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A Method of Breeding and Raising

THREE TEXAS DARTERS

Kirk Strawn
University of Texas

PART II

There is little available information on the breeding habits of darters. Most published accounts are of field observations or aquarium observations made on ripe, freshly caught, wild fish. There are no accounts stating how to bring darters into breeding condition or, except for Fahy's recent paper (1954), presenting means of obtaining repeated spawnings from a single pair.

Proper temperature and food are essential for repeated spawnings.

A pair of greenthroat darters will spawn repeatedly when kept at temperatures ranging from 60 (and probably lower) to 74° F. Between 75 and 80° F, the females stop laying and if kept in the 80's for long they require a stay of about ten days to three weeks at breeding temperatures before they will...
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spawn again. Though a
show little change in frequen
at different temperatures, it
are greatly slowed down by
temperatures. At 72 to 74° F., a
d will spawn every four and
twhile in the low 60's spawning
one-half as frequent. Both
and Rio Grande darters spawn
in the low 70's and high 80's.
Marcos Springs the four
spawns the year around in
ning 3 to 5 degrees above
72° F.

Frequent spawning results
feeding of suitable food. This
is one that the darters eat
is before them twenty-four
Houston dwarf white won
quito larvae both fill the

Daphnia magna
in sufficient quantities and
used as a supplement rather
main fare. Brine shrimp has
advantage of not living in
water and are ignored by
throat darters when larger
able. On the bottom of the

tuberfex worms have not been
try, I believe they would
excellent. Daphnia magna

JANUARY 1956
spawn again. Though a few females show little change in frequency of spawns at different temperatures, most females are greatly slowed down by lower temperatures. At 72 to 74° F, a good female will spawn every four and one-half days while in the low 60's spawnings are about one-half as frequent. Both the fountain and Rio Grande darters spawn readily in the low 70's and high 60's. At San Marcos Springs the fountain darter spawns the year around in water ranging 3 to 5° degrees above and below 72° F.

Frequent spawning result from heavy feeding of suitable food. The best food is one that the darters eat avidly and is before them twenty-four hours a day. Houston dwarf white worms and mosquitado larvae both fill the bill. Though the darters do most of their feeding, drosophila larvae die in an hour or so and the darters will not touch a drowned larvae. Mass deaths of darters frequently occur in tanks with dead and rotting drosophila larvae on the bottom even though the water is well aerated and does not appear to be foul. It is possible that the greenthroat and Rio Grande darters would spawn on a diet of either one of the wet meat base foods advertised in the aquarium magazines or on homemade Gordon's formula (Gordon, 1955). The greenthroat darter stays fat and lives for months in a large community tank even when little besides good quality dried food is fed. The fountain darter, on the other hand, is very slow to take dead food.

Even though darters spawn readily, tuberfex worms have not been available to try. I believe they would also prove excellent. *Daphnia magna* are not eaten in sufficient quantities and should be used as a supplement rather than as the main fare. Brine shrimp have the disadvantage of not living long in fresh water and are ignored by adult greenthroat darters when larger food is available. On the bottom of the tank, where on a dwarf white worm diet, dwarf white worms alone are not always a satisfactory diet. A condition similar to the blue sac disease of trout (Davis, 1953) appears to be associated with the feeding of dwarf white worms. Frequently all or part of a spawn of eggs will hatch into larval fish that have large Photo: A male fountain darter, *Etheostoma fonticola*, 3 1/2 inches in total length. Taken from San Marcos springs. Photo: John S. Mecham.
yolks which are not absorbed. These larvae do not feed and die in about a week. The addition of mosquito larvae to the parents’ diet minimizes the production of these abnormal larvae.

A pair of darters can be successfully spawned in a five gallon tank. After several spawnings a female Rio Grande or greenthroat darter may look chewed and should be removed from the tank and given a rest or else the male will eventually kill her. Providing two or three females so that the male’s attention is divided, using a larger tank, and furnishing rock piles and plants for shelter all help prevent torn fins on the female.

Freshly caught wild darters usually produce yellow eggs. In contrast, darters fed white worms produce colorless eggs. The addition of mosquito larvae or brine shrimp to the diet puts some color into the eggs but none of the laboratory stocks have produced the beautiful bright yellow eggs found in nature. As the embryo develops, yellow eggs fade and become nearly colorless.

