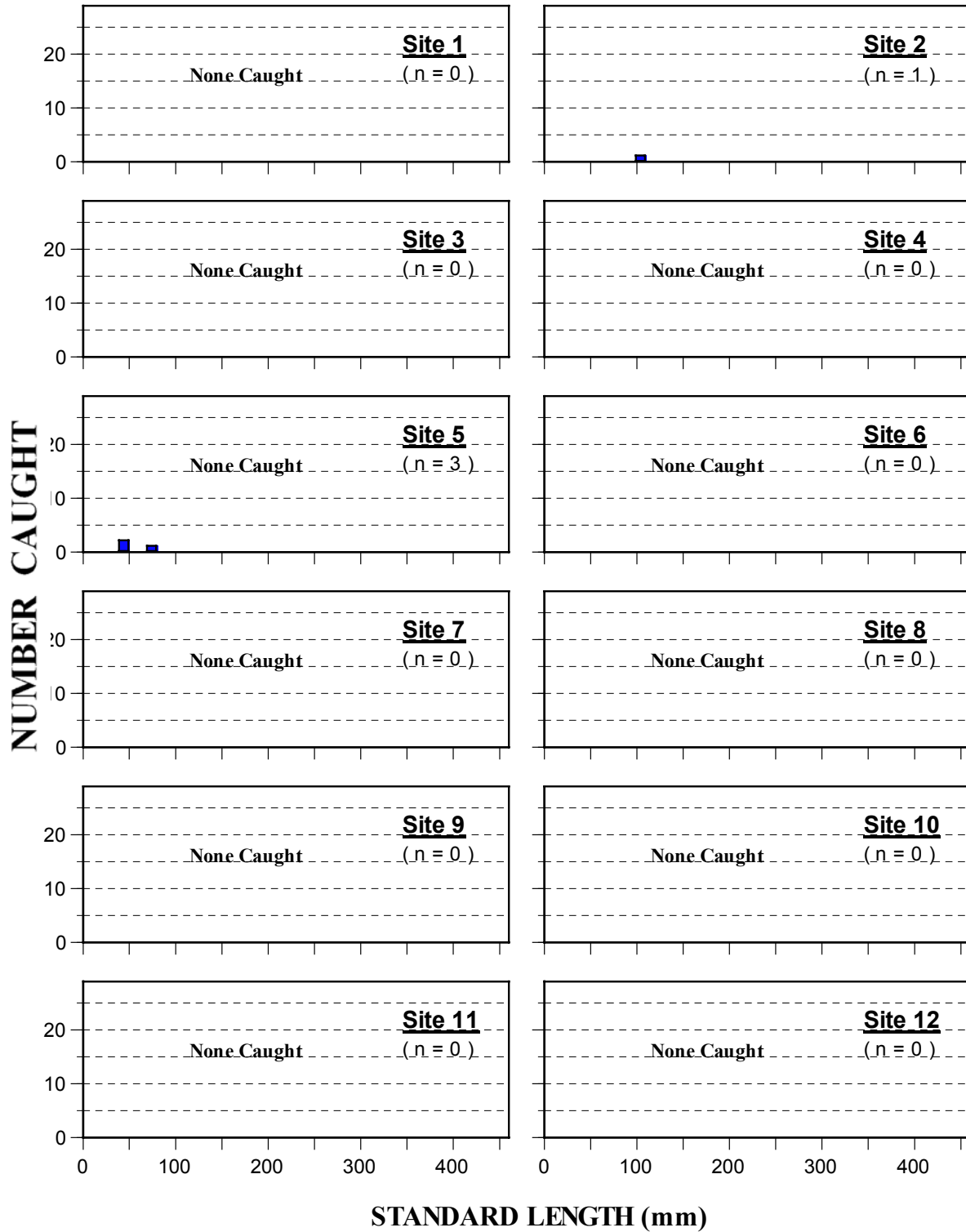


Figure B-8. Golden Shiner - Length frequencies and specimens caught at the various sampling sites.

