

**Part II: Scoring Criteria for the Index of Biotic Integrity and the
Index of Well-Being to Monitor Fish Communities in Wadeable
Streams in the Piedmont Ecoregion of Georgia**

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Introduction

The Piedmont ecoregion is one of six Level III ecoregions found in Georgia (Part 1, Figure 1). The Piedmont ecoregion covers most of the north central portion of Georgia, between the Southeastern Plains ecoregion to the south and the Ridge and Valley and Blue Ridge Mountains ecoregions to the north. It is the second largest ecoregion in Georgia, covering over 17,000 square miles (United States Census Bureau 2000) and including all or portions of 65 counties (Fig. 1).

The biotic indices developed by the GAWRD are based on the Level III ecoregion delineations (Griffith et al 2001). The metrics and scoring criteria adapted to the Piedmont ecoregion were developed from biomonitoring samples collected in the eight major drainage basins located in the Piedmont ecoregion. These major drainage basins include the Chattahoochee, Coosa, Flint, Ocmulgee, Oconee, Ogeechee, Savannah, and Tallapoosa. Based on similarities in species richness and composition, the eight major drainage basins were aligned into three basin groups. The Alabama Drainage Basin (ACT) includes the Coosa and Tallapoosa drainage basins; the Apalachicola Drainage Basin (ACF) includes the Chattahoochee and Flint drainage basins; and the Atlantic Slope Drainage Basins (AS) include the Ocmulgee, Oconee, Ogeechee, and Savannah drainage basins. A total of 378 biomonitoring samples have been collected by the GAWRD in the Piedmont ecoregion since 1998.

The Alabama drainage basin was the most species rich in the Piedmont ecoregion, with a total of 64 native species collected. Fifty-seven native species were collected in the Atlantic Slope drainage basins and 55 native species were collected in the Apalachicola drainage basin. A total of 14 state listed species were collected in the Piedmont ecoregion. The state listed fish collected in the Piedmont ecoregion were ranked as endangered (E), threatened (T), or rare (R) based on the Endangered Wildlife Act of 1973 (Georgia Department of Natural Resources, Nongame – Endangered Wildlife Program, 1999). Endangered species collected in the Piedmont ecoregion include the Altamaha shiner (*Cyprinella xaenurus*), collected in the Ocmulgee and Oconee drainage basins, and the lipstick darter (*Etheostoma chuckwachatte*), found in the Tallapoosa drainage basin. Threaten species included the bluestripe shiner (*Cyprinella callitaenia*) collected in the Flint drainage basin, the pretty shiner (*Lythrurus bellus*), collected in the Tallapoosa drainage basin, the highscale shiner (*Notropis hypsilepis*), collected in the

Chattahoochee and Flint drainage basins, and the holiday darter (*Etheostoma brevirostrum*), Etowah darter (*Etheostoma etowahae*), and Cherokee darter (*Etheostoma scotti*), all collected in the Coosa drainage basin. Species ranked as rare included the Tallapoosa shiner (*Cyprinella gibbsi*), found in the Tallapoosa drainage basin, the sandbar shiner (*Notropis szepticus*), found in the Savannah drainage basin, the black madtom (*Noturus funebris*), found in the Chattahoochee and Tallapoosa drainage basins, the goldstripe darter (*Etheostoma parvipinne*), collected in the Ocmulgee drainage basin, and the Tallapoosa darter (*Etheostomna tallapoosae*) and the muscadine bridled darter (*Percina sp.*), found in the Tallapoosa drainage basin. The Etowah darter (endangered) and the Cherokee darter (threatened) are both federally listed under the Endangered Species Act of 1973. Table 1 shows a complete list of state listed fish found in the Piedmont ecoregion of Georgia.

Based on the IBI integrity classes (Part I, Table 2), 25 sites scored in the excellent class, 54 scored in the good class, 108 scored in the fair class, 87 scored in the poor class, and 104 scored in the very poor class. IBI scores in the Piedmont ecoregion ranged from a maximum of 58 to a minimum of 10. Based on the IBI scoring criteria, over 50% of the streams sampled in the Piedmont ecoregion scored in the poor and very poor integrity class ($[191/378] * 100 = 50.5$). Major impacts to streams in the Piedmont ecoregion include the effects of erosion and sedimentation, impoundments, point source pollution, and urban / suburban development. The Piedmont ecoregion is the most densely populated area in Georgia, averaging nearly 316 individuals per square mile (United States Census Bureau 2000). Approximately 63% of the total population of Georgia lives in the Piedmont ecoregion, an area covering only 29.5% of the entire state. Most of the major metropolitan areas in Georgia are located in the Piedmont ecoregion, including Atlanta, Gainesville, Athens, and portions of Columbus, Macon, and Augusta.

Table 2 shows the scoring criteria for the IBI metrics in the Piedmont ecoregion. The Maximum Species Richness (MSR) graphs for each basin group within the Piedmont ecoregion are included in Appendix 1. Figures ACF1 – PDT through ACF6b - PDT depict the MSR graphs used to score the species richness metrics (metrics 1- 6b) in the Apalachicola drainage basin. Figures ACT1 - PDT through ACT6b - PDT depict the MSR graphs used to score the species richness metrics in the Alabama drainage basin. Figures AS1 - PDT through AS6b - PDT depict the MSR graphs used to score the species richness metrics in the Atlantic Slope drainage basins.

The fish list for the Piedmont ecoregion showing the water quality tolerance rankings, feeding guilds, and species categories used in calculating the IBI score is also included in Appendix 1.

Based on the modified Index of Well-Being integrity classes for the Piedmont ecoregion (Table 3), 35 sites scored in the excellent class, 65 scored in the good class, 153 scored in the fair class, 40 scored in the poor class, and 62 scored in the very poor class. Modified Iwb scores in headwater streams ranged from a maximum score of 9.98 to a minimum of 0.21. At larger wadeable streams modified Iwb scores ranged from a maximum of 10.58 to a minimum of 3.83. There was a significant relationship between the indices across the Piedmont ecoregion ($r = 0.8051$, $p = 0.0000$, $N = 355$), although the relationship was stronger in the larger wadeable streams ($r = 0.8701$, $p = 0.0000$, $N = 95$) compared to the headwater streams ($r = 0.7797$, $p = 0.0000$, $N = 260$).

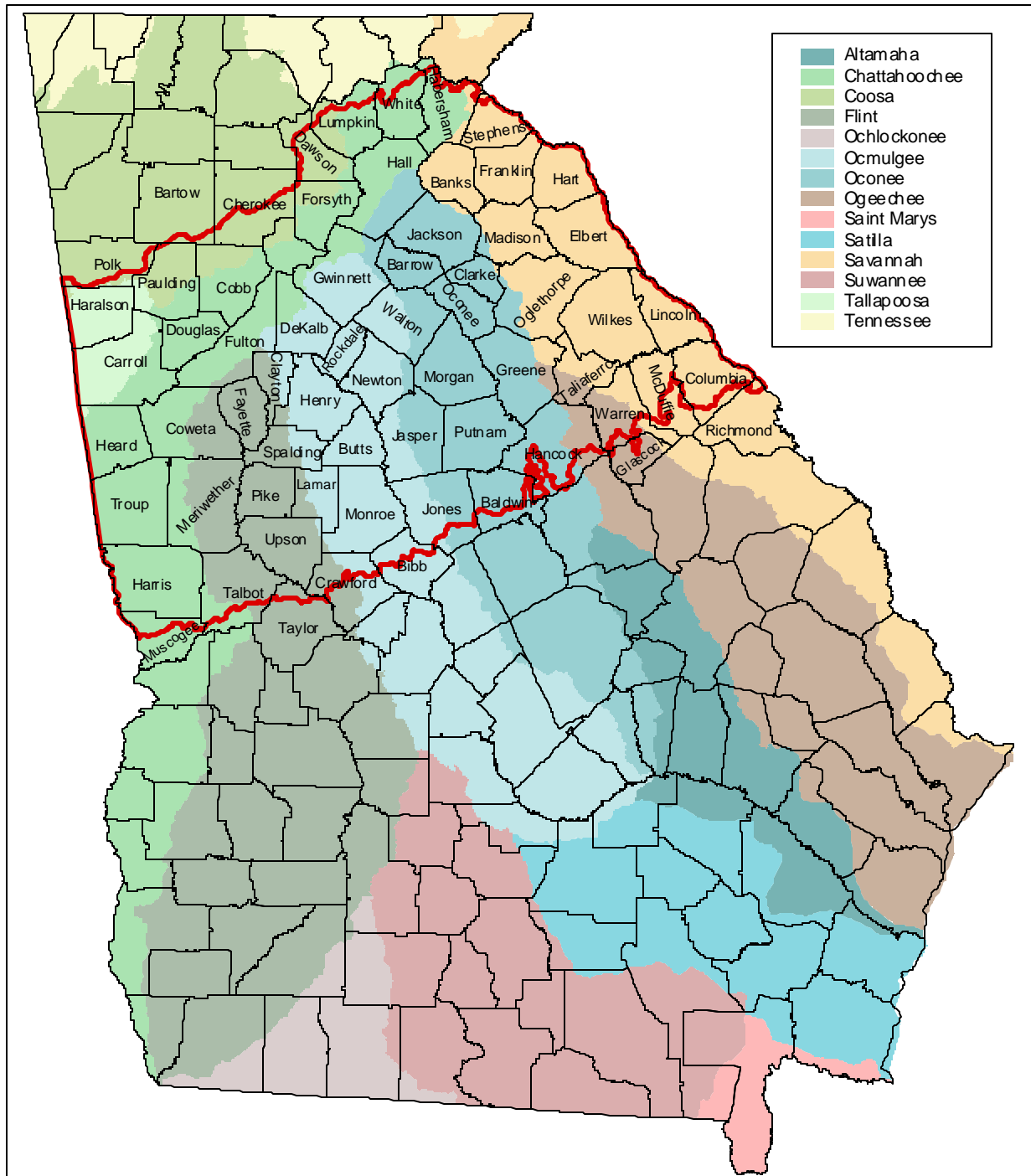


Figure 1. Level III Piedmont ecoregion (outlined in bold red) in Georgia. Major drainage basins include the Coosa, Tallapoosa, Chattahoochee, Flint, Ocmulgee, Oconee, Ogeechee, and Savannah.

Table 1. State listed fish found in the Piedmont ecoregion of Georgia (Georgia Department of Natural Resources, Nongame – Endangered Wildlife Program, 1999).

Species	State Status	Federal Status	Basin
Bluestripe Shiner (<i>Cyprinella callitaenia</i>)	T	None	CHA, FLI
Tallapoosa Shiner (<i>Cyprinella gibbsi</i>)	R	None	TAL
Altamaha Shiner (<i>Cyprinella xaenura</i>)	E	None	OCM, OCO
Holiday Darter (<i>Etheostoma brevirostrum</i>)	T	None	COO
Lipstick Darter (<i>Etheostoma chuckwachatte</i>)	E	None	TAL
Etowah Darter (<i>Etheostoma etowahae</i>)	T	E	COO
Goldstripe Darter (<i>Etheostoma parvipinne</i>)	R	None	CHA, FLI, OCM
Cherokee Darter (<i>Etheostoma scotti</i>)	T	T	COO
Tallapoosa Darter (<i>Etheostoma tallaposae</i>)	R	None	TAL
Stippled Studfish (<i>Fundulus bifax</i>)	E	None	TAL
Pretty Shiner (<i>Lythrurus bellus</i>)	T	None	TAL
Robust Redhorse (<i>Moxostoma robustum</i>)	E	None	OCO, SAV
Highscale Shiner (<i>Notropis hypsilepis</i>)	T	None	CHA, FLI
Sandbar Shiner (<i>Notropis szepticus</i>)	R	None	SAV
Black Madtom (<i>Noturus funebris</i>)	R	None	CHA, TAL
Frecklebelly Madtom (<i>Noturus munitus</i>)	E	None	COO
Amber Darter (<i>Percina antesella</i>)	E	E	COO
Freckled Darter (<i>Percina lenticula</i>)	E	None	COO
Muscadine Bridled Darter (<i>Percina</i> sp.)	R	None	TAL
Upland Bridled Darter (<i>Percina</i> sp.)	R	None	COO

Status: E = endangered; R = rare; T = threatened

Basin: CHA = Chattahoochee; COO = Coosa; OCM = Ocmulgee; OCO = Oconee; SAV = Savannah; TAL = Tallapoosa

Table 2. Index of Biotic Integrity metrics for wadeable streams in the Piedmont ecoregion of Georgia. ACF includes the Chattahoochee and Flint drainage basins, ACT includes the Coosa and Tallapoosa drainage basins, and AS includes the Ocumulgee, Oconee, Ogeechee, and Savannah drainage basins.

Metric	Basin Group	Scoring Criteria		
1. Number of native species	ACF/ACT/AS			
2. Number of benthic invertivore species	ACF/ACT/AS			
3a. Number of native sunfish species ^a	ACF/ACT/AS			
3b. Number of native centrarchid species ^b	ACF/ACT/AS			
4. Number of native insectivorous cyprinid species	ACF/ACT/AS			
5. Number of native round-bodied sucker species	ACF/ACT/AS			
6a. Number of sensitive species ^a	ACF/ACT/AS			
6b. Number of intolerant species ^b	ACF/ACT/AS			
		<u>5</u>	<u>3</u>	<u>1</u>
7. Evenness	ACF	≥ 72	72 - ≥ 62	< 62
	ACT	≥ 79	79 - ≥ 69	< 69
	AS	≥ 68	68 - ≥ 57	< 57
8. % of individuals as <i>Lepomis</i> species	ACF	≤ 27	27 - ≤ 53	> 53
	ACT	≤ 23	23 - ≤ 46	> 46
	AS	≤ 23	23 - ≤ 45	> 45

		<u>5</u>	<u>3</u>	<u>1</u>
9. % of individuals as insectivorous cyprinids	ACF	≥ 42	42 - ≥ 21	< 21
	ACT	≥ 32	32 - ≥ 16	< 16
	AS	≥ 50	50 - ≥ 27	< 27
10a. % of individuals as generalist feeders and herbivores ^a	ACF	≤ 22	22 - ≤ 40	> 40
	ACT	≤ 15	15 - ≥ 28	> 28
	AS	≤ 20	20 - ≤ 36	> 36
10b. % of individuals as top carnivores ^b	ACF/ACT/AS	$\geq 3.8 - \leq 9.5$	$\geq 1.9 - < 3.8$ or $> 9.5 - \leq 11.4$	< 1.9 or > 11.4
11. % of individuals as benthic fluvial specialist	ACF	≥ 38	38 - ≥ 19	< 19
	ACT	≥ 36	36 - ≥ 21	< 21
	AS	≥ 28	28 - ≥ 14	< 14
12. Number of individuals per 200 meters	ACF	≥ 670	670 - ≥ 335	< 335
	ACT	≥ 450	450 - ≥ 225	< 225
	AS	≥ 640	640 - ≥ 320	< 320
13. % of individuals with external anomalies	ACF/ACT/AS		> 1.2 – subtract 4 points from total score	

^a used at sites with an upstream drainage basin area < 15 square miles

^b used at sites with an upstream drainage basin area ≥ 15 square miles

Table 3. Index of well-being scoring criteria and integrity classes for wadeable streams in the Piedmont ecoregion of Georgia.

