RECREATIONAL PONDS AND LAKES

POND ECOLOGY

AQUATIC PLANTS & FISH

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AQUATIC PLANTS

POND HEALTH

Chemical Recycling

Oxygen Generation

Phytoplankton

Macrophytes

AQUATIC PLANTS

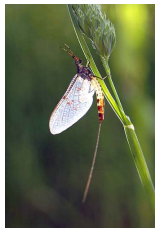
POND HEALTH

Source of Food

Phytoplankton - Zooplankton - Larval Fish

Provides Food for Invertebrate Fish Prey

Foundation of the Ponds Food Web



AQUATIC PLANTS

POND HEALTH

Habitat for Pond Life Forms

Provides Habitat for Food Invertebrates

Submerged Vegetation

Emergent Vegetation

Floating Vegetation

AQUATIC PLANTS

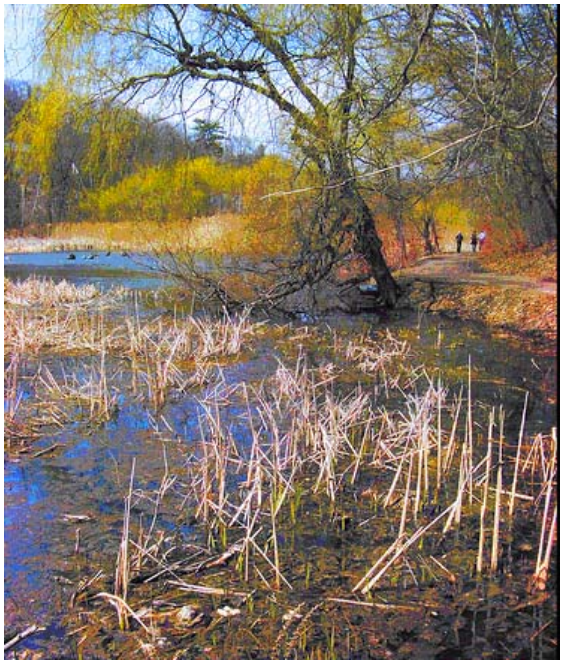
POND HEALTH

Habitat for Fish

- Protection from Larger Predators
- Ambush Site for taking Prey
- Detritus for Nest Building
- Attachment Substrate for Fish Spawn

