SPECIES FACT SHEET

Common Name: Pygmy Whitefish
Scientific Name: *Prosopium coulterii*

Conservation Status:
Global Status: G5 – (Secure) Common; widespread and abundant.
National Status: N4 – (Apparently Secure) Uncommon but not rare; some cause for long-term concern due to declines or other factors.
State Status: Washington: S1S2 – Imperiled to critically imperiled because of extreme rarity or other factors making it especially vulnerable to extirpation from the state.

Technical Description:
Pygmy whitefish are small, cigar-shaped fish, brown backed with silver sides and a blunt snout. Adults average 10 cm to 14 cm fork length (FL, measured from the tip of the snout to the fork in the tail). The maximum length recorded for an adult in British Columbia is 26.2 cm FL (Alberta Sustain Resource Development [ASRD] and Alberta Conservation Association [ACA] 2011). The head of pygmy whitefish is longer than the body depth, with eyes that are larger than the snout length. Other distinctive characteristics include a dorsal fin ray count of 7-13, anal fin ray count of 8-10, single nostril flap, and lateral line scale count of 54-70 (Hallock and Mogillo 1998).

Two morphological forms of pygmy whitefish are known: high-raker and low-raker. The forms are distinguished by the gillraker count; 17 or more for the high-raker form and 16 or fewer for the low-raker form. A study completed by McCart (1970) observed that sympatric high and low raker forms were found to differ in their appearance, specifically the head features (size, mouth location, and shape of snout). McCart also noted a geographical distribution amongst the two forms. The high-raker form had an entirely northern distribution (Alaska, Yukon Territory, and Northern British Columbia). Low-raker forms appeared to have a larger distribution overlapping the high-raker form in the Bristol Bay area and extending southward as far as the Columbia River (McCart). McCart (1970) concluded the geographic distribution of the two forms reflected descent from populations isolated in different glacial refugia.

Features that distinguish pygmy whitefish from other *Prosopium* species include relatively large eyes, elongate head, small adipose fin, and blunt snout (ASRD and ACA 2011). Pygmy whitefish are most likely to be confused with mountain whitefish. Conducting a simple and quantitative field identification technique of counting the scales above the lateral line, anterior to the dorsal fin, can distinguish a pygmy whitefish from a mountain whitefish: Mountain whitefish have 11 rows of scales above the lateral line, whereas pygmy whitefish have 6 rows (ASRD and ACA 2011).

Life History:
Although pygmy whitefish are potamodromous (migratory in fresh water), they have exhibited a wide variety of spawning migrations within this life history. They may migrate within river systems, between river and lakes, entirely in lakes, or may be entirely non-migratory. For example, pygmy whitefish in Chester Morse Lake, WA migrate into the Cedar and Rex rivers to spawn, while pygmy whitefish in Priest Lake, ID move into the shallows of the lake to spawn (Hallock and Magillo 1998).

Spawning usually occurs from late summer to early winter depending upon geographic location and elevation. In Chester Morse Lake (approximately 1,500 feet in elevation), spawning is observed December to early January, while spawning in Glacier National Park (elevation approximately 2,300 feet) in Montana has been reported in November or December (ASRD and ACA 2011) .

Eggs are broadcast over rock or gravel substrate, similar to other species in this genus. Pygmy whitefish most likely spawn in the evening hours (Barnett and Paige 2014). Fecundity, like in most salmonids, is directly related to the size of the species. Fecundity records range from 97 to over 1,000 eggs (ASRD and ACA 2011). Little is known about the early life history of the pygmy whitefish or water temperature requirements. In one study conducted on the Chester Morse Lake population, the incubation period ranged from 127 to 145 days (Barnett and Paige 2012). The relatively long incubation period is most likely due to spawning occurring when stream temperatures are at their coldest, slowing egg development and growth.

Pygmy whitefish, in general, mature early in life and at a small size. At Flathead Lake, Montana Hallock and Mongillo (1998) found that 74 percent of age 1 males collected were mature, and all males age 2 and older were mature. Twenty-eight percent of females collected at age 1 were mature, 90 percent of age 2 females were mature, and all older females were mature. Mature females were also found with developing eggs in their ovaries, indicating females spawn in consecutive years. Hallock and Mongillo surmise that because pygmy whitefish mature early in life and at a small size, this could possibly be a survival adaptation during glaciation, when waters were very low in nutrients and cold.