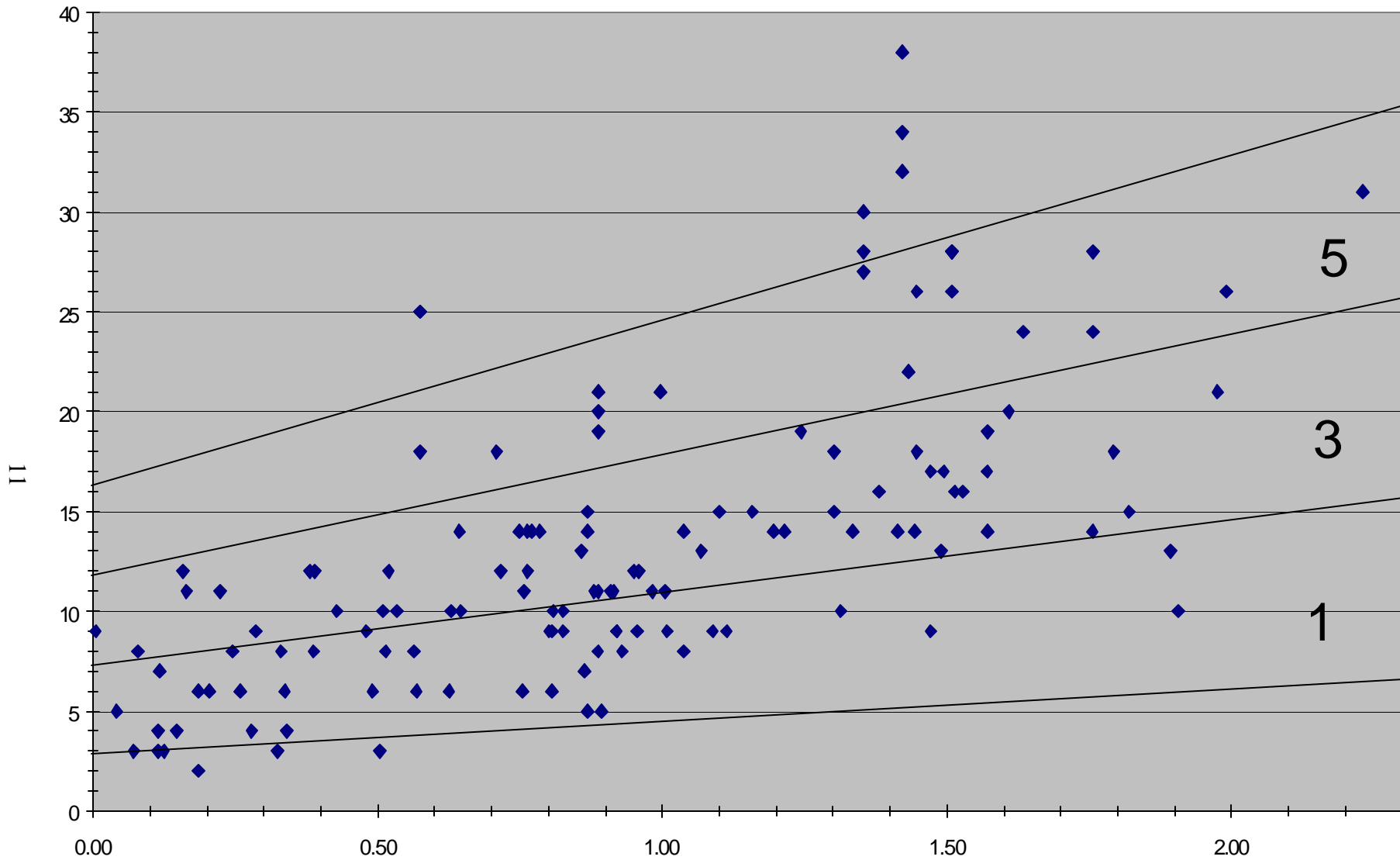
Iwb Score	DBA (Sq. miles)	Integrity Class	Attributes
≥ 8.1	< 15	Excellent	Comparable to the best regional reference conditions; all regionally expected species for the habitat and stream size, including the most intolerant species, are present with a full array of size classes; healthy species diversity within the fish community, indicated by elevated evenness scores; number of individuals abundant; total biomass is high, with each level of the food web represented, indicating a balanced trophic structure.
≥ 9.6	≥ 15		
8.1 - ≥ 7.3	< 15	Good	Species richness somewhat below expectation; evenness scores decrease as species diversity falls, especially due to the loss of the most intolerant forms; good number of individuals in the sample, with several species of benthic fluvial specialists and insectivorous cyprinids present; some decreases in total biomass as trophic structure shows some signs of stress.
9.6 - ≥ 8.6	≥ 15		
∞ 7.3 - ≥ 5.7	< 15	Fair	Species richness and diversity decline as some expected species are absent; abundance of individuals declines; total biomass continues to decline as some levels of the food web in low abundance or missing; trophic structure skewed toward generalist feeders and/or <i>Lepomis</i> species as the abundance of insectivorous cyprinid and benthic fluvial specialist species decreases.
8.6 - ≥ 6.6	≥ 15		
5.7 - ≥ 4.9	< 15	Poor	Number of individuals is low; species richness and diversity are very low, with benthic fluvial specialist and insectivorous cyprinid species in low abundance or absent; sample dominated by generalist feeders, herbivores, and <i>Lepomis</i> species; increase in the proportions of non-native species and hybrids; growth rates depressed as sample is heavily skewed to the smaller size classes; total biomass low.
6.6 - ≥ 5.6	≥ 15		
< 4.9	< 15	Very Poor	Sample represented by few individuals, mainly generalist feeders and <i>Lepomis</i> species; some sites dominated by non-native species; total biomass very low.
< 5.6	≥ 15		

References

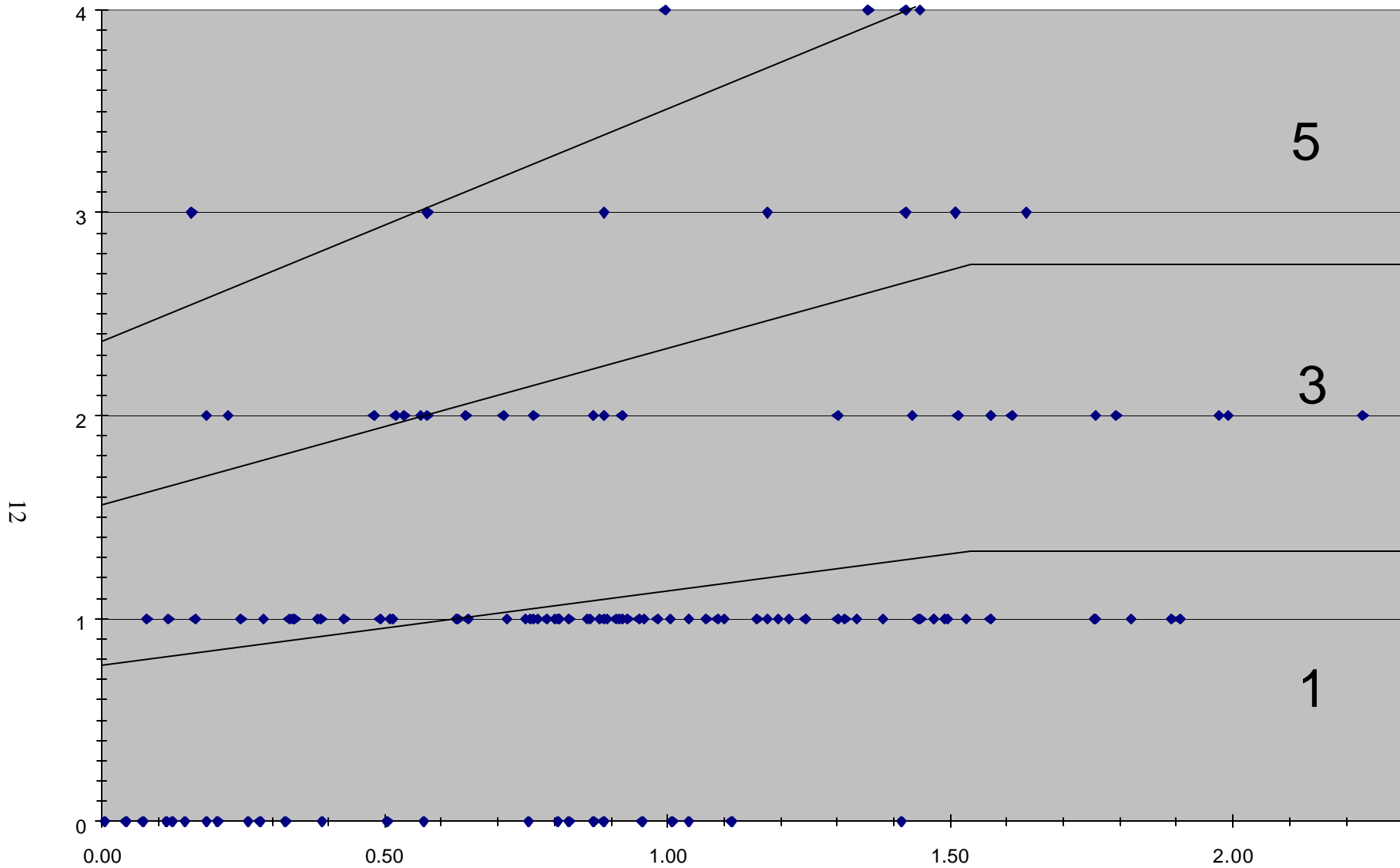
- Georgia Department of Natural Resources, Wildlife Resources Division. 1999. Protected Animals of Georgia. Nongame Wildlife – Natural Heritage Section, Forsyth, Georgia.
- Griffith, G.E., J.M. Omernik, J.A. Comstock, S. Lawrence, and T. Foster. 2001. Level III and IV Ecoregions of Georgia, (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia, U.S. Geological Survey.
- United States Census Bureau. 2000. 2000 Census of Population and Housing. United States Census Bureau, Washington, D.C.

Appendix 1

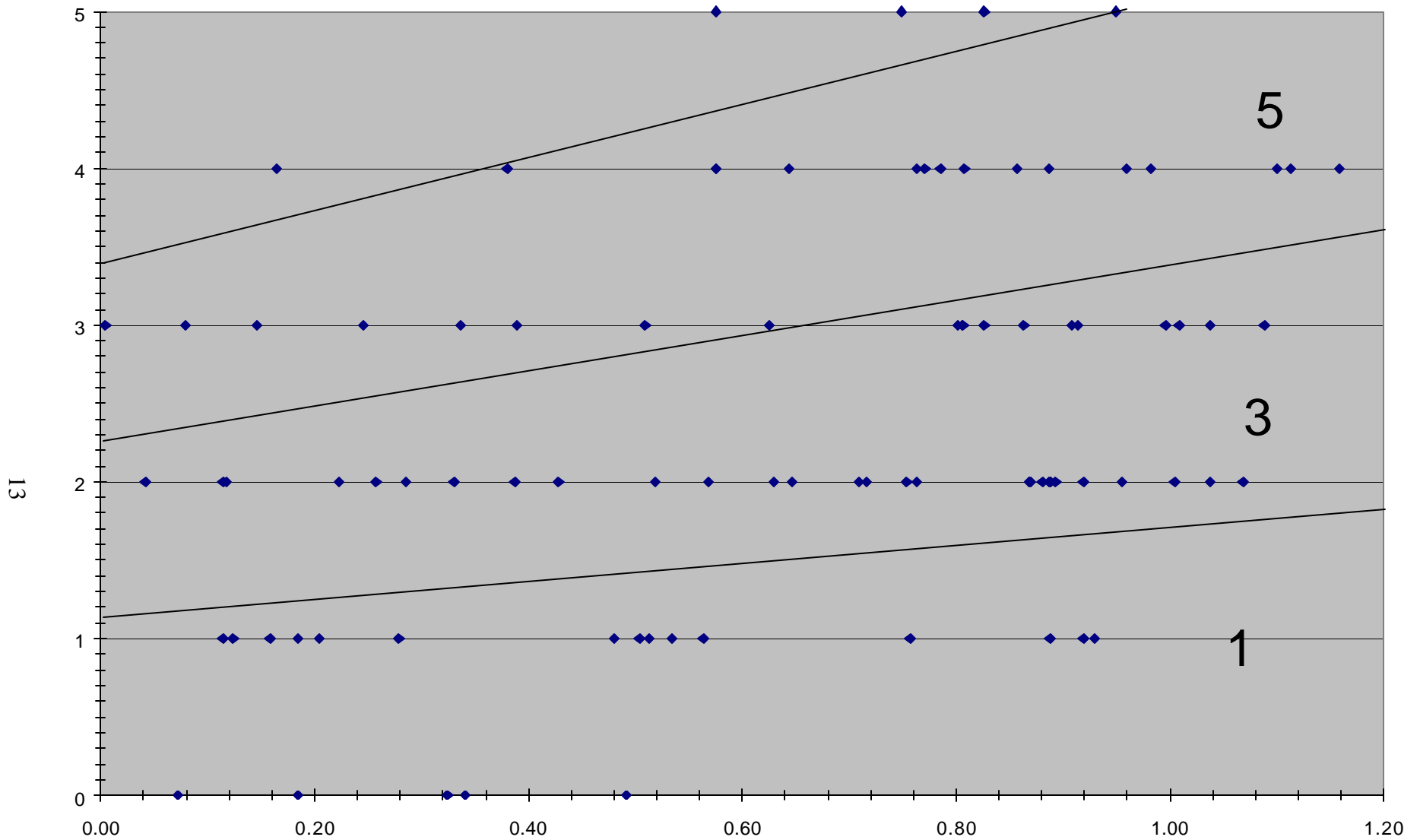
Apalachicola Basin Group (ACF) MSR Graphs.....	Pg. 11
Alabama Basin Group (ACT) MSR Graphs.....	Pg. 19
Atlantic Slope Basins Group (AS) MSR Graphs.....	Pg. 27
Piedmont Ecoregion Fish List.....	Pg. 35



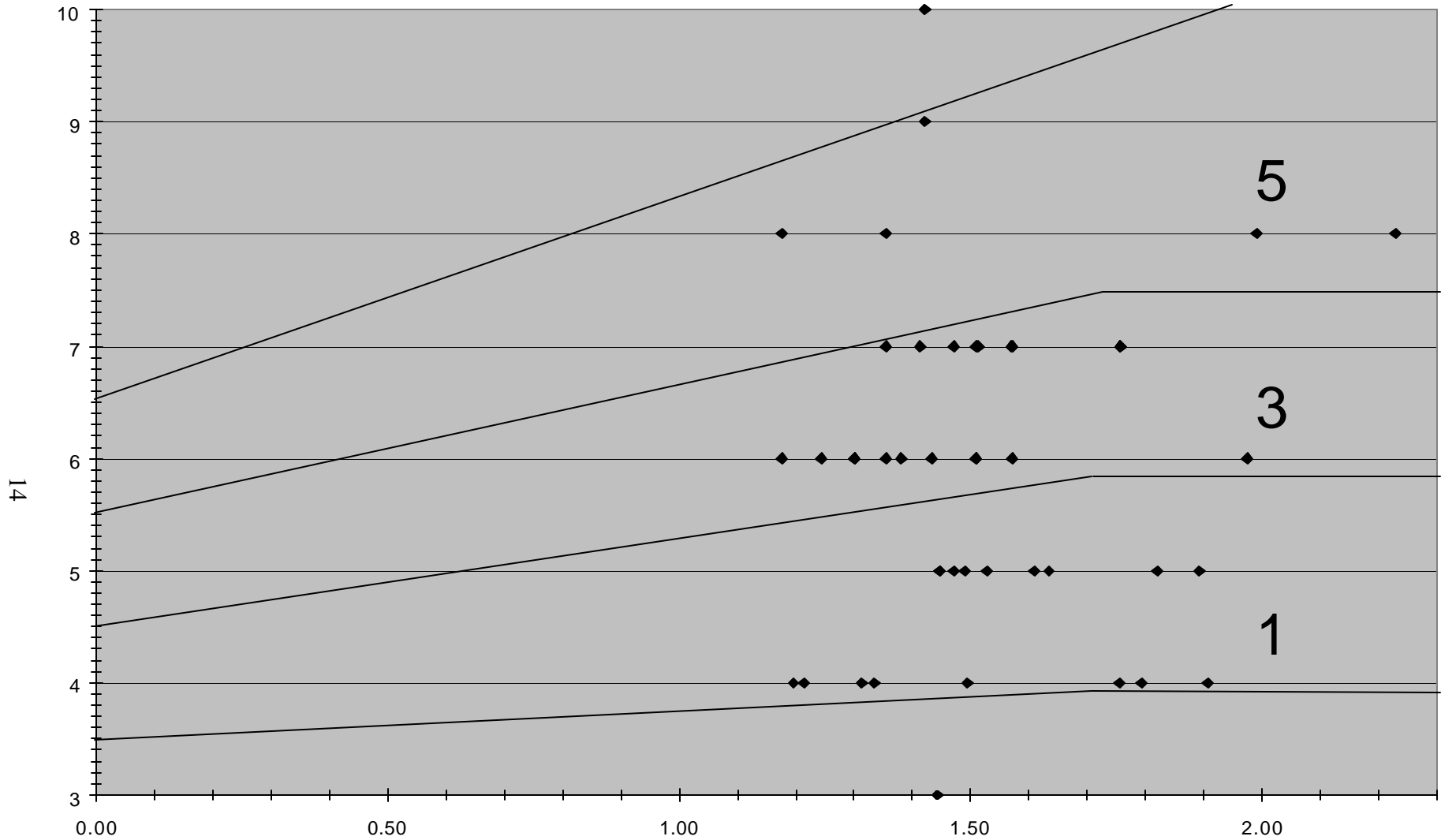
ACF 1 – PDT. Total number of native species in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 141.



