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Evaluation of translocations of the fringed darter, *Etheostoma crossopterum*, in Illinois

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Introduction

The fringed darter (*Etheostoma crossopterum*) is a small fish that occurs in rocky streams in portions of Alabama, Tennessee, Kentucky, and Illinois (Braasch & Mayden 1985; Page et al. 1992; Poly & Wilson 1998). Until recently, populations of fringed darter in Illinois had been misidentified as a similar species, the spottail darter (*Etheostoma squamiceps*), which in Illinois occurs only in the southeastern portion of the State (Poly & Wilson 1998). The fringed darter and other members of the subgenus *Catonotus* are egg-clusterers, depositing a single layer of eggs on the undersides of slab rocks or other objects (Page 1974; Bandoli et al. 1991; Poly 2000). Aspects of the life history of fringed darters in Kentucky and Illinois have been studied, and spawning season extends from March through May or June (Page 1974; Poly & Wilson 1998; Poly 2000).

In 1997 fringed darters were found in six streams in the lower portion of the Cache River basin but were absent at many other sites within the basin (Poly & Wilson 1998; unpubl. data). Modifications to streams in the Cache River basin, including channelization and removal of riparian vegetation, have resulted in degraded aquatic habitats (Lopinot 1972; Illinois Natural History Survey 1978). Lopinot (1972) listed the amount of stream and river lengths affected by channelization per county in Illinois. One hundred sixty-eight km of stream have been channelized in Union and Alexander counties in which lies the majority of the range of fringed darter in Illinois. In streams that contain populations of fringed darters, about 26 km have been channelized (Lopinot 1972). The negative effects of such changes on fish and invertebrate communities are well documented (Etnier 1972; Illinois Natural History Survey 1978; Trautman 1981; Berkman & Rabeni 1987). Because the fringed darter has a small distribution within the Cache River basin, possibly because of past disturbances to streams in the basin, introduction of fringed darters to other suitable streams in the basin could be advantageous for the continued existence of the species in Illinois, particularly because streams continue to be impacted by anthropogenic activities. Translocation is likely the only means by which fringed darters can gain access to streams in the upper Cache River basin because there is much distance and degraded habitat between extant stream populations and these streams.

During sampling efforts in 1997 to determine where the fringed darter occurred, two streams in the headwaters of the Cache River basin were sampled that did not yield fringed darters. Bradshaw Creek and an unnamed tributary of the Cache River appeared suitable for fringed darters; both streams are moderate sized creeks with clear water and rocky substrates. Because there are no historical records of fringed darters in the two streams or any nearby streams, this translocation should be considered an introduction, rather than repatriation or augmentation (Reinert 1991). The only darters captured at both creeks were blackside darter (*Percina maculata*), bluntnose darter (*Etheostoma chlorosoma*), and slough darter (*Etheostoma gracile*), which are not ecologically similar to the fringed darter in terms of feeding, reproduction, and habitat use (Braasch & Smith 1967; Kuehne & Barbour 1983; Page 1983). *Percina maculata* is an egg burier, whereas *E. chlorosoma* and *E. gracile* are egg attachers (Page et al. 1982). Due to lack of other ecologically-similar darters, presence of suitable habitat, and native status of fringed darters within the river basin, successful introductions of the species from other streams seemed feasible and would expand the overall population. Fringed darters occur sympatrically with fantail darters (*Etheostoma flabellare*) in Little Creek and adjacent Big Creek, but in most streams in the Cache River basin are not sympatric with either fantail darter or stripetail darter (*Etheostoma kennicotti*).

Captive breeding and reintroduction of some fish species has become necessary for rebuilding or maintaining their populations (Minckley 1995; Shute et al. 1998; Rakes et al. 1999). Often this work is done when a species becomes critically endangered. One of the earliest efforts involving translocation for the purpose of conserving a species was for the snail darter (*Percina tanasi*) (Etnier & Starnes 1993). Several transplants of large numbers of wild-caught snail darters were made; the numbers were large because the source population was in danger of total annihilation from the Tellico Dam; therefore, as many darters as possible were moved (Hickman & Fitz 1978). Such a large initial seed population conserves genetic diversity, but in some cases, might not be possible. Most translocations have the intention of establishing a new population while not affecting the source population from overharvesting.

