

Assessment of Lake Gaston Hydrilla Management Efforts in 2005



A Final Report to the Lake Gaston Weed Control Council

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Introduction

Lake Gaston is a 20,300-acre reservoir on the Roanoke River located on the Virginia-North Carolina border. Hydrilla has spread rapidly in Lake Gaston since its introduction in the early 1980's, with little decline in its spread (Madsen and Owens 2000). Madsen and others (2000) estimated that hydrilla was found in 24% of the lake, or 4,900 acres. If hydrilla colonized a maximum depth of 10 feet, the total potential acreage would have been 5,000 acres. Since 2000, hydrilla has colonized waters as deep as 15 feet, which would include 40% of the lake or a total of 8,120 acres.

Regular assessment of management effectiveness is a significant component of successful long-term maintenance management programs. I was asked by the Lake Gaston Weed Board to evaluate the success of fluridone (SONAR[®]) treatments to control monoecious hydrilla in Lake Gaston. Aquatic Nuisance Plant Control, Inc. of Littleton, NC, performed treatments.

I specifically looked for effectiveness of cove treatments in the year of treatment, and attempted to apply simple metrics for evaluation.

Methods

A total of sixteen sites were evaluated during 31 October to 1 November 2005 (Figure 1), and are listed in Table 1. Ten of the sites (1-10) were treatments performed during 2005, two sites were treated in 2004, one in 2003, one in 2000, and two were never treated. The 2003 treatment sites were evaluated to examine the longevity of treatments.

Marginal shoreline (Table 2) and submersed plant species (Table 3) were noted for each site. I also noted any evidence of grass carp feeding, which was usually evidenced by golf ball sized pockmarks in the bottom in shallow water (Table 4).

At each site, twenty regularly spaced points were sampled. At each point, one to two rake tosses were performed to check for the presence of submersed species, and each species present was recorded, based on a previously developed method (Madsen 1999). In addition, the depth at each point was recorded. The presence of hydrilla at the surface was recorded at each point. An efficacy or nuisance rating of 1 to 4 was also used at each point, using the following ranking:

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Rating	Description
1	Poor control, Extensive nuisance problem with hydrilla at the surface
2	Fair control, abundant hydrilla but not to the surface
3	Good control, hydrilla present but sparse
4	Excellent control, only sprigs of hydrilla observed

Point observations were averaged for each site, and presented as a mean and standard error for species found, depth, average number of species and native species per point, hydrilla growing to the surface, and treatment ratings (Table 5).

Results

Site-by-Site Description

Dogwood Branch (1). Dogwood Branch was treated with fluridone in 2005. Dogwood Branch (Figure 3) was a successful treatment, with an average rating of 4 (Figure 7). No hydrilla was observed at any point (Figure 6), nor was any topped-out hydrilla observed (Figure 8). Species diversity was average for the sites examined (Figure 9), though native species diversity was high for the sites assessed (Figure 10). Dogwood Branch had waterwillow as marginal vegetation (Table 2), and also had Chara and Lyngbya (Table 3).

Flat Creek (2). Flat Creek was treated with fluridone in 2005. Flat Creek (Figure 5) was a successful treatment, with 30% of points having hydrilla (Figure 6) and an average rating of 3.8 (Figure 7). Only 5% of points had topped-out hydrilla (Figure 8). Average species diversity (Figure 9) and average number of native species (Figure 10) were both high for the assessed sites. Marginal vegetation was cattail and pickerelweed (Table 2). Other plant species observed at Flat Creek were chara, coontail, and egeria (Table 3).

Gaston Heights (3). Gaston Heights was treated with fluridone in 2005, but only three weeks before assessment (Figure 4). Hydrilla was found in 100% of the points, but the hydrilla was beginning to die by this time (Figure 6). Treatment rating averaged 2.5, which is between fair and good (Figure 7). Hydrilla was topped out at 70% of the points. Native plant diversity was poor at this site (Figure 10). Marginal vegetation included waterwillow and giant cutgrass (Table 2). The only other species observed was coontail (Table 3).

Hawtree Creek (4). Hawtree Creek was treated with fluridone in 2005 (Figure 5). The Hawtree Creek treatment was excellent, with only 5% of points with hydrilla (Figure 6) and an average rating of 4 (Figure 7). No points had topped out hydrilla (Figure 8). Native species diversity, in terms of average number of native species per point, was the highest in the assessment (Figure 10). Hawtree Creek had all six species of marginal vegetation observed in the survey (Table 2), and American lotus and yellow pond lily were observed as well (Table 3).

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Lizard Creek (5). Lizard Creek was treated with fluridone in 2005 (Figure 3). The Lizard Creek treatment was excellent, with no points having hydrilla (Figure 6), and an average rating of 4 (Figure 7). No points had topped-out hydrilla (Figure 8). No marginal vegetation was observed (Table 2), and chara was the only species observed (Table 3). Grass carp feeding was observed at this site (Table 4). However, species diversity at this site was very low (Figures 9, 10).

Lyons Creek (6). Lyons Creek was treated with fluridone in 2005 (Figure 4). The treatment had excellent results, with only 10% of points having hydrilla (Figure 6), and an average rating of 4 (Figure 7). No topped out hydrilla was observed (Figure 8). However, species diversity at this site was very low (Figures 9, 10). Marginal vegetation included waterwillow, American lotus, and pickerelweed (Table 2). Other species at points included American lotus (Table 3).

Northpoint Cove (7). Northpoint Cove was treated with fluridone in 2005 (Figure 2). The treatment was excellent, with hydrilla found at 45% of points (Figure 6), but an average rating of 4 (Figure 7). None of the points had topped-out hydrilla (Figure 8). Species diversity was a little lower than the average for all sites (Figures 9, 10). The marginal vegetation was waterwillow (Table 2), and other species observed at points was chara, lyngbya, and leafy pondweed (Table 3).

Poe Creek (8). Poe Creek was treated with fluridone in 2005 (Figure 3). The treatment was excellent, with 20% of points with hydrilla (Figure 6), and an averaged rating of 4 (Figure 7). No points had topped-out hydrilla (Figure 8). Species diversity was a little lower than the average for all sites (Figures 9, 10). No marginal species were observed (Table 2), and other species observed at points were chara, lyngbya, and southern naiad (Table 3). Evidence of grass carp feeding was observed (Table 4).