In general, pygmy whitefish are short-lived and grow slowly. A study in Lake Superior identified most fish collected were under age 6 and measured less than 13 cm (5.2 in) (Hallock and Mongillo 1998). The oldest pygmy whitefish to date is a 9 year old 27.1 cm (20.7 in) female collected from British Columbia (Hallock and Mongillo 1998). Information on mortality in pygmy whitefish is limited. However, due to their size, they are often prey to most predatory fish and birds. Bull trout, Dolly Varden, and pygmy whitefish often co-occur in

Washington lakes. In Chester Morse Lake, contents of Dolly Varden stomachs had pygmy whitefish 5-10% of the time (Hallock and Mongillo 1998).

Pygmy whitefish consume a variety of benthic aquatic invertebrates, including crustaceans, fish eggs, and small molluscs. Feeding behavior observed in Brooks River, Alaska revealed pygmy whitefish taking food often from the bottom but also up in the current (Hallock and Mogillo 1998). Pygmy whitefish would make a quick dart at a targeted food item when feeding on the bottom of the river, passing any sand or debris through their gill openings.

Range, Distribution, and Abundance:

Remnants from the last ice age, the range of pygmy whitefish is wide, with spotty distribution in northern North America and Siberia. In western North America, this species has been identified in Montana, Washington, northern Idaho, southwest Alaska, and western Canada (Wydoski and Whitney 2003). Only one river population is known to exist east of the Rocky Mountains (ASRD and ACA 2011).

In Washington, the first record of this species was in 1894 at Diamond Lake, Pend Oreille County (Wydoski and Whitney 2003). Historically pygmy whitefish occupied 15 lakes in Washington. Presently, they are thought to occupy only 9 of those 15 lakes (Attachment 3; Hallock and Mongillo 1998). These lakes are located at the extreme southern end of their natural range. Table 1 displays known historical locations of pygmy whitefish in Washington (M. Hallock and P. Mongillo, WDFW, 1996-1997 unpublished data).

Table 1. Lakes in Washington Occupied by Pygmy Whitefish (past and present)

Lake	**County**	**Elevation (m)**	**Size (ha)**	**Max Depth (m)**	**Distribution**	
					Past	**Present**
Bead	Pend Oreille	877	291	52	Yes	Yes
Buffalo	Okanogan	733	219	37	Yes	No
Chelan	Chelan	341	13,402	486	Yes	Yes
Chester Morse	King	474	681	35	Yes	Yes
Cle Elum	Kittitas	682	1948	102	Yes	Yes
Crescent	Clallum	177	2075	189	Yes	Yes
Diamond	Pend Oreille	720	305	18	Yes	No
Horseshoe	Pend Oreille	608	57	44	Yes	No
Kachess	Kittitas	689	1837	131	Yes	Yes
Keechelus	Kittitas	767	1039	99	Yes	Yes
Little Pend Oreille	Pend Oreille	966	4-66	27	Yes	No

Lakes						
Marshall	Pend Oreille	846	79	28	Yes	No
North Twin	Ferry	784	301	15	Yes	No
Osoyoos	Okanogan	280	2319	63	Yes	Yes
Sullivan	Pend Oreille	796	574	102	Yes	Yes

Current distribution was documented through a survey by the Washington Department of Fish and Wildlife (WDFW) between 1993 and 1997. Table 2 lists lakes sampled by WDFW but did not contain pygmy whitefish (Hallock and Mongillo, unpublished). Six of the 9 lakes with known occupancy are located on Forest Service land: Lakes Cle Elum (southernmost distribution), Kachess, Keechelus, and Chelan (Okanogan-Wenatchee), and Lakes Sullivan and Bead (easternmost distribution; Colville). The remaining three lakes with known populations are: Crescent Lake (westernmost distribution; Olympic National Park), Chester Morse Lake (Seattle Public Utilities), and Osoyoos Lake (northernmost distribution; Osoyoo Lake State Park). The population status in these lakes is unknown.