Recommendations and guidelines for conducting animal translocations have been published with the intention of increasing the success of future translocation efforts (Williams et al. 1988; Griffith et al. 1989; Dodd & Seigel 1991). The number of individuals released must be adequate, should consist of several age classes of wild-caught individuals, and should be released in areas with suitable habitat. Other factors to be considered are sex ratio of natural populations, reproductive season and fecundity, and presence of congeneric species or other potential competitors at introductions sites. Griffith et al. (1989:479) recommended that "Those planning translocations should adopt rigorous data recording procedures." Translocation and captive breeding programs should be initiated well before a species is critically imperiled, and initial studies could be performed on biologically-similar, more abundant species (Meffe 1987; Griffith et al. 1989). "The greatest potential for establishing satellite populations may occur when a candidate population is expanding and numbers are moderate to high. These conditions are the ones that tend to make endangered species biologists relax; our analysis suggests that these conditions may point out the time for action." Griffith et al. (1989:479). The methodology described below generally follows the recommendations of authors mentioned above.

The purpose of the study was to establish new stream populations of fringed darters within a drainage basin where the species is native and to determine if a new population could be established from a relatively small number of parental fishes. If additional populations of Illinois fringed darters can be established now, future listing of the species as threatened or endangered in the State or loss of the species from the Illinois fauna might be avoided. The proposed times of translocation and nest searching should allow for rapid initiation of reproductive efforts as well as provide a method for assessing the initial success of translocation of adults.

Materials and Methods

On 25 March 2001 adult fringed darters were collected with a seine from two sites where the species is abundant (Mill Creek at Miller Rd. (Co. Rd. 1500E) near quarry, 7 km W Dongola, Union Co., Illinois (T13S, R1W, Sec. 20, 37°22′02″/89°14′55″) and unnamed tributary of Big

Creek at old U.S. Rt. 51 bridge (Co. Rd. 1975E/1980E) in Dongola, Union Co., Illinois (T13S, R1W, 37°21′53″/89°09′48″)). The time period of collection for adults was near the beginning of the breeding season and allowed males and females to be distinguished easily because of sexual dimorphism. All females were gravid, and all males possessed nuptial pigmentation typical of mature individuals preparing to reproduce. Sex, length, and weight of each fish as well as stream name, location, and water temperature were recorded. Total length (mm) of each darter was measured with a stainless steel ruler, and individual weights were measured to 0.1 g with an Acculab® Pocket Pro® 250-B portable electronic balance. Water temperature was measured to 0.1 °C with a Taylor® digital thermometer. Two days prior to collecting darters for translocation, water temperature was taken in receiving streams and source streams to insure that temperature acclimation of fishes would not be a problem. At least two year classes of adults (Age-I and Age-II) were represented among the 60 darters based on length frequency data. Darters were held in aerated coolers from period of capture and data collection to time of release. Fishes were allowed to acclimate for 30 minutes in a mixture of water from the original capture site and release site before being released into the receiving stream. Sixty darters were relocated to a single site on each of two receiving streams (Bradshaw Creek & an unnamed tributary of Cache River) on the same day of collection (25 March 2001). Each introduction site received 13 males and 27 females from Mill Creek and 7 males and 13 females from tributary of Big Creek. Each site received 40 females and 20 males because more than one female may spawn with a single male (W. Poly pers. obs.), and the sex ratio of a population in Ferguson Creek, Kentucky was 1.9 female: 1 male (Page 1974). Bradshaw Creek is a fourth order stream with an average width of 8.5 m (6.8-10.2, n = 5) within the study section (upstream of Winghill Rd., 9 km E Cobden, Union Co., Illinois (T11S, R1E, Sec. 30, 37°31′49″/89°08′58″)). Tributary of Cache River is third order and has an average width of 4.6 m (2.1-6.2, n = 5) within the study section (at U.S. Rt. 51 bridge, 3.5 km SSE Cobden, Union Co., Illinois (T12S, R1W, Sec. 5, 37°30′12″/89°13′54″)). Slab rocks were far more abundant at Bradshaw Creek than at tributary of Cache River.

Visual searches for nesting males were conducted on six dates between 28 March and 27 May 2001 over a 100 m reach of stream at each introduction site. Searches were accomplished by gently tilting rocks and looking for eggs and darters (eggs attached to underside of rocks). When a nest was located, the nest depth (cm) and number of adult males and females at the nest were recorded. Egg clusters were photographed quickly for counting number of eggs per nest (Bandoli et al. 1991), and rocks with eggs were replaced (generally, males return to the nest rock and continue guarding the nest after such a disturbance (W. Poly pers. obs.). The number of bluntnose minnow (*Pimephales notatus*) nests were recorded because this species also deposits its eggs on the undersides of rocks and other objects. Nests of fringed darters contain larger, golden-yellow or orange eggs compared to smaller, purple or gray eggs of bluntnose minnows and can be distinguished easily (Bandoli et al. 1991; W. Poly pers. obs.). In addition, identification of nests can be based on presence of either species because males of both species guard the nests. On 15-16 September 2001, a seining survey was performed to determine abundance and size classes of fringed darters present at the two introduction sites. All adult and young-of-the-year darters were measured and weighed by the same method as the parental stock (see above) and were distinguished as adults or juveniles by size. All darters were held in an aerated cooler, then returned to the stream after data were recorded.