# Sacramento Sucker

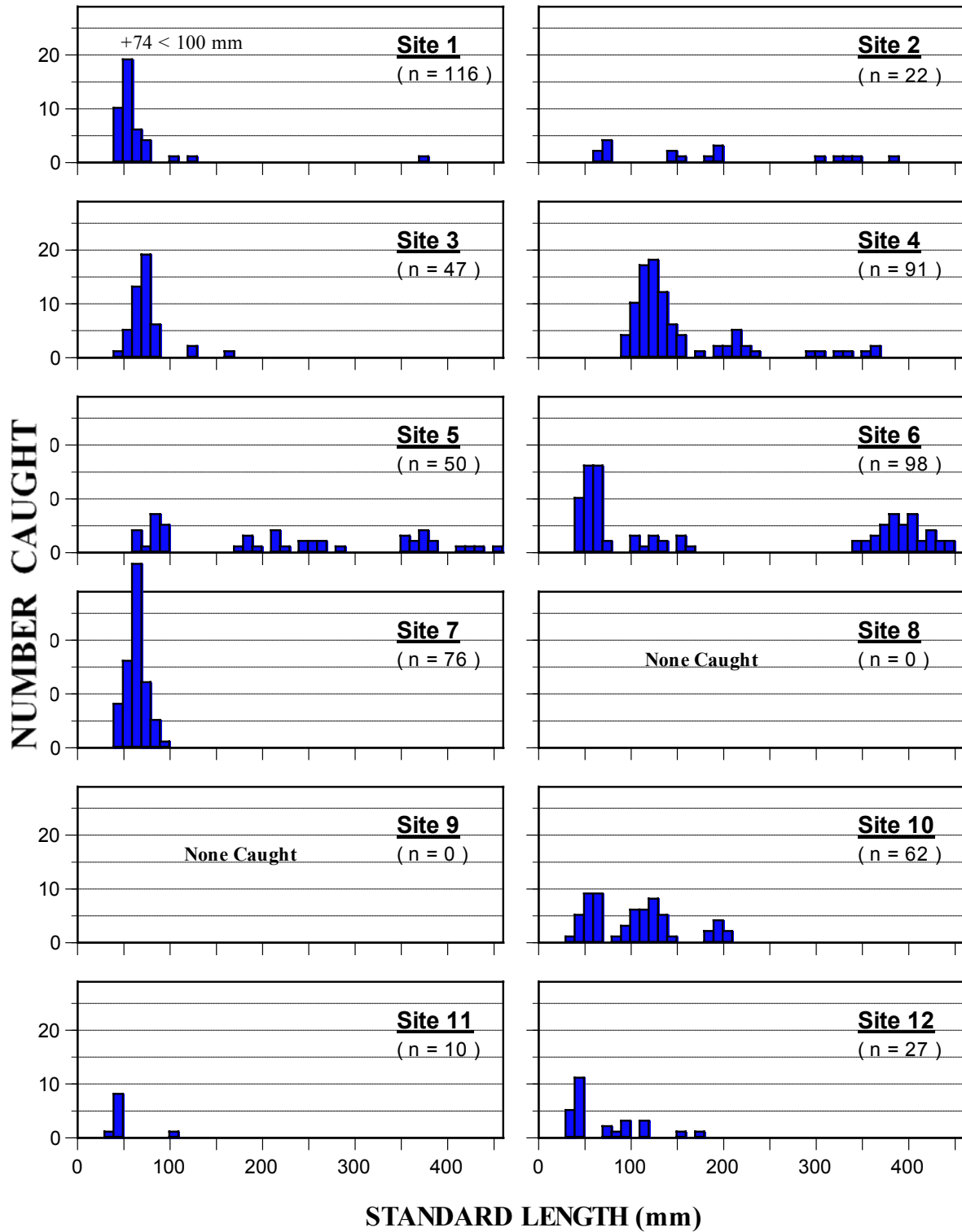


Figure B-9. Sacramento Sucker - Length Frequencies and specimens caught at the various sampling sites.

