WHEELING JESUIT UNIVERSITY

Impact of Longwall Mining on Central Appalachian Headwater Streams

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