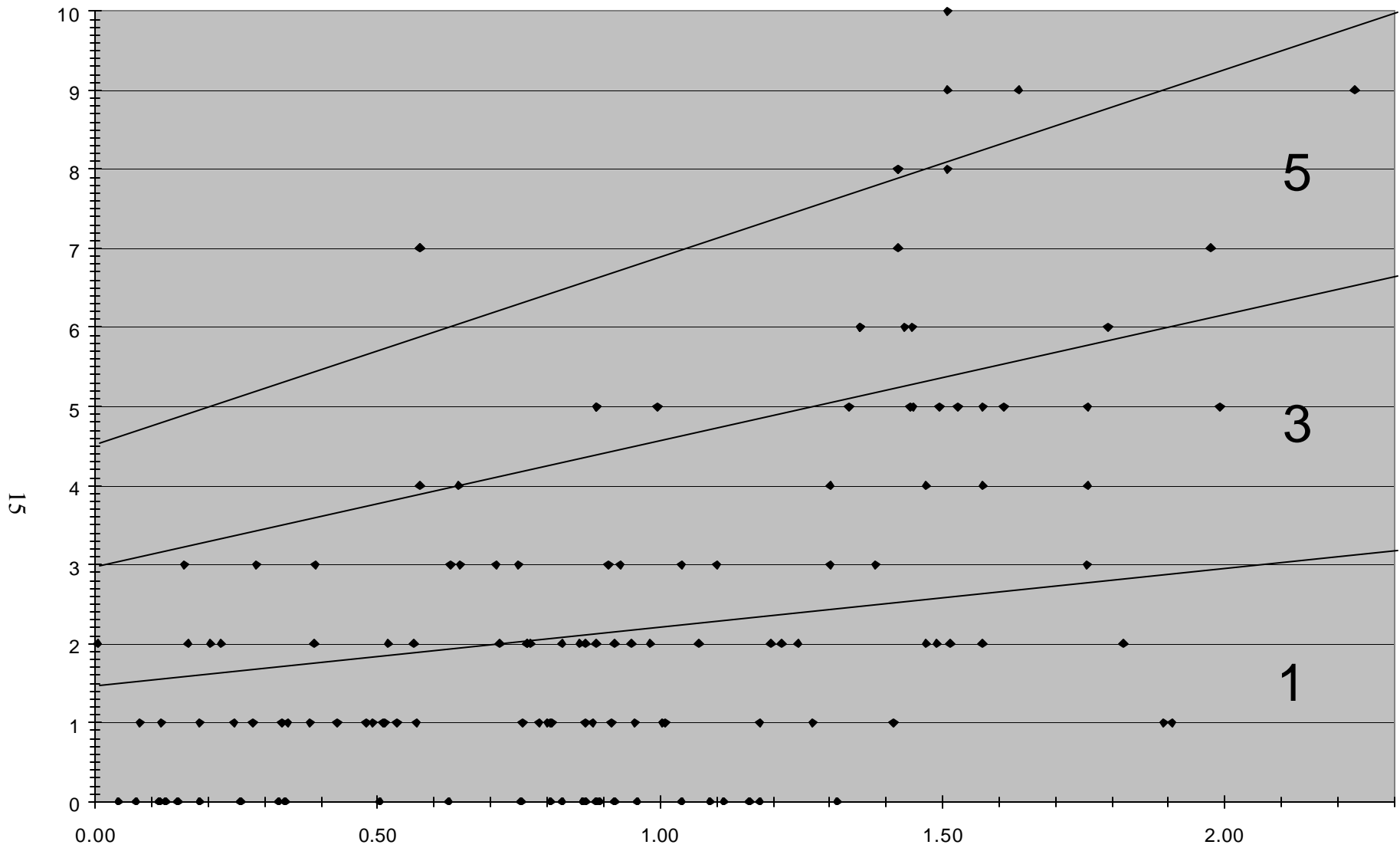
ACF2 – PDT. Number of benthic invertebrate species in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Flatlines at 30 square miles. Total samples equal 141.



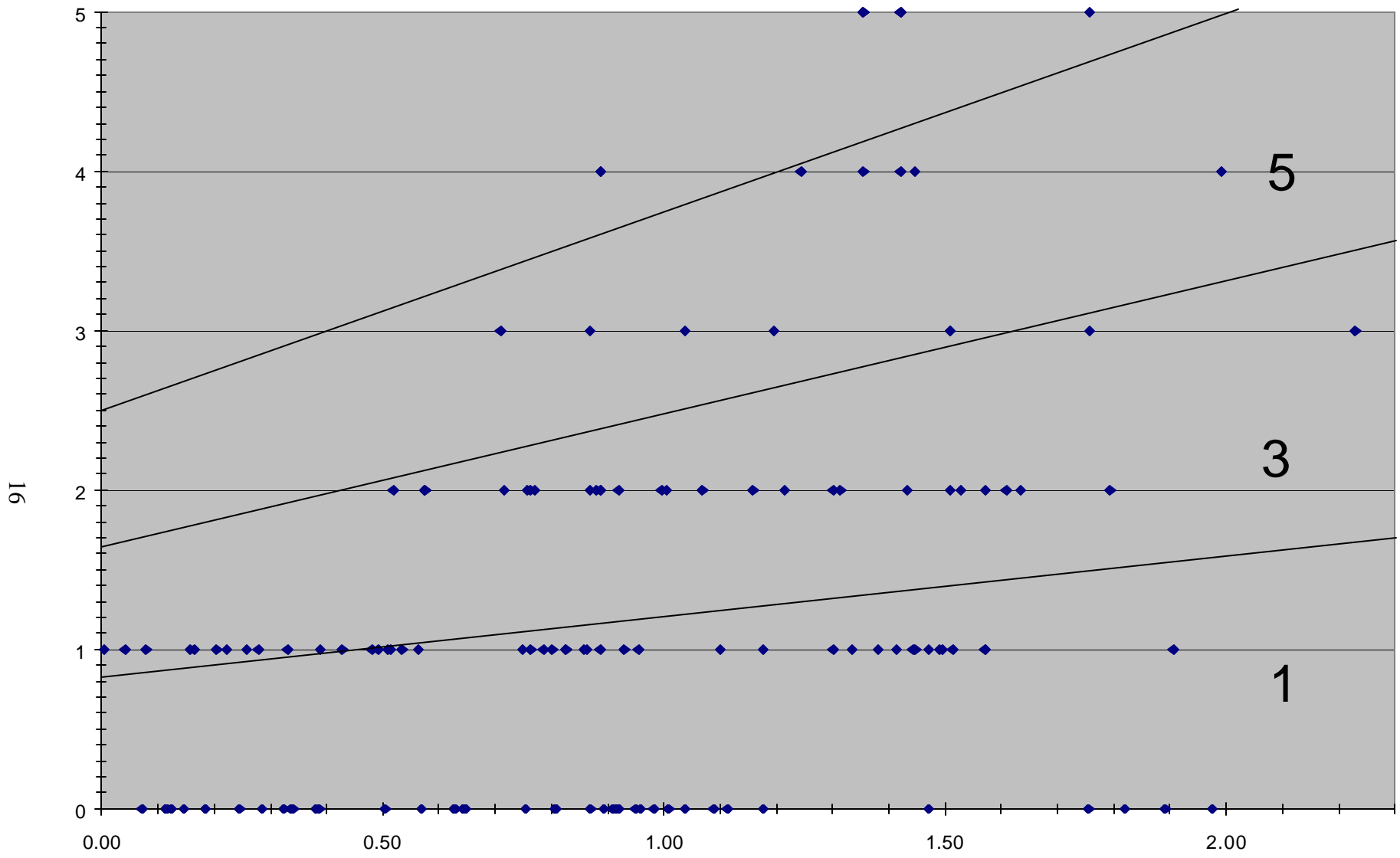
ACF3a – PDT. Number of native sunfish species in headwater streams (<15 square miles drainage basin area) in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 96.



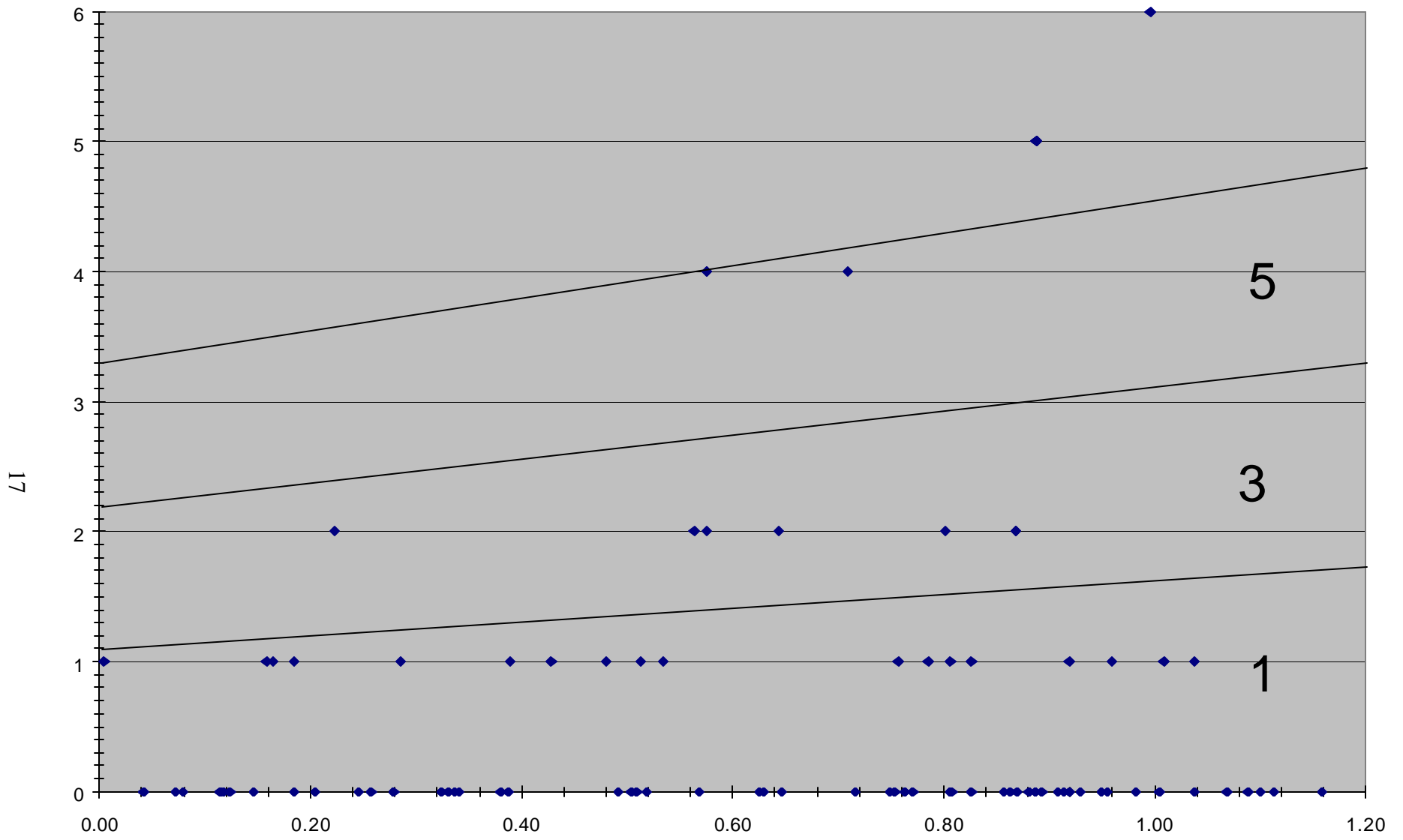
ACF3b – PDT. Number of native centrarchid species in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Flatlines at 50 square miles. Total samples equal 45.



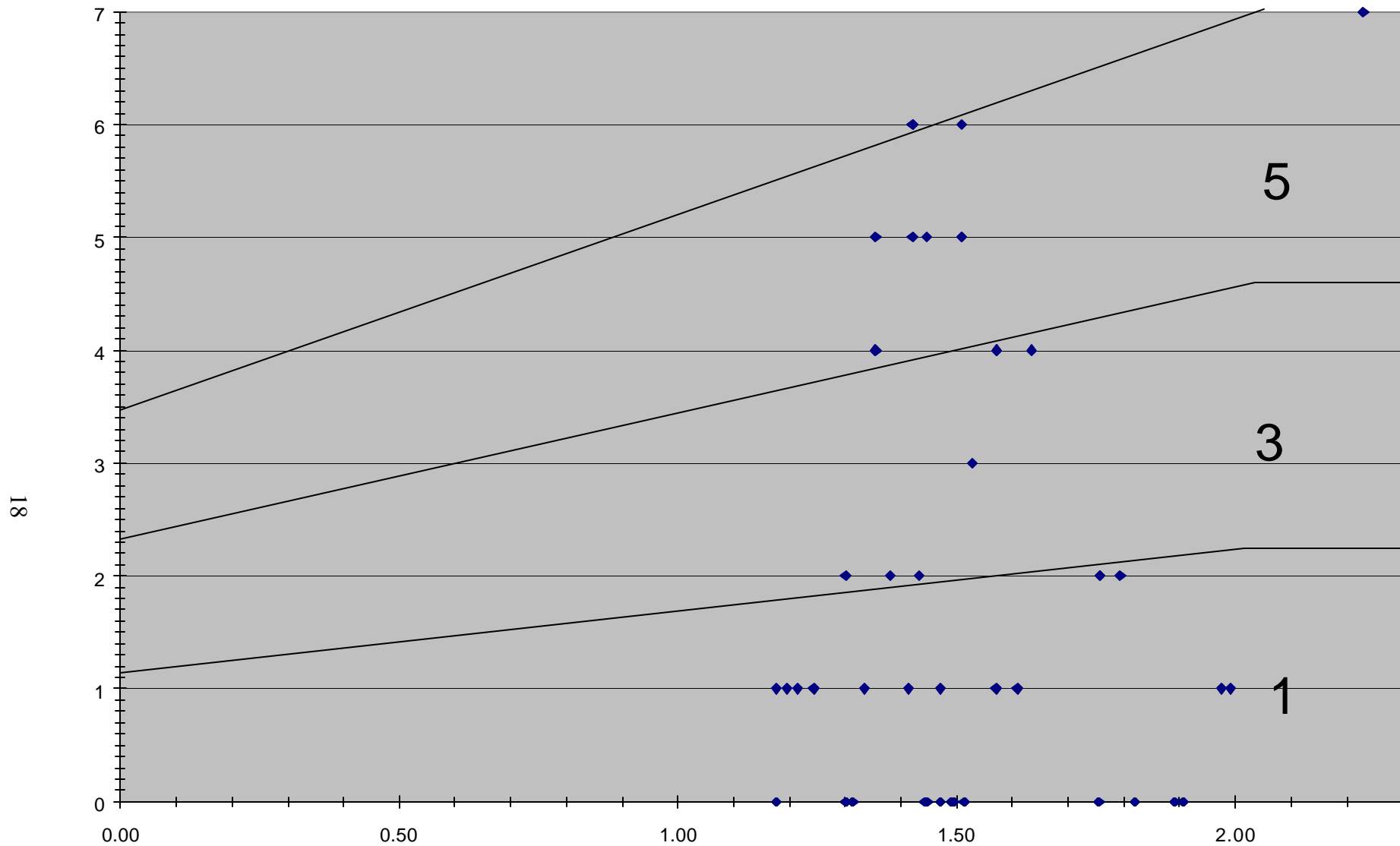
ACF4 – PDT. Number of native insectivorous cyprinid species in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 141.