# Brown Bullhead

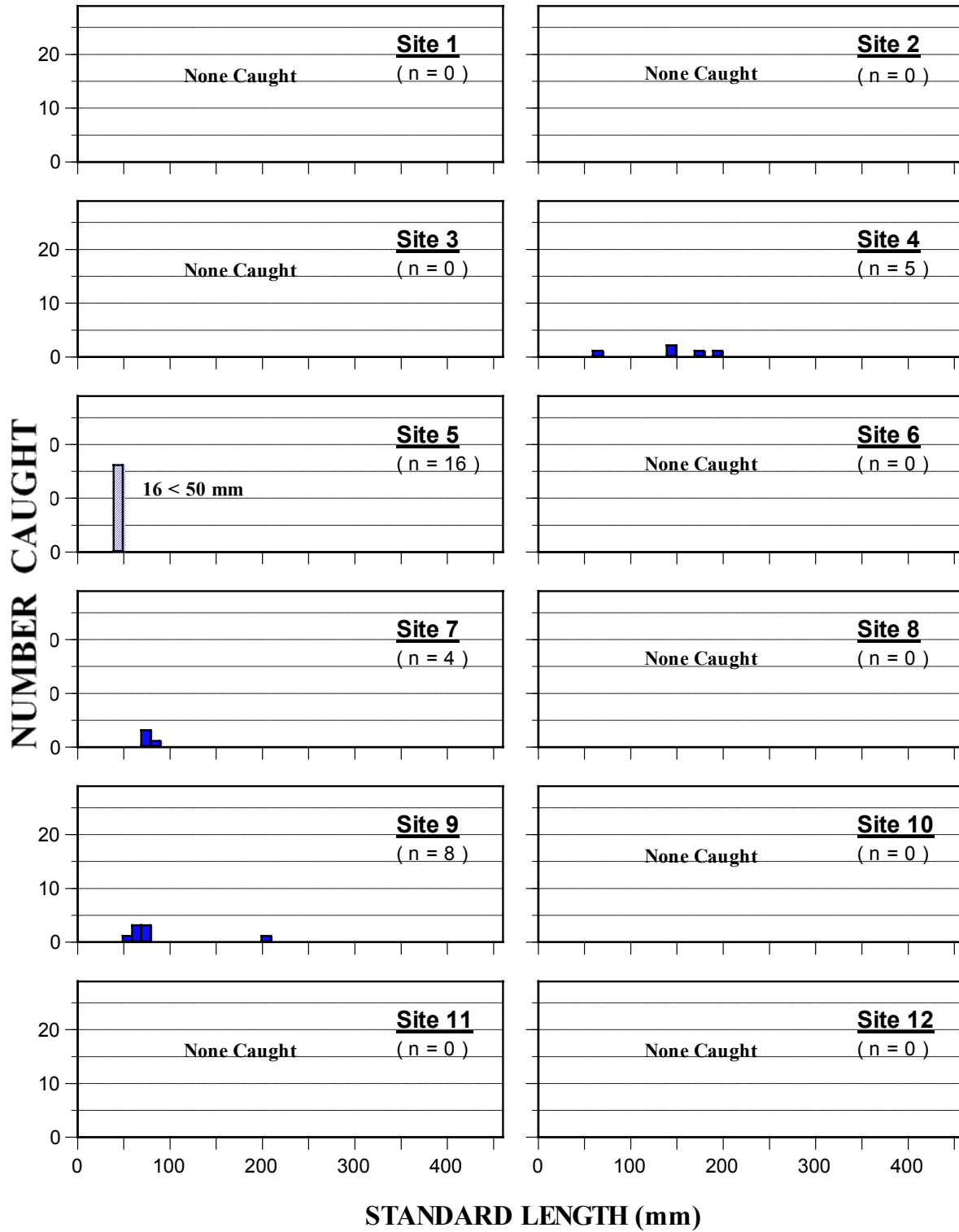


Figure B-10. Brown Bullhead - Length frequencies and specimens caught at the various sampling sites.