AQUATIC PLANTS

POND HEALTH



Vegetation Imbalance

Plant Deficiency

- **Reduced Pond Productivity**
- **Reduced Oxygen Input**

Plant Overabundance

- **Prey Fish Become Over Abundant**

AQUATIC PLANTS

POND HEALTH

Vegetation Imbalance

Phytoplankton Overabundance

Shades out desirable macrophytes

Extreme fluctuations in dissolved oxygen

AQUATIC PLANTS

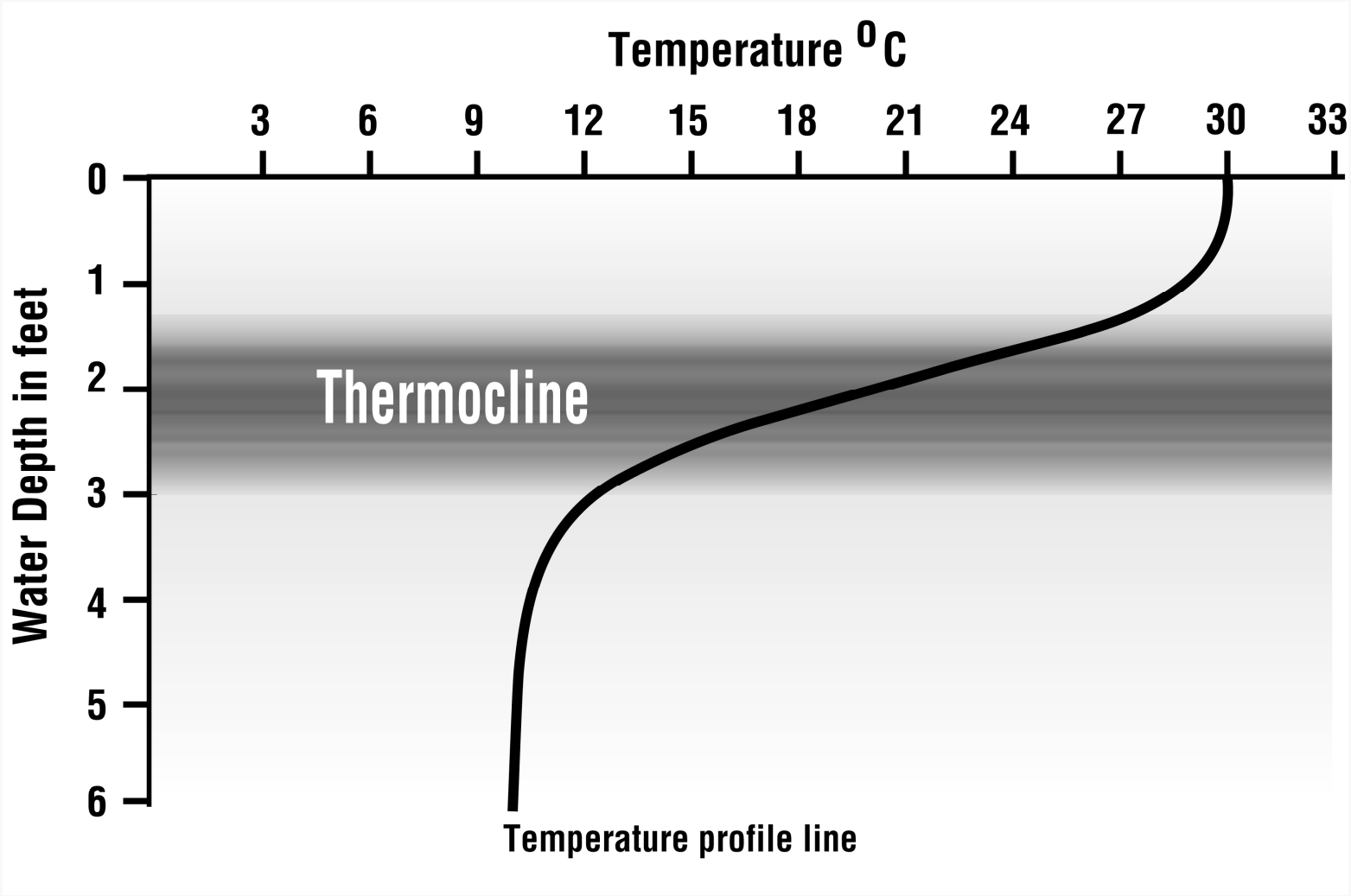
POND HEALTH

Natural Pond Turnover

Seasonal Turnover

Inclement Weather

Diurnal Temperature Change


Temperature °C
3
6
9
12
15
18
21
24
27
30
33
0
1
2
3
4
5
6
Water Depth in feet
Thermocline
Temperature profile line

