University of California, Davis Department of Animal Science
CALIFORNIA AQUACULTURE

SPECIES SELECTION FOR RECREATIONAL FISHING IN SMALL PONDS AND LAKES

Introduction

Recreational ponds and lakes are a valuable asset to property values and the enjoyment of life, and fishing in farm ponds, reservoirs and small lakes is a popular activity. The concept originated on farms and ranches where fish were stocked in water impoundments used for crop irrigation and watering livestock. The value of this water for recreation was apparent and activities such as recreational fishing, swimming, and observing aquatic wildlife quickly evolved.

Most landowners with adequate space, proper soil, and good quality water sources develop interests in creating aquatic environments, or improving existing ponds or lakes for recreational activities. These interests have created inquires for information concerning pond construction, suitable species for stocking, and pond management practices. This publication will address the selection of fish species as it relates to physical resources and the size of the impoundment. Emphasis will be placed on smaller water impoundments: i.e., small ponds (¼ to < 5 surface acres) to small lakes (5 to 10 surface acres). For convenience, the term “pond” will be used to describe all of these bodies of water.

Building a new pond or restocking an older pond for recreational fishing requires some knowledge of the relationship between seasonal water temperature and fish species. Like many other western states, California has a diverse topography resulting in various micro-climates that affect water temperature in ponds. In addition, the size, depth, and other physical characteristics of a pond influence annual water temperature. Water temperatures and size of the impoundment are among the primary factors which determine what species or combination of species will survive and flourish in a pond. Among the first steps in determining what species of fish will do well in a water system is to determine the seasonal water temperature profile of the pond and to match this information to the biological requirements of the available fish.

Water Temperature Classification

The annual temperature range of a pond determines what species of fish or combination of species are suitable for the system. In general, a healthy fish environment is one in which fish exhibit reasonable growth, reach sexual maturity, and reproduce. Each species responds to environmental cues that stimulate growth and trigger sexual behavior and reproduction. The upper range of the spring and early summer water temperatures in ponds usually serves as a major trigger for fish reproduction. The high range of summer water temperatures is generally used to classify ponds as either warm water, cool water, or cold water environments (Table 1).

Most ponds in California will be classified as either cold or warm water. In many instances, species selection can be made from knowledge of other ponds located in relative proximity and having similar size and depth characteristics. Generally, ponds in the Great Central Valley and the hot valleys of Southern California are warm water ponds, while high elevation ponds are usually cold water. Intermediate elevation and coastal ponds are often influenced by micro-climatic conditions imposed by topography and wind patterns and fall

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Table 1. Summer water temperature ranges used to classify warm, cool and cold water ponds.

Classification	Condition
Warm Water	Summer water temperatures reach 80-90° F and above.
Cool Water	Summer water temperatures reach 70° F, but seldom above 80° F in summer.
Cold Water	Summer water temperatures are seldom above 70° F.

into a cool water category. Water temperature data needs to be collected to determine the specific category and to select suitable species. There are exceptions to these generalizations, including influences imposed by artesian springs, geothermal activity, wind, and effects of fog in coastal climates.

Classification of a water system is determined by using seasonal water temperature data. Samples should be obtained from representative areas of a pond and taken at depths of one foot, midway in the water column, and one foot from the bottom. Many ponds possess characteristics such as variations in the contour of the pond or the influx of spring water that may create warm and cold pockets within the system. These special features allow certain fish species to survive excessive water temperatures by providing temporary refuge within the water column.

Fish Species and Temperature Classification

Warm, cool, and cold water fish are generally classified as those fish that grow and often reproduce within the summer temperature ranges exhibited in Table 1. These three temperature categories are also meant to be used in general terms, since many species of fish may have genetic variations that exhibit wider tolerance ranges based on their particular genetic makeup.

Table 2 provides general temperature profiles for some of the more common fish found in recreational ponds in California. Data for crappie and red-ear sunfish are not as accurate as that presented for the other fish in the list, and information for these species will be updated in the future.