The number of eggs produced varies in different spawnings. For example, a pair of greenthroat darters from the West Frio River fed a combination white worm and Daphnia magna diet, given constant light and kept in a five gallon tank at 62 to 68°F. laid on the glass wool of an open bottom filter 13 batches of eggs during a 63-day period numbering 47, 70, 100, 109, 84, 61, 86, 87, 86, 96, 75, 106, and 108. Large females from the Guadalupe and Colorado River Systems frequently lay two or even three times as many eggs at a time while Rio Grande females lay somewhat fewer eggs.

Darters may bury their eggs (Winn, 1953), lay them under a rock, a shell, etc. and guard them (Rainey and Lachner, 1939 and Atz, 1940) or lay eggs here and there on vegetation (Fahy, 1954) and other solid objects. The three dealt with in this paper are of the latter type.

The male courts the female on the bottom of the tank. When the female is ready to spawn she swims, followed by the male, up to an object upon which she deposits her adhesive eggs. These darters lay their eggs on the side of the tank, particularly the corners, on aquarium filters, or on plants. If filamentous algae is present in the aquarium, the eggs of the fountain and greenthroat darters are deposited almost exclusively on it. A mass of white fluffy glass wool is also a preferred spawning site. The fountain darter lays its eggs almost exclusively in the upper half of the aquarium and will ignore glass wool in the lower half of the tank. In contrast the greenthroat darter will spawn almost exclusively in the lower half provided the glass wool is confined to the lower parts of the aquarium and no filamentous algae is present. The Rio Grande darter does not show as strong a preference for glass wool as the greenthroat darter and even with only this spawning medium present it frequently lays most of its eggs on solid objects such as under and on top of rocks and on the sides of the aquarium. The fountain darter usually deposits eggs singly or in twos or threes. The Rio Grande and the greenthroat darters from the Nueces River System generally lay less than ten eggs to a mass while greenthroat darters from the Guadalupe and Colorado River Systems frequently lay 30 or more eggs in one spot.

No care is taken of the eggs except that the dominant male greenthroat darter chases other males from the females’ preferred spawning site.

Few if any of the eggs laid on glass wool or filamentous algae are eaten. Eggs laid on the sides of the tank frequently disappear and it is possible that
The male courts the female on the top of the tank. When the female is ready to spawn she swims, followed by the male up to an object upon which she sits her adhesive eggs. These eggs remain on the sides of the tank, particularly the corners, on aquaspheres, or on plants. If filamentous algae are present in the aquarium, the eggs of the fountain and greenthroat darters are laid almost exclusively on it. The white fluffy glass wool is also a favored spawning site. The fountain darter lays its eggs almost exclusively in the upper half of the aquarium and will abandon the glass wool in the lower half of the aquarium. In contrast the greenthroat darter will spawn almost exclusively in the upper half provided the glass wool is not taken down to the lower parts of the aquarium, and no filamentous algae is present. The Rio Grande darter does not have a strong preference for glass wool, but the greenthroat darter and even the fountain darter usually deposit their eggs singly or in twos or threes. The Rio Grande and the greenthroat darter from the Nueces River System will deposit less than ten eggs to a mass of glass wool, whereas darters from the Guadalupe and Colorado River Systems frequently deposit 30 or more eggs in one spot.

Only the eggs except those of the dominant male greenthroat darter are eaten. Any of the eggs laid on glass wool or filamentous algae are eaten. The eggs on the sides of the tank frequently adhere and it is possible that the female has left them there. If you really care about the condition of your fish, every word in this ad will be of importance to you.

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the parents eat them. They do not see newly hatched larvae. When insects and filamentous algae are the food, the fry of the green-throat darters will hatch to maturity in an aquarium with adults. Frequently a batch of Grande darters develop at least as the free-swimming stage. Most of the young of the free-swimming stage of the green-throat darter rarely survive the first few days after hatching when the eggs are still in the aquarium. If the aquarist wishes to raise a batch of young, he should either remove the eggs or the parents from the breeding tank. The easiest way to furnish the fish with glass spawning medium and then to cover the glass wool and eggs in the aquarium is to place an enamel dish pan on the mouth of the aquarium. The unfertilized eggs and young are then observed against a white background. Once the fry are well started, they can be transferred to a rearing tank.