# Sacramento Perch

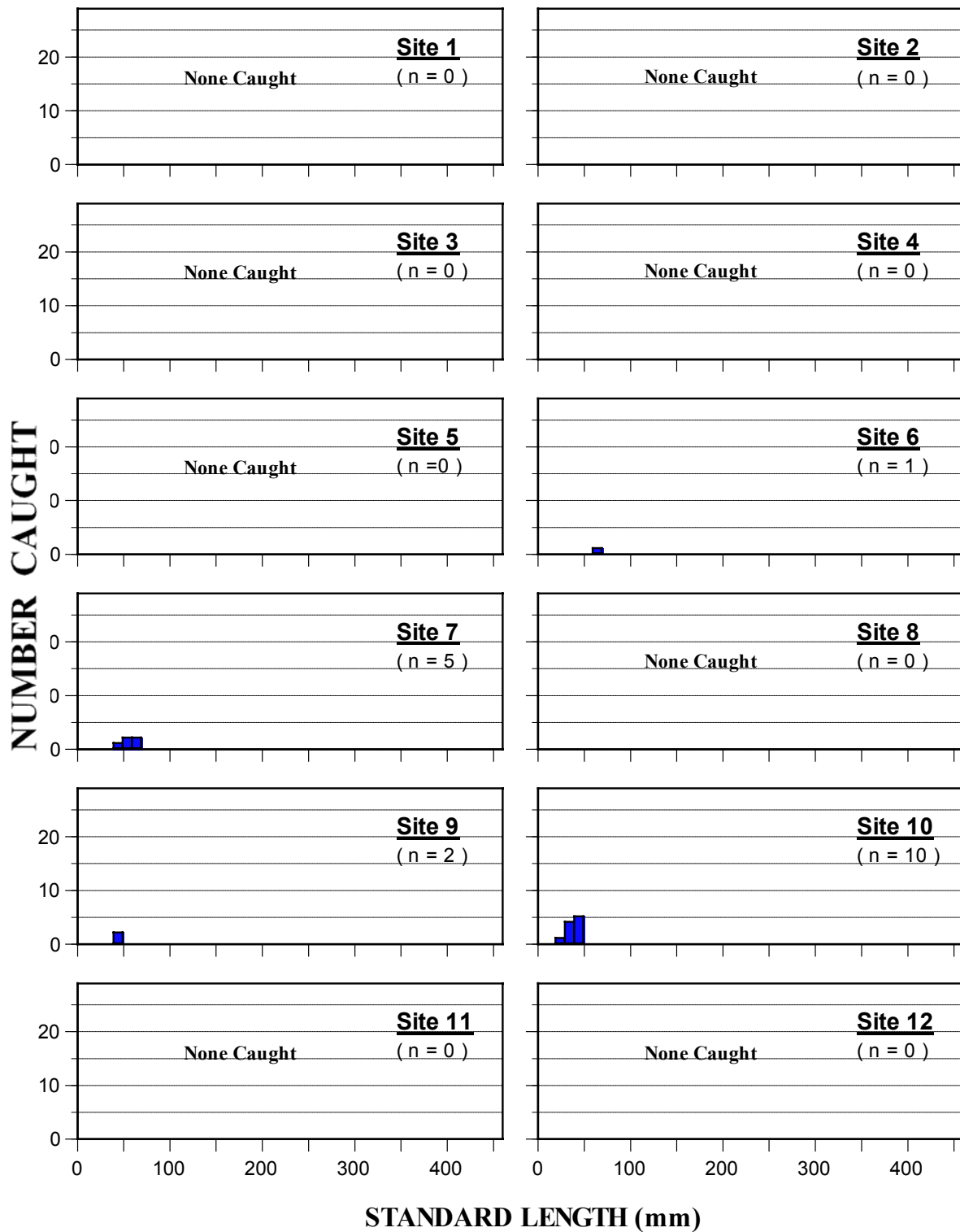


Figure B-11. Sacramento Perch - Length frequencies and specimens caught at the various sampling sites.