AQUATIC PLANTS

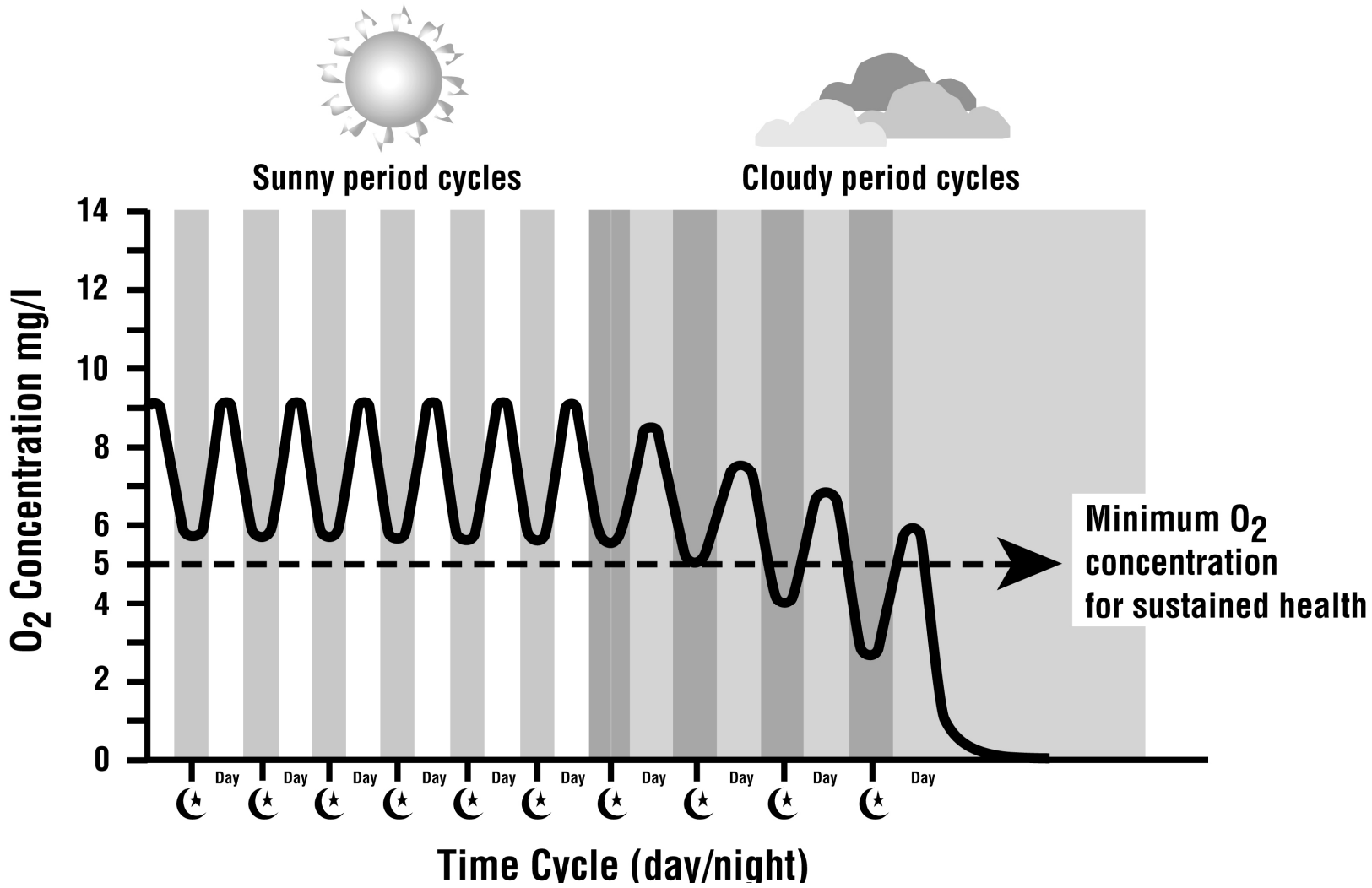
POND HEALTH

Phytoplankton Crash

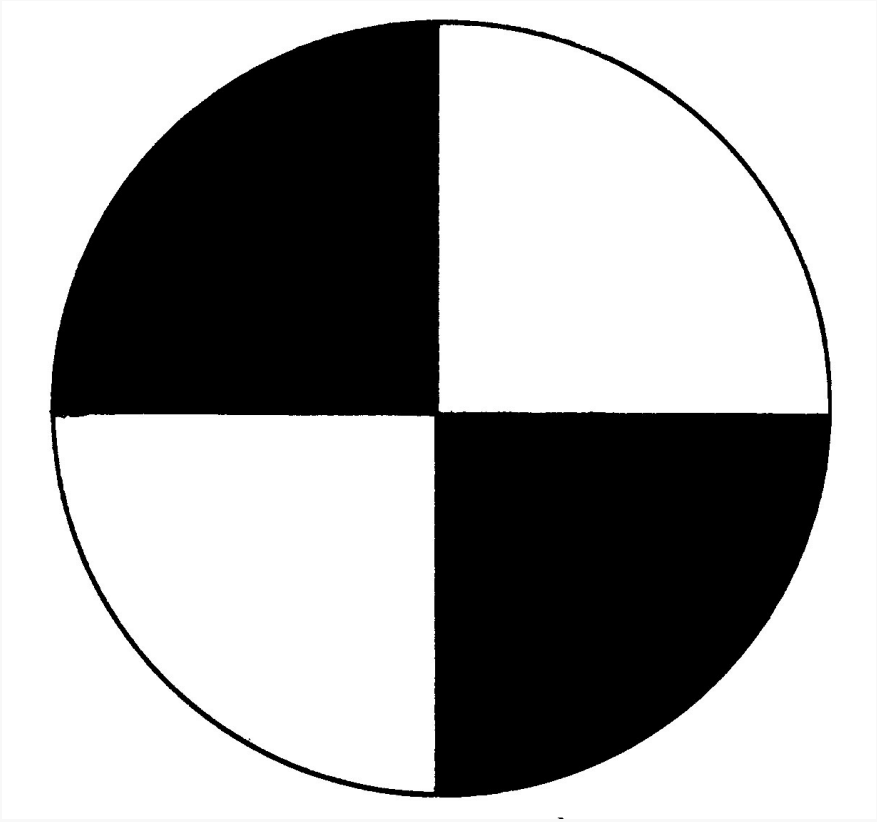
Vegetation Die-off

Nutrient Depletion

Sudden Temperature Drop


Sunny period cycles
Cloudy period cycles
14
12
10
8
6
5
4
2
0
O2 Concentration mg/l
Minimum O2 concentration for sustained health
Day
Day
Day
Day
Day
Day
Day
Day
Day
Day
Time Cycle (day/night)