Speckle Cove (9). Speckle Cove was treated with fluridone in 2005 (Figure 2). The treatment was excellent, with no hydrilla observed at any points (Figure 6), and an average rating of 4 (Figure 7). No topped-out hydrilla was observed (Figure 8). Species diversity was a little lower than the average for all sites (Figures 9, 10). Waterwillow was the only marginal vegetation species (Table 2), and chara and waterwillow were observed at points (Table 3).

Stillhouse Branch (10). Stillhouse Branch is the last of the sites treated in 2005, and the treatment occurred only three weeks before the assessment (Figure 4). Due to this late treatment, hydrilla was still found at 80% of points (Figure 6), and the rating was only 3.2 (Figure 7). Topped-out hydrilla was found at 32% of points (Figure 8). The fluridone exposure time was not yet sufficient for complete control, but plants were showing definite symptoms and were beginning to senesce. While average number of species was relatively high (Figure 9), none of these were native species (Figure 10). Waterwillow was the only marginal species (Table 2), and Lyngbya the only species observed other than hydrilla (Table 3). Grass carp feeding was observed at this site (Table 4).

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Jimmie Creek (11). Jimmie Creek was treated with fluridone in 2004 (Figure 2). All of the points in Jimmie Creek had hydrilla (Figure 6). Jimmie Creek, which had a rating of 4 in 2004, had a rating of 2.1 in 2005, indicating extensive regrowth (Figure 7). Topped out hydrilla was observed in 63% of points (Figure 8). No native species were observed at any points in Jimmie Creek (Figure 10, Table 3). Waterwillow and lyngbya were also observed (Tables 2, 3).

Poplar Creek (12). Poplar Creek was treated with fluridone in 2003 and 2004 (Figure 4). Only 40% of points had hydrilla (Figure 6), and the rating for this site was just short of 4 (Figure 7). No topped out hydrilla was observed (Figure 8). Native species diversity was observed at this site (Figure 10). Waterwillow and brittle naiad were also observed (Tables 2, 3). This site demonstrates that two successive years of treatment with fluridone may slow the reestablishment rate from tubers in large creeks.

Pretty Creek (13). Pretty Creek was treated with fluridone in 2003 (Figure 3). Hydrilla was observed at 85% of points (Figure 6), and topped out at 40% of points (Figure 8). The average rating for this site was 2.9, which is less than good (Figure 7). No native species were observed (Figure 10). Waterwillow, and lyngbya were also observed (Tables 2, 3). Reinvasion by hydrilla is well underway.

Great Creek (14). Great Creek was treated with fluridone in 2000 (Figure 5). Hydrilla was observed in 30% of the points (Figure 6), and the rating averaged 3.8 (Figure 7). Hydrilla was topped-out at only 10% of points (Figure 8). Species diversity was low (Figure 9, 10). Waterwillow and cattail comprised the marginal vegetation (Table 2). No submersed plants other than hydrilla was observed, but the water was unusually turbid, even for Lake Gaston (Table 3). The Great Creek treatment in 2000 has maintained good control of hydrilla for five years, though it may be advisable to treat the remaining hydrilla soon before it spreads.

Hamline Creek (15). Hamline Creek has never been treated with fluridone for hydrilla, and may be considered a baseline of what an area would look like without treatments (Figure 2). Hydrilla was found at 90% of points (Figure 6), and the rating was 2.4 (fair; Figure 7). Hydrilla was topped-out at 35% of points (Figure 8). Diversity of native species was extremely low (Figure 10). Waterwillow and lyngbya were the only other plants observed (Tables 2, 3).

Lakeview (16). Lakeview was the second site that was assessed that has never been treated with fluridone for hydrilla (Figure 3). Hydrilla was found at all points (Figure 6), and rating was 2.1 (fair, Figure 7). Topped out hydrilla was found at 60% of the points (Figure 8). No native species were found at any points (Figure 10, Table 3). Waterwillow was the only marginal plant species (Table 2).

Analysis

Hydrilla Frequency. Fluridone treatments significantly reduce the frequency of hydrilla in treatment sites (Table 5). Even including the two sites that had only been treated three

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weeks prior to survey, treated sites had significantly less hydrilla (29.3%) than any of the other sites but the fluridone site treated in 2000, and the comparison to untreated sites (95% of points with hydrilla) is highly significant. Excluding those two sites (Gaston Heights and Stillhouse Branch), hydrilla percent frequency is 13%. Large-scale fluridone treatments can control large areas of hydrilla; often beyond the treatment zone, and in some instances the control can last for multiple years.

Success Rating and Nuisance Level. The average rating for all ten sites treated in 2005 was 3.7, which is significantly higher than all other years other than the treatment in year 2000 (Table 6). If the two recently treated sites are excluded, this average increased to 3.97. Fluridone treatments can control hydrilla over a wide area, and give excellent relief from nuisance growth. Nuisance growth, measured by the frequency of topped-out hydrilla, also was lowest in the sites treated with fluridone in 2005. Only 11% of points had topped-out hydrilla in the sites treated in 2005, as compared to 40% of sites treated in 2003 and 47.5% of points in the untreated sites (Table 7). If the two recently treated sites are omitted, the remaining eight sites averaged 0.65% of the points having topped-out hydrilla – a near-complete removal of the nuisance problem.

Species Diversity. Although native plant diversity is low in all sites, the recently treated sites (2005) have significantly more native species per point than all other years (Table 8). Although fluridone treatment may well cause mortality of some native plants, the competitive exclusion of natives by hydrilla is apparently more of a problem to native species.

Grass Carp Feeding. Evidence of grass carp feeding was seen at four of the sixteen sites, three in the lower portion of the reservoir and one in the middle reaches of the reservoir (Table 4). At none of these sites did it appear that grass carp were controlling a significant proportion of the vegetation at the site.