# Green Sunfish

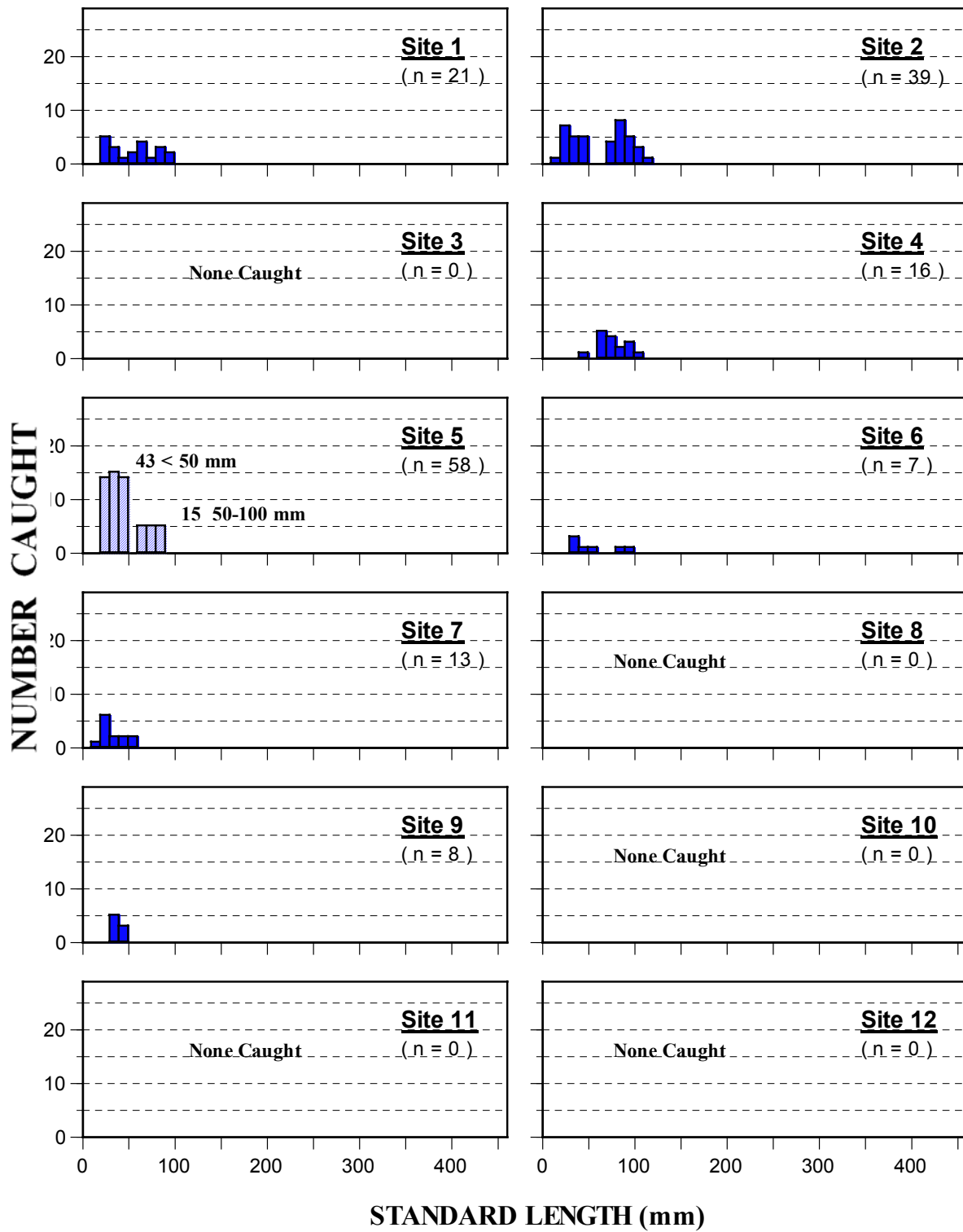


Figure B-12. Green Sunfish - Length frequencies and specimens caught at the various sampling sites.