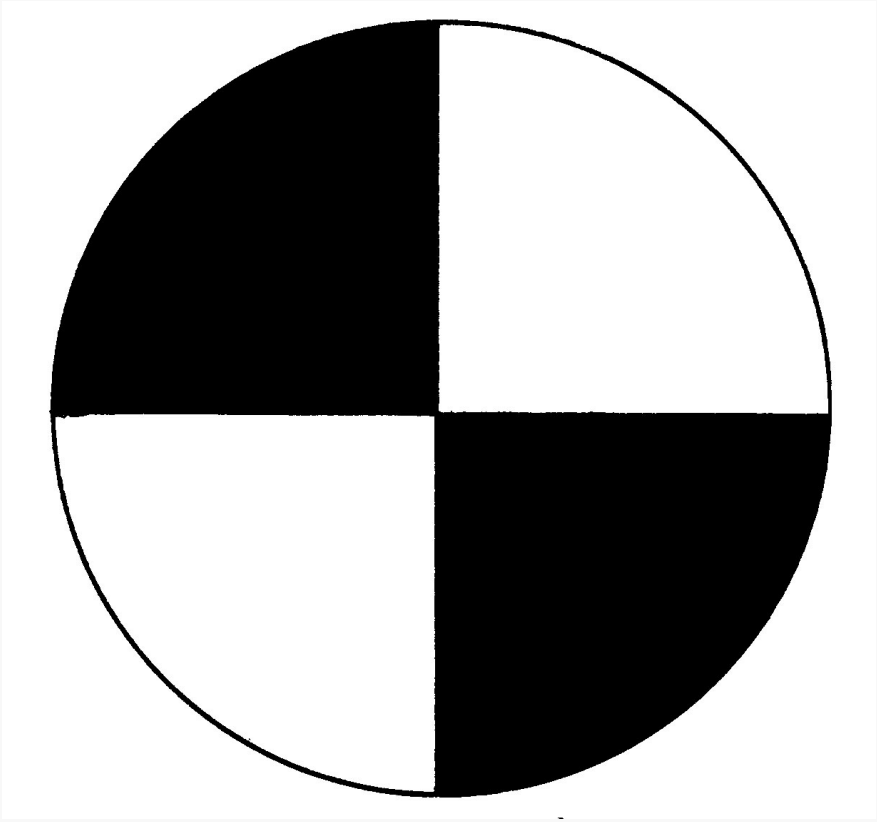
Secchi Disk Pattern



8”

SD Reading	Algal Bloom
> 24 inches	Inadequate
18 – 24 inches	Healthy
12 – 18 inches	Dense
6 – 12 inches	Excessive
< 6 inches	Critical

Secchi Disk Pattern



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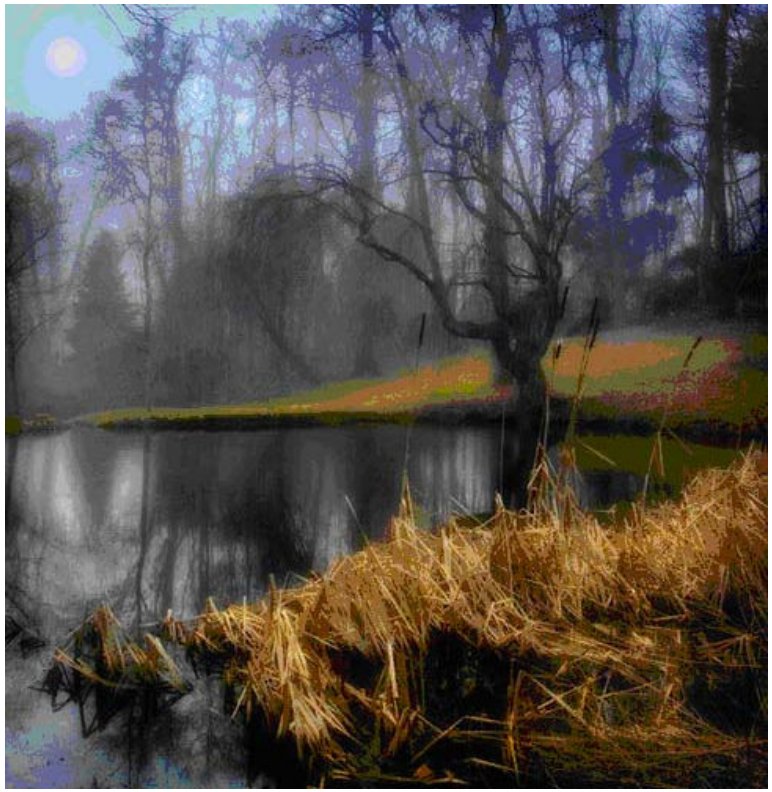
Summer Water Temperature Ranges Used To Classify Warm, Cool and Cold Water Ponds

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.

RECREATIONAL PONDS AND LAKES

Species - Stocking Strategies - Fisheries Management



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Common Fish Species Found in California Recreational Ponds and Lakes

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 Crappy	33-80° F	55-80° F	58-64° F
White Crappy	**	**	64-68° F
Bluegill Sunfish	36-93° F	60-80° F	67-80° F
Red-ear Sunfish	***	~ 75° F	72-75°F

* Temperatures are general ranges, individual genetic populations may vary.

