

**OROVILLE FERC RELICENSING
(PROJECT No. 2100)**

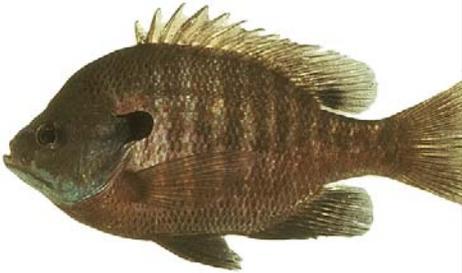
**INTERIM REPORT
SP-F3.2 TASK 2
SP-F21 TASK 1**

**APPENDIX A
MATRIX OF LIFE HISTORY AND HABITAT REQUIREMENTS FOR
FEATHER RIVER FISH SPECIES**

**LITERATURE REVIEW OF LIFE HISTORY AND
HABITAT REQUIREMENTS FOR
FEATHER RIVER FISH SPECIES**

BLUEGILL

JANUARY 2003

Element	Element Descriptor	General	Feather River Specific
General			
common name (s)	English name (usually used by fishers and laypeople).	Bluegill	
scientific name (s)	Latin name (referenced in scientific publications).	<i>Lepomis macrochirus</i>	
taxonomy (family)	Common name of the family to which they belong. Also indicate scientific family name.	Sunfish and Bass - <i>Centrarchidae</i>	
depiction	Illustration, drawing or photograph.		
range	Broad geographic distribution, specifying California distribution, as available.	The native range of bluegill is the freshwaters of Central and Eastern North America. Bluegill have been introduced into many places east and west of this area (Wang 1986).	
native or introduced	If introduced, indicate timing, location, and methods.	Bluegill were introduced to California in 1908 and now populate the Delta and westward to San Pablo Bay (Wang 1986).	

Element	Element Descriptor	General	Feather River Specific
ESA listing status	Following the categories according to California Code of Regulations and the Federal Register, indicate whether: SE = State-listed Endangered; ST =State-listed Threatened; FE = Federally listed Endangered; FT = Federally-listed Threatened; SCE = State Candidate (Endangered); SCT = State candidate (Threatened); FPE = Federally proposed (Endangered); FPT = Federally proposed (Threatened); FPD = Federally proposed (Delisting); the date of listing; or N = not listed.	Bluegill are not listed.	
species status	If native, whether: Extinct/extirpated; Threatened or Endangered; Special concern; Watch list; Stable or increasing. If introduced, whether: Extirpated (failed introduction); highly localized; Localized; Widespread and stable; Widespread and expanding.	The status of bluegill is "widespread and stable" (Moyle 2002).	
economic or recreational value	Indicate whether target species sought for food or trophy. Whether desirable by recreational fishers, commercial fishers, or both.	Bluegill are desirable by recreational fishers and is one of the most abundant gamefish in California (Wang 1986).	
warmwater or coldwater	Warmwater if suitable temperature range is similar to basses; coldwater if suitable temperature range is similar to salmonids.	Bluegill are a warmwater fish.	
pelagic or littoral	Environment: Pelagic - living far from shore; Littoral - living near the shore.	Bluegill inhabit littoral habitat.	

