Appendix A. Common and Scientific Names of All Fish Species Used Throughout this Report Organized by Family from Less to More Derived Characters and Alphabetically Within Family by Common Name

Table A-1. Common and scientific names of all fish species used throughout the body of this report listed from the least to the most derived families.

Family	Common name	Scientific name
Petromyzontidae	Sea lamprey	*Petromyzon marinus*
Anguillidae	American eel	*Anguilla rostrata*
Clupeidae	Gizzard shad	*Dorosoma cepedianum*
Channidae	Koravai	*Channa* sp.
	Snakehead	*C. punctata*
Cyprinidae	Utah chub	*Gila atraria*
	Common carp	*Cyprinus carpio*
	Goldfish	*Carassius auratus*
	Grass carp	*Ctenopharyngodon idella*
	Loach minnow	*Tiaroga cobitis*
	Northern pikeminnow	*Ptychocheilus oregonensis*
	Punti	*Puntius* sp.
	Red shiner	*Cyprinella lutrensis*
	Rohu	*Labeo rohita*
	Silver barb	*Puntius gonionotus*
	Silver carp	*Hypopthalmichthyes molitrix*
	Spikedace	*Meda fulgida*
Catostomidae	Utah sucker	*Catostomus ardens*
	White sucker	*Catostomus c. commersonnii*
Ictaluridae	Channel catfish	*Ictalurus punctatus*
	Flathead catfish	*Pylodictus olivaris*
Esocidae	Chain pickerel	*Esox niger*
	Northern pike	*E. luscius*
Bagridae	Tengra	various
Clariidae	Walking catfish	*Clarias* sp.
Osmeridae	Rainbow smelt	*Osmerus mordax*
Galaxiidae	Black mudfish	*Neochanna diversus*

Table A-1. Continued

Family	Common name	Scientific name
Salmonidae	Brook trout	*Salvelinus fontinalis*
	Brown trout	*Salmo trutta*
	Lake trout	*Salvelinus namaycush*
	Rainbow or steelhead trout	*Oncorhynchus mykiss*
	Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*
Poeciliidae	Mosquitofish	*Gambusia affinis*
	Plague minnow	*G. holbrooki*
	Guppy	*Lebistes reticulatus*
	Gila topminnow	*Poeciliopsis occidentalis*
Sybranchidae	Cuchia	*Monopterus cuchia*
Moronidae	White perch	*Morone americana*
Centrarchidae	Bluegill	*Lepomis macrochirus*
	Green sunfish	*L. cyanellus*
	Largemouth bass	*Micropterus salmoides*
	Pumpkinseed	*Lepomis gibbosus*
	Rock bass	*Ambloplites rupestris*
Percidae	Yellow perch	*Perca flavescens*
	Walleye	*Stizostideon vitreum*
	Ruffe	*Gymnocephalus cernuus*
Nanidae	Nandus	*Nandus nandus*
Cichlidae	Tilapia	*Oreochromis niloticus*
Anabantidae	Climbing perch	*Anabas testudineus*

Appendix B. Life-history and Taxonomic Information for Native and Nonnative Fishes of Concern

Species-specific information on life history, habitat, biology and physicochemical tolerances are presented by life stage in separate tables (Tables B-1-B-12). In instances where the life-history information was reported without reference to a specific life stage, the information was placed into the adult category. These tables are not comprehensive. Also included is a summary of these data (Table B-13) and data obtained elsewhere that was used to develop a data matrix (Table B-14) analyzed by a series of one-way analyses of variance to determine differences in the species characteristics of native and nonnative fishes of concern in the Gila River basin.

Included in Appendix B–

Table B-1. Taxonomy of native and nonnative southwestern United States fishes of concern

Table B-2. Adult habitat preferences of native and nonnative fishes of concern

Table B-3. Characteristics of the biology of adult native and nonnative fishes of concern

Table B-4. Physicochemical needs for adult native and nonnative fishes of concern

Table B-5. Reproductive life history of native and nonnative fishes of concern

Table B-6. Habitat requirements for successful reproduction of adult native and nonnative fishes of concern

Table B-7. Habitat preferences and diet of juvenile native and nonnative fishes of concern

Table B-8. Physicochemical requirements of juvenile native and nonnative fishes of concern

Table B-9. Habitat preferences, size, and diet of larval native and nonnative fishes of concern

Table B-10. Physicochemical requirements of larval native and nonnative fishes of concern

Table B-11. Habitat requirements and characteristics of embryos of native and nonnative fishes of concern

Table B-12. Embryo physicochemical criteria

Table B-13. Raw data, both summarized from Tables B-1 to B-12 and collected from other sources, used to develop data matrix that was used to evaluate differences between native and nonnative fishes of concern

Table B-14. Data matrix developed from Table B-13 that was used to conduct one-way analyses of variance to determine how native fishes of concern in the Gila River basin differ from those nonnative fishes of concern

List of references. References used to collect life-history information for native and nonnative fishes of concern in Arizona are in the above tables.

Table B-1. Taxonomy of native and nonnative southwestern United States fishes of concern.

Common name	Genus	Species	Order	Family
		Native		
Loach minnow	*Tiaroga*	*cobitis*	Cypriniformes	Cyprinidae
Spikedace	*Meda*	*fulgida*	Cypriniformes	Cyprinidae
Roundtail chub	*Gila*	*robusta*	Cypriniformes	Cyprinidae
Headwater chub	*Gila*	*nigra*	Cypriniformes	Cyprinidae
Gila chub	*Gila*	*intermedia*	Cypriniformes	Cyprinidae
Longfin dace	*Agosia*	*chrysogaster*	Cypriniformes	Cyprinidae
Speckled dace	*Rhinichthys*	*osculus*	Cypriniformes	Cyprinidae
Sonora sucker	*Catostomus*	*insignis*	Cypriniformes	Catostomidae
Desert sucker	*Catostomus*	*clarki*	Cypriniformes	Catostomidae
Razorback sucker	*Xyrauchen*	*texanus*	Cypriniformes	Catostomidae
Gila topminnow	*Poeciliopsis*	*occidentalis*	Cyprinodontiformes	Poeciliidae
Desert pupfish	*Cyprinodon*	*macularius*	Cyprinodontiformes	Cyprinodontidae
		Nonnative		
Channel catfish	*Ictalurus*	*punctatus*	Siluriformes	Ictaluridae
Flathead catfish	*Pylodictis*	*olivaris*	Siluriformes	Ictaluridae
Black bullhead	*Ameiurus*	*melas*	Siluriformes	Ictaluridae
Yellow bullhead	*Ameiurus*	*natalis*	Siluriformes	Ictaluridae
Smallmouth bass	*Micropterus*	*dolomieu*	Perciformes	Centrarchidae
Largemouth bass	*Micropterus*	*salmoides*	Perciformes	Centrarchidae
Green sunfish	*Lepomis*	*cyanellus*	Perciformes	Centrarchidae
Bluegill	*Lepomis*	*macrochirus*	Perciformes	Centrarchidae
Redear sunfish	*Lepomis*	*microlophus*	Perciformes	Centrarchidae
Mosquitofish	*Gambusia*	*affinis*	Cyprinodontiformes	Poeciliidae
Red shiner	*Cyprinella*	*lutrensis*	Cypriniformes	Cyprinidae
Common carp	*Cyprinus*	*carpio*	Cypriniformes	Cyprinidae

Table B-2. Adult habitat preferences of native and nonnative fishes of concern. Numbers in parentheses are references (which can be found at the end of the tables).

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Water body type[b]	Substrate type[c]	Elevation (m)
Loach minnow	lotic (1)	littoral, <0.3 (3), 0.1-0.25 for all life stages (24)	B, 2 (3)	1,2 (1)	1 (1), seasonally associated with filamentous algae (24)	up to ~2,513 (1)
Spikedace	lotic (1)	0.04-0.3, prefer 0.15-0.18, <0.168 in winter (3), 0.2 (11), <1 (31)	B, 3,4 in winter (3), P, 1,5,6 (1), 2 (24)	2 low-moderate gradient (1), low-moderate gradient <1% up to 1.4 m^3/sec (3)	1,2,3 (3)	494-1,373 (1)
Roundtail chub[d]	lotic/lentic (3)	<2 (1), littoral, up to 3.1, prefer deep pools (3), 2+ (24), 0.9-3.1 (21)	1,2,5 (3)	1,2,4 (1), low gradient, up to 1.4 m^3/sec mean annual flow (3)	1,2 (3)	369-2,202, most common between 610 and 1,525 (1), 310-1,830 (3)
Gila chub	lotic (1)	deep pools (3)	1,4 (1)	5,6,7 (1), 4 (24)	3 (1)	830-1,653 (1)
Longfin dace	lotic (1)	<0.3 (3)	B/P (3)	2 usually small (1), coastal streams to headwaters (30), low gradient, up to 1.4 m^3/sec mean annual flow (3)	1,2 (3)	415-2,056, generally <1,500 (1), sea level to 2,300, rarely abundant over 1,500 (30)
Speckled dace	lotic (1)	< 0.5 (1), 0.12-0.16 (3), 0.2-1.5 (17)	1 in headwater creeks, 2,5,6 rarely in lakes (1), B/P 3 (3), 4 during day (17)	1 rarely in 3,6, low-high gradient, up to 1.4 m^3/sec (3)	1,2,3,4 (3)	473-3,000, rarely below 1,500, now only above 1,830 (1), 1,800-2,100 in Arizona (3)
Sonora sucker	lotic/lentic (3)	littoral, <0.3 (3)	B, 1 (3)	1,2 intolerant of lake conditions, low gradient, up to 1.4 m^3/sec mean annual flow (1)	1,2 (3)	369-2,663 (1)
Desert sucker	lotic (1)	<0.3 (3)	B (1), 1,2 (3)	1,2 (1), low gradient, up to 1.4 m^3/sec mean annual flow (3)	1,2,4 (1)	146-2,696 (1)

Table B-2. Continued

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Water body type[b]	Substrate type[c]	Elevation (m)
Razorback sucker	lotic/lentic (3)	littoral, limnetic, 1.2-3, 15 in reservoirs (3), 1.5-2.7 (21), 0.3-3.4, use shallow 0.9-0.99 in May and June and 1.6-2.16 in other months (38)	B, 1,3,5,6 (3), 3,4 flooded areas in spring (38)	1,2,3,4 (3)	1,2,4 (1), sand and gravel not used (21)	55-1,525 (1)
Gila topminnow	lotic (1)	shallow (24)	P, 3 (1), 4, below riffles (3), 7 (36)	6,7 (1), 1,2 (3), 5 (36)	3 (1)	403-2,291, most <1,525 (1)
Desert pupfish	lotic (1)	shallow (1)		2,5,7 (1)	4 (1)	366-<1,500 (1)
Channel catfish	lotic/lentic (2,3)	littoral/limnetic (2), 0.3-7.6 (3), up to 15 (4)	B (2,6), 1 day, 2 night (2)	1,2,3,4 (2,3), low-moderate gradient, 28-140 m^3/sec (3)	1,4 (2)	up to 1,829 (3)
Flathead catfish	lotic/lentic (4)	deep pools (3)	B/P, 1 day, 2 night (6)	1,3,4 (4,6), low moderate gradient (4)		
Black bullhead		littoral, 0.3-1.5 (3), up to 10 (4)	1,2,3,7 (2,3,6)	2,3,4 (2,6), low gradient (2)	1,2,3,4 (2)	
Yellow bullhead	lotic/lentic (3)	0.5-1.2 (2)	1,3 (4,6)	1,2,3,4 (3,4,6)		
Smallmouth bass	lotic/lentic (3)	littoral/limnetic <0.3-1.5, up to 12 (3), deeper pools in the day and move into shallows at dawn and dusk (2)	P, 1,2,7 (3), near riffles but out of current (6), epilimnion (2)	primarily 2 (7), 1,3,4 (3), in lakes use cooler nonvegetated areas <12 m deep (3), moderate-high gradient (9), low-moderate gradient (3)	1,2,3 (3)	
Largemouth bass	lotic/lentic (3)	littoral/limnetic (3), up to 7 (4)	P, 1,3 (3,4)	1,2,3,4,5 (2,4), low gradient (3)	1,2,3,4 (2)	
Green sunfish	lotic/lentic (3)	littoral/limnetic (3), usually <1.5 (2)	P, 1,3 (3)	1,2,3,4 low gradient (2)		

Table B-2. Continued

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Water body type[b]	Substrate type[c]	Elevation (m)
Bluegill	lotic/lentic (3)	littoral at dawn/dusk, limnetic during day (2,6), up to 7.6 (3)	B/P (4), P (3), 1,3 (2)	1,2,3,4,5 (2,3,4,6,7), low gradient, large and medium streams 1.4-140 m^3/sec (3)	1,2,3,4 (2,3)	
Redear sunfish	lotic/lentic (7)	littoral (9)	B (4), 3,7 (6), 1 (7)	1,2,3,4 (7)	2,4 (4), 3 (6)	
Mosquitofish	lotic/lentic (3)	littoral/limnetic up to 3 (3)	1,3,4,7 (4,5,7,9), B/P (4), P (6)	1,2,3,4,5 (3,4,5,7,9), low gradient, <0.14->140 m^3/sec mean annual flow (3)	3 (4,5,9)	310-2,440, larvae 2,130-2,440 (3)
Red shiner	lotic/lentic (3)	littoral, <0.3 (3)	P (2), B/P (6), 1,3,7 (9), 2 (6)	1,2,3 (2)	1,2,4 (2)	
Common carp	lotic/lentic (2)	primarily littoral, up to 30.5 (3), move into shallows in afternoon/evening (2)	B/P (3,4), 1,4 (6)	1,2,3,4 (2,6), 5 (3), large streams-rivers 28-140 m^3/sec, low-moderate gradient (3)	1,2,3,4 (2)	310-2,130 (3)

[a]B = benthic, P = pelagic, 1 = pool, 2 = riffle, 3 = backwater, 4 = stream margins, 5 = run, 6 = eddy, 7 = slack water
[b]1 = river, 2 = stream, 3 = lake, 4 = reservoir, 5 = marsh, 6 = headwaters, 7 = springs
[c]1 = rock, 2 = sand, 3 = vegetation, 4 = silt/soft
[d]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*

Table B-3. Characteristics of the biology of adult native and nonnative fishes of concern. Numbers in parentheses are references (which can be found at the end of tables).

Common name	Size of mature fish[a] (cm)	Age at maturity (years)	Life span (years)	Feeding trait[b]	Prey items[c]	Migratory
Loach minnow	3.8-<8 (15), rarely exceed 6 (24)	2 (1), 1 (24)	4 (1), few live more than 2 (24)	2 (1)	3 (1)	
Spikedace	<7.5 (1), 4 (12), 4 at 1 year (31)	1 (1), 2 (3)	2 (12), many live only 13 months (24), 1-2 (31)	2 (1), diurnal (31)	1,3,4 (1), primarily 3 (11)	
Roundtail chub[c]	25-30, size that individuals frequently attain (1)	2 males, 3 females (24)	20+ (24)	2 (1)	1,3,4,5 (1), 6,7 (24)	
Gila chub	>7.5 (34), females grow to 25, males seldom reach 15 (1), 15 typically (24)	2-3 (1), 1-3 most at 2-3 (34)	3 (3)	6 (1), crepuscular feeders (24)	1,3,4 (1), 5 (3),	
Longfin dace	rarely exceeds 6.5 SL[d] (1), 4.2 SL (30)	1 (30)		6 (1), diurnal feeder (30)	3,5,6 (1), primarily 6 (3)	
Speckled dace	rarely >7.6 (1)	2 females (45)		6 (1), 2 (3)	3,5,7 (1), primarily benthic insects, 3,5,6 (3)	
Sonora sucker	80 maximum (1)			6 (1)	3,5, aufwuchs (1), 6,7 (3)	some move into tributaries to spawn (1)
Desert sucker	10-28 SL (1)			5 (1)	5,6, aufwuchs (1)	

Table B-3. Continued

Common name	Size of mature fish[a] (cm)	Age at maturity (years)	Life span (years)	Feeding trait[b]	Prey items[c]	Migratory
Razorback sucker	100 maximum (1), 40 (38), 50 males and 54 females (40)	4 (1)	40+ (1)	6 (1)	3,5,6 (1), 7 (3)	some migrate long distances to spawning grounds (38)
Gila topminnow	adult size: males ~2.5 SL, females 3.0-4.5 SL (1)	a few weeks to several months (1)	1 (1)	6 (1)	3,5,6,7 (1)	
Desert pupfish	1.5-7.5 (35)	6 weeks if conditions are favorable (1), most during second summer (35)	seldom >1 (1)	6 (1)	3,4,5,6,7 (1)	
Channel catfish	33.7 (42)	4-5 (6), 2-3 in southern extent of range (2)	few >8 (2), usually 6-7 (6)	6 (2,3,4,6)	all (2,3,4,6)	yes, move upstream in spring (2)
Flathead catfish	46 (2,6)	4-5 (2,6)	20 maximum (4)	1 (2,3,6)	1,2 (2,3,6), 3 (4)	
Black bullhead	11 (42), 16 (43)	2-4 (2)	10 (4)	6 (2), largely nocturnal (2,4)	3,4,5,6,7 (2,4)	
Yellow bullhead	23 (42)	3 (2)	6,7 (42)	6 (2), 1 primarily (3)	all (2,3)	
Smallmouth bass	24.3-29 (6), 26-36 (2)	3-4 (2)	10-12 (6)	1 (2)	1,2,3,4 (2)	largely non-migratory (2), migrate up tributaries to spawn (8)
Largemouth bass	25-30 (2)	3-4 (2)	13 (42)	1 (2,4,6)	1,2,3 (2,4,6)	
Green sunfish	7.6 (2)	2 (7), as early as 16 weeks in the lab (2)	5 (4)	6 (2)	1,2,3,4,5,7 (2)	yes, up tributaries in spring (2)

Table B-3. Continued

Common name	Size of mature fish[a] (cm)	Age at maturity (years)	Life span (years)	Feeding trait[b]	Prey items[c]	Migratory
Bluegill	16 (42)	first summer in southern extent of range, 2 to 3 in northern extent of range (2)	11 maximum (4)	6 (2,3,4,6)	3,4,5,6,7 (2,3,4,6)	yes, to warm water in spring (2)
Redear sunfish	13 (42)	2 (6)	5 (7)	4 (6)	3, primarily snails (6)	
Mosquitofish	males 1.9-3.8, females 3.2-5.7 (10)	3 months (6)	3 (4)	6 (4,5,6)	1,3,5,6 (4,5,6)	no (4)
Red shiner	2.4-7.5 SL (5), >4 (2)	males 2, females 3 (6), 1(7)	3 (6), 2.5 (43)	6 (2)	3,5,7 (2)	
Common carp	28 age 2 to 36 age 3 (6)	males 2, females 3 (2)	9-15 (2)	6 (2,3)	3 primarily, 5,6,7 (2,6)	not highly migratory (6), not migratory (4), yes in lakes (3)

[a]Total length
[b]1 = piscivore, 2 = insectivore, 3 = zooplanktivore, 4 = molluscivore, 5 = herbivore, 6 = omnivore
[c]1 = fish, 2 = crayfish, 3 = aquatic inverts, 4 = terrestrial inverts, 5 = algae, 6 = detritus, 7 = vegetation
[d]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*
[e]SL = standard length

Table B-4. Physicochemical needs for adult native and nonnative fishes of concern. Numbers in parentheses are references (which can be found at the end of the tables).

Common name	Dissolved oxygen (DO; mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	pH	Total dissolved solids (ppm)	Turbidity tolerance	Comments
Loach minnow		>34 lethal (23)	0.24-0.79 (3), average 0.573 (24)					tolerates changing water conditions and competition with exotic fishes better than most native cyprinids (3), has a reduced air bladder that allows them to exist in high velocity habitats with minimal energy expenditure (3)
Spikedace		>34 lethal (23)	<0.95 (3), mean 0.3 (11)				found in clear streams (3)	abundance at any one site is extremely variable from year to year (1)
Roundtail chub[a]		CTM[b] 30.5-39.5, minimum <1-7.7, (3), >34 lethal (23)	typically <0.2 (24), 0-0.96 (21)					adults occupy pools <2 m deep that are adjacent to swifter riffles and runs (1)
Gila chub		>34 lethal (23)	sluggish (1)					
Speckled dace	highly tolerant to supersaturated water (3), 1.1-1.5, LD_{50}[c] 1.4 (27)	<15 cold >27 warm, prefer 15.8, CTM 30.5-36.8 (3)	fast, strong, 0.4 (3)					does not fair well in the presence of nonnative predatory fish, not in danger of extinction (1)
Longfin dace	0.6-1.3, LD_{50} 1.0 (27)	>34 (23)	0.15-0.35 (3)				clear water (3)	remarkable ability to disperse into new habitats, appearing a few hours or days after flow reestablishes in formerly dry stream channels; can survive in small volumes of water beneath mats of filamentous algae, then

Table B-4. Continued

Common name	Dissolved oxygen (DO; mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	pH	Total dissolved solids (ppm)	Turbidity tolerance	Comments
								reproduce a few days after summer rains rejuvenate stream; found in intermittent low desert streams to cool high elevation streams (1)
Sonora sucker		warm water to trout streams (1), >34 lethal (23)	<0.3 (1)					found in warm rivers, trout streams, has an affinity for gravelly rocky pools, or at least deep quiet pools (1)
Desert sucker	comparatively low tolerance to reduced DO (1)	survive 32+, prefer 17.5 within modal bounds ranging from 10 to 21 (1), <15 cold >27 warm (3)	0.3-0.46 (3)					
Razorback sucker		>0-32, 22-25 optimum (1), avoid 8.0-14.7 and 27.4-31.6 (3), some mortality at 34+ (39)	0.3 (3), <0.3, preferred 0.15 (21), 0.03-0.3 in winter, 0.5 in summer (38)					predation is limiting factor in Lake Mohave (3)
Gila topminnow	2.2-11.0 (1)	0-37.8 (1), 37.2-38.4 CTM (28), typically found in >20 (24)	moderate current (1), slow (24)	tap sea water (1)	6.6-8.9 (1)			prefer shallow warm water with moderate current and dense vegetation (1), restricted to waters that do not freeze (3), more abundant after floods than mosquitofish (36)

Table B-4. Continued

Common name	Dissolved oxygen (DO; mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	pH	Total dissolved solids (ppm)	Turbidity tolerance	Comments
Desert pupfish	can survive low DO (3), 0.1-0.4, LD_{50} 0.2 (27)	35+ (1)		tolerate 3 times seawater (1)			associated with areas of clear water (1)	when breeding males are territorial and unintentionally guard eggs, in soft substrate males dig small pits in search of food and guard these pits (1), endangered (3)
Channel catfish	0.95-1.08 at 25-35°C lethal (2), 5-7 <5 low, >7 high (3)	10-32 (4), collected in 37.8 (2), 35 lethal when acclimated at 7.2 (3), prefer 21.1 (2)	<0.15-0.48 (3)	may enter brackish (5), <0.5-30 (3)	6-8 (4), <5 is strongly acidic (3)	<5,000 (3)	prefer clean, well oxygenated water (2,4), tolerate high turbidity, saprophilic[d], saprophobic[e] (3)	dH[f] 4-30 (4), alkalinity 30->200 (3), larvae survival is low in clear water (6)
Flathead catfish		optimum 31.5-33.5 (2)						
Black bullhead		lethal 35-39 (2,3), 18-29 optimal (3)	<0.04, <0.15 (3)		6.5-8.0 (4), 3.4, 5.0 acidic (3)	<5,000 (3)	more tolerant of turbidity, warm water, and agricultural, industrial, and domestic human-made organic chemicals than the other bullhead species (2)	dH 4-25 (4), largely nocturnal (2,4)
Yellow bullhead	0-0.3 winter (2)		gentle-fast (2), prefer calm (6)				prefer clear water (6)	
Smallmouth bass	0.96 at 21.1°C lethal (2), 5-7 moderate, <5 low (3)	10-30 (4), prefer 21.1-26.7 (2)	fast flowing (5)		avoid <6 (3)	<5,000, 100-350 optimal (3)	saprophobic, little tolerance for turbidity (3)	winter in larger, deeper waters with gradients of <1.3 m/km (8)

Table B-4. Continued

Common name	Dissolved oxygen (DO; mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	pH	Total dissolved solids (ppm)	Turbidity tolerance	Comments
Largemouth bass	3.1 at 15°C was lethal, 0.6-2.3 in winter (2)	lethal 35.6-38 (2)	slow or standing (2)	brackish, 24.4 (2), >11.8 decreases adult abundance, >50 not conducive to spawning (3)	7-7.5 (4), <5 or >10 not conducive to spawning (3)	<5,000, 100-350 optimal (3)	intolerant of turbidity (6), saprophobic (3)	dH 10.0 (4), diurnal (3), bass tapeworm considered a significant parasite that causes sterility (2)
Green sunfish	3.6 winter threshold, died if 1.5 for 48 hours (2)	survive 33-36, prefer 28.2 (2)	<0.3 (3)		tolerated changes from 7.2 to 9.6, 6.0-8.1 at 17-19.5°C with 4-9 ppm DO (2), <5 strongly acidic (3)	<5,000 (3)	most silt tolerant sunfish except for the orange-spotted, tolerate extreme turbidity, temperatures, DO, current velocity (6), saprophobic (3)	dH 10-15 (4), the first to penetrate up streams during high water and repopulate intermittent streams, diurnal, crepuscular (3), builds nest after rise in mean water temperature (2)
Bluegill	0.6-0.8 toleration threshold, supersaturation is lethal (2), <5 is low (3)	0-36 (4), collected in 35-41, some mortality at 36.1 (2)	calm to moderately swift (2,3)	collected in 4.5 (2), <0.5 (3)	endure 4.0-10.35 (2), 7-7.5 (4)		cannot tolerate constant high turbidity (6)	dH 10-15 (4), often the first to die in winter kill lakes, supersaturation of DO seems to cause rapid mortality (2)
Redear sunfish		less tolerant of low temperatures than many other species (7)		occasionally found in brackish water (5)			more tolerant of silt than many other species (7)	subject to winter kill (8), most abundant in clear artificial lakes (7)
Mosquitofish	5-7,<5 low, >7 high, tolerate low levels (3), 0.5 (28)	18-24 (4), 15-27, <15 cold, >27 warm, >37.3 or <4	<0.15-0.3 (3)	<0.5-30 (3)	6.0-8.0 (4)		prefer clear water with vegetation (8), saprophilic, tolerates turbidity (3)	dH 5-19 (4), does not adapt to extremely cold environments (3)

Table B-4. Continued

Common name	Dissolved oxygen (DO; mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	pH	Total dissolved solids (ppm)	Turbidity tolerance	Comments
		lethal (3), 36.4-38.8 CTM (28)						
Red shiner	1.5 (16), critical oxygen concentration 1.2-2.0 (19)	15-25 (4), taken in 39.5 (2), prefer 27	moderate flow (7), slow flow (3), 0.062 (32)	10 (16)	7-7.5 (4), 5-10 (16)		tolerant of high turbidity (2)	absent in clear high gradient streams (5), avoided highly alkaline conditions in the field (18)
Common carp	tolerate low (can use atmospheric) and supersaturation (2), <5 low, >7 high (3)	-0.7 is the lower lethal temperature, 31-35.7 is the upper lethal temperature dependent on acclimation temperature (2), 3-35 (4)	avoid swift water except during spawning (2)	up to 17 (2)			thrive in turbid rivers (4), tolerate high turbidity, saprophilic (3)	need meso-eutrophic conditions (3), last survivor in oxygen depleted waters (2)

[a]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*
[b]Critical thermal maxima (CTM)—the maximum temperature at which a species can survive indefinitely (28)
[c] LD_{50}—the lethal dosage or amount of a toxin necessary to cause death in 50% of the recipients
[d] Saprophilic—ability to tolerate human-made organic chemicals (3)
[e] Saprophobic—unable to tolerate human-made organic chemicals (3)
[f]dH = degrees of hardness (carbonate hardness) where 1 dH = 17.86 ppm

Table B-5. Reproductive life history of native and nonnative fishes of concern. Numbers in parentheses are references (which can be found at the end of the tables).

Common name	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Season[b]	Water body type[c]	Substrate type[d]	Strategy[e]	Periodicity
Loach minnow	littoral, 1.0 (3), 0.1-0.25 (24)	B, 2 (3)	WN (1), SP, and FL (24)	2 (1)	1 cobble, gravel (1)	7 nest cavities open to downstream side of rocks (1)	
Spikedace	<1.5 (3), 0.15 (12), shallow (24)	2 (3), P (12)	SP,SM (1), when discharge is decreasing and temperature is increasing (31)	2 (1)	2 (1), 1 (3)	2,6 (3), 2 (13)	1-2 age one usually once per year, age two twice per year (1)
Roundtail chub[f]	shallow (33)	1,2 (24), 6 (33)	SP, early SM early as spring runoff subsides (1)	2 (1)	1,3 (1)	2 (1)	
Gila chub			late SP into SM (1), late WN into SM (3)		3 (1)	3 (1)	
Longfin dace	0.15-0.20 (3), mean 0.085 (30)	B, 1 (14), 3,5 (30)	primarily SP but may spawn throughout year (1), WN,SP,SM (14)	1,2 (1), nest near mouths of streams (30)	1,3 (3), 2 (14), areas free of detritus and plant debris (30)	2,6 saucer-shaped nest spawner (14)	twice per year (30)
Speckled dace	0.025-0.1 (45)	2 (3)	two periods, SP and late SM (1)	1,2 (1)	1 course substrate (1)	8 nest spawner (3)	twice per year (1)
Sonora sucker		2 (3)	late WN through mid-SM (1)	2,3 (1)	1 (1)	2 (1)	
Desert sucker		2 (1)	late WN and early SP (1), SP (3)	2 (1)	1,2,4 (1)	2 (1)	

Table B-5. Continued

Common name	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Season[b]	Water body type[c]	Substrate type[d]	Strategy[e]	Periodicity
Razorback sucker	littoral/limnetic, 0.3-7.6 (3), most <2.0 (38), 0.7-1.0 (39)	4 (1), 3,6 (38)	late WN through early SP (1), SP with rising water levels and temperatures (39)	1,4 (1)	1,2 (3)	2,6 (3)	
Gila topminnow			year-round in warm waters (3)			viviparous, live bearer (22)	up to 15 broods/year (36)
Desert pupfish	<1.0 (35)		SP,SM, year-round if temperatures stay warmer (3)			1 some unintentional guarding (1), 1 (4)	
Channel catfish	1.8-7.6 (3)	B, 4 (2)	SP,SM (2,3,6)	1 (2)	1,4 if turbid (2)	7 (22)	annual (3)
Flathead catfish	1.8-7.6 (3)	4 (2)	SP,SM (2,3)			7 (6)	
Black bullhead	littoral, 0.3-1.5 (3)	1,3,4 (2,3)	SP (2,6), SP through SM (3)	low gradient (3)	2,3,4 (2)	8 (22)	annual (3)
Yellow bullhead	0.6 (2)	4 (2)	SP through SM (2)	3 (2)	3 (2)	7 (22)	
Smallmouth bass	littoral nest built in <4.0 (3)	B, 1,6,7 (3)	SP through SM (6)	2, low gradient (3)	1, 2,3 (3)	8 nest spawner (22)	1 to >3 per year (3)
Largemouth bass	0.2-7.6 average 0.6 (2,3,6)	1 (3)	SP,SM (6), SP in NM (3)	low gradient (3)	1,2,3 (2,6), prefer sand and gravel (3)	nest spawner guarder-phytophil (22)	annual (3)
Green sunfish	littoral/limnetic, 0.04-3.55, up to 61 (3), usually <0.35 (2)	B (3), 1 (7), 3 (6)	SP through SM (2)	2,3,4 (2)	1,2,3,4 (3)	8 nest spawner (22), nest in colonies (2)	

Table B-5. Continued

Common name	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Season[b]	Water body type[c]	Substrate type[d]	Strategy[e]	Periodicity
Bluegill	up to 1.5 (3)	B, 1,3,7 (3)	SP,SM ripe females collected year round in cooling pond (2)	1,2,3,4 (2,3)	1,2,3,4 (2,3,6)	8 nest spawner (22), in colonies of 40-50 nest (2)	>3 per year (3)
Redear sunfish		B, 1, 7 (7)	SP,SM second nesting in August (6)	2,4 (6), 3 (2)	4 (6)	8 nest spawner (22), nest in colonies (6)	
Mosquitofish	up to 1.5 (3)	P, 1,3,7 (3)	SP through SM (3)	low gradient (3)	3,4 (3)	viviparous, live bearer (22)	3 to 4 broods per year (5,6)
Red shiner	littoral (3)	1,7 (7), 2 (3)	SP,SM peak, FL (2,6),	2,3 (3)	1,2,4, over sunfish nest (2,6)	5 (2,6)	>3 per year (3)
Common carp	littoral, 0.8-1.83 (2)	3,7 (2)	SP,SM (2,6)	2,3,4,5, floodplain (2)	3 (2,3,4), 1 (6)	3 need freshly flooded vegetation (22)	annual, can last several weeks (2)

[a]B = benthic, P = pelagic, 1 = pool, 2 = riffle, 3 = backwater, 4 = stream margins, 5 = run, 6 = eddy, 7 = slack water
[b]SP = spring (Mar-Jun), SM = summer (Jun-Sep), FL = fall (Sep-Dec), WN = winter (Dec-Mar)
[c]1 = river, 2 = stream, 3 = lake, 4 = reservoir, 5 = marsh, 6 = headwaters, 7 = springs
[d]1 = rock, 2 = sand, 3 = vegetation, 4 = silt/soft
[e]1 = nonguarder litho-pelagophil, 2 = nonguarder lithophil, 3 = nonguarder phytophil, 4 = nonguarder pelagophil, 5 = nonguarder phyto-lithophil, 6 = nonguarder psammophil, 7 = guarder spelophil, 8 = guarder lithophil
[f]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*

Table B-6. Habitat requirements for successful reproduction of adult native and nonnative fishes of concern. Numbers in parentheses are references (which can be found at the end of the tables).