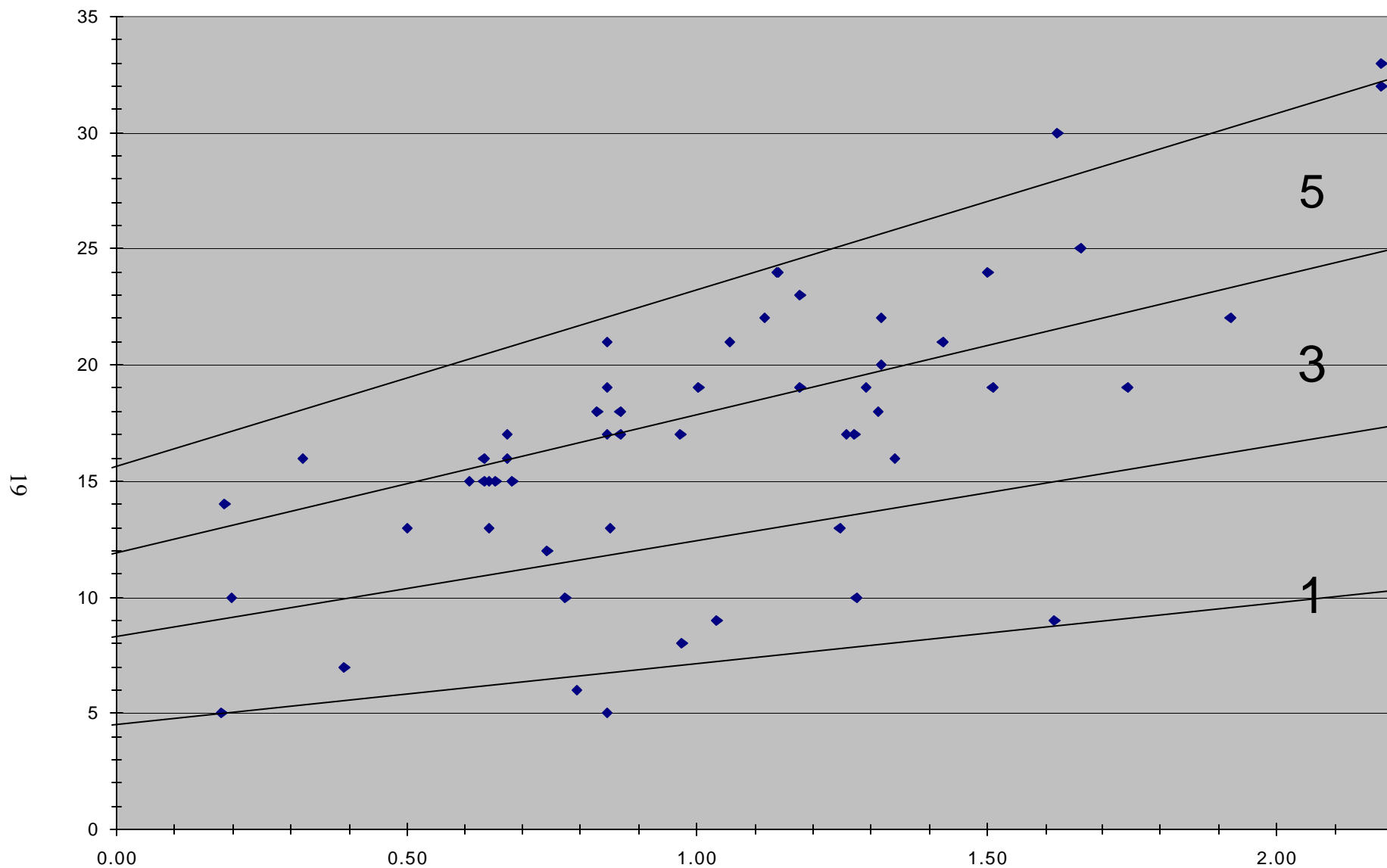
ACF5 – PDT. Number of native round-bodied sucker species in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 141.



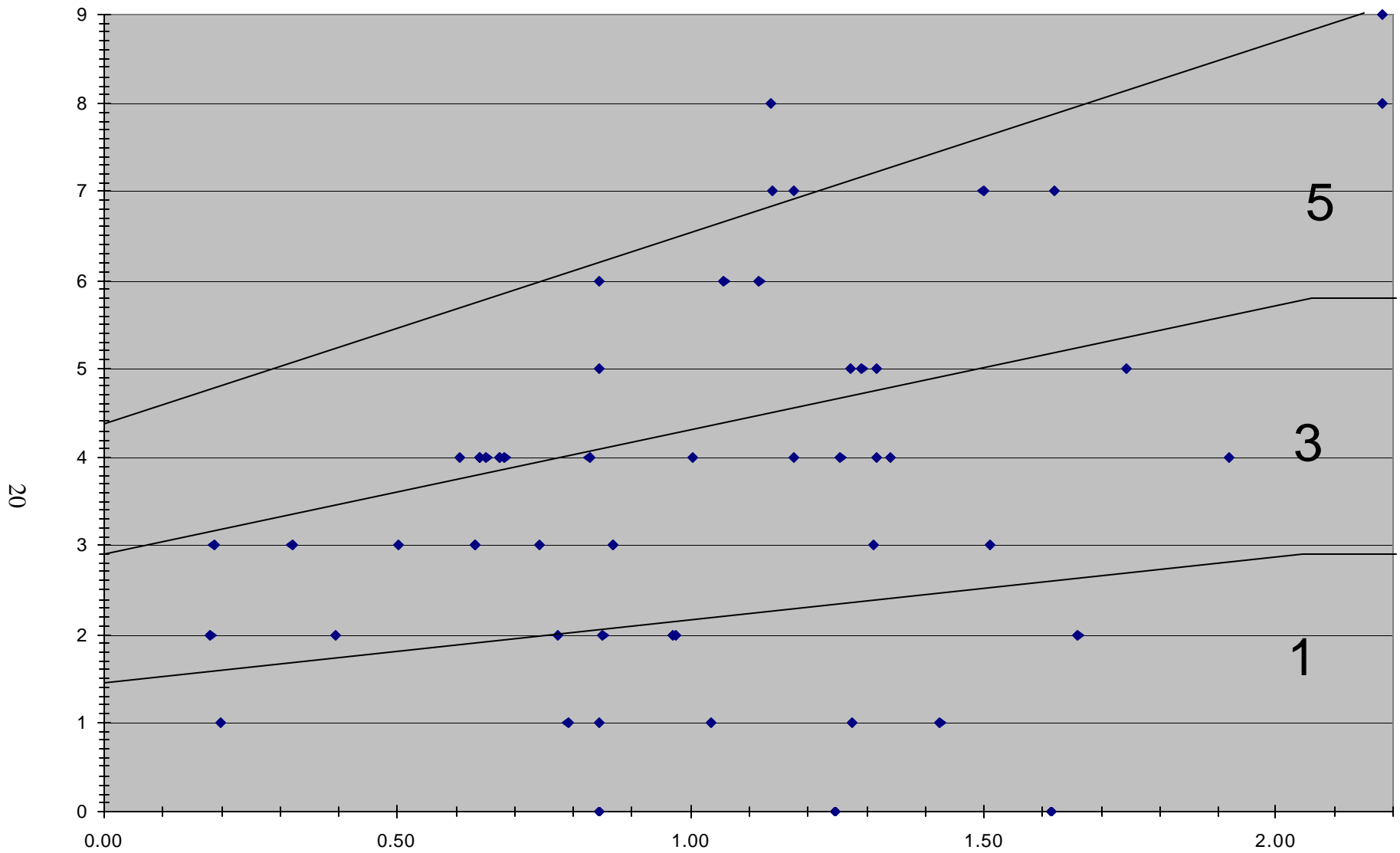
ACF6a – PDT. Total number of species ranked as sensitive at headwater sites (<15 square miles drainage basin area) in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 96.



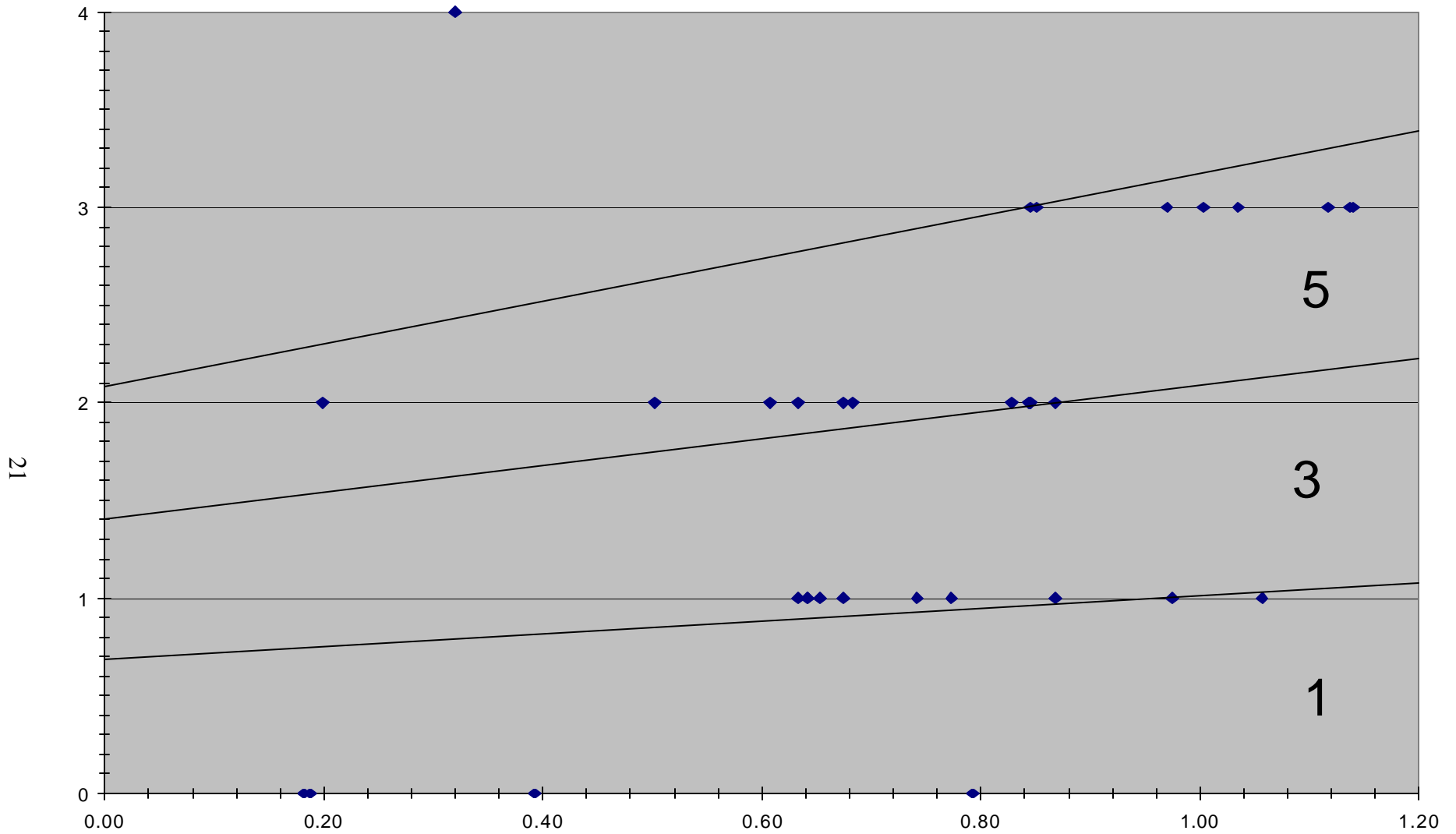
ACF6b – PDT. Number of species ranked as intolerant in the Piedmont ecoregion of the Apalachicola drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Flatlines at 100 square miles. Total samples equal 45.



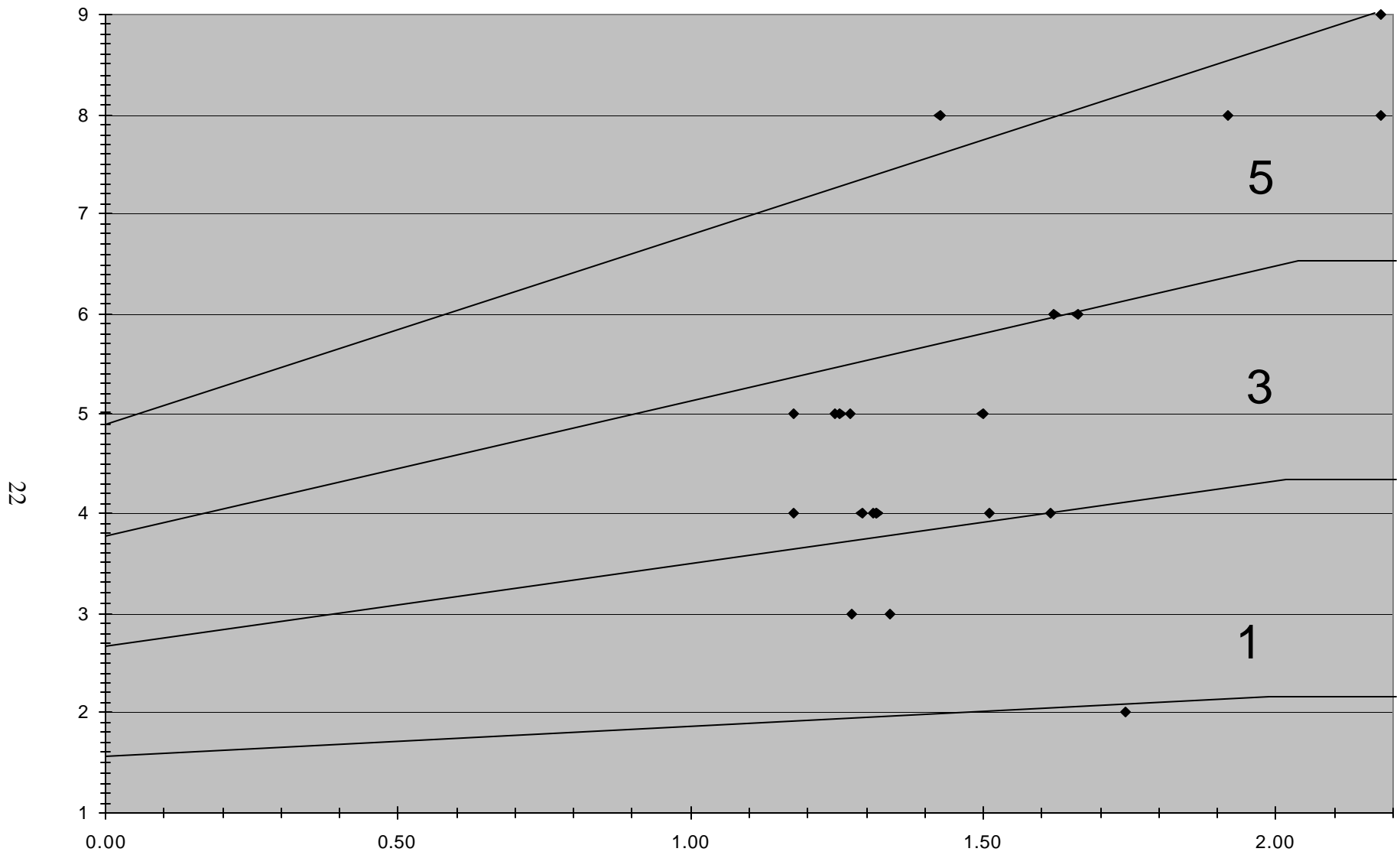
ACT1 – PDT. Total number of native species in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 55.



