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Supplement: A Priori Habitat Accounts for Candy Darter and Ancillary Data

Supplementary Table S.1. Previous accounts of instream habitat associations of Candy Darters. "Predicted relationship" refers to the expected correlations between Candy Darter density and a habitat gradient interpreted from the references listed below (e.g., adult density increases as water velocity increases, but adult density decreases as water depth increases; Kuehne and Barbour 1983). Predicted relationships were not applicable (NA) if information was not available for variables at specific life stages. Asterisks indicate primary literature.

Variable	Life stage	Habitat description	Predicted relationship
Water depth	Adult	20.3–50.8 cm (Addair 1944); 20.4–29.6 cm, "shallow water" (Chipps et al. 1994*); 40–100 cm (Jenkins and Burkhead 1994); <22 cm, "shallow water" (Leftwich et al. 1996)	–
	Juvenile	No information	NA
	Age 0	No information	NA
Water velocity	Adult	"... swift clear water..." (Addair 1944); 27.4–32.9 cm/s, "fast water" (Chipps et al. 1994*); "rocky montane... with turbulent flow" (Kuehne and Barbour 1983); "fast water" (Leftwich et al. 1996)	+
	Juvenile	"...slower current than adults" (Jenkins and Kopia 1995)	+
	Age 0	No information	NA
Substrate size	Adult	"... large rocks and gravel..." (Addair 1944); "rubble" (Kuehne and Barbour 1983); cobble (Chipps et al. 1994*); "rubble and boulder in runs and riffles" (Jenkins and Burkhead 1994); "gravel, cobble, boulder, and occasional bedrock" (Jenkins and Kopia 1995); "boulder" (Leftwich et al. 1996)	+
	Juvenile	No information	NA
	Age 0	No information	NA
Embeddedness	Adult	No information	NA
	Juvenile	No information	NA
	Age 0	No information	NA
Silt cover	Adult	"...relatively silt-free streams" (Jenkins and Kopia 1995); "Excessive siltation characterized areas where the Candy Darter was absent or much diminished" (Chipps et al. 1993*)	–
	Juvenile	No information	NA
	Age 0	No information	NA

Supplementary Table S.2. Pearson's product-moment correlation coefficients (Pearson's *r*) between instream microhabitat variables and nonmetric multidimensional scaling axes for two seasons. Pearson's *r*-values that were ≥ |0.50| are presented in Figure 4 and in Figure S.2.

	Spring		Fall	
Variable	Axis 1	Axis 2	Axis 1	Axis 2
Depth	0.40	0.92	0.96	–0.29
Velocity	–0.62	0.79	–0.70	0.72
Substrate size	–0.77	–0.64	–0.37	0.93
Embeddedness	0.95	0.30	0.93	0.37
Silt cover	0.91	–0.42	0.93	0.37

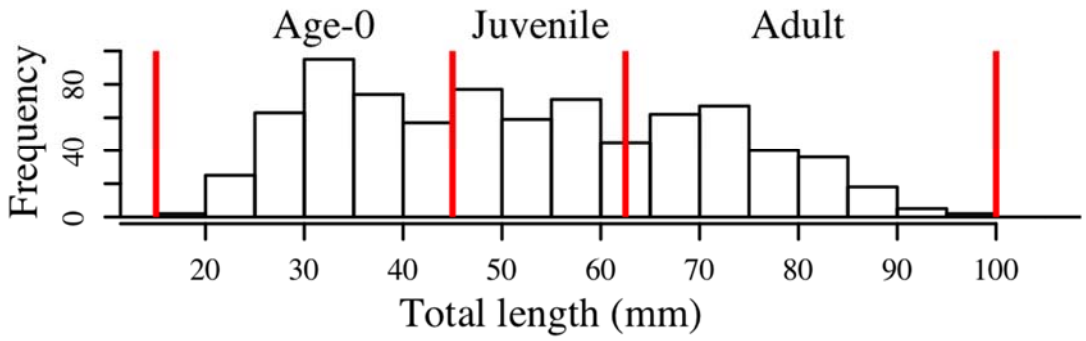
Supplementary Table S.3. Observations by life stage (*N*), area sampled, and density of Candy Darters in three streams (EFG = East Fork Greenbrier River; LC = Laurel Creek; SFC = South Fork Cherry River) and two seasons.