Table 2. Lakes Sampled by WDFW that Did Not Contain Pygmy Whitefish

Lake	County	Elevation (m)	Size (ha)	Max Depth (m)
Baker	Whatcom	223	1,464	87
Bonaparte	Okanogan	1,093	68	34
Chain	Pend Oreille	600	41	45
Cooper	Kittitas	858	49	14
Cushman	Mason	226	1,621	36
Deer	Stevens	761	477	23
Loon	Stevens	733	458	30
Palmer	Okanogan	352	846	24
Sutherland	Clallam	161	150	27
Trout	Pend Oreille	692	39	52
Waptus	Kittitas	917	100	33+
Wenatchee	Chelan	575	1,012	77

Habitat Associations:

Most often pygmy whitefish occupy deep, cold oligotrophic lakes and in moderate to swift, silty or clear montane rivers. However, a few cases have documented pygmy whitefish in small, shallow, more productive lakes in British Columbia and Washington (Hallock and Mongilla 1998). In Chester Morse Lake, this species has been found in water depths from six to over 100 feet in June, but during the winter months pygmy whitefish were collected in water less than 6 feet deep (Wyodski and Whitney 2003). Specific to Washington, there have been no populations identified as completely river populations. Only lake-dwelling or lake-dwelling with stream spawning populations have been documented in Washington.

Pygmy whitefish appear to need habitat that either has an escape refuge (deep water) from predators or, barring no refuge, has no predators at all.

Generally, adults are found in deep water habitats or in the shallows during spawning season. However, in the Naknek System in Alaska, Heard and Hartman (1965) found pygmy whitefish in a wide variety of habitats, from deep water benthic (168 m; 554 ft) to littoral (1 m; 3.3 ft). They were also found in open water areas at or near the surface. Age 0 pygmy whitefish were found in both open water and nearshore habitats.

Habitat requirement such as, temperature tolerances, preferences, spawning habitat and dissolved oxygen requirements are not known for this species. During WDFW's distribution survey, temperature profiles were recorded at all lakes surveyed. These fish were almost always collected in water temperatures below 10° C (50°F). Although dissolved oxygen requirements are unknown, it is recommended by the United States Environmental Protection Agency (1976) that dissolved oxygen levels not fall below five mg/l for salmonids. Barnett and Paige's (2014) study observed spawning habitat preferences to be in areas with low gradient and substrate consisting primarily of gravel. But, overall, very little has been documented in regards to habitat requirements.

Threats:

The majority of the watersheds surrounding the nine remaining lakes containing pygmy whitefish in Washington are managed by a public utility and various government agencies. Shoreline development is minimal to moderate around the lakes. Because of this, these lakes appear to be fairly well protected.

In spite of the protected status of many of the lakes and corresponding watersheds, introduction of exotic species may negatively impact pygmy whitefish. Extirpation of pygmy whitefish in Washington's historical sites is associated with the introduction of exotic species (such as smallmouth and largemouth bass, lake trout, and Burbot) with or without the use of piscicide.

Pygmy whitefish populations may also be affected by climate change. Ice cover records show the period of ice cover to have been reduced over the past several years, alluding to warmer stream temperatures (ASRD and ACA 2011). The consequence of this on a species that is highly dependent on cold stream temperatures will likely increase extinction risk. Other ecological changes associated with climate change, such as earlier spawning runs as observed in alewives, could have unforeseen consequences.

<u>Conservation Considerations</u>:
The pygmy whitefish is classified as a Forest Service and BLM Sensitive Species in Washington. Although the occupied habitats in Washington appear to be stable, forest practices which protect riparian zones and limit erosion should continue to be implemented. In addition, maintaining water quality, spawning habitat and preventing the spread of exotic species will be key to maintaining the persistence of these sites.

<u>Other pertinent information (references to Survey Protocols, etc)</u>:
This species has not been extensively surveyed, and when surveyed, may have been mistaken for juvenile mountain whitefish (ASRD and ACA 2011). Therefore this species may be more widely distributed than its current known distribution. WDFW's distribution survey only surveyed a specific lake once and only surveyed 30 lakes within Washington. These lakes were selected based on specific criteria such as temperature, depths, and introduced fish species. Studies from other regions have documented pygmy whitefish existing outside the criteria WDFW used to identify lakes to survey (ASRD and ACA 2011). Surveys were also only conducted in lakes, leaving streams as a potential habitat undocumented.