Conclusion. With the exception of the two sites in which fluridone treatments were performed only three weeks before assessment, the fluridone treatments performed in 2005 showed uniformly excellent results with significant control of hydrilla and removal of nuisance growth. I also noted that one bay treated in the year 2000, and one bay treated in both 2003 and 2004, retained a high degree of control for multiple years. The problem remains that sites treated in one year often regrow rapidly from tubers, and may achieve nuisance levels of hydrilla in one to two years following treatment. One possible approach is to treat sites for successive years, and use tuber monitoring to indicate when control has been adequate, rather than waiting for the appearance of a nuisance level of growth. This would require monitoring for a tuber bank in the sites being managed, which entails some cost. The treatments remain tactically sound, with few failures, but the Lake Gaston Weed Board should develop some strategic thinking in how these treatments can be better planned to produce long-term management of hydrilla in Lake Gaston.

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Table 1. Sites evaluated in the 2005 assessment.

Site Name	Site Number	Treatment	Treated in
Dogwood Branch	1	Fluridone	2005
Flat Creek	2	Fluridone	2005
Gaston Heights	3	Fluridone	2005
Hawtree Creek	4	Fluridone	2005
Lizard Creek	5	Fluridone	2005
Lyons Creek	6	Fluridone	2005
Northpoint Cove	7	Fluridone	2005
Poe Creek	8	Fluridone	2005
Speckle Cove	9	Fluridone	2005
Stillhouse Branch	10	Fluridone	2005
Jimmie Creek	11	Fluridone	2004
Poplar Creek	12	Fluridone	2004
Pretty Creek	13	Fluridone	2003
Great Creek	14	Fluridone	2000
Hamline Creek	15	Untreated	0
Lakeview	16	Untreated	0

Table 2. Marginal shoreline vegetation at assessment sites in 2005.

Site Name	Site Number	<i>Justicia americana</i> Waterwillow	<i>Nelumbo lutea</i> American lotus	<i>Nuphar advena</i> Yellow pondlily	<i>Pontederia cordata</i> Pickersweed	<i>Typha</i> sp. Cattail	<i>Zizaniopsis milacea</i> Giant cutgrass
Dogwood Branch	1	X					
Flat Creek	2				X	X	
Gaston Heights	3	X					X
Hawtree Creek	4	X	X	X	X	X	X
Lizard Creek	5						
Lyons Creek	6	X	X		X		
Northpoint Cove	7	X					
Poe Creek	8						
Speckle Cove	9	X					
Stillhouse Branch	10	X					
Jimmie Creek	11	X					
Poplar Creek	12	X					
Pretty Creek	13	X					
Great Creek	14	X				X	
Hamline Creek	15	X					
Lakeview	16	X					

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Table 3. Shallow water native and invasive plant species (submersed, floating-leaf, and emergent) at sample sites in Lake Gaston.

Site Name			Dogwood Branch	Flat Creek	Gaston Heights	Hawtree Creek	Lizard Creek	Lyons Creek	Northpoint Cove	Poe Creek	Speckle Cove	Stillhouse Branch	Jimmie Creek	Poplar Creek	Pretty Creek	Great Creek	Hamline Creek	Lakeview
Site Number																		
Common Name	Scientific name	Native (n) or Invasive (I)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
American lotus	<i>Nelumbo lutea</i>	N				X		X										
Brittle naiad	<i>Najas minor</i>	I																
Chara	<i>Chara sp.</i>	N	X	X			X		X	X	X							
	<i>Ceratophyllum demersum</i>	N		X	X													
Coontail	<i>Drepanocladus sp.</i>	N																
Moss	<i>Egeria densa</i>	I		X														
Eurasian watermilfoil	<i>Myriophyllum spicatum</i>	I																
	<i>Limnobium spongia</i>	N																
Frogsbit	<i>Hydrilla verticillata</i>	I		X	X	X		X	X	X		X	X	X	X	X	X	X
Hydrilla	<i>Lyngbya sp.</i>	I	X						X	X		X			X		X	
Lyngbya	<i>Potamogeton foliosus</i>	N							X									
Leafy pondweed	<i>Potamogeton pusillus</i>	N																
Narrowleaf pondweed	<i>Najas guadalupensis</i>	N								X								
Southern Naiad	<i>Justicia americana</i>	N									X							X
Waterwillow	<i>Nuphar advena</i>	N				X												
Yellow pondlily																		

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Table 4. Sites with evidence of grass carp feeding.

Site Name	Site Number	Evidence of Grass Carp Feeding
Dogwood Branch	1	
Flat Creek	2	
Gaston Heights	3	
Hawtree Creek	4	
Lizard Creek	5	X
Lyons Creek	6	
Northpoint Cove	7	
Poe Creek	8	X
Speckle Cove	9	X
Stillhouse Branch	10	X
Jimmie Creek	11	
Poplar Creek	12	
Pretty Creek	13	
Great Creek	14	
Hamline Creek	15	
Lakeview	16	

Table 5. Comparison of the frequency of hydrilla occurrence at sites treated in 2005, 2004, 2003, 2000, and untreated sites. Statistical comparison using a Kruskal-Wallis nonparametric test.

Treatment	N	Percent Frequency Hydrilla	Standard Error of the Mean	Means Comparison
2005	194	29.38	3.28	C
2004	39	71.79	7.3	AB
2003	20	85	8.19	A
2000	20	30	10.51	BC
Untreated	40	95	3.49	A

Kruskal-Wallis $p < 0.001$

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Table 6. Comparison of control rating at sites treated in 2005, 2004, 2003, 2000, and untreated sites. Statistical comparison using a Kruskal-Wallis nonparametric test.

Treatment	N	Rating	Standard Error of the Mean	Means Comparison
2005	194	3.7423	0.0482	A
2004	39	2.9487	0.1871	B
2003	20	2.9	0.28	BC
2000	20	3.8	0.117	A
Untreated	40	2.275	0.1825	C

Kruskal-Wallis $p < 0.001$

Table 7. Comparison of the frequency of topped-out hydrilla occurrence at sites treated in 2005, 2004, 2003, 2000, and untreated sites. Statistical comparison using a Kruskal-Wallis nonparametric test.

Treatment	N	Percent Frequency of Topped-out Hydrilla	Standard Error of the Mean	Means Comparison
2005	194	11.34	2.28	B
2004	39	33.33	7.65	A
2003	20	40	11.24	A
2000	20	10	6.88	B
Untreated	40	47.5	8	A

Kruskal-Wallis $p < 0.001$

Table 8. Comparison of the average number of native species per point at sites treated in 2005, 2004, 2003, 2000, and untreated sites. Statistical comparison using a Kruskal-Wallis nonparametric test.