Stream	Status	Life stage	*N*	Area sampled (m^2)	Density (fish/100 m^2)
			Spring		
EFG	Robust	Total	115	13,059	0.88
		Adult	66		
		Juvenile	31		
		Age 0	18		
SFC	Robust	Total	175	14,614	1.20
		Adult	71		
		Juvenile	54		
		Age 0	50		
LC	Localized	Total	14	5,455	0.26
		Adult	11		
		Juvenile	3		
		Age 0	0		
			Fall		
EFG	Robust	Total	286	8,764	3.26
		Adult	69		
		Juvenile	87		
		Age 0	130		
SFC	Robust	Total	222	11,480	1.93
		Adult	80		
		Juvenile	37		
		Age 0	105		
LC	Localized	Total	52	4,383	1.19
		Adult	19		
		Juvenile	11		
		Age 0	22		

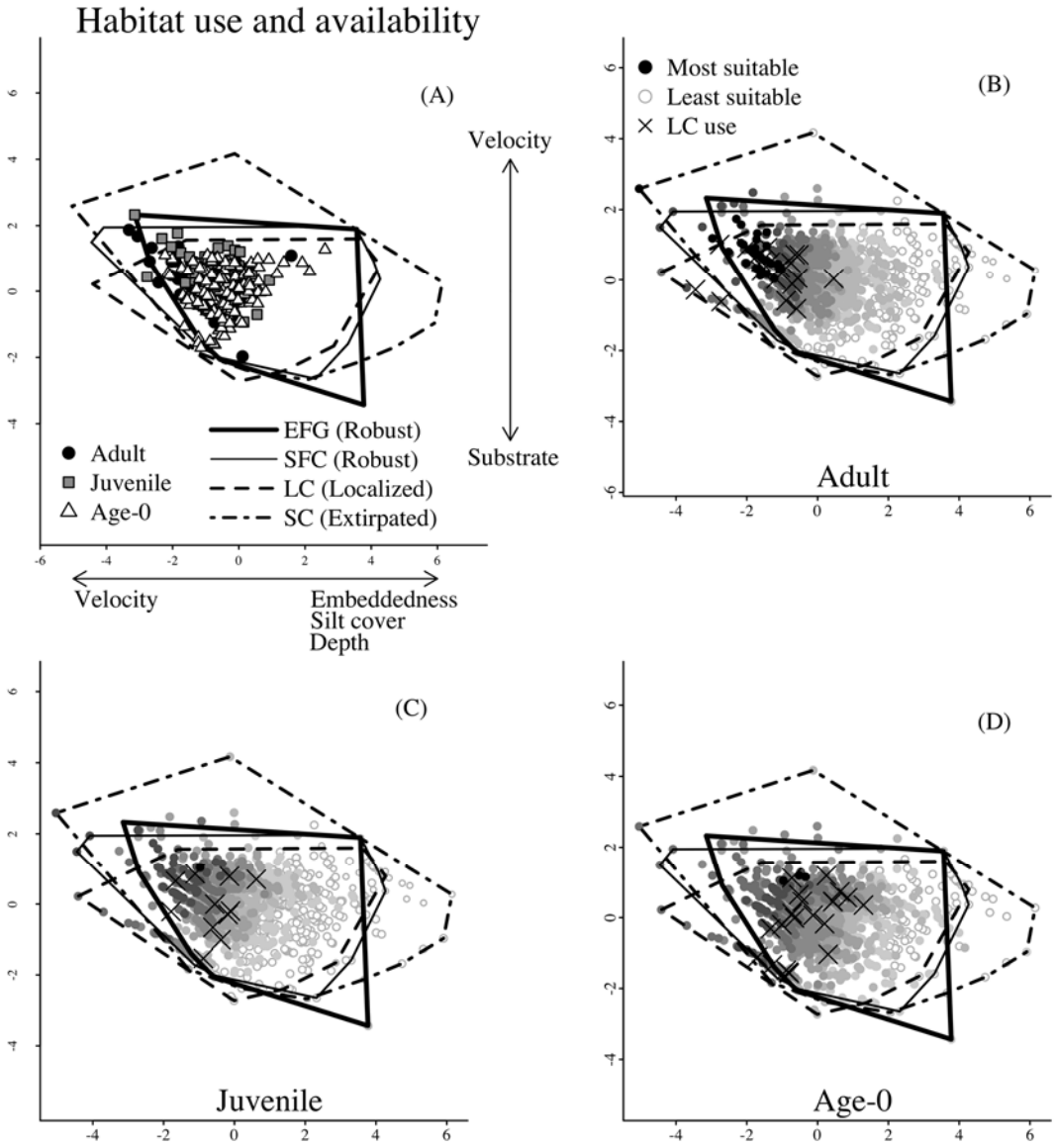
Supplementary Table S.4. Predicted individual habitat suitability (mean with 95% confidence intervals in parentheses) by life stage and season within four streams that varied in Candy Darter population status. Possible habitat suitability values ranged from 0 to 1, indicating no selection and maximum selection, respectively. "Multi-stage" is the average suitability across life stages; "multi-variable" is the average suitability calculated from all habitat variables within each stream. The East Fork Greenbrier River (EFG) and South Fork Cherry River (SFC) support robust Candy Darter populations; Laurel Creek (LC) supports a localized population; and the Sinking Creek (SC) population is extirpated.