Common name	Temperature (°C)	Current velocity (m/sec)	Total dissolved solids (ppm)	Turbidity/pollution tolerance	Comments
Loach minnow	18-20 (1), 10-12 in the laboratory (29), 16-20 (24)				
Spikedace	<15 cold >27 warm (3)	moderate (24)			
Roundtail chub[a]	20 (3), 15-22 (24)	moderate (3)			water temperature most significant in triggering spawning (3)
Gila chub	20-24 optimal (24)				
Longfin dace	23.4 average, 14.2-29.7 (30)	0.07±0.04, and in 0 flow (30)			spawn a few days after summer rains rejuvenate streams (1)
Speckled dace	12-18 (3)	swift (1)			
Sonora sucker		flowing (3)			
Desert sucker		flowing (3)			
Razorback sucker	10-20, 20 optimum (3), 9.5-22, peak at 10-15 (26)	standing water (3), 0.74 (38), 0.3 (39)			
Gila topminnow					
Desert pupfish	middle-upper 20s (35)				
Channel catfish	26.7 optimal (2), 15-29 (2,3)	standing or flowing water (3)			
Flathead catfish	22.2-23.9 (2), 21-29 (3)				
Black bullhead	20 (3)	<0.15 (3)	<5,000 (3)		

Table B-6. Continued

Common name	Temperature (°C)	Current velocity (m/sec)	Total dissolved solids (ppm)	Turbidity/pollution tolerance	Comments
Yellow bullhead					
Smallmouth bass	12.8-23.9 (2), 15.5 (6), 15-27 <15 cold (3)	out of current (6)	<5,000 (3)	saprophobic[b], little tolerance for turbidity (3)	
Largemouth bass	in New Mexico starts at 14-15 (3), 16.7-18.3, and in waters with mean annual temperatures of 25.5 (2)	out of current or waves (3)			
Green sunfish	15-28 (2), >21 (6), 15-31, >27 warm (3)	<0.15, low gradient, prefer <0.1, tolerate up to 0.25 (3)	<5,000 (3)		
Bluegill	15.0-26.7 (3), prolonged periods >20.0 may extend season (2)				
Redear sunfish					
Mosquitofish	15-27, >27 warm (3)	<0.15 (3)			
Red shiner	15.6-29.4 (2,3)	flowing or standing (3)		tolerate turbidity (3)	
Common carp	18.3-23.9 (2), 15-27 (3)				

[a]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*
[b]Saprophobic—no ability to tolerate organic pollution (3)

Table B-7. Habitat preferences and diet of juvenile native and nonnative fishes of concern. Numbers in parentheses are references (which can be found at the end of the tables).

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (cm)	Feeding trait[d]	Prey items[e]
Loach minnow	lotic (3)	littoral, <0.3 (3), 0.1-0.25 (24)	B (3)	1 (3)	2 (1)	2.9-3.7 (15)	2 (3)	3 (3)
Spikedace	lotic (1)	<0.3 (3), 0.16 (11), average depth 0.19 (24)	P, 3,4 (3)	1,2,3,4 (3)	2 (1)	2.6-3.5 (11)		3 (24)
Roundtail chub[f]	lotic (3)	0.3-1.5 (3), 0.9-1.5 (21)	4 (1), 2 (3)	1,2 (3)	2 (3)	<5 (1)	2,6 (1)	3,4,5 (1)
Gila chub	lotic (1)		1,2,3,4 (1)	3 (1)	2,5,6 (1)		6 (1)	3,4,5 (1), 6,7 (24)
Longfin dace				3 (3)				
Speckled dace			B/P (25)				6 (25)	3,5,6 (25)
Sonora sucker	lotic (1)		4 (1)		2 (1)		6 (1)	3,5 (1)
Desert sucker	lotic (3)		1,4 (3)		2 (3)		2 (3)	3 (3)
Razorback sucker	lotic (38)		3,6,7 (38)				limited information (38)	5,6 (38)
Gila topminnow								
Desert pupfish								
Channel catfish	lotic (3)	shallow (3)	1,2 (2,3,6)	1,2 (2)	1,2 (3)		6 (2)	1,2,3,7 (2,3)
Flathead catfish			2 (2,4)	1,2 (2,4)	2 (3)		2 (2,3)	3 (2,3)
Black bullhead		littoral, shallow (2)	1,2,3 (3)		ponds, 2 (3)		2,3 (3)	3,4, plankton (3)
Yellow bullhead				1,3 (3)			6 (3)	all (3)
Smallmouth bass	lotic/lentic (2)	littoral/limnetic <0.3-1.5, up to 12 (3)	P, 2 (3)	1,3 (3)	2 low-moderate gradient (3)		primarily 2 (2)	1,2,3,4 (2)

Table B-7. Continued

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (cm)	Feeding trait[d]	Prey items[e]
Largemouth bass	lotic/lentic (3)	shallow (3)	P, 1 (3)	3 (3)	ponds, 2 (3)		primarily 2 (2,3)	1,3 (2,3,6)
Green sunfish	lotic/lentic (3)		P, 1,3 (3)	1,3 (3)	ponds, 2 (3)		primarily 3 (3)	3,4 (3)
Bluegill	lotic/lentic (2,3)	littoral/limnetic, <0.3-1.5 (3)	1,3 (3)	1,2,3,4 (3)	1,2,3 (2)		2,3 (3)	3 (3)
Redear sunfish								
Mosquitofish	lotic/lentic (3)	littoral/limnetic, up to 3 (3)	1,3,4,7 (4,5,7,9), B/P (4), P (6)	1,2,3,4 (3,4,5,7,9)	3 (4,5,9)		6 (3)	3,5 (3)
Red shiner								
Common carp							6 (3)	3,5 (3)

[a]B = benthic, P = pelagic, 1 = pool, 2 = riffle, 3 = backwater, 4 = stream margins, 5 = run, 6 = eddy, 7 = slack water
[b]1 = rock, 2 = sand, 3 = vegetation, 4 = silt/soft
[c]1 = river, 2 = stream, 3 = lake, 4 = reservoir, 5 = marsh, 6 = headwaters
[d]1 = piscivore, 2 = insectivore, 3 = zooplanktivore, 4 = molluscivore, 5 = herbivore, 6 = omnivore
[e]1 = fish, 2 = crayfish, 3 = aquatic inverts, 4 = terrestrial inverts, 5 = algae, 6 = detritus, 7 = vegetation
[f]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*

Table B-8. Physicochemical requirements of juvenile native and nonnative fishes of concern. Numbers in parentheses are references (which are at the end of the tables).

Common name	Dissolved oxygen (mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	Total dissolved solids (ppm)	Turbidity/pollution tolerance
Loach minnow			0.27-0.67 (3)			
Spikedace		21-27 (3)	<0.15 (3), 0-0.58, mean 0.49 (24)			
Roundtail chub[a]			0-0.61 (21)			
Gila chub			moderate velocities (24)			
Longfin dace						
Speckled dace						
Sonora sucker						
Desert sucker			move to swifter water as they mature (3)			
Razorback sucker						
Gila topminnow		37.4-38.3 CTM[b] (28)				
Desert pupfish						
Channel catfish	5.0-7.0 moderate (3)	36.6-37.8 lethal (2)				
Flathead catfish						
Black bullhead		35-39 lethal (3)	low gradient, <0.15 (3)		<5,000 (3)	
Yellow bullhead			avoid strong currents (3)			prefer clear water (3,6)
Smallmouth bass	5.0-7.0, <5.0 low (3)		moderate gradient (3)		<5,000 (3)	saprophobic[c], little tolerance for turbidity (3)

Table B-8. Continued

Common name	Dissolved oxygen (mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	Total dissolved solids (ppm)	Turbidity/pollution tolerance
Largemouth bass	<5.0 low, 5.0-7.0 moderate (3)	21-27, >27 warm (3)	low gradient (3)			
Green sunfish		prefer 28.2 avoid >31 or <26 (3)	low gradient, prefer <0.1, tolerate up to 0.25 (3)		<5,000 (3)	
Bluegill	5.0-7.0, <5.0 is low (3)	prefer 31.2 (2), 15-27 (3)	low gradient, large and medium streams 1.4-140 m^3/sec (3)	<0.5 (3)		
Redear sunfish						
Mosquitofish	5.0-7.0, <5.0 low, >7.0 high (3)	15-27, <15 cold, >27 warm (3), 37.4-38.3 CTM (28)		<0.5-30 (3)		
Red shiner						
Common carp				17 (2)		

[a]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*
[b]CTM = critical thermal maxima
[c]Saprophobic—no ability to tolerate organic pollution (3)

Table B-9. Habitat preferences, size, and diet of larval native and nonnative fishes of concern. Numbers in parentheses are references (which are provided at the end of the tables).

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (cm)	Duration	Feeding trait[d]	Prey items[e]
Loach minnow	lotic, seek out low velocity sites (3)	littoral, depth <0.3 (3), 0.1-0.25 (24)	B, 4 (3)	1 (3)	2 (1)	<0.28 (15), 0.54 (24),		2 (3)	3 (3)
Spikedace		<0.30 (3), mean 0.08 (11), <0.3 (24)	3,4 (3)	1,2,3 (3), 2,4 (1)	2 (1)	≤0.25 (11), 0.5-0.7 (24),			
Roundtail chub[f]			3 until reach 25-50 mm (1), 4 (3)					6 (1)	3,5 (1)
Gila chub		shallow (24)		3 (24)		0.7-0.8 (3)			
Longfin dace						0.64 average (30)			
Speckled dace			B/P (25)				remain in nest 7-8 days (1)	6 (25)	3,5,6 (25)
Sonora sucker	lotic, margins of streams (1)					0.5 (3)		6 (1)	crustaceans, protozoans (1)
Desert sucker	lotic, in quiet water along banks (1)		1 (1), 4 (3)						
Razorback sucker	lotic/lentic (38)	littoral (41)	4 (1), 3 flooded bottomlands essential (3), 4 (38)		1,2,4 (38)	0.7-0.9 (38), 0.7-1.0 (46)		2,3 (38)	4,5 (38)
Gila topminnow									
Desert pupfish									
Channel catfish			B, 1,2 (6)		1 (2), low gradient (3)	0.64 minimum (2), 0.6-0.98 (44)	several weeks (2), remain in nest 7 days, then school for several weeks (2)	6 (2,3)	3,5,6 (2,3)

Table B-9. Continued

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (cm)	Duration	Feeding trait[d]	Prey items[e]
Flathead catfish		shallow (2)	2 (2)	beneath stone or cover (2)		1.1 (2)			
Black bullhead		near surface in deep water (2)	P, 1,2,3 (2,3)	3,4 (3)	ponds, 2 low gradient (3)	0.9-1.0 (44)		3 (6)	3, plankton (6)
Yellow bullhead						0.28 (44), 0.6-0.8 (44)		2 (2)	3,4 (2)
Smallmouth bass	lotic/lentic (2)		P, 1,2 (3)	1,2,3 moderate density (3)	2,3 (2), low gradient (3)	0.4-1.0 (44)	6-15 days in nest, guarded 2-9 days up to 28 days (2)	primarily 3 (2)	1,3 (2)
Largemouth bass	lotic/lentic (3)		P, 1 (3), B,P (2)	3 (3)	ponds, 2 low gradient (3)	0.3 upon hatching (2), 0.3-0.6 (44)	B for 6-7 days, then P for 31 days (2)	3 (3,6)	3 (3,6)
Green sunfish	lotic/lentic (3)	littoral, <0.3 (3)	P, 1,3 (3)	1,2,3 (3)	2,3 (2), low gradient (3)	0.35-0.37 upon hatching, 0.6 at swim up (2), 0.3-0.6 (44)	5-6 days to swim-up (2)	3 (2)	3 (2)
Bluegill		littoral at first migrate from nest to limnetic area after absorb yolk sac (2,3), up to 1.5 (3)	P, 1,3 (3)	1,2,3,4 (3)	1,2,3 (2), low gradient, 28-140 m^3/s (3)	0.2-0.3 at hatching, 0.5-0.55 at 3 days (2), 0.2-0.5 (44)	31 days at 23.5°C (4)	3 (3)	3,5 (3)
Redear sunfish						0.5 (44)			
Mosquitofish	lotic/lentic (3)	littoral/limnetic <1.5 (3)	1,3,4,7 (4,5,7,9), B/P (4), P (6)	1,2,3,4 (3,4,5,7,9)	3 (4,5,9), low gradient, <140->140 m^3/sec mean annual flow (3)	0.74, 0.8-1.0, 0.7 (47)	larval stage short (3)	6 (3)	3,5 (3)

Table B-9. Continued

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (cm)	Duration	Feeding trait[d]	Prey items[e]
Red shiner						0.33 (2)			
Common carp		littoral/limnetic (2), <3 (3)	B (2)	3 (2)	2,3 (2)	0.3-0.64 (2), 0.3-0.8 (44)	1-2 days attached/near vegetation, in 4-5 days yolk sac is absorbed and they move to bottom, spend most of summer in deeper water (2)	6 (3)	3,5 (3)

[a]B = benthic, P = pelagic, 1 = pool, 2 = riffle, 3 = backwater, 4 = stream margins, 5 = run, 6 = eddy, 7 = slack water
[b]1 = rock, 2 = sand, 3 = vegetation, 4 = silt/soft
[c]1 = river, 2 = stream, 3 = lake, 4 = reservoir, 5 = marsh, 6 = headwaters
[d]1 = piscivore, 2 = insectivore, 3 = zooplanktivore, 4 = molluscivore, 5 = herbivore, 6 = omnivore
[e]1 = fish, 2 = crayfish, 3 = aquatic inverts, 4 = terrestrial inverts, 5 = algae, 6 = detritus, 7 = vegetation
[f]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*

Table B-10. Physicochemical requirements of larval native and nonnative fishes of concern. Numbers in parentheses are references (which are at the end of the tables).

Common name	Dissolved oxygen (mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	Total dissolved solids (ppm)	Turbidity/pollution tolerance
Loach minnow			< 0.15 (3), average 0.73 (24)			
Spikedace			slow <0.05 (3), 0.08 (11)			
Roundtail chub[a]						
Gila chub						
Longfin dace						
Speckled dace						
Sonora sucker						
Desert sucker			quiet (3)			
Razorback sucker						
Gila topminnow						
Desert pupfish						
Channel catfish	5.0-7.0 moderate (3)	36.6-37.8 lethal (2), 15-27, >27 warm (3)	<0.15-0.3 (3)	<0.5-30 (3)	<5,000 (3)	
Flathead catfish						
Black bullhead		35-39 lethal (3)	<0.15 (3)		<5,000 (3)	
Yellow bullhead						
Smallmouth bass	5.0-7.0 moderate <5.0 low (3)	15-27 (3)			<5,000 (3)	saprophobic[b], little tolerance for turbidity (3)
Largemouth bass	<5.0 low, 5.0-7.0 moderate (3)	15-27, >27 warm (3)		>16.6 decreases growth (3)		
Green sunfish		15-27, >27 warm (3)	<0.15, <0.05 optimal (3)		<5,000 (3)	

Table B-10. Continued

Common name	Dissolved oxygen (mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	Total dissolved solids (ppm)	Turbidity/pollution tolerance
Bluegill	5.0-7.0 moderate (3)	21-27 (3)		<0.5 (3)		
Redear sunfish						
Mosquitofish	5.0-7.0, <5.0 low, >7.0 high (3)	15-27, <15 cold, >27 warm (3)	<0.15-0.3 (3)			
Red shiner						
Common carp		15-27 (3)				

[a]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*
[b]Saprophobic—no ability to tolerate organic pollution (3)

Table B-11. Habitat requirements and characteristics of embryos of native and nonnative fishes of concern. Numbers in parentheses are references (which are at the end of the tables).

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/ pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (mm)	Duration to hatch	Egg typed	Fecundity (number of eggs)
Loach minnow	lotic (3)	littoral, <0.3 (3), 0.1-0.25 (24)	B, 2 (3)	1 (1)	2 (1)	1.55 (1), 1.3-1.8 (53)	5-6 days at 18-20°C (1)	1 (1)	150-1,200 (1), 145-300 (24)
Spikedace	lotic (1)	littoral (1)		1,2,3,4 (3)		1.5-1.8 (12)	probably 4-7 days (11)	1,2 (24)	100-300 (1), 100-800 (3), 319 for age 2, 101 for age 1 (24)
Roundtail chub[d]	lotic (1)	littoral (1)	1,5 (3)	1 (3)		0.48-1.69 (3)	4-7 (3)	1 (3)	600-45,125 (3), 33,400 for a 30-cm female (24)
Gila chub							4-7 days at 18°C (3)	1 (23)	
Longfin dace	lotic (1)	<0.3 (3)		2,3 (3), 4 (20)	2 (20)	2.3 (30)	3-4 days need, 4 days at >24°C (3)	2, non-adhesive (23)	80 or less mature ova (30)
Speckled dace	lotic (1)	littoral (1)	B (3)	1 (3)	1 (37)	1 (37), 1.5 (54)	5-7 days at 16-19°C (3)	1 (23)	174, 514 for a 47- and 71-mm fish, respectively (3)
Sonora sucker	lotic/lentic (3)	littoral (1)	2 (1)			1.5 fertilized (3)	6 (3)	2 (1), 1 (23)	
Desert sucker	lotic (1)	littoral (1)						1 (23)	
Razorback sucker	lotic (1)	littoral (1)	B (3)			2.3-2.8 hardened (55)	a few days (1)	1,2 (1)	75,000-144,000 (3)
Gila topminnow									11-15 live young (1)
Desert pupfish							a few days (1)		
Channel catfish			B, 4 (2)	1,4 (2)	1 (2)	3.2 without chorion (2)	5-10 days at 21.1-29.4°C (2), 7 days (6)	2 (3)	2,660-52,000 (2)
Flathead catfish						3.7 (2)	5-14 days (3), 6-9 days at 23.9-27.8°C (2)		4,076-58,972 (2,3)

Table B-11. Continued

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/ pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (mm)	Duration to hatch	Egg typed	Fecundity (number of eggs)
Black bullhead		littoral, 0.3-1.5 (3)	B, 1,3 (3)	3,4 (3)	low gradient (3)	0.8-1.6 (2), 3.0 (3)	1-14 days (3)	1,2 (3)	3,500 (4), 2,000-6,000 (56), 2,500-3,500 (43)
Yellow bullhead						2.8 (52)	5-10 days (2), 5-14 days (3)	1 (2)	860-7,000 (3)
Smallmouth bass	lotic, downstream of obstructions (6), lentic (2)	littoral, 0.3-1.5 (3)	B, 1,7 (3)	1,2,3 (3)	2 (3)	2.5 (6)	1-14 days (3), 9.5 days at 12.8°C, <2 days coupled with rising water temperatures that level off at 23-25°C (2)	1,2 (3)	2,000-20,800 (3), 4,896-5,364 for 33-to 41-cm females (2)
Largemouth bass		0.3-7.6 (3)	B, 1 (3)	2,3 (3)	low gradient (3)	1.4-2.0 (2,3)	1-7 days (2,3,6), 2 days at 19°C (2)	1,2 (2)	55,000 (42), 2,000-20,000 (2)
Green sunfish	lotic/lentic (3)	littoral/limnetic, <0.3-61.0 (3)	B, 1,3 (3)	1,2,3,4 (3)	2,3 (3)	0.8-1.4 (2)	1.4-2.33 days at 24-27°C, 3-7 days (3)	1,2 (2)	2,000-10,000 (3)
Bluegill	lotic/lentic (3)	littoral up to 1.5 (3)	B, 7 (3)	1,2,3,4 (3)	1,2,3 (2), low gradient, 1.4-140 m^3/sec (3)	1.09-1.4 (2)	1.3, 1.4, 3 days at 27.3, 26.9, and 22.2°C, respectively (2), 10 days, 2-3 days at >21°C (3)	1,2 (2)	1,900-46,000 (2), 7,200-38,000 (3)
Redear sunfish	lotic/lentic (7)								49,750 (42)
Mosquitofish						3.4 (52)	24-30 days (4,5)		30 live young/ brood (9), 1-315 embryos (5,6), 1-300 (58)
Red shiner						1.3-1.7 (58)	5-7 days (3)		485-684 (2), 1,000 (42), 500-1,000 (43)

Table B-11. Continued

Common name	Lotic/lentic	Littoral/limnetic depth (m)	Benthic/ pelagic[a]	Substrate type[b]	Water body type[c]	Size total length (mm)	Duration to hatch	Egg typed	Fecundity (number of eggs)
Common carp	lotic/lentic (3)	littoral, <3.0 (3)	B, 7 (3)	3 (3)	1,2,3,4 (2,6), 5 (3), large streams-rivers 28-140 m^3/sec, low-moderate gradient (3)	0.9-2.0 (2), 1.5-2.1 (52)	3-16 days, 3-5 days at 20°C (2)	1,2 (2)	100,000-2,200,000 (2), 300,000 for a 47-cm female (4)

[a]B = benthic, P = pelagic, 1 = pool, 2 = riffle, 3 = backwater, 4 = stream margins, 5 = run, 6 = eddy, 7 = slack water
[b]1 = rock, 2 = sand, 3 = vegetation, 4 = silt/clay
[c]1 = river, 2 = stream, 3 = lake, 4 = reservoir, 5 = marsh, 6 = headwaters
[c]1 = adhesive, 2 = sink
[d]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*

Table B-12. Embryo physicochemical criteria. Numbers in parentheses are references (which are at the end of the tables).

Common name	Dissolved oxygen (mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	Total dissolved solids (ppm)	Turbidity/ pollution tolerance	Comments
Loach minnow			< 0.43 (3), flow important (24)				
Spikedace		15-27 (3)					
Roundtail chub[a]			moderate (3)				
Gila chub		15-21 (3)					
Longfin dace							eggs are buried in pit walls and not guarded (20)
Speckled dace							
Sonora sucker							
Desert sucker							
Razorback sucker		15-21, 20 best, die at 5, 10, or 30 (3)					
Gila topminnow							female has two broods developing simultaneously with one more advanced than the other (24)
Desert pupfish							
Channel catfish	1.7 lethal (2)	21-27, >27 warm, need >15.5 (3)	<0.15 (3)	limited spawning if >2, tolerate up to 16 (3)			
Flathead catfish							
Black bullhead		20-27, optimal 20-22, lethal 35-39 (3)	<0.15 (3)	>0.8 impairs development (3)	<5,000 (3)		
Yellow bullhead							

Table B-12. Continued

Common name	Dissolved oxygen (mg/L)	Temperature (°C)	Current velocity (m/sec)	Salinity (ppt)	Total dissolved solids (ppm)	Turbidity/ pollution tolerance	Comments
Smallmouth bass		15-27 (3), 12.5-25 (2)			<5,000 (3)	saprophobic[b], little tolerance for turbidity (3)	
Largemouth bass		15-27 (3)		>1.5 decreases survival (3)			
Green sunfish		21-27 (3)	<0.15, <0.10 optimal (3)		<5,000 (3)		
Bluegill	5.0-7.0 moderate (3)	21-27 (3)		<0.5 (3)			
Redear sunfish							
Mosquitofish							
Red shiner		34-35 may be lethal (3)					
Common carp		15-21 (3)					water-level drawdown is effective in killing eggs and sac fry by exposing to air (2)

[a]Headwater chub *Gila nigra* is a recently described species subsumed in the existing literature under the roundtail chub *Gila robusta*
[b]Saprophobic—no ability to tolerate human-made organic chemicals (3)

Table B-13. Raw data, both summarized from Tables B-1 to B-12 and collected from other sources, used to develop data matrix that was used to evaluate differences between native and nonnative fishes of concern. Numbers in parentheses are references (which are at the end of the tables).

Common name	Family	Native or exotic	Lentic or lotic	Mature fish length (mm)	Age at maturity (years)	Longevity (years)	Prey type
Channel catfish	ictaluridae	exotic (BOR)	both (2, 3)	337 (42)	4-5 (6), 2-3 (2)	8 (2), 6-7 (6)	fish, crustaceans, clams, snails
Flathead catfish	ictaluridae	exotic (BOR)	both (4)	460 (2, 6)	4-5 (2, 6)	20 (4)	fish, crayfish, insects, invertebrates
Black bullhead	ictaluridae	exotic (BOR)	both (42)	110 (42), 160 (43)	2-4 (2)	10 (4)	invertebrates, terrestrial insects, algae, detritus, vegetation
Smallmouth bass	centrarchidae	exotic (BOR)	both (3)	243-290 (6), 260-360 (2)	3-4 (2)	10-12 (6)	fish, crayfish, invertebrates, terrestrial insects
Largemouth bass	centrarchidae	exotic (BOR)	both (3)	250-300 (2)	3-4 (2)	13 (42)	fish, crayfish, invertebrates
Green sunfish	centrarchidae	exotic (BOR)	both (3)	76 (2)	2 (7)	5 (4)	fish, crayfish, invertebrates, terrestrial insects, algae, vegetation
Bluegill	centrarchidae	exotic (BOR)	both (3)	160 (42)	2-3, 1 (2)	11 (4)	invertebrates, terrestrial insects, algae, detritus, vegetation
Redear sunfish	centrarchidae	exotic (BOR)	both (7)	130 (42)	2 (6)	5 (7)	invertebrates, especially snails
Mosquitofish	poeciliidae	exotic (BOR)	both (3)	32-57 (10)	00.4 (6)	3 (4)	fish, invertebrates, algae, detritus
Red shiner	cyprinidae	exotic (BOR)	both (3)	24-75 SL[a] (5), >40 (2)	3 (6), 1 (7)	3 (6), 2.5 (43)	invertebrates, algae, vegetation
Common carp	cyprinidae	exotic (BOR)	both (2)	280-360 (6)	3 (2)	9-15 (2)	invertebrates, algae, detritus, vegetation
Loach minnow	cyprinidae	native (BOR)	lotic (1)	38-<80 (15); rarely >60 (24)	2 (1), 1 (24)	4 (1) , 2 (24)	insects
Spikedace	cyprinidae	native (BOR)	lotic (1)	<75 (1), 40 (12), 40 (31)	1 (1), 2 (3)	2 (12), 1.1 (24), 1-2 (31)	fish, invertebrates, terrestrial insects
Roundtail chub	cyprinidae	native (BOR)	both (3)	250-300 (1)	3 (24)	20+ (24)	fish, invertebrates, terrestrial insects, algae, detritus, vegetation
Gila chub	cyprinidae	native (BOR)	lotic (1)	>75 (34), 150 typically (24)	2-3 (1), 1-3 (34)	3 (3)	fish, invertebrates, algae, insects
Longfin dace	cyprinidae	native (BOR)	lotic (1)	65 SL (1), 42 SL (30)	1 (30)	No data	detritus, invertebrates, algae, zooplankton
Speckled dace	cyprinidae	native (BOR)	lotic (1)	76 rarely (1)	2 (45)	No data	invertebrates, algae, vegetation; detritus
Sonora sucker	catostomidae	native (BOR)	both (3)	800 (1)	No data	No data	invertebrates, algae; plants, detritus
Desert sucker	catostomidae	native (BOR)	lotic (1)	100-280 SL (1)	No data	No data	algae, detritus
Razorback sucker	catostomidae	native (BOR)	both (3)	400 (38), 540 (40)	4 (1)	40 + (1)	invertebrates, algae, detritus; vegetation
Gila topminnow	poeciliidae	native (BOR)	lotic (1)	30-45 SL (1)	0.4 (1)	1 (1)	invertebrates, algae, detritus, vegetation
Desert pupfish	cyprinodontidae	native (BOR)	lotic (1)	15-75 (35)	0.2 (35), 1 (2)	1 (1)	invertebrates, terrestrial insects, algae, detritus, vegetation

Table B-13. Continued.

Common name	Upper water temperature (°C)	Egg diameter (mm)	Incubation (days)	Fecundity	Hatchling (mm)
Channel catfish	35 (3)	3.2 (2)	5-10 (2), 7 (6)	2,660-52,000 (2)	6.4 (2), 6-9.8 (44)
Flathead catfish	33.5 optimum (2)	3.7 (2)	5-14 (3), 6-9 (2)	4,076-58,972 (2, 3)	11 (2)
Black bullhead	35-39 (2, 3)	0.8-1.6 (2), 3.0 (3)	1-14 (3)	3,500 (4), 2,500-3,500 (43)	9-10 (44)
Smallmouth bass	32 (48)	2.5 (6)	1-14 (3), 9.5 (2)	2,000-20,800 (3), 4,896-5,364 (2)	4-10 (44)
Largemouth bass	35.6-38 (2)	1.4-2.0 (2, 3)	1-7 (2,3,6), 2 (2)	55,000 (42), 2,000-20,000 (2)	3 (2), 3-6 (44)
Green sunfish	survive 33-36 (2)	0.8-1.4 (2)	1.4-2.3, 3-7 (3)	2,000-10,000 (3)	3.5-3.7 (2), 3-6 (44)
Bluegill	38.5-41.4 (49)	1.09-1.4 (2)	1,3, 1.4, 3 (2), 10, 2-3 (3)	1,900-46,000 (2), 7,200-38,000 (3)	2-3 (2), 2-5 (44)
Redear sunfish	36 (49)	1.4 (50)	No data	42,750 (42)	5 (44)
Mosquitofish	>37.3 lethal (3), CTM 36.4-38.8 (28)	3.4 (44)	24-30 (4,5)	30/brood (9), 1-315 embryoes (5, 6), 1-300 (47)	7.4, 8-10, 7 (47)
Red shiner	taken in 39.5 (2)	1.3-1.7 (47)	5-7 (3)	485-684 (2), 1,000 (42), 500-1,000 (43)	3.3 (2)
Common carp	31-35.7 (2)	0.9-2.0 (2), 1.5-2.1 (44)	3-16, 3-5 (2)	100,000-2,200,000 (2), 300,000 (4)	3-6.4 (2), 3-8 (44)
Loach minnow	>34 lethal (23)	1.55 (1)	5-6 (1)	150-1,200 (1), 145-300 (24)	2.8 (15), 5.4 (24)
Spikedace	>34 lethal (23)	1.5-1.8 (12)	4-7 (11)	100-300 (1), 100-800 (3), 319, 101 (24)	2.5 (11), 5-7 (24)
Roundtail chub	CTM 30.5-39.5 (3), >34 lethal (23)	0.48-1.69 (3)	4-7 (3)	600-45,125 (3), 33,400 (24)	No data
Gila chub	>34 lethal (23)	No data	4-7 (3)	No data	7-8 (3)
Longfin dace	>34 lethal (23)	2.3 (30)	3-4 (23)	80 (30)	No data
Speckled dace	CTM 30.5-36.8 (3)	1 (37)	5-7 (3)	174, 514 (45)	No data
Sonora sucker	>34 lethal (23)	1.5 (3)	6 (3)	No data	5 (3)
Desert sucker	survive 32+ (1)	No data	No data	No data	No data
Razorback sucker	some mortality 34+ (39)	2.3-2.8 (46)	Few days (1)	75,000-144,000 (3)	7-9 (38), 7-10 (46)
Gila topminnow	CTM 37.2-38.4 (28)	No data	No data	11-15 live (1)	No data
Desert pupfish	35+ (1)	No data	Few days (1)	No data	No data

[a]SL = standard length
[b]CTM = critical thermal maximum

Table B-14. Data matrix developed from Table B-13 that was used to conduct one-way analyses of variance to determine how native fishes of concern in the Gila River basin differ from those nonnative fishes of concern.