# Bluegill

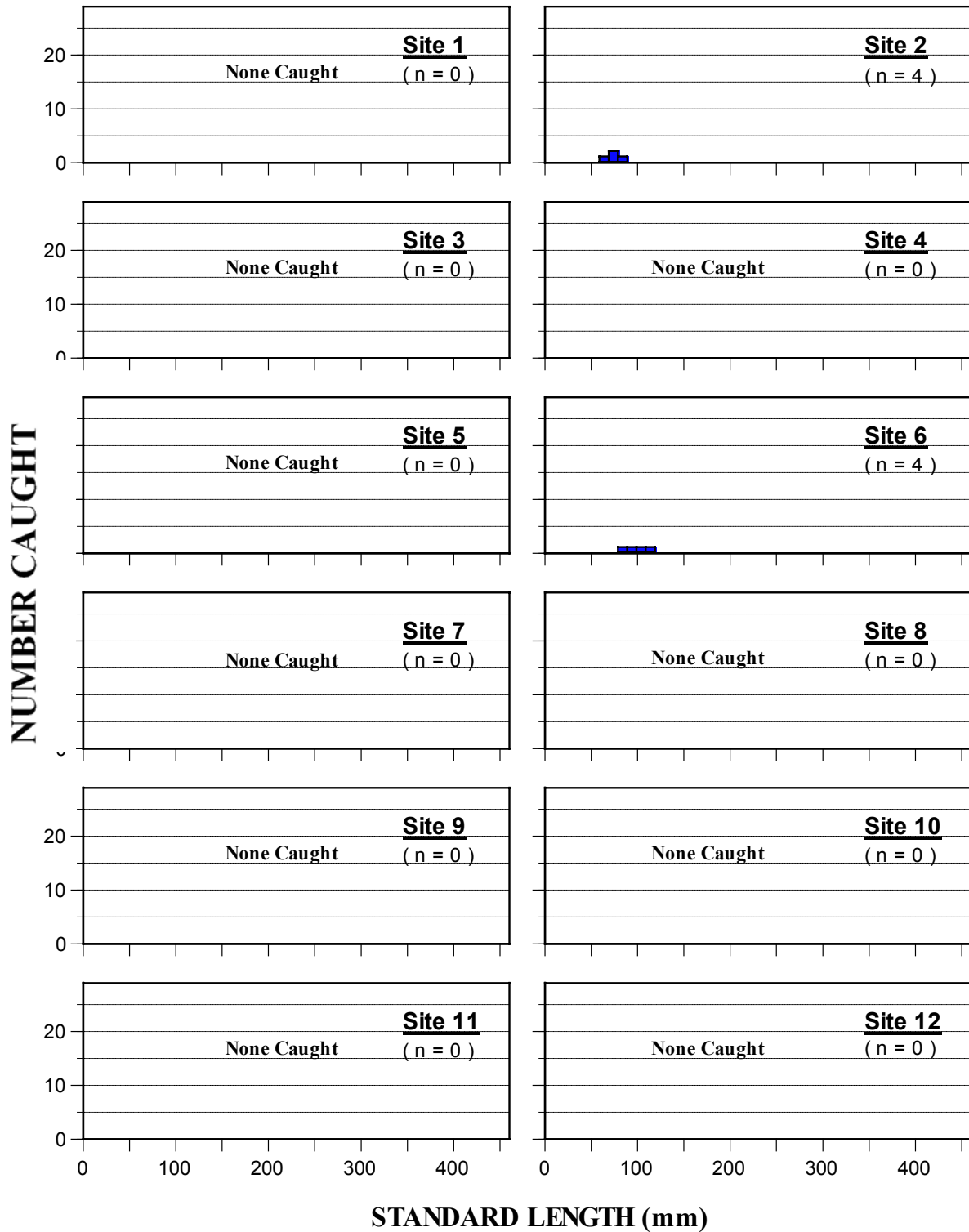


Figure B-13. Bluegill - Length frequencies and specimens caught at the various sampling sites.