Sampling was conducted throughout the Cache River basin in an attempt to locate other streams that contained fringed darters. A 3.0 x 1.8 m seine and dip nets were used as well as visual searching for nest-guarding males. The pre- and post-introduction fish communities at each translocation site were determined by seining a 150 m section of each stream on 14 October 2000 and 15-16 September 2001. All captured fishes were held in coolers until a section of stream had been sampled (to avoid recaptures), then were identified, enumerated, and returned to the stream (except for voucher specimens retained on 14 October 2000). Voucher specimens of fringed darters from new sites of occurrence and of other fishes from the translocation sites were preserved in 10% formalin, washed in several changes of water, and taken through a series of 35%, 50%, and 70% ethanol.

Mean adult and juvenile sizes (weight & length) were compared between source and between introduced populations, respectively (unequal sample sizes). Weight data were not normally distributed and had unequal variances; therefore, all comparisons were made using the Mann-Whitney *U* test (Zar 1999). Regressions of length vs weight (log-transformed data) were calculated for all darters, excluding adult darters recaptured in September at the introduction sites. All statistics were performed with StatView 5.0, and results were considered significant at $p < 0.05$ (adjusted for number of comparisons: $p < 0.0125$ for adults from source populations & $p < 0.025$ for juveniles from introduced populations). Means of weight and length for adults introduced to each site were not compared statistically because doing so would be a case of pseudoreplication (Hurlbert 1984); therefore, graphic comparisons were made among the source and introduction size distributions.

Results

Male and female darters from Mill Creek were larger than those from tributary of Big Creek (Table 1). Male weight ($p = 0.005$) and length ($p = 0.0006$) and female weight ($p = 0.008$) and length ($p = 0.0009$) were significantly different between the source populations. However, size distributions were equalized when darters from both source streams were combined for the receiving streams (Table 1 & Figs. 1a,b, 2). All darters appeared to be in good condition when captured and at time of release.

Brief observations were made of several large males released into Bradshaw Creek. After about 10 minutes of watching the fishes, male-male combat was observed for about 15 minutes. Three males were under a large rock and were boldly marked with black stripes on the side of the body, black heads, and black fins. Two males were displaying to one another laterally and at one point had their mouths locked in combat. Periodically, clouds of sediment emanated from under the rock due to disturbance from the agonistic behavior of the male darters. Their actions were observable because their bodies protruded from under the rock occasionally. These displays indicated that the act of moving the fishes to a new stream did not deter their impetus to procure nesting sites.

Table 1. Size distributions (mean & range) for adult and juvenile fringed darters.

Stream	Total Length (mm) Mean (Range)		Weight (g) Mean (Range)	
Adult darters	**Male**	**Female**	**Male**	**Female**
Mill Creek (source)[a]	81 (64-90)*	62 (49-77)*	5.4 (2.6-7.5)*	2.6 (1.1-4.7)*
Trib. Big Creek (source)[b]	68 (55-89)*	55 (45-75)*	3.5 (1.5-7.2)*	2.2 (1.0-5.6)*
Bradshaw Creek (introduction)[c]	77 (55-89)	60 (46-77)	4.9 (1.5-7.5)	2.5 (1.0-5.6)
Trib. Cache River (introduction)[d]	75 (57-90)	59 (45-76)	4.5 (1.7-7.2)	2.5 (1.1-5.2)
Juvenile darters	**Male & Female**		**Male & Female**	
Bradshaw Creek (2001 offspring)[e]	46 (36-57)*		0.9 (0.4-1.6)*	
Trib. Cache River (2001 offspring)[f]	38 (29-48)*		0.5 (0.2-1.1)*	

[a]N = 26 male, 54 female, [b]N = 14 male, 26 female, [c]N = 20 male, 40 female, [d]N = 20 male, 40 female, [e]N = 46 juveniles, [f]N = 107 juveniles. *Pairs of means in each column differed significantly ($p < 0.05$; adjusted for number of comparisons: $p < 0.0125$ for adults from source populations & $p < 0.025$ for juveniles from introduced populations).

