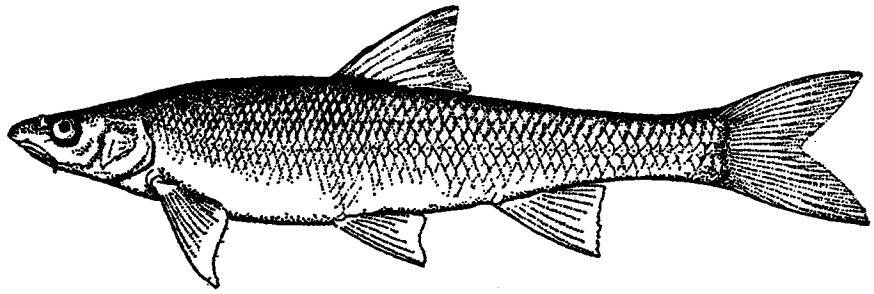
FLATHEAD CHUB
(*Platygobio gracilis*)
Rangewide Status Assessment



Prepared for
the U.S. Fish and Wildlife Service, Region 3
Minneapolis, Minnesota

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TAXONOMY

The first description of the flathead chub was from the Saskatchewan River at Carleton House by Richardson in 1836 as *Cyprinus (Leuciscus) gracilis*. This species has alternately been placed in the genera *Hybopsis* and *Pogonichthys*. Specific or subspecific names include *communis*, *gracilis, gulonella, gulonellus*, *pallidus*, and *physignathus*. The current accepted binomen for the flathead chub is *Platygobio gracilis*, following McPhail and Lindsey (1970). Another common name for this species is the Saskatchewan dace (Scott and Crossman 1973).

Two subspecies and their ranges were defined by Olund and Cross (1961) (Figure 1), perhaps based in part on the earlier work of Johnson (1942) who found a creek subspecies of flathead chub in the headwaters of the North Platte in Wyoming, and in Logan Creek in Northeastern Nebraska. The range of *Platygobio gracilis gracilis* includes the MacKenzie Basin south from Fort Good Hope near the Arctic Circle in the Northwest territories; Saskatchewan Basin in Alberta, Saskatchewan, and Manitoba east to Lake Winnipeg; the mainstem of the Missouri River; and the mainstem of the Mississippi River south of the Missouri River confluence. The range of *Platygobio gracilis gulonella* includes the upper mainstem and tributaries of the Rio Grande, Pecos, Arkansas, and North Platte rivers, as well as isolated populations in tributaries to the upper Missouri River. Meristic counts and morphometric characters of flathead chubs in Iowa tributaries to the Missouri River showed that *P. g. gulonella* was the dominant subspecies there, perhaps to the exclusion of *P. g. gracilis* (Donofrio 1984).

Intergrades between the two subspecies are found in the upper Missouri Basin, and lower reaches of major tributaries to the Missouri River in Nebraska and Kansas. Frank Cross (*in litt.*) stated "Leonard Olund and I recognized two subspecies, but with strong reservations. The geographic pattern of morphometric variation, as evident in the figures, does not really support that taxonomic conclusion very well. We were aware of that, but editorial policy of the series in which the study was published required recognition of at least these two forms. Some populations are clearly distinguishable from others, but I would prefer that no taxonomic distinction be made now, pending a more satisfactory resolution, perhaps based on genetic rather than morphometric evidence." Others have also called for a clarification of flathead chub taxonomy using genetic information (Robert Hrabik, *in litt.*, David Galat, pers. comm.). Some meristic counts, such as vertebral number (Bailey and Allum 1962) have been shown to be a function of the environment.

PHYSICAL DESCRIPTION

General description

The flathead chub is a slender silvery minnow, slightly compressed, with a wide, flat, wedge-shaped head, small eye, barbels at the corner of the mouth, and long, sickle-shaped fins (Figure 2).

Figure 1. Distribution of the two subspecies of the flathead chub, *Platygobio gracilis gracilis* and *Platygobio gracilis gulonella*, in North America (modified from Olund and Cross, 1961).

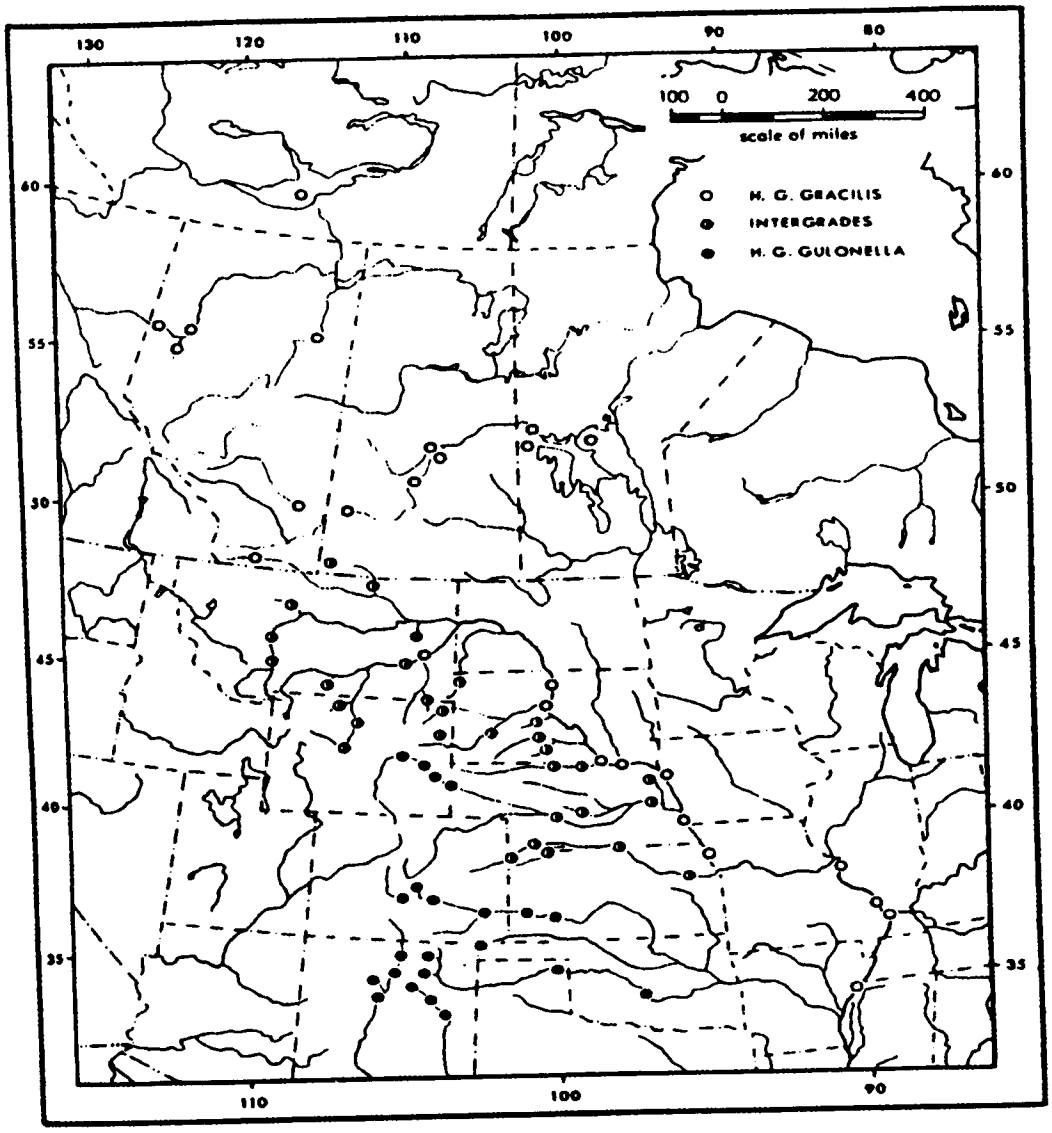
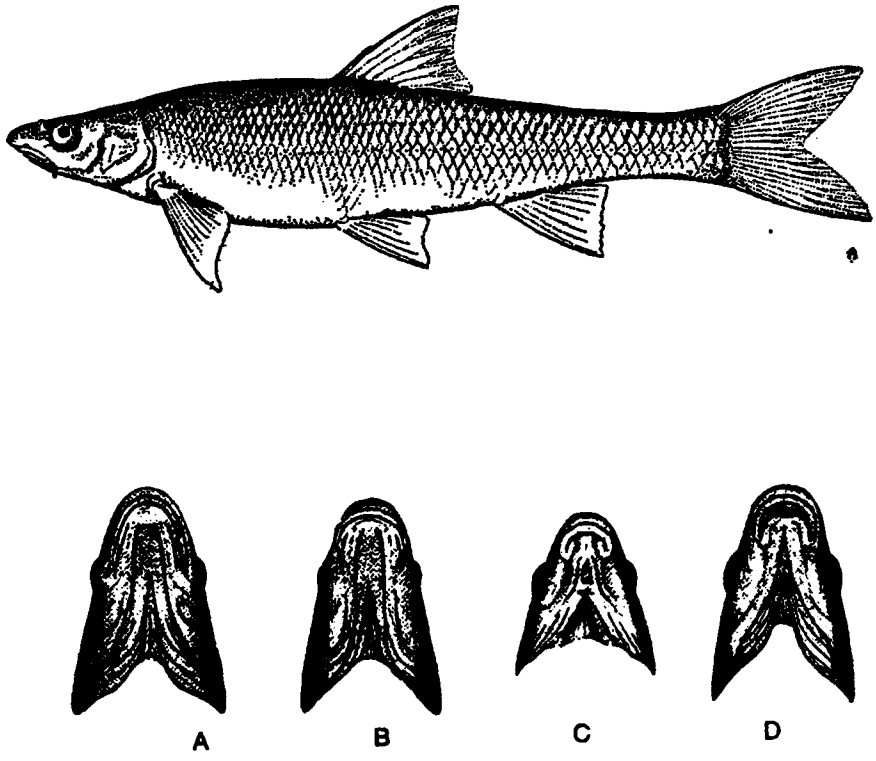