** Similar to black crappie, white crappie are less tolerant to colder water.

*** Similar to bluegill, but less tolerate rapid temperature fluctuations.

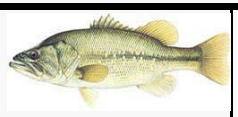
~ Approximately

General classification of relative pond fertility and carrying capacity of non-fed pond biomass expressed in pounds of fish per surface acre of pond

POND CONDITION		CARRYING CAPACITY (lbs. per Surface Acre)	
High Fertility		400	
Average Fertility		200	
Low Fertility		100	

Represents ponds receiving no supplemental feed. Smaller ponds of ¼- to ½-surface acre that receive supplemental feed can support a larger fish biomass of about 25 percent. This requires water exchange and attention to water quality and feeding protocol.

Stocking densities for largemouth bass, bluegill and red-ear sunfish in combinations – Based on relative pond fertility, with and without inclusion of channel catfish, and based on 1.0 surface acre of pond

POND FERTILITY	 BASS	 BLUEGILL	 RED EAR	 CHANNEL CATFISH
HIGH	150-200			300*
	150-200	1000	-	100
	150-200	700	300	100
AVERAGE	100-125			150*
	100-125	750	-	75
	100-125	525	225	75
LOW	75-100			75*
	75-100	500	-	50
	75-100	350	150	50

* Stocking protocols using bass and channel catfish without a suitable pan fish as forage should be supplemented with a forage minnow.

Traditional stocking strategy for a bass, bluegill, red-ear combination, with and without channel catfish

FISH	STOCKING PERIOD
Bluegill & Red-ear  	Spring through mid-November
Largemouth Bass 	Spring of the following year
Channel Catfish 	Anytime, preferably early spring

Western stocking strategy for bass, bluegill, red-ear, minnow combination stocked in same season, with and without channel catfish

FISH	STOCKING PERIOD
Minnows 	Early Spring
Bluegill & Red-ear 	One month after stocking minnows
Largemouth Bass 	One month following minnows
Channel Catfish 	One month following minnows, or before Fall

Combinations of densities for fingerling and adult largemouth bass stocked with fathead minnows, mosquitofish, or golden shiners based on relative pond fertility, and 1.0 surface acre of pond

POND FERTILITY	BASS 4" to 6"	BASS 8" to 10"	Minnows**
High	150 *	100 *	2000 *
	100	50	1500
Average	100 *	75 *	1000 *
	75	35	750
Low	75 *	50 *	1000 *
	50	25	750

* Higher recommendations are presented for areas where predation is a factor.

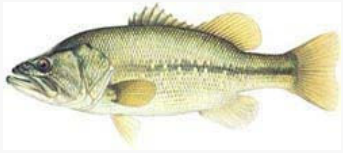
** Fathead minnows, mosquitofish, golden shiners.

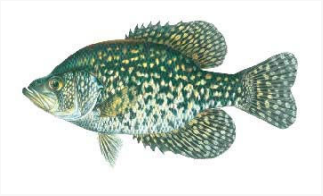
Western stocking strategy for Largemouth bass and minnows

FISH	STOCKING PERIOD
Largemouth Bass 	Spring, at the recommended stocking rates provided earlier
Minnows 	Spring, at the recommended stocking rates provided earlier

Stocking densities for combination of fingerling and adult largemouth bass and black crappie

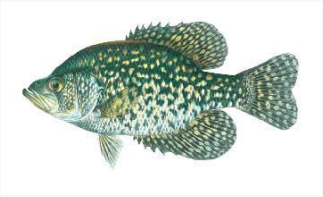
FISH	ALTERNATIVE STOCKING DENSITY AND PERIOD
Bass & Crappie	100, 4" to 6" fingerlings, May through September
	200, 4" to 5" fingerlings, May through September
Bass & Crappie	50, 8" to 10" juveniles, May through September
	25 adults, May through September





Stocking densities for combinations of fingerling and adult largemouth bass and black crappie based on average pond fertility and per 1.0 surface acre of pond

POND FERTILITY	BASS	CRAPPY*
Average	100 4 to 6-inch fingerlings	200 Fingerlings Any Size
Average	50 8 to 10-inch fingerlings	25 Adults



* Not recommended to stock crappy with bass in ponds less than 5-surface acres.