ATTACHMENTS:

(1) References
(2) Map of conservation status of pygmy whitefish in the United States and Canada
(3) Map of historic and present distribution of pygmy whitefish in Washington (Hallock and Mongillo 1998)
(4) Photo using scale counts to differentiate pygmy whitefish from mountain whitefish (ASRD and ACA 2011)
(5) Potential Survey Methods

ATTACHMENT 1: References

Alberta Sustainable Resource Development (ASRD) and Alberta Conservation Association (ACA). 2011. Status of the Pygmy Whitfish (*Prosopium coulterii*) in Alberta: Update 2011. Alberta Sustainable Resource Development. Alberta Wildlife Status Report No. 27 (Update 2011). Edmonton, AB. 46 pp.

Barnett, H.K., and D.K. Paige. 2000. Bull trout and pygmy whitefish protocol. Retrieved from http://www.seattle.gov/util/groups/public/@spu/@ssw/documents/webcontent/spu02_015180.pdf

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Heard, W. R., and W. L. Hartman. 1965. Pygmy Whitefish, *Prosopium coulteri*, in the Nakenek River system of southwest Alaska. Fisheries Bulletin U.S. Fish and Wildlife Service 65:555-579.

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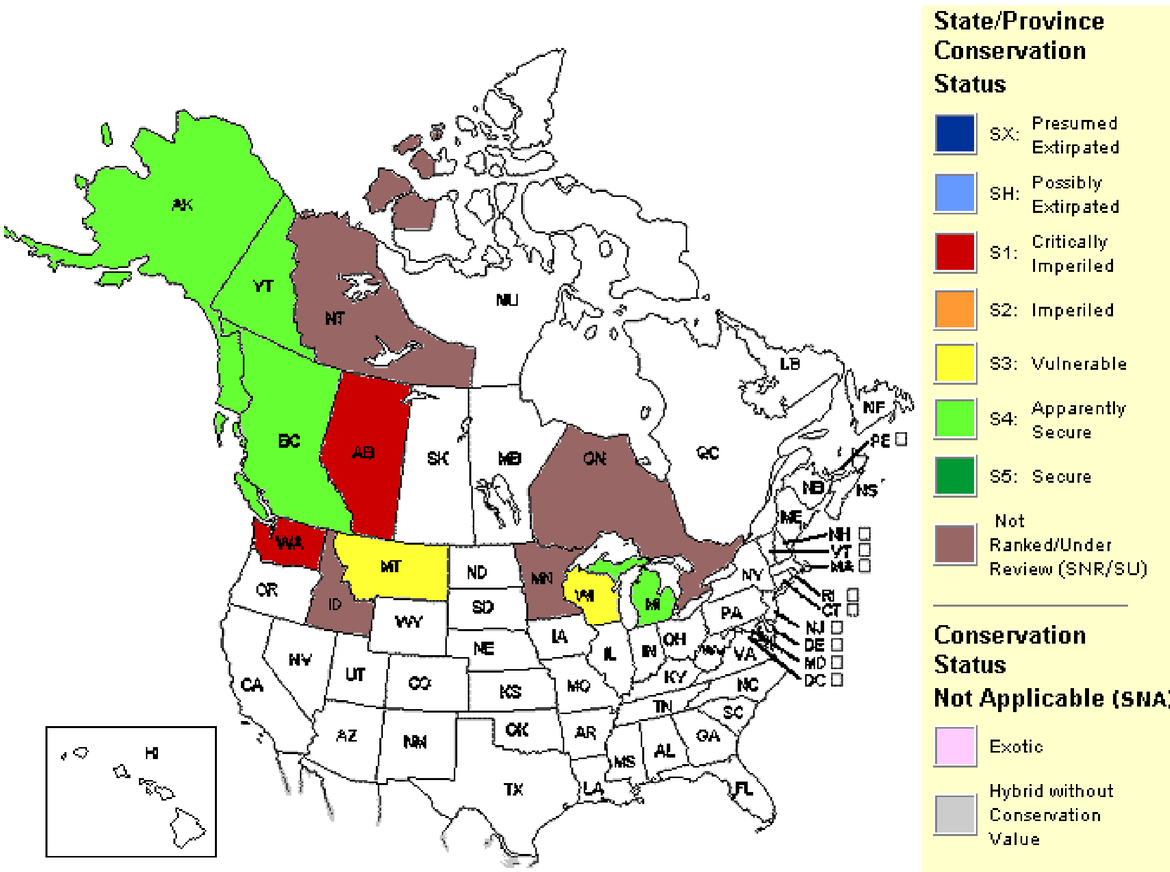
Sullivan, M. G. (2014, December 12). Interviewed by C. D. Pyle [Phone conversation]. Author of Status of Pygmy Whitefish (*Prosopium coulterii*) in Alberta: Update 2011, Alberta Sustainable Resource Development and Alberta Conservation Association.