Common name	Family	Native or exotic	Habitat	Mature length	Age at maturity	Longevity	Diet breadth	Upper temperature	Egg diameter	Incubation time
Channel catfish	50	1	3	337	3.5	7.3	2	35	3.2	7.3
Flathead catfish	50	1	3	460	4.5	20	3	No data	3.7	8.5
Black bullhead	50	1	3	165	3	10	5	37	2.1	7.5
Smallmouth bass	130	1	3	288	3.5	11	4	32	2.5	8.5
Largemouth bass	130	1	3	275	3.5	13	3	36.8	1.7	3.6
Green sunfish	130	1	3	76	2	5	6	36	1.1	3.5
Bluegill	130	1	3	160	1.8	11	5	39.3	1.3	3.6
Redear sunfish	130	1	3	130	2	5	1	36	1.4	No data
Mosquitofish	115	1	3	45	0.4	3	4	37.5	3.4	27.0
Red shiner	34	1	3	50	2	2.8	3	39.5	1.5	6.0
Common carp	34	1	3	320	3	12	4	33.2	1.7	7.0
Loach minnow	34	2	1	59	1.5	3	1	34	1.6	5.5
Spikedace	34	2	1	40	1.5	1.5	3	34	1.7	6.5
Roundtail chub	34	2	3	275	3	20	6	34.5	1.1	6.5
Gila chub	34	2	1	113	2.3	3	4	34	No data	6.5
Longfin dace	34	2	1	54	1	No data	4	34	2.3	3.5
Speckled dace	34	2	1	76	2	No data	4	33.7	1	6.5
Sonora sucker	36	2	3	800	No data	No data	4	34	1.5	6.0
Desert sucker	36	2	1	190	No data	No data	2	32	No data	No data
Razorback sucker	36	2	3	470	4	40	4	34	2.6	3.5
Gila topminnow	115	2	1	38	0.4	1	4	37.8	No data	No data
Desert pupfish	117	2	1	45	0.6	1	5	35	No data	3.5

Table B-14. Continued.

Common name	Fecundity	Larval length	Spawning seasons	Parental care	Human use	History introduction	History invasive
Channel catfish	27,330	7.2	2	4	32	1	2
Flathead catfish	31,524	11	2	4	9	2	2
Black bullhead	3,250	10	2	5	27	1	1
Smallmouth bass	8,265	7	2	5	18	1	1
Largemouth bass	33,000	3.8	2	5	25	1	1
Green sunfish	6,000	4.1	2	5	18	1	2
Bluegill	23,275	2.5	2	5	23	1	1
Redear sunfish	42,750	5	2	5	12	1	2
Mosquitofish	154	7.8	2	6	15	1	1
Red shiner	778	3.3	3	1	5	2	2
Common carp	725,000	5.1	2	1	27	1	1
Loach minnow	449	4.1	3	4	2	2	2
Spikedace	287	4.3	2	1	2	2	2
Roundtail chub	28,131	No data	2	1	2	2	2
Gila chub	No data	6	4	2	2	2	2
Longfin dace	80	6.4	3	3	2	2	2
Speckled dace	344	No data	2	4	4	2	2
Sonora sucker	No data	5	3	1	2	2	2
Desert sucker	No data	No data	2	1	2	2	2
Razorback sucker	109,500	8.3	2	1	2	2	2
Gila topminnow	13	No data	4	6	2	2	2
Desert pupfish	No data	No data	4	3	5	2	2

References used to collect life-history information for native and nonnative fishes of concern in Arizona in Appendix B tables.

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Appendix C. Technical Data for Chemicals Either Registered with the U.S. Environmental Protection Agency, Used As, or Proposed to Be Used as Fish Toxicants

Included are the names and formulations of each chemical, their primary and secondary uses or proposed uses, mode of action, toxicity to a variety of taxa, safety hazard, persistence in the environment, and registration status.

Ammonia

Alternative names: Anhydrous ammonia, urea
Chemical formula: NH_3
Formulation: Liquid under pressure
Primary use: Fertilizer
Secondary use: Control of aquatic weeds; fish toxicant
Mode of action: Corrosive action in gastrointestinal tract; alkalosis
Toxicity to fish: Highly toxic; toxicity is pH dependent at low concentrations
Toxicity to birds: No information available
Toxicity to invertebrates: No information available
Toxicity to mammals: Moderately toxic
Safety hazard: Liquid under pressure; inhalation of leaking fumes; rupture of lines
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Antimycin

Alternative names: Fintrol®-5, Fintrol®-15, and Fintrol®-concentrate
Chemical formula: $C_{28}H_{40}N_3O_9$
Formulation: Controlled-release coating on sand grains and water-soluble liquid
Primary use: Registered fish toxicant in the United States and Canada
Secondary use: Fungicide; miticide
Mode of action: Irreversible inhibitor of cellular respiration
Toxicity to fish: Extremely toxic to freshwater and marine fishes
Toxicity to birds: Highly toxic to quail
Toxicity to mammals: Highly toxic to mouse, rat, rabbit, guinea-pig, dog, and lamb
Safety hazard: Conjunctivitis; protect eyes with safety glasses
Persistence in environment: Nonpersistent
Registration status: Registered as a fish toxicant in the United States and Canada

Aqualin

Alternative names: Acrolein, r-propenal, acrylic aldehyde
Chemical formula: C_3H_4O
Formulation: Liquid
Primary use: Industrial; military in poison gas mixture
Secondary use: Fish toxicant
Mode of action: Irritant; lacrimator
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Toxic
Safety hazard: Highly volatile and flammable; avoid contact with liquid and vapors

Persistence in environment: None
Registration status: Not registered as a fish toxicant in the United States

Bayluscide®

Alternative names: Bayer 73, Yomesan
Chemical formula: $C_{15}H_{15}Cl_2O_5N_3$
Formulation: Wettable powder; granular timed-release; liquid (formulation not yet registered)
Primary use: Molluscicide
Secondary use: Registered fish toxicant in the United States and Canada
Mode of action: No information available
Toxicity to fish: Extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: Moderately toxic
Safety hazard: Prevent oral or dermal contact; avoid inhalation
Persistence in environment: Nonpersistent
Registration status: Registered as a fish toxicant for restricted use in the United States and Canada

Baythroid®

Alternative names: Synthetic pyrethroid; cyano(4-fluoro-3-phenoxyphenyl)methyl-3(2,2-dichloroethanyl)-2,2-dimethyl-cyclopropanecarboxylate
Chemical formula: $C_{22}H_{19}O_3NCl_2F$
Formulation: No information available
Primary use: Agricultural insecticide
Secondary use: Experimental crayfish or fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: LC_{50} (mg/kg) for rats were oral, 1,015; dermal, >5,000
Safety hazard: Prevent oral or dermal contact; avoid inhalation; wear protective clothing
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Bleaching powder and urea

Alternative names: Calcium hypochlorite and ammonia
Chemical formula: $Ca(ClO)_2 \bullet H_2O : NH_3$
Formulation: No information available
Primary use: Industrial uses and fertilizer
Secondary use: Fish toxicant
Mode of action: Oxidizing agent
Toxicity to fish: Highly toxic
Toxicity to birds: No information available

Toxicity to mammals: No information available
Safety hazard: Avoid inhalation of fumes; protective clothing recommended
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Calcium carbide

Alternative names: Acetylenogen
Chemical formula: CaC_2
Formulation: Crystals
Primary use: Generating acetylene gas; other industrial purposes
Secondary use: Fish toxicant
Mode of action: Inflation in gut
Toxicity to fish: No information available
Toxicity to birds: No information available
Toxicity to mammals: No information available
Safety hazard: No information available
Persistence in environment: None
Registration status: Not registered as a fish toxicant in the United States

Calcium hypochlorite

Alternative names: Bleaching powder, chlorine
Chemical formula: $Ca(ClO)_2 \bullet H_2O$
Formulation: Powder
Primary use: Industrial processes
Secondary use: Disinfectant; fish toxicant
Mode of action: Oxidizing agent
Toxicity to fish: Extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: Highly toxic
Safety hazard: Avoid inhalation of fumes; explosive in some formulations
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Copper sulfate pentahydrate

Alternative names: Bluestone, blue citriol, cupric sulfate pentahydrate
Chemical formula: $CuSO_4 \bullet 5\ H2O$
Formulation: Crystal; powder
Primary use: Herbicide; industrial
Secondary use: Medical and veterinary; fish toxicant
Mode of action: Strong irritant on mucous membranes
Toxicity to fish: Extremely toxic

Toxicity to birds: Slightly toxic
Toxicity to mammals: Practically nontoxic
Safety hazard: Keep well away from foodstuffs, animal feed, and their containers
Persistence in environment: Persistent and cumulative in soft water
Registration status: Not registered as a fish toxicant in the United States

Croton seed powder

Alternative names: No information available
Chemical formula: No information available
Formulation: Powder
Primary use: Fish toxicant in China
Secondary use: No information available
Mode of action: Vesicant, purgative
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Highly toxic
Safety hazard: Powerful vesicant
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

Cunaniol

Alternative names: Cunani
Chemical name: Polyacetylenic alcohol
Formulation: Aqueous extract of leaves from *Clibadium sylvestre*
Primary use: Fish toxicant
Secondary use: No information available
Mode of action: No information available
Toxicity to fish: Extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: No information available
Safety hazard: No information available
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

DANEX-80

Alternative names: Dimethyl-1,2,2-trichloro-1-hydroxyethylphosphonate
Chemical formula: $C_4H_8Cl_3O_4P$
Formulation: Crystal
Primary use: Insecticide
Secondary use: Fish toxicant
Mode of action: Cholinesterase inhibitor

Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Moderately toxic; rat oral LD_{50} 630 mg/kg
Safety hazard: Protective clothing recommended
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

DDVP

Alternative names: Nuvan 100 EC, Vapona®, Herkol, Dichlorvos
Chemical formula: $C_4H_7Cl_2O_4P$
Formulation: Liquid
Primary use: Insecticide
Secondary use: Vermifuge in livestock; fish toxicant
Mode of action: Cholinesterase inhibitor
Toxicity to fish: Highly toxic
Toxicity to birds: Acute oral LD_{50} for mallards is 7.78 mg/kg and for pheasants is 11.3 mg/kg
Toxicity to mammals: Acute oral LD_{50} in rats is 70 mg/kg
Safety hazard: Avoid inhalation and contamination of food
Persistence in environment: About 3 weeks in water
Registration status: Not registered as a fish toxicant in the United States

Dibrom®-malathion

Alternative names: Dibrom®:malathion, Ortho Fish Thinner
Chemical formula: $C_4H_7O_4PBr_2Cl_2$: $C_{10}H_{19}O_6PS_2$
Formulation: Liquid
Primary use: Singly as insecticides
Secondary use: Selective fish toxicant (removal of sunfishes from largemouth bass)
Mode of action: Cholinesterase inhibitor
Toxicity to fish: Highly to extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: Slightly toxic
Safety hazard: Protect eyes with safety glasses
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Dieldrin

Alternative names: 1,2,3,4,10,10-hexachloro-exo-6,7-epoxy-14,40,5,6,7,8,8a-octahydro-endo-exo-5,8-dimethanonaphthalene
Chemical formula: $C_{12}H_8Cl_6O$
Formulation: Crystals
Primary use: Insecticide

Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: Highly toxic
Toxicity to mammals: Highly toxic; rat oral LD_{50} 46 mg/kg
Safety hazard: Avoid direct contact; may be absorbed by ingestion, inhalation, or through skin
Persistence in environment: Persistent
Registration status: Manufacture and use discontinued in the United States

Endosulfan

Alternative names: Thiodan®, Thionex®, Malix, Malic, Thimul, Cyclodan; 1,4,5,6,7,7-hexachloro-5-norbornene-2,3-dimethanol cyclic sulfite
Chemical formula: $C_9H_6Cl_6O_3S$
Formulation: Crystals, powder
Primary use: Insecticide
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: Acute oral LD_{50} for mallards is 33 mg/kg
Toxicity to mammals: Acute oral LD_{50} for rats is 100 mg/kg
Safety hazard: No information available
Persistence in environment: Moderately persistent
Registration status: Not registered as a fish toxicant in the United States

Endrin

Alternative names: Compound 269, Experimental Insecticide 269, mendrin, nendrin, hexadrin
Chemical formula: $C_{12}H_8Cl_6O$
Formulation: Crystals, powder
Primary use: Insecticide
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Extremely toxic
Toxicity to birds: Highly toxic and cumulative toxicity
Toxicity to mammals: Highly toxic; rat oral LD_{50} 18 mg/kg
Safety hazard: Avoid direct contact; may be absorbed by ingestion, inhalation, or through skin
Persistence in environment: Persistent
Registration status: Manufacture and use discontinued in the United States

***Euphorbia antiquorum* extract**

Alternative names: Extract from Indian hedge plant
Chemical formula: No information available

Formulation: Powder
Primary use: Experimental fish toxicant
Secondary use: No information available
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: No information available
Safety hazard: No information available
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

GD-174

Alternative names: 2-(digeranylamino)-ethanol
Chemical formula: $C_{21}H_{43}NO$
Formulation: Liquid
Primary use: Experimental fish toxicant
Secondary use: Experimental herbicide
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Low toxicity
Safety hazard: No information available
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Guthion®

Alternative names: Gusathion, Methyl Guthion, DBD, Bay 9027
Chemical formula: $C_{10}H_{12}N_3O_3PS_2$
Formulation: Crystals, powder, liquid concentrate
Primary use: Insecticide
Secondary use: Selective fish toxicant (removal of centrarchids from bait minnow ponds)
Mode of action: Cholinesterase inhibitor
Toxicity to fish: Extremely toxic
Toxicity to birds: Highly toxic
Toxicity to mammals: Highly toxic; rat oral LD_{50} 11 mg/kg
Safety hazard: Protect eyes with safety glasses
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Ichthyothereol

Alternative names: Cunabi, cunami, cunambi
Chemical formula: $C_{14}H_{14}O_2$
Formulation: Extract from leaves of *Ichthyothere terminalis*
Primary use: Fish toxicant
Secondary use: No information available
Mode of action: Convulsant
Toxicity to fish: Extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: Extremely toxic
Safety hazard: No information available
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

Juglone

Alternative names: 5-hydroxy-1,4-napthoquinone; walnut extract
Chemical formula: $C_{10}H_6O_3$
Formulation: Powder
Primary use: Experimental fungicide and bactericide
Secondary use: Folk medicine; experimental fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Doses of 5 mg/kg were not toxic to dogs, but 10 mg/kg were fatal
Safety hazard: No hazards identified; protective clothing recommended
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Lime

Alternative names: Quick lime, burnt lime, caustic lime, calcium oxide
Chemical formula: CaO (quicklime); $Ca(OH)_2$ (hydroxide)
Formulation: Crystals or powder
Primary use: Building materials
Secondary use: Pesticides; fish toxicant
Mode of action: Caustic
Toxicity to fish: Highly to moderately toxic
Toxicity to birds: Practically nontoxic
Toxicity to mammals: No information available
Safety hazard: Quick lime may cause severe irritation of skin and mucous membranes
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Limil

Alternative names: No information available
Chemical formula: No information available
Formulation: No information available
Primary use: No information available
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: No information available
Safety hazard: No information available
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

Malathion

Alternative names: Malathon, carbophos, karbofos, phyphanon
Chemical formula: $C_{10}H_{19}O_6PS_2$
Formulation: Liquid
Primary use: Insecticide
Secondary use: Ectoparasiticide for livestock; fish toxicant
Mode of action: Cholinesterase inhibitor
Toxicity to fish: Highly to extremely toxic
Toxicity to birds: Slightly toxic
Toxicity to mammals: Slightly toxic
Safety hazard: Poisonous if swallowed; keep well away from foodstuffs and animal feed
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Ozone

Alternative names: Triatomic oxygen
Chemical formula: O_3
Formulation: gas
Primary use: Disinfectant
Secondary use: Fish toxicant
Mode of action: Oxidizing agent
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: High concentration may cause severe irritation of respiratory tract and eyes
Safety hazard: Avoid inhalation
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Phosphamidon

Alternative names: Dimicron, OR-1191, ENT 25515, C 570, ML-97
Chemical formula: $C_{10}H_{19}ClNO_5P$
Formulation: Oil
Primary use: Systemic insecticide
Secondary use: Fish toxicant
Mode of action: Cholinesterase inhibitor
Toxicity to fish: Highly toxic
Toxicity to birds: Highly toxic
Toxicity to mammals: Highly toxic
Safety hazard: Prevent inhalation and skin contamination
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Phostoxin®

Alternative names: Aluminum phosphide, phosphine, Celphos
Chemical formula: AlP
Formulation: Crystal, powder
Primary use: Insecticidal fumigant
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Phosphine highly toxic
Safety hazard: Avoid inhalation and contact
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

Polychlorpinene

Alternative names: PCIP
Chemical formula: No information available
Formulation: Liquid
Primary use: Insecticide
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: Toxic
Safety hazard: Absorbs through skin, gut, or respiratory tract
Persistence in environment: Up to 1.5 years in some waters
Registration status: Not registered as a fish toxicant in the United States

Potassium permanganate

Alternative names: Permanganic acid potassium salt, chameleon mineral
Chemical formula: $KMnO_4$
Formulation: Powder
Primary use: Industrial uses
Secondary use: Experimental fish toxicant
Mode of action: Oxidizing agent
Toxicity to fish: Moderately toxic
Toxicity to birds: No information available
Toxicity to mammals: Relatively nontoxic
Safety hazard: Protective clothing recommended
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Rotenone

Alternative names: Noxfish®, Pro-Noxfish®, NuSyn-Noxfish®, Chem-fish Regular, Chem-fish Special, Fish-tox, Derris, Cube', Derrin, Nicouline, Tubatoxin, Timbe Powder
Chemical formula: $C_{23}H_{22}O_6$
Formulation: Liquid, synergized liquid, and powdered plant roots
Primary use: Insecticide
Secondary use: Fish toxicant
Mode of action: Inhibitor of cellular respiration
Toxicity to fish: Extremely toxic
Toxicity to birds: Slightly toxic
Toxicity to mammals: Moderately toxic
Safety hazard: Contact causes irritation of eyes and skin; protective clothing recommended
Persistence in environment: Seldom over 2 weeks; longer in soft or cold water
Registration status: Some formulations are registered for fishery use

Salicylanilide I

Alternative names: Sal I, 2',5-dichloro-e-tert-butyl-6-methyl-4'-nitrosalicylanilide
Chemical formula: $C_{18}H_{18}N_2O_2$
Formulation: Powder
Primary use: Experimental germicide and fish toxicant
Secondary use: None
Mode of action: No information available
Toxicity to fish: Extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: Unknown, however, its structure is closely related to Bayluscide®
Safety hazard: Protective clothing recommended

Persistence in environment: Detoxified within a week
Registration status: Not registered as a fish toxicant in the United States

Saponins

Alternative names: Sapongenin glycosides
Chemical formula: No information available
Formulation: Tea-seed cake
Primary use: Foaming agent in textile and food industries
Secondary use: Fish toxicant
Mode of action: Dissolves red corpuscles
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Low oral toxicity; powerful hemolytic
Safety hazard: Protective clothing recommended
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Sodium cyanide

Alternative names: Cyanide
Chemical formula: NaCN
Formulation: Cyanogram, Cyan-o-brick, Cyaneggs
Primary use: Fumigant; electroplating
Secondary use: Fish toxicant
Mode of action: Inhibits oxidative enzymes; respiratory failure
Toxicity to fish: Highly toxic
Toxicity to birds: Highly toxic
Toxicity to mammals: Highly toxic
Safety hazard: Deadly poison; protective clothing required
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Sodium fluoride

Alternative names: Chemifluor, Florocid, Lemoflur, Ossalin
Chemical formula: NaF
Formulation: Crystal, powder
Primary use: Insecticide; industrial uses
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Moderately toxic
Toxicity to birds: No information available
Toxicity to mammals: Moderate oral toxicity; rat oral LD_{50} 180 mg/kg

Safety hazard: Protective clothing recommended
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

Sodium hydroxide

Alternative names: Caustic soda, soda lye, sodium hydrate
Chemical formula: NaOH
Formulation: Lumps, sticks, pellets, ships, and liquid solutions
Primary use: Many industrial uses
Secondary use: Fish toxicant
Mode of action: Corrosive to all tissues
Toxicity to fish: Highly to moderately toxic
Toxicity to birds: No information available
Toxicity to mammals: Slightly toxic
Safety hazard: Protective clothing recommended; avoid inhalation of dust or mist
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Sodium nitrite

Alternative names: Nitrous acid sodium salt
Chemical formula: $NaNO_2$
Formulation: Powder
Primary use: Industrial uses
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic
Toxicity to birds: No information available
Toxicity to mammals: Rat oral LD_{50} 180 mg/kg
Safety hazard: Protective clothing recommended
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

Sodium pentachlorophenate

Alternative names: Santobrite, Dowicide G, PCP
Chemical formula: NaC_6HCl_5O
Formulation: Powder
Primary use: Insecticide; herbicide
Secondary use: Wood preservative; slimicide; fish toxicant
Mode of action: No information available
Toxicity to fish: Extremely toxic
Toxicity to birds: No information available

Toxicity to mammals: Causes lung, liver, and kidney damage
Safety hazard: Avoid contact and inhalation; more toxic in organic solvents
Persistence in environment: Persistent
Registration status: Not registered as a fish toxicant in the United States

Sodium sulfite

Alternative names: No information available
Chemical formula: Na_2SO_3
Formulation: Crystal or powder, Heptahydrate ($Na_2SO_3 \bullet 7H_2O$)
Primary use: Industrial, photographic developers
Secondary use: Medical; fish toxicant
Mode of action: Reducing agent; suffocates fish
Toxicity to fish: Moderately toxic
Toxicity to birds: No information available
Toxicity to mammals: Slightly toxic; mouse LD_{50} 175 mg/kg
Safety hazard: Protective clothing recommended
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Squoxin

Alternative names: 1,1'-methylenedi-2-naphthol, Sonar 300
Chemical formula: $C_{12}H_{16}O_2$
Formulation: Powder, liquid solution, emulsion
Primary use: Industrial uses
Secondary use: Selective toxicant for squawfishes (*Ptychocheilus* spp.)
Mode of action: Vaso-constrictor
Toxicity to fish: Extremely toxic to squawfishes; highly to extremely toxic to salmonids and other fresh-water fishes
Toxicity to birds: No acute effects in domestic ducks at 14.7 mg/kg/day over 7 days
Toxicity to mammals: No acute effects in lambs at 1.2 mg/kg/day over 7 days
Safety hazard: Flammable; use with adequate ventilation
Persistence in environment: Nonpersistent
Registration status: Not currently registered as a fish toxicant in the United States

Sumithion®

Alternative names: Fenitrothion
Chemical formula: O,O-Dimethyl-O-(3-methyl-4-nitrophenyl)phosphorodithioate
Formulation: Yellow oil
Primary use: Insecticide
Secondary use: Fish toxicant
Mode of action: Cholinesterase inhibitor

Toxicity to fish: Moderately toxic
Toxicity to birds: No information available
Toxicity to mammals: Rat oral LD_{50} 250 mg/kg
Safety hazard: Protective clothing recommended
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

TFM

Alternative names: 3-trifluoromethyl-4-nitrophenol, Lamprecid®
Chemical formula: $CF_3C_6H_3(NO_2)OH$
Formulation: Crystalline solid, liquid
Primary use: Selective toxicant for larvae of sea lamprey (*Petromyzon marinus*)
Secondary use: No information available
Mode of action: Circulatory collapse; sever hemorrhage of respiratory capillaries
Toxicity to fish: Highly toxic to sea lamprey larvae; highly toxic to teleosts
Toxicity to birds: Moderately toxic
Toxicity to mammals: No acute effects in deer or dairy cattle; acute oral LD_{50} for rabbit is 0.16 g/kg
Safety hazard: Protective clothing recommended when handling concentrated forms of toxicant
Persistence in environment: Nonpersistent
Registration status: Registered as a fish toxicant for restricted use in the United States and Canada

Thanite

Alternative names: Isobornyl thiocyanoacetate
Chemical formula: $C_{13}H_{19}NO_2S$
Formulation: Liquid
Primary use: Insecticide, especially in cattle sprays
Secondary use: Fish-collecting aid, fish toxicant
Mode of action: No information available
Toxicity to fish: Highly to extremely toxic
Toxicity to birds: No information available
Toxicity to mammals: Moderately toxic
Safety hazard: Irritant to eyes and mucous membranes
Persistence in environment: Nonpersistent
Registration status: Not registered as a fish toxicant in the United States

Tobacco waste

Alternative names: Nicotine
Chemical formula: $C_{10}H_{14}N_2$
Formulation: Waste portions of tobacco plant; tobacco dust
Primary use: Fertilizer for fish ponds

Secondary use: Insecticide; fish toxicant
Mode of action: No information available
Toxicity to fish: Highly toxic (active ingredient)
Toxicity to birds: Slightly toxic
Toxicity to mammals: Highly toxic (active ingredient)
Safety hazard: No information available
Persistence in environment: No information available
Registration status: Not registered as a fish toxicant in the United States

Toxaphene

Alternative names: Chlorinated camphene, Hercules 3956, Phenacide, Phenatox®, Cooper-Tox, Melipax-Spritzmittel
Chemical formula: $C_{10}H_{10}Cl_8$
Formulation: Liquid emulsion
Primary use: Insecticide
Secondary use: Fish toxicant
Mode of action: No information available
Toxicity to fish: Extremely toxic
Toxicity to birds: Highly toxic
Toxicity to mammals: Moderately to highly toxic; rat oral LD_{50} 90 mg/kg
Safety hazard: Avoid oral or dermal exposure; protective clothing and respirator recommended
Persistence in environment: Persistent
Registration status: Not registered as a fish toxicant in the United States

Appendix D. Fish Toxicants and Candidate Fish Toxicants

Table D-1. Fish toxicants and candidate fish toxicants rated for their potential use as piscicides based on eight criteria (each of which received a rating from 1 to 5). Higher ratings indicate greater potential. No rating was assigned (indicated by –) if insufficient information was available for any criterion. Overall rating was determined by summing the criteria ratings for each chemical, dividing by the number of points possible, and converting to a percentage. Chemicals receiving overall ratings of 75 or greater are bolded and were considered good potential for use as piscicides.

Toxicant	Selectivity[a]	Ease of Application[b]	Nontarget toxicity[c]	Safety to humans[d]	Environmental persistence[e]	Bioaccumulation[f]	Cost[g]	Registration status[h]	Overall rating
Ammonia (urea)	1	1	4	4	4	4	4	3	63
Antimycin	**3**	**4**	**3**	**3**	**5**	**5**	**2**	**5**	**75**
Aqualin (acrolein)	1	2	3	2	3	3	3	1	45
Bayluscide®	**3**	**4**	**3**	**4**	**4**	**5**	**3**	**5**	**78**
Baythroid®	2	3	3	4	4	4	3	2	63
Bleaching powder and urea	2	4	3	3	4	4	4	2	65
Calcium carbide	3	3	3	3	2	3	3	2	55
Calcium hypochlorite	1	3	2	4	5	5	3	2	63
Copper sulfate pentahydrate	2	4	3	4	2	3	3	3	60
Croton seed powder	1	3	3	4	–	–	4	2	57
Cunaniol	1	3	3	–	–	–	4	2	52
DANEX-80	4	3	3	3	–	–	4	2	63
DDVP	4	3	4	3	4	3	–	2	66
Dibrom®-malathion	4	3	3	3	4	3	3	2	63
Dieldrin	2	3	2	2	1	2	4	1	43
Endosulfan	2	3	3	2	2	2	3	2	48
Endrin	2	3	2	2	2	2	3	1	43

Table D.1. Continued

Toxicant	Selectivity[a]	Ease of Application[b]	Nontarget toxicity[c]	Safety to humans[d]	Environmental persistence[e]	Bioaccumulation[f]	Cost[g]	Registration status[h]	Overall rating
Euphorbia antiquorum extract	4	3	3	–	4	4	4	3	71
GD-174	4	3	4	4	4	4	3	3	73
Guthion®	4	3	2	3	4	3	3	2	60
Ichthyothereol	2	3	2	2	.	3	–	2	47
Juglone	3	3	3	3	4	4	3	3	65
Lime	2	3	4	4	4	5	4	3	73
Limil	2	3	–	–	–	–	–	3	53
Malathion	4	3	3	3	4	3	3	2	63
Ozone	2	2	3	4	4	5	3	4	68
Phosphamidon	4	2	2	2	4	3	–	2	54
Phostoxin®	2	3	3	2	4	–	–	2	53
Polychlorpinene	2	3	2	2	1	3	–	2	43
Potassium permanganate	2	3	3	4	4	4	4	3	68
Rotenone	**2**	**4**	**4**	**4**	**4**	**4**	**3**	**5**	**75**
Salicylanilide I	2	3	3	3	4	4	3	3	63
Saponins	2	3	3	4	4	3	4	2	63
Sodium cyanide	2	3	2	1	3	3	4	1	48
Sodium fluoride	2	3	3	3	.	4	3	3	60
Sodium hydroxide	2	2	3	3	4	5	3	3	63

Table D.1. Continued

Toxicant	Selectivity[a]	Ease of Application[b]	Nontarget toxicity[c]	Safety to humans[d]	Environmental persistence[e]	Bioaccumulation[f]	Cost[g]	Registration status[h]	Overall rating
Sodium nitrite	2	3	3	4	4	5	3	3	68
Sodium pentachlorophenate	2	3	3	2	3	2	–	2	49
Sodium sulfite	3	4	4	4	4	4	3	3	73
Squoxin	**5**	**4**	**4**	**4**	**4**	**4**	**3**	**4**	**80**
Sumithion®	2	3	3	3	.	3	2	3	54
TFM	**5**	**4**	**4**	**4**	**4**	**4**	**3**	**5**	**83**
Thanite	4	3	3	3	4	3	3	3	65
Tobacco waste	2	3	3	3	3	3	4	3	60
Toxaphene	3	3	1	2	1	2	4	1	43

[a]1 means nonselective; 5 means highly selective
[b]1 means difficult to apply; 5 means easy to apply
[c]1 means toxic to nontarget organisms; 5 means relatively nontoxic
[d]1 means dangerous; 5 means safe
[e]1 means persistent; 5 means nonpersistent
[f]1 means piscicide bioaccumulates; 5 means it does not bioaccumulate
[g]1 means very expensive; 5 means relatively inexpensive
[h]1 means probably difficult to obtain registration as a piscicide; 5 means already registered as a piscicide

Appendix E. List of Studies for Pesticide Registration

The following test guidelines show studies required to register a pesticide with the U.S. Environmental Protection Agency. The actual studies required to register a pesticide are determined by the U.S. Environmental Protection Agency based on the registrant's intended use. For example, a pesticide used on ornamental plants will have different requirements than a pesticide used on food crops.