Treatment	N	Average Number of Native Species per Point	Standard Error of the Mean	Means Comparison
2005	194	0.2732	0.0337	A
2004	39	0.1026	0.0492	AB
2003	20	0	0	B
2000	20	0	0	B
Untreated	40	0.025	0.025	B

Kruskal-Wallis $p < 0.001$

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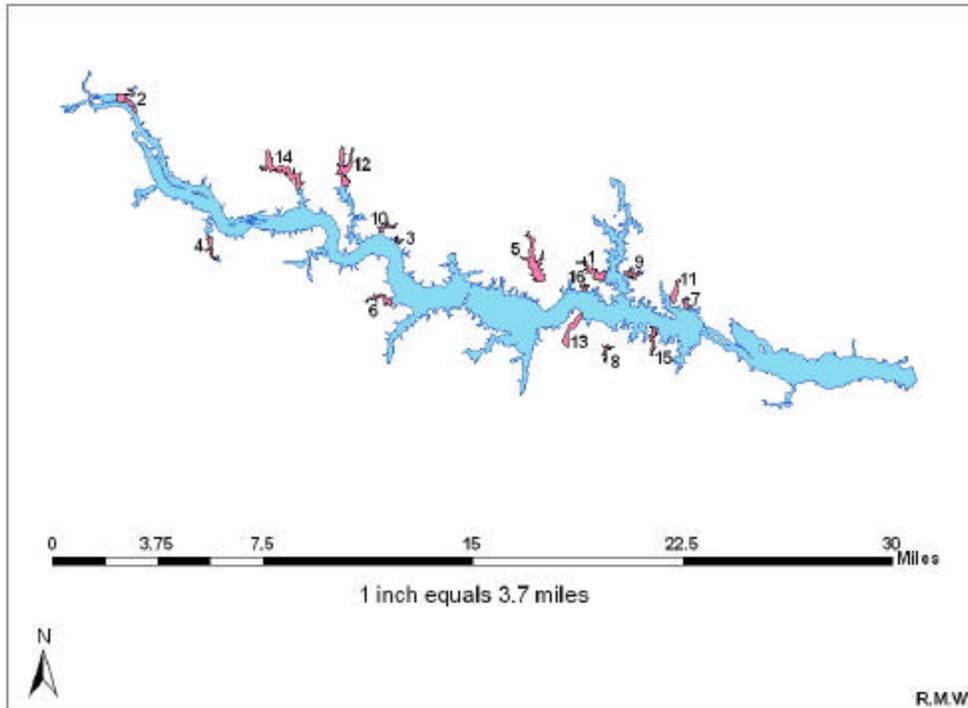


Figure 1. Sample sites and points in Lake Gaston. Numbers correspond to site names in Table 1.

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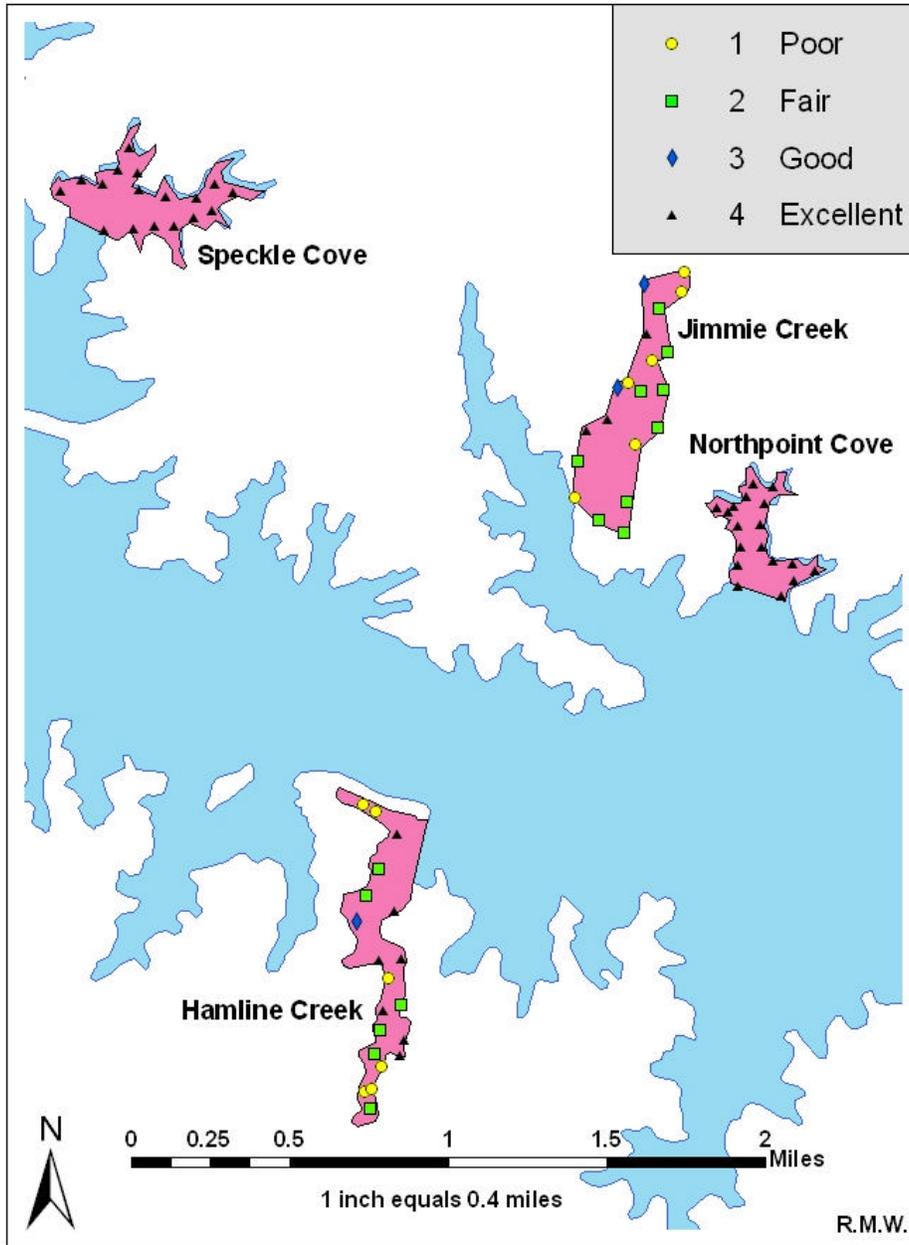


Figure 2. Map of assessment sites Hamline Creek (15), Jimmie Creek (11), Northpoint Cove (7), and Speckle Cove (9) in Lake Gaston. Symbol shape and color indicate efficacy rating (see legend).