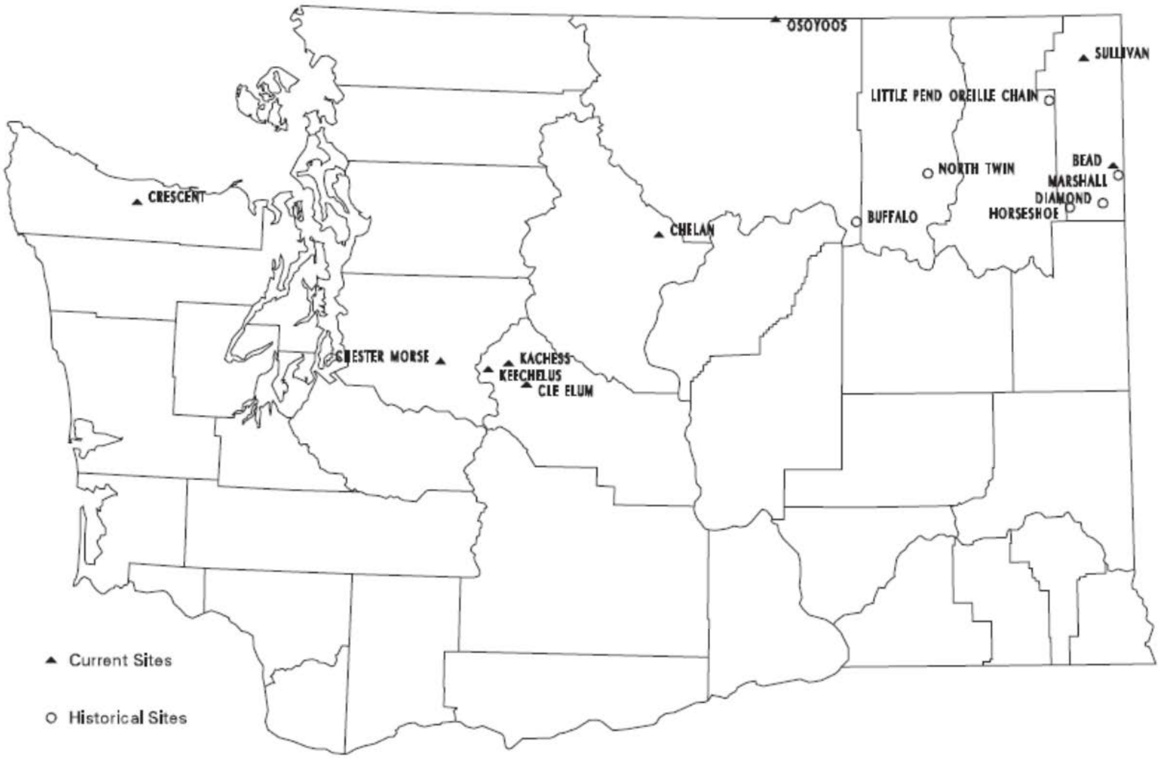
United States Environmental Protection Agency. 1976. Quality criteria for water. U.S. Government Printing Office: 1977 O-222-904. 256 pp.

Wydowski, R.S., and R.R. Whitney. 2003. Inland fishes of Washington. Second edition, revised and expanded. University of Washington Press, Seattle.

ATTACHMENT 2: Map of Conservation Status of pygmy whitefish in the United States and Canada (NatureServe, Accessed December 9, 2014)



ATTACHMENT 3: Map of historic and present (1998) distribution of pygmy whitefish in Washington (Hallock and Mongillo 1998)



ATTACHMENT 4: Photo using scale counts to differentiate pygmy whitefish from mountain whitefish (ASRD and ACA 2011)

Photo of adult pygmy whitefish (top) and juvenile whitefish (bottom). Notice the differences in profiles; pygmy whitefish have a blunt snout versus mountain whitefish with a more pointed snout. Scale counts above the lateral line also reveal differences, with pygmy whitefish having six rows of scales and mountain whitefish having 11 rows of scales. Photo by Ward Hughson, Jasper National Park, Parks Canada.