Eggs laid on plants and washed into the aquarium are easily removed with a medicine dropper or better, with a piece of glass tubing inscribed with a filter starting bulb. Eggs are easily ruptured when first laid and should be given a few hours to settle before they are knocked into the hatching pan. The breeder should not move them because an end result of the egg shell prior to hatching is damaged by rough treatment. Eggs laid by salmon eggs must be handled with care until they become eyed. Damage to the eggs does not seem to be killed or killed during this period.

The hatching pan should have clean, hard water. At 72-74°F of the green-throat darter hatches 4 and 6 days after being laid.
the parents eat them. They definitely eat newly hatched larvae. When the plants and filamentous algae are thick many fountain darters will hatch and grow to maturity in an aquarium crowded with adults. Frequently a few Rio Grande darters develop at least as far as the free-swimming stage. Greenthroat darters rarely survive much past hatching when the eggs are left with the parents. If the aquarist wishes to raise a batch of young, he should take either the eggs or the parents out of the breeding tank. The easiest method is to furnish the fish with glass wool as a spawning medium and then to remove the glass wool and eggs to a white enamel dish pan. If preferred, the eggs can be picked off the glass wool by hand and the glass wool discarded. I prefer a dish pan to an aquarium because the eyed eggs and young are very easily observed against a white background. Once the fry are well started they can be transferred to a rearing tank.

Eggs laid on plants and the sides of the aquarium are easily removed with a medicine dropper or better yet with a piece of glass tubing inserted into a water starting bulb. Eggs are soft and easily ruptured when first laid and should be given a few hours to harden before they are knocked lose and removed. The breeder should not wait until they are ready to hatch before removing them because an enzyme softens the egg shell prior to hatching. The eggs of many fish (Davis, 1953) have a critical period in which they are easily damaged by rough treatment. After the first day or two salmon and trout eggs must be handled with extreme care until they become eyed. Darter eggs do not seem to be killed or damaged by handling during this period.

The hatching pan should contain clean, hard water. At 72-74° F. the eggs of the green-throat darter hatch between 4 and 6 days after being laid. At 67-69° F. they hatch in 6 to 9 days, and at lower temperatures they are much slower to hatch. A few eggs turn white and become fungused before the eyes of the developing embryos can be seen. These eggs are probably defective before fungus attacks them. Dead eggs should be removed because fungus may spread to a good egg when it is in contact with an infected one and also when aeration is not used dead eggs tend to foul the water. Aeration insures good hatches, particularly at high temperatures. Un-aerated eggs at 72-74° F. frequently die just prior to hatching and the larvae may prove less vigorous than those hatched with aeration. Good hatches can be obtained without the use of dyes such as acriflavine and methylene blue.

If the female spawns readily but none of the eggs become eyed the male may be infertile and a different male should be used. If the eggs still fail to develop the fault may lie with the female. Frequently the last spawn before one of a pair dies fails to hatch. Very few of the eggs fathered by a one-eyed male Rio Grande darter proved fertile. Perhaps he could not see well enough to successfully follow the female during spawning.

How soon after hatching the larvae will accept their first food and at what age they will be large enough to eat a given size food is dependent on temperature. They develop more slowly at low temperatures and faster at higher temperatures. Newly hatched fountain darters, at about 70° F., need infusoria for about a week before they can take newly hatched San Francisco Aquarium Society brine shrimp. Most hatches of Rio Grande and greenthroat darters can be successfully raised without using infusoria and will feed on brine shrimp within two to four days after hatching. However, larvae from small eggs require in-
which have no recorders at-Here there is no chance of acci-
tal erasure of the recording by re-
go far into the technicali-
ty purchased in a number of popu-
pere-second might take ap-
ble recording.

Silver Dollars
(continued from page 5)
the market after an absence of more than ten years—at least we hadn’t seen any
since before World War II.

Another easily recognized silver dol-
lar is *Mylossoma aureum*. The shape of
its body and anal fin is quite different
from any of the other silver dollars im-
ported, and the orange color of the anal
is also a distinguishing feature.