Variable	Stream	Adult suitability	Juvenile suitability	Age-0 suitability	Multi-stage suitability
		Spring			
Depth	EFG	0.54 (0.03)	0.66 (0.02)	0.61 (0.03)	0.60 (0.02)
	SFC	0.49 (0.02)	0.63 (0.03)	0.57 (0.03)	0.56 (0.02)
	LC	0.50 (0.03)	0.62 (0.03)	0.56 (0.03)	0.56 (0.03)
	SC	0.50 (0.03)	0.64 (0.03)	0.52 (0.03)	0.55 (0.03)
Velocity	EFG	0.18 (0.01)	0.51 (0.02)	0.88 (0.01)	0.53 (0.01)
	SFC	0.15 (0.01)	0.42 (0.01)	0.88 (0.01)	0.48 (0.01)
	LC	0.16 (0.01)	0.46 (0.02)	0.89 (0.01)	0.50 (0.01)
	SC	0.19 (0.01)	0.51 (0.02)	0.88 (0.02)	0.53 (0.01)
Substrate	EFG	0.80 (0.02)	0.72 (0.02)	0.69 (0.01)	0.74 (0.01)
	SFC	0.67 (0.02)	0.65 (0.02)	0.70 (0.01)	0.67 (0.01)
	LC	0.57 (0.03)	0.54 (0.03)	0.75 (0.02)	0.62 (0.02)
	SC	0.59 (0.03)	0.55 (0.02)	0.77 (0.02)	0.64 (0.01)
Embeddedness	EFG	0.84 (0.02)	0.90 (0.02)	0.91 (0.01)	0.88 (0.01)
	SFC	0.88 (0.02)	0.90 (0.02)	0.92 (0.02)	0.90 (0.02)
	LC	0.52 (0.04)	0.60 (0.04)	0.66 (0.03)	0.59 (0.03)
	SC	0.33 (0.02)	0.41 (0.03)	0.54 (0.02)	0.43 (0.02)
Silt cover	EFG	0.44 (0.03)	0.67 (0.02)	0.82 (0.02)	0.64 (0.02)
	SFC	0.58 (0.03)	0.75 (0.02)	0.76 (0.01)	0.70 (0.02)
	LC	0.53 (0.04)	0.65 (0.04)	0.62 (0.03)	0.60 (0.03)
	SC	0.57 (0.04)	0.72 (0.03)	0.72 (0.02)	0.67 (0.02)
Multi-variable	EFG	0.56 (0.01)	0.69 (0.01)	0.78 (0.01)	0.68 (0.01)
	SFC	0.55 (0.01)	0.67 (0.01)	0.77 (0.01)	0.66 (0.02)
	LC	0.46 (0.02)	0.57 (0.02)	0.70 (0.01)	0.58 (0.02)
	SC	0.44 (0.02)	0.57 (0.02)	0.69 (0.01)	0.56 (0.01)
		Fall			
Depth	EFG	0.52 (0.05)	0.49 (0.05)	0.51 (0.05)	0.51 (0.05)
	SFC	0.68 (0.04)	0.62 (0.05)	0.65 (0.04)	0.65 (0.04)
	LC	0.66 (0.03)	0.61 (0.04)	0.64 (0.03)	0.63 (0.03)
	SC	0.68 (0.04)	0.49 (0.04)	0.58 (0.03)	0.58 (0.03)
Velocity	EFG	0.16 (0.02)	0.17 (0.02)	0.33 (0.02)	0.22 (0.02)
	SFC	0.20 (0.02)	0.22 (0.03)	0.36 (0.02)	0.26 (0.02)
	LC	0.20 (0.02)	0.23 (0.02)	0.37 (0.02)	0.27 (0.09)
	SC	0.21 (0.02)	0.22 (0.02)	0.36 (0.01)	0.26 (0.02)
Substrate	EFG	0.86 (0.03)	0.43 (0.02)	0.42 (0.02)	0.57 (0.02)
	SFC	0.76 (0.03)	0.38 (0.02)	0.41 (0.02)	0.51 (0.02)
	LC	0.73 (0.03)	0.44 (0.02)	0.47 (0.02)	0.55 (0.02)