Figure 2. Line drawing of the flathead chub, including detail of the mouth. **A** is the flathead chub. **B** is the Plains minnow. **C** is the Suckermouth minnow. **D** is the Central stoneroller (from Scott and Crossman 1973, Cross and Collins 1995).



Technical description

Lateral-line scales 42-59, predorsal scale rows 19-22. Dorsal fin rays 8. Anal fin rays 8 (7-9). Pectoral fin rays 14-20. Pelvic fin rays 8. Gill rakers short, totaling 4-6. Pharyngeal teeth 2,4-4,2, rarely 2,4-4,3. Branchiostegal rays 3 + 3. Vertebrae 40-47, including 4 Weberian vertebrae. Eye diameter much less than snout length. Snout flattened and pointed, projecting slightly beyond upper lip. Mouth deeply u-shaped when viewed ventrally. Fins high and falcate. Cycloid scales, smooth, not keeled. Breast fully scaled. Intestine short, with single S-shaped loop. Peritoneum silvery, with scattered dark speckles. Body color silvery without distinctive markings. Lower lobe of caudal fin darker than upper lobe, with white lower edge. Nuptial males have minute tubercles on the top of the head and back, on all fins except the caudal, and on the ventral scales of the caudal peduncle. Adults commonly 95 to 190 mm (3.7-7.5 inches) TL. (Etnier and Starnes 1993, Robison and Buchanan 1988, Pflieger 1975, McPhail and Lindsey 1970)

Olund and Cross (1961) differentiate the two subspecies of flathead chub using meristic counts and morphometric characters. *Platygobio gracilis gracilis:* Post-Weberian vertebrae 40-42, usually 41-42; lateral-line scales 50-56; pectoral rays 15-20, usually 17 or more; head-depth 12.3-15.1% of standard length, usually 14.7% or less. *Platygobio gracilis gulonella*: Post-Weberian vertebrae 36-38, rarely 39; lateral-line scales 42-54, usually less than 50; pectoral rays 14-19, usually fewer than 17; head-depth 13.5-18.0% of standard length, usually 14.8% or more.

NATURAL HISTORY

Basic life history information on the flathead chub, like many other small non-game fish species, is incomplete and often unavailable. Gould (1985) said it best when he stated: "The basic information available on the food habits, age and growth, and fecundity of the flathead chub is fragmentary and inadequate. Information on the seasonal movements and habitat usage, spawning behavior, embryology, and interaction with other fish species appears to be nonexistent." Nonetheless, some information is available.

Habitat

The flathead chub inhabits turbid alkaline waters with shifting sand or gravel substrates in streams and rivers. *Platygobio gracilis gracilis* is found in the mainstems of larger rivers in moderate to strong current. *Platygobio gracilis gulonella* is found in small rivers and creeks, generally in small pools with moderate currents (Olund and Cross, 1961). Flathead chub are generally found in depths of less than one meter, in current less than 40 cm/s, over sand substrate (Klutho 1983, Dieterman et al. 1996).

Food

Aquatic and terrestrial insects are the primary food organisms of the flathead chub, although stomachs have contained plants, berries, seeds, feathers, fishes, and even a rodent (Olund and Cross 1961, McPhail and Lindsey 1970). Stomachs of flathead chubs collected in the Athabasca River, Alberta, contained Diptera larvae (61.8%), adult

Coleoptera (26.5%), Hemiptera (23.5%), Hymenoptera (26.5%), larval Trichoptera (26.5%), Ephemeroptera nymphs (23.5%), and Plecoptera (20.6%) (Bond and Berry 1980).

Growth and longevity

Bishop (1975) found one flathead chub that was ten years old, another that was eight years old, with the rest seven years old and younger in Peace River, Alberta collections (Table 1). Bond and Berry (1980) found all ages between zero and eight to be well-represented. Martyn and Schmulbach (1978) found four age groups for flathead chubs collected in Perry Creek, Iowa. Gould (1985) found three size classes for flathead chubs collected in the Musselshell River, Montana, but could not verify them as age groups. The largest recorded specimen was 370 mm total length, weighed 510 grams, and was collected in the Wood Buffalo National Park section of the Peace-Athabasca Delta (Kristensen 1980).

Table 1. Mean length-at-age (mm) for flathead chubs in three different locations. Data from Bishop (1975) (Peace River, Alberta), Bond and Berry (1980) (Athabasca River, Alberta; Athabasca Delta, Alberta), Martyn and Schmulbach (1978) (Perry Creek, Iowa), and Gould (1985) (Musselshell River, Montana). Lengths from Alberta are fork length, whereas Iowa and Montana are total lengths. Lengths for Montana were not verified as age groups.

Age	Peace	Athabasca	Athabasca Delta	Iowa	Montana
0	61	32	27	-	43
1	91	104	50	102	81
2	112	161	123	131	116
3	168	178	168	144	
4	182	208	203	162	
5	221	247	235		
6	239	264	253		
7	268	281	275		
8	287	284	321		
9	-				
10	324				

Reproduction

Gould (1985) found that the average number of mature eggs ($\geq$ 1.0 mm) produced by female flathead chubs in the Musselshell River, Montana was 491 $\pm$ 83 SD (N = 8). These fish were collected on July 19, 1983 and August 15, 1983 at water temperatures similar to those measured by Martyn and Schmulbach (1978). Total length of these eight

fishes ranged from 113 to 160 mm, and total weight ranged from 12.99 to 37.72 g. Weight of the ovaries ranged from 2.3 to 5.9% of total body weight. Six ripe males were collected on July 19, 1983, and ranged from 123 to 143 mm total length. Seven ripe males and five unripe males were collected on August 15, 1983. Ripe males ranged from 127 to 146 mm total length, and the unripe males ranged from 122 to 140 mm total length.

Martyn and Schmulbach (1978) found that the average number of eggs produced by female flathead chubs in Perry Creek, Iowa was 4,974 $\pm$ 2,200 SD (N = 101). These fish were collected between July 15, and August 31, 1975 at temperatures between 18.5 and 25° C. Thirty-two percent of age 1 fish were mature, 73% of age 2 fish were mature, and all age 3 and 4 fish were mature. During peak spawning (July 15-26), the ovaries averaged 10.3%, and the testes 1.3% of total body weight.

