

Identifying Sources of Fecal Bacteria in a Virginia Watershed

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Project Justification

- Fecal contamination of water is widespread.
- Fecal bacteria are the most common pollutant in surface waters in Virginia.
- Determining the source(s) is difficult.
- Restoration efforts are hampered without accurate source identification.
- Sourcing fecal pollution is a developing methodology.

Spout Run Watershed Page Brook Basin

- Page Brook is 3.7 miles long.
- There are 4,879 acres in the basin.
- Land use is 1,296 acres wooded, 3,257 acres pasture/crop, 270 acres residential, and 56 acres other/urban.
- Peak average stream flow rate is 2,500 gal/min.

Step 1: Building a Library of Known Source Profiles

- Isolates collected from known sources (human, waterfowl, beef cow, dairy cow, chicken, deer & wildlife).
- Twenty-one tests performed on each isolate to develop a biochemical profile.
- Database now contains over 7,000 isolates.
- Database analyzed with **Cluster Analysis** and **Discriminant Analysis**.

Database of Isolates from Known Sources

<u>Source</u>	<u>No. of Isolates</u>	<u>Correctly Identified</u>	<u>Correct Rate(%)</u>
Cattle	1,926	1,656	86
Human	1,195	968	81
Sheep	667	654	98
Horse	913	877	96
Deer	1,245	1,208	97
Geese	1,284	1,233	96
Total	7,230	6,652	92

Known Source Isolates from Page Brook - 10/96-11/96

<u>Source</u>	<u>No. of Isolates</u>	<u>Correctly Identified</u>	<u>Correct Rate(%)</u>
Cattle	576	472	82
Human	288	264	92
Deer	144	117	81
Geese	240	211	88
Total	1,248	1,067	86

Known Source Isolates from Page Brook - 7/98-8/98

<u>Source</u>	<u>No. of Isolates</u>	<u>Correctly Identified</u>	<u>Correct Rate(%)</u>
Cattle	193	151	78
Human	152	131	86
Deer	131	106	81
Geese	166	136	82
Total	642	524	82

Known Source Classifications with All Animals Pooled

No. of Source Isolates Correctly Identified Correct Rate(%)

Known Source Database

Animal	5,122	5,019	98
Human	1,195	1,147	96

Known Sources, Page Brook

Animal	635	612	96
Human	288	273	95

Unknown Stream Isolates from Page Brook, 5/97-10/97

Sampling Source Identification (%)

Site	Cow	Deer	Human	Geese	?
PB10	81	11	0	4	4
PB12	86	6	0	5	3
PB16	78	5	0	8	9

Unknown Stream Isolates from Page Brook, 5/98-10/98

Sampling Source Identification (%)

Site	Cow	Deer	Human	Geese	?
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PB10	38	23	0	31	8
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PB12	44	19	0	30	7
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PB16	37	28	0	24	11
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Fecal Coliform Isolates from Page Brook, 7/97-10/97

Sampling Site	No. per 100 ml		
	Average	Minimum	Maximum
PB10	3,103	410	4,800
PB12	42,400	7,900	72,000
PB16	2,347	610	4,400

Fecal Coliform Isolates from Page Brook, 7/98-10/98

Sampling Site	Average	Minimum	Maximum
PB10	347	190	610
PB12	1,596	260	4,100
PB16	934	290	1,700