# Pit Sculpin

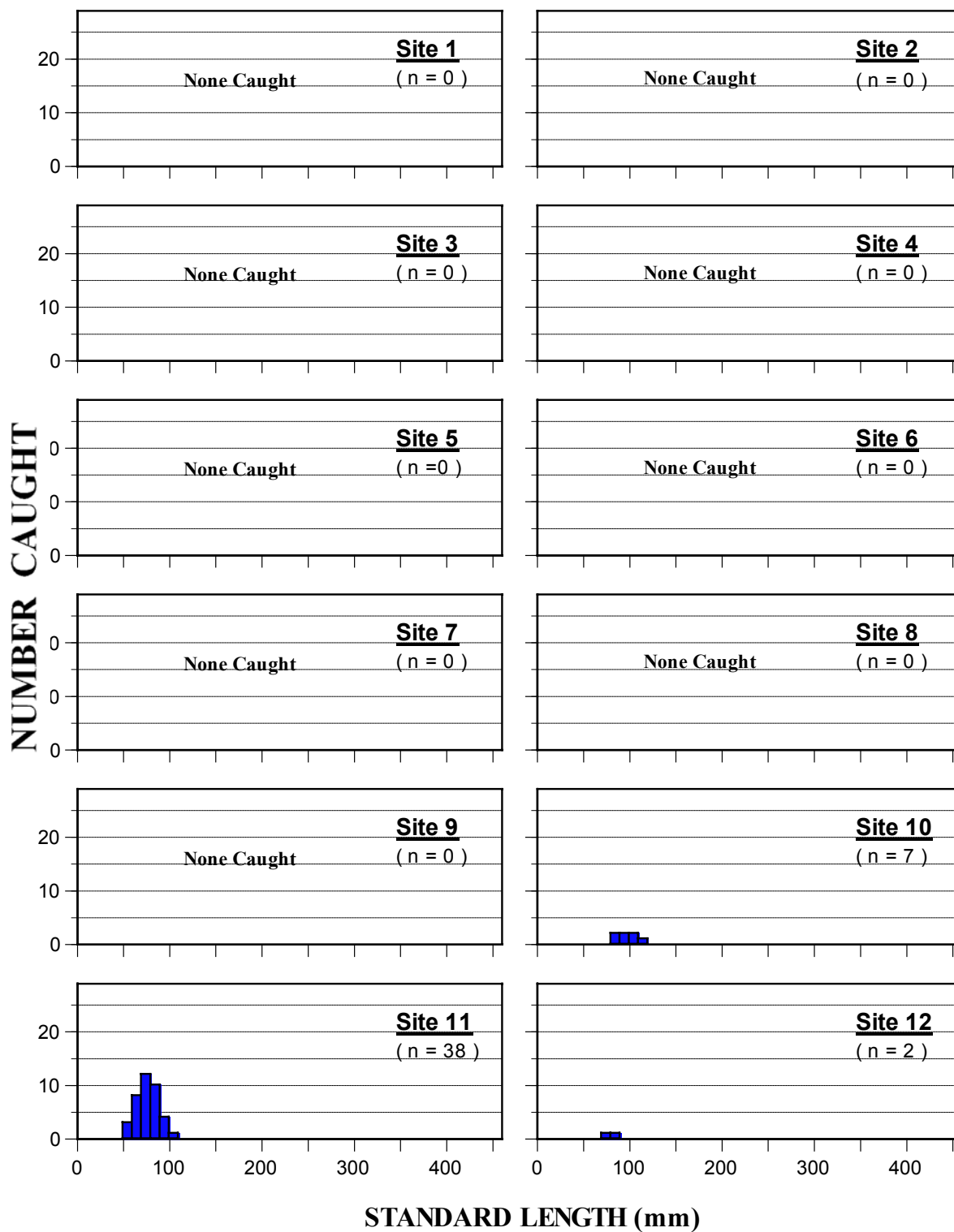


Figure B-14. Pit Sculpin - Length frequencies and specimens caught at the various sampling sites.