Bond and Berry (1980) found that the average number of eggs produced by female flathead chubs in the Athabasca River, Alberta, was 10,564 (N = 11) and ranged from 7,000 to 15,170 eggs among fish ranging from 235 to 297 mm fork length. Of 53 flathead chubs collected between June 1 and June 16, 58% were ripe, and 8% were spent.

Olund and Cross (1961) state that flathead chubs spawn from July through September, which is corroborated by Martyn and Schmulbach (1978) and Gould (1985). McPhail and Lindsey (1970) found that spawning in extreme northern latitudes may occur as early as late June. Bond and Berry (1980) found spent flathead chubs in early June. Spawning habitat is unknown, the only reference in the literature being that of Martyn and Schmulbach (1978). They state that they collected flathead chubs only from the pooled portions of Perry Creek, Iowa during July and August, and suggested that spawning might occur in pools.

CURRENT AND HISTORICAL RANGE

The flathead chub is endemic to North America, and was historically found between 30° and 68°N latitude, and from 90° to 120°W longitude (Figure 3). Flathead chub populations are extirpated in the following drainages: Arkansas, Cimmaron, Kansas, and Republican basins in Kansas (Table 2). Flathead chub populations have declined from historic levels in the following drainages; Mississippi mainstem in Missouri and Illinois, Missouri mainstem in Missouri, Kansas, Iowa, Nebraska, South Dakota, and North Dakota, Cimmaron Basin in Oklahoma, Big Nemaha, Little Nemaha, and Republican basins in Nebraska, Cannonball, Heart, and Knife basins in North Dakota, and the Belle Fourche, Bighorn, Little Missouri, North Platte, Powder, and Tongue basins in Wyoming. Flathead chubs are so infrequently caught in the Mississippi River mainstem in Louisiana, Mississippi, Arkansas, Tennessee, and Kentucky, and the North Canadian and the Salt Fork of the Red River in Oklahoma, that it is difficult to determine a population trend. Scott and Crossman (1973) and McPhail and Lindsey (1970) state that the flathead chub is quite abundant across Canada, but an apparent lack of recent surveys precludes determination of current abundance or trends in the populations in the North Saskatchewan, South Saskatchewan, Frenchman, Milk, Peace, Red Deer, Fort Nelson, Lynx, Muskwa, and Mackenzie basins.

Figure 3. Distribution map of the flathead chub in North America (from Lee et al. 1980, modified from Olund and Cross 1961).

Table 2. Summary of flathead chub population abundance and trends in the United States and Canada, by state or province and basin. Abundance rankings for extant populations range from Abundant (collected in large numbers at many sites in a basin many times a year) to Rare (Very few individuals collected usually at a single site often less than once a year).

State or Province	Basin	Current abundance	Trend
FWS Region 2			
New Mexico	Canadian	Common	Stable
	Cimarron	Uncommon	Stable
	Pecos	Common	Stable
	Rio Grande	Common	Stable
Oklahoma	Cimmaron	Common	Declining
	North Canadian	Rare	Unknown
	Salt Fork, Red River	Rare	Unknown
Texas	Canadian	Uncommon	Stable
FWS Region 3			
Illinois	Mississippi mainstem	Rare	Declining
Iowa	Missouri mainstem	Rare	Declining
	Big Sioux	Common	Stable
	Boyer	Common	Stable
	Keg	Common	Stable
	Little Sioux	Common	Stable
	Moser	Common	Stable
	Mosquito	Common	Stable
	Nishnabotna	Common	Stable
	Nodaway	Common	Stable
	Tarkio	Rare	Unknown
Missouri	Mississippi mainstem	Rare	Declining
	Missouri mainstem	Rare	Declining
FWS Region 4			
Arkansas	Mississippi mainstem	Rare	Unknown
Kentucky	Mississippi mainstem	Rare	Unknown
Louisiana	Mississippi mainstem	Rare	Unknown
Mississippi	Mississippi mainstem	Rare	Unknown
Tennessee	Mississippi mainstem	Rare	Unknown

Table 2 continued. Summary of flathead chub population abundance and trends in the United States and Canada, by state or province and basin. Abundance rankings for extant populations range from Abundant (collected in large numbers at many sites in a basin many times a year) to Rare (Very few individuals collected usually at a single site often less than once a year).

State or Province	Basin	Current abundance	Trend
FWS Region 6			
Colorado	Arkansas	Common	Stable
Kansas	Missouri mainstem	Rare	Declining
	Arkansas	Extirpated	Declining
	Cimarron	Extirpated	Declining
	Kansas	Extirpated	Declining
	Republican	Extirpated	Declining
Montana	Missouri mainstem	Abundant	Stable
	Little Missouri	Common	Stable
	Marias	Common	Stable
	Musselshell	Abundant	Stable
	Sun	Common	Stable
	Teton	Common	Stable
	Yellowstone	Abundant	Stable
Nebraska	Missouri mainstem	Rare	Declining
	Big Nemaha	Rare	Declining
	Elkhorn	Common	Stable
	Little Nemaha	Rare	Declining
	Loup	Common	Stable
	Niobrara	Common	Stable
	North Platte	Uncommon	Stable
	Platte	Uncommon	Stable
	Republican	Rare	Declining
	White	Common	Stable
North Dakota	Missouri mainstem		
	-Above Sakakawea	Abundant	Stable
	-Below Garrison	Rare	Declining
	Cannonball	Common	Declining
	Heart	Common	Declining
	Knife	Uncommon	Declining
	Little Missouri	Abundant	Stable
	Yellowstone	Abundant	Stable

Table 2 continued. Summary of flathead chub population abundance and trends in the United States and Canada, by state or province and basin. Abundance rankings for extant populations range from Abundant (collected in large numbers at many sites in a basin many times a year) to Rare (Very few individuals collected usually at a single site often less than once a year).

State or Province	Basin	Current abundance	Trend
FWS Region 6			
South Dakota	Missouri mainstem	Rare	Declining
	Bad	Common	Stable
	Belle Fourche	Abundant	Stable
	Cheyenne	Abundant	Stable
	Grand	Common	Stable
	Little Missouri	Abundant	Stable
	Moreau	Abundant	Stable
	White	Common	Stable
Wyoming	Belle Fourche	Common	Declining
	Bighorn	Abundant	Declining
	Cheyenne	Common	Stable
	Little Missouri	Rare	Declining
	North Platte	Rare	Declining
	Powder	Abundant	Declining
	Tongue	Rare	Declining
Canada			
Alberta	Milk	Unknown	Unknown
	North Saskatchewan	Unknown	Unknown
	Peace	Common	Stable
	Red Deer	Unknown	Unknown
	South Saskatchewan	Unknown	Unknown
	Athabasca	Abundant	Stable
British Columbia	Fort Nelson	Unknown	Unknown
	Lynx	Unknown	Unknown
	Muskwa	Unknown	Unknown
	Peace	Unknown	Unknown
Manitoba	Assiniboine	Abundant	Stable
Northwest Territories	Mackenzie	Unknown	Unknown
Saskatchewan	Frenchman	Unknown	Unknown
	North Saskatchewan	Unknown	Unknown
	South Saskatchewan	Unknown	Unknown

STATE SUMMARIES

FWS Region 2

New Mexico

Summary: The flathead chub is common in New Mexico and the population is stable.

Major populations: The flathead chub occurs in the Rio Grande, Pecos, Canadian and Cimarron basins. It is common in the Rio Grande north of Albuquerque, with the northernmost collection of the species in this drainage approximately 60 km south of the Colorado border. The flathead chub becomes less common downstream from Albuquerque, with the southernmost collections in the headwaters of Elephant Butte Reservoir (Vernon Tabor, *in litt.*). The flathead chub is common, but not abundant upstream from Sumner Lake, but does not exist below Sumner Dam (Vernon Tabor, *in litt.*). The largest population of flathead chubs in New Mexico appears to be in the Canadian Basin upstream from Conchas Dam, where it was the second most abundant fish collected during sampling in 1994 (David Propst, *in litt.*). It is also common and locally abundant between Conchas Dam and Ute Lake (Vernon Tabor, *in litt.*), and was recently collected (31 specimens) from downstream of Ute dam west of the Texas border (Bonner et al. 1997). Sublette et al. (1990) state that populations of flathead chub are expanding in the Rio Grande Basin, and stable in the Pecos, Canadian, and Cimarron Basins.