OPPTS Series 810 Test Guidelines

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
	Series 810—Product Performance Test Guidelines				
	Group A—General.				
810.1000	Overview, Definitions, and General Considerations	none	90–1, 90–3 90–30	none	98–001
	Group C—Invertebrate Control Agent Product Performance Test Guidelines.				
810.3000	General considerations for efficacy of invertebrate control agents	none	95–1	none	98–409
810.3100	Soil treatments for imported fire ants	none	95–3	none	98–410
810.3200	Livestock, poultry, fur- and wool-bearing animal treatments	none	95–8	none	98–414
810.3300	Treatments to control pests of humans and pets	none	95–9, 95–30	none	98–411
810.3400	Mosquito, black fly, and biting midge (sand fly) treatments	none	95–10	none	98–419
810.3500	Premises treatments	none	95–11, 95–30	none	98–413
810.3600	Structural treatments	none	95–12	none	98–424

Series 830—Product Properties Test Guidelines

August 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
830.1000	Background for product properties test guidelines	none	none	none	96–310
	Group A—Product Identity, Composition, and Analysis Test Guidelines.				
830.1550	Product identity and composition	none	158.155	none	96–006
830.1600	Description of materials used to produce the product	none	158.160	none	96–007
830.1620	Description of production process	none	158.162	none	96–008
830.1650	Description of formulation process	none	158.165	none	96–009
830.1670	Discussion of formation of impurities	none	158.167	none	96–010
830.1700	Preliminary analysis	none	158.170	none	96–011
830.1750	Certified limits	none	158.175	none	96–012
830.1800	Enforcement analytical method	none	158.180	none	96–013
830.1900	Submittal of samples	none	64–1	none	96–015
	Group B—Physical/Chemical Properties Test Guidelines.				
830.6302	Color	none	63–2	none	96–019
830.6303	Physical state	none	63–3	none	96–020
830.6304	Odor	none	63–4	none	96–021
830.6313	Stability to normal and elevated temperatures, metals, and metal ions	none	63–13	none	96–022
830.6314	Oxidation/reduction: chemical incompatability	none	63–14	none	96–023
830.6315	Flammability	none	63–15	none	96–024
830.6316	Explodability	none	63–16	none	96–025
830.6317	Storage stability	none	63–17	none	96–026
830.6319	Miscibility	none	63–19	none	96–027
830.6320	Corrosion characteristics	none	63–20	none	96–028
830.6321	Dielectric breakdown voltage	none	63–21	none	96–029
830.7000	pH	796.1450	63–12	none	96–030
830.7050	UV/Visible absorption	796.1050	none	101	96–031
830.7100	Viscosity	none	63–18	114	96–032
830.7200	Melting point/melting range	796.1300	63–5	102	96–033
830.7220	Boiling point/boiling range	796.1220	63–6	103	96–034
830.7300	Density/relative density/bulk density	796.1150	63–7	109	96–035
830.7370	Dissociation constants in water	796.1370	63–10	112	96–036
830.7520	Particle size, fiber length, and diameter distribution	796.1520	none	110	96–037
830.7550	Partition coefficient (*n*-octanol/water), shake flask method	796.1550	63–11	107	96–038
830.7560	Partition coefficient (*n*-octanol/water), generator column method	796.1720	63–11	none	96–039
830.7570	Partition coefficient (*n*-octanol/water), estimation by liquid chromatography	796.1570	63–11	117	96–040
830.7840	Water solubility: Column elution method; shake flask method	796.1840	63–8	105	96–041
830.7860	Water solubility, generator column method	796.1860	63–8	none	96–042
830.7950	Vapor pressure	796.1950	63–9	104	96–043

Series 835—Fate, Transport and Transformation Test Guidelines

April 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
	Group A—Laboratory Transport Test Guidelines.				
835.1110	Activated sludge sorption isotherm	none	none	none	96–298
835.1210	Soil thin layer chromatography	796.2700	none	none	96–047
835.1220	Sediment and soil adsorption/desorption isotherm	796.2750	none	106	96–048
	Group B—Laboratory Abiotic Transformation Test Guidelines.				
835.2110	Hydrolysis as a function of pH	796.3500	none	111	96–057
835.2130	Hydrolysis as a function of pH and temperature	796.3510	none	none	96–059
835.2210	Direct photolysis rate in water by sunlight	796.3700	none	none	96–060
835.2310	Maximum direct photolysis rate in air from UV/visible spectroscopy	796.3800	none	none	96–066
	Group C—Laboratory Biological Transformation Test Guidelines.				
835.3100	Aerobic aquatic biodegradation	796.3100	none	none	96–075
835.3110	Ready biodegradability	796.3180, .3200, .3220, .3240, .3260	none	301	96–076
835.3120	Sealed-vessel carbon dioxide production test	none	none	none	96–311
835.3170	Shake flask die-away test	none	none	none	96–297
835.3180	Sediment/water microcosm biogradation test	none	none	none	96–083
835.3200	Zahn-Wellens/EMPA test	796.3360	none	302B	96–084
835.3210	Modified SCAS test	796.3340	none	302A	96–085
835.3220	Porous pot test	none	none	none	96–301
835.3300	Soil biodegradation	796.3400	none	304A	96–088
835.3400	Anaerobic biodegradability of organic chemicals	796.3140	none	none	96–090
	Group D—[Reserved].				
	Group E—Transformation Chemical-Specific Test Guidelines.				
835.5045	Modified SCAS test for insoluble and volatile chemicals	795.45	none	none	96–097
835.5154	Anaerobic biodegradation in the subsurface	795.54	none	none	96–098
835.5270	Indirect photolysis screening test: Sunlight photolysis in waters containing dissolved humic substances	795.70	none	none	96–099
	Groups F-D—[Reserved].				

OPPTS Series 840 Test Guidelines

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
	Series 840—Spray Drift Test Guidelines.				
840.1000	Background for pesticide aerial drift evaluation	none	201–1, 201–4	none	98–319
840.1100	Spray droplet size spectrum	none	201–1	none	98–055
840.1200	Spray drift field deposition	none	201–1	none	98–112

Series 850—Ecological Effects Test Guidelines

April 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
850.1000	Special considerationd for conducting aquatic laboratory studies	none	none	none	96–113
	Group A—Aquatic Fauna Test Guidelines.				
850.1010	Aquatic invetebrate acute toxicity, test, freshhwater daphnids	797.1300	72–2	none	96–114
850.1020	Gammarid acute toxicity test	795.120	none	none	96–130
850.1025	Oyster acute toxicity test (shell deposition)	797.1800	72–3	none	96–115
850.1035	Mysid acute toxicity test	797.1930	72–3	none	96–136
850.1045	Penaeid acute toxicity test	797.1970	72–3	none	96–137
850.1055	Bivalve acute toxicity test (embryo larval)	none	72–3	none	96–100
850.1075	Fish acute toxicity test, freshwater and marine	797.1400	72–1, 3	203	96–118
850.1085	Fish acute toxicity mitigated by humic acid	797.1460	none	none	96–117
850.1300	Daphnid chronic toxicity test	797.1330	72–4	202	96–120
850.1350	Mysid chronic toxicity test	797.1950	72–4	none	96–166
850.1400	Fish early-life stage toxicity test	797.1000	72–4	210	96–121
850.1500	Fish life cycle toxicity	none	72–5	none	96–122
850.1710	Oyster BCF	797.1830	72–6	none	96–127
850.1730	Fish BCF	797.1520	72–6, 165–4	305	96–129
850.1735	Whole sediment acute toxicity invertebrates, freshwater	none	none	none	96–354
850.1740	Whole sediment acute toxicity invertebrates, marine	none	none	none	96–355
850.1790	Chironomid sediment toxicity test	795.135	none	none	96–313
850.1800	Tadpole/sediment subchronic toxicity test	797.1995	none	none	96–132
850.1850	Aquatic food chain transfer	none	72–6	none	96–133
850.1900	Generic freshwater microcosm test, laboratory	797.3050, .3100	none	none	96–134
850.1925	Site-specific aquatic microcosm test, laboratory	797.3100	none	none	96–173
850.1950	Field testing for aquatic organisms	none	72–7, 165–5	none	96–135
	Group B—Terrestrial Wildlife Test Guidelines.				
850.2100	Avian acute oral toxicity test	797.2175	71–1	none	96–139
850.2200	Avian dietary toxicity test	797.2050	71–2	205	96–140
850.2300	Avian reproduction test	797.2130, .2150	71–4	206	96–141
850.2400	Wild mammal acute toxicity	none	71–3	none	96–142
850.2450	Terrestrial (soil-core) microcosm test	797.3775	none	none	96–143
850.2500	Field testing for terrestrial wildlife	none	71–5	none	96–144
	Group C—Beneficial Insects and Invertebrates Test Guidelines.				
850.3020	Honey bee acute contact toxicity	none	141–1	none	96–147
850.3030	Honey bee toxicity of residues on foliage	none	141–2	none	96–148
850.3040	Field testing for pollinators	none	141–5	none	96–150
	Group D—Nontarget Plants Test Guidelines.				
850.4000	Background—Nontarget plant testing	none	120–1	none	96–151
850.4025	Target area phytotoxicity	none	121–1	none	96–152
850.4100	Terrestrial plant toxicity, Tier I (seedling emergence)	none	122–1	none	96–153
850.4150	Terrestrial plant toxicity, Tier I (vegetative vigor)	none	122–1	none	96–163
850.4200	Seed germination/root elongation toxicity test	797.2750	122–1	none	96–154
850.4225	Seedling emergence, Tier II	797.2750	123–1	none	96–363
850.4230	Early seedling growth toxicity test	797.2800	123–1	none	96–347
850.4250	Vegetative vigor, Tier II	797.2750	123–1	none	96–364
850.4300	Terrestrial plants field study, Tier III	none	124–1	none	96–155
850.4400	Aquatic plant toxicity test using *Lemna* spp. Tiers I and II	797.1160	122–2, 123–2	none	96–156
850.4450	Aquatic plants field study, Tier III	none	124–2	none	96–157
850.4600	*Rhizobium*-legume toxicity	797.2900	none	none	96–158
850.4800	Plant uptake and translocation test	797.2850	none	none	96–159
	Group E—Toxicity to Microorganisms Test Guidelines.				
850.5100	Soil microbial community toxicity test	797.3700	none	none	96–161
850.5400	Algal toxicity, Tiers I and II	797.1050	122–2, 123–2	none	96–164
	Group F—Chemical-Specific Test Guidelines.				
850.6200	Earthworm subchronic toxicity test	795.150	none	207	96–167
850.6800	Modified activated sludge, respiration inhibition test for sparingly soluble chemicals	795.170	none	209	96–168
	Group G—Field Test Data Reporting Guidelines.				
850.7100	Data reporting for environmental chemistry methods	none	none	none	96–348

Series 860—Residue Chemistry Test Guidelines

August 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
860.1000	Background	none	170–1	none	96–169
860.1100	Chemical identity	none	171–2	none	96–170
860.1200	Directions for use	none	171–3	none	96–171
860.1300	Nature of the residue—plants, livestock	none	171–4a,b	none	96–172
860.1340	Residue analytical method	none	171–4c,d	none	96–174
860.1360	Multiresidue method	none	171–4m	none	96–176
860.1380	Storage stability data	none	171–4e	none	96–177
860.1400	Water, fish, and irrigated crops	none	171–4f,g,h, 165–5	none	96–178
860.1460	Food handling	none	171–4i	none	96–181
860.1480	Meat/milk/poultry/eggs	none	171–4j	none	96–182
860.1500	Crop field trials	none	171–4k	none	96–183
860.1520	Processed food/feed	none	171–4l	none	96–184
860.1550	Proposed tolerances	none	171–6	none	96–186
860.1560	Reasonable grounds in support of the petition	none	171–7	none	96–187
860.1650	Submittal of analytical reference standards	none	171–13	none	96–016
860.1850	Confined accumulation in rotational crops	none	165–1	none	96–188
860.1900	Field accumulation in rotational crops	none	165–2	none	96–189

870–Health Effects Test Guidelines

Revised June 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
	Group A—Acute Toxicity Test Guidelines.				
870.1000	Acute toxicity testing–background	none	none	none	96–189
870.1100	Acute oral toxicity	798.1175	81–1	401	96–190
870.1200	Acute dermal toxicity	798.1100	81–2	402	96–192
870.1300	Acute inhalation toxicity	798.1150	81–3	403	96–193
870.1350	Acute inhalation toxicity with histopathology	none	none	none	96–291
	Group B—Specific Organ/Tissue Toxicity Test Guidelines.				
870.2400	Acute eye irritation	798.4500	81–4	405	96–195
870.2500	Acute dermal irritation	798.4470	81–5	404	96–196
870.2600	Skin sensitization	798.4100	81–6	406	96–197
	Group C—Subchronic Toxicity Test Guidelines.				
870.3100	90-Day oral toxicity	798.2650	82–1	408	96–199
870.3150	Subchronic nonrodent oral toxicity–90-day	none	82–1	409	98–200
870.3200	Repeated dose dermal toxicity–21/28-Day	none	82—2	410	96–201
870.3250	Subchronic dermal toxicity–90-day	798.2250	82–3	411	96–202
870.3465	Subchronic inhalation toxicity	798.2450	82–4	413	96–204
870.3500	Preliminary development toxicity screen	798.4420	none	none	96–205
870.3600	Inhalation developmental study	796.4350	none	none	96–206
870.3700	Prenatal developmental toxicity study	798.4900	83–3	414	96–207
870.3800	Reproduction and fertility effects	798.4700	83–4	416	96–208
	Group D—Chronic Toxicity Test Guidelines.				
870.4100	Chronic toxicity	798.3260	83–1	452	96–210
870.4200	Carcinogenicity	798.3300	83–2	451	96–211
870.4300	Combined chronic toxicity/carcinogenicity	798.3320	83–5	453	96–212
	Group E—Genetic Toxicity Test Guidelines.				
870.5100	Bacterial reverse mutation test	798.5100, .5265	84–2	471, 472	96–247
870.5140	Gene mutation in *Aspergillus nidulans*	798.5140	84–2	none	96–215
870.5195	Mouse biochemical specific locus test	798.5195	84–2	none	96–216
870.5200	Mouse visible specific locus test	798.5200	84–2	none	96–217
870.5250	Gene mutation in *Neurospora crassa*	798.5250	84–2	none	96–218
870.5265	*The Salmonella typhimurium* reverse mutation assay	798.5265	84–2	471, 472	96–219
870.5275	Sex-linked recessive lethal test in *Drosophila melanogaster*	798.5275	84–2	477	96–220
870.5300	In vitro mammalian cell gene mutation test	798.5300	84–2	476	96–221
870.5375	In vitro mammalian chromosome aberration test	798.5375	84–2	473	96–223
870.5380	Mammalian spermatogonial chromosomal aberration test	798.5380	84–2	483	96–224
870.5385	Mammalian bone marrow chromosomal aberration test	798.5385	84–2	475	96–225
870.5395	Mammalian erythrocyte micronucleus test	798.5395	84–2	474	96–226
870.5450	Rodent dominant lethal assay	798.5450	84–2	478	96–227
870.5460	Rodent heritable translocation assays	798.5460	84–2	none	96–228
870.5500	Bacterial DNA damage or repair tests	798.5500	84–2	none	96–229
870.5550	Unscheduled DNA synthesis in mammalian cells in culture	798.5550	84–2	482	96–230
870.5575	Mitotic gene conversion in *Saccharomyces cerevisiae*	798.5575	84–2	481	96–232
870.5900	In vitro sister chromatid exchange assay	798.5900	84–2	479	96–234
870.5915	In vivo sister chromatid exchange assay	798.5915	84–2	none	96–235
	Group F—Neurotoxicity Test Guidelines.				
870.6100	Acute and 28-day delayed neurotoxicity of organophosphorus substances	798.6450, .6540, .6560	81–7, 82–5, 82–6	418, 419	96–237
870.6200	Neurotoxicity screening battery	798.6050, .6200, .6400	81–8, 82–7, 83–1	424	96–238
870.6300	Developmental neurotoxicity study	none	83–6	none	98–239
870.6500	Schedule-controlled operant behavior	796.6500	85–5	none	98–240
870.6850	Peripheral nerve function	796.6850	85–6	none	98–241
870.6855	Neurophysiology: Sensory evoked potentials	796.6855	none	none	98–242
	Group G—Special Studies Test Guidelines.				
870.7200	Domestic animal safety	none	none	none	96–349
870.7485	Metabolism and pharmacokinetics	798.7485	85–1	417	95–244
870.7600	Dermal penetration	none	85–3	none	96–350
870.7800	Immunotoxicity	none	85–7	none	98–351
	Group H—Health Effects Chemical-Specific Test Guidelines.				
870.8223	Pharmacokinetic test	795.223	none	none	96–250

870–Health Effects Test Guidelines—Continued

Revised June 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
870.8245	Dermal pharmacokinetics of DGBE and DGBA	795.225	none	none	96–251
870.8300	Dermal absorption for compounds that are volatile and metabolized to carbon dioxide	795.226	none	none	96–252
870.8320	Oral/dermal pharmacokinetics	795.228	none	none	96–253
870.8340	Oral and inhalation pharmacokinetic test	795.230	none	none	96–254
870.8355	Combined chronic/toxicity carcinogenicity testing of respirable fibrous particles	798.3320	none	none	99–352
870.8360	Pharmacokinetics of isopropanol	795.231	none	none	96–255
870.8380	Inhalation and dermal pharmacokinetics of commercial hexane	795.232	none	none	96–256
870.8500	Toxicokinetic test	795.235	none	none	96–257
870.8600	Developmental neurotoxicity screen	795.250	none	none	96–258
870.8700	Subchronic oral toxicity test	795.260	none	none	96–259
870.8800	Morphologic transformation of cells in culture	795.285	none	none	96–260

Series 875—Occupational and Residential Exposure Test Guidelines

February 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
	Group A—Applicator Exposure Monitoring Test Guidelines.				
875.1000	Background for application exposure monitoring test guidelines	none	230	none	96–261
875.1100	Dermal exposure—outdoor	none	231	none	96–262
875.1200	Dermal exposure—indoor	none	233	none	96–209
875.1300	Inhalation exposure—outdoor	none	232	none	96–263
875.1400	Inhalation exposure—indoor	none	234	none	96–213
875.1500	Biological monitoring	none	235	none	96–264
875.1600	Application exposure monitoring data reporting	none	236	none	96–265
	Group B—Postapplication Exposure Monitoring Test Guidelines.				
875.2000	Background for postapplication exposure monitoring test guidelines	none	130, 131	none	96–266
875.2100	Foliar dislodgeable residue dissipation	none	132–1	none	96–267
875.2200	Soil residue dissipation	none	132–1	none	96–243
875.2400	Dermal exposure	none	133–3	none	96–269
875.2500	Inhalation exposure	none	133–4	none	96–270
875.2600	Biological monitoring	none	235	none	96–271
875.2800	Descriptions of human activity	none	133–1	none	96–283
875.2900	Data reporting and calculations	none	134	none	96–272

Series 880—Biochemicals Test Guidelines

February 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
	Group A—Product Analysis Test Guidelines.				
880.1100	Product identity and composition	none	151–10	none	96–273
880.1200	Description of starting materials, production and formulation process	none	151–11	none	96–274
880.1400	Discussion of formation of impurities	none	151–12	none	96–275
	Group B—Toxicology Test Guidelines.				
880.3550	Immunotoxicity	none	152–18	none	96–280
880.3800	Immune response	none	152–24	none	96–281
	Group C—Nontarget Organisms and Environmental Testing Test Guidelines.				
880.4350	Nontarget insect testing	none	154–11	none	96–285
880.4425	Dispenser water leaching	none	155–5	none	96–286

Series 885—Microbial Pesticide Test Guidelines

February 1996

OPPTS Number	Name	Existing Numbers			EPA Pub. no.
		OTS	OPP	OECD	712–C–
885.0001	Overview for microbial pest control agents	none	150A	none	96–290
	Group A—Product Analysis Test Guidelines.				
885.1100	Product identity	none	151A–10	none	96–292
885.1200	Manufacturing process	none	151A–11	none	96–293
885.1300	Discussion of formation of unintentional ingredients	none	151A–01	none	96–294
885.1400	Analysis of samples	none	151A–13	none	96–295
885.1500	Certification of limits	none	151A–15	none	96–296
	Group B—Residues Test Guidelines.				
885.2000	Background for residue analysis of microbial pest control agents	none	153A–1	none	96–299
885.2100	Chemical identity	none	153A–4	none	96–300
885.2200	Nature of the residue in plants	none	153A–6	none	96–302
885.2250	Nature of the residue in animals	none	153A–7	none	96–311
885.2300	Analytical methods—plants	none	153A–8a	none	96–301
885.2350	Analytical methods—animals	none	153A–8b	none	96–305
885.2400	Storage stability	none	153A–9	none	96–306
885.2500	Magnitude of residues in plants	none	153A–10	none	96–307
885.2550	Magnitude of residues in meat, milk, poultry, eggs	none	153A–11	none	96–308
885.2600	Magnitude of residues in potable water, fish, and irrigated crops	none	153A–01	none	96–309
	Group C—Toxicology Test Guidelines.				
885.3000	Background–mammalian toxicity/pathogenicity/infectivity	none	152A–1	none	96–314
885.3050	Acute oral toxicity/pathogenicity	none	152A–10	none	96–315
885.3100	Acute dermal toxicity/pathology	none	152A–11	none	96–316
885.3150	Acute pulmonary toxicity/pathogenicity	none	152A–12	none	96–317
885.3200	Acute injection toxicity/pathogenicity	none	152A–13	none	96–318
885.3400	Hypersensitivity incidents	none	152A–15	none	96–320
885.3500	Cell culture	none	152A–16	none	96–321
885.3550	Acute toxicology, Tier II	none	152A–20	none	96–322
885.3600	Subchronic toxicity/pathogenicity	none	152A–21	none	96–323
885.3650	Reproductive/fertility effects	none	152A–30	none	96–324
	Group D—Nontarget Organism and Environmental Expression Test Guidelines.				
885.4000	Background for nontarget organism testing of microbial pest control agents	none	154A–1, 2, 3, 4, 5	none	96–328
885.4050	Avian oral, Tier I	none	154A–16	none	96–329
885.4100	Avian inhalation test, Tier I	none	154A–17	none	96–330
885.4150	Wild mammal testing, Tier I	none	154A–18	none	96–331
885.4200	Freshwater fish testing, Tier I	none	154A–19	none	96–332
885.4240	Freshwater aquatic invertebrate testing, Tier I	none	154A–20	none	96–333
885.4280	Estuarine and marine animal testing, Tier I	none	154A–21	none	96–334
885.4300	Nontarget plant studies, Tier I	none	154A–22	none	96–335
885.4340	Nontarget insect testing, Tier I	none	154A–23	none	96–336
885.4380	Honey bee testing, Tier I	none	154A–24	none	96–337
885.4600	Avian chronic pathogenicity and reproduction test, Tier III	none	154A–26	none	96–342
885.4650	Aquatic invertebrate range testing, Tier III	none	154A–27	none	96–343
885.4700	Fish life cycle studies, Tier III	none	154A–28	none	96–344
885.4750	Aquatic ecosystem test	none	154A–29	none	96–345
	Group E—Environmental Expression Test Guidelines.				
885.5000	Background for microbial pesticides testing	none	155A–1, 2	none	96–056
885.5200	Expression in a terrestrial environment	none	155A–10	none	96–338
885.5300	Expression in a freshwater environment	none	155A–11	none	96–339
885.5400	Expression in a marine or estuarine environment	none	155A–12	none	96–340

Appendix F. Current Labels for All Piscicide Formulations Currently Registered in the United States and Material Safety Data Sheets for the Active Ingredients in Those Piscicide Formulations

Included in Appendix F:

Labels for Registered Piscicide Formulations in the United States

Label for Fintrol® Concentrate (23% antimycin A)

Label for Rotenone Fish Toxicant Powder (7.4% active rotenone)

Label for Prentox® Prenfish™ Fish Toxicant Powder (5% active rotenone)

Synpren-fish® Toxicant (2.5% active rotenone)

Lampricid® (38% active TFM)

TFM Bar (23% active TFM)

Bayluscide® Wettable Powder (70% active niclosamide, aminoethanol salt)

Bayluscide® Granular (3.2% active niclosamide, aminoethanol salt)

Bayluscide® Emulsifiable Concentrate (20.6% active niclosamide, aminoethanol salt)

Material Safety Data Sheets for Registered Piscicide Formulations in the United States

Antimycin A

Prentox® Prenfish™ Fish Toxicant Powder (rotenone)

TFM

Bayluside Technical

Label for Fintrol® Concentrate (23% Antimycin A)

RESTRICTED USE PESTICIDE

Due to Aquatic Toxicity & Need for Highly Specialized Applicator training.

For retail sale to, and use only by, Certified Applicators, or persons under their direct supervision, and only for those uses covered by the Certified Applicators' Certification.

FINTROL®-

CONCENTRATE (ANTIMYCIN A) FISH TOXICANT KIT

(contains Fintrol Concentrate and Fintrol Diluent)

This can contains 1 bottle of FINTROL-Concentrate and 1 bottle of Fintrol-Diluent.

FINTROL CONCENTRATE (8 fl. Oz.)		
Active Ingredients		
Antimycin A	23%	w/w
Inert Ingredients		
Soy lipids	15%	
Acetone	62%	
	100%	w/w

FINTROL DILUENT (8 fl. Oz.)		
Inert Ingredients		
Diethyl Phthalate (surfactant)	30.5%	w/w
Nonoxyl-9 (detergent)	16.7%	
Acetone	52.8%	
	100.0%	w/w

AQUABIOTICS CORP. P.O. BOX 10576. Bainbridge Island, WA 98110
E.P.A. Reg. No 39096-2 E.P.A. Est. No 39096-WA-01

DANGER  **POISON**

Keep out of reach of children

See side panel for other Precautionary Statements.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling. See "USE DIRECTIONS LEAFLET" for "Fintrol (Antimycin A) Fish Toxicant Kit"

TAKE TIME

OBSERVE LABEL DIRECTIONS

FINTROL-® CONCENTRATE

(antimycin A) (solution 20%)

PRECAUTIONARY STATEMENTS
Hazards to Humans and Domestic Animals

DANGER: Fatal if swallowed. May be fatal if absorbed through skin. Causes substantial but temporary eye injury. Causes skin irritation. Do not breathe spray mist. Do not get in eyes, on skin or on clothing. Wear protective goggles. Wear chemical gloves. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

Environmental Hazards
This product is very highly toxic to fish.

STORAGE AND DISPOSAL
Do not contaminate water, food or feed by storage or disposal. SEE OUTER CAN LABEL FOR PROPER STORAGE, PESTICIDE DISPOSAL AND CONTAINER DISPOSAL

EPA Reg. No. 39096-2
EPA Est. No. 39096-WA-01

Fintrol Concentrate for use with Fintrol (Antimycin) Fish Toxicant Kit

Ingredients	(w/w%)
Active Ingredients	
Antimycin A	23%
Inert Ingredients	
Soy lipids	15%
Acetone	62%
	100%

DANGER

POISON

KEEP OUT OF REACH OF CHILDREN

Aquabiotics Corp.
PO Box 10576
Bainbridge Island, WA

Physical or Chemical Hazards:
Extremely Flammable: Keep away from fire, sparks and heated surfaces.
FIRST AID IF SWALLOWED: Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. If person is unconscious, do not give anything by mouth and do not induce vomiting.
IF INHALED: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.
IF ON SKIN: Wash with plenty of soap and water. Get medical attention.
IF IN EYES: Hold eyelids open and flush with a steady, gentle stream of water for 15 minutes. Get medical attention.
DIRECTIONS FOR USE
It is a violation of federal law to use this product in a manner inconsistent with its labeling. See "USE DIRECTIONS LEAFLET" for "FINTROL (Antimycin A) Fish Toxicant Kit".

FINTROL CONCENTRATE
PRECAUTIONARY STATEMENTS
Hazards to Humans and Domestic Animals

DANGER: Fatal if swallowed. May be fatal if absorbed through skin. Causes substantial but temporary eye injury. Causes skin irritation. Do not breath spray mist. Do not get in eyes, on skin or on clothing. Wear protective goggles. Wear chemical gloves. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

Environmental Hazards
This product is very highly toxic to fish
Physical or Chemical Hazards

Extremely Flammable: Keep away from fire, sparks and heated surfaces.

FIRST AID: IF SWALLOWED: Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. If person is unconscious, do not give anything by mouth and do not induce vomiting.

IF INHALED: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

IF ON SKIN: Wash with plenty of soap and water. Get medical attention.

IF IN EYES: Hold eyelids open and flush with a steady, gentle stream of water for 15 minutes. Get medical attention.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store only in original containers, in a dry place inaccessible to children and pets. Fintrol Concentrate will thicken if stored at temperatures below 65 F. Before use store overnight above 70 F. Fintrol Concentrate is stable for a minimum of 3 years when stored in unopened original glass bottles.

Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of federal law. If these wastes cannot be disposed of by use according to label instructions, contact your state pesticide or environmental Control Agency or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Disposal: Triple rinse (or equivalent). Then dispose of in a sanitary landfill or by other approved state and local procedures.

TAKE TIME

OBSERVE LABEL DIRECTIONS

FINTROL DILUENT

FOR USE WITH

PRECAUTIONARY STATEMENTS
Hazards to Humans & Domestic Animals

CAUTION: Harmful if swallowed. Harmful if inhaled. Harmful if absorbed through skin. Causes moderate eye irritation. Avoid contact with skin and clothing. Do not breathe spray mist. Do not get in eyes, on skin or on clothing. Wear protective goggles. Wear chemical gloves. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

Physical or Chemical Hazards:
Extremely Flammable: Keep away from fire, sparks and heated surfaces.

First Aid: See Outer Can Label

EPA Reg. No. 39096-2
EPA Est. No. 39096-WA-01

FINTROL®

(Antimycin)

Fish Toxicant Kit

Ingredients	(w/w%)
Inert Ingredients	
Diethyl Phthalate (surfactant)	30.5%
Nonoxyl-9 (detergent)	16.7%
Acetone	52.8%
	100%

CAUTION
Keep out of reach of children

DIRECTIONS FOR USE
It is a violation of federal law to use this product in a manner inconsistent with its labeling. See "USE DIRECTIONS LEAFLET" for FINTROL (Antimycin A) Fish Toxicant Kit.

STORAGE AND DISPOSAL
Do not contaminate water, food or feed by storage or disposal. SEE OUTER CAN LABEL FOR PROPER STORAGE, PESTICIDE DISPOSAL AND CONTAINER DISPOSAL.

AQUABIOTICS CORP.
P.O. Box 10576
Bainbridge Island, WA 98110

FINTROL DILUENT
PRECAUTIONARY STATEMENTS
Hazards to Humans and Domestic Animals

CAUTION: Harmful if swallowed. Harmful if inhaled. Harmful if absorbed through skin. Causes moderate eye irritation. Avoid contact with skin and clothing. Do not breath spray mist. Do not get in eyes, on skin or on clothing. Wear protective goggles. Wear chemical gloves. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

Physical or Chemical Hazards

EXTREMELY FLAMMABLE: KEEP AWAY FROM FIRE, SPARKS AND HEATED SURFACES.

FIRST AID

IF SWALLOWED: Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. If person is unconscious, do not give anything by mouth and do not induce vomiting.

IF INHALED: Remove victim to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

IF ON SKIN: Wash with plenty of soap and water. Get medical attention.

IF IN EYES: Hold eyelids open and flush with a steady, gentle stream of water for 15 minutes. Get medical attention.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store only in original containers, in a dry place inaccessible to children and pets. Fintrol Concentrate will thicken if stored at temperatures below 65 F. Before use store overnight above 70 F. Fintrol Concentrate is stable for a minimum of 3 years when stored in unopened original glass bottles.

Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of federal law. If these wastes cannot be disposed of by use according to label instructions, contact your state pesticide or environmental Control Agency or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Disposal: Triple rinse (or equivalent). Then dispose of in a sanitary landfill or by other approved state and local procedures.

FINTROL®

Fish Toxicant Kit

Use Direction Leaflet

Directions For Use

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

FINTROL-CONCENTRATE is designed for use in running water, streams and shallow waters. This liquid form of FINTROL may be applied to lakes and ponds by boat bailer method or spray equipment. Spray methods are useful at depths to 1 foot. Boat bailer and drip tubes, applied at the propeller wash, are used at other depths. Application from an airplane is NOT recommended.

Each can of Fintrol-Concentrate (Antimycin A) Fish Toxicant Kit [containing 240 cc. Fintrol-Concentrate (solution 20%) and 240 cc. Diluent] will, after mixing, make 480 cc., which treats approximately 38 acre-feet of water at 1 p.p.b. (1 part per billion)

AQUABIOTICS CORP.
P.O. Box 10576
10750 Arrow Point Dr. NE
Bainbridge Island, WA 98110

EPA Reg. No. 39096-2
EPA Est. No. 39096-WA-01

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Trademark licensed by: Ayerst Laboratories, Inc.

Before applying FINTROL to either public or private waters, contact the Director of the State Fish and Game Department or Conservation Department for State and Federal regulations governing the use of fish toxicants in your area.

DESCRIPTION

The active ingredient of FINTROL is antimycin A. When absorbed through the gills of fish, antimycin A kills by interfering with the respiration of body cells. Antimycin A does not repel fish. This is an important advantage, particularly when running waters, bog lakes, and the epilimnion, or upper layer, of large lakes are treated. Fish make no attempt to escape contact with the toxicant by seeking to move into waters that are clear of it. FINTROL'S action is rapid and irreversible.

Sensitivity to FINTROL varies widely among fish species. Hence it may be employed to selectively destroy certain species, without affecting other species concurrently inhabiting the same body of water.

Sensitive:
Gizzard shad, trouts, pikes, carp, minnows, suckers, brook stickleback, white bass, sunfishes, perches, freshwater drum, sculpins.

Least Sensitive:
Shortnose gar, bowfin, goldfish, catfish.

FINTROL also may be used to selectively destroy certain age groups of species; younger fish are more sensitive to FINTROL.

Providing the concentration is correctly estimated, FINTROL can be used effectively at any time of year in either cold, warm, soft, hard, acid, alkaline, clear or turbid (muddy) waters. (See TABLE 1 and instruction for bioassay.)

FINTROL does not impart detectable taste or odor to treated waters. In the usual, recommended concentrations it causes no apparent harm to aquatic plants, insects, or bottom fauna. Since FINTROL'S active ingredient degrades rapidly, the reclaimed waters may be restocked soon after treatment. **(See HOW TO DETERMINE WHEN TREATED WATER MAY BE RESTOCKED.)** There is very little interruption in availability of the waters for recreational, agricultural, industrial, or other purpose.

USES

FINTROL is used to cull undesirable species of fish from freshwater lakes, ponds, and streams. It can be used to eliminate all fish from a body of water (complete kill). Or, it can be used to remove only certain fish species or size groups from mixed populations (selective kill).

A **complete kill** may be achieved with a concentration of anywhere from 5 to 25 p.p.b. of active ingredient. **(See HOW TO DETERMINE THE MOST EFFECTIVE CONCENTRATION.)** FINTROL is particularly advantageous for complete kills because if detoxifies so rapidly the pond can usually be restocked in about a week, or as soon as caged fish survive 48 hours' exposure to the treated waters.

Under optimal circumstances, in ponds managed for sports fishing, **selective kills** may be achieved at concentrations as low as 0.5 to 1.0 p.p.b. However, because these concentrations are extremely low, there is no rule of thumb that can be relied upon to determine them accurately. A BIOASSAY IS ALWAYS REQUIRED TO PINPOINT THE OPTIMAL CONCENTRATION FOR SELECTIVE KILLS. (Literature describing this procedure is available upon request.)

A **selective kill** has these advantages: It can be made without interrupting sport fishing for more than a week or so, and fishing may be gradually improved without restocking. In the past, when bluegill, minnows, or green sunfish dominated a pond managed for bass, the usual solution to the problem was the total removal of all the fish with a fish toxicant. This meant restocking and little or no fishing for one or two years. Now — with FINTROL — this is no longer necessary. Low concentrations of FINTROL will affect small bluegill, green sunfish, and minnows primarily. Only a few of the very small bass will succumb. The bulk of the adult bluegill and green sunfish will not be affected. Thus FINTROL helps to bring about a balanced relationship between the bass and bluegill populations. This improves fishing without interrupting it for any appreciable length of time.

In **catfish farming** FINTROL can be used to *selectively eliminate* the trash fish (scale fish) that commonly reduce the yields and increase the costs of the commercial catfish farmer. It is possible to do this with FINTROL because concentrations that will eliminate scale fish generally will not harm adult catfish. The scale fish most often encountered by the catfish farmer will succumb to anywhere from 5 to 10 p.p.b. of active ingredient (See TABLE 1) whereas, under ordinary circumstances, it takes in excess of 20 p.p.b. to kill catfish. (Caution should be exercised during stress conditions of unusually high water temperature and reduced oxygen content when the sensitivity of fishes to chemicals may increase.)

HOW TO SELECT THE APPROPRIATE FORMULATION

The nature of the water to be treated (its depth and rate of flow) and the character of the surrounding land are factors to be taken into consideration when determining the formulation of FINTROL to employ in a given situation.

HOW TO DETERMINE THE MOST EFFECTIVE CONCENTRATION

For complete kills and also,
for removal of scale fish from catfish ponds.
The concentration of antimycin A required to kill one or more species of fish in any given body of water depends upon: 1) the sensitivity of the species to be eradicated, and 2) the chemical and physical properties of the water at the time of application of the toxicant; the pH and the temperature of the water are the most important of these chemical and physical factors under ordinary circumstances. Therefore, to determine what concentration of antimycin A will be required to kill the undesirable fish in your pond or lake:

1) identify the species to be eradicated,
2) determine the pH and average water temperature by measuring at various sites and depths,
3) refer to TABLE 1 for approximate concentrations.
4) conduct a bioassay to pinpoint the optimal concentration.

TABLE 1 provides a rough estimate of the concentrations required for a **complete kill** under various environmental conditions. However, since water chemistry is subject to sudden alteration by many variables and often unpredictable factors (pollution, heavy algae bloom, weather, drawdown, etc.) it should be realized that such changes may affect the performance of the toxicant. For this reason, measurements of pH and water temperature should always be taken as close to the time of treatment as is feasible.

TABLE 1—FOR ROUGH ESTIMATION OF CONCENTRATIONS* OF FINTROL (ANTIMYCIN A) NEEDED FOR COMPLETE† ERADICATION OF DIFFERENT FISH SPECIES, UNDER VARIOUS COMBINATION OF WATER TEMPERATURE AND WATER pH

TARGET SPECIES	SENSITIVITY OF TARGET SPECIES TO FINTROL (in p.p.b. of active ingredient)	EFFECTIVE CONCENTRATION OF FINTROL* (in p.p.b. of active ingredient)			
		When pH is 8.5 or less		When pH is 8.5 or more	
		water temperature above 60°F.	water temperature below 60°F.	water temperature above 60°F.	water temperature below 60°F
gizzard shad trouts pikes carp minnows suckers brook stickleback white bass sunfishes perches freshwater drum sculpins	5-10	5	7.5	7.5	10
short nose gar bowfin goldfish catfish	15-25	15	20	20	25

***The concentration level suggested by this table should be confirmed by an on-site bioassay.**

† This table is applicable only when a *complete* kill is desired. Do not use it for a selective kill. (See the following section.)

* Fish nomenclature according to American Fisheries Society

Note (columns 1 and 2) that the sensitivity of the target species determines the concentration range. To eradicate sensitive species, it is recommended that the appropriate formulation at FINTROL be applied so that the body of water will have a concentration of from 5 to 10 p.p.b. of antimycin A, depending upon variation in pH and water temperature. For more tolerant species, higher concentrations are recommended. Laboratory Studies indicate that less sensitive fish will succumb at concentrations of from 15 to 25 p.p.b of antimycin A, depending upon variations in pH and water temperature. Columns 3 to 6 show how to adjust for pH and water temperature. Note that, in general, the lower the pH, the less FINTROL required. The higher the water temperature, the less FINTROL required. The ideal situation for a complete kill would combine a highly sensitive species, low pH and high water temperature.

For selective kills in ponds managed for sports fishing

The only way to determine the concentration of FINTROL needed for a selective kill is to perform a bioassay. This involves subjecting both the target and nontarget fish to several concentrations of FINTROL to determine the minimum lethal dose. (A description of the bioassay procedure is available upon request.)

HOW TO CALCULATE THE AMOUNT OF FINTROL TO BE ADDED TO A BODY OF WATER TO OBTAIN A GIVEN CONCENTRATION

To calculate the amount of FINTROL to be added to a body of water for eradication of undesired species, the following steps should be taken:

- Determine the volume of water to be treated in acre-feet. This can be arrived at by multiplying the surface area in acres by the average depth in feet.
- Determine the concentration to be used from Table 1.
- Multiply the number of acre-feet by the value given in Table 2, opposite the desired concentration.
- Divide this number by the total kit volume (480 cc. or 16 oz.) to get number of Fish Toxicant Kits needed.

TABLE 2—RAPID ESTIMATION OF FINTROL-CONCENTRATE REQUIREMENTS

Desired Concentration (p.p.b. active ingredient)	Amount of FINTROL-CONCENTRATE per acre-foot	
	cc*	oz.(approx.)
1 p.p.b	12.3	½
2 p.p.b.	24.6	¾
3 p.p.b.	36.9	1¼
4 p.p.b.	49.2	1½
5 p.p.b.	61.5	2
6 p.p.b.	73.8	2½
7 p.p.b.	86.1	2¾
8 p.p.b.	98.4	3¼
9 p.p.b.	110.7	3¾
10 p.p.b.	123.0	4

*Obtained by multiplying 12.3 cc. by the p.p.b.

Note: 1 measuring teaspoon = 5 cc.; 1 measuring tablespoon = 15 cc.; ¼ standard measuring cup = 60 cc.; ½ standard measuring cup = 120 cc.; 1 standard meas. cup = 240 cc.

Sample calculation:

To treat 75 acre-feet at 3 p.p.b., use:

75 x 36.9 cc = 2,767 cc. of FINTROL-CONCENTRATE / 480 cc. = 5.8 Kits, or

75 x 1¼ fl. oz. = 93¾ fl. oz. of FINTROL-CONCENTRATE / 16 oz = 5.8 kits).

METHODS OF APPLICATION

IMPORTANT: DURING APPLICATION OF FINTROL, ALL PERSONS IN THE IMMEDIATE VICINITY SHOULD WEAR PROTECTIVE GOGGLES AND PROTECTIVE GLOVES

Liquid formulation: Directions for mixing: Add the Diluent [blue label] to the FINTROL CONCENTRATE (solution 20%) [Green label] in the oversize mixing container. Cap tightly and invert 2 to 3 times to mix thoroughly. Further dilute with AT LEAST five (5) gallons of water to insure that the acetone contained in FINTROL-CONCENTRATE will not affect rubber parts on any equipment that might be used to apply it. After water has been added, apply within eight (8) hours. [Note: The solution obtained by mixing the Diluent with FINTROL-CONCENTRATE (solution 20%) retains potency for up to seven (7) days. But once water has been added to this solution, it must be used within eight (8) hours to ensure potency.]

After appropriate dilution with water, the liquid formulation of FINTROL can be applied to lakes and ponds by the boat bailer method or spray equipment. Spray methods are useful at depths to one foot. Boat bailer and drip tubes when applied at the propeller wash are useful at greater depths. Pinpoint applications to shoal areas and small, isolated ponds can readily be made with backpack sprayers. (See CAUTION on use of PROTECTIVE GOGGLES AND PROTECTIVE GLOVES.)

In streams, FINTROL-CONCENTRATE is most often applied through drip stations established to meter the toxicant at a precalculated rate. Information on the use of such equipment may be obtained from state and/or federal agencies, experienced in stream treatment.

It is recommended that all applications of FINTROL be made at daybreak or as soon as there is enough light to work by.

PRECAUTIONS

Fish killed with antimycin A should not be consumed by man or animals. Treated waters must not be used for drinking by man or animals, or for crop irrigation, until fingerling rainbow trout or fingerling bluegills survive 48 hours' exposure in livecars in the treated waters.

Leftover portions of mixed liquid formulation retain potency for up to seven (7) days. But once water has been added to FINTROL-CONCENTRATE, it must be used within eight (8) hours to ensure potency.

Due to its acetone component, FINTROL-CONCENTRATE is flammable: keep away from heat and flame.

HOW TO DETERMINE WHEN TREATED WATER MAY BE RESTOCKED

Since antimycin A degrades rapidly following application, waters can usually be restocked about one week following treatment with FINTROL. Place livecars containing a sensitive species of fish in the treated water. It is recommended that these fish be fingerling rainbow trout or fingerling bluegills if the water temperature is between 35° and 68° F. When the water temperature exceeds 68° F, only fingerling bluegills should be used. If the fish survive for 48 hours, the water may be restocked.

HOW TO DETOXIFY FINTROL WITH POTASSIUM PERMANGANATE ($KMnO_4$)

If it should be necessary to detoxify FINTROL in the outflow of a pond to prevent killing fish downstream, apply potassium permanganate at 1 part per million (1 p.p.m.) to the outflow. (More potassium permanganate may be needed if the stream has a high permanganate demand). Drip systems of hose-and-clamp or carburetor types can be employed to continuously dispense a solution of potassium permanganate into the water at the discharge outlet.

To evaluate the effectiveness of the detoxification process, place livecars containing fingerling rainbow trout or fingerling bluegills approximately 100 yards downstream from the site of $KMnO_4$ introduction. The water is considered detoxified if the fish survive for at least 48 hours in the livecar.

To detoxify FINTROL-treated streams, apply $KMnO_4$ at 1 p.p.m. at detoxification stations. (More $KMnO_4$ may be needed if the stream has a high permanganate demand). Continue the application of $KMnO_4$ until all FINTROL-treated water has passed the station. The water may be considered detoxified when fingerling rainbow trout or fingerling bluegills survive for at least 48 hours in livecars placed 100 yards downstream from the site of potassium permanganate ($KMnO_4$) introduction.

RE-ENTRY STATEMENT

Do not allow swimming in, drinking, or irrigation with FINTROL (Antimycin) treated water until a livecar of sensitive species of fish (fingerling rainbow trout or bluegill) survive for 48 hours in the treated waters. (See statement of How To Determine When Treated Water May Be Restocked).

SPECIAL INSTRUCTIONS

Prior to the use of a fish toxicant in either public or private waters, the Director of the State Fish and Game Department or Conservation Department must be contacted to determine whether a permit is required. Such products must be used by or under the technical supervision of personnel of state and federal fish and game agencies, trained in fisheries management, who will provide any special instructions applicable to the particular geographical area.

Label for Rotenone Fish Toxicant Powder (7.4% active rotenone)

RESTRICTED USE PESTICIDE
DUE TO AQUATIC, ACUTE ORAL AND INHALATION TOXICITY
For retail sale to, and use by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

ROTENONE FISH TOXICANT POWDER

ACTIVE INGREDIENTS:

Rotenone- Minimum Guaranteed	7.4% w/w
Other Associated Resins	11.1%
OTHER INGREDIENTS:	81.5%
TOTAL:	100.0% w/w

ROTENONE ASSAY _____% ROTENONE

PRENTOX® - Registered Trademark of Prentiss Incorporated

KEEP OUT OF REACH OF CHILDREN

DANGER
POISON

FIRST AID
Have the product container or label with you when calling a poison control center or physician, or going for treatment.

If swallowed	• Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the Poison Control Center or physician. • Do not give anything by mouth to an unconscious or convulsing person.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a Poison Control Center, physician, or the National Pesticide Information Center at 1-800-858-7378 for treatment advice.

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

SEE INSIDE LEAFLET FOR ADDITIONAL PRECAUTIONARY STATEMENTS AND DIRECTIONS FOR USE

Manufactured by: 5/02 **E.P.A. REG. NO. 655-691**
E.P.A. EST. NO. 655-GA-1

PRENTISS INCORPORATED

Plant: Kaolin Road, Sandersville, GA 31082
Office: C.B. 2000, Floral Park, NY 11002-2000

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER

Fatal if inhaled or swallowed. Harmful if absorbed through the skin. Causes moderate eye irritation. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Do not breathe dust. Use a dust/mist filtering respirator (MSHA/NIOSH approval number prefix TC-21C), or a NIOSH approved respirator with any N, R, P or HE filter. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash clothing before reuse.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to fish. Fish kills are expected at recommended rates. Consult your State Fish and Game Agency before applying this product to public waters to determine if a permit is needed for such an application. Do not contaminate untreated water when disposing of equipment washwaters.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
STORAGE: Store only in original container, in a dry place inaccessible to children and pets. If spilled, sweep up and dispose of as below.
PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.
CONTAINER DISPOSAL: Completely empty bag into application equipment. Then dispose of bag in a sanitary landfill or by incineration, or if allowed by State and local authorities by burning. If burned, stay out of smoke.

DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

USE RESTRICTIONS:
Use against fish in lakes, ponds, and streams (immediately above lakes and ponds).

Since such factors as pH, temperature, depth, and turbidity will change effectiveness, use this product only at locations, rates, and times authorized and approved by appropriate state and Federal fish and wildlife agencies. Rates must be within the range specified in the labeling.

Properly dispose of dead fish and unused product. Do not use dead fish as food or feed.

Do not use water treated with rotenone to irrigate crops or release within ½mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

Note to User: Adjust pounds of Rotenone according to the actual Rotenone Assay as noted under the Ingredient Statement on this label. For example, if the required amount of 5% rotenone is 21 pounds, and the Rotenone Assay is 7%, use 5/7 of 21 pounds or 15 pounds of this product to yield the proper amount of active rotenone.

APPLICATION DIRECTIONS:

Treatment of Lakes and Ponds

1. **Application Rates and Concentrations of Rotenone**

The actual application rates and concentrations of rotenone needed to control fish will vary widely, depending on the type of use (e.g. selective treatment, normal pond treatment, etc.) and the factors listed above. The table below is a general guide for the proper rates and concentrations.

2. **Total Amount of Product Needed for Treatment**

To determine the total number of pounds needed for treatment, divide the number of acre-feet covered by one pound for a specific type of use (e.g., selective treatment, etc), as indicated in the table below, into the number of acre-feet in the body of water.

General Guide to the Application Rates and Concentrations of Rotenone Needed to Control Fish in Lakes and Ponds[1]

Type of Use	No. of Acre-Feet Covered by One Pound	Parts Per Million	
		Active Rotenone	5% Product
Selective Treatment	3.7 to 2.8	0.005 - 0.007	0.10 - 1.3
Normal Pond Use	0.74 to 0.37	0.025 - 0.050	0.5 - 1.0
Remove Bullheads or Carp	0.37 to 0.185	0.050 - 0.100	1.02 - 2.0
Remove Bullheads or Carp in Rich Organic Ponds	0.185 to 0.093	0.100 - 0.200	2.0 - 4.0
Pre-impoundment Treatment above Dam	0.123 to 0.074	0.150 - 0.250	3.0 - 5.0

5. **Restocking**

Waters treated with this product detoxify within 2 to 4 weeks after treatment, depending on pH, temperature, water hardness, and depth. To determine if detoxification has occurred, place live boxes containing samples of fish to be stocked in treated waters. More rapid detoxification can be accomplished by adding Potassium Permanganate or chlorine at a 1:1 ratio with the concentration of rotenone applied, plus sufficient additional compound to satisfy the chemical oxidation demand caused by organic matter that may be present in the treated water.

Treatment of Streams Immediately Above Lakes and Ponds

The purpose of treating streams immediately above lakes and ponds is to improve the effectiveness of lake and pond treatments and not to control fish in streams per se. The term "immediately" means the first available site above the lake or pond where treatment is practical.

In order to treat a stream immediately above a lake or pond, you must select a concentration of active rotenone, compute the flow rate of a stream, calculate the application rate, select an exposure time, estimate the amount of product needed, and follow the method of application.

1. **Concentration of Active Rotenone**

Select the "Concentration of Active Rotenone" based on the type of use from those on the table. For example, if you select "Normal Pond Use" you could select a concentration of "0.025 Parts per Million".

2. **Computation of Flow Rate for Stream**

Select a cross section of the stream where the banks and bottom are relatively smooth and free of obstacles. Divide the surface width into 3 equal sections and determine the water depth and surface velocity at the center of each section. In slowly moving streams, determine the velocity by dropping a float attached to 5 feet of loose, monofilament fishing line. Measure the time required for the float to move 5 feet. For fast-moving streams, use a longer distance. Take at least three readings at each point. To calculate the flow rate from the information obtained above, use the following formula:

$$F = \frac{Ws \times D \times L \times C}{T}$$

where F = flow rate (cu. ft./sec.), Ws = surface width (ft.), D = mean depth (ft.), L = mean distance traveled by float (ft.), C = constant (0.8 for rough bottoms and 0.9 for smooth bottoms), and T = mean time for float (sec.).

For example, after using the above formula, you might have computed the stream's flow rate to be "10 cu. ft. per sec."

3. **Calculation of Application Rate**

In order to calculate the application rate (expressed as "pound per sec"), you convert the rate in the table (expressed as "pound per acre-feet"), to "pound per cu. feet" and multiply by the flow rate (expressed as "cu. ft. per sec."). Depending on the size of the stream and the type of equipment, the rate could be expressed in other units, such as "ounces per hr."

The application rate for the stream above is calculated as follows:

$$R_s = R_p \times C \times F$$

where R_s = Application Rate for Stream (lb/sec), R_p = Application Rate for Pond (lb/acre feet), C = 1 acre foot/43560 cu. ft., and F = Flow Rate (cu. ft/sec).

In the example, the Application Rate for Stream would be:
R_s = 1 lb/0.74 acre-foot x 1 acre-foot/43560 cu. ft. x 10 cu. ft./sec.
R_s = .00031 lb/sec or 17.9 oz./hr.

4. **Exposure Time**

The "Exposure Time" would be the period of time (expressed in hours or seconds) during which target fish should **not** enter the lake or pond under treatment. In the example, this period of time could be 4 hours.

5. **Amount of Product**

Calculate the "Amount of Product" for a stream by multiplying the "Application Rate for Stream" by the "Exposure Time". In the example, the "Amount of Product" would be 71.6 oz. (17.9 oz./hr. x 4 hr.) or 4.5 lb.

RE-ENTRY STATEMENT
Do not allow swimming in rotenone-treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to labeling instructions.

[1]Adapted from Kinney, Edward, 1965 Rotenone in Fish Pond Management. USDI Washington, D.C. Leaflet FL-576.

Computation of acre-feet for lake or pond: An acre-foot is a unit of water volume having a surface area of one acre and a depth of one foot. Make a series of transects across the surface, taking depths with a measured pole or weighted line. Add the measurements and divide by the number made to determine the average depth. To compute **total acre-feet**, multiply this average depth by the number of surface acres, which can be determined from an aerial photograph or plat drawn to scale.

3. **Pre-Mixing Method of Application**

Pre-mix one pound of Rotenone with 3 to 10 gallons of water. Uniformly apply over water surface or bubble through underwater lines.

Alternately place undiluted powder in burlap sack and trail behind boat. When treating deep water (20 to 25 feet) weight bag and tow at desired depth.

4. **Removal of Taste and Odor**

Rotenone treated waters do not retain a detectable taste or odor for more than a few days to a maximum of one month. Taste and odor can be removed immediately by treatment with activated charcoal at a rate of 30 ppm. for each 1 ppm. Rotenone remaining (Note: As Rotenone detoxifies, less charcoal is required).

Label for Prentox® Prenfish™ Fish Toxicant Powder (5% active rotenone)

Product: 655-691 Prentox® Prenfish™ Fish Toxicant Powder

Material Safety Data Sheet
U.S. Department of Labor (OSHA 29 CFR 1910.1200)

Section 1: Product and Company Identification

Product: 655-691 Prentox® Prenfish™ Fish Toxicant Powder

Manufacturer's Name: **Prentiss Incorporated**
C. B. 2000
Floral Park, NY 11001
Telephone Number: **(516) 326-1919**

Section II: Composition/Information on Ingredients

Ingredient Name:	OSHA PEL	ACGIH TLV	%
Rotenone (CAS # 83-79-4)	(TWA) 5 mg/M³	(TWA) 5 mg/M³	7.4
Other Cube Resins	None	None	11.1
Other Ingredients	None	None	81.5

Section 3: Hazards Identification:

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Emergency Overview:

A tan powder with a wet chalk or dirt-like odor.

- Fatal if inhaled or swallowed
- Harmful if absorbed through skin
- Causes moderate eye irritation
- May cause allergic skin reactions in some individuals
- This pesticide is extremely toxic to fish

Potential Health Effects:

Primary Route(s) of Entry:

Ingestion, inhalation, and skin contact

Eyes:

Causes moderate eye irritation

Skin:

Harmful if absorbed through the skin. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals.

Ingestion:

Fatal if swallowed

Inhalation:

Fatal if inhaled

Signs and symptoms of acute overexposure:

May cause irritation of the eyes, nose and throat in addition to temporary numbness. Prolonged or repeated exposure can cause nausea, vomiting, abdominal cramps, muscle tremors, poor muscle coordination, seizures, shallow breathing, skin rashes and eye, nose and mouth lesions.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store only in original containers, in a dry place inaccessible to children and pets. Prentox Prenfish Toxicant will not solidify nor show any separation at temperatures down to 40°F and is stable for a minimum of one year when stored in sealed drums at 70°F.

Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of federal law. If these wastes cannot be disposed of by use according to label instructions contact your state pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

General Information

Prentox Prenfish Toxicant is a specially formulated product containing rotenone, to be used in fisheries management for the eradication of fish from lakes, ponds, reservoirs and streams.

Since such factors as pH, temperature, depth and turbidity will change effectiveness, use this product only at locations, rates, and times authorized and approved by appropriate state and federal fish and wildlife agencies. Rates must be within the range specified on the label.

Properly dispose of unused product. Do not use dead fish for food or feed. Do not use water treated with rotenone to irrigate crops or release within 1/2 mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

Re-entry Statement: Do not allow swimming in rotenone-treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to labeling instructions.

For Use in Ponds, Lakes and Reservoirs

The actual application rates and concentrations of rotenone needed to control fish will vary widely, depending on the type of use (e.g., selective treatment, normal pond use, etc.) and the factors listed above. The table below is a general guide for the proper rates and concentrations.

Prentox Prenfish Toxicant disperses readily in water both laterally and vertically, and will penetrate below the thermocline in thermally stratified bodies of water.

Computation of Acre-Feet: An acre-foot is a unit of volume of a body of water having the area of one acre and the depth of one foot. To determine acre feet in a given body of water, make a series of transects across the body of water taking depths with a measured pole or weighted line. Add the soundings and divide by the number made to determine the average depth. Multiply this average depth by the total surface area in order to determine the acre feet to be treated. If number of surface acres is unknown, contact your local Soil Conservation Service, which can determine this from aerial photographs.

Amount of Prentox Prenfish Toxicant Needed for Specific Uses: To determine the approximate number of gallons of Prentox Prenfish Toxicant (5.0% Rotenone) needed, find your "Type of Use" in the first column of the table below and then divide the corresponding numbers in the forth column, "Number of Acre-Feet Covered by One Gallon" into the number of acre-feet in your body of water.

General Guide to the Application Rates and Concentrations of Rotenone Needed to Control Fish in Lakes, Ponds and Reservoirs[1]

Type of Use	Parts Per Million		Number of Acre-Feet Covered by One Gallon
	Prenfish Toxicant	Active Rotenone	
Selective Treatment	0.10 to 0.13	0.005 to 0.007	30 to 24
Normal Pond Use	0.5 to 1.0	0.025 to 0.050	6.0 to 3.0
Remove bullheads or carp	1.0 to 2.0	0.050 to 0.100	3.0 to 1.5
Remove bullheads or carp in rich organic ponds	2.0 to 4.0	0.100 to 0.200	1.5 to 0.75
Preimpoundment treatment above dam	3.0 to 5.0	0.150 to 0.250	1.0 to 0.60

[1] Adapted from Kinney, Edward. 1965. Rotenone in Fish Pond Management. USDI Washington, D.C. Leaflet FL-576.

Pre-Mixing and Method of Application: Pre-mix with water at a rate of one gallon Prentox Prenfish Toxicant to 10 gallons of water. Uniformly apply over water surface or bubble through underwater lines.

Detoxification: Prentox Prenfish Toxicant treated waters detoxify under natural conditions within one week to one month depending upon temperatures, alkalinity, etc. Rapid detoxification can be accomplished by adding chlorine or potassium permanganate to the water at the same rate as Prentox Prenfish Toxicant in parts per million, plus enough additional to meet the chlorine demand of the untreated water.

Removal of Taste and Odor: Prentox Prenfish Toxicant treated waters do not retain a detectable taste or odor for more than a few days to a maximum of one month. Taste and odor can be removed immediately by treatment with activated charcoal at a rate of 30 ppm for each 1 ppm Prentox Prenfish Toxicant remaining. (Note: As Prentox Prenfish Toxicant detoxifies, less charcoal is required.)

Restocking After Treatment: Wait 2 to 4 weeks after treatment. Place a sample of fish to be stocked in wire cages in the coolest part of the treated waters. If the fish are not killed within 24 hours, the water may be restocked.

Use in Streams Immediately Above Lakes, Ponds and Reservoirs

The purpose of treating streams immediately above lakes, ponds and reservoirs is to improve the effectiveness of lake, pond and reservoir treatments by preventing target fish from moving into the stream corridors, and not to control fish in streams per se. The term "immediately" means the first available site above the lake, pond or reservoir where treatment is practical, while still creating a sufficient barrier to prevent migration of target fish into the stream corridor.

In order to completely clear a fresh water aquatic habitat of target fish, the entire system above or between fish barriers must be treated. See the use directions for streams and rivers on this label for proper application instructions.

In order to treat a stream immediately above a lake, pond or reservoir you must: (a) select the concentration of active rotenone, (b) compute the flow rate of the stream, (c) calculate the application rate, (d) select an exposure time, (e) estimate the amount of product needed, (f) follow the method of application. To prevent movement of fish from the pond, lake or reservoir, stream treatment should begin before and continue throughout treatment of the pond, lake or reservoir until mixing has occurred.

1. Concentration of Active Rotenone

Select the concentration of active rotenone based on the type of use from those listed on the table. Example: If you select "normal pond use" you could select a concentration of 0.025 part per million.

2. Computation of Flow Rate for Stream

Select a cross section of the stream where the banks and bottom are relatively smooth and free of obstacles. Divide the surface width into 3 equal sections and determine the water depth and surface velocity at the center of each section. In slowly moving streams, determine the velocity by dropping a float attached to 5 feet of loose monofilament fishing line. Measure the time required for the float to move 5 feet. For fast-moving streams, use a longer distance. Take at least three readings at each point. To calculate the flow rate from the information obtained above, use the following formula:

$$F = \frac{Ws \times D \times L \times C}{T}$$

Where F = flow rate (cubic feet/second), Ws = surface width (feet), D = mean depth (feet), L = mean distance traveled by float (feet), C = constant (0.8 for rough bottoms and 0.9 for smooth bottoms), and T = mean time for float (sec.).3.

Calculation of Application Rate

In order to calculate the application rate (expressed as gallons/second), you convert the rate in the table (expressed as gallons/acre-feet), to gallons per cubic feet and multiply by the flow rate (expressed as cubic feet/second). Depending on the size of the stream and the type of equipment, the rate could be expressed in other units, such as ounces/hour, or cc/minute.