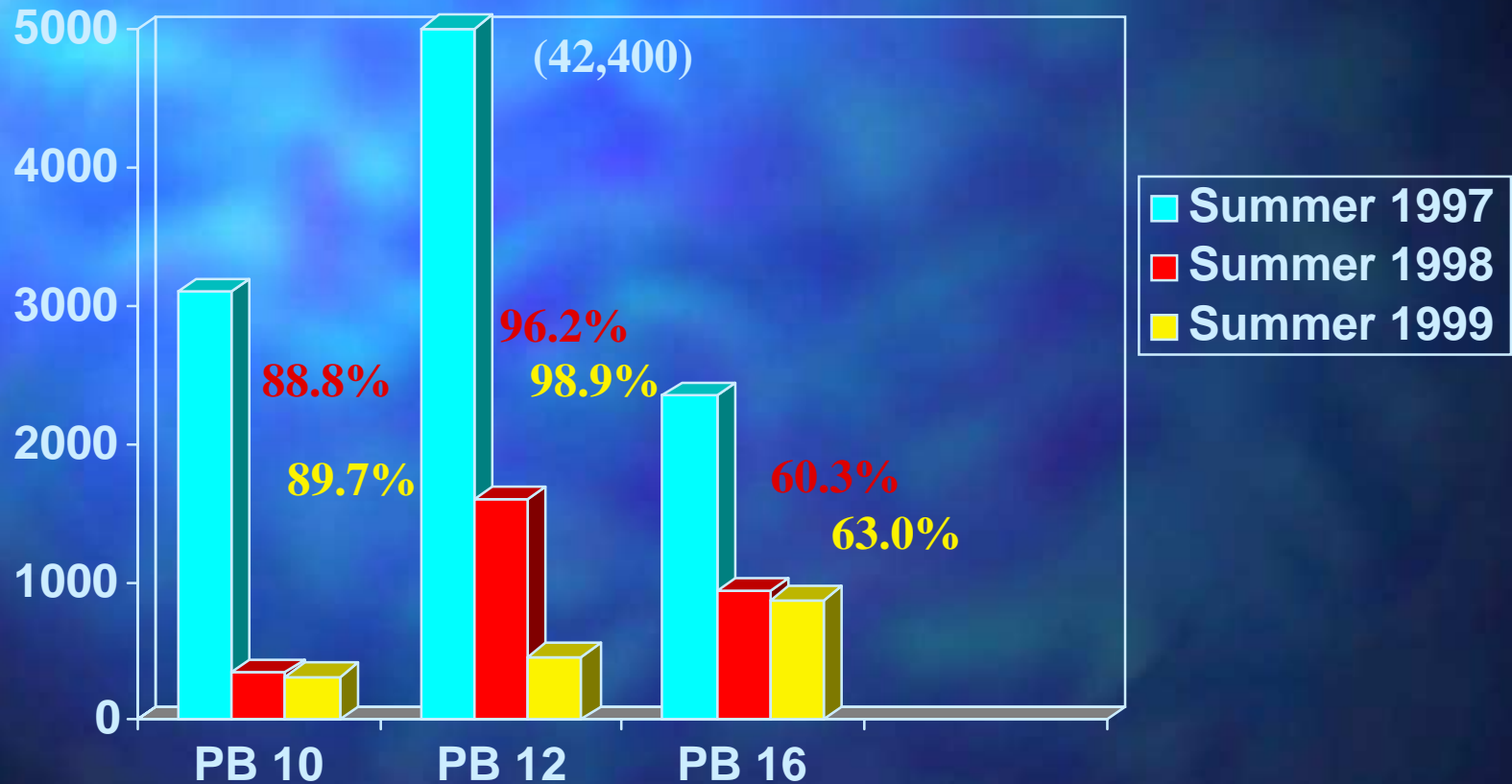
Fecal Coliform Isolates from Page Brook, 7/99-9/99

Sampling Site	Average	Minimum	Maximum
PB10	320	<10	780
PB12	460	<10	560
PB16	870	<10	1,940

Reductions in Fecal Coliforms from Page Brook

Sampling Site	Average No/100 ml	(% Reduction)	
	<u>7/97-10/97</u>	<u>7/98-10/98</u>	<u>7/99-9/99</u>
PB10	3,103	347 (88.8)	320 (89.7)
PB12	42,400	1,596 (96.2)	460 (98.9)
PB16	2,347	934 (60.3)	870 (63.0)

Percent Fecal Coliform Reductions in Page Brook



Conclusions to Date

- Antibiotic resistance profiles with a large isolate database accurately sourced fecal streptococcus isolates.
- Database validated with over 4,000 known and unknown isolates.
- Differentiation between human and animals is excellent, less so between livestock, poultry and wildlife.

What's Next in Methodology?

- Test method on a larger watershed with more types of sources.
- Continue to build a database of DNA profiles of isolates.
- Compare - combine antibiotic resistance profiles with DNA fingerprints.