Habitat condition: Habitat conditions appear favorable for the flathead chub. Some influences due to reservoir releases are evident, but do not seem to have changed the distribution of flathead chubs as compared to historic times.

State status: The flathead chub is not a state listed species in New Mexico.

Oklahoma

Summary: The flathead chub is uncommon in Oklahoma and populations are likely declining.

Major populations: The flathead chub has never been common in Oklahoma and is likely declining (Jimmy Pigg, pers. comm.) The largest population is in the Cimarron river in the western-most portion of the panhandle where 387 flathead chubs were collected in the vicinity of Kenton between 1926 and 1983 (Pigg 1987). Of those, 133 were collected between 1980 and 1983 (Jerry Brabander, *in litt.*). Only 22 flathead chubs were collected from that area between 1985 and 1989 (Jerry Brabander, *in litt.*). In recent years, a small number of flathead chubs have been collected in the Salt Fork of the Red River (Pigg and Gibbs 1992), the North Canadian River (Pigg et al. 1992), and one was collected in the Cimmaron River in Kingfisher County (Ron Suttles, *in litt.*). None have

been reported from the mainstem of the Canadian River. No flathead chub have been reported since 1994 outside of the Cimarron river in the Panhandle (Mark Howery, *in litt.*)

Habitat condition: Impoundments and reduced streamflows because of groundwater withdrawal and irrigation uses are threats to the flathead chub in Oklahoma (Ken Collins, *in litt.*)

State status: The flathead chub is not a state listed species in Oklahoma.

Texas

Summary: The flathead chub is uncommon in Texas and is limited to the Canadian River mainstem above Sanford Dam.

Major populations: Historical collections in the Canadian Basin found flathead chubs to be locally common in the river mainstem in Oldham, Roberts, and Hemphill counties, but absent from tributaries and impoundments (Lewis and Dalquest 1955). Twenty-four flathead chubs were collected from the Canadian River in Oldham county during 1990 (Ron Suttles, *in litt.*). Recently 17 flathead chubs were collected from the Canadian River mainstem in Oldham and Potter counties (Bonner et al. 1996, Bonner et al. 1997). There are no records of flathead chubs downstream of Sanford dam on the Canadian River mainstem.

Habitat conditions: Impoundments and reduced streamflows because of groundwater withdrawal and irrigation uses are threats to the flathead chub in Texas. (Ken Collins, *in litt.*).

State status: The flathead chub is not a state listed species in Texas.

FWS Region 3

Illinois

Summary: The flathead chub is rare in Illinois and the population is declining.

Major populations: Flathead chubs were collected many times from the 1930's through the early 1980's in the Mississippi River and the mouths of its tributaries south of the Missouri River confluence (Larry Page, *in litt.* Jeff Stewart, *in litt.*, Doug Nelson, *in litt.*). Smith (1979) concluded that the flathead chub was common in flowing stretches of that section of the river. Klutho (1983) collected 42 flathead chubs between 1978 and 1983 in the Mississippi River near Grand Tower. It was the 17th most common fish captured and found in slightly less than 35% of all collections. Flathead chubs were always found over sand substrate, with less than 30 cm/sec. current present. The flathead chub was one of two species noted as being less abundant than in historical collections. Recent collections

by the Illinois Department of Natural Resources below river mile 202 have resulted in only three specimens from 544 seine hauls (Mike Conlin, *in litt.*). These three were collected in the vicinity of Grand Tower over sand substrates. It is possible that this represents the last population of flathead chubs in the Mississippi River adjacent to Illinois.

Habitat condition: The Mississippi River adjacent to Illinois has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel.

State status: The flathead chub is not a state listed species in Illinois.

Iowa

Summary: The flathead chub is rare in the Missouri River mainstem, and populations are declining. The flathead chub is common in western Iowa tributaries to the Missouri River, and populations are stable.

Major populations: The population in the Missouri River has declined significantly as detailed in Hesse (1994). Collections by Pegg and Pierce (1996) in the Missouri River mainstem between the Big Sioux and the Nishnabotna rivers failed to produce any flathead chubs, despite using seines and benthic trawls designed to capture small benthic fish. In contrast to this, populations in western flowing tributaries to the Missouri appear stable. The flathead chub historically occurred in the Nodaway, Nishnabotna, Boyer, Soldier, and Little Sioux Basins, as well as the lower reach of the Big Sioux River (Harlan and Speaker 1956). Harlan et al. (1987) indicate that flathead chub populations still exist in these streams, as well as the Keg, Mosquito, Moser basins, with no mention of declines in abundance. John Olson (*in litt.*) collected many flathead chubs in all of these streams (except the Big Sioux) and also a single chub in Tarkio Creek using backpack electrofishing and seining. His records indicate that all size classes of flathead chub remain well-represented in these tributaries, despite extensive channelization. Donofrio (1984) concluded that the majority, if not all, flathead chubs collected in Iowa tributaries were the *P. g. gulonella* subspecies.

Habitat condition: The Missouri River has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel. Mainstem impoundments in the Missouri River have decreased sediment loads from historic conditions (Slizeski et al. 1982). Tributaries to the Missouri river have been channelized extensively in Iowa (John Olson, *in litt.*) and quite possibly are the most impacted streams in the State (John Olson, pers. comm.). Erosion control structures are also present on the uppermost headwater reaches of the Loess Hills tributaries (Robert Hrabik, *in litt.*, John Olson, pers. comm.).

State status: The flathead chub is not a state listed species in Iowa.

Missouri

Summary: The flathead chub is rare in the Missouri River mainstem and Mississippi River mainstem and populations are declining. Tributary populations may be extirpated.

Major populations: William Pflieger (*in litt.*) indicates that flathead chubs historically occurred along the entire length of the Missouri River, in the Mississippi River from the mouth of the Missouri to the southern border of the State, and in streams entering the Missouri River from Nodaway River westward. Evidence indicates a marked decline in flathead chubs in Missouri. In the Missouri River, flathead chubs comprised 31.0% of small fishes in seine collections in the 1940's, 8.1% in the 1960's, and 1.1% in the 1980's. Fisher (1962) indicates that flathead chubs were the second most abundant species in lower Missouri River collections made during 1945, with over 5,000 individuals collected. In the middle Mississippi River, flathead chubs comprised 29.2% of small fishes in seine collections in the 1940's, 3.8% in the 1960's, and less than 0.1% in the 1980's. In the lower Mississippi River below the Ohio confluence, flathead chubs comprised 4.4% of small fishes collected with seines in the 1940's, 3.7% in the 1960's, and less than 0.1% in the 1980's (William Pflieger, *in litt.*). The situation appears to have deteriorated further in recent years. A single flathead chub was collected in the Missouri River during 1994 (Gelwicks et al. 1996). Braaten and Guy (1996) collected three flathead chub from the Missouri River between the Grand River and Kansas City using sampling gears designed to capture small benthic fish. Dieterman and Galat (1996), using the same gears as Braaten and Guy (1996), failed to collect any flathead chubs in the section of Missouri River mainstem between Glasgow, MO and the Osage River mouth, and the section between river km 80 and the mouth. Kubisiak (1997) failed to capture any flathead chubs in off-channel habitats in the Missouri River between river km 257 and 529 during 1995 and 1996, despite seining over 1200 times and collecting almost 30,000 small fishes. David Etnier (*in litt.*) collected a single flathead chub at rkm 50 during 1996 and another at rkm 26 during 1997. The Long Term Resource Monitoring Program field station established on the middle Mississippi in 1991 has not collected a single flathead chub between rkm 48 and 129, despite capturing approximately 80,000 fish using many different gears, including seines (Robert Hrabik, *in litt.*). Tibbs (1995) also failed to collect a single flathead chub in the lower Mississippi River between rkm 1,345 and 1,522, despite collecting over 33,000 small fishes on sandbars using a seine. No flathead chubs have been collected in the Nodaway, Tarkio, or Nishnabotna basins in Missouri since before 1946. However, in Iowa during 1990 and 1991, John Olson (*in litt.*) collected several in the Nodaway Basin, one in the Tarkio Basin, and found them to be common in the East and West Nishnabotna basins.