Rainbow Trout Pond Stocking Strategies

Spring Stocking With No Feeding

	RESULT
Stock 500 2 to 4-inch Fingerlings	7 to 8-inch (4 oz) in the First Year
Stock 250 2 to 4-inch Fingerlings	10-inch (8 oz) in the First Year

Spring Stocking With Feeding

	RESULT
Stock 2000 2 to 4-inch Fingerlings	1000 lbs of ½ lb Fish in First Year

Stocking rate of channel catfish in ponds of 1.0 to 10.0 surface acres based on nutrient input, feeding frequency, and incident of predation

	Number of 4 to 6-inch Fingerlings per Surface Acre	
NUTRIENT INPUT & FEED	**LOW PREDATION**	**SIGNIFICANT PREDATION**
No Fertilizer; No Feed	100 - 200	300 - 500
Fertilizer Only	200 - 400	300 - 500
Feed Once a Week	200 - 400	300 - 500
Feed 2-3 Times a Week	400 - 600	500 - 700
Feed Daily	600 - 1000	700 - 1000

Higher feeding rates should only be undertaken if the pond is under regular monitoring. Hot summer conditions and/or overfeeding can cause oxygen depletion

Largemouth Bass Fishing Protocols

Once a pond has been established and fish have spawned once, fish the pond moderately or heavily to maintain a good population balance

Start fishing bass in the third year in early June

Return all bass under 10-inches

Fish bluegill heavily and remove 3-4 pounds of bluegill for every pound of bass removed

Usually, removing 25 to 35 pounds of fish per year leads to a well-balanced pond

Assessing Condition of Bass and Lesser Sunfish

EXAMINATION OF CATCH

BALANCED	**Bluegill average 6-inches; Bass average weight 1 to 2 pounds**
BLUEGILL UP	**Bluegill average 3 to 5-inches; Bass few and weigh 2-pounds or more**
BASS UP	**Bluegill are ½ pound or larger; Bass average less than 1-pound**

SHORELINE SEINING IN MID-SUMMER

Balance: Presence of young bass and bluegill

Imbalance: Presence of many intermediate-sized bass; 3” to 5”

Rainbow Trout Supplementary Feeding

Feed according to dealer recommendations; about 3% of estimated body weight

Below 55 F	**No Feeding**
55 to 65 F	**Feed about 3% of body weight**
Above 65 F	**No Feeding**

In cooler weather, go to afternoon feeding during warmer portion of day

Do not fertilize a pond receiving rations

Trout fingerlings do best with split feedings, feed twice a day

Rainbow Trout Fishing Protocol

Using good management and no supplementary feed, the pond usually reaches carrying capacity in one year

Unless fished moderately or hard, there will be little growth the second year

Start fishing when fish are 6 to 8-inches in length

Early in the second year, trout should be between 12 and 14-inches and weigh about 1-pound

Rainbow Trout Restocking Strategy

Ponds stocked in the fall will have many small but usable fish the first year

Fish lightly and you will have many 1 ¾ to 2-lb fish in the first year

After 2-lbs, growth may be slower and mortalities may increase

Spawning seldom occurs in ponds unless there is a stream containing a riffle area entering the pond

Fish hard and restock with 4 to 5-inch fingerlings every two years

Fish lightly and go with less frequent restocking

References and Selected Readings

Conte, F.S. J.S. Cubbage. 2001. Phytoplankton and pond culture. Western Regional Aquaculture Center, WRAC -105. 6 pp.

Conte, F.S., J.B. Waldvogel and T. Vaught. 2001. Fish stocking strategies for largmouth bass in recreational ponds and lakes. U.C. Davis, Animal Science Aquaculture, ASAQ-C14. 10 pp

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Conte, F.S. 2000. Pond fertilization: Initiating an algal bloom. Western Regional Aquaculture Center, WRAC -104. 9 pp.

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