Rainbow trout are considered cold water fish. There are strains of rainbow trout that may survive temperatures from about 33 to 78° F , but most rainbow trout that have been observed to survive the higher temperatures are rare and appear more in the literature than in ponds. Temperatures above 68° F should be avoided for rainbow trout. Optimal growth rates and survival range occur between 50 and 60° F. The farther the temperature moves in either direction from this optimal range, the greater the stress to the animal's biological systems. As stress increases, so does the incidence of disease and death.

Caution: When water temperature profiles of a pond indicate a cold water system, but upon occasion exceed the 70° F range, then a risk decision must be made to sustain a rainbow trout stock. Several years may pass when the fish do well, but one sustained summer of higher temperatures will cause fish losses.

Pond Reproduction and Restocking Requirements

A temperature-spawning range for rainbow trout is given in Table 2. However, unless other special conditions exist in the pond, reproduction will not occur. Rainbow trout spawning can occur where fresh water of suitable spawning temperature flows into the pond from a creek that also contains good spawning habitat. The trout often swim up these small tributaries and spawn on suitable gravel beds. Few small ponds have this feature and most trout ponds require restocking every few years to maintain a good fishery.

Warm water fish have a relatively wider tolerance range for survival and growth, but each species has its own particular reproductive requirements. The sunfish such as bass, bluegill, red-ear, and crappie (pronounced "croppie") make depression nests in shallow margins of the pond. Bass and crappie use similar nesting areas and spawn at similar temperatures, so there is potential competition for reproduction habitat. Bluegill and red-ear sunfish use the same spawning areas as the bass, but competition with bass is reduced because the lesser sunfish are triggered to spawn at slightly higher water temperatures. Channel catfish use cave-like depressions as nesting areas, and this reproductive habit reduces competition with the sunfish. All of these species provide a level of parental protection for their young and the closer the nesting and spawning behavior between species, the greater the competition for space and other limited supportive resources.

The criteria for successful reproduction of sunfish and channel catfish are usually present in adequately sized warm water ponds. Channel catfish may be encouraged to reproduce by

providing suitable spawning containers such as five gallon milk cans or other suitable structures with similar size openings and internal capacity. To encourage reproduction among sunfish, it is recommended that the sunfish's spawning areas not be disturbed by walking or swimming along the shoreline areas of a pond during the early spring and summer. Once stocked, a functioning warm water pond does not require restocking. The fish will replenish the pond through natural reproduction.

Table 2. List of some common fresh water fish species found in recreational ponds in California, and general temperature profiles for survival, optimal growth and reproduction* (Modified from Calhoun, 1966; Piper et al., 1982; Bell, 1991).

Species	Survival Range	Optimal Range	Spawning Range
Rainbow Trout	33-78° F	50-60° F	50-55° F
Channel Catfish	33-95° F	70-85° F	72-82° F
Black Bass	33-95° F	55-80° F	60-65° F
Black Crappie	~33-80° + F	~55-80° F	58-64° F
White Crappie	**	**	64-68° F
Bluegill Sunfish	36-93° F	60-80° F	67-80° F
Red-ear Sunfish	° F***	75° F	~72-75° + F

* Temperatures given are general ranges for the species, and individual genetic populations may vary.

** Similar to black crappie, but evidence shows that white crappie are less tolerant to colder temperatures.

*** Similar to bluegill, but does not tolerate rapid fluctuations.

~ = approximate, and based on scarce data for California.

For successful reproduction, many warmwater fish require water temperatures below 45° F for part of the winter, followed by a spring and early summer rise in water temperature. For many fish this is a requirement for good ova (unfertilized egg) development. In California's lower valleys, with little exception, this natural temperature change occurs annually.

Selection of Fish Species For Pond Stocking

***Natural and Managed Ponds*:** The primary function of a pond should be determined prior to selection of fish species for stocking. One popular pond concept today is the "natural" or "ecologically balanced" pond in which a large number of diverse species are stocked, including frogs, crayfish and other aquatic species, as well as plants. However, stocking a pond, in itself, is an unnatural event. If the pond were left on its own, a more natural succession of plants and animals would immigrate to the new habitat.