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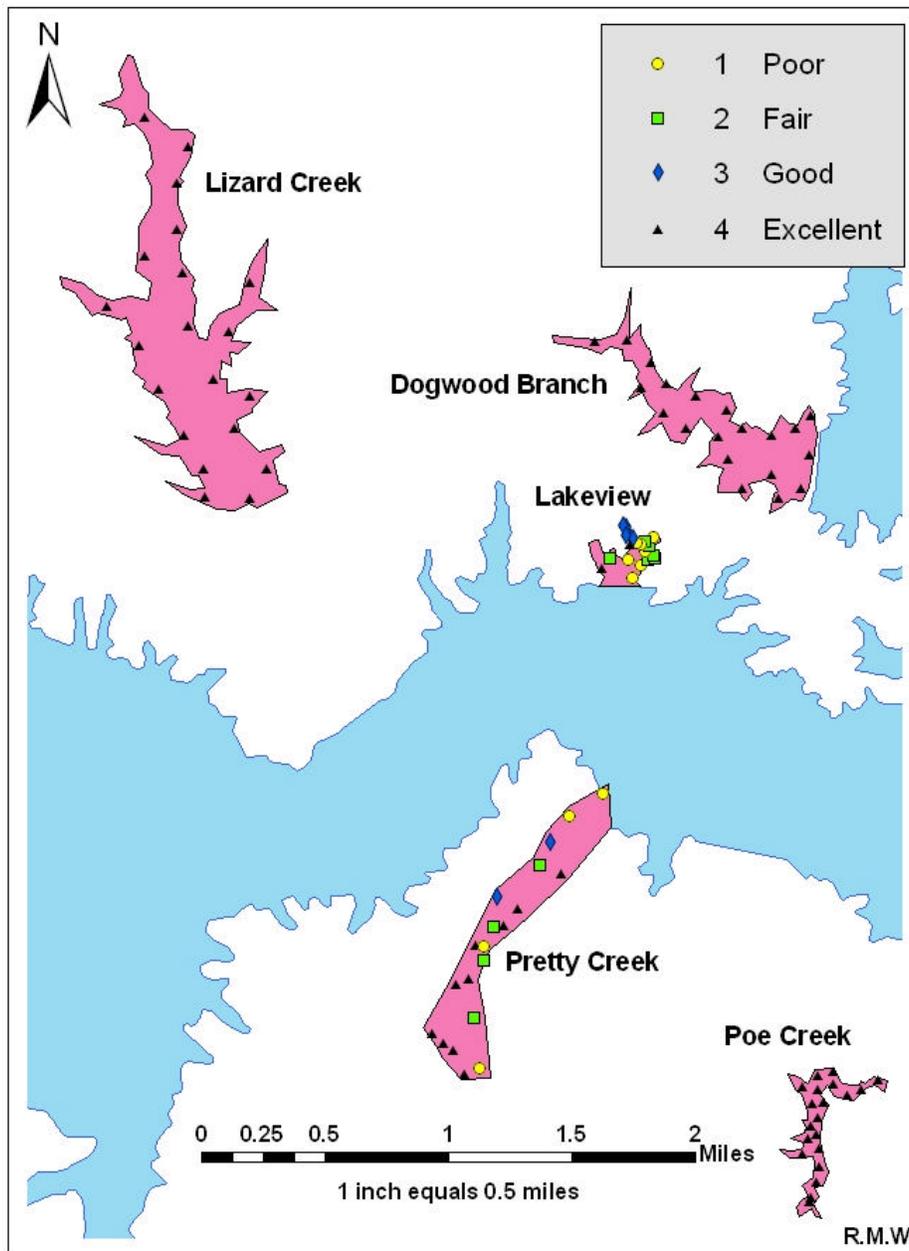


Figure 3. Assessment sites Dogwood Branch (1), Lakeview (16), Lizard Creek (5), Poe Creek (8), and Pretty Creek (13) in Lake Gaston. Symbol shape and color indicate efficacy rating (see legend).