Attachment 5: Potential Survey Methods

Below are several survey methods used by various researchers. No set protocols have been created yet for pygmy whitefish, although most researchers have used similar protocols for collecting resident salmonids.

Lake surveys by WDFW (Presence/absence surveys; WDFW 1998)

Lakes were sampled from the months of April through October. Each lake was sampled for two consecutive nights. Approximately 5-7 multifilament, single mesh sized gillnets were used each night and pulled and reset every 18-24 hours. Net sizes used were: two nets of 25 mm (1.0 in) stretch mesh, two nets of 38 mm (1.5 in) stretch mesh (both sets of two were 2.4 m x 37.8 m), and one net of 13 mm(0.5 in) stretch mesh (1.8 m x. 30 m). Nets were set in the deepest part of the lake for lakes less than 40 m (132 ft.) deep and at 40-60 m (132-198 ft.) for lakes that were deeper.

Considerations for this method:
After reviewing the various literature referenced in this report, it is suggested that one should consider the time of year chosen to survey using this method, which could affect the depth at which to set nets. If the survey is chosen to be conducted in the fall, the species could be undetected because spawning could be occurring during this time. If it is unknown if spawning is occurring; place nets at various depths.

Alberta Sustainable Resource Development & Alberta Conservation Association survey methods

There are no specific survey protocols for pygmy whitefish for these agencies. Instead, focus is placed on field protocols for a broad spectrum fish species. Below is the website for Lake, River, and Stream Collection Protocols and Data Sheets. Please note that these documents are living documents and that not all protocols will be pertinent to Washington.

http://www.abmi.ca/abmi/reports/reports.jsp?categoryId=0

Considerations for this method:
This method may be beneficial where there are a multitude of species of concern that must be monitored and/or there is a fiscal constraint (M. Sullivan, pers. comm.). This method also encourages the use of site-specific information to direct surveyors where to survey and when.

In Alberta, river surveys were conducted around October when visibility was high. It was also noted that when juvenile mountain whitefish were collected, pygmy whitefish were also collected (M. Sullivan, pers. comm.).

Spawning Surveys by Barnett and Paige (conducted in Washington; Barnett and Paige 2014)

Below are the methods used for this survey:

*For the full document please visit: http://www.seattle.gov/util/groups/public/@spu/@ssw/documents/webcontent/spu02_015180.pdf

Visual surveys were conducted in reaches with known bull trout spawning as pygmy whitefish are known to use the same spawning reaches. Surveys were conducted concurrently during bull trout spawning and continued through December. Two surveyors would walk the river from the mouth to approximately 4.0 km upstream and recorded the location of each pygmy whitefish school (using GPS points), visually estimated the number of individual fish in each school, and captured notes on behavior and habitat.

Considerations for this method:

After reviewing the literature referenced in this report it is suggested that one should consider that visual surveys can be very subjective and difficult. For the Barnett and Paige (2014) study, the same observers were used for throughout the entire study which most likely reduced inconsistencies. When conducting visual surveys, one must also consider potential for misidentification. Pygmy whitefish most often are confused with juvenile mountain whitefish. Therefore, it would be important to know all species that reside at survey sites before using this protocol.

It was also mentioned in the report (Barnett and Paige 2014) that surveyors could be missing the majority of pygmy whitefish migration due to the fact that surveys were done during daylight hours. Increased activity during the evening hours are commonly reported for other salmonid species. This type of evening activity was affirmed for this population in Chester Morse Lake from the PIT tag array (Barnett and Paige 2014).

Surveys during the spawning season can be very difficult due to the time of year: Daylight hours are shortened and accessibility to sites can be restricted. Stream flows should also be considered during this time of year. Precipitation in the streams surveyed for this study was typically snow and never iced over, leaving stream flow conditions to be reliable and wade-able.

Pygmy Whitefish Spawning Survey Methods

(From "Bull trout and pygmy whitefish protocol", Barnett and Paige 2000)

The following outlines some key information to consider with regards to equipment, timing of surveys, and data collection. The data sheet shown here would need alteration for use for Forest Service or BLM survey work; or agency-specific corporate data sheets and data bases should be utilized.