If recreational fishing is the primary objective, fish selection and pond management practices should be the highest priority. This decision will increase chances that the fishing experience will be satisfactory and long-lasting. This does not preclude other recreational activities such as swimming and observing pond life. Even in the most managed pond, natural immigration of other animal and plant species will occur and provide hours of entertainment for all ages. Swimming in recreational fishing ponds is also viewed by many as a natural event and guidelines for human safety and related activities associated with good fishery management practices should be followed. An example is, avoid swimming or wading in shallow nesting areas during spawning season.

***Never stock a pond with wild-caught fish*!** In most states, including California, it is illegal to stock private ponds with wild-caught fish. Fish are available from commercial fish farms, and assistance with stocking recommendations can also be obtained from these sources.

Influence of Pond Size on Fish Selection

Pond size is one of the first criteria that should be examined. The size of the pond, usually expressed in surface acres, is a primary determining factor for the amount of natural food and diverse habitat that a pond can provide. The larger the pond, the greater the amount of food and potential habitat provided. Combinations of fish are recommended for ponds larger than one surface acre since larger ponds have the potential to produce more natural food and diverse habitat. Provision of habitat is important to prevent competition among species that have similar nesting behavior and spawning times. Most small recreational fishing ponds either contain a single principal species or a limited number of targeted fish species; and pond size is a major influence for either recommendation.

region is the combination of black bass (largemouth bass) with lesser sunfish (i.e. red-ear and/or bluegill). In this combination the red-ear and bluegill are the forage (feed) fish for the bass, but all three species provide good fishing. The bass feed primarily on juvenile sunfish.

The most common bass/lesser sunfish stocking program recommends the bass/bluegill combination. However, a cited disadvantage is overpopulation of the bluegill leading to stunting of both the bluegill and the bass. This is usually caused by a combination of large spawns of the bluegill, fishing only for bass, and inadequate aquatic weed control. A major stocking recommendation used in California is to switch to a bass/red-ear sunfish combination, or a bass and red-ear/bluegill sunfish combination. Red-ear sunfish produce fewer eggs and do not tend to overpopulate and exhibit stunted. An additional advantage is the red-ear's preference for snails as a food which helps control this molluscan intermediate host for many parasitic fish infections.

The long-term success of a sustained fishery using a bass/lesser sunfish combination depends on a pond with a high natural productivity that provides food for the black bass and other sunfish. In general, this stocking program is not recommended for ponds of less than one surface acre, as smaller ponds usually do not produce enough natural food or habitat to sustain the fishery.

Feeding of manufactured fish rations is not recommended for bass and lesser sunfish stocking programs. Young black bass trained to take pelletized rations in a hatchery will switch to natural food in a pond or lake. However, other sunfish like the bluegill will feed on the pelletized ration. Feeding bluegill in a pond improves their ability to reproduce, and more often leads to overpopulation and eventual stunted growth. Uneaten rations add nutrients to the pond that can result in aquatic weed control problems.

Ponds larger than one surface acre, preferably five acres or larger, can sustain additional species to the bass/lesser sunfish combination. A good recommendation for a third species is the channel catfish. The channel catfish and the bass have feeding and nesting behaviors that do not result in intense competition. Other popular species often requested for recreational ponds are the white and black crappie. However, combining crappie with bass in ponds less than 20 to 25 surface acres is not recommended, as it leads to competition for resources such as nesting areas and feeding habitat. Bass and crappie have similar requirements causing the fish to compete for limited resources in smaller ponds. Larger ponds provide enough habitat and other resources for species with similar spawning and feeding behavior.

***Bass-Minnow Combination*:** Some pond owners have adopted a bass/minnow combination as a single species fishery. This technique avoids pond management problems often associated with bass/lesser sunfish combinations and is compatible with ponds less than one surface acre in size. A minnow (usually the fathead minnow) serves as the forage fish for the bass. Minnows usually reproduce in warm water ponds, but additional stockings may be necessary if adequate reproductive environment for the minnow is not provided.