Variable	Stream	Adult suitability	Juvenile suitability	Age-0 suitability	Multi-stage suitability
Embeddedness	SC	0.73 (0.02)	0.49 (0.02)	0.49 (0.02)	0.57 (0.02)
	EFG	0.76 (0.05)	0.80 (0.04)	0.87 (0.03)	0.81 (0.04)
	SFC	0.78 (0.04)	0.80 (0.04)	0.86 (0.03)	0.81 (0.04)
	LC	0.53 (0.04)	0.58 (0.03)	0.73 (0.02)	0.61 (0.03)
Silt cover	SC	0.25 (0.02)	0.35 (0.02)	0.58 (0.02)	0.40 (0.02)
	EFG	0.34 (0.06)	0.37 (0.05)	0.59 (0.05)	0.43 (0.05)
	SFC	0.46 (0.05)	0.48 (0.05)	0.70 (0.04)	0.55 (0.04)
	LC	0.47 (0.04)	0.50 (0.04)	0.67 (0.03)	0.55 (0.04)
Multi-variable	SC	0.32 (0.04)	0.35 (0.03)	0.53 (0.03)	0.40 (0.02)
	EFG	0.53 (0.02)	0.45 (0.02)	0.54 (0.02)	0.51 (0.02)
	SFC	0.57 (0.02)	0.50 (0.02)	0.60 (0.02)	0.56 (0.02)
	LC	0.52 (0.02)	0.47 (0.02)	0.58 (0.01)	0.52 (0.02)
	SC	0.44 (0.02)	0.38 (0.02)	0.51 (0.01)	0.44 (0.01)



Supplementary Figure S.1. Length frequency histogram of Candy Darter TLs (N = 798 individuals) measured by snorkelers in the East Fork Greenbrier and South Fork Cherry rivers, West Virginia. We used different thresholds for separating juveniles from adult females (60 mm) and males (65 mm) based on differences in pigmentation. The line between adults and juveniles is drawn at 62.5 mm.



Supplementary Figure S.2. Nonmetric multidimensional scaling (NMDS) plots of habitat use, availability, and suitability for Candy Darters in fall: **(A)** habitat use by three life stages and availability in four streams (polygons; EFG = East Fork Greenbrier River; LC = Laurel Creek; SC = Sinking Creek; SFC = South Fork Cherry River); **(B)** predicted microhabitat suitability for adults; **(C)** predicted microhabitat suitability for juveniles; and **(D)** predicted microhabitat suitability for age-0 fish. Symbols for "LC use" represent locations used by Candy Darters in Laurel Creek during the fall. Variables that were highly correlated (Pearson's product-moment correlation coefficient [Pearson's r] ≥ 0.50) with axes are shown. All Pearson's r-values are presented in Table S.2. The NMDS stress value was 0.14.

SUPPLEMENTAL REFERENCES

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