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bottom or water column distribution	Environment: bottom (benthic) or along water column.		
lentic or lotic	Environment: Lentic - pertaining to stagnant water, or lake-like; Lotic - moving water, or river-like.	Bluegill are found in shallow lakes, reservoirs, ponds, streams, and sloughs at low elevations (Moyle 2002). Bluegill are a lentic species.	
Adults			
life span	Approximate maximum age obtained.	Bluegill live 8 to 10 years and spawn every 1 to 3 years (Wang 1986). Few bluegill live longer than 6 years (Moyle 2002).	
adult length	Indicate: Length at which they first reproduce; average length and maximum length the fish can attain.	The maximum length of bluegill is 11.8 inches (300 millimeters) (Wang 1986). By the end of their first year, bluegill are typically 1.6 to 2.5 inches (4 to 6 centimeters) in length, and grow 0.79 to 2.0 inches (2 to 5 centimeters) during each subsequent year. A typical bluegill is 5.9 inches (15 centimeters) at 4 to 5 years (Moyle 2002).	
adult weight	Indicate: Weight at which they first reproduce; average weight and maximum weight the fish can attain.	Bluegill weight 3.17 ounces (90 grams) at 4 to 5 years, and 0.66 pounds (300 grams) at 8 to 9 years. The maximum weight of bluegill in California is 3.5 pounds (1.6 kilograms) (Moyle 2002).	
physical morphology	General shape of the fish: elongated, fusiform, laterally compressed, etc.	Bluegill have deep, compressed bodies (Moyle 2002).	
coloration	Indicate color, and color changes, if any, during reproduction phase.	Nonbreeding bluegill usually have an iridescent purple sheen. Breeding male bluegill become very dark olive to bronze on their back and sides and have orange breasts; their pelvic and anal fins turn an iridescent black, and a large dark spot develops on the soft rayed portion of the dorsal fin (Moyle 2002).	
other physical adult descriptors	Unique physical features for easy identification.	Bluegill have flexible blue or black flaps on the rear of the opercula (Moyle 2002).	
adult food base	Indicate primary diet components.	Bluegill eat the larvae of aquatic insects, such as midges, mayflies, caddisflies, and dragonflies, and also eat planktonic crustaceans, flying insects, snails, small fish, fish eggs, and crayfish. In the Delta, the bluegill summer diet was benthic organisms, such as amphipods, isopods and chironomid larvae and pupae. When prey becomes	

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		scarce, bluegill feed on algae and other aquatic plants (Moyle 2002).	
adult feeding habits	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder.	Bluegill are highly opportunistic feeders, and feed on whatever is most abundant. Bluegill feeding is continuous in summer, peaking in mid-afternoon and again at dusk. Bluegill will feed on the bottom, in mid-water, in aquatic vegetation, and off the surface (Moyle 2002).	
adult in-ocean residence time	For anadromous species, age when they migrate to the ocean and duration spent in the ocean before returning to freshwater to spawn.	N/A	
adult habitat characteristics in-ocean	For anadromous species, description of the ocean habitat utilized: whether along major current systems, gyres, pelagic (beyond continental shelves) and neritic (above continental shelves) zones, etc.	N/A	
Adult upstream migration (immigration)			
range of adult upstream migration timing	Time of year adults migrate upstream. If applicable, indicate for various runs.	N/A	
peak adult upstream migration timing	Time of year most adults migrate upstream. If applicable, indicate for various runs.	N/A	
adult upstream migration water temperature tolerance	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	
adult upstream migration water temperature preference	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	N/A	

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Adult holding (freshwater residence)			
water temperature tolerance for holding adults	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Bluegill survive winter water temperatures of 35.6°F to 41°F (2°C to 5°C), and summer water temperatures of 104°F to 105.8°F (40°C to 41°C) (Moyle 2002).	
water temperature preference for holding adults	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	Bluegill select water temperatures of 80.6°F to 89.6°F (27°C to 32°C) (Moyle 2002).	
water depth range for holding adults	Reported range of observed (minimum and maximum) water depth utilization.	Bluegill seldom live deeper than 16.4 feet (5 meters) (Moyle 2002).	
water depth preference for holding adults	Reported range of most frequently observed water depth utilization.		
substrate preference for holding adults	If bottom dwellers, indicate substrate: mud, sand, gravel, boulders, aquatic plant beds, etc. If gravel, indicate range or average size of gravel.	Bluegill are associated with rooted aquatic plants and with river and lake bottoms consisting of silt, sand, or gravel (Moyle 2002).	
water velocity range for holding adults	Reported range of observed (minimum and maximum) water velocity utilization.		
water velocity preference for holding adults	Reported range of most frequently observed water velocity utilization.		
other habitat characteristics for holding adults	General description of habitat (e.g. turbid or clear waters, lentic or lotic, presence of aquatic plant beds, debris, cover, etc.).		
timing range for adult holding	Time of year (earliest-latest) and duration of stay from upstream migration to spawning.		
timing peak for adult holding	Time of year when maximum number of adults are present before spawning.		