***Channel Catfish*:** Channel catfish are an excellent choice for ponds of all sizes. Because channel catfish readily accept pelletized rations, a catfish fishery can be sustained in ponds that are too small to support a fish population on food derived from natural productivity. If the pond is large enough, a fishery can be sustained without supplementary feeding as channel catfish feed readily on food produced through natural productivity. A major advantage, besides the catfish's excellent flavor, is that the population of fish in the pond can be increased far beyond natural production by employing a feeding program using fish rations. However, feeding fish rations are not recommended if lesser sunfish are present.

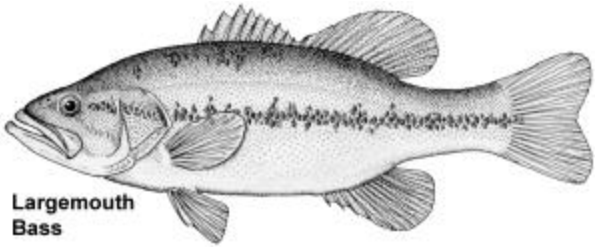
Channel catfish are available for stocking from sources throughout California. If the targeted pond has a water temperature profile that meets the reproductive requirements of the catfish, then restocking the pond may not be necessary. Pond owners can enhance nesting sites and the natural food source to improve reproduction by providing artificial "caves" (spawning cans) and fathead minnows as a source of extra nutrition. If reproduction does not occur, a source of inexpensive 2 to 4 inch fingerlings can be obtained from the industry.

If stocked at recommended densities, there are no population management problems associated with channel catfish culture. Feeding and maintenance protocols are readily available. Surprisingly, the channel catfish is also a good sport fish and will frequently take a surface fly (Tie it with brown wool, the size of a #12 fish pellet).

***Rainbow Trout*:** The rainbow trout is the common choice of cold water pond owners. Like channel catfish, rainbow trout readily accept pelletized rations and can be maintained in the smallest of cold water ponds. If the pond is large enough to support a natural food source, then feeding rations is not necessary. Rainbow trout are readily available from commercial hatcheries throughout the state and easily adapt to cold water ponds. It is not recommended, however, that rainbow trout be stocked with other species in smaller recreational ponds.

Species Profiles

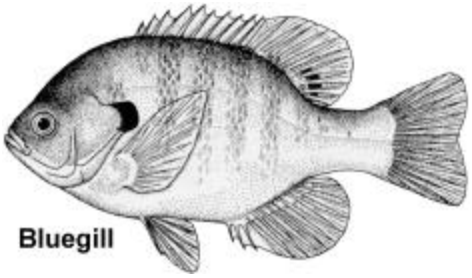
***Recommended Warm Water Fish*:** The warm water fish recommended for recreational fish ponds include the sunfish (Centrarchids), channel catfish, and a few minnows. Scientific names are presented so the reader has the option to consult additional literature and to avoid confusion using common names. All of the species listed in the Species Profiles were introduced to California and are not native species. Before stocking any fish in a recreational pond, you must (by law) call your Regional Office of the California Department of Fish & Game for recreational pond stocking regulations in your area.



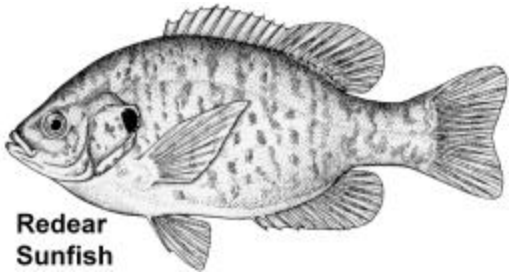
Largemouth Bass: *Micropterus salmoides*
Largemouth bass are also referred to as black bass. It is a primary targeted sports fish. Distinguishing characters that separate it from the smallmouth bass (*M. dolomieu*) include a dorsal fin that is almost completely divided, and a maxillary bone of the mouth that extends beyond the posterior margin of the eye. Largemouth bass growth rates vary with pond condition, fish density, and fisheries management practices. Certain strains of largemouth bass (Florida strain) may be available from some hatcheries. Genetic characteristics for the Florida strain of largemouth bass are reported to include faster growth rates and longer life span.