The application rate for the stream is calculated as follows:

$$R_s = R_p * C * F$$

where R_s = application rate for stream (gallons/second), R_p = application rate for pond (gallons/acre-feet), C = 1 acre foot/43560 cubic feet, and F = flow rate of the stream (cubic feet/second).

4. Exposure Time

The exposure time would be the period of time (expressed in hours or minutes) during which Prentox Prenfish Toxicant is applied to the stream in order to prevent target fish from escaping from the pond into the stream corridor.

5. Amount of Product

Calculate the amount of product for a stream by multiplying the application rate for streams by the exposure time.

$$A = R_s * H$$

where A = the amount of product for the stream application, R_s = application rate for stream (gallons/second), and H = the exposure time expressed in seconds.

For use in Streams and Rivers

Only state or federal Fish and Wildlife personnel or professional fisheries biologists under the authorization of state or federal Fish and Wildlife Agencies are permitted to make applications of Prentox Prenfish Toxicant for control of fish in streams and rivers. Informal consultation with Fish and Wildlife personnel regarding the potential occurrence of endangered species in areas to be treated should take place. Applicators must reference Prentiss Incorporated's Prentox Prenfish Toxicant Stream and River Use Monograph before making any application to streams or rivers.

Warranty Statement: Our recommendations for the use of this product are based upon tests believed to be reliable. The use of this product being beyond the control of the manufacturer, no guarantee, expressed or implied, is made as to the effects of such or the results to be obtained if not used in accordance with directions or established safe practice. The buyer must assume all responsibility, including injury or damage, resulting from its misuse as such, or in combination with other materials.

PRENTOX® PRENFISH TOXICANT STREAM AND RIVER USE MONOGRAPH

USE IN STREAMS AND RIVERS

The following use directions are to provide guidance on how to make applications of Prentox Prenfish Toxicant to streams and rivers. The unique nature of every application site could require minor adjustments to the method and rate of application. Should these unique conditions require major deviation from the use directions, a Special Local Need 24(c) registration should be obtained from the state.

Before applications of Prentox Prenfish Toxicant can be made to streams and rivers, authorization must be obtained from state or federal Fish and Wildlife agencies. Since local environmental conditions will vary, consult with the state Fish and Wildlife agency to ensure the method and rate of application are appropriate for that site.

Contact the local Water Department to determine if any water intakes are within one mile down flow of the section of stream, river or canal to be treated. If so, coordinate the application with the water department to make sure the intakes are closed during treatment and detoxification.

Application Rates and Concentration of Rotenone

Slow Moving Rivers: Apply rotenone as a drip for 4 to 8 hours to the flowing portion of the stream. Multiple application sites are used along the length of the treated stream, spaced approximately 1/2 to 2 miles apart depending on the water flow travel time between sites. Multiple sites are used because rotenone is diluted and detoxified with distance. Application sites are spaced at no more than 2 hours or at no less than 1 hour travel time intervals. This assures that the treated stream remains lethal to fish for a minimum of 2 hours. A non-toxic dye such as Rhodamine-WT® or fluorescein can be used to determine travel times. Cages containing live fish placed immediately upstream of the downstream application sites can be used as sentinels to assure that lethal conditions exist between sites.

Apply rotenone at each application site at a concentration of 0.25 to 1.0 part per million of Prentox Prenfish Toxicant. The amount of Prentox Prenfish Toxicant needed at each site is dependent on stream flow (see Computation of Flow Rate for Stream).

Application of Undiluted Material

Prentox Prenfish Toxicant can drain directly into the center of the stream at a rate of 0.85 to 2.4 cc per minute for each cubic foot per second of stream flow. Flow of undiluted Prentox Prenfish Toxicant into the stream should be checked at least hourly. This is equivalent to from 0.25 to 1.0 ppm Prentox Prenfish Toxicant, or from 0.012 to 0.050 ppm rotenone. Back-water, stagnant and spring areas of streams should be sprayed by hand with a 10% v/v solution of Prentox Prenfish Toxicant in water to assure a complete coverage.

Calculation of Application Rate:

$$X = F(1.69\ B)$$

X = cc per minute of Prentox Prenfish Toxicant applied to the stream, F = the flow rate (cu. ft./sec.) see Computation of Flow Rate for Stream section of the label, B = parts per million desired concentration of Prentox Prenfish Toxicant.

Total Amount of Product Needed for Treatment: Streams should be treated for 4 to 8 hours in order to clear the treated section of stream of fish. To determine the total amount of Prentox Prenfish Toxicant required use the following equation:

$$Y = X(0.0158\ C)$$

Y = gallons of Prentox Prenfish Toxicant required for the stream treatment, X = cc per minute of Prentox Prenfish Toxicant applied to the stream, C = time in hours of the stream treatment.

Application of Diluted Material

Alternatively, for stream flows up to 25 cubic feet per minute, continuous drip of diluted Prentox Prenfish Toxicant at 80 cc per minute can be used. Flow of diluted Prentox Prenfish Toxicant into the stream should be checked at least hourly. Use a 5 gallon reservoir over a 4 hour period, a 7.5 gallon reservoir over a 6 hour period, or a 10 gallon reservoir over an 8 hour period. The volume of the reservoir can be determined from the equation:

$$R = H * 1.25$$

where R = the volume of the reservoir in gallons, and H = the duration of the application in hours.

The volume of Prentox Prenfish Toxicant diluted with water in the reservoir is determined from the equation:

$$X = Y(102\ F)H$$

where X = the cc of Prentox Prenfish Toxicant diluted in the reservoir, Y = parts per million desired concentration of Prentox Prenfish Toxicant, F = the flow rate (cubic feet/second), H = the duration of the application (hours).

For flows over 25 cubic feet per minute, additional reservoirs can be used concurrently. Back-water, stagnant and spring areas of streams should be sprayed by hand with a 10% v/v solution of Prentox Prenfish Toxicant in water to assure a complete coverage.

Detoxification

To limit effects downstream, detoxification with potassium permanganate can be used at the downstream limit of the treated area. Within 1/2 to 2 miles of the furthest downstream Prentox Prenfish Toxicant application site, the rotenone can be detoxified with a potassium permanganate solution at a resultant stream concentration of 2 to 4 parts per million, depending on rotenone concentration and permanganate demand of the water. A 2.5% (10 pounds potassium permanganate to 50 gallons of water) permanganate solution is dripped in at a continuous rate using the equation:

$$X = Y(70\ F)$$

where X = cc of 2.5% permanganate solution per minute, Y = ppm of desired permanganate concentration, and F = cubic feet per second of stream flow.

Flow of permanganate should be checked at least hourly. Live fish in cages placed immediately above the permanganate application site will show signs of stress signaling the need for beginning detoxification. Detoxification can be terminated when replenished fish survive and show no signs of stress for at least four hours.

Detoxification of rotenone by permanganate requires between 15 to 30 minutes contact time (travel time). Cages containing live fish can be placed at these downstream intervals to judge the effectiveness of detoxification. At water temperature of less than 50° F detoxification may be retarded, requiring a longer contact time.

Adhesive Panel

RESTRICTED USE PESTICIDE
DUE TO AQUATIC AND ACUTE INHALATION TOXICITY
For retail sale to, and use only by, Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

PRENFISH TOXICANT

Liquid Emulsifiable

*For Control of Fish in Lakes, Ponds, Reservoirs and Streams

ACTIVE INGREDIENTS:	
Rotenone	5.0%
Other Associated Resins	5.0%
INERT INGREDIENTS*:	90.0%
TOTAL	100.0%

*This product contains aromatic hydrocarbons.
PRENTOX® - Registered Trademark of Prentiss Incorporated

KEEP OUT OF REACH OF CHILDREN

DANGER - POISONOUS

See inside booklet for additional precautionary statements.

FIRST AID
Have product container or label with you when obtaining treatment advice.

If swallowed	• Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Do not induce vomiting unless told to do so by the Poison Control Center or physician. • Do not give any liquid to the person. • Do not give anything by mouth to an unconscious or convulsing person.
If inhaled	• Remove victim to fresh air. • If not breathing, give artificial respiration, preferably mouth-to-mouth. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If in eyes	• Hold eyelids open and rinse slowly and gently with water for 15-20 minutes. • Remove contacts, if present, after the first 5 minutes, then continue rinsing eye. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a physician, Poison Control Center, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

EPA Reg. No. 655-422 9/02 EPA Est. No. 655-GA-1

Manufactured by:

PRENTISS INCORPORATED
Plant: Kaolin Road, Sandersville, GA 31082
Office: C.B. 2000, Floral Park, NY 11002-2000

Synpren-fish® Toxicant (2.5% active rotenone)

RESTRICTED USE PESTICIDE
DUE TO AQUATIC AND ACUTE INHALATION TOXICITY
For retail sale to, and use only by, Certified applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification

SYNPREN-FISH TOXICANT

Liquid-Emulsifiable
***For Control of Fish in Lakes, Ponds, Reservoirs and Streams**

ACTIVE INGREDIENTS:	
Rotenone	2.5% w/w
Other Associated Resins	5.0%
Piperonyl Butoxide, Technical*	2.5%
INERT INGREDIENTS:**	90.0%
TOTAL:	100.0%

*Equivalent to 2.0% [Butylcarbityl] [6-propylpiperonyl] ether and 0.5% related compounds.
**This product contains aromatic petroleum solvents.

PRENTOX® - Registered Trademark of Prentiss Incorporated

KEEP OUT OF REACH OF CHILDREN

DANGER – POISONOUS

See Additional Precautionary Statements Below.

FIRST AID
Have product container or label with you when obtaining treatment advice.

If swallowed	• Call a poison control center, doctor, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center, doctor, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center, doctor, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center, doctor, or the National Pesticide Information Center at 1-800-858-7378 immediately for treatment advice.

For information on this pesticide product (including health concerns, medical emergencies, or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
DANGER

Fatal if inhaled. May be fatal if swallowed. Harmful if absorbed through skin. Causes substantial but temporary eye injury. Causes skin irritation. Do not breathe spray mist. Do not get in eyes, on skin or on clothing. Wear goggles or safety glasses. When working with undiluted product, wear either a respirator with an organic-vapor-removing cartridge with a prefilter approved for pesticides (MSHA/NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G), or a NIOSH approved respirator with an organic vapor (OV) cartridge or canister with any R, P or HE prefilter. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to fish. Fish kills are expected at recommended rates. Consult your State Fish and Game Agency before applying this product to public waters to determine if a permit is needed for such an application. Do not contaminate untreated water when disposing of equipment washwaters.

CHEMICAL AND PHYSICAL HAZARDS

Combustible mixture. Flash point of this formulation is 115° F. DO NOT USE OR STORE NEAR HEAT OR OPEN FLAME.

E.P.A. REG. NO. 655-421 **5/01** **E.P.A. EST. NO. 655-GA-1**

Manufactured by:

PRENTISS INCORPORATED

Plant: Kaolin Road, Sandersville, GA 31082
Office: C.B. 2000, Floral Park, NY 11002-2000

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Storage: Store only in original containers, in a dry place inaccessible to children and pets. Prentox Synpren-Fish Toxicant will not solidify nor show any separation at temperatures down to 40° F and is stable for a minimum of one year when stored in sealed drums at 70° F.

Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions contact your state pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

General Information

Prentox Synpren-Fish Toxicant is a specially formulated product containing synergized rotenone, to be used in fisheries management for the eradication of fish from lakes, ponds, reservoirs and streams. Since such factors as pH, temperature, depth and turbidity will change effectiveness, use this product only at locations, rates, and times authorized and approved by appropriate state and federal fish and wildlife agencies. Rates must be within the range specified on the label.

Properly dispose of unused product. Do not use dead fish for food or feed.

Do not use water treated with rotenone to irrigate crops or release within 1/2 mile upstream of a potable water or irrigation water intake in a standing body of water such as a lake, pond or reservoir.

RE-ENTRY STATEMENT: Do not allow swimming in rotenone-treated water until the application has been completed and all pesticide has been thoroughly mixed into the water according to labeling instructions.

For Use in Ponds, Lakes and Reservoirs

The actual application rates and concentrations of rotenone needed to control fish will vary widely, depending on the type of use (e.g., selective treatment, normal pond use, etc.) and the factors listed above. The table below is a general guide for the proper rates and concentrations. Prentox Synpren-Fish Toxicant disperses readily in water both laterally and vertically, and will penetrate below the thermocline in thermally stratified bodies of water.

Computation of Acre-Feet: An acre-foot is a unit of volume of a body of water having the area of one acre and the depth of one foot. To determine acre feet in a given body of water, make a series of transects across the body of water taking depths with a measured pole or weighted line. Add the soundings and divide by the number made to determine the average depth. Multiply this average depth by the total surface area in order to determine the acre-feet to be treated. If number of surface acres is unknown, contact your local Soil Conservation Service, which can determine this from aerial photographs.

Amount of Prentox Synpren-Fish Toxicant Needed for Specific Uses: To determine the approximate number of gallons of Prentox Synpren-Fish Toxicant (2.5% Rotenone) needed, find your "Type of Use" in the first column of the table below, and then divide the corresponding numbers in the third column, "Number of Acre-Feet Covered by One Gallon" into the number of acre-feet in your body of water.

General Guide to the Application Rates and Concentrations of Rotenone Needed to Control Fish in Lakes, Ponds and Reservoirs[1]

Type of Use	Parts Per Million		Number of Acre-Feet Covered by One Gallon
	Synpren-Fish Toxicant	Active Rotenone	
Selective Treatment	0.20 to 0.25	0.005 to 0.007	15 to 12
Normal Pond Use	1.0 to 2.0	0.025 to 0.050	3.0 to 1.5
Remove bullheads or carp	2.0 to 4.0	0.050 to 0.100	1.5 to 0.75
Remove bullheads or carp in rich organic ponds	4.0 to 8.0	0.100 to 0.200	0.75 to 0.38
Preimpoundment treatment above dam	6.0 to 10.0	0.150 to 0.250	0.50 to 0.30

[1] Adapted from Kinney, Edward. 1965. Rotenone in Fish Pond Management. USDI Washington, D.C. Leaflet FL-576

Pre-Mix and Method of Application: Pre-mix with water at a rate of one gallon Prentox Synpren-Fish Toxicant to 10 gallons of water. Uniformly apply over water surface or bubble through underwater lines.

Detoxification: Prentox Synpren-Fish Toxicant treated waters detoxify under natural conditions within one week to one month depending upon temperatures, alkalinity, etc. Rapid detoxification can be accomplished by adding chlorine or potassium permanganate to the water at the same rate as Prentox Synpren-Fish Toxicant in parts per million, plus enough additional to meet the chlorine demand of the untreated water.

Removal of Taste and Odor: Prentox Synpren-Fish Toxicant treated waters do not retain a detectable taste or odor for more than a few days to a maximum of one month. Taste and odor can be removed immediately by treatment with activated charcoal at a rate of 30 ppm for each 1 ppm Prentox Synpren-Fish Toxicant remaining. (Note: As Prentox Synpren-Fish Toxicant detoxifies, less charcoal is required.)

Restocking After Treatment: Wait 2 to 4 weeks after treatment. Place a sample of fish to be stocked in wire cages in the coolest part of the treated waters. If the fish are not killed within 24 hours, the water may be restocked.

Use in Streams Immediately Above Lakes, Ponds, and Reservoirs

The purpose of treating streams immediately above lakes, ponds and reservoirs is to improve the effectiveness of lake, pond and reservoir treatments by preventing target fish from moving into the stream corridors, and not to control fish in streams per se. The term "immediately" means the first available site above the lake, pond or reservoir where treatment is practical, while still creating a sufficient barrier to prevent migration of target fish into the stream corridor.

In order to completely clear a fresh water aquatic habitat of target fish, the entire system above or between fish barriers must be treated. See the use directions for streams and rivers on this label for proper application instructions.

In order to treat a stream immediately above a lake, pond or reservoir, you must: (a) select the concentration of active rotenone, (b) compute the flow rate of the stream, (c) calculate the application rate, (d) select an exposure time, (e) estimate the amount of product needed, (f) follow the method of application. To prevent movement of fish from the pond, lake or reservoir, stream treatment should begin before and continue throughout treatment of pond, lake or reservoir until mixing has occurred.

1. Concentration of Active Rotenone:

Select the concentration of active rotenone based on the type of use from those listed on the table. Example: If you select "normal pond use" you could select a concentration of 0.025 part per million.

2. Computation of Flow Rate for Stream:

Select a cross section of the stream where the banks and bottom are relatively smooth and free of obstacles. Divide the surface width into 3 equal sections and determine the water depth and surface velocity at the center of each section. In slowly moving streams, determine the velocity by dropping a float attached to 5 feet of loose, monofilament fishing line. Measure the time required for the float to move 5 feet. For fast-moving streams, use a longer distance. Take at least three readings at each point. To calculate the flow rate from the information obtained above, use the following formula:

$$F = \frac{Ws \times D \times L \times C}{T}$$

where F = flow rate (cubic feet/second), Ws = surface width (feet), D = mean depth (feet), L = mean distance traveled by float (feet), C = constant (0.8 for rough bottoms and 0.9 for smooth bottoms), and T = mean time for float (sec.).

3. Calculation of Application Rate:

In order to calculate the application rate (expressed as gallons/second), you convert the rate in the table (expressed as gallons/acre-feet), to gallons per cubic feet and multiply by the flow rate (expressed as cubic feet/second). Depending on the size of the stream and the type of equipment, the rate could be expressed in other units, such as ounces/hour, or cc/minute. The application rate for the stream is calculated as follows:

$$R_s = R_p * C * F$$

where R_s = application rate for stream (gallons/second), R_p = application rate for pond (gallons/acre-feet), C = 1 acre foot/43560 cubic feet, and F = flow rate of the stream (cubic feet/second).

4. Exposure Time:

The exposure time would be the period of time (expressed in hours or minutes) during which Prentox Synpren-Fish Toxicant is applied to the stream in order to prevent target fish from escaping from the pond into the stream corridor.

5. Amount of Product:

Calculate the amount of product for a stream by multiplying the application rate for streams by the exposure time.

$$A = R_s * H$$

where A = the amount of product for the stream application, R_s = application rate for stream (gallons/second), and H = the exposure time expressed in seconds. require major deviation from these use directions a Special Local Need 24(c) registration should be obtained from the state.

Before applications of Prentox Synpren-Fish Toxicant can be made to streams and rivers, authorization must be obtained from state or federal Fish & Wildlife agencies. Since local environmental conditions will vary, consult with the state Fish & Wildlife agency to ensure the method and rate of application are appropriate for that site.

Contact the local water department to determine if any water intakes are (within one mile) down flow of the section of stream, river or canal to be treated. If so, coordinate the application with the

For Use in Streams and Rivers

Only state or federal Fish & Wildlife personnel or professional fisheries biologists under the authorization of state or federal Fish & Wildlife agencies are permitted to make applications of Prentox Synpren-Fish Toxicant for control of fish in streams and rivers. Informal consultation with Fish & Wildlife personnel regarding the potential occurrence of endangered species in areas to be treated should take place. Applicators must reference Prentiss Incorporated's Prentox Synpren-Fish Toxicant Stream and River Use Monograph before making any application to streams or rivers.

Warranty Statement. Our recommendations for the use of this product are based upon tests believed to be reliable. The use of this product being beyond the control of the manufacturer, no guarantee, expressed or implied, is made as to the effects of such or the results to be obtained if not used in accordance with directions or established safe practice. The buyer must assume all responsibility, including injury or damage, resulting from its misuse as such, or in combination with other materials. **PRENTOX® SYNPREN-FISH TOXICANT**

STREAM AND RIVER MONOGRAPH

USE IN STREAMS AND RIVERS

The following use directions are to provide guidance on how to make applications of Prentox Synpren-Fish Toxicant to streams and rivers. The unique nature of every application site could require minor adjustments to the method and rate of application. Should these unique conditions

water department to make sure the intakes are closed during treatment and detoxification.

Application Rates and Concentration of Rotenone

Slow Moving Rivers: In slow moving rivers and streams with little or no water exchange use instructions for ponds, lakes and reservoirs.

Flowing Streams and Rivers: Apply rotenone as a drip for 4 to 8 hours to the flowing portion of the stream. Multiple application sites are used along the length of the treated stream, spaced approximately 1/2 to 2 miles apart depending on the water flow travel time between sites. Multiple sites are used because rotenone is diluted and detoxified with distance. Application sites are spaced at no more than 2 hours or at no less than 1 hour travel time intervals; this assures that the treated stream remains lethal to fish for a minimum of 2 hours. A non-toxic dye such as Rhodamine-WT® or fluorescein can be used to determine travel times. Cages containing live fish placed immediately upstream of the downstream application sites can be used as sentinels to assure that lethal conditions exist between sites.

Apply rotenone at each application site at a concentration of 0.5 to 2.0 parts per million of Prentox Synpren-Fish Toxicant. The amount of Prentox Synpren-Fish Toxicant needed at each site is dependent on stream flow (see Computation of Flow Rate for Stream).

Application of Undiluted Material

Prentox Synpren-Fish Toxicant can drain directly into the center of the stream at a rate of 0.85 to 2.4 cc per minute for each cubic foot per second of stream flow. Flow of undiluted Prentox Synpren-Fish Toxicant into the stream should be checked at least hourly. This is equivalent to from 0.5 to 2.0 ppm Prentox Synpren-Fish Toxicant, or from 0.012 to 0.050 ppm rotenone.

Back-water, stagnant and spring areas of streams should be sprayed by hand with a 10% v/v solution of Prentox Synpren-Fish Toxicant in water to assure a complete coverage.

Calculation of Application Rate:

$$X = F(1.692\ B)$$

where X = cc per minute of Prentox Synpren-Fish Toxicant to the stream F = the flow rate (cu. ft/sec) (see *Computation of Flow Rate for Stream* section of the label) and B = parts per million desired concentration of Prentox Synpren-Fish Toxicant.

Total Amount of Product Needed for Treatment: Streams should be treated for 4 to 8 hours in order to clear the treated section of stream of fish. To determine the total amount of Prentox Synpren-Fish Toxicant required, use the following equation:

$$Y = X(0.0158C)$$

Y = gallons of Prentox Synpren-Fish Toxicant required for the stream treatment, X = cc per minute of Prentox Synpren-Fish Toxicant applied to the stream, C = time in hours of the stream treatment.

Application of Diluted Material

Alternatively, for stream flows up to 25 cubic feet per minute, continuous drip of diluted Prentox Synpren-Fish Toxicant at 80 cc per minute can be used. Flow of diluted Prentox Synpren-Fish Toxicant into the stream should be checked at least hourly. Use a 5 gallon reservoir over a 4 hour period, a 7.5 gallon reservoir over a 6 hour period, or a 10 gallon reservoir over an 8 hour period. The volume of the reservoir can be determined from the equation:

$$R = H * 1.25$$

where R = the volume of the reservoir in gallons, and H = the duration of the application in hours.

The volume of Prentox Synpren-Fish Toxicant diluted with water in the reservoir is determined from the equation:

$$X = Y(102\ F)H$$

where X = the cc of Prentox Synpren-Fish Toxicant diluted to 5 gallons, Y = parts per million desired concentration of Prentox Synpren-Fish Toxicant, F = the flow rate (cubic feet/second), H = the duration of the application (hours).

For flows over 25 cubic feet per minute, additional reservoirs can be used concurrently. Back-water, stagnant and spring areas of streams should be sprayed by hand with a 10% v/v/ solution of Prentox Synpren-Fish Toxicant in water to assure a complete coverage.

Detoxification

To limit effects downstream, detoxification with potassium permanganate can be used at the downstream limit of the treated area. Within 1/2 to 2 miles of the furthest downstream Prentox Synpren-Fish Toxicant application site, the rotenone can be detoxified with a potassium permanganate solution at a resultant stream concentration of 2 to 4 parts per million, depending on rotenone concentration and permanganate demand of the water. A 2.5% (10 pounds potassium permanganate to 50 gallons of water) permanganate solution is dripped in at a continuous rate using the equation:

$$X = Y(70\ F)$$

where X = cc of 2.5% permanganate solution per minute, Y = ppm of desired permanganate concentration, and F = cubic feet per second of stream flow.

Flow of permanganate should be checked at least hourly. Live fish in cages placed immediately above the permanganate application site will show signs of stress signaling the need for beginning detoxification. Detoxification can be terminated when replenished fish survive and show no signs of stress for at least four hours.

Detoxification of rotenone by permanganate requires between 15 to 30 minutes contact time (travel time). Cages containing live fish can be placed at these downstream intervals to judge the effectiveness of detoxification . Water temperature of less than 50 $^{\circ}$ F detoxification may be retarded, requiring a longer contact time.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Acute Hazards: Corrosive. Causes irreversible eye damage and skin burns. May be fatal if swallowed. Harmful if absorbed through skin.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Do not breath dust. Wear protective clothing and protective eyewear as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE):

Handlers who mix LAMPRICID Sea Lamprey Larvicide must wear:

- Coveralls over long-sleeved shirt and long pants
- Chemical-resistant gloves (such as butyl rubber)
- Chemical-resistant footwear plus socks
- Protective eyewear (goggles or face shield)

Applicators who apply diluted product must wear:

- Chemical-resistant gloves (such as butyl rubber)

USER SAFETY REQUIREMENTS:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This product is toxic to fish and aquatic invertebrates. Nontarget aquatic organisms may be killed at rates recommended on this label. Directions for Use must be strictly followed to minimize hazard to non-target organisms. Do not contaminate water by cleaning of equipment or disposal of wastes.

Not to be used by unauthorized personnel. Nr. 2039

RESTRICTED USE PESTICIDE

DUE TO ACUTE HAZARDS TO THE EYE AND SKIN AND TO NONTARGET AQUATIC ORGANISMS, NEED FOR HIGHLY SPECIALIZED APPLICATOR TRAINING, AND NEED FOR SPECIALIZED EQUIPMENT.

ONLY FOR SALE TO AND APPLICATION BY CERTIFIED APPLICATORS OF THE U.S. FISH AND WILDLIFE SERVICE, FISHERIES AND OCEANS CANADA, AND PROVINCIAL AND STATE FISH AND GAME EMPLOYEES OR PERSONS UNDER THEIR DIRECT SUPERVISION.

LAMPRICID

SEA LAMPREY LARVICIDE

ACTIVE INGREDIENT:	
a,a,a -Trifluoro-4-Nitro-m-Cresol, Sodium Salt*:	38.0%
INERT INGREDIENTS:	62.0%
TOTAL:	100.0%

*Equivalent to [34.4%] a,a,a -Trifluoro-4-Nitro-m-Cresol

THIS PRODUCT CONTAINS 3.8 LBS OF SODIUM TFM PER GALLON

EPA Reg. No. 6704-45
EPA Est. No. 002-384-NJ-001

KEEP OUT OF REACH OF CHILDREN
DANGER - POISON

FIRST AID

Have label with you when obtaining treatment advice.

IF SWALLOWED	• Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor.
IF ON SKIN OR CLOTHING	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor immediately for treatment advice.
IF INHALED	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center or doctor immediately for treatment advice.
IF IN EYES	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor immediately for treatment advice.

Manufactured by:
Pfister Chemical Inc.
Linden Ave.
Ridgefield, NJ 07657

for: Fish and Wildlife Service
United States Department of Interior,
18th and C Streets, N.W.
Washington, D.C. 120240

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

CATEGORY OF APPLICATOR:
Aquatic Pest Control.

USE RESTRICTIONS:
For control of Sea Lamprey Larvae (*Petromyzon marinus*) in the Great Lakes Basin, the Lake Champlain system and the Finger Lakes.

Aerial applications of this product are prohibited.

PROTECTION OF DRINKING WATER:
Local, State, and Provincial Fish and Game Agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators that use streams requiring treatment as a source of irrigation water must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators must turn off their irrigation system for a 24-hour period during and after treatment. Prior to use of any water potentially having residues must be tested for the presence of TFM. Water must not be used if there are any detectable residues of TFM.

PRETREATMENT DIRECTIONS:
Pretreatment surveys are always made to determine abundance of sea lamprey larvae (*Petromyzon marinus*). All waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes selected for treatment must first be analyzed on site to determine both the minimum concentration of LAMPRICID required to kill sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. "Analysis" constitutes live animal toxicity tests, or the use of a multiple regression relating toxicity test results to on-site determination of total alkalinity and pH of the body of water.

APPLICATION DIRECTIONS:
When applying this product, do not apply in a way that will cause the concentrated product to contact unprotected workers or other persons, either directly or through drift.

Persons applying LAMPRICID must follow the Standard Operating Procedure for Application of Lampricides in the Great Lakes Fishery Commission's Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program, and ensure that the correct application rates are used. Prior to and during the application of this chemical, take appropriate actions to notify public water users including notification actions specified in this manual.

The concentration of LAMPRICID needed to kill sea lamprey larvae may vary depending upon water chemistry. Measure volume or flow-rate and add the amount of LAMPRICID necessary at rates based on the foregoing analysis. Dispense LAMPRICID by application devices sufficiently accurate to maintain predetermined concentration. Concentration in the body of water must be monitored either by colorimetric analysis, gas chromatography, or high-performance liquid chromatography. LAMPRICID may be used by itself in the treatment of waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes. At times, however, formulations of Bayluscide (EPA REG. NO. 6704-88) may be used in combination with LAMPRICID (EPA REG. NO. 6704-45) for control of sea lamprey larvae. Application of Bayluscide may be as a simultaneous addition with LAMPRICID to reduce the amount of LAMPRICID required or as a subsequent addition downstream to enhance LAMPRICID larvicidal activity. Prior to using Bayluscide-LAMPRICID, pretreatment surveys must be made to determine larvae populations. When using Bayluscide in combination with LAMPRICID, mix in proportions that result in a final concentration of Bayluscide of not more than 2% of LAMPRICID by weight (based on active ingredient). Bayluscide may be added to LAMPRICID in two ways:

1. One method of application is to apply both lampricides at the primary application site. LAMPRICID is metered into the stream while Bayluscide is applied with a separate pump system in amounts calculated to deliver the desired ratio of Bayluscide to LAMPRICID. Bayluscide is applied separately to provide a uniform application and to enhance control of concentration.

2. A second application method is to apply Bayluscide into an existing LAMPRICID bank. Because a LAMPRICID bank can be diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates are calculated, the toxicity of the bank in the stream must be raised by the addition of LAMPRICID or Bayluscide. The latter may be used in place of LAMPRICID. In these situations, LAMPRICID alone is pumped into the stream at the primary application site. Bayluscide is introduced into the LAMPRICID bank at a point or points downstream in amounts calculated to produce the desired Bayluscide to TFM ratio.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals.

SPILLS: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed below. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: LAMPRICID spray mixture or rinsate that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticides or buried in a safe place away from water supplies.

CONTAINER DISPOSAL: Triple rinse (or equivalent) container and then offer for recycling, reconditioning, or disposal in approved landfill or bury in a safe place. Consult federal, provincial, state, or local authorities for approved alternative procedures.

TFM Bar (23% Active TFM)

[Front Panel]

RESTRICTED USE PESTICIDE

Due to Acute Eye Irritation, Acute Oral Toxicity and Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI, FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control or persons under their direct supervision.

TFM BAR

Active Ingredient:	
TFM, α,α,α-Trifluoro-4-Nitro-m-Cresol, Free Cresol	23.0%
Inert Ingredients:	77.0%
TOTAL:	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	• Call a poison control center or doctor immediately for treatment advice • Have person sip a glass of water, if able to swallow • Do not induce vomiting unless told to do so by poison control center or doctor
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately, with plenty of water, for 15-20 minutes. • Call a poison control center or doctor immediately for treatment advice.

[Front Panel]

If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center or doctor immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor immediately for treatment advice.
Hot Line Number: You may also contact 1-800-858-7378 for health concerns, emergency medical treatment information of pesticide incidents	

See Left Panel for additional precautionary statements.