Habitat condition: The Missouri and Mississippi rivers have been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing

the depth of the channel. Mainstem impoundments upstream in the Missouri River have decreased sediment loads from historic conditions (Slizeski et al. 1982, Pflieger and Grace 1987).

State status: The flathead chub is endangered in Missouri.

FWS Region 4

Arkansas

Summary: The flathead chub is rare in Arkansas. Population status is unknown.

Major populations: Robison and Buchanan (1988) state "The flathead chub is a rare member of the Arkansas fish fauna, having been taken only in the Mississippi River from turbid, flowing waters over a firm sand substrate in the main channel". The flathead chub was collected from three locations in the Mississippi River: Mississippi county (1939), Desha County (1974), and Crittenden County (1980) (Robison and Buchanan 1988). There is no evidence to suggest that the flathead chub was ever abundant in Arkansas. It is unlikely that a breeding population of flathead chubs is present in Arkansas.

Habitat condition: The Mississippi River adjacent to Arkansas has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel.

State status: The flathead chub is not a state listed species in Arkansas.

Kentucky

Summary: The flathead chub is rare in Kentucky. Population status is unknown.

Major populations: The flathead chub in Kentucky is known from a single collection of 20 specimens on the Ohio River near Cairo, IL during 1880 (Clay 1975). There is no evidence to suggest that the flathead chub was ever abundant in Kentucky. It is unlikely that a breeding population of flathead chubs is present in Kentucky.

Habitat condition: The Mississippi River adjacent to Kentucky has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel.

State status: The flathead chub is not a state listed species in Kentucky.

Louisiana

Summary: The flathead chub is rare in Louisiana. Population status is unknown.

Major populations: The flathead chub is known in Louisiana from a collection in the Mississippi River near Delta (Douglas 1974), and another just upstream from Baton Rouge (Conner and Guillory 1974). The latter collection represents the known southernmost extension of the flathead chub. There is no evidence to suggest that the flathead chub was ever abundant in Louisiana. It is unlikely that a breeding population of flathead chubs is present in Louisiana.

Habitat condition: The Mississippi River in Louisiana has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel.

State status: The flathead chub is not a state listed species in Louisiana

Mississippi

Summary: The flathead chub is rare in Mississippi. Population status is unknown.

Major populations: The flathead chub is known in Mississippi from only a single specimen in the Mississippi River in Bolivar County (S. T. Ross, *in press.*). This is likely a waif from upstream (Ron Larson, *in litt.*). There is no evidence to suggest that the flathead chub was ever abundant in Mississippi. It is unlikely that a breeding population of flathead chubs is present in Mississippi.

Habitat condition: The Mississippi River adjacent to Mississippi has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel.

State status: The flathead chub is not a state listed species in Mississippi.

Tennessee

Summary: The flathead chub is rare in Tennessee. Population status is unknown.

Major populations: The flathead chub is known in Tennessee from a single collection in the Mississippi River in Tipton County (Etnier and Starnes 1993). There is no evidence to suggest that the flathead chub was ever abundant in Tennessee. It is unlikely

that a breeding population of flathead chubs is present in Tennessee.

Habitat condition: The Mississippi River adjacent to Tennessee has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat.

State status: The flathead chub is not a state listed species in Tennessee.

FWS Region 6

Colorado

Summary: The flathead chub is common in the Arkansas River Basin and the population is stable. The flathead chub does not occur in the South Platte Basin.

Major populations: The flathead chub occurs in the mainstem of the Arkansas river upstream to a large diversion structure near the town of Florence, as well as in tributaries such as Fountain Creek and the Purgatoire River (Woodling 1985). Flathead chubs were the first or second most common species in the Purgatoire river in collections made from 1983 to 1994 (Lohr and Fausch 1995). The flathead chub was not collected by Olund and Cross (1961), or by Propst (1982) in the South Platte Basin, and it does not appear to have ever been collected there (Woodling 1985). There are no records from the Cimarron river (Woodling 1985), despite the fact that it is presently extant upstream in Oklahoma (Jerry Brabander, *in litt.*) and New Mexico (Sublette et al. 1990), and historically was collected in Kansas, where it is now believed to be extirpated (Cross and Moss 1987).

Habitat condition: Degradation in water quality due to mining activities was common at the turn of the century in the upper Arkansas, but has greatly improved since that time (Woodling 1985). Lohr and Fausch (1995) indicated that no degradation of aquatic resources was occurring due to land practices adjacent to their sampling sites in the Purgatoire Basin.

State status: The flathead chub is not a state listed species in Colorado.

Kansas

Summary: The flathead chub is extirpated in the State with the possible exception of the Missouri River mainstem, where it is rare and the population is declining.

Major populations: The flathead chub is known from the Missouri River adjacent to Kansas, the lower Kansas River, the Republican River, the Cimarron River, and the Arkansas River. The most recent collection of flathead chubs in Kansas was two specimens in the Missouri River mainstem upstream from St. Joseph, MO (Braaten and Guy 1996). The flathead chub was commonly collected from the lower Kansas River until 1959, the Republican River until 1959, the Cimarron River until 1964, and the

Arkansas River until 1973 (Cross and Moss 1987, Frank Cross, *in litt.*). Intensive sampling failed to collect flathead chubs in the lower Kansas River (Frank Cross, *in litt.*) or in the upper Kansas, Republican, Arkansas, or Cimarron basins (Eberle et al. 1997, Eberle et al. 1989). The flathead chub is presumed extirpated in Kansas (Frank Cross, *in litt.*, Eberle et al. 1997).

Habitat condition: The Missouri River has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel. Mainstem impoundments upstream in the Missouri River have decreased sediment loads from historic conditions (Slizeski et al. 1982). Possible reasons for the decline in flathead chubs in tributaries to the Missouri river include construction of impoundments and altered land use practices (State-wide), and extensive use of groundwater for irrigation (western Kansas) (Cross and Moss 1987, Frank Cross, *in litt.*). Recent conditions in Kansas streams indicated somewhat restored flows that should enhance reproduction and dispersal of fishes (Eberle et al. 1997).

State status: The flathead chub is classified an S1 (critically imperiled) species in Kansas.

Montana

Summary: The flathead chub is common to abundant in the Missouri River mainstem, tributaries to the Missouri River, and in the Yellowstone River Basin and populations are stable.

Major Populations: Flathead chubs are abundant in the eastern half of Montana, with no evidence of declines or threats (Gould 1994, William Gould, *in litt.*, pers. comm.). Bergstedt and White (1996) collected 1,458 flathead chubs during 1996 in a variety of habitats in the Missouri River mainstem upstream of Fort Peck Lake to Marais Creek. At the same time, Ruggles (1996) found no flathead chubs in the 18 km below Fort Peck Dam where cold clear water is discharged, five chubs in the next 95 km below the Milk River, which increases turbidity and warms the water, and 67 chubs in the next 161 km where more sandbars are present and numerous tributaries increase turbidity and water temperature. The lower 114 km of the Yellowstone River yielded 1,189 flathead chubs during 1996 (Ruggles 1996). Elser et al. (1980) found flathead chub to be the fourth most common fish collected in the Yellowstone drainage, occurring throughout the mainstem and in virtually every tributary, including major ones, like the Powder and Tongue rivers. However, they only collected flathead chubs in one of five sites in the Little Missouri Basin. Flathead chubs were the most abundant species in collections made during summer of 1997 in the lower Tongue and Powder rivers (Trenka *in litt.*). Barfoot (1993) found flathead chubs to be the third most abundant species in the lower section of Little Beaver Creek, a tributary to the Little Missouri River, but found none upstream in that tributary. Phil Stewart (*in litt.*) also found flathead chub to be one of the most abundant

fishes in the Yellowstone drainage. Mike Vaughn (*in litt.*) found flathead chub to be abundant throughout the Musselshell River which enters the Missouri River in the headwaters of Fort Peck Lake. Flathead chub also commonly occur in the Teton, Marias, and Sun rivers (Bill Hill, *in litt.*) which are tributaries to the Missouri River above Fort Peck Lake.