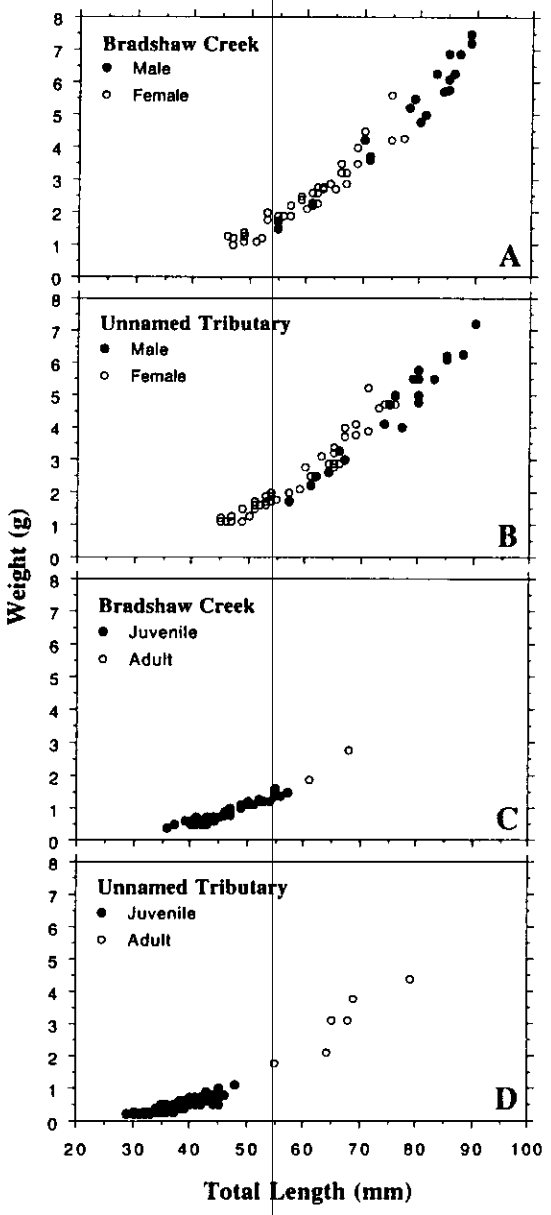

Figure 1. Weight vs length scatterplots for adult fringed darters released in Bradshaw Creek (A) and Tributary of Cache River (B); same for juveniles and adults captured at Bradshaw Creek (C) and Tributary of Cache River (D) in the fall.

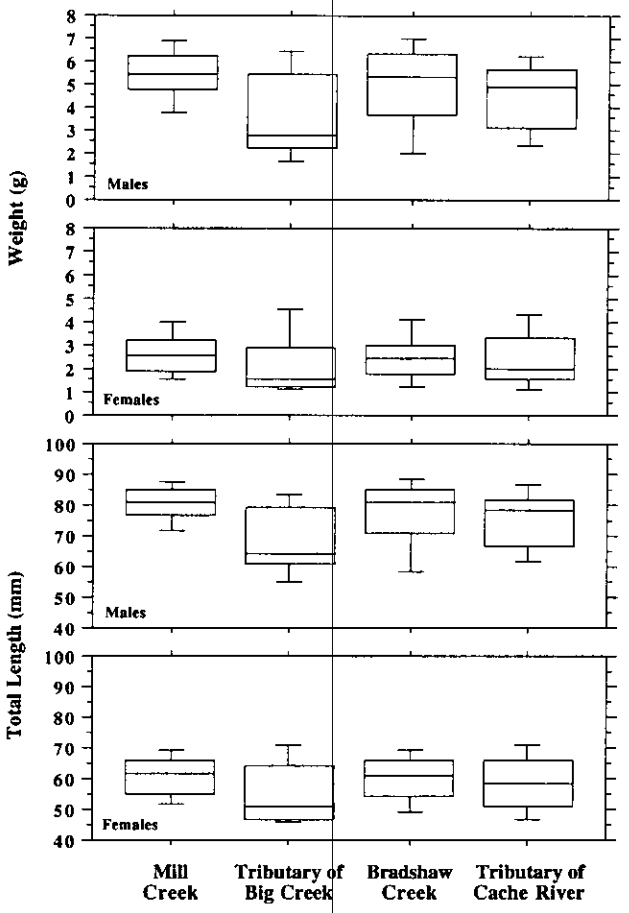

Figure 2. Box plots of weight and length for adult male and female fringed darters from source populations (Mill Creek & tributary of Big Creek) and mixtures from source populations released at introduction sites (Bradshaw Creek & tributary of Cache River). Median is indicated by horizontal line in box; box includes 25th and 75th percentiles, whereas whiskers indicate upper and lower 10th percentiles.