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Spawning			
fecundity	Average or range in the number of eggs females lay in a spawning season.	Bluegill produce 2,000 to 18,000 eggs per nest, laying 2,500 to 64,000 total eggs. Fecundity increases with the size and age of female bluegill (Wang 1986). Single female bluegill lay 2,000 to 50,000 eggs, although 62,000 bluegills have been hatched from one nest. Bluegill typically lay 2,000 to 18,000 eggs per nest (Moyle 2002).	
nest construction	Location and general description of nest -- substrates, aquatic plants, excavations, crevices, habitat types, etc.	Male bluegill excavate depressions in sandy, gravel, or hard clay bottoms, then add sticks and dead leaves, or pine needles (Wang 1986). Bluegill create bowl-shaped depressions in the substrate in colonies ranging in size from 15 to 500 nests (Dominey 1981).	
nest size	Size and average dimensions of the nest.	Bluegill lay 2,000 to 18,000 eggs per nest (Moyle 2002).	
spawning process	Indicate whether nest builder, broadcast spawner, or other.	The parental male bluegill attracts the female to the nest and the two spawn side-by-side. At each spawning, the female bluegill releases about a dozen eggs, which are fertilized by the male. Each male bluegill courts many females in succession, so a single nest can contain thousands of embryos (Moyle 2002). Female bluegill are attracted to spawning pairs and deposit eggs in adjacent nests, creating areas of spawning activity or spawning centers (Dominey 1981).	
spawning substrate size/characteristics	Range of substrates used during spawning (e.g. mud, sand, gravel, boulders, beds of aquatic plants). Indicate presence of plant/wood debris, crevices at spawning sites. If gravel, indicate range of average size.	Bluegill nests are constructed of gravel, sand, or mud and interspersed with debris, twigs, dead leaves, sand, or hard clay. Bluegill eggs are deposited on sticks or dead leaves (Wang 1986). Bluegill nests are constructed on gravel, sand, or mud that contain pieces of debris (Moyle 2002).	
preferred spawning substrate	Indicate preferred spawning substrate (e.g. mud, sand, gravel, boulders, plant bed, etc).		

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water temperature tolerance for spawning	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Bluegill spawn in water temperatures ranging from 62.6°F to 80.6°F (17°C to 27°C), beginning when water temperatures range between 64.4°F and 69.8°F (18°C and 21°C). Most bluegill spawning occurs in water temperatures over 68°F (20°C) (Wang 1986). Bluegill spawning begins when water temperatures reach 64.4°F to 69.8°F (18°C to 21°C) (Moyle 2002).	
water temperature preference for spawning	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
water velocity range for spawning	Minimum and maximum speed of water current the spawning fish can tolerate.		
water velocity preference for spawning	Preferred water current (flow velocity) during spawning.		
water depth range for spawning	Reported range of observed (minimum and maximum) water depth utilization.		
water depth preference for spawning	Reported range of most frequently observed water depth utilization.		
range for spawning timing	Earliest and latest time of season or year in which spawning occurs.	Bluegill spawn in May through August in Delaware, and throughout the summer in California (Wang 1986). Bluegill spawn in spring and continue through September (Moyle 2002).	
peak spawning timing	Time of year most fish start to spawn.	Bluegill peak spawning occurs in June and July (Wang 1986).	

Element	Element Descriptor	General	Feather River Specific
spawning frequency (iteroparous/semelparous)	Semelparous - producing all offspring at one time, such as in most salmon. Usually these fish die after reproduction. Iteroparous - producing offspring in successive, e.g., annual or seasonal batches, as is the case in most fishes.		
Incubation/early development			
egg characteristics	Shape, size, color, in clusters or individuals, stickiness, and other physical attributes.	Bluegill eggs are spherical, averaging 0.04 inches (1.04 millimeters) in diameter, ranging from 0.04 to 0.05 inches (1.1 to 1.3 millimeters) in diameter, pale yellow, granular, transparent, thick, adhesive, and demersal (Wang 1986).	
water temperature tolerance for incubation	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Bluegill eggs tolerate water temperatures ranging from 72°F to 74°F (22.2°C to 23.3°C) (Wang 1986). Bluegill eggs hatch at 68°F (20°C) (Moyle 2002).	
water temperature preference for incubation	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
time required for incubation	Time duration from fertilization to hatching. Note: Indicate at which temperature range. Incubation time is temperature-dependent.	Bluegill eggs hatch in 32 hours (Wang 1986). Bluegill eggs hatch in 2 to 3 days (Moyle 2002).	
size of newly hatched larvae	Average size of newly hatched larvae.	Bluegill larvae range from 0.08 to 0.13 inches (2 to 3.2 millimeters) in length (Wang 1986).	
time newly hatched larvae remain in gravel	Time of year of hatching, and duration between hatching and emergence from gravel.	Bluegill larvae are abundant in June and July (Wang 1986).	
other characteristics of larvae	Alevin -- early life history phase just after hatching (larva) when yolk-sac still present.	There is no pigmentation on newly hatched bluegill larvae. Newly hatched bluegill larvae remain in the nesting area; free-swimming larvae inhabit shallow water with vegetation (Wang 1986).	
timing range for emergence	Time of year (earliest-latest) hatchlings (larvae and alevins) leave or emerge from the nesting/hatching (gravel) sites.	Bluegill fry were free swimming 6 days after hatching (Wang 1986). Male bluegill guard embryos and fry for about 1 week	