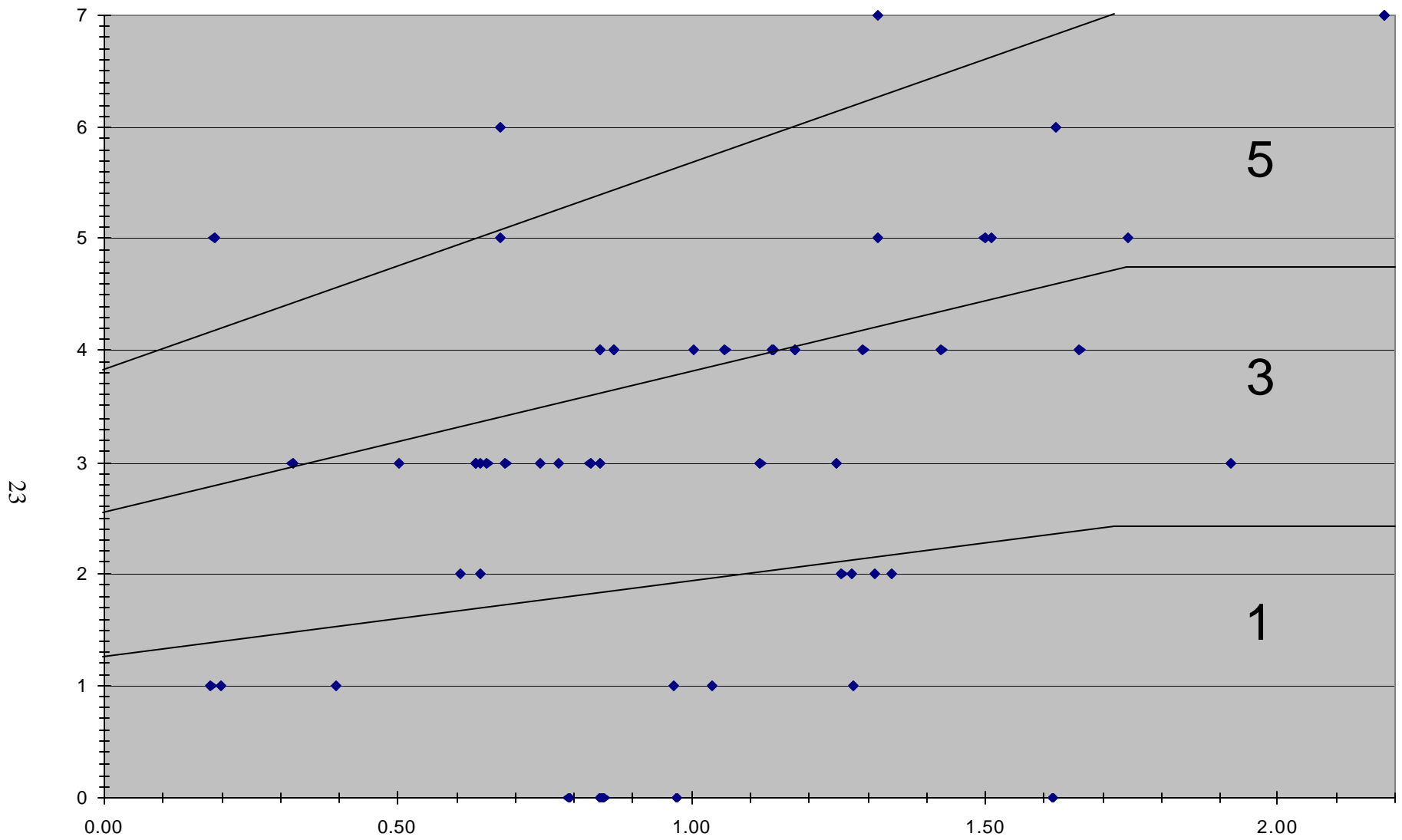
ACT2 – PDT. Number of benthic invertivore species in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Flatlines at 100 square miles. Total samples equal 55.



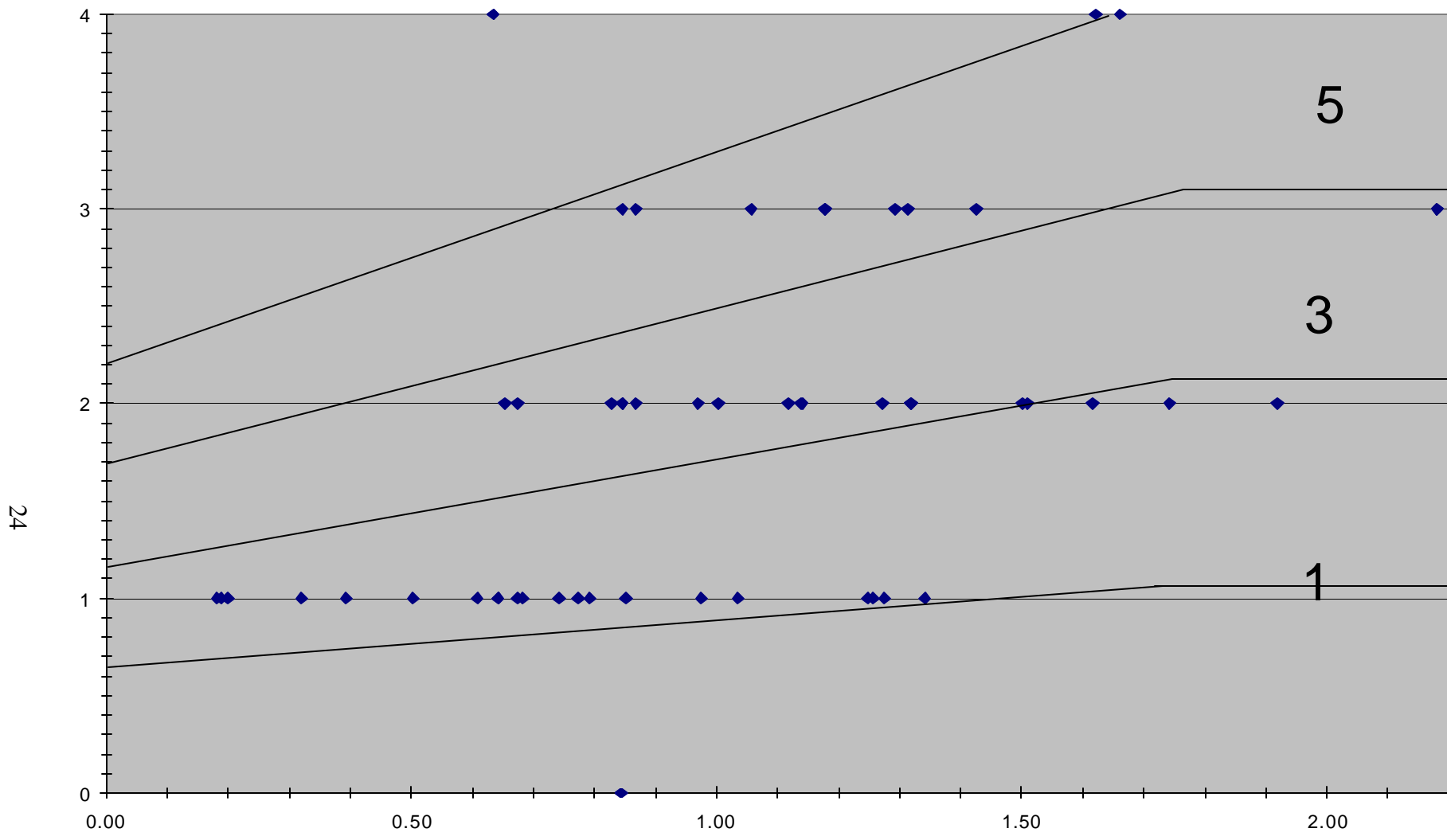
ACT3a – PDT. Number of native sunfish species in headwater streams (<15 square miles drainage basin area) in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 34.



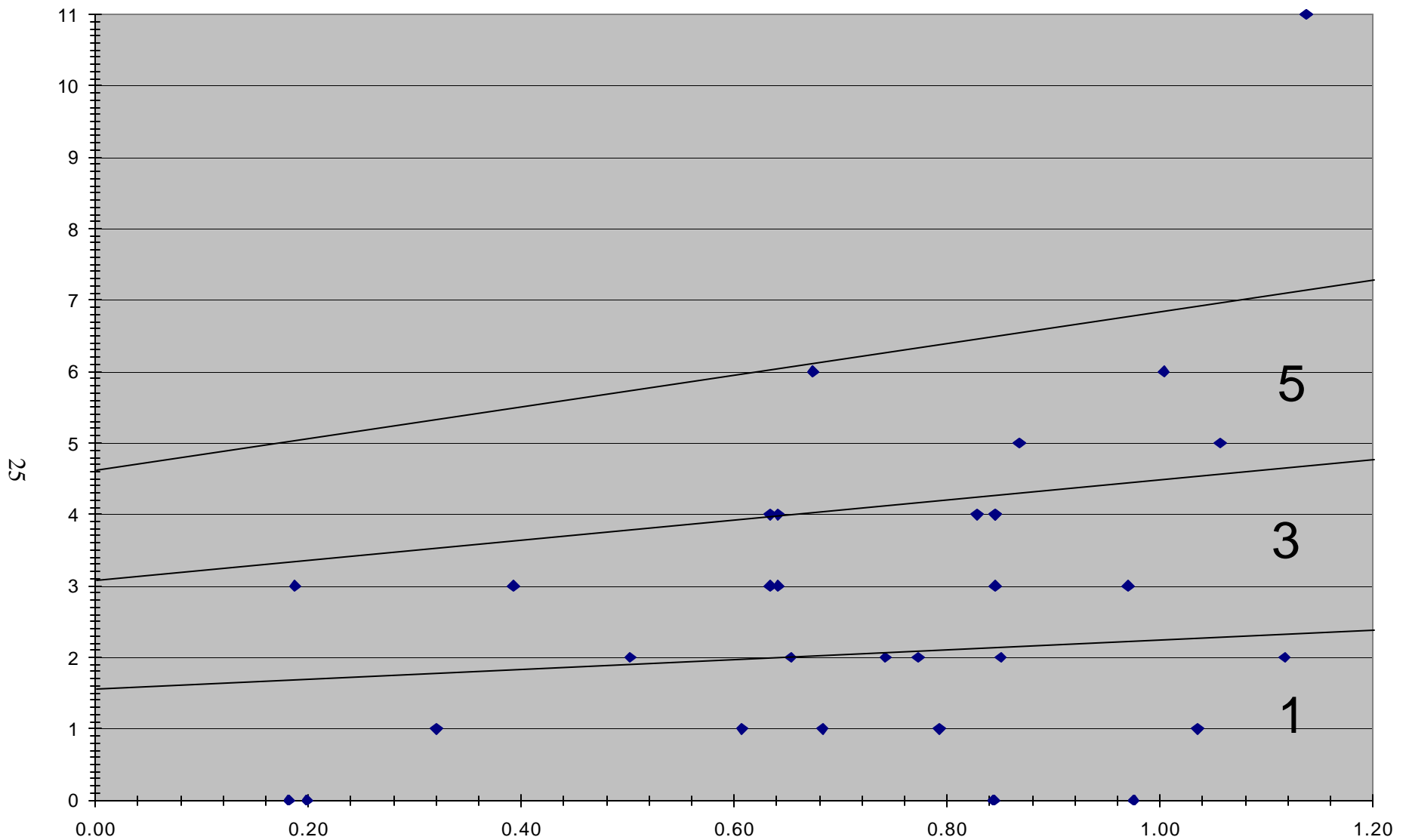
ACT3b – PDT. Number of native centrarchid species in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Flatlines at 100 square miles. Total sites equal 21.



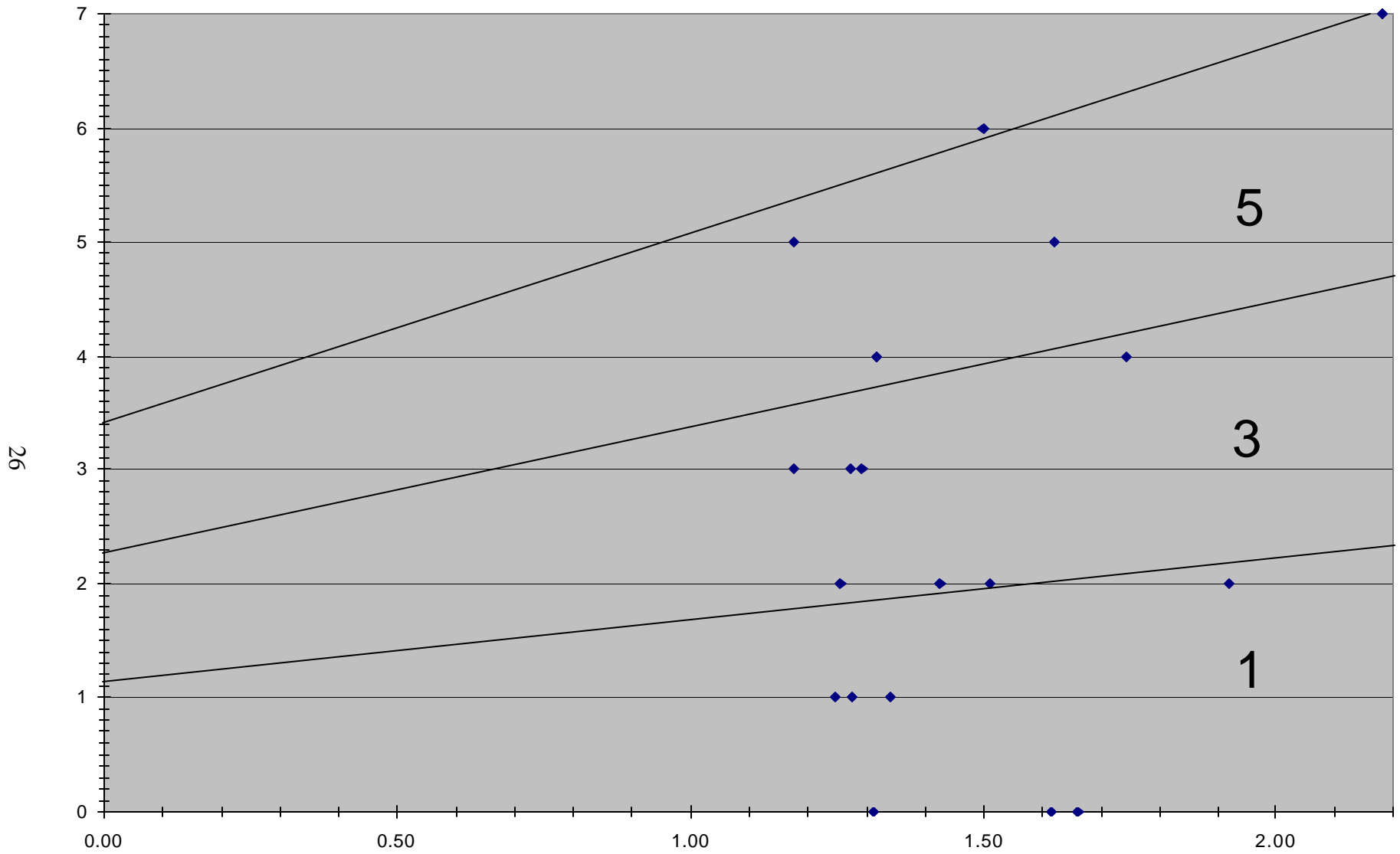
ACT4 – PDT. Number of native insectivorous cyprinid species in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Flatlines at 50 square miles. Total samples equal 55.