Consistent with these observations was the presence of egg clusters (nests) at both sites only 3 days post-introduction (Table 2). The maximum number of nests possible per site on any date was 20 (the number of males introduced at each site). A total of 3,680 rocks were examined for nests, resulting in detection of 25 nests (1-4 (mean = 2) per date). Eighteen nests had males present, but some males could have escaped detection, and low visibility at tributary of Cache River on 5 April resulted in no males being observed at three nests. Females were observed at two nests occupied by males, and in the study areas females and juveniles were seen occasionally. Mean depth of nest rocks was 15.2 cm (range = 8.3-28.7 cm, n = 24 nests). Total egg count was 8,714 (n = 22 nests), and mean number of eggs per nest was 413 (range = 65-2,016; n = 19 nests). Total egg count was low due to exclusion of several nests in which eggs were not countable. All eggs in one nest were covered with fungus, and three other nests had lower egg counts due to fungus covering and destroying some eggs. Twenty-eight nests of *Pimephales notatus* were found during the same period (Table 2).

Juvenile darters were larger in Bradshaw Creek than in tributary of Cache River, and mean weights ($p < 0.0001$) and lengths ($p < 0.0001$) compared between the two sites were significantly different (Table 1 & Figs. 1 c,d). The relationship of weight (W) vs total length (L) for adult and juvenile fringed darters was: $\log W = -5.652 + 3.368 \log L$ ($r = .988$) or $\log L = 1.679 + 0.29 \log W$ ($r = 0.988$) (Fig. 3).

The fish communities of both introductions sites were similar in terms of species composition and abundance, and fringed darter comprised 15% and 20% of the fish communities at tributary of Cache River and Bradshaw Creek, respectively. Forty-six juveniles and two adults were captured in Bradshaw Creek, whereas 107 juveniles and six adults were collected in tributary of Cache River (Table 3).

Table 2. Summary of nest data for fringed darter (*Etheostoma crossopterum*) and bluntnose minnow (*Pimephales notatus*) at the translocation sites from March to May 2001.

	Number of nests	Number of eggs	Number of rocks examined	Water Temperature (°C)	Date	Number of *P. notatus* nests
1) Bradshaw Creek						
	1	295	210	7.3	28 March	0
	4	1,359	211	15.8	5 April	0
	4	1,252*	300	16.4	19 April	3
	4	1,527**	722	19.1	29 April	4
	1	65	591	19.6	13 May	7
	0	0	222	20.5	27 May	2
Subtotal	14	4,498	2,256	—	—	16
2) Tributary of Cache River						
	1	173	177	6.9	28 March	0
	3	739	226	15.4	5 April	0
	2	795	238	15.8	19 April	3
	1	2,016***	296	15.9	29 April	3
	2	****	285	18.8	13 May	5
	2	493	202	19.2	27 May	1
Subtotal	11	4,216	1,424	—	—	12
Total	25	8,714	3,680	—	—	28

*Some eggs had fungus and could not be counted. **Total based on three nests; all eggs in fourth nest had fungus. ***Not an error. ****No egg count obtained.

Table 3. Species composition and abundance at translocation sites (Bradshaw Creek and tributary of Cache River) on 14 October 2000 (pre-introduction) and 15-16 September 2001 (post-introduction) (absolute abundance followed by relative abundance in parentheses).

	Bradshaw Creek		Tributary of Cache River	
Species	Pre	Post	Pre	Post
Cyprinidae				
Campostoma anomalum pullum	17 (6%)	17 (7%)	23 (9%)	46 (6%)
Cyprinella lutrensis	— (0%)	— (0%)	— (0%)	4 (1%)
Lythrurus umbratilis	1 (<1%)	35 (14%)	11 (4%)	20 (3%)
Pimephales notatus	51 (18%)	21 (9%)	51 (20%)	51 (7%)
Semotilus atromaculatus	4 (1%)	4 (2%)	4 (2%)	72 (10%)
Catostomidae				
Catostomus commersoni	— (0%)	— (0%)	2 (1%)	56 (8%)
Erimyzon oblongus	— (0%)	4 (2%)	— (0%)	24 (3%)
Ictaluridae				
Ameiurus natalis	3 (1%)	7 (3%)	— (0%)	3 (<1%)
Ameiurus nebulosus	1 (<1%)	— (0%)	— (0%)	— (0%)
Noturus gyrinus	— (0%)	— (0%)	1 (<1%)	2 (<1%)
Fundulidae				
Fundulus olivaceus	15 (5%)	45 (18%)	27 (10%)	41 (6%)
Aphredoderidae				
Aphredoderus sayanus	15 (5%)	9 (4%)	15 (6%)	177 (24%)
Poeciliidae				
Gambusia affinis	— (0%)	— (0%)	8 (3%)	23 (3%)

Table 3 (continued)