Average lengths for black bass may vary from 2 to 7 inches in their first year, and frequently reach 9 to 10 inches by their third year. Largemouth bass mature in 1 to 2 years and usually spawn in spring when water temperatures reach 60° F or above. Bass nest in the shallow margins of a pond. The nests are depressions constructed from gravel, roots, and/or aquatic vegetation. The fry hatch from the egg masses in about 5 days at temperatures around 66° F. Higher temperatures accelerate egg development and fry can hatch in 2 days at 72° F.

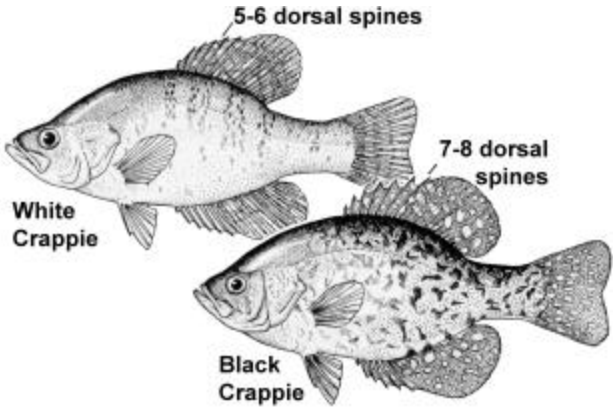
Smallmouth bass are not available through commercial hatcheries in California, but do exist in numerous ponds and lakes throughout the state. However, it is illegal to transfer wild fish from one location to another. Wild fish are under the jurisdiction of state and federal regulatory agencies, and the illegal stocking of wild fish can result in a severe fine.



Bluegill: *Lepomis macrochirus* Bluegill are usually considered a secondary sports fish and serve as a forage fish for black bass. They are distinguished from other lesser sunfish by their dark blue-black gill covers (operculum). Bluegill growth varies with pond condition, fish density, and available resources. Some reports show growth in excess of 6 inches in their first year if conditions are optimal, but growth expectations are not this high in most situations. Adults in well managed ponds may reach 7 to 8 inches in their second and third year. Bluegill mature at 1 to 3 years, depending on pond conditions. They spawn later in the season than bass, when water temperatures reach the mid-seventies (° F). Bluegill spawn in shallow depression nests in the shallow margins of the pond and nests are constructed using sand, gravel, dead leaves, sticks, and mud. Eggs hatch in about 32 hours. If good pond management practices are used, the early summer spawn can reach 3 inches by late fall, 5 inches by the end of the second year, and 7 inches by end of the third year.

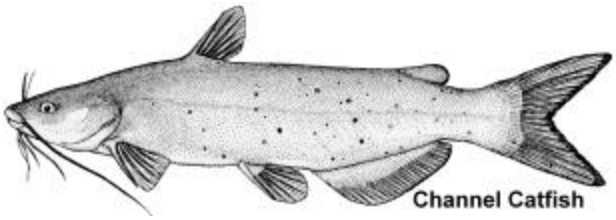


Red-ear Sunfish: *Lepomis microlophus* Red-ear are considered a secondary sports fish and, like the bluegill, also serve as a forage fish for black bass. They are identified by the red color on the posterior margin of the operculum. Red-ear have similar growth rates to bluegill and have been reported to grow in excess of 5 to 6 inches in their first year if conditions are favorable. Adults have reached 8 to 9 inches in older, well-managed ponds. Red-ear spawns are smaller than bluegill, and red-ear spawn when pond temperatures reach 75° F. Spawning may occur in the spring and fall. Red-ear nests are similar to a bluegill and may be in groups of several hundred 2 to 10 inch depressions in the pond margins. Another common name used for the red-ear is the "shell cracker"; named for its habit of feeding on snails. Red-ear are valued because they reach a comparable size to bluegill, spawn fewer eggs, create less of a problem in population management, and consume snails that serve as intermediate hosts for fish parasites. They are also recommended as a biological control of snails which harbor parasitic larval forms that cause "swimmers itch" in humans.