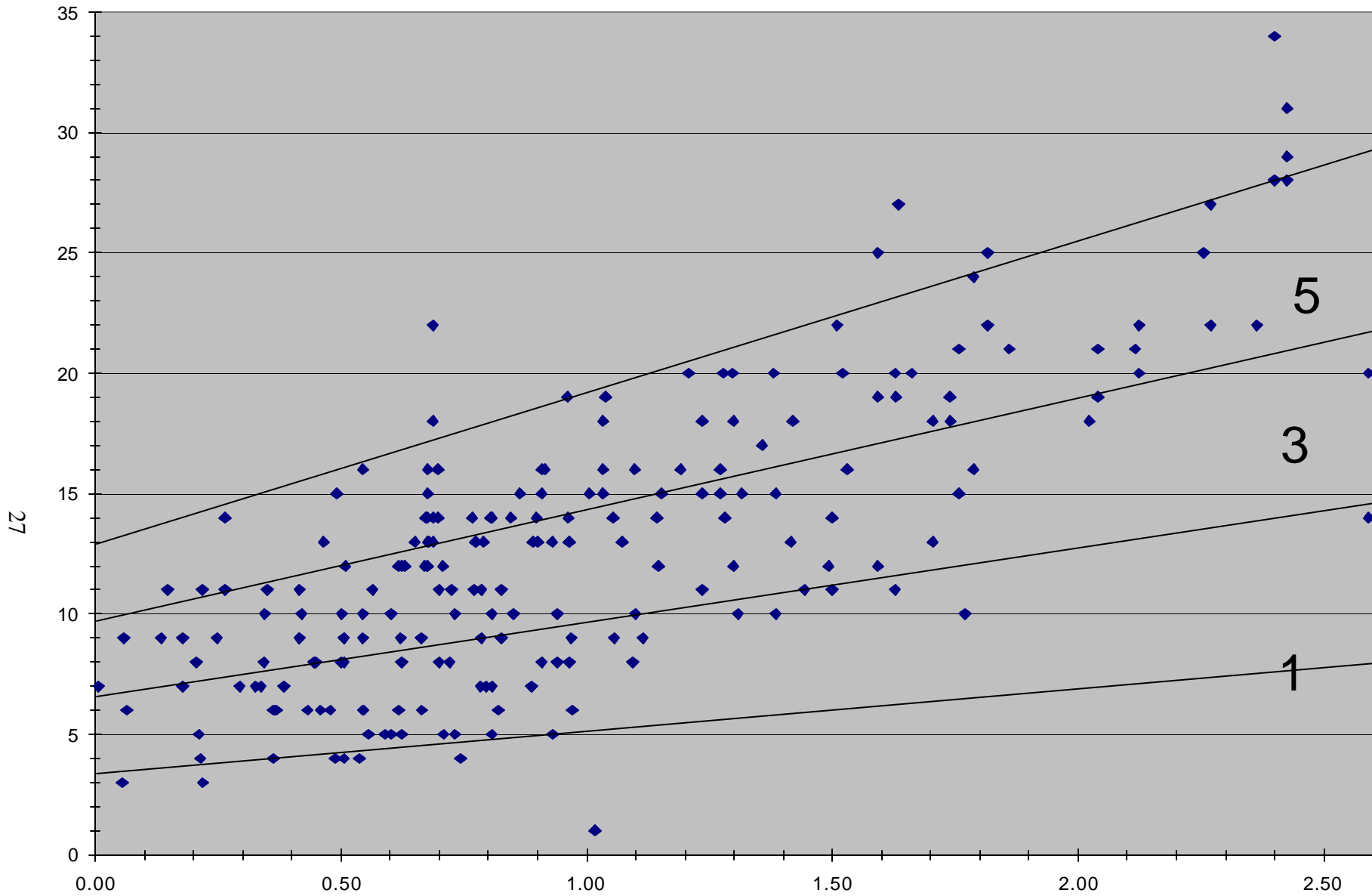
ACT5 – PDT. Number of native round-bodied sucker species in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Flatlines at 50 square miles. Total samples equal 55.



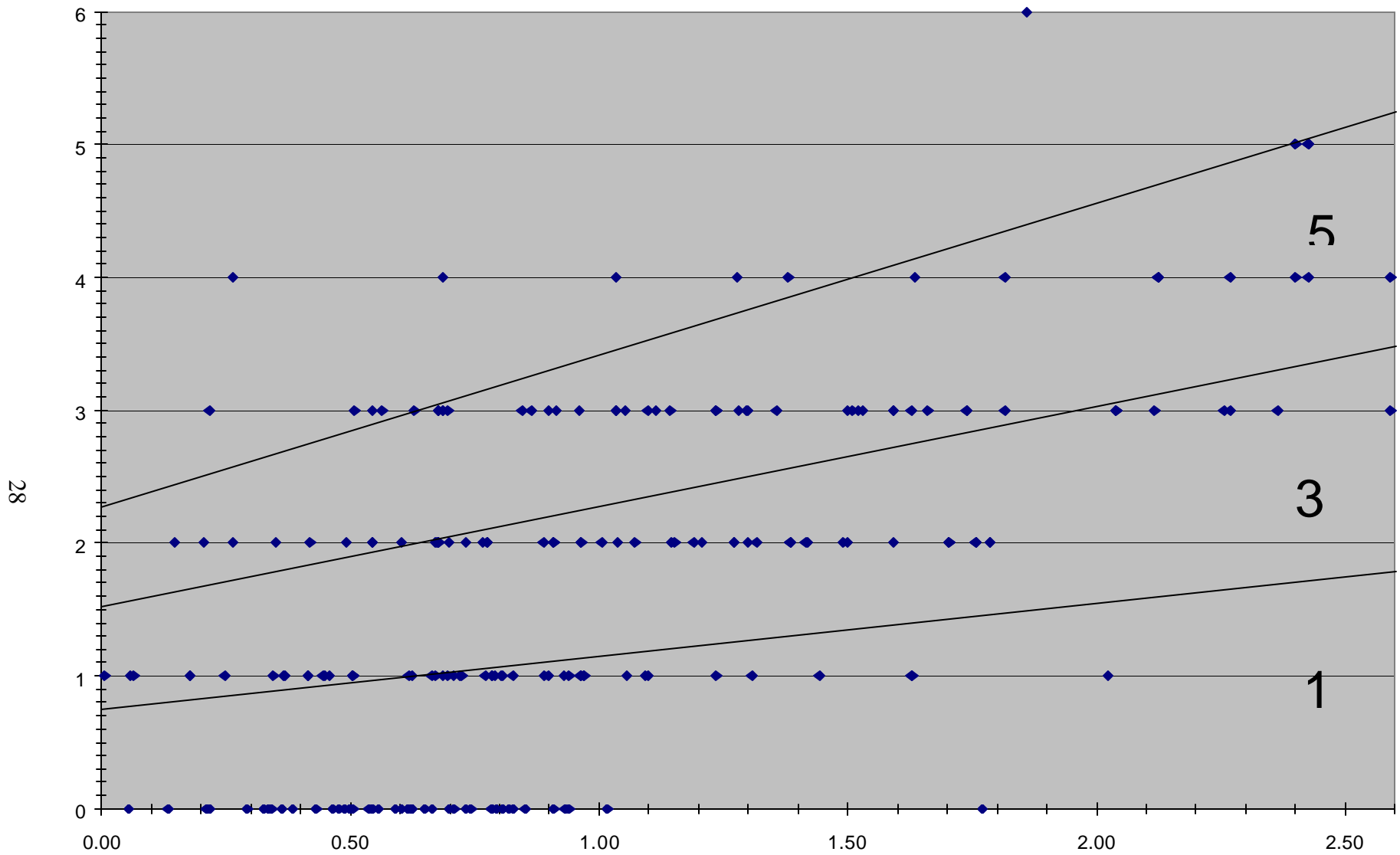
ACT6a – PDT. Total number of species ranked as sensitive at headwater sites (<15 square miles drainage basin area) in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 34.



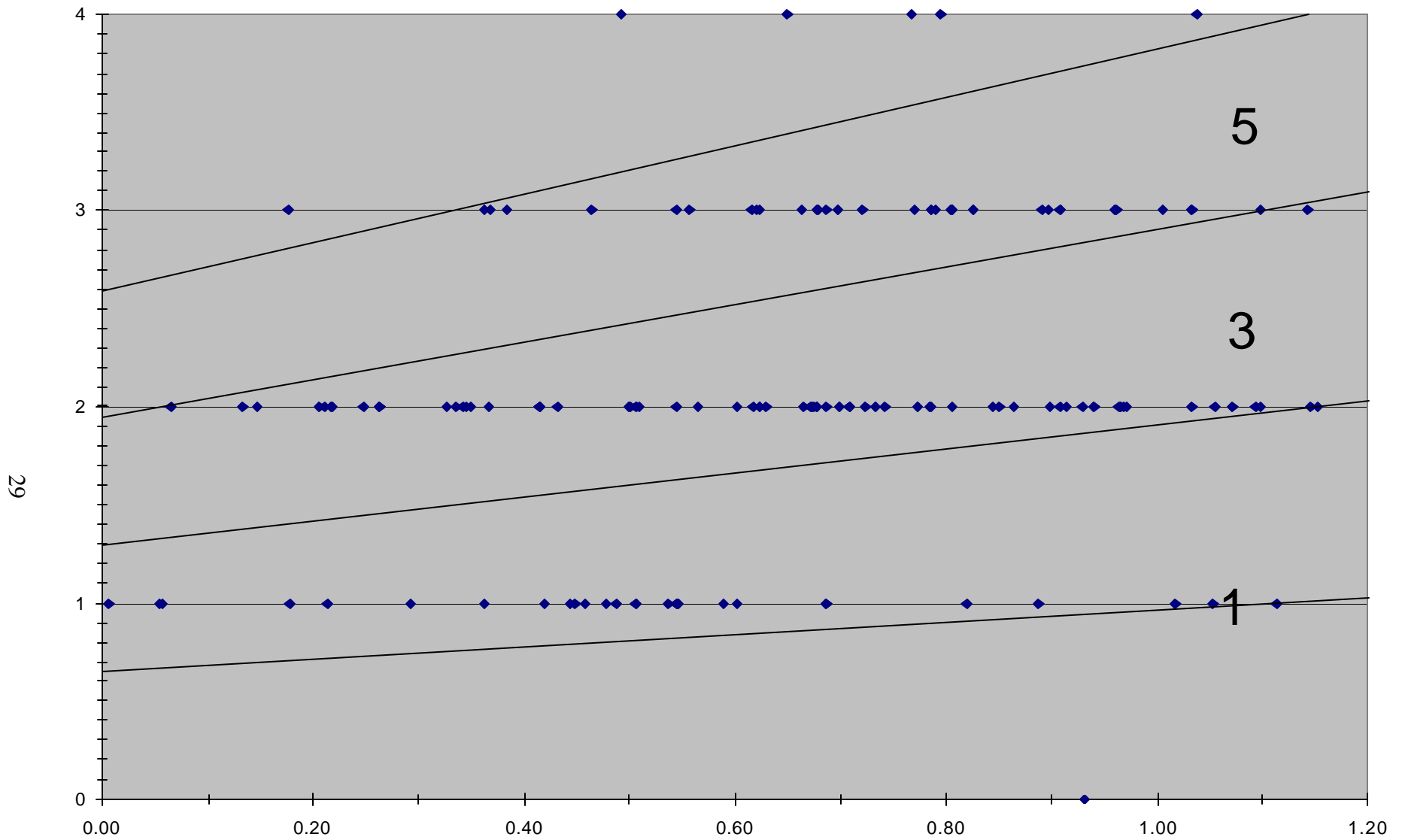
ACT6b – PDT. Number of species ranked as intolerant in the Piedmont ecoregion of the Alabama drainage basin plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 21.



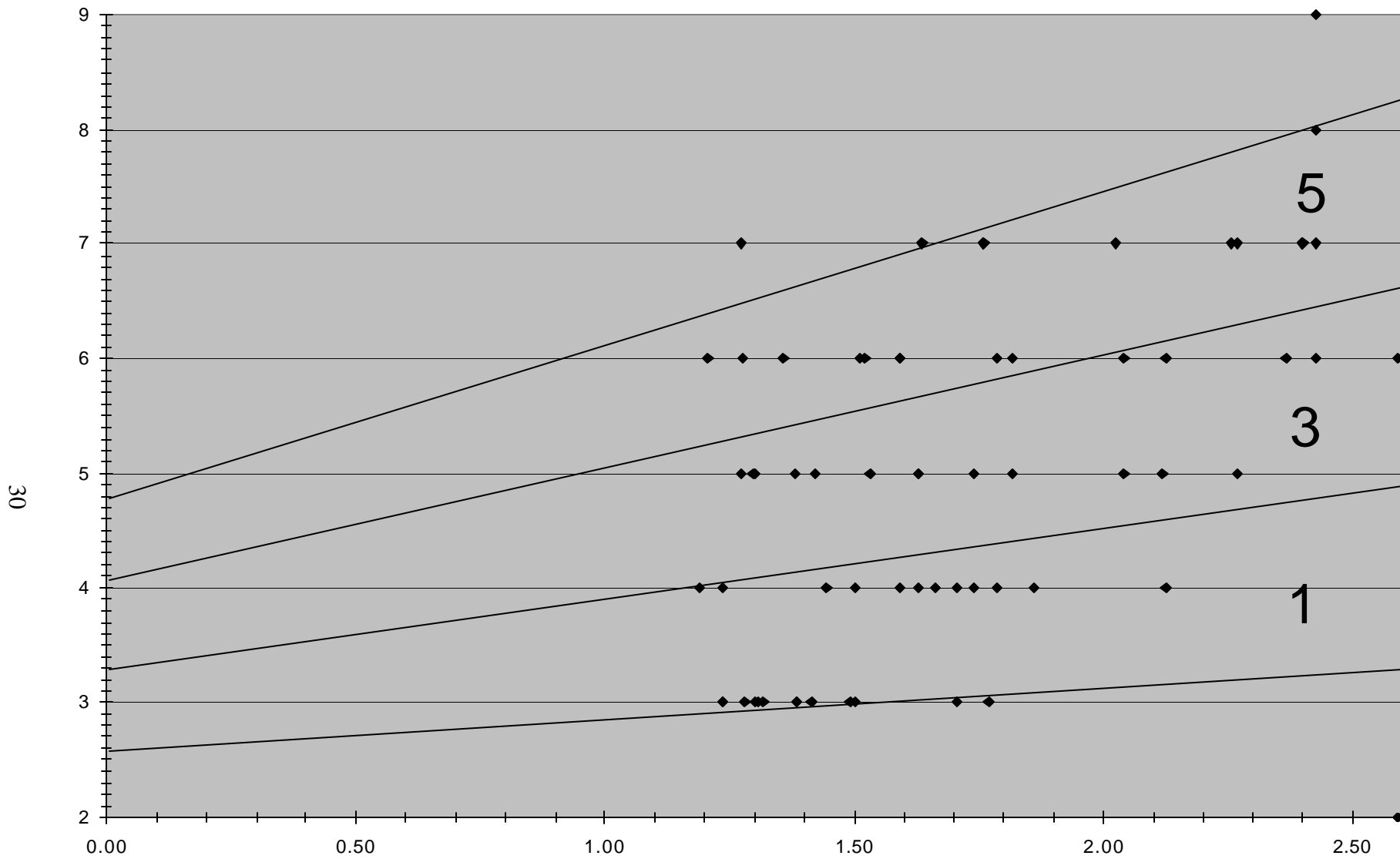
AS1 – PDT. Total number of native species in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 233.