Habitat condition: The mainstem of the Missouri River immediately below Fort Peck dam is affected by hypolimnetic discharge of cold clear water from the reservoir (Ruggles 1996). The rest of the mainstem is relatively pristine, with the exception of the Holter, Hauser, and Canyon Ferry dams. In fact, the reach from Fort Benton to the headwaters of Fort Peck Lake is designated a National Wild and Scenic Riverway. The Yellowstone also retains its natural state for the most part, without a single large mainstem dam.

State status: The flathead chub is not a state listed species in Montana.

Nebraska

Summary: The flathead chub is rare and declining in the Missouri River mainstem and in Southern Nebraska tributaries. The flathead chub is uncommon to common in other tributaries, and populations remain stable.

Major Populations: Flathead chubs were historically found throughout most of Nebraska's rivers except for the Big Blue, Little Blue, and Hat Creek drainages (Jones 1963, cited in Hesse 1994) and were quite common in the larger streams with shifting sand substrates (Witt 1970). Hesse (1994) noted that abundance of flathead chubs in the channelized portion of the Missouri River adjacent to Nebraska declined from 2.0% of small fishes captured in a seine between 1970 and 1975, to 0.06% from 1986 to 1993. No flathead chubs were caught in the unchannelized Missouri between 1983 and 1993, despite the fact that 19,495 small fish were collected. Stasiak (1990) collected 13 flathead chubs at 7 sites in the channelized Missouri, mile 501 to 690 during 1989. These fish represented 0.3% of the 3,801 small fish collected. Morris (1960), using seines and rotenone, found low densities of flathead chubs in the Platte River, comprising 3% of the total collection in the eastern third of the basin, a trace in the central third, and 2% in the western third of the basin. A few years ago, flathead chubs were infrequently caught in the Platte, but recent collections have yielded locally abundant populations in the lower Platte, and some chubs in the central Platte upstream of the Loup River confluence (Ed Peters, pers. comm., Chadwick et al. 1997). However, during recent years only a few flathead chubs have been collected in the North Platte, and none in the South Platte. Olund and Cross (1961) also failed to collect flathead chub in the South Platte Drainage during 1959. Hesse (1994) used primacord to sample fishes in the lower Niobrara River in the period 1976 to 1978, and in 1991. Catch of flathead chubs averaged 30.73 per blast and comprised 15.3% of the total fishes collected. In 1991, catch averaged 5.00 flathead chubs per blast, but still comprised 12.6% of the catch, due to fewer fishes being collected. Robert Hrabik (*in litt.*) collected 9 flathead chubs in the Little Nemaha during

1984, 12 flathead chubs in the Dismal River, and "dozens" in the Niobrara in 1991. He concurred with Hesse's (1994) conclusion that the flathead chub population in the Missouri River and the lower portion of its tributaries in Nebraska were declining, but suggested that populations in the Sand Hills region were secure. Ed Peters (pers. comm.) also thought that flathead chubs were relatively secure and widespread in the Sand Hills region, having collected them in abundance in the Elkhorn, Loup, and Niobrara rivers.

Habitat condition: The Missouri River has been extensively modified for navigation through the use of wing dams and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel. Mainstem impoundments in the Missouri River have decreased sediment loads from historic conditions (Slizeski et al. 1982). Tributaries to the Missouri river have been dammed extensively in Nebraska, resulting in greatly altered hydrographs (Robert Hrabik, *in litt.*). However, high water conditions in recent years have rejuvenated sand bar habitats on the Lower Platte and have restored a semblance of the natural hydrograph with a measurable increase in flathead chubs (Ed Peters, pers. comm.).

State status: The flathead chub is not a state listed species in Nebraska.

North Dakota

Summary: The flathead chub is abundant in the Missouri River mainstem above Lake Sakakawea and in tributaries to the Missouri River above Garrison Dam, and populations are stable. The flathead chub is rare in the Missouri River mainstem below Garrison Dam. The flathead chub has become uncommon in many tributaries to the Missouri River below Garrison Dam.

Major populations: Flathead chub were the most common fish collected during 1996 in the Missouri River mainstem between the Yellowstone River confluence and Lake Sakakawea, a reach characterized by a shallow braided channel, high sediment load, and a fluctuating hydrograph with a March and June rise (Welker and Scarnecchia 1996). In contrast, no flathead chubs were collected between Garrison Dam and Lake Oahe, a region characterized by reduced turbidity and an altered temperature regime (Welker and Scarnecchia 1996). Flathead chubs were abundant in the Yellowstone, and Little Missouri rivers, and were found in fewer numbers in the Knife, Heart, and Cannonball rivers in collections during 1976 and 1977 (Reigh and Owen, no date). Flathead chubs remain abundant in the Little Missouri River, comprising 72% of all fishes captured by seines in 1993 (Kelsch 1993). In seine collections during 1996, flathead chubs comprised over 40% of the small fishes collected in the lower Cannonball River, but were not collected in upper reaches of the Cannonball or in Cedar Creek, a tributary (USFWS 1997). Flathead chubs also remain common in the Yellowstone River, but have declined in the Heart River (Greg Powers, *in litt.*) The Knife River may not support a viable population, as only a few flathead chubs were collected at only one of twelve sampling stations during 1993 (Peterka 1993).

Habitat condition: Mainstem impoundments in the Missouri River have altered its natural flow regime and decreased sediment loads from historic conditions (Slizeski et al. 1982). The Missouri River has been stabilized to a great degree using rip-rap and levees. This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel. Tributaries to the Missouri River in North Dakota (e.g. Cannonball River) have many low-head dams, and may suffer water withdrawals (USFWS 1997), but still exhibit most of their natural characteristics (Greg Power, *in litt.*)

State status: The flathead chub is listed as a species of concern in North Dakota.

South Dakota

Summary: The flathead chub is rare in the Missouri River mainstem, and populations are declining. The flathead chub is abundant in western South Dakota tributaries flowing into the Missouri River, and populations are stable.

Major populations: The flathead chub population in the Missouri River appears to have declined significantly. Bailey and Allum (1962) indicated that the flathead chub was the dominant minnow of the Missouri River and in all of the larger streams in the western half of South Dakota. Werdon (1992) failed to collect a single specimen in the Missouri River during 1989 and 1990. Flathead chubs were collected only one year in annual population surveys of Lake Oahe using seines from 1991 to 1995 (Johnson et al. 1996). Six flathead chub were collected in the Missouri River between Fort Randall Dam and Ponca, SD during 1996 (Young and Berry 1996). In western tributaries to the Missouri River, flathead chub populations appear to be stable. Flathead chub were very abundant in Little Missouri River collections made during 1950 (Personius and Eddy 1955), and 1976 (Bich and Scalet (1977). Werdon (1992) found that flathead chub in the Little Missouri River were widespread and abundant. In the Moreau River, flathead chub were collected at 100 % of 11 stations and were in the top three most abundant species in collections made during 1995 and 1996 (Loomis 1997). Populations in the Cheyenne and Belle Fourche rivers also appear secure (Chuck Berry, *in litt.*). The flathead chub comprised 40% of the total catch in the Cheyenne during 1996, and 23% during 1997 (Doug Hampton, *in litt.*). Flathead chubs comprised 8% of the total catch in the Belle Fourche during 1996, and 27% during 1997 (Ryan Doorenbos, *in litt.*). Craig Milewski (*in litt.*) found that flathead chub comprised 5% of the total fish collected in the Bad River during 1996. Dozens of flathead chub were collected in the upper Grand River during 1995 (Meester, 1996). Several recent collections in the White River and its tributaries contained flathead chubs (Doug Backlund, *in litt.*). In a 1994 survey of tributaries west of the Missouri River, flathead chubs were collected in 14 of 46 sites (Cunningham et al. 1995).

Habitat condition: Mainstem impoundments in the Missouri River have altered its natural flow regime and decreased sediment loads from historic conditions (Slizeski et al. 1982). The Missouri River has been stabilized to a great degree using rip-rap and levees.

This has reduced the amount of off-channel habitat and altered in-channel habitat by reducing the width and increasing the depth of the channel. Tributaries to the west of the Missouri River in South Dakota remain for the most part unaltered, relative to the mainstem of the Missouri River (Werdon 1992, Loomis 1997), but populations therein may remain vulnerable to extreme drought (Kent Keenlyne, *in litt.*).