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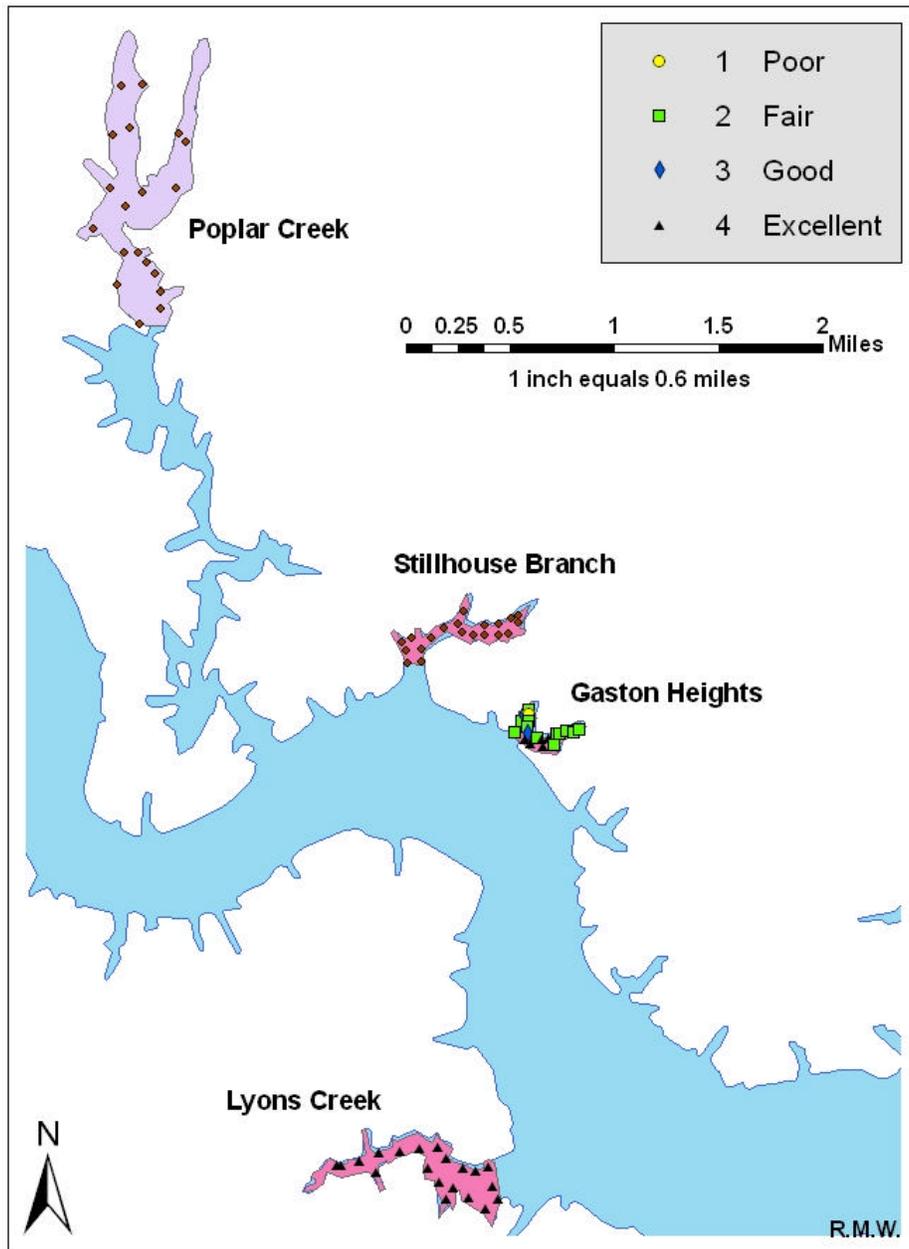


Figure 4. Assessment sites Gaston Heights (3), Lyons Creek (6), Poplar Creek (12), and Stillhouse Branch (10) in Lake Gaston. Symbol shape and color indicate efficacy rating (see legend).

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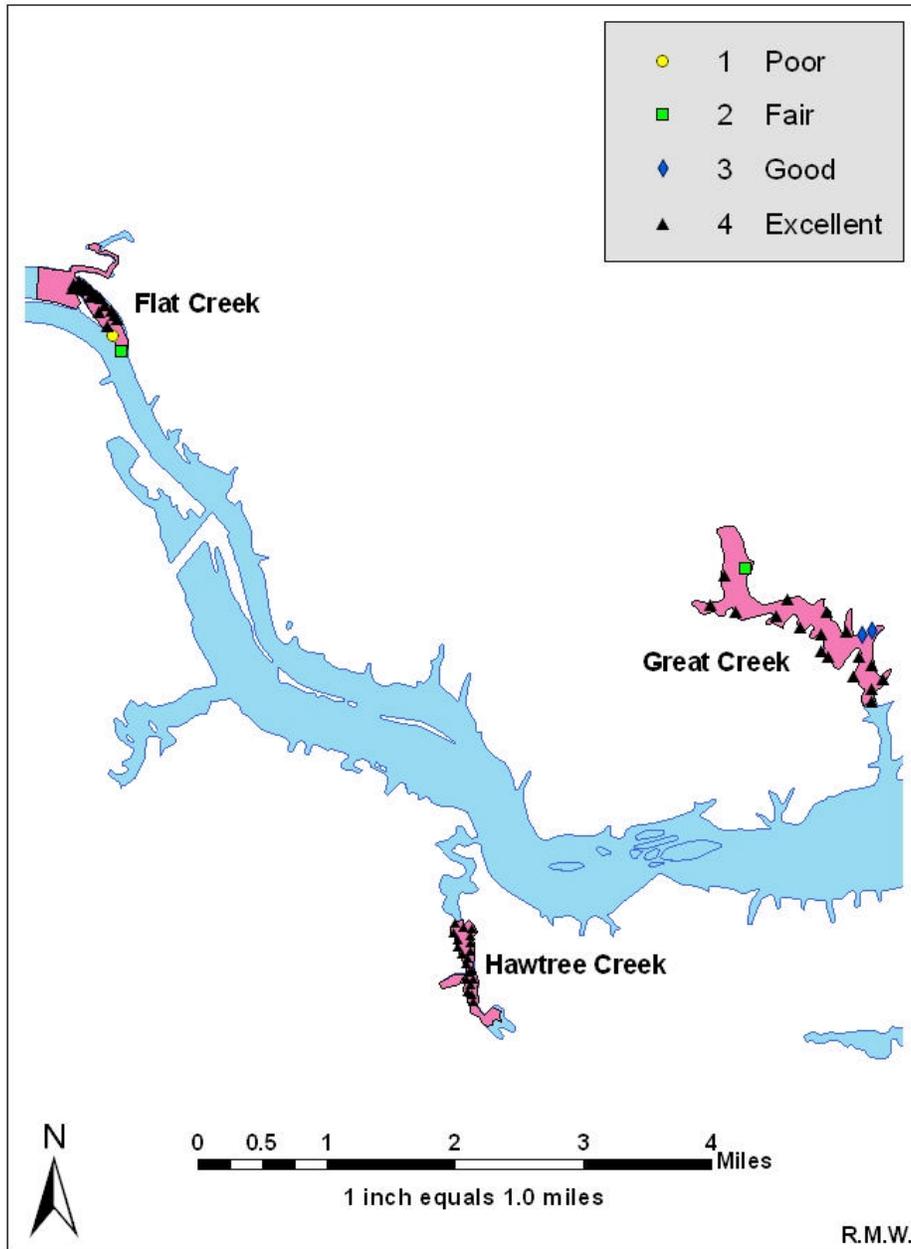


Figure 5. Assessment sites Flat Creek (2), Great Creek (14), and Hawtree Creek (4) in Lake Gaston. Symbol shape and color indicate efficacy rating (see legend).