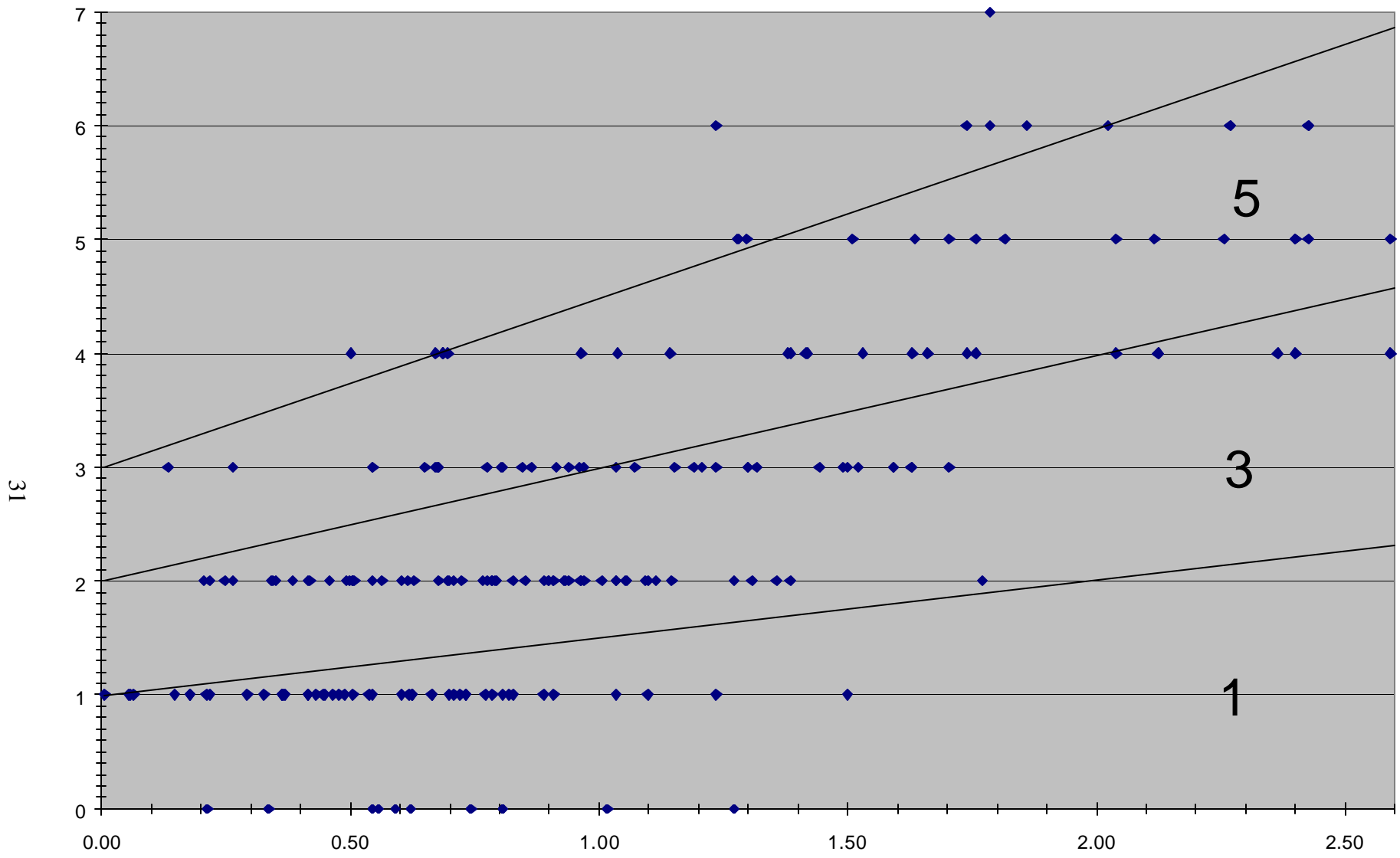
AS2 – PDT. Number of benthic invertivore species in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 233.



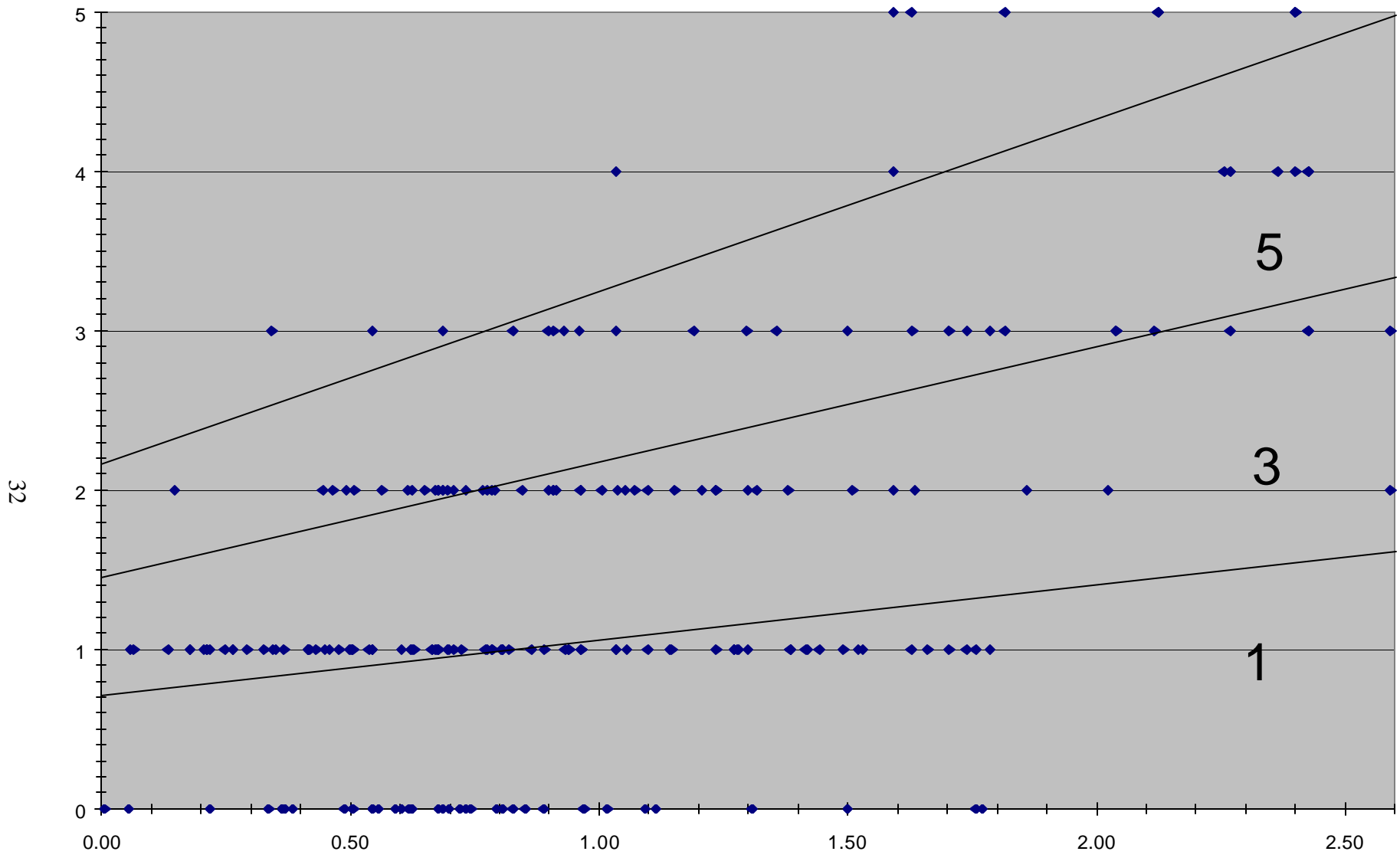
AS3a – PDT. Number of native sunfish species in headwater streams (<15 square miles drainage basin area) in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 167.



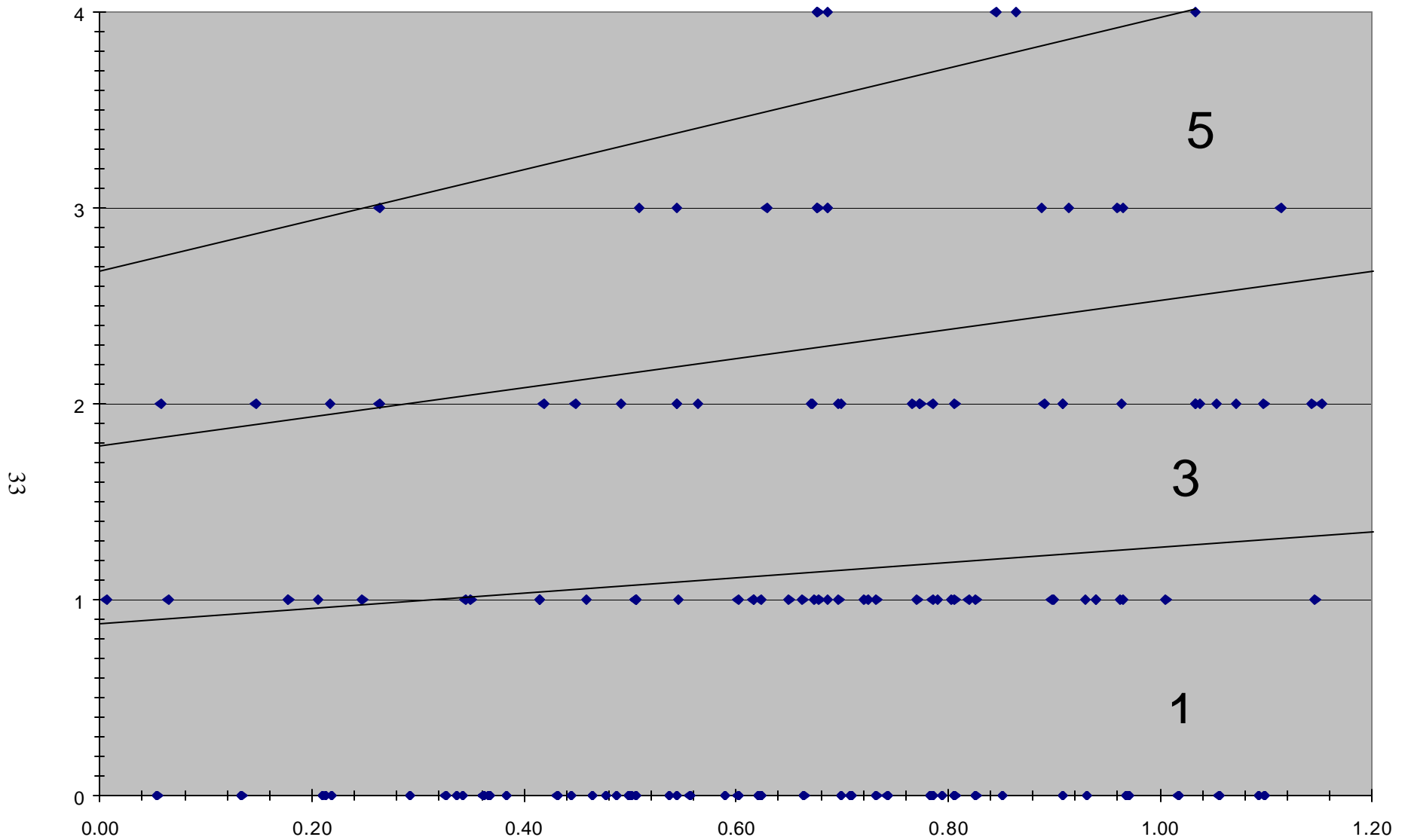
AS3b – PDT. Number of native centrarchid species in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 66.



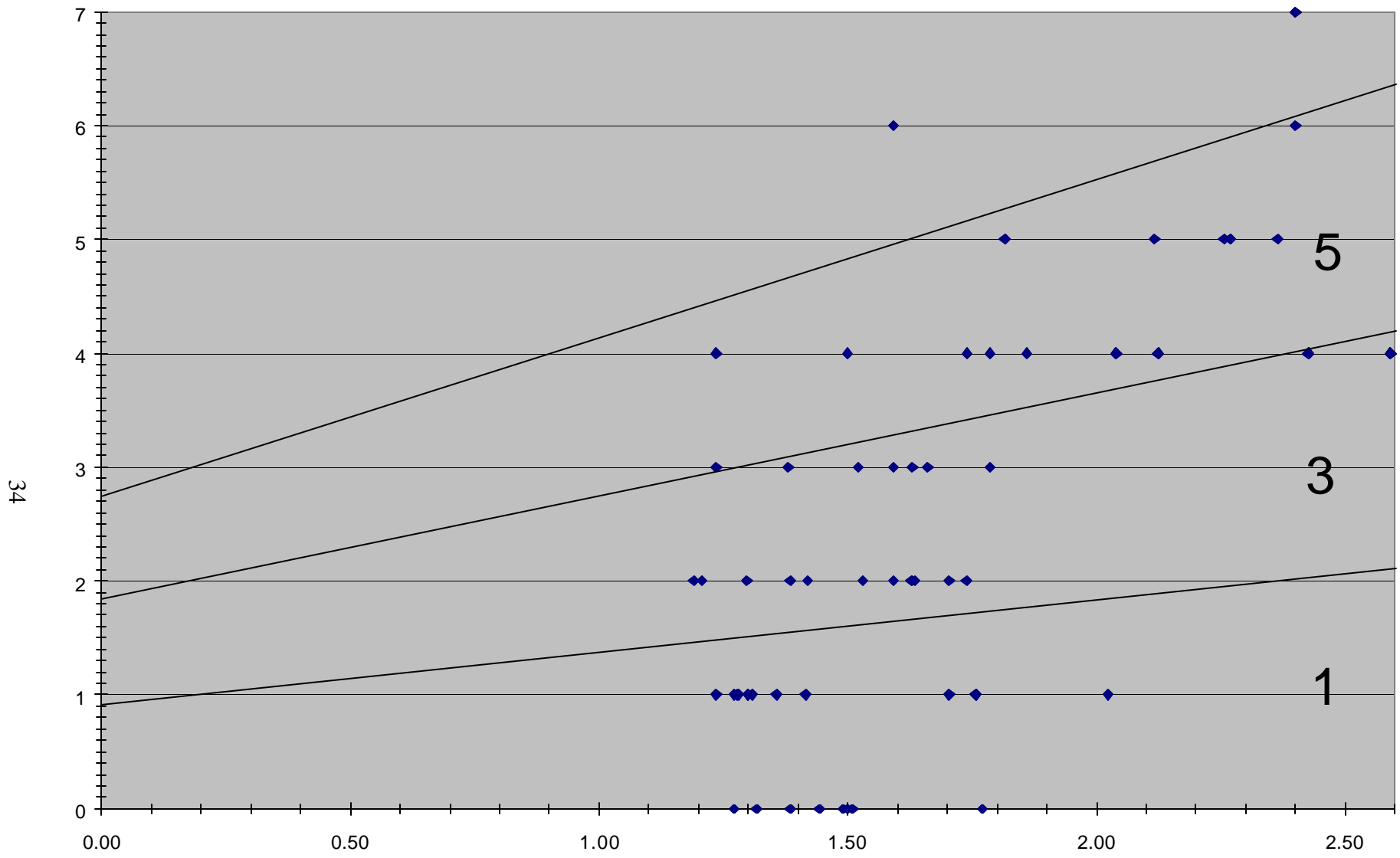
AS4 – PDT. Number of native insectivorous cyprinid species in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin (square miles). Total samples equal 233.



AS5 – PDT. Total number of native round-bodied sucker species in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 233.



AS6a – PDT. Total number of species ranked as sensitive in headwater streams (< 15 square miles drainage basin area) in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 167.



AS6b - PDT. Number of species ranked as intolerant in the Piedmont ecoregion of the Atlantic Slope drainage basins plotted against the log (base 10) transformed value of the drainage basin area (square miles). Total samples equal 66.