State status: The flathead chub is not a state listed species in South Dakota.

Wyoming

Summary: The flathead chub ranges from rare to abundant in Wyoming rivers, where distribution is declining. The flathead chub is likely extirpated from the North Platte.

Major populations: Baxter and Simon (1970) indicate that, in Wyoming, the flathead chub was present in the Bighorn, Tongue, Powder, Little Missouri, Belle Fourche, Cheyenne, and North Platte Basins. The flathead chub remained very common in the Powder drainage during 1986 and 1987 (Smith and Hubert 1989). Patton (1997) recently surveyed all of the drainages within the range of the flathead chub in Wyoming. Flathead chubs were not found in the Little Missouri Basin or the North Platte Basin. Compared to historical information, flathead chub distribution was restricted in the Bighorn Basin, but abundance remained similar (moderate to highly abundant) to historic collections where they were found. Flathead chubs declined in abundance in the mainstem of the Powder River, but were still moderately to highly abundant. In tributaries to the Powder, flathead chub populations remained stable (moderately abundant). Flathead chubs were not collected in tributaries to the Belle Fourche River, but abundances remained similar (low to moderately abundant) to historic collections in the mainstem. Distribution and abundance of flathead chubs in the Cheyenne Basin remained similar to historic collections, being moderately abundant in the Cheyenne mainstem, and in low abundance in Beaver Creek, a tributary. It should be noted that flathead chubs may not ever have been abundant in the North Platte (Steve Facciani *in litt.*).

Habitat condition: Timothy Patton (pers. comm.) indicated that the hydrology of the Platte River Basin is highly modified because of reservoir construction, dams for irrigation water diversion, and groundwater withdrawal. In contrast the Powder River remains pristine, characterized by a meandering, braided channel and variable hydrograph. He felt that the Bighorn Basin fit somewhere between these two extremes, with water development projects beginning to take their toll on the natural system.

State status: Wyoming does not maintain a list of rare and endangered fish in the state (Mike Stone, pers. comm.).

Canada

Alberta

Summary: Flathead chub abundance and population trends are unknown in Alberta, with the exception of the Peace River, where it is common and the population is stable.

Major populations: Scott and Crossman (1973) reported that the flathead chub occurred throughout the province, in the Milk River, North and South Saskatchewan rivers, and the Red Deer and Peace rivers. Bishop (1975) found the flathead to be common throughout the Peace River. Kristensen (1980) collected 293 flathead chub in the Wood Buffalo National Park section of the Peace-Athabasca Delta during 1976 and 1977 and reported them to be very common, attributing their abundance to highly turbid water and abundant insects. The largest chub was 370 mm total length, and weighed 510 grams, easily the largest flathead chub on record. Bond and Berry (1980) reported that flathead chubs made up 2.6% of the total catch and occurred in 16% of the samples in the Athabasca River, whereas in the Athabasca Delta, flathead chubs comprised 5.3% of the total catch and occurred in 63% of all samples when using beach seines around sandbars and islands. Two tagged chubs were recovered in the same location where they were first captured, one 28 days later and the other 245 days later.

Habitat conditions: Recent pulp mill developments on the Peace River have been blamed for release of dioxin, but are not perceived as a serious threat to the river (Dave Berry, pers. comm.).

Province status: The flathead chub is not a listed species in Alberta.

British Columbia

Summary: Flathead chub abundance and population trends are unknown in British Columbia.

Major populations: Scott and Crossman (1973) reported flathead chubs from the Peace River, Lynx Creek, and in the Fort Nelson and Muskwa rivers. No recent information is available on flathead chub distribution in British Columbia.

Habitat conditions: Streams in northeastern British Columbia likely remain relatively pristine.

Province status: The flathead chub is not a listed species in British Columbia.

Manitoba

Summary: The flathead chub is abundant and populations are stable in Manitoba.

Major populations: Scott and Crossman (1973) reported flathead chubs from Lake Winnepeg and the Assiniboine River. Prouse and Derksen (1974) reported a flathead chub from Lake Winnepeg that was 367 mm total length and weighed 440 grams. The current status of flathead chub appears stable in Manitoba, and has recently been collected from the Red River. It remains abundant in the Assiniboine River, a turbid, swift river often with a hard, scoured substrate similar to pavement. It is most effectively collected with 1-1.25" monofilament gill nets drifted with the current, often in conjunction with a block net (Kenneth Stewart, pers. comm.).

Habitat conditions: Water development projects have been proposed and some implemented in the upper Assiniboine river Basin (Kenneth Stewart, pers. comm.).

Province status: The flathead chub is not a listed species in Manitoba.

Northwest Territories

Summary: Flathead chub abundance and population trends are unknown in the Northwest Territories

Major populations: Scott and Crossman (1973) report flathead chubs from the Great Slave lake through the Mackenzie River to the delta in Mackenzie Bay. No recent information is available on flathead chub distribution in the Northwestern Territories.

Habitat conditions: The Mackenzie River likely remains relatively pristine.

Province status: The flathead chub is not a listed species in British Columbia.

Saskatchewan

Summary: Flathead chub abundance and population trends are unknown in Saskatchewan.

Major populations: Scott and Crossman (1973) reported the flathead chub from the Cypress Hills area, the South and North Saskatchewan rivers, and Lake Athabasca. Atton and Merkowski (1983) report flathead chubs from the Frenchman River (a tributary to the Missouri River), the North and South Saskatchewan rivers, as well as Cumberland Lake, Tobin Lake, and Athabasca Lake. The focus of fisheries personnel in Saskatchewan has shifted toward game fishes in recent years, primarily due to budget constraints. Therefore little, if any, recent information on the flathead chub is available (Bruce Howard, pers. comm.).

Habitat conditions: The North and South Saskatchewan rivers have been dammed for hydroelectric and flood control purposes.

Province status: The flathead chub is not a listed species in Saskatchewan.

THREATS

In accordance with the Endangered Species Act of 1973, five factors are used to determine whether a species is endangered are threatened:

A. The present or threatened destruction, modification, or curtailment of its habitat or range
B. Overutilization for commercial, recreational, scientific, or educational purposes
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other natural or manmade factors affecting its continued existence

These factors will form the basis for the summary of known threats to the flathead chub which follows.

Present or threatened destruction, modification, or curtailment of its habitat or range

The Missouri River has been named the most endangered river for 1997 by American Rivers, a conservation group whose mission it is to call attention to degraded river systems (American Rivers 1997). The organization's concerns echo that of Hesse et al. (1993) who discussed reasons for the decline of selected fish species, including flathead chubs, in the Missouri River adjacent to Nebraska. They were: 1) altered hydrograph, 2) loss of floodplain connectivity, 3) snag removal, 4) loss of sediment transport, and 5) altered water temperature. These concerns appear applicable to the entire stretch of the Missouri River from Fort Peck Lake to the Missouri/Mississippi confluence, and the Mississippi River downstream. These alterations are the direct result of modifying the river for navigation, flood control, and floodplain agriculture.

Six mainstem dams were constructed between 1938 and 1963 for the purposes of navigation, hydropower, and recreation, impounding 1,233 km of the Missouri River's mainstem. As a result, present hydrographs on the Missouri River mainstem at Omaha, Nebraska bear little resemblance to historic conditions (Hesse and Mestl 1993). The seasonal flooding which characterized the pre-impounded Missouri has been largely lost between Fort Peck Lake and Kansas City, Missouri. An extensive levee system along the Missouri River has eliminated a great deal of the connection between the river and its floodplain. For example, in the states of Nebraska, Iowa, and Missouri, 83,519 ha of the Missouri River's floodplain have been prevented from flooding (Hesse and Sheets 1993). These alterations reduce spatial and temporal heterogeneity in the river which has been postulated as vital to maintaining species biodiversity (Poff and Ward 1990, Sedell et al. 1990, Townshend and Hildrew 1994). Floodplains and associated backwater habitats are

important reproductive and nursery areas for fishes adapted to large rivers (Kallemeyn and Novotny 1977, Guillory 1979, Shaeffer and Nickum 1986, Kwak 1988). Additionally floodplains are an important source of carbon, in the form of woody debris or snags, that is the fundamental energy source for the system (Junk et al. 1989).