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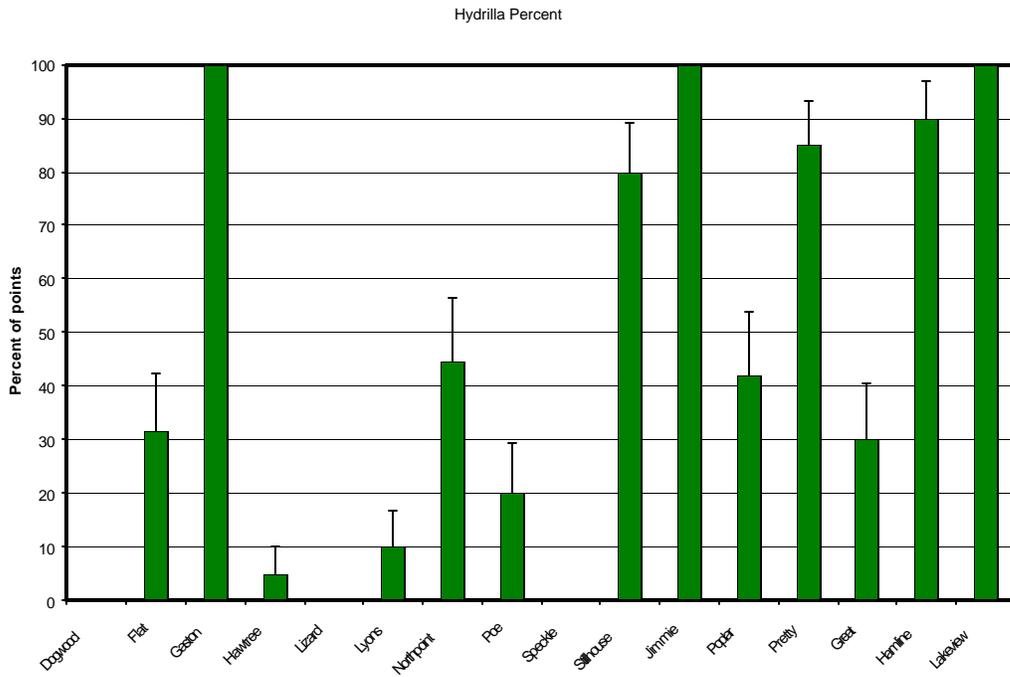


Figure 6. Hydrilla percent frequency at assessment sites.

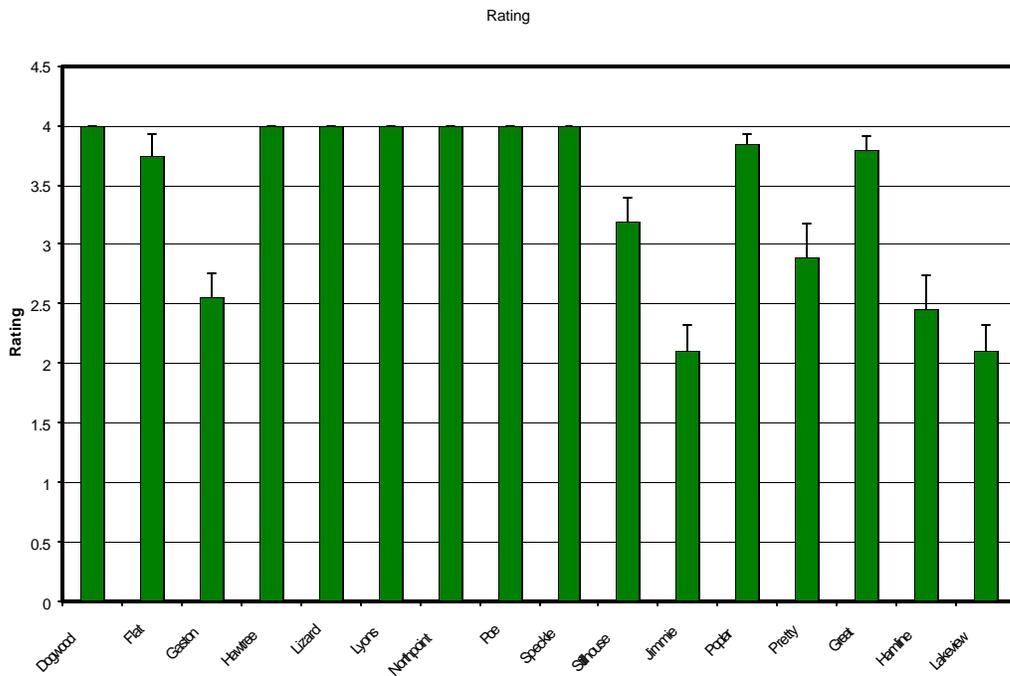


Figure 7. Treatment rating for assessment sites in Lake Gaston. Rating scale given in Methods section.

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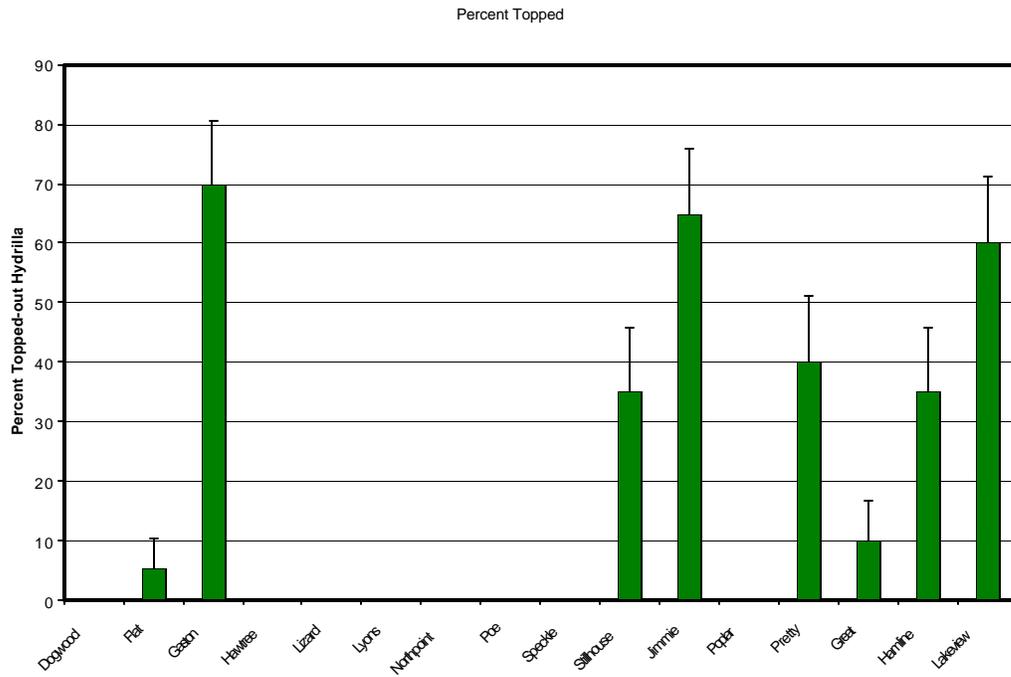