Quite recently the New York
Aquaarium obtained the first specimen
we had ever seen of a close relative of
the silver dollars, which in appearance
and behavior seems to bridge the gap
between the more or less peaceful, vege-
tarian or snail-eating silver dollars and
their savage carnivorous relatives, the
piranhas. This is *Catoprion mento*, from
the Guianas and the Amazon. Our fish
had grown up in one of the tanks of Mr.
Sol Soberman, a local fancier of unusual
tastes and abilities. Although it is a good
five inches long (total length) and is
well equipped with sharp teeth, it will
not eat anything larger than a female
guppy. Larger fish, like killies, are some-
times chased, but no attempt is made to
bite them in half or to take chunks out
of them the way piranhas do. Instead
*Catoprion* swallows them whole, with
a motion so fast that the eye cannot
follow.

One reason the silver dollars are hard
to identify and name properly is that
some of them change quite a bit as they
grow up. Small spotted ones usually lose
their spots, for example, and the shape of
the body alters in important, but
hard-to-describe ways. Males of some
species develop falcate (sickle-shaped)
anal fins. But even if you can’t name
them, you can keep them.

Texas Darters
(continued from page 17)
fusoria to tide them over until they can
take brine shrimp. If they do not eat
brine shrimp within a week, close in-
spection usually reveals abnormally
shaped yolks, indicating blue sac dis-
ease. Darter fry have to feed for several
days on San Francisco brine shrimp be-
fore they are big enough to eat the
larger Great Salt Lake brine shrimp.

If a brine shrimp smaller than the
San Francisco one is available it would
prove an advantage in starting darters.
The sooner they will eat brine shrimp,
the faster they will grow. Little darters
require at least two brine shrimp feed-
ings a day and three widely spaced
feedings are better than two. The warmer the water they are raised in, the
more often they should be fed.

The addition of a couple of strands
of *Elodea* or a pinch of *Riccia* or a
similar plant, some pond snails, a few
dozen daphnia and some limestone to
the rearing pan are all valuable aids in
raising the little fish. Aquarists cannot
seem to agree as to why plants are bene-
ficial, but most of us agree that vigor-
ously growing plants are desirable. The
snails clean up the dead uneaten food,
the daphnia are excellent filters and
keep the water clear, and the limestone
tends to keep the water hard. Pond
snails are safe with living darter eggs
and larvae and perform a useful function
by eating dead eggs and larvae that
otherwise are sources of infection for
viable eggs. Dead brine shrimp and
mulm should occasionally be siphoned
off the bottom of the pan and part of
the water replaced with fresh hard
water. About two weeks after hatching
the fry settle to the bottom and are
ready for dwarf white worms. The
young fish grow faster and fewer die
when brine shrimp are continued as a
supplement. Young feeding on white
worms have white bellies in contrast to
the orange bellies of those fed brine
shrimp. Small *Daphnia magna* are eaten
somewhat later.
A few of the small fish will die trying to swallow too large a daphnia if insufficient small daphnia are available. The presence of white worms in the tank prevents this type of loss. Darters continue to grow well on a brine shrimp, daphnia and Houston white worm diet. My first aquarium raised fountain and greenthroat darters spawned by the age of eight months. With improved feeding techniques I have gotten greenthroat darters to spawn by the age of five months, and hybrids between greenthroat and Rio Grande darters to spawn by six months and one-half months, Rio Grande darters by six months, and greenthroat darters spawned by the age of eight months. With improved feeding techniques I have gotten greenthroat daphnia and Houston white worm diet.

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Arts, James W. 1940.—"Reproductive behavior in the Eastern Johnny Darter, Boleosoma nigripinnis (Sauvage)." In: Copeia, no. 2, pages 100-105.


Gordon, Myron. 1955.—"Guppies as pets. a guide to the selection, care and breeding of guppies." TFH Publications, 71 Jackson Ave., Jersey City 6, N.J.


Marine Aquarium

(continued from page 10)

little experimentation should provide you with the best system to follow.)

It is quite possible and, in most cases, does no great harm, occasionally to leave your specimens without food for several days. In fact, if occasion should arise when it might be necessary for you to be absent for a few days, it is better to leave them quite without food than to have some inexperienced neighbor come in to feed them.

[Which about concludes this session. Rollo! Any questions? What? No, Rollo, I do not think goldfish wafers would make good food for marine fishes, although I have never tried it. Let us know when you do, will you? In the meantime you are all set except for the inhabitants of your aquarium. In the next issue we will take up COLLECTING.]

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