Element	Element Descriptor	General	Feather River Specific
		(Moyle 2002).	
timing peak for emergence	Time of year most hatchlings emerge.		
size at emergence from gravel	Average size of hatchlings at time of emergence.		
Juvenile rearing			
general rearing habitat and strategies	General description of freshwater environment and rearing behavior.		
water temperature tolerance for juvenile rearing	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
water temperature preference for juvenile rearing	Range of suitable, preferred, or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
water velocity ranges for rearing juveniles	Reported range of observed (minimum and maximum) water velocity utilization.		
water velocities preferred by rearing juveniles	Reported range of most frequently observed water velocity utilization.		
water depth range for juvenile rearing	Reported range of observed (minimum and maximum) water depth utilization.		

Element	Element Descriptor	General	Feather River Specific
water depth preference for juvenile rearing	Reported range of most frequently observed water depth utilization.		
cover preferences for rearing juveniles	Type of cover for protection from predators used by rearing juveniles (e.g., crevices, submerged aquatic vegetation, overhanging vegetation, substrate cover, undercover bank, small woody debris, large woody debris).	Juvenile bluegill swim in small schools near or among plant beds (Wang 1986). Juvenile bluegill swim in aquatic plant beds; in streams, they may enter the water column and be washed into backwaters. At 0.4 to 0.5 inch (10 to 12 millimeters), bluegill move into surface waters, where they remain for 6 to 7 weeks. Bluegill return permanently to aquatic plant beds near shore at 0.8 to 1 inch (21 to 25 millimeters) (Moyle 2002).	
food base of juveniles	Indicate primary diet components. Also indicate the diet changes, if any, as growth occurs.	Juvenile bluegill eat copepods and cladocerans, planktonic crustaceans, and aquatic and flying insects (Wang 1986). Juvenile bluegill eat planktonic crustaceans (Moyle 2002).	
feeding habits of rearing juveniles	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder. Also indicate change of feeding habits growth occurs.		
predation of juveniles	Indicate which species prey on juveniles.		
timing range for juvenile rearing	Range of time of year (months) during which rearing occurs.	N/A	
timing peak for juvenile rearing	Time of year (months) during which most rearing occurs.	N/A	

Element	Element Descriptor	General	Feather River Specific
Juvenile emigration			
time spent in fresh water prior to emigrating	Duration (in years and/or months) from emergence to emigration to the ocean.	N/A	
water temperature tolerances during emigration	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	
water temperature preferences during emigration	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	N/A	
emigration timing range	Time of year juveniles commence emigration and duration of emigration.	N/A	
emigration timing peak	Time of year most juveniles are emigrating.	N/A	
size range of juveniles during emigration	Minimum and maximum sizes (inches or mm) of emigrating juveniles. Indicate average size.	N/A	
factors associated with emigration	Pulse flows, water temperature changes, turbidity levels, photoperiod, etc.		
Other potential factors			
DO	Levels of dissolved oxygen in water expressed in mg/l tolerated by fish.	Maximum growth and reproduction of bluegill occurs with dissolved oxygen (DO) levels of 4 to 8 mg/L. Bluegill can survive at DO levels less than 1 mg/L (Moyle 2002).	
pH	Alkalinity/acidity of water (expressed in pH) that fish can tolerate.		
turbidity	Indicate turbidity or state of water (e.g., clear water or presence of siltation or organic/inorganic matter in water) that fish can tolerate.		

Element	Element Descriptor	General	Feather River Specific
factors contributing to mortality	e.g. fishing/angling mortality, drastic habitat alterations, unfavorable climatic changes, etc.		

References

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