Centrarchidae				
Lepomis cyanellus	9 (3%)	9 (4%)	— (0%)	— (0%)
Lepomis macrochirus	39 (14%)	5 (2%)	92 (35%)	5 (1%)
Lepomis megalotis	71 (25%)	8 (3%)	6 (2%)	27 (4%)
Micropterus salmoides	4 (1%)	2 (1%)	6 (2%)	— (0%)
Percidae				
Etheostoma chlorosoma	6 (2%)	3 (1%)	— (0%)	— (0%)
Etheostoma crossopterum	— (0%)	48 (20%)	— (0%)	113 (15%)
Etheostoma gracile	31 (11%)	26 (11%)	5 (2%)	13 (2%)
Percina maculata	19 (7%)	2 (1%)	10 (4%)	59 (8%)
Total individuals	286	245	261	736
Total species	15	15+1	14	16+1

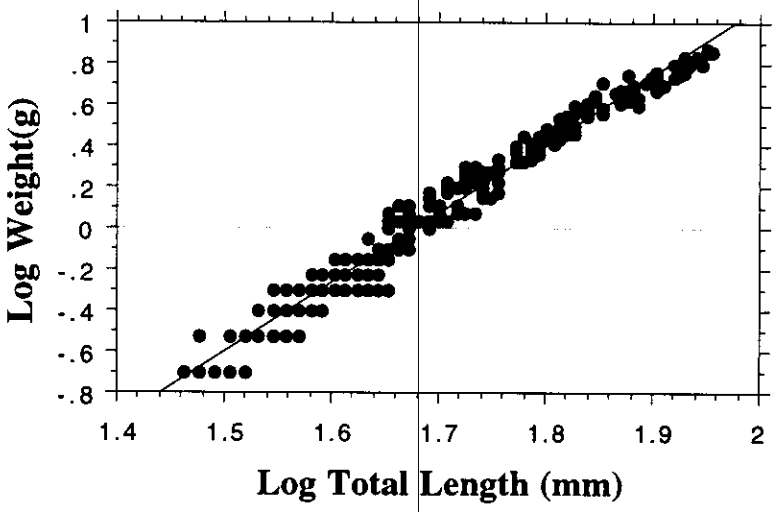

Figure 3. Weight vs length scatterplot of log-transformed data for fringed darters (N = 120 adults & 153 juveniles).

Thirteen sites were sampled throughout the Cache River basin during April and May in search of additional populations of fringed darters. Fringed darters were found at three sites where they had not been collected previously; however, all of these new sites were located within the same general area and stream systems where fringed darters were known to occur. The distribution of the fringed darter thus remains restricted to a relatively small area in southeastern Illinois (Fig. 4).

Discussion

The concept of the present study design was to move fishes at the beginning of their natural breeding season so that the number of introduced fishes can be considered in terms of the adults and their offspring, which substantially raises the number of fishes introduced. Moreover, if the fishes begin breeding soon after release at the new site, the chances of finding mates and reproducing successfully should be higher because they are in proximity and can breed before dispersal and mortality lower encounter rates among conspecifics. If successful reproduction occurs, there will be an additional year class, which should improve the chances of establishment of a self-sustaining population. This same strategy can be repeated over successive years to boost the initial stocking while not taxing the source population by removing a large number of fishes at one time. Seining at the sites during the reproductive season was avoided because of the potential for disruption of spawning or destruction of nests, adults, and young-of-the-year darters. For the same reasons seining will not be carried out at the sites during the breeding season for the next several years.

The total number of eggs counted during the survey (n = 8,714) likely was lower than the actual number of eggs present due to inability to locate all nests (and eggs in two nests could not be counted). Fungal infection of eggs was a cause of mortality, and adult losses also were possible. Adult males not discovered during surveys could have been nesting either inside or outside the study sections or might have been eliminated from the effective breeding population through predation, disease, or excessive dispersal. Troll (1986) estimated mortality rates of 16 and 33 percent for eggs of spottail darter (*E. squamiceps*) in two Illinois streams. Accurately estimating