Figure 8. Percent frequency of points with topped-out hydrilla at each assessment site in Lake Gaston.

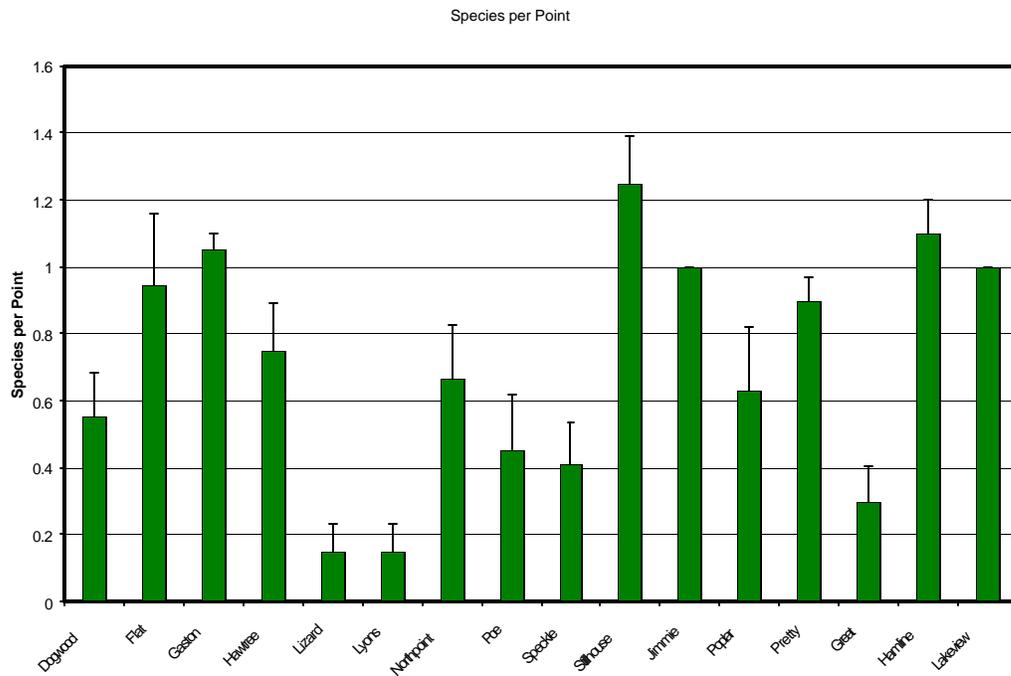


Figure 9. Average number of species per point in the assessment sites in Lake Gaston.

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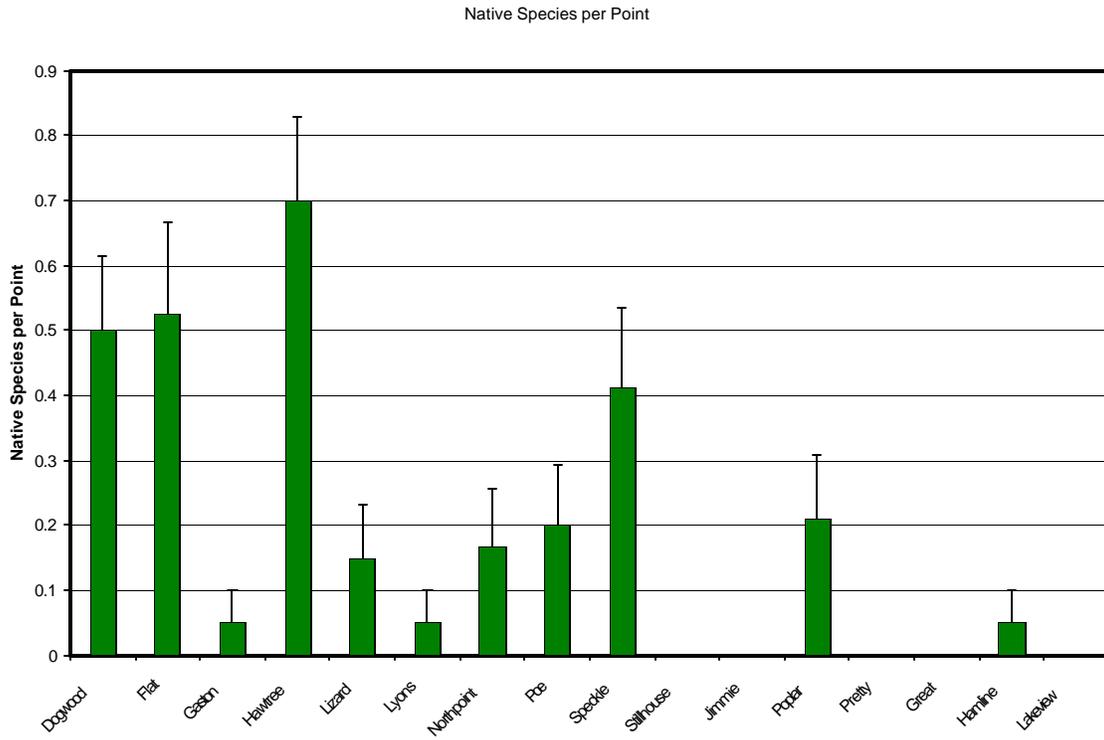


Figure 10. Average number of native species per point at assessment sites in Lake Gaston.