4.1 Equipment Needed

- 2 surveyors
- Field notebook and datasheets (J:\SSW\WS541\Secure\Fish and Wildlife\Field Data (survey forms)\pygmy whitefish, file: PWF data sheet.doc).
- Weather sheet (J:\SSW\WS541\Secure\Fish and Wildlife\Field Data (survey forms)\Bull Trout Data Sheets, file: Survey form environmental tables.doc)
- Thermometer
- Walking Stick
- Waders, warm field gear, raingear, hat, polarized sunglasses
- Measuring device – (can use measuring tape, but they tend to break due to the water), might put tick marks on walking stick to use as a measuring tool
- GPS unit
- Maps if needed

4.2 Timing of Surveys

Pygmy whitefish typically appear in the Cedar and Rex rivers at the beginning of December, but have been observed as early as mid-November. Surveys for bull trout in the same reaches are ongoing through this time period. Once pygmy whitefish appear in the rivers, surveys for this species will begin.

4.3 Data Collection

Surveys occur simultaneously with bull trout spawning surveys. Data sheets are printed on rite-in-the-rain paper and have the same heading information as bull trout spawning sheets. Reference Section 3.3 for that information. An SPU biologist who has conducted pygmy whitefish surveys in the past should train new crews in the field.

When a school (or individual) pygmy whitefish is encountered during a survey data collection begins. The “school no.” begins at 1 for the day and ascends numerically for each subsequent sighting of a school.

Surveyors must next estimate the number of fish (No. of fish) in a particular school. In order to do this, both surveyors should watch a certain group of fish closely and try to count the number in an area (typically a basketball sized area). Alternatively, you can count 50 fish and get an estimate in your head for the area these fish take up within the school. Once the eye is calibrated to know the approximate number of fish within a given area, estimate the overall size of the school and multiply to determine an estimate for the number of fish in the school. Do not assume that all schools have fish at the exact same density. Some pygmy whitefish schools may be located in deeper water so that fish are stacked up on top of one another while others are moving through a shallow riffle. Surveyors should recalibrate by counting fish within a set area if a given school has significantly different fish densities. Each surveyor should get an independent estimate for the number of fish at each school and both numbers should be recorded to get a range of the estimate of fish. For example, one surveyor may estimate 250 fish and the other 300 fish. The data should be recorded as “250-300” for that school. If both surveyors estimate the same number, just record that number.

Size of fish in school: Often carcasses will be located along the river and can help to calibrate your eye. Give an estimate for the average size of a fish in the school. This is done because past surveys show some variability between years.

Substrate: Use the particle table listed in Section 3.3 to note the dominant and subdominant size of particles that the school is over.

Depth of Water: Estimate the depth of water where the school is located. You can use your walking stick to measure it if the school moves off due to your presence. Record the data in inches.

Site/Habitat Type: Describe the macrohabitat type at the site (pool, riffle, glide).

Behavior: Note what the fish are doing if unusual. The typical data recorded for this entry include: school, moving through riffle, individual, carcass.

Field Location: Use green flagging used in bull trout surveys to determine distance along the survey route. You can also use the GPS unit to get locations for each school.
One survey each year should be done to investigate the uppermost extent of pygmy whitefish use in the Cedar and Rex rivers. On these surveys, walk from the inundation zone upstream to Roaring Creek on the Cedar River and from the inundation zone upstream to the 300 road (or above if needed) on the Rex river.

Page _____/______
CEDAR RIVER WATERSHED
RESIDENT PYGMY WHITEFISH SPAWNING SURVEY

STREAM: ________________________ SECTION:____
DATE: ____________ SURVEY NO: _____
OBSERVERS: _________ / _________ / _________ START TIME: ___________ END TIME: __________
TOTAL SURVEY TIME ____________ X # of observers _______ = SURVEY HOURS: _______________
USGS GAGE: ______ / _______
H20 CLARITY: _________________________ WEATHER: T (air) ______ T (water) ______ C ______ P ______ WD ______ WV ______
COMMENTS:
____
____

School No.	No. of Fish	Fish Size	Substrate	Depth of Water	Site/Habitat Type	Behavior	Field Location

Preparer: Christine Pyle, USFS

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