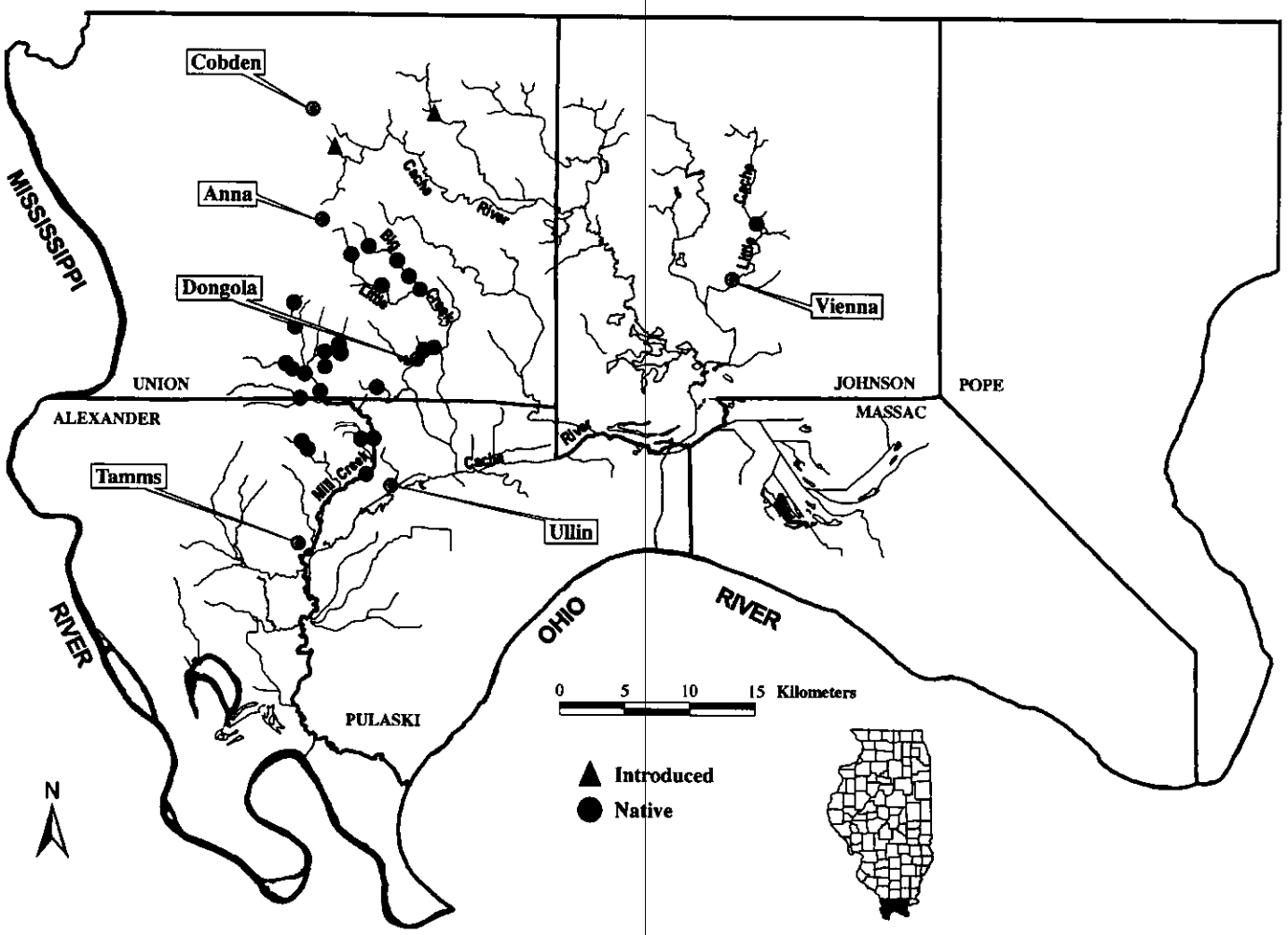

Figure 4. Distribution of the fringed darter (*Etheostoma crossopterum*) in the Cache River basin of southern Illinois from collection records through the year 2001. Solid circles = native populations, solid triangles = introduced populations. Modified from Poly & Wilson (1998).

the number of survivors in the present study would be difficult, and future abundance data and genetic analyses may provide more informative result than such estimates.

Detailed records were kept on weights, lengths, sex, and origins of fishes being introduced; such records should be a routine part of translocation efforts (Griffith et al. 1989). Review of such information might be useful for determining limitations of certain species in becoming established when successful and failed attempts are compared later. The same factors involved in successful biological invasions, primarily by nonnative species, should be considered in translocation efforts for purposes of conservation (Burke 1991; Moyle & Light 1996). Abiotic factors were considered most important concerning invasion success of fishes (Moyle & Light 1996).

Although the long-term success of the translocations remains to be seen, the initial evaluation indicates the protocol used herein was successful based on (1) rapid initiation of breeding by adults, (2) normal period of breeding activity (March – May), and (3) presence of juveniles (young-of-the-year) and adults during a follow-up survey. The use of wild-caught individuals alleviates potential negative effects of artificial selection that can occur in captive-raised populations (Meffe 1986). Numbers of juvenile darters were not high at the two sites; however, in terms of relative proportion of the fish community (15% & 20%), fringed darters were abundant at both sites (Table 2). The number of darters might be low because depletion sampling was not performed, emigration from the study area by adults and juveniles might have contributed to reduced numbers of individuals, or darters simply avoided capture. Surveys of the introduction sites and other areas in these streams in future years will reveal whether the species has become established. The mainstem of the upper Cache River adjacent to its junction with one introduction stream has excellent habitat quality, and if fringed darters are able to move 0.6 km downstream in tributary of Cache River and enter this section of the river, their numbers are expected to increase further. In addition to numbers of fishes, nests can be recorded as a measure of abundance in future years (by seining, snorkeling, and visual inspection of rocks). If the fringed darter becomes established, a question that can be addressed in the near future is the genetic composition of the new populations compared with the source populations. Although the starting population size was 60 fishes (20 male, 40 female), the true