Manufactured by:

Bell Laboratories
Madison, WI 53704

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-86
EPA Establishment No. 12455-WI-01

Batch No. _____

Net Contents _____ lbs.

[Left Panel]

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Acute Hazards: Corrosive. Causes irreversible eye damage. May be fatal if swallowed. Harmful if absorbed through skin or inhaled.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Avoid breathing vapors. Wear protective clothing as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Protective eyewear (goggles, face shield, or safety glasses)
- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as Natural Rubber, selection Category A)
- Socks and shoes

[Left Panel]

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget organisms (such as freshwater clams and mussels) may be killed at recommended rates. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

[Right Panel]

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL:

Read the entire label and Sea Lamprey Control Document No. SLC-92-001.3 [Standard Operating Procedures for Application of Lampricides in the Great Lakes Fishery Commission Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with both the label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

GENERAL INFORMATION:

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget species are potentially vulnerable to TFM, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS:

Use Pattern:

TFM Bars may be used for control of sea lamprey (*Petromyzon marinus*) in waters in the Great Lakes Basin, the Lake Champlain system and the Finger Lakes. Only apply this product according to this label.

Permits:

Obtain any permits needed from local, State, Provincial and Federal wildlife authorities.

Potable Water:

At least 24 hours prior to application, notify municipalities and agricultural irrigators that potable and irrigation water will be treated. Agricultural irrigators must turn off their irrigation systems for a 24-hour period during and after treatment. Prior to and during the application of this chemical, take all appropriate actions to notify public water users and municipalities including notification actions specified in the application manual referred to above.

[Right Panel]

Unauthorized Personnel:

May not be used by unauthorized personnel.

PRE-APPLICATION DIRECTIONS:

Pretreatment Surveys:

Pretreatment surveys are always made to determine abundance of sea lamprey larvae (*Petromyzon marinus*). All waters in the Great Lakes basin, Lake Champlain system and Finger Lakes that are selected for treatment must first be analyzed on site to determine both the minimum concentration of TFM required to kill sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. "Analysis" constitutes live animal bioassays, or the use of multiple regression curves relating toxicity test results to on-site determination of pH or total alkalinity and conductivity of the body of water.

Lethal Concentration:

The concentration of TFM needed to kill a sea lamprey larvae may vary depending upon water chemistry and temperature. Measure volume or flow rate and add the amount of chemical necessary at rates based on the foregoing analysis. Concentration in the body of water must be monitored by spectrophotometric analysis or high performance liquid chromatography.

APPLICATION DIRECTIONS

Bar Placement: Suspend each bar at least one inch above the bottom of the stream to permit movement of water on all sides.

TFM Delivery Rate: When submerged in water, TFM bars dissolve in approximately 8 to 10 hours at 17 °C and 10 to 12 hours at 12 °C in current velocities 0.09 to 0.12 meter/sec. More rapid velocities will cause the bars to dissolve faster. First, calculate the amount of TFM (grams/hr) needed to supply a lethal concentration to larval sea lampreys in the stream. Then calculate the amount of TFM (grams/hr) released from a TFM bar based on the length of time the bars are expected to last at the prevailing temperature. Divide the amount of TFM needed by the amount released per bar to find the number of bars needed.

[Right Panel]

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a cool (85°F or less) dry place inaccessible to children, pets and domestic animals, and where spills and leakage can be contained. If product becomes soft or liquifies due to high temperatures, cooling to below 85°F will return it to a solid state.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of according to instructions in the application manual, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Dispose of empty plastic wrappers and packing cartons in a sanitary landfill, or if allowed by state and local authorities, by burning. If burned, stay out of smoke.

Bayluscide® Wettable Powder (70% Active Niclosamide, Aminoethanol Salt)
[Front Panel]

RESTRICTED USE PESTICIDE

Due to Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI, FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control or persons under their direct supervision.

BAYLUSCIDE 70% WETTABLE POWDER-SEA LAMPREY LARVICIDE

Active Ingredient:	
Niclosamide, Aminoethanol Salt[1]	70.0%
Inert Ingredients:	30.0%
TOTAL:	100.0%

[1]Niclosamide, Active Equivalent (a.e.) = 59.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID

Have label with you when obtaining treatment advice.

If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes. •Call a poison control center, doctor or 1-800-858-7378 immediately for treatment advice.
If inhaled	•Move person to fresh air. •If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. •Call a poison control center or doctor immediately for treatment advice.

[Front Panel]

If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. •Call a poison control center or doctor immediately for treatment advice.

See Left Panel for additional precautionary statements.

Manufactured by:

Pro-Serve
400 E. Brooks Rd., P.O. Box 161059
Memphis, TN 38186-1059

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-87
EPA Establishment No. 33560-TN-01

Batch No. _____

Net Contents _____ lbs.

[Left Panel]

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Acute Hazards: Harmful if absorbed through skin or inhaled. Causes moderate eye irritation.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Avoid breathing dust. Wear protective clothing as listed under "Personal Protective Equipment". Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as rubber or made out of any water-proof material)
- Socks and shoes

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget organisms (such as freshwater clams and mussels) may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

[Right Panel]

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL:

Read the entire label and Sea Lamprey Control Document No. SLC-92-001.3 [Standard Operating Procedures for Application of Lampricides in the Great Lakes Fishery Commission Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with both label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

Before using this product, obtain all necessary permits.

GENERAL INFORMATION:

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget species are potentially vulnerable to Bayluscide, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS:

Use Pattern:

Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide may be used as an additive in combination with TFM (EPA Reg. No. 6704-45) for control of sea lamprey (*Petromyzon marinus*) in waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes. Application of Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide may be made as a simultaneous addition with TFM to reduce the amount of TFM required or as a subsequent addition downstream to enhance TFM larvicidal activity.

Pre-Application Notification:

Prior to and during the application of this chemical, take all appropriate actions to notify public water users including notification actions specified in the application manual referred to above.

Aerial Application:

Aerial application of this product is prohibited.

Pretreatment Surveys:

Prior to using Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide-TFM, pretreatment surveys must be made to determine populations of larvae. All waters selected for treatment must first be analyzed on site to determine both the minimum concentration of material required to kill lamprey larvae and the maximum concentration that can be applied without causing undue fish mortality. "Analysis" constitutes live animal toxicity tests or the use of a regression established by past toxicity tests and the total alkalinity and pH of the water.

Lethal Concentration:

Lethal concentration may vary depending upon water chemistry and temperature. Carefully calculate stream discharge and add the amount of lampricide necessary to kill lamprey larvae with minimal fish mortality. Use application devices that accurately deliver Bayluscide at calculated rates. Bayluscide concentrations will be monitored by high-performance liquid chromatography to insure that minimum lethal concentrations for sea lampreys are maintained and calculated maximum concentrations are not exceeded.

Application Directions:

Prior to and during the application of this chemical, take appropriate actions to notify public water users including notification actions specified in the Sea Lamprey Control Document No. SLC-92-001.3. When using Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide as an additive in combination with TFM, mix in proportions that result in a final concentration of Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide of not more than 2% of TFM by weight (based on active ingredient). Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide may be added to TFM in two ways:

1. One method of application is to apply both lampricides at the primary application site. TFM is metered into the stream while Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide is applied with a separate pump system in amounts calculated to deliver the desired ratio of Bayluscide to TFM.

2. A second application method is to apply Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide into an existing TFM bank. Because a TFM bank can be diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates are calculated, the toxicity of the bank in the stream must be raised by the addition of TFM or Bayluscide. The latter may be used in place of TFM. In these situations, TFM alone is pumped into the stream at the primary application site. Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide is introduced into the TFM bank at a point or points downstream in amounts calculated to produce the desired Bayluscide to TFM ratio.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals and where spills and leakage can be contained. Spills: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed above. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Triple rinse (or equivalent), and then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

Bayluscide® Granular (3.2% Active Niclosamide, Aminoethanol Salt)

EPA Reg. No. 6704-91 - April 24, 2003
Bayluscide 3.2% Granular Sea Lamprey Larvicide

[Front Panel]

RESTRICTED USE PESTICIDE

Due to Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control.

BAYLUSCIDE 3.2% Granular Sea Lamprey Larvicide

Active Ingredient: Niclosamide, Aminoethanol Salt[1]	3.2%
Inert Ingredients:	96.8%
TOTAL:	100.0%

[[1]Niclosamide, Active Equivalent (a.e.) = 2.7%]

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID
Have label with you when obtaining treatment advice.

If swallowed	•Call a poison control center or doctor immediately for treatment advice. •Have person sip a glass of water if able to swallow. •Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes. •Call a poison control center or doctor immediately for treatment advice.

If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. •Call a poison control center or doctor or 1-800-858-7378 immediately for treatment advice.

See Left Panel for additional precautionary statements.

Manufactured by:

Coating Place, Inc.
P.O. Box 930310
Verona, WI 53593

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-91
EPA Establishment No. 043108-WI-001

Batch No. _____

Net Contents _____ lbs.

[Left Panel]

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Acute Hazards: Harmful if swallowed. Harmful if absorbed through skin. Causes moderate eye irritation.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Wear protective clothing as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as rubber or made out of any water-proof material, Selection Category A)
- Socks and shoes

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside, then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget aquatic organisms may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to nontarget organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

[Right Panel]

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL

Read the entire label and Technical Operating Procedures of the Sea Lamprey Control Document No. SLC-92-001.3 [Manual for Application of Lampricides in the U.S. Fish and Wildlife Service Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with the label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

GENERAL INFORMATION

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget aquatic species are potentially vulnerable to Bayluscide, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS

Use Pattern:

Bayluscide 3.2% Granular Sea Lamprey Larvicide is used in waters of the Great Lakes basin, the Lake Champlain system, and the Finger Lakes. This formulation may be used alone or in conjunction with applications of TFM, or the combination of TFM and Bayluscide 70% Wettable Powder Sea Lamprey Larvicide. Bayluscide 3.2% Granular Sea Lamprey Larvicide may also be used as a assessment tool in deep or turbid water. When applied to a water's surface, the granules fall rapidly to the bottom where they are lethal to sea lamprey larvae.

Pre-application Notification:

Prior to and during the application of this chemical, take all appropriate actions to notify public water users, including notification actions specified in the application manual referred to above.

Permits:

Obtain any permits needed from Local, State, Provincial, and Federal wildlife agencies.

Potable Water:

Local, State, and Provincial Fish and Game agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators that use streams requiring treatment as a source of irrigation water must turn off their irrigation systems for a 24-hour period during and after treatment.

Unauthorized Personnel:

May not be used by unauthorized personnel.

PRE-APPLICATION DIRECTIONS

Aerial Application:

Aerial application of this product is prohibited.

Pretreatment Surveys:

Prior to using Bayluscide 3.2% Granular Sea Lamprey Larvicide, pretreatment surveys must be made to determine populations of larvae.

APPLICATION DIRECTIONS

Persons applying Bayluscide 3.2% Granular Sea Lamprey Larvicide must follow Sea Lamprey Control Document No. SLC-92-001, "Standard Operating Procedure for Application of Lampricides in the Great Lakes Fishery Commission's Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program," and ensure that the correct application rates are used. Prior to and during the application of this chemical, take appropriate actions to notify public water users, including notification actions specified in this manual. Determine water temperatures and pH. For best results, apply granules at water temperatures greater than 10 °C and pH greater than 7. Measure the area to be treated (length x width, in feet). Place markers to delineate the plot perimeter. Compute the total surface area to be treated in square feet. Application rate for Bayluscide 3.2% Granular Sea Lamprey Larvicide is 5 lb. AI/Acre. Compute the weight of granules to apply: ***lbs. of formulation required = square feet to be treated x .00359 lbs. formulation/sq. foot***. Use equipment that can be accurately calibrated to distribute the required amount of Bayluscide 3.2% Granular Sea Lamprey Larvicide evenly over the area to be treated.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals and where spills and leakage can be contained.
Spills: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed above.
In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Improper disposal of excess pesticide or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Triple rinse (or equivalent), and then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

Bayluscide® Emulsifiable Concentrate (20.6% Active Niclosamide, Aminoethanol Salt)

[Front Panel]

RESTRICTED USE PESTICIDE

Due to Eye Corrosiveness to Humans; Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control or persons under their direct supervision.

BAYLUSCIDE 20% EMULSIFIABLE CONCENTRATE

Active Ingredient:	
Niclosamide.	20.6%
Inert Ingredients:	79.4%
TOTAL:	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER

Corrosive to the eye and Skin Sensitizer

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	•Call a poison control center or doctor immediately for treatment advice. •Have person sip a glass of water if able to swallow. •Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes. •Call a poison control center or doctor immediately for treatment advice.

If inhaled	•Move person to fresh air. •If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. •Call a poison control center or doctor immediately for treatment advice.
If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. •Call a poison control center or doctor immediately for treatment advice.

NOTE TO PHYSICIAN

Probable mucosal damage may contraindicate the use of gastric lavage. No specific antidote is available. Treat symptomatically. See additional PRECAUTIONARY STATEMENTS on Left/Right/Side Panel.

[Left Panel]

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Acute Hazards: Corrosive. Causes irreversible eye damage. Harmful if absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Wear protective clothing and protective eyewear as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as nitrile or butyl))
- Socks and shoes
- Protective eyewear (goggles, face shield, or safety glasses)

[Right Panel]

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining Personal Protective Equipment (PPE). If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget organisms (such as freshwater clams and mussels) may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

PERMITS

Obtain any permits needed from local, State, Provincial, and Federal wildlife authorities.

POTABLE WATER

At least 24 hours prior to application, notify municipalities and agricultural irrigators that potable and irrigation water will be treated . Agricultural irrigators must turn off their irrigation systems for a 24-hour period during and after treatment.

UNAUTHORIZED PERSONNEL

May not be used by unauthorized personnel.

UNITED STATES DEPARTMENT OF INTERIOR Fish and Wildlife Service 18th and C Streets, NW Washington, DC 20240 EPA Reg. No. 6704-OE	Manufacturing by Pro-Serve 400 E. Brooks Road P.O. Box 161059 Memphis, TN 38186-1059 EPA Est. No. 33560-TN-01

Net Contents: _____

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL:

Read the entire label and Sea Lamprey Control Document No. SLC-92-001.3 [Manual for Application of Lampricides in the U.S. Fish and Wildlife Service Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with both label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

Before using this product, obtain all necessary permits.

GENERAL INFORMATION:

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget species are potentially vulnerable to Bayluscide, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS:

<u>Use Pattern:</u>

Baylusicide 20% Emulsifiable Concentrate may be used as an additive in combination with TFM (EPA Reg. No. 6704-45) for control of sea lamprey (*Petromyzon marinus*) in waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes. Application of Bayluscide 20% Emulsifiable Concentrate may be made as a simultaneous addition with TFM to reduce the amount of TFM required or as a subsequent addition downstream to enhance TFM larvicidal activity.

Pre-Application Notification:

Prior to and during the application of this chemical, take all appropriate actions to notify public water users including notification actions specified in the application manual referred to above.

Aerial Application:

Aerial application of this product is prohibited.

Pretreatment Surveys:

Prior to using Bayluscide 20% Emulsifiable Concentrate-TFM, pretreatment surveys must be made to determine populations of larvae. All waters selected for treatment must first be analyzed on site to determine both the minimum concentration of material required to kill lamprey larvae and the maximum concentration that can be applied without causing undue fish mortality. "Analysis" constitutes live animal toxicity tests or the use of a regression established by past toxicity tests and the total alkalinity and pH of the water.

Lethal Concentration:

Lethal concentration may vary depending upon water chemistry and temperature. Carefully calculate stream discharge and add the amount of lampricide necessary to kill lamprey larvae with minimal fish mortality. Use application devices that accurately deliver Bayluscide at calculated rates. Bayluscide concentrations will be monitored by gas chromatography or by high-performance liquid chromatography to insure that minimum lethal concentrations for sea lampreys are maintained and calculated maximum concentrations are not exceeded.

Application Directions:

Prior to and during the application of this chemical, take appropriate actions to notify public water users including notification actions specified in the Sea Lamprey Control Document No. SLC-92-001.3. When using Bayluscide 20% Emulsifiable Concentrate as an additive in combination with TFM, mix in proportions that result in a final concentration of Bayluscide 20% Emulsifiable Concentrate of not more than 2% of TFM by weight (based on active ingredient). Bayluscide 20% Emulsifiable Concentrate may be added to TFM in two ways:

1. One method of application is to apply both lampricides at the primary application site. TFM is metered into the stream while Bayluscide 20% Emulsifiable Concentrate is applied with a separate pump system in amounts calculated to deliver the desired ratio of Bayluscide to TFM.

2. A second application method is to apply Bayluscide 20% Emulsifiable Concentrate into an existing TFM bank. Because a TFM bank can be diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates are calculated, the toxicity of the bank in the stream must be raised by the addition of TFM or Bayluscide. The latter may be used in place of TFM. In these situations,

TFM alone is pumped into the stream at the primary application site. Bayluscide 20% Emulsifiable Concentrate is introduced into the TFM bank at a point or points downstream in amounts calculated to produce the desired Bayluscide to TFM ratio.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Triple rinse (or equivalent), and then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

Material Safety Data Sheet for Antimycin A

MATERIAL SAFETY DATA SHEET

Antimycin A in Acetone Issued 04/17/97

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Material Name: Antimycin A in Acetone
MANUFACTURER: Aquabiotics Corporation
10750 Arrow Point Drive
Bainbridge Island, WA 98110
TELEPHONE NUMBER: 1-206-842-1708
FAX NUMBER: 1-206-842-7266

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME: Acetone *
CONCENTRATION: 80.0000%
CAS/RTECS NUMBERS: 67-64-1 / AL3150000
OSHA-PEL 8HR TWA: 750 ppm
STEL: 1000ppm
CEILING: N/L
ACGIH-TLV 8HR TWA: 750 PPM
STEL: 1000 PPM
CEILING: N/L
OTHER LIMITS 8HR TWA: N/A
STEL: N/A
CEILING: N/A
* Hazardous per OSHA criteria

INGREDIENT NAME: Antimycin A *
CONCENTRATION: 20.0000 %
CAS/RTECS NUMBERS: 1397-94-0 / CD0350000
OSHA-PEL 8HR TWA: N/L
STEL: N/L
CEILING: N/L
ACGIH-TLV 8HR TWA: N/L
STEL: N/L
CEILING: N/L
OTHER LIMITS 8HR TWA: N/A
STEL: N/A
CEILING: N/A
* Hazardous per OSHA criteria

3. HAZARDS INFORMATION

EMERGENCY OVERVIEW: Flammable Liquid and a marine hazard. The active component is toxic by ingestion and may
also by skin absorption. It is an eye, skin and respiratory irritant.
ROUTE(S) OF ENTRY: Skin: Yes
Inhalation: Yes
Ingestion: Yes
INGESTION RATING: Highly Toxic
SKIN ABSORPTION RATING: Possibly highly toxic
INHALATION RATING: N/D
CORROSIVENESS RATING: N/D
SKIN CONTACT RATING: Irritant
SKIN SENSITIZATION RATING: N/D
EYE CONTACT RATING: Irritant
TARGET ORGANS: Eyes, skin, respiratory tract, cardiovascular system, nervous system, kidneys, possibly fetus
CARCINOGENICITY RATING: NTP: N/L IARC: N/L OSHA: N/L
ACGIH: N/L

None

SIGNS AND SYMPTOMS: N/D. Inhalation of vapors or aerosol could irritate the eyes, nose and respiratory tract. Direct contact with skin or eyes could produce severe irritation. Systemic intake could produce a decrease in blood pressure, nausea, light headedness, dizziness, excitement, incoordination, weakness, loss of coordinated speech and drowsiness.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: N/D. Available information suggests pre-existing eye, skin, respiratory, kidney, nervous system or cardiovascular ailments.

4. FIRST AID MEASURES

EYES: Remove from source of exposure. Flush with copious amounts of water. If irritation persists or signs of toxicity occur, seek medical attention. No known antidote. Provide symptomatic/supportive care as necessary.

SKIN: Remove from source of exposure. Flush with copious amounts of water. If irritation persists or signs of toxicity occur, seek medical attention. No known antidote. Provide symptomatic/supportive care as necessary.

INGESTION: Remove from source of exposure. Seek immediate medical attention. No known antidote. Provide symptomatic/supportive care as necessary.

INHALATION: Remove from source of exposure. If signs of irritation or toxicity occur, seek medical attention. No known antidote. Provide symptomatic/supportive care as necessary.

5. FIRE FIGHTING PROCEDURES

FLASH POINT: O F (for acetone)
FLASH POINT METHOD: Closed Cup
LOWER EXPLOSIVE LIMIT(%): 2.6% (for acetone)
UPPER EXPLOSIVE LIMIT(%): 12.8% (for acetone)
AUTOIGNITION TEMPERATURE: 869 F (for acetone)

FIRE & EXPLOSION HAZARDS: Flammable Liquid. Keep away from heat, sparks and open flame.
EXTINGUISHING MEDIA: Use "alcohol" foam, dry chemical or carbon dioxide. Water may be ineffective.
FIRE FIGHTING INSTRUCTIONS: Wear protective clothing and self-contained breathing apparatus.

6. ACCIDENTAL RELEASE MEASURES

SPILL OR RELEASE PROCEDURES: Recover product and place in an appropriate container for disposal. Ventilate and wash the spill area.

7. HANDLING AND STORAGE

HANDLING: Ground and bond all containers during transfer operations.
STORAGE: Tight container.
SPECIAL PRECAUTIONS: Wash hands and face after handling this compound.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Use local exhaust.
RESPIRATORY PROTECTION: Air purifying respirator with organic vapor cartridge.
SKIN PROTECTION: Butyl rubber.
EYE PROTECTION: Full-face respirator.
OTHER PROTECTION: Wear saranex tyvek coverings with hood and shoe covers if contact may occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE: Brown to black liquid
ODOR: Acetone
BOILING POINT: 56.2 C (for acetone)
MELTING/FREEZING POINT: -94.6 C (for acetone)
VAPOR PRESSURE (mm Hg): N/D
VAPOR DENSITY (Air=1): N/D
EVAPORATION RATE: N/D

BULK DENSITY: N/D
SPECIFIC GRAVITY: 0.8 (for acetone)
SOLUBILITY: Miscible in water, alcohols, ethers and most organic solvents.
pH: N/D
VISCOSITY: N/D

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Neutralize active component with bleach, potassium permanganate, or other strong oxidizer.
INCOMPATIBILITIES: Oxidizers.
HAZARDOUS DECOMPOSITION PRODUCTS: N/D
HAZARDOUS POLYMERIZATION: N/D

11. TOXICOLOGICAL INFORMATION

ORAL TOXICITY: N/D. LD50 = 30 mg/kg in rates for antimycin A. LD50 = 1738-10, 700 mg/kg in mice, rats and rabbits for acetone.
DERMAL TOXICITY: N/D. Cumulative lethal dosage for antimycin A in rabbits about 65-150 mg/kg in animals receiving one gram of a 5% suspension in carbowax twice daily for three applications. Death possibly the result of absorption through broken skin as marked inflammation present after second application. LD50 = 20,000 mg/kg in rabbits for acetone.
INHALATION TOXICITY: N/D. A 10% formulation of antimycin A in alcohol administered to rats and guinea pigs as an aerosol for 10 minutes a day for 5 days at a nominal concentration of 170 mg/m3 produced eye irritation with corneal lesions and respiratory irritation and damage. LCLo = 16,000 ppm/4H in rats and 467,300 ppm/1H in mice for acetone. Vapors can cause irritation of the respiratory tract.
CORROSIVENESS: N/D
DERMAL IRRITATION: N/D. No irritation found following dermal application of 0.5 gram of a 5% suspension of antimycin A in carbowax (25 mg antimycin A); however, exudation, edema and scab formation were found after the first two of six applications over three days. Acetone mildly irritating to rabbit skin. Repeated or prolonged contact can cause dermatitis.
OCULAR IRRITATION: N/D. Corneal opacity clearing in four weeks resulted following application of 0.1 gram of antimycin A to the eyes of guinea pigs. Application of 0.5 grams of 5% antimycin A in alcohol to the eyes of rabbits resulted in slight redness. Acetone severely6 irritating, with corneal injury in rabbits. Vapors can cause eye irritation and burning. Can cause stinging if splashed in the eyes.
DERMAL SENSITIZATION: N/D.
SPECIAL TARGET ORGAN EFFECTS: N/D. Dietary administration of antimycin A a dosage of 10 mg/kg/day for four weeks produced soft stools and reduced weight gain in rats. Dietary administration at a dosage of 0.5 mg/kg/day to rats prior to and during pregnancy resulted in reduced body weight of the offspring (about 10%). Infusion to dogs at a rate of 1mcg/kg/minute for 1 hour produced no adverse effects; however, infusion of 10 mcg/kg/minute produced decreased blood pressure, slowed heart rate and death. Acetone causes central nervous system depression at elevated vapor concentrations and irritation at lower concentrations. Produced kidney injury in rats at oral dosages of 500 mg/kg/day or more.
CARCINOGENICITY INFORMATION: N/D

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION: Marine hazard. Used in conjunction with a surfactant to kill fish.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHODS: Dispose of product in accordance with federal, state and local regulations.

14. TRANSPORTATION INFORMATION

DOT STATUS: Regulated
PROPER SHIPPING NAME: Flammable Liquids, toxic, n.o.s. (Acetone, Antimycin A), 3, UN1992, II
HAZARD CLASS: 3
UN NUMBER: UN1992
PACKING GROUP: II
REPORTABLE QUANTITY: 5000/2270

IATA/ICAO STATUS: Regulated
PROPER SHIPPING NAME: Flammable liquid, toxic, n.o.s., (Acetone, Antimycin A)
HAZARD CLASS: 3
UN NUMBER: UN1992
PACKING GROUP: II
REPORTABLE QUANTITY: 5000/2270
IMO STATUS: Regulated
PROPER SHIPPING NAME: Not Authorized
HAZARD CLASS: N/D
UN HUMBER: N/D
PACKING GROUP: N/D
REPORTABLE QUANTITY: N/D
FLASH POINT: O F (for acetone)

15. REGULATORY INFORMATION

TSCA STATUS: Exempt
CERCLA STATUS: N/D
SARA STATUS: N/D
RCRA STATUS: N/D
PROP 65 (ca): N/D

16. OTHER INFORMATION

LEGEND: N/A =
N/D = Not Determined
N/L = Not Listed
L = Listed
C = Ceiling
S = Short-term
® = Registered Trademark of Aquabiotics Corporation
™ = Registered Trademark of Aquabiotics Corporation

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Material Safety Data Sheet for Prentox® Prenfish™ Fish Toxicant Powder (rotenone)

Product: 655-691 Prentox® Prenfish™ Fish Toxicant Powder

Material Safety Data Sheet
U.S. Department of Labor (OSHA 29 CFR 1910.1200)

Section 1: Product and Company Identification

Product: 655-691 Prentox® Prenfish™ Fish Toxicant Powder

Manufacturer's Name: **Prentiss Incorporated**
C. B. 2000
Floral Park, NY 11001
Telephone Number: **(516) 326-1919**

Section II: Composition/Information on Ingredients

Ingredient Name:	OSHA PEL	ACGIH TLV	%
Rotenone (CAS # 83-79-4)	(TWA) 5 mg/M³	(TWA) 5 mg/M³	7.4
Other Cube Resins	None	None	11.1
Other Ingredients	None	None	81.5

Section 3: Hazards Identification:

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Emergency Overview:

A tan powder with a wet chalk or dirt-like odor.

- Fatal if inhaled or swallowed
- Harmful if absorbed through skin
- Causes moderate eye irritation
- May cause allergic skin reactions in some individuals
- This pesticide is extremely toxic to fish

Potential Health Effects:

Primary Route(s) of Entry:
Ingestion, inhalation, and skin contact

Eyes:
Causes moderate eye irritation

Skin:
Harmful if absorbed through the skin. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals.

Ingestion:
Fatal if swallowed

Inhalation:
Fatal if inhaled

Signs and symptoms of acute overexposure:
May cause irritation of the eyes, nose and throat in addition to temporary numbness. Prolonged or repeated exposure can cause nausea, vomiting, abdominal cramps, muscle tremors, poor muscle coordination, seizures, shallow breathing, skin rashes and eye, nose and mouth lesions.

Section 4: First Aid Measures:

Eyes:
Flush eyes with plenty of water for 15 minutes. Get medical attention if irritation persists

Skin:
Wash with plenty of soap and water. Get medical attention if irritation persists

Ingestion:
Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.

Inhalation:
Remove person to fresh air. If not breathing, give artificial respiration, preferably mouth to mouth. Get medical attention

Note to Physician:
If a small amount is ingested (or if treatment is delayed), oral administration of large amounts of activated charcoal and a cathartic is probably sufficient therapy.
Do not administer milk, cream or other substances containing vegetable or animal fats, which enhance the absorption of lipophilic substances.

Section 5: Fire Fighting Measures:

Extinguishing Media:
Carbon dioxide, dry chemical, foam or water

Fire Fighting Instructions:
As in any fire, wear self-contained breathing apparatus, pressure demand, MSHA/NIOSH approved (or equivalent), and full protective gear. Keep upwind. Isolate hazard area. Avoid inhalation of smoke and fumes. Use water or foam to reduce fumes. Do not touch spilled material. If possible, move containers from area. Extinguish only if flow can be stopped. Use flooding amounts of water as a fog. Cool containers with flooding amounts of water from as far a distance as possible. Avoid breathing vapors.

Flammability Classification/Rating:
NFPA/OSHA Class: IIIB
NFPA Rating (Fire): 1

Section 6: Accidental Release Measures:

General and Disposal: Use proper protective equipment to minimize personal exposure (see Section 8). Take all necessary action to prevent and to remedy the adverse effect of the spill. Ensure that the disposal is in compliance with all Federal, State/Provincial, and local regulations (see Section 13 for applicable RCRA number). Refer to Section 15 for applicable Reportable Quantity (RQ) and other regulatory requirements.

Land Spill: Sweep or shovel spilled material into a tightly sealed container. Dispose of with chemical waste.

Section 7: Handling and Storage:

Handling Precautions:
Do not breathe dust. Avoid contact with eyes, skin or clothing.

Storage Precautions:
Do not contaminate water, food or feed by storage. Store in a dry place, away from excessive temperature extremes.

Work/Hygienic Practices:
Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco. Remove contaminated clothing and wash before reuse.

Section 8: Exposure Controls/Personal Protection:

Manufacturing, formulation and other Non-Agricultural uses.

Engineering controls:
Control airborne concentrations below the appropriate exposure guideline (see Section 2 for applicable OSHA/ACGIH Exposure Limits). Local exhaust ventilation may be necessary.

Eye/Face Protection:
Wear safety glasses, splash goggles or face shield.

Skin Protection:
Wear chemical resistant gloves (Neoprene, Nitrile rubber or PVC) and other protective clothing to avoid skin contact.

Respiratory Protection:
Ensure good ventilation. If not adequate, use a chemical cartridge type respirator approved by the National Institute of Occupational Health and Safety.

General Protection:
Eye wash facility and safety shower should be available. Wear a protective apron, long sleeves and pants to prevent skin contact.

Section 9: Physical and Chemical Properties:

Appearance:
Tan powder

Odor:
Wet chalk or dirt-like odor.

Basic Physical Properties:

Physical State: Solid

Solubility (H_2O): Insoluble

Bulk Density: Fluffed – 0.24 gm/cm^3 (14.7 lb./cu. Ft.). Packed – 0.45 gm/cm^3 (28.1 lb./cu. Ft.)

Section 10: Stability and Reactivity:

Stability: Stable.

Conditions to Avoid (Stability): High temperatures and constant exposure to sunlight

Incompatible Materials: Avoid strong oxidizers and reducing agents

Hazardous Polymerization: Will not occur

Section 11: Toxicological Information:

The following data were developed with rotenone dust containing 5% rotenone.

Eye Effects:

Irritation (Rabbit): Slightly irritating.

Skin Effects:

Irritation (Rabbit): Non-irritating.

Absorption (Rabbit): LD_{50} > 2,020 mg/kg (Slightly Toxic).