Mainstem impoundments on the Missouri mainstem have also reduced the amount of transported sediment in the river and altered the natural temperature regime. Slizeski et al. (1982) documented a decrease in average annual suspended sediment load at Yankton, South Dakota after dam construction, from 126,008,100 to 6,143,300 metric tons, and at Omaha, Nebraska from 148,930,000 to 29,487,600 metric tons. Pflieger and Grace (1987) compared pre- and post-dam turbidities in the Missouri River at St. Louis and documented a four-fold decrease. Dieterman et al. (1996) compared average turbidity among river segments from the headwaters to the Missouri/Mississippi confluence, and found that segments below Fort Peck, Garrison, and Fort Randall dams had lower turbidity values than any other. The flathead chub characteristically inhabits highly turbid systems, and appears well-adapted for such an existence (Scott and Crossman 1973). Increased water clarity favors sight-feeding minnows, like the emerald shiner, and possibly allows them to outcompete the flathead chub for food resources (William Pflieger *in litt.*).

Mainstem dams alter the natural temperature regime in the mainstem if they discharge hypolimnetic water. Dieterman et al. (1996) compared average temperature among river segments from the headwaters to the Missouri/Mississippi confluence during late summer and early fall. They found that average water temperature was 7° to 16° C colder in all mainstem habitats below Fort Peck and Garrison dams compared to those same habitats upstream in the headwaters. Fishes adapted to life in large rivers use temperature as a cue to initiate spawning (Sparks et al. 1990, Sparks 1992). Aquatic insects also use thermal cues for emergence and maturation (Petts, 1984). Alteration of the natural temperature regime almost certainly negatively impacts flathead chub spawning success and food resources.

Habitat degradation is also a reality in smaller streams and rivers in every state, and likely every province within the range of the flathead chub. Factors suspect in the decline of many fishes characteristic of the Great Plains include mainstem impoundments, channelization, intensive agriculture, soil conservation practices, and dewatering due to streamflow diversion and groundwater withdrawal for irrigation (Tabor 1993). Others also cite one or more of these factors as negatively impacting the flathead chub (Cross and Moss 1987, Frank Cross *in litt.*, Ken Collins *in litt.*, Robert Hrabik *in litt.*). These practices alter the natural flow regime, have likely caused the extirpation of the flathead chub in Kansas, and could jeopardize the continued existence of the flathead chub in the rest of its range.

Over utilization for commercial, recreational, scientific, or educational purposes

The flathead chub was used extensively as a baitfish in the lower Missouri River because of its large size and vitality (Harlan and Speaker 1956). It is also occasionally angled for in northern parts of its range, and was historically used by natives as a food

fish (Scott and Crossman 1973, Bishop 1975). The flathead chub is often collected and preserved for scientific purposes. It is extremely unlikely that any of these consumptive uses was the cause of population declines, but in selected drainages, continuance of scientific and baitfish collections could exacerbate the condition of imperiled populations.

Disease or predation

Flathead chubs have been documented with tapeworm (Scott and Crossman 1973) and trematode ("black grub") infections (Scott and Crossman 1973, Martyn and Schmulbach 1978). These parasites have the potential to harm isolated populations of the flathead chub, but likely pose little threat to populations of high abundance.

The flathead chub is likely an important forage fish for predatory fish within its range. Historically, piscivorous fishes adapted to highly turbid waters were the most important predators in the Missouri River (e.g. pallid sturgeon, sauger). Greatly increased water clarity in the Missouri River as compared to historic conditions possibly allows sight-feeding predators to be much more effective. Pflieger and Grace (1987) documented increased abundance of sight-feeding predatory fishes in the mainstem of the Missouri River in Missouri between 1940 and 1983, and a corresponding decrease in small fishes adapted to historic river conditions. Lentic conditions within reservoirs favor sight-feeding piscivores such as crappie and bass, which were historically restricted mainly to backwaters and floodplain lakes. During drought conditions, populations of the flathead chub in ephemeral tributaries may also be at increased risk of predation as they retreat downstream (Kent Keenlyne *in litt.*).

Inadequacy of existing regulatory mechanisms

The flathead chub was formerly considered a Category 2 candidate species. However, both the Category 1 and Category 2 designations have been discontinued. A new policy has been established by the Service that defines candidate species. Under the new designation, a "candidate species" is a species for which the Service has on file sufficient information on biological vulnerability and threats to support issuance of a proposed rule to list as endangered or threatened.

Few states have listed the flathead chub under state statutes. Kansas lists the flathead chub as threatened which protects the species from take and from habitat loss associated with publicly funded projects (Kansas State Legislative Act 1997). In Missouri, the species is listed as endangered. Missouri state law prohibits the importation, transportation, sale, purchase, taking, or possession of any endangered species of wildlife (Missouri Department of Conservation 1997). The flathead chub is listed solely as a species of concern in North Dakota and Oklahoma. In the remaining states, protection is limited to laws which prevent the excessive take of individuals for baitfishing.

Other natural or manmade factors affecting its continued existence

There is no evidence of factors negatively affecting the flathead chub other than those detailed in the habitat degradation section.

LAND OWNERSHIP

Land adjacent to rivers and streams inhabited by the flathead chub is a mixture of Federal, State, Tribal, and private lands.

MANAGEMENT ACTIONS NEEDED

Maintenance or restoration of natural flow, sediment, and temperature regimes is critical to native fishes adapted to presettlement conditions like the flathead chub (Galat et al. 1996). Hesse et al. (1993) provided three solutions for these problems, which appear germane to all drainages in which the flathead chub occurs. They recommended using reservoir releases to mimic the natural pre-impoundment hydrograph which was characterized by peak stages in March-April and in June (Hesse and Mestl 1993). This has been hypothesized to increase the production of fishes adapted for spawning during seasonal peaks in river stage (Bayley 1991). Sediment transport could be enhanced by installing sediment bypass systems in mainstem impoundments. This would decrease water clarity, favoring the flathead chub which is adapted to highly turbid waters (Scott and Crossman 1973). Additional benefits to sediment bypass include increased reservoir capacity and decreased degradation below dams, which also causes head cutting in tributary streams. Return to a more normal thermal regime could be accomplished by mixing bottom and surface water in reservoirs before discharge into the river. This would restore the temperature cues native fishes use to initiate spawning (Junk et al. 1989, Sparks et al. 1990, Sparks 1992).

In smaller streams and rivers not yet extensively developed, these problems, as well as dewatering due to groundwater withdrawal, can be avoided or reduced by considering the impact further water development projects would have on native fishes. Those development projects found to negatively impact native fishes, like the flathead chub, should be opposed or modified to reduce their impact to an acceptable level.

RESEARCH NEEDED

A genetic study comparing *P. g. gracilis* and *P. g. gulonella* is needed to verify division into two subspecies based on morphometric and meristic data (Frank Cross, *in litt.*, Robert Hrabik, *in litt.*). Based on the distribution of the two subspecies in Olund and Cross (1961) in the United States, most *P. g. gracilis* populations and many "intergrade" populations are declining, whereas most *P. g. gulonella* populations remain stable.

Defining seasonal habitat usage, including spawning locales, is also important, as information appears to be almost totally lacking in these areas (Gould 1985). Complete life-history information is needed for management efforts to be most effective.

Monitoring programs which use similar sampling gears across a wide geographic range (e.g. Dieterman et al. 1996) are needed to determine spatial and temporal trends in native fishes like the flathead chub. This information could be used to pinpoint factors

within a basin that negatively impact native fishes.

Surveys within smaller tributary basins or reaches of larger basins that are designed to catalog presence and relative abundance of small fishes are vitally important (e.g. Kubisiak 1997, Loomis 1997. Patton 1997, Tibbs 1995). These relatively low-cost studies can yield information with higher spatial resolution than basin-wide monitoring programs and, coupled with historic collections, reveal valuable temporal trends.

Research on husbandry and captive rearing of flathead chubs is also a potential need. If no other options exist, and large-scale extirpation occurs, these techniques would be vital tools in the reintroduction of the species.

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