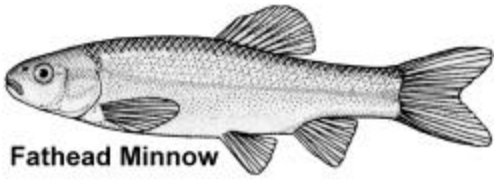


Crappie: (Genus *Pomoxis)* The Black Crappie, *Pomoxis nigromaculatus*, and the White Crappie, *P. annularis*, are considered primary sport fish and are the largest of the “pan fish”. They have similar feeding habits as black bass and often reach 12 to 14 inches in length. Both the black and white crappie mature in 2 to 3 years from hatch at 7 to 8 inches in length. The crappie have similar nesting habits as that of black bass and this may result in competition for limited resources in smaller bodies of water. Crappie spawn from March through July, black crappie at water temperatures between 58 and 64° F, and white crappie between 64 and 68° F.

In general, crappie do poorly in ponds, smaller bodies of water with fluctuating depths, and in higher elevation lakes. Both black and white crappie do poorly in highly turbid water, but the white croppie has a higher tolerance for turbid water conditions.



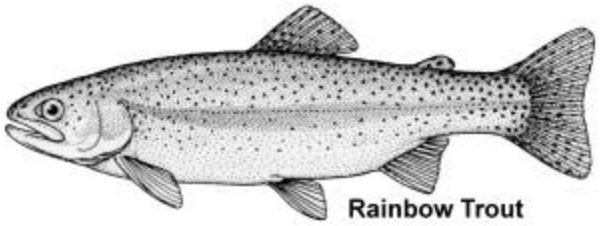
Channel Catfish: *Ictalurus punctatus* The channel catfish is distinguished from other catfish by its short base and rounded anal fin that possesses 24 to 29 fin rays. The tail is deeply forked and the chin barbels are usually dark. The wild, adult, channel catfish body color ranges from olive green to steel blue, with dark spots appearing over the body. However, hatchery-produced animals may be dark blue-black in color. Channel catfish begin reproduction and spawning when spring water temperatures reach above 72° F. Reproductive activity may continue into the summer. After the female spawns, the male fertilizes and aggressively guards the egg mass. Channel catfish are prized for their meat, have the advantage of thriving in small ponds receiving prepared rations, and do well in larger ponds with other species. The channel catfish growth rate is rapid, but actual growth rate will depend on the stocking density and water temperature. Most rapid growth occurs at about 84° F.



Fathead Minnow: *Pimephales promelas* The fathead minnow is used as a forage fish for black bass in recreational ponds. This fish reaches a total length of about 4 inches, is thin-bodied, and has a wide blunt head. The first fin ray on the dorsal fin is unbranched and separated by a

membrane. The dorsal and anal fins have 8 and 7 fin rays respectively. Fathead minnows are readily available from commercial hatcheries, but have warm water fish spawning characteristics and may reproduce naturally in the pond.

***Recommended Cold Water Fish*:** Rainbow Trout: *Oncorhynchus mykiss* is the only recommended cold water fish. Other trout are sometimes available, including the brown trout (*Salmo trutta*) and the brook trout (*Salvelinus fontinalis*). If other cold water fish are available, they should not be stocked in a recreational pond without first consulting with your regional office of the California Department of Fish and Game.


Rainbow Trout

Rainbow Trout: *Oncorhynchus mykiss* Rainbow trout may be recognized by the many irregular spots on the fish's back, sides, dorsal fin, and tail. Natural rainbow trout have a reddish-violet line on either side of the fish. However, hatchery fish often will be blue-black on its dorsal side and silvery in their lower portions. The fish may gain the "typical" coloration if they have access to more natural food. Hatchery fish are readily available throughout California and growth rates will depend on factors such as density, whether the fish are fed prepared rations, or have access to the natural productivity of the pond. Several strains of rainbow trout are available that show different growth rates, survival, and coloration. Most rapid growth occurs between 50 and 65° F. Rainbow trout are often stocked as six inch fingerlings and may average ½ pound at the end of the first year of pond life. Rainbow trout reproduction seldom occurs in a recreational pond, but it may occur if resources exist such as described earlier in this publication.

Illustrations: Illustrations taken from Freshwater Fishes of California by Samuel McGinnis (1984), with permission of University of California Press.

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