Sensitization (Guinea Pig): Sensitizing

Acute Oral Effects:

LD_{50} (Rat, male): 874 mg/kg (Slightly Toxic).

(Rat, female): 99.2 mg/kg (Moderately Toxic).

Acute Inhalation Effects:

4 hour LC_{50} (Rat, Male): 0.087 mg/L (Moderately Toxic).

4 hour LC_{50} (Rat, Female): 0.045 mg/L (Highly Toxic).

4 hour LC_{50} (Rat): 0.056 mg/L (Moderately Toxic).

Note: the severity classifications listed above are those of Prentiss Incorporated, and, particularly for eye irritation, may not always coincide with EPA-mandated Precautionary Statements.

The following data were developed with rotenone, the active ingredient in this product.

Chronic (Cancer) Information:

Rotenone was not carcinogenic when tested in rats and mice.

Carcinogenicity: **NTP:** No **IARC:** No **OSHA:** No

Teratogenicity (Birth Defects):

Rotenone was not teratogenic or fetotoxic when tested in rats and mice.

Reproductive Effects:

Rotenone had no adverse effects on reproduction when tested over two successive generations in rats.

Mutagenicity (Genetic Effects):

Rotenone was not mutagenic nor clastogenic when tested in the Ames test, Yeast test, Mouse Lymphoma test, Mouse Micronucleus test, Chromosome Aberration test and the Mitotic Recombination test in Yeast.

Section 12: Ecological Information:

Other Environmental Information:

This pesticide is extremely toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters, unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA

Section 13: Disposal Considerations:

Do not contaminate water, food or feed by disposal.

Pesticide Disposal:

Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

Container Disposal:

Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into application equipment. Then dispose of liner in a sanitary landfill or by incineration if allowed by State and local authorities. If drum is contaminated and cannot be reused, dispose of in the same manner.

RCRA Information:

RCRA Hazardous Waste Ingredients: None.

Section 14: Transport Information:

Proper Shipping Name: Pesticide, Solid, Toxic, n.o.s. (Rotenone)
Hazard Class: 6.1, PG I
DOT Identification Number: UN2588
DOT Shipping Label: POISON

Additional Shipping Paper Description: Marine Pollutant

Note: For transport purposes (49 CFR Part 173.132), the calculated 1 hour LC_{50} (Rat) is: 0.224 mg/L (dust)

Section 15: Regulatory Information:

U.S. Federal Regulatory Information:

EPA Reg. No.: 655-691
TSCA Inventory: Registered pesticide, exempt from TSCA.
SARA Title III Notification and Information:

Section 302 (EHS) ingredients: None.
Section 304 (CERCLA & EHS) ingredients (RQ): None.
Section 313 ingredients: None.

SARA Title III Notifications and Information:

SARA Title III Hazard Classes:

Acute Health Hazard: Yes
Chronic Health Hazard: No
Fire Hazard: No
Sudden Release of Pressure Hazard: No
Reactivity Hazard: No

Material Safety Data Sheet for TFM

MATERIAL SAFETY DATA SHEET
(In accordance with OSHA CFR 1910.1200, ANSI Z 400.1-1998)

SECTION 1: Chemical Product & Company Identification

Product Name: TFM, Lampricide Sea Lamprey Larvicide, Sea Lamprey Larvicide LAMPRECID®
Chemical Name: α,α,α-trifluoro-4-nitro-m-cresol liquid formulation

Registrant Name & Address:
U.S. Fish and Wildlife Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240

Telephone Contact Number & Hours of Operation: (202) 483-7616 8:00 am-4:30 pm Monday-Friday

Emergency Telephone Contact Number: In the United States: Chemtrec:1-800-424-9300
In Canada: Canutec: 1-613-996-6666 (Collect)

SECTION 2: Composition/Information on Ingredients

Hazardous Ingredients(*):	% by weight	CAS No.	OSHA PEL TWA	OSHA PEL STEL	ACGIH TWA	TLV STEL
α,α,α-trifluoro-4-nitro-m-cresol	36-40	88-30-2	NE	NE	NE	NE
water	35-43	7732-18-6	NE	NE	NE	NE
isopropyl alcohol	11-13	67-63-0	980 mg/m^3	NE	983 mg/m^3	1230 mg/m^3
sodium hydroxide	6.4-7.8	1310-73-2	2 mg/m^3	NE	NE	2 mg/m^3 (1)
Other TFM related materials:						
3-hydroxy-4-nitrobenzoic acid	1.5-4.0	619-14-7	NE	NE	NE	NE
3-nitro-4-hydroxybenzoic acid	3.0-8.0	616-82-0	NE	NE	NE	NE
5-trifluoromethyl-2-nitrophenol	2.0-6.0	NA	NE	NE	NE	NE

*all ingredients in quantities > 1.0 % (0.1 % for carcinogens) that are **potentially** hazardous per OSHA definitions
(1) This is a ceiling value

Some States enforce the PEL's that OSHA promulgated in 1989, which were subsequently vacated by the U.S. Supreme Court. Check with your State OSHA agency to determine which PEL is enforced in your jurisdiction.

NDA = no data available NE = not established

SECTION 3: Hazards Identification EMERGENCY OVERVIEW

Physical description: Dark brownish red liquid

Odor: oily-nutty, phenolic

Potential Health Effects: WARNING! Causes eye and skin irritation. May be harmful or fatal if swallowed. May cause central nervous system depression with nausea, vomiting, dizziness and drowsiness. Personnel responding to a spill of this material should wear appropriate personal protective equipment.

Fire Fighting Measures: Keep away from heat, sparks or open flames.

NFPA RATING:	Health - 2	Flammability - 1	Reactivity -NDA	Special-NDA
HMIS RATING:	Health - 2	Flammability - 1	Reactivity - NDA	Protective Equipment - X

Revision Number: 1 **Date of Issue: 8/6/2001** **MSDS Number: EHS-USFW004**

SECTION 4: First Aid Measures

Skin Contact: Remove contaminated clothing. Flush affected area with water for at least 15 minutes. Wash affected area with mild soap and water. Seek medical attention if symptoms develop and persist.
Ingestion: Immediately rinse mouth out with plenty of water. If within 30 minutes after ingestion, give victim a small glass of water or milk (NEVER give anything by mouth to an unconscious person). Do not induce vomiting unless instructed to do so by a physician or poison center. Seek medical attention immediately.
Eye Contact: Immediately flush with plenty of water. Remove contact lenses (if easy to do) and continue flushing for at least 15 minutes. Seek medical attention immediately.

Inhalation: Remove to fresh air. Seek medical attention immediately if breathing becomes difficult or other symptoms develop.

Antidotes/Notes to Physicians: There is no known specific antidote.

SECTION 5: Fire Fighting Measures

Flashpoint: 211.1°F (99.5°C)

Autoignition temperature: NDA

Flammable Limits: LEL: NDA UEL: NDA

Extinguishing media: Use water, foam, CO2

Hazardous products of combustion: Carbon monoxide, carbon dioxide, nitrogen containing chemicals (e.g. NO_2, NO_x, NH_3), and flourine containing compounds (e.g. HF).

Unusual fire and explosion hazards: Keep away from heat, sparks and flame.

Protective Equipment: Use NIOSH/MSHA approved SCBA and full protective gear.

SECTION 6: Accidental Release Measures

Extinguish all ignition sources immediately. Do not attempt to clean up chemical spills without appropriate personal protective equipment (see section 8). Do not touch or walk through spilled material. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers for disposal. For large spills, dike far ahead for later disposal. For large spills, water spray may reduce vapor, but may not prevent ignition in closed spaces. Keep waste out of sewers, watersheds, and waterways. Extinguish or remove all ignition sources. See Disposal Comments in Section 13.

SECTION 7: Handling & Storage

Handling: Avoid contact with eyes and skin. Use with proper personal protective equipment (see Section 8).

Storage: Store upright in a cool, dry, well ventilated area out of direct sunlight. Store away from incompatible materials (see Section 10). Use with proper personal protective equipment (see Section 8). Keep containers tightly closed at all times. Do not reuse container. Keep out of reach of children.

SECTION 8: Exposure Controls & Personal Protective Equipment

Engineering Controls: Use local exhaust in processing or storage areas. If any of the limits in section 2 are exceeded, local ventilation or respiratory protection may be necessary.
Skin: Protective gloves recommended to prevent skin contact. Contact glove manufacturer for more information.

Eye Protection Wear safety glasses with side shields.

Respiratory: If industrial hygiene surveys show that the exposure limits in Section 2 are exceeded, use of a NIOSH approved respirator is necessary. Seek professional advice prior to respirator selection or use. Follow OSHA respirator regulations (29 CFR 1910.134). Use a positive pressure air supplied respirator if there is a potential for an uncontrolled release, exposure levels are not known, or under any other circumstances where air purifying respirators may not provide adequate protection.

SECTION 9: Physical & Chemical Parameters

Physical State: Liquid
Odor: oily-nutty, phenolic
Vapor Density (air = 1): NDA
Boiling Point: NDA
Viscosity: NDA
Specific Gravity: NDA
pH: 9.0

Solubility in other solvents: NDA

Appearance: Dark brownish
Vapor Pressure: NDA
Percent Volatile by Volume: NDA
Freezing Point: NDA
Melting Point: NDA
Solubility in water: NDA
Density: 1.270 g/mL

Viscosity: 23.28 centipoise at 77°F (25°C)

SECTION 10: Stability & Reactivity

Stability: Stable

Incompatible Materials and conditions to avoid: NDA
Hazardous polymerization: Will not occur.

Hazardous decomposition products: Carbon monoxide, carbon dioxide, nitrogen containing chemicals (e.g NO_2, NO_x, NH_3), and flourine containing compounds (e.g HF).

SECTION 11: Toxicological Information

Product based:
There are no toxicological data available for this product. Exposure to this product can occur by eye and skin contact, ingestion and inhalation of vapors or mists. Overexposure by all routes may cause central nervous system depression with headache, nausea, dizziness and drowsiness. Eye and skin contact is expected to cause irritation. Ingestion is expected to cause irritation to the mouth, throat and esophagus and possibly nausea and vomiting. The rat-oral LD50 for technical grade TFM is 151 mg/kg. Based on this information, this product is expected to be harmful or fatal if swallowed. Inhalation of mists or vapors is expected to cause upper respiratory tract irritation with coughing and nasal discharge. There were no data located for this product regarding potential developmental, reproductive, mutagenic/genotoxic or carcinogenic effects following exposure.

Ingredient based:
This product contains technical grade α,α,α-trifluoro-4-nitro-m-cresol bars (TFM) (CAS# 88-30-2). Eye contact with technical grade TFM caused severe irritation in animal studies. Skin contact caused severe irritation in animal studies. The rabbit-dermal LD50 ranged from > 2.0 g/kg in females to 2.1 g/kg in males. Clinical signs of toxicity included decreased activity, lack of coordination, excessive salivation, prostration and death. TFM did not cause skin sensitization in animal studies using guinea pigs. Ingestion can cause severe irritation to the mouth, throat, esophagus, and stomach with nausea, vomiting, and diarrhea. Technical grade TFM may be harmful or fatal if swallowed based on a rat-oral LD50 (combined for males and females) of 151 mg/kg. Inhalation may cause upper respiratory tract irritation with coughing and nasal discharge. Tests for mutagencity have yielded mixed results. TFM was considered positive for inducing chromosome aberrations in Chinese hamster ovary cells under conditions of both nonactivation and activation. However, TFM did not induce significant changes in the *in vitro* rat primary hepatocyte unscheduled DNA synthesis assay or in the *in vivo* mouse micronucleus assay. TFM did not cause developmental effects at concentrations less than or equal to 125 mg/kg in animal studies. No significant reproductive effects were

observed in animal studies, particularly at low and middle dosing levels. There were no data located addressing potential carcinogenic effects following exposure to TFM.

This product also contains the TFM related materials 3-hydroxy-4-nitrobenzoic acid (CAS#619-14-7), 3-nitro-4-hydroxybenzoic acid (CAS# 616-82-0), and 5-trifluoromethyl-2-nitrophenol (no CAS#). No toxicological data were located for any of these ingredients.

Isopropyl alcohol (CAS#67-63-0) is a colorless liquid with an alcohol odor. Acute exposures by skin contact, inhalation, or ingestion can result in central nervous system depression, persistent nausea, vomiting, abdominal pain, hematemesis, areflexia, depressed respirations, and liguria followed by diuresis. The dermal toxicity of isopropyl alcohol is generally considered low. Skin contact with isopropyl alcohol can result in irritation, a burning sensation, rashes and an overall drying effect. Cases of hypersensitivity characterized by eczematous reactions have been observed. Absorption of harmful amounts can occur from prolonged skin contact. Symptoms of delayed skin absorption that have occurred in pediatric poisonings include respiratory distress, stupor, and coma with complete recovery in 36 hours. Humans exposed by inhalation to 400 ppm for 3-5 minutes experienced mild irritation of the eyes, nose, and throat; exposure to 800 ppm yielded increased (yet not severe) irritation and an uncomfortable atmosphere. Overexposure to the vapor can cause headaches, drowsiness, loss of coordination, collapse, and death. Ingestion of isopropyl alcohol can cause vomiting, depression, coma, shock, hypotension, facial flushing, bradycardia and dizziness. Complications following ingestion include renal insufficiency, including anuria followed by oliguria, nitrogen retention, and edema. The toxic dose is about 1 mL/kg of a 70% isopropyl alcohol solution but as little as 0.5 mL/kg may cause symptoms. Isopropyl alcohol has not been adequately evaluated in terms of carcinogenicity or potential reproductive or developmental toxicity.

This product contains sodium hydroxide (CAS#1310-73-2). Sodium hydroxide is corrosive to the skin, eyes and mucous membranes. Skin contact with 25-50% sodium hydroxide solutions have produced skin irritation in about 3 minutes. Prolonged skin contact can result in severe burns with deep ulcerations. Severe eye injury has been reported in workers exposed to high concentrations of dust or liquids. Eye contact can cause disintegration and sloughing of the conjunctival and corneal epithelium, corneal opacification, redness and ulceration. Inhalation of vapors can result in burning of the nose, throat, eyes and upper respiratory systems. Ingestion produces severe abdominal pain, corrosion of the lips, mouth, tongue, pharynx and vomiting of large pieces of mucosa. Corrosive injury to the mouth, throat, esophagus, and stomach may result in perforation, hemorrhage, and narrowing of the gastrointestinal tract. Death can result from shock, infection of corroded tissues, or asphixia. There were no data located classifying sodium hydroxide as a carcinogen or indicating reproductive or developmental toxicity.

Possible target organs: All tissues (irritation), central nervous system.
Medical conditions that may be aggravated by exposure: Existing skin (e.g. sensitive skin) disorders, central nervous system disorders.

Carcinogens: None of the components listed in Section 2 are considered carcinogens (or classified in regards to carcinogenicity) by OSHA, NTP, and IARC.

SECTION 12: Ecological Information

Ecotoxicity: NDA

Environmental Fate: NDA

SECTION 13: Disposal Considerations

This material (as packaged) may be considered a hazardous waste. Be aware that the waste owner has responsibility for final disposal. Regulations may also apply to empty containers, liners or rinsate. Laws may change or be reinterpreted; state and local regulations may be different from federal regulations. This information applies to materials as manufactured; contamination or processing may change waste characteristics and requirements.

SECTION 14: Transport Information

DOT Hazard Description: NDA

SECTION 15: Regulatory Information

Chemical Inventories: This product is exempt from TSCA regulation under FIFRA Section 3 (2) (B) (ii) when used as a pesticide.

Isopropyl alcohol (CAS#67-63-0) and sodium hydroxide (CAS# 1310-73-1) are listed on the TSCA Inventory, the DSL and the EINECS. α,α,α-trifluoro-4-nitro-m-cresol bars (TFM) (CAS# 88-30-2) is listed on the DSL and the EINECS. 3-hydroxy-4-nitrobenzoic acid (CAS#619-14-7), 3-nitro-4-hydroxybenzoic acid (CAS#616-82-0) are listed on the EINECS.

Reportable Quantities (RQ) (40 CFR table 302.4): Sodium hydroxide (CAS# 1310-73-1) 1000 lbs

SARA TITLE III (Superfund Amendments and Reauthorization Act):

Section 302 Extremely Hazardous Materials (40 CFR 355): None listed

Section 304 Notification Of Accidental Release (40 CFR 355): None listed

Sections 311/312 Hazard Categories (40 CFR 370):

Immediate (Acute) Health Effects:	YES
Delayed (Chronic) Health Effects:	YES
Fire Hazard:	NO
Sudden Release of Pressure Hazard:	NO
Reactivity Hazard:	NDA

Section 313 Toxic Chemical Release Reporting (40 CFR 372.65(a)): Isopropyl alcohol (CAS#67-63-0), only persons who manufacture by the strong acid process, no supplier notification required.

STATE REGULATORY INFORMATION: Since each state has the authority to promulgate standards more stringent than the federal government, this section cannot provide an inclusive list of all state regulations which apply to this product. Questions related to state regulations should be directed toward local officials.

SECTION 16: Other Information

For additional information, refer to the 2000 North American Emergency Response Guidebook and the ACGIH Documentation of the TLV's for individual components.

This information is provided in good faith, but without express or implied warranty.

This MSDS was prepared by Environmental Health & Safety, Inc., St. Paul, MN, 55116, USA

Material Safety Data Sheet for Bayluside Technical

MATERIAL SAFETY DATA SHEET
(In accordance with OSHA CFR 1910.1200, ANSI Z 400.1-1998)

SECTION 1: Chemical Product & Company Identification

Product Name: Bayluscide Technical
Chemical Name: Niclosamide ethanolamine salt, clonitralide
Synonyms: Bayer 73, Bayluside, Baylucit, 2-aminoethanol salt, Mollutox, Salicylanilide, 2'5-dichloro-4-nitro,-ethanolamine salt

Registrant Name & Address:
U.S. Fish and Wildlife Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240

Telephone Contact Number & Hours of Operation: (202) 483-7616 8:00 am-4:30 pm Monday-Friday

Emergency Telephone Contact Number: In the United States: Chemtrec:1-800-424-9300
In Canada: Canutec: 1-613-996-6666 (Collect)

SECTION 2: Composition/Information on Ingredients

Hazardous Ingredients(*):	% by weight	CAS No.	OSHA PEL TWA	OSHA PEL STEL	ACGIH TLV TWA	ACGIH TLV STEL
Niclosamide ethanolamine salt	>95.4	1420-04-8	15 mg/m^3 (1) 5 mg/m^3 (2)	NE NE	10 mg/m$^{3(1)}$ 3 mg/m$^{3(2)}$	NE NE
**2-chloro-4-nitroaniline	0.4-1.5	121-87-9	NE	NE	NE	NE
**5-chloro-2-hydroxybenzoic acid	0.15-1.5	321-14-2	NE	NE	NE	NE

This product is capable of generating a nuisance dust.

1 - PNOC (Particulate not otherwise classified) as total dust
2 - PNOC as respirable fraction
*all ingredients in quantities > 1.0 % (0.1 % for carcinogens) that are **potentially** hazardous per OSHA definitions

**Present as impurities
Some States enforce the PEL's that OSHA promulgated in 1989, which were subsequently vacated by the U.S. Supreme Court. Check with your State OSHA agency to determine which PEL is enforced in your jurisdiction.

NDA = no data available NE = not established

SECTION 3: Hazards Identification EMERGENCY OVERVIEW

Physical description: Powdered bright yellow (with slight green tint) solid

Odor: metallic

Potential Health Effects: WARNING! TOXIC! Harmful if inhaled. Causes eye irritation. May cause skin irritation. Avoid breathing dusts. May cause upper respiratory irritation with coughing and nasal discharge. Personnel responding to a spill of this material should wear appropriate personal protective equipment.

Fire Fighting Measures: Keep away from heat, sparks or open flames.

NFPA RATING:	Health - 3	Flammability - 0	Reactivity -NDA	Special-NDA
HMIS RATING:	Health - 3	Flammability - 0	Reactivity - NDA	Protective Equipment - X

SECTION 4: First Aid Measures

Skin Contact: Remove contaminated clothing. Flush affected area with water for at least 15 minutes. Wash affected area with mild soap and water. Seek medical attention if symptoms develop and persist.
Ingestion: Immediately rinse mouth out with plenty of water. If within 30 minutes after ingestion, give victim a small glass of water or milk (NEVER give anything by mouth to an unconscious person). Do not induce vomiting unless instructed to do so by a physician or poison center. Seek medical attention immediately.
Eye Contact: Immediately flush with plenty of water. Remove contact lenses (if easy to do) and continue flushing for at least 15 minutes. Seek medical attention immediately.

Inhalation: Remove to fresh air. Seek medical attention immediately if breathing becomes difficult or other symptoms develop.

Antidotes/Notes to Physicians: There is no known specific antidote. Additional information about niclosamide may be found in the Physician's Generix.

SECTION 5: Fire Fighting Measures

Flashpoint: NDA

Autoignition temperature: NDA

Flammable Limits: LEL: NDA UEL: NDA

Extinguishing media: Use dry chemical or water

Hazardous products of combustion: Carbon monoxide, carbon dioxide, nitrogen containing chemicals (e.g. NO_2, NO_x, NH_3), and chlorine containing compounds (e.g. HCl).

Unusual fire and explosion hazards: Dusts may form an explosion hazard. Cool containers with water spray.

Protective Equipment: Use NIOSH/MSHA approved SCBA and full protective gear.

SECTION 6: Accidental Release Measures

Extinguish all ignition sources. Do not breathe dust. Harmful if inhaled. Cover with plastic sheet to prevent spreading. Absorb or cover with dry earth, sand or other non-combustible material and transfer to container. Remove containers from the spill area. Do not attempt to clean up chemical spills without appropriate personal protective equipment (see section 8). Ventilate area and wash spill site after material pickup is complete. See section 13 for information on the disposal of recovered material.

SECTION 7: Handling & Storage

Handling: Do not breathe dust. Harmful if inhaled. Minimize dust generation.

Storage: Store upright in a cool, dry, well ventilated area out of direct sunlight. Handling in both unloading and loading operations as well as fabrication may cause nuisance dust to be generated. Necessary precautions for personal protection should be taken. Store away from incompatible materials (see Section 10). Use with proper personal protective equipment (see Section 8). Keep containers tightly closed at all times. Do not reuse container. Keep out of reach of children.

SECTION 8: Exposure Controls & Personal Protective Equipment

Engineering Controls: Use local exhaust in processing or storage areas. If any of the limits in section 2 are

exceeded, local ventilation or respiratory protection may be necessary.
Skin: Protective gloves recommended to prevent skin contact. Contact glove manufacturer for more information.

Eye Protection Wear safety glasses with side shields.

Respiratory: If industrial hygiene surveys show that the exposure limits in Section 2 are exceeded, use of a NIOSH approved respirator is necessary. Seek professional advice prior to respirator selection or use. Follow OSHA respirator regulations (29 CFR 1910.134). Use a positive pressure air supplied respirator if there is a potential for an uncontrolled release, exposure levels are not known, or under any other circumstances where air purifying respirators may not provide adequate protection.

SECTION 9: Physical & Chemical Parameters

Physical State: Solid
Appearance: Bright yellow (with faint green tint) solid
Odor: metallic
Vapor Pressure: 2.0×10^{-14} Pa @ 77°F (25°C)
Vapor Density (air = 1): NDA
Percent Volatile by Volume: NDA
Boiling Point: NDA
Freezing Point: NDA
Viscosity: NDA
Melting Point: 408°F-419°F (209°C-215°C)
Specific Gravity: NDA
Bulk Density: 0.45 g/mL
pH: 9.27 for a 1% suspension
Solubility in water at pH 7: 2.83×10^{-5} g/mL @ 68°F (20°C)
Solubility in other solvents: slightly soluble in hexane, octanol, and methanol

Log K_{ow}: 5.33

SECTION 10: Stability & Reactivity

Stability: Stable

Incompatible Materials and conditions to avoid: Heat, strong oxidizing agents, strong acids.
Hazardous polymerization: Will not occur.

Hazardous decomposition products: Carbon monoxide, carbon dioxide, nitrogen containing chemicals (e.g. NO_2, NO_x, NH_3), and chlorine containing compounds (e.g. HCl).

SECTION 11: Toxicological Information

Product Based Information:
This product consists mostly of niclosamide ethanolamine salt (CAS# 1420-04-8). Exposure can occur by inhalation, eye or skin contact, and ingestion. This product may be harmful if inhaled based on a four hour LC50 of 1.95 mg/L. Inhalation may cause upper respiratory tract irritation with coughing and nasal discharge. Eye contact caused irritation based on animal studies. Skin contact caused mild irritation based on animal studies. The rabbit dermal LD50 is > 2000 mg/kg. This product did not cause skin allergic reactions in animal studies. Ingestion may cause irritation to the mouth, throat and esophagus and possibly nausea and vomiting. The rat-oral LD50 is > 5,000 mg/kg. Ingestion caused adverse effects to the gastrointestinal tract and dark or red lungs in random animals in animal studies. Additionally, ingestion resulted in red stained faces, non-formed feces, and/or hunched posture in some animals, which resolved by day 1 after treatment. Rats treated five days/week for three weeks in a subacute dermal toxicity study tolerated treatment without effects at the maximum dose of 200 mg/kg. Rats were fed dietary doses in a chronic feeding study. The no-observed effect level in this study was 2000 ppm. No pathological symptoms or demonstrated symptoms of poisoning were noted in dissected animals in chronic rat feeding studies (1-2.5% added to standard food five times weekly for 326 and 219 days, respectively. Niclosamide ethanolamine salt was found to be non-mutagenic in the Ames test. Additionally, niclosamide did not cause mutagenic effects using the *in vivo* test for chromosomal aberrations in mouse bone marrow cells or in the mouse lymphoma forward mutation assay. There were

no data located addressing potential developmental or reproductive effects. There were limited data located addressing the carcinogenicity of niclosamide ethanolamine salt. The National Cancer Institute conducted a study regarding the carcinogenicity of niclosamide amino ethanol salt in 1978 and found that niclosamide ethanolamine salt was not carcinogenic to male Osborne-Mendel rats or to female B6C3F1 mice. It was carcinogenic to female Osborne-Mendel rats and caused mammary adenocarcinomas and carcinomas of the glandular portion of the stomach. However, the occurrence of these cancers was not significantly higher than in control animals. It was concluded that there was no convincing evidence of carcinogencity following exposure to niclosamide ethanolamine salt to the species examined. Additional information about niclosamide may be found in the Physician's Generix.

Ingredient Based Information:
This product contains 2-chloro-4-nitroaniline (CAS#121-87-9). Limit data were located regarding this chemical. This chemical was shown to cause the transformation of hemoglobin to methemoglobin, nitrosulfhemoglobin, sulfhemoglobin and a decrease in oxyhemoglobin in animal studies.

There were no toxicological data located for 5-chloro-2-hydroxybenzoic acid (CAS#321-14-2).

Carcinogens: None per OSHA, NTP, or IARC
Target Organs: All tissues (irritation), and respiratory system (e.g. lungs).

Medical Conditions that May be Aggravated by Exposure: Existing skin (e.g. sensitive skin) conditions and respiratory or lung diseases/disorders (e.g. asthma, emphysema, bronchitis).

SECTION 12: Ecological Information

Ecotoxicity: Niclosamide ethanolamine salt (CAS# 1420-0408) is the active ingredient in formulations for molluscides and piscicides.

- In flow through tests, a 70% niclosamide ethanolamine salt mixture resulting in a water concentration of 0.38 mg/L caused a 50% decrease in reproduction in Daphnids.
- Niclosamide ethanolamine salt is not considered very toxic to birds. LD50's ranged from 500 mg/kg in gulls to > 2000 mg/kg in Mallards and Bobwhites for a 70% formulation of niclosamide ethanolamine salt.
- The LC50 for a 70% niclosamide ethanolamine salt mixture for Daphnids was 0.65 mg/L/21 days in a static bioassay without aeration at a pH of 7.2-7.5, water hardness of 40-50 mg/L as calcium carbonate and alkalinity of 30-35 mg/L.
- The LC50 for a 70% niclosamide ethanolamine salt mixture for Rainbow trout was 340 µg/L/96 hours (95% confidence limit of 289-399 µg/L) at 55.4°F (13°C) weight 1.4 grams, in a static bioassay without aeration at a pH of 7.2-7.5, water hardness of 40-50 mg/L as calcium carbonate and alkalinity of 30-35 mg/L.
- The LC50 for a 70% niclosamide ethanolamine salt mixture for *Gammarus pseudolimnaeus* was 2400 ug/L/96 hours (95% confidence limit of 1800-3100 µg/L) at 70°F (21°C) weight 1.4 grams, in a static bioassay without aeration at a pH of 7.2-7.5, water hardness of 40-50 mg/L as calcium carbonate and alkalinity of 30-35 mg/L.
- The LC50 for a 70% niclosamide ethanolamine salt mixture for *Orconectes* was 25,000 µg/L/96 hours (95% confidence limit of 19,000-33,000 µg/L) early instar, at 70°F (21°C) in a static bioassay without aeration at a pH of 7.2-7.5, water hardness of 40-50 mg/L as calcium carbonate and alkalinity of 30-35 mg/L.

Environmental Fate:

Terrestrial fate:	estimated K_{oc} of 350 (moderate soil mobility)
Aquatic fate:	estimated K_{oc} of 350 (expected to adsorb to suspended solids and sediment in water)
	Estimated Henry's Law Constant: < 3.8 x 10^{-8} atm-m^3/mole (mainly non-volatile from water surfaces
Estimated BCF:	46 (moderate, but not high potential for bioaccumulation)

Atmospheric fate: experimental vapor pressure < 7.5 x 10^{-8} mm Hg at 68°F (20°C) (will exist mainly in the particulate phase in the atmosphere).

Vapor phase niclosamide ethanolamine salt is degraded in the atmosphere by photochemically produced hydroxyl radicals with an estimated atmospheric half-life of 4.5 hours

SECTION 13: Disposal Considerations

This material (as packaged) may be considered a hazardous waste. Be aware that the waste owner has responsibility for final disposal. Regulations may also apply to empty containers, liners or rinsate. Laws may change or be reinterpreted; state and local regulations may be different from federal regulations. This information applies to materials as manufactured; contamination or processing may change waste characteristics and requirements.

SECTION 14: Transport Information

DOT Hazard Description: Pesticides, solid, toxic, n.o.s (niclosamide ethanolamine salt), 6.1, UN 2588, PGIII

SECTION 15: Regulatory Information

Chemical Inventories: This product is exempt from TSCA regulation under FIFRA Section 3 (2) (B) (ii) when used as a pesticide. In terms of inventories, niclosamide ethanolamine salt (CAS# 1420-04-8), 2-chloro-4-nitroaniline (CAS#121-87-9) and 5-chloro-2-hydroxybenzoic acid (CAS#321-14-2) are listed on the EINECS.

Reportable Quantities (RQ) (40 CFR table 302.4): None

SARA TITLE III (Superfund Amendments and Reauthorization Act):

Section 302 Extremely Hazardous Materials (40 CFR 355): None listed

Section 304 Notification Of Accidental Release (40 CFR 355): None listed

Sections 311/312 Hazard Categories (40 CFR 370):

Immediate (Acute) Health Effects:	YES
Delayed (Chronic) Health Effects:	NDA
Fire Hazard:	NO
Sudden Release of Pressure Hazard:	NO
Reactivity Hazard:	NDA

Section 313 Toxic Chemical Release Reporting (40 CFR 372.65(a)): Not listed

STATE REGULATORY INFORMATION: Since each state has the authority to promulgate standards more stringent than the federal government, this section cannot provide an inclusive list of all state regulations which apply to this product. Questions related to state regulations should be directed toward local officials.

SECTION 16: Other Information

For additional information, refer to the 2000 North Emergency Response Guidebook and the ACGIH Documentation of the Threshold Limit Values for individual components.

This information is provided in good faith, but without express or implied warranty.

This MSDS was prepared by Environmental Health & Safety, Inc., St. Paul, MN, 55116, USA