Fish List for the Piedmont Ecoregion of Georgia. (Updated May 11, 2005)

Species	Tolerance Ranking	Feeding Guild	Species Category	Drainage Basin
Petromyzontidae				
Chestnut Lamprey <i>Ichthyomyzon castaneus</i>		PR		COO
Southern Brook Lamprey <i>Ichthyomyzon gagei</i>		HB		CHA, COO, FLI, TAL
Least Brook Lamprey <i>Lampetra aepyptera</i>		HB		COO
Lepisosteidae				
Longnose Gar <i>Lepisosteus osseus</i>		CR		CHA, COO, FLI, OCM, OCO, OGE, SAV
Amiidae				
Bowfin <i>Amia calva</i>		CR		CHA, FLI, OCM, OCO, OGE, SAV, TAL
Anguillidae				
American Eel <i>Anguilla rostrata</i>		CR		OCM, OCO, OGE, SAV
Clupeidae				
Blueback Herring <i>Alosa aestivalis</i>		IN		CHA**, OCM, OCO
American shad <i>Alosa sapidissima</i>		IN		OCM, OCO, OGE, SAV
Gizzard Shad <i>Dorosoma cepedianum</i>		GE		CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Threadfin Shad <i>Dorosoma petenense</i>		HB		CHA, COO, FLI, OCM**, OCO**, SAV**

Fish List for the Piedmont Ecoregion of Georgia.

Species	Tolerance Ranking	Feeding Guild	Species Category	Drainage Basin
Cyprinidae				
Largescale Stoneroller <i>Campostoma oligolepis</i>		HB		COO, TAL
Bluefin Stoneroller <i>Campostoma pauciradii</i>		HB		CHA, FLI, OCM, OCO, TAL
Goldfish <i>Carassius auratus</i>		GE		EXOTIC
Rosyside Dace <i>Clinostomus funduloides</i>		IC		SAV
Grass Carp <i>Ctenopharyngodon idella</i>		HB		EXOTIC
Ocmulgee Shiner <i>Cyprinella callisema</i>	INT	IC	SMM	OCM, OCO, OGE
Alabama Shiner <i>Cyprinella callistia</i>	INT	IC	SMM	COO, TAL
Bluestripe Shiner <i>Cyprinella callitaenia</i>	INT	IC	SMM	CHA, FLI
Tallapoosa Shiner <i>Cyprinella gibbsi</i>		IC		TAL
Red Shiner <i>Cyprinella lutrensis</i>		GE		EXOTIC
Whitefin Shiner <i>Cyprinella nivea</i>		IC	SMM	SAV

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Tricolor Shiner <i>Cyprinella trichroistia</i>	INT	IC		COO, TAL
Blacktail shiner <i>Cyprinella venusta</i>		IC		CHA, COO, FLI, OCM, TAL
Altamaha Shiner <i>Cyprinella xaenura</i>	INT	IC		OCM, OCO
Common Carp <i>Cyprinus carpio</i>		GE		EXOTIC
Silverjaw Minnow <i>Ericymba buccata</i>		IN	IC	CHA, COO, FLI, OCM, OCO
Eastern Silvery Minnow <i>Hybognathus regius</i>	INT	HB		OCM, OCO, OGE, SAV
Lined Chub <i>Hybopsis lineapunctata</i>		IC	SMM	COO, TAL
Rosyface Chub <i>Hybopsis rubrifrons</i>		IC	SMM	OCM, OCO, OGE, SAV
Coastal Chub <i>Hybopsis sp.</i>	INT	IC	SMM	CHA, COO, FLI
Striped Shiner <i>Luxilus chrysocephalus</i>		IC		COO, TAL
Bandfin Shiner <i>Luxilus zonistius</i>		IC		CHA, COO**, FLI, OCO, TAL**
Blacktip Shiner <i>Lythrurus atrapiculus</i>	INT	IC		CHA, FLI

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Pretty Shiner <i>Lythrurus bellus</i>	INT	IC		TAL
Speckled Chub <i>Macrhybopsis aestivalis</i>		IC	SMM	COO, TAL
Bluehead Chub <i>Nocomis leptocephalus</i>		GE		CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
River Chub <i>Nocomis micropogon</i>		IC	SMM	COO**, SAV**
Golden Shiner <i>Notemigonus crysoleucas</i>		GE		CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Rough Shiner <i>Notropis baileyi</i>		IC		CHA**
Rainbow Shiner <i>Notropis chrosomus</i>	HWI	IC		COO
Dusky Shiner <i>Notropis cummingsae</i>		IC		FLI, OCM, OCO, OGE, SAV
Spottail Shiner <i>Notropis hudsonius</i>		IC	SMM	CHA, FLI, OCM, OCO, OGE, SAV
Highscale Shiner <i>Notropis hypsilepis</i>		IC	SMM	CHA, FLI
Longnose Shiner <i>Notropis longirostris</i>		IC	SMM	CHA, COO, FLI, OCM
Yellowfin Shiner <i>Notropis lutipinnis</i>		IC		CHA, COO, FLI, OCM, OCO, OGE, SAV

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Coastal Shiner <i>Notropis petersoni</i>		IC		OCM, OCO, OGE, SAV
Sandbar Shiner <i>Notropis scepticus</i>	INT	IC		SAV
Silverstripe Shiner <i>Notropis stilbius</i>	INT	IC		COO, TAL
Weed shiner <i>Notropis texanus</i>		IC		CHA, FLI, OCM, TAL
Coosa Shiner <i>Notropis xaenocephalus</i>		IC		COO
Pugnose Minnow <i>Opsopoeodus emiliae</i>	INT	IC		FLI
Rifle Minnow <i>Phenacobius catostomus</i>		IC	SMM	COO, TAL
Fathead Minnow <i>Pimephales promelas</i>		GE		EXOTIC
Bullhead Minnow <i>Pimephales vigilax</i>		GE		COO, TAL
Sailfin Shiner <i>Pteronotropis hypselopterus</i>		IC		OCO
Creek Chub <i>Semotilus atromaculatus</i>		GE		CHA, COO, OCM, OCO, OGE, SAV, TAL

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Dixie Chub <i>Semotilus thoreauianus</i>		GE		CHA, FLI, TAL
Catostomidae				
White Sucker <i>Catostomus commersoni</i>		IN	RBS	CHA**
Creek Chubsucker <i>Erimyzon oblongus</i>		IN	RBS	CHA, FLI, OCM, OCO, OGE, SAV
Alabama Hogsucker <i>Hypentelium etowanum</i>		IN	RBS	CHA, COO, TAL
Northern Hogsucker <i>Hypentelium nigricans</i>		IN	RBS	OCO, SAV
Spotted Sucker <i>Minytrema melanops</i>		IN	RBS	CHA, COO, FLI, OCM, OCO, OGE, SAV
V-lip Redhorse <i>Moxostoma collapsum</i>	INT	IN	RBS	OCM, OCO, OGE, SAV
Black Redhorse <i>Moxostoma duquesnei</i>		IN	RBS	COO, TAL
Golden Redhorse <i>Moxostoma erythrurum</i>		IN	RBS	COO, TAL
Blacktail Redhorse <i>Moxostoma poecilurum</i>		IN	RBS	COO, TAL
Robust Redhorse <i>Moxostoma robustum</i>		IN	RBS	OCO, OGE, SAV

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Apalachicola Redhorse <i>Moxostoma</i> sp.	INT	IN	RBS	CHA, FLI
Greater Jumprock <i>Scartomyzon lachneri</i>	INT	IN	RBS	CHA, FLI
Striped Jumprock <i>Scartomyzon rupiscartes</i>		IN	RBS	CHA, FLI, OCM, OCO, OGE, SAV
Brassy Jumprock <i>Scartomyzon</i> sp.	INT	IN	RBS	OCM, OCO, OGE, SAV
Ictaluridae Snail Bullhead <i>Ameiurus brunneus</i>		GE		CHA, COO, FLI, OCM, OCO, OGE, SAV
White Catfish <i>Ameiurus catus</i>		GE		CHA, FLI, OCM, OCO, OGE, SAV
Black Bullhead <i>Ameiurus melas</i>		GE		CHA**, COO, TAL
Yellow Bullhead <i>Ameiurus natalis</i>		GE		CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Brown Bullhead <i>Ameiurus nebulosus</i>		GE		CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Flat Bullhead <i>Ameiurus platycephalus</i>		GE		OCM, OCO, OGE, SAV, TAL**
Blue Catfish <i>Ictalurus furcatus</i>		CR		OCO**, SAV**

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Channel Catfish <i>Ictalurus punctatus</i>		GE		CHA, COO, FLI, OCM**, OCO**, OGE**, SAV**, TAL
Black Madtom <i>Noturus funebris</i>	INT	IN	BI	CHA, TAL
Tadpole Madtom <i>Noturus gyrinus</i>	HWI	IN	BI	OCM, OCO, OGE, SAV
Margined Madtom <i>Noturus insignis</i>	INT	IN	BI	OCM, OCO, OGE, SAV
Speckled Madtom <i>Noturus leptacanthus</i>	HWI	IN	BI	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Frecklebelly Madton <i>Noturus munitus</i>		IN	BI	COO
Flathead Catfish <i>Pylodictis olivaris</i>		CR		COO, FLI**, OCM**, OCM**, OGE**, SAV**
Esocidae				
Redfin Pickerel <i>Esox americanus</i>		CR		CHA, FLI, OCM, OCO, OGE, SAV, TAL
Chain Pickerel <i>Esox niger</i>		CR		CHA, COO, FLI, OCM, OCO, OGE, SAV
Salmonidae				
Rainbow Trout <i>Oncorhynchus mykiss</i>		CR		EXOTIC
Brown Trout <i>Salmo trutta</i>		CR		EXOTIC

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Aphredoderidae Pirate Perch <i>Aphredoderus sayanus</i>		IN		FLI, OCM, OCO, OGE, SAV
Fundulidae Stippled Studfish <i>Fundulus bifax</i>		IN		TAL
Blackspotted Topminnow <i>Fundulus olivaceus</i>		IN		CHA, COO, TAL
Southern Studfish <i>Fundulus stellifer</i>	HWI	IN		CHA, COO
Poeciliidae Mosquitofish <i>Gambusia sp.</i>		GE		CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Atherinidae Brook Silversides <i>Labidesthes sicculus</i>		IN		CHA, FLI, OCM, OCO, OGE, SAV
Cottidae Mottled Sculpin <i>Cottus bairdi</i>		IN	BI	COO
Banded Sculpin <i>Cottus carolinae</i>		IN	BI	CHA, COO, TAL
Percichthyidae White Bass <i>Morone chrysops</i>		CR		CHA**, COO**, FLI**, OCM**, OCO**, SAV**
Striped Bass <i>Morone saxatilis</i>		CR		CHA, COO, FLI, OCM, OCO, OGE, SAV

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Centrarchidae				
Shadow Bass <i>Ambloplites ariommus</i>	INT	CR	SF	CHA, COO, FLI, TAL
Flier <i>Centrarchus macropterus</i>		IN	SF	CHA, FLI, OCM, OCO, OGE, SAV
Redbreast Sunfish <i>Lepomis auritus</i>		IN	SF	CHA, COO**, FLI, OCM, OCO, OGE, SAV, TAL**
Green Sunfish <i>Lepomis cyanellus</i>		IN	SF	CHA**, COO, FLI**, OCM**, OCO**, OGE**, SAV**, TAL
Pumpkinseed <i>Lepomis gibbosus</i>		IN	SF	SAV
Warmouth <i>Lepomis gulosus</i>		CR	SF	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Bluegill <i>Lepomis macrochirus</i>		IN	SF	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Dollar Sunfish <i>Lepomis marginatus</i>		IN	SF	CHA, OGE, SAV
Longear Sunfish <i>Lepomis megalotis</i>		IN	SF	CHA**, COO, OCM**, OCO**, SAV**, TAL
Redear Sunfish <i>Lepomis microlophus</i>		IN	SF	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Spotted Sunfish <i>Lepomis punctatus</i>		IN	SF	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Shoal Bass <i>Micropterus cataractae</i>	INT	CR	CENT	CHA, FLI, OCM**

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Redeye Bass <i>Micropterus coosae</i>	HWI	CR	CENT	CHA, COO, OCM, OCO, OGE, SAV, TAL
Spotted Bass <i>Micropterus punctulatus</i>		CR	CENT	CHA**, COO, FLI**, OCO**, OCM**, TAL
Largemouth Bass <i>Micropterus salmoides</i>		CR	CENT	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
White Crappie <i>Pomoxis annularis</i>		CR		CHA**, COO, FLI**, OCM**, OCO**, OGE**, SAV**
Black Crappie <i>Pomoxis nigromaculatus</i>		CR	CENT	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Percidae				
Holiday Darter <i>Etheostoma brevirostrum</i>		IN	BI	COO
Lipstick Darter <i>Etheostoma chuckwachatte</i>	INT	IN	BI	TAL
Coosa Darter <i>Etheostoma coosae</i>		IN	BI	COO
Etowah Darter <i>Etheostoma etowahae</i>	INT	IN	BI	COO
Swamp Darter <i>Etheostoma fusiforme</i>		IN	BI	FLI, OCM, OCO, SAV
Christmas Darter <i>Etheostoma hopkinsi</i>	HWI	IN	BI	OCM, OCO, OGE, SAV

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Turquoise Darter <i>Etheostoma inscriptum</i>	HWI	IN	BI	OCM, OCO, OGE, SAV
Greenbreast Darter <i>Etheostoma jordani</i>	INT	IN	BI	COO
Tessellated Darter <i>Etheostoma olmstedi</i>	INT	IN	BI	OCM, OCO, OGE, SAV
Goldstripe Darter <i>Etheostoma parvipinne</i>		IN	BI	CHA, FLI, OCM
Rock Darter <i>Etheostoma rupestre</i>		IN	BI	COO
Cherokee Darter <i>Etheostoma scotti</i>	HWI	IN	BI	COO
Speckled Darter <i>Etheostoma stigmaeum</i>	INT	IN	BI	COO, TAL
Gulf Darter <i>Etheostoma swaini</i>	INT	IN	BI	CHA, FLI
Tallapoosa Darter <i>Etheostoma tallapoosae</i>		IN	BI	TAL
Trispot Darter <i>Etheostoma trisella</i>		IN	BI	COO
Amber Darter <i>Percina antesella</i>		IN	BI	COO
Mobile Logperch <i>Percina kathae</i>	INT	IN	BI	COO, TAL

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Species	Tolerance Ranking	Feeding Guild	Species Category	Drainage Basin
Freckled Darter <i>Percina lenticula</i>		IN	BI	COO
Blackbanded Darter <i>Percina nigrofasciata</i>		IN	BI	CHA, COO, FLI, OCM, OCO, OGE, SAV, TAL
Bronze Darter <i>Percina palmaris</i>	HWI	IN	BI	COO, TAL
Upland Bridled Darter <i>Percina</i> sp.		IN	BI	COO
Muscadine Bridled Darter <i>Percina</i> sp.		IN	BI	TAL
Yellow perch <i>Perca flavescens</i>		CR		EXOTIC
Sauger <i>Stizostedion canadense</i>		CR		CHA**, SAV**
Walleye <i>Stizostedion vitreum</i>		CR		CHA**, COO, OCO**, SAV**
Sciaenidae Freshwater Drum <i>Aplodinotus grunniens</i>		CR		COO

Water Quality Tolerance: **HWI** = headwater intolerant; **INT** = intolerant
 Feeding Guild: **CR** = top carnivore; **GE** = generalist; **HB** = herbivore; **IC** = insectivorous cyprinid; **IN** = insectivore/invertivore; **PR** = parasitic
 Species Category: **BI** = benthic insectivore species; **CENT** = centrarchid species; **RBS** = round-bodied sucker species; **SF** = sunfish species; **SMM** = subterminal mouth minnow species;
 Drainage Basin: **CHA** = Chattahoochee; **COO** = Coosa; **FLI** = Flint; **OCM** = Ocmulgee; **OCO** = Oconee; **OGE** = Ogeechee; **SAV** = Savannah; **TAL** = Tallapoosa
EXOTIC = introduced to Georgia; ** = species introduced to that drainage basin