effective population size during the initial colonization cannot be known but could have been smaller. Nevertheless, the genetic evaluation will provide valuable information in regards to the number of individuals necessary for such a stocking program. Population genetics of *Etheostoma crossopterum* (across its entire range, including Illinois) and similar species was investigated by Strange (2000). The stage has been set for a field test of several genetic principles believed to affect the survival of animal populations (Meffe 1986). Nonlethal sampling of darters from the introduction sites is planned (by R.M. Strange & W. Poly) to compare genetic characteristics of these populations to the source populations as well as to other stream populations in Illinois. If 60 fish proves to be sufficient to establish the species in a stream, and especially, if no loss of genetic diversity is apparent, translocations can be attempted with less potential impact to source populations from removal of large numbers of individuals. Additional fringed darters could be moved to the two sites, but greater benefit to future translocation programs involving endangered species will be gained by evaluating the success of the translocations based on the number of darters used in the initial stocking. Three of 13 introductions of four species of fishes in streams in Sri Lanka were successful with starting population sizes of 28, 31, and 91 individuals; unsuccessful translocations involved initial population sizes between 22-87 (mean = 48) (Wikramanayake 1990). Besides the intended conservation goals of translocations in the Sri Lankan streams, a number of ecological questions were able to be addressed as well (Wikramanayake & Moyle 1989). Annual sampling of the fish community at both introduction sites and genetic comparisons among the source populations, introduced populations, and other stream populations in the Cache River basin are being planned.

Investigations of streams in the upper half of the Cache River basin did not result in captures of fringed darters, which is consistent with past efforts in that portion of the river basin (Poly & Wilson 1998). Thus the fringed darter has a restricted distribution, primarily in Mill Creek, Big Creek, and their tributaries (Fig. 4). Due to its recent discovery in Illinois, the fringed darter is not on the list of State threatened and endangered fishes (Illinois Endangered Species Protection Board 1999). As recommended earlier (Poly & Wilson 1998), the fringed darter should not be listed as a

protected species in Illinois at present. Instead, efforts to restore habitats that have been disturbed, to prevent further degradation, and to acquire land for protection of fringed darter habitat as a preserve or conservation area would be most beneficial to this and other aquatic species.

Summary

The fringed darter, *Etheostoma crossopterum*, was introduced into two streams where neither the fringed darter nor any other species of the same subgenus occur but that otherwise have suitable habitat. Darters were collected from two streams in the Cache River basin, and a combination of darters from each source stream were moved to the receiving streams, which also were in the headwaters of the Cache River basin (20 males & 40 females to each). Darters were moved in late March near the beginning of their reproductive season, which continues for approximately two months. Moving darters at the beginning of their reproductive season could increase the chance of successful reproduction and eventual establishment. Fringed darter nests were present within three days at both introduction sites and nests were found thereafter until late May at which time searching for nests was terminated. Twenty-five nests were found, and 8,714 eggs were counted in 22 nests at both sites. In September a survey for juveniles indicated successful recruitment in both streams as well as the presence of a low number of adults. Size of juvenile darters from Bradshaw Creek was significantly higher than that of darters from a tributary of the Cache River. The design of this study allowed for a rapid, initial assessment of the translocations, aspects of which appeared successful. The protocol for translocation of fringed darters might be applicable to other similar and endangered darters such as *Etheostoma forbesi* and *E. chienense*. Sampling was conducted in other areas of the Cache River basin in search of additional populations of fringed darters. An updated account is given of the distribution of the fringed darter in Illinois.

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Budget for project:

Funds from Illinois Department of Natural Resources, Illinois Wildlife Preservation Fund		estimated	actual
Pocket digital thermometer	qty. 3	$40.00	$42.35
Chest waders	qty. 1	$80.00	$76.04
Seine (net)	qty. 1	$80.00	$69.54
Coolers	qty. 2	$40.00	$59.90
Mileage		$200.00	$180.73
		[for 650 mi]	[for 556 mi.]
	Total:	**$440.00**	**$428.56**

Funds contributed by William J. Poly		estimated	actual
Acculab Pocket Pro 250B electronic balance	qty. 1	$170.00	$166.20
Film & developing	2 rolls	$30.00	$34.91
Report preparation		$100.00	$100.00
Cost of publication		$170.00	$170.00*
	Total:	**$470.00**	**$471.11****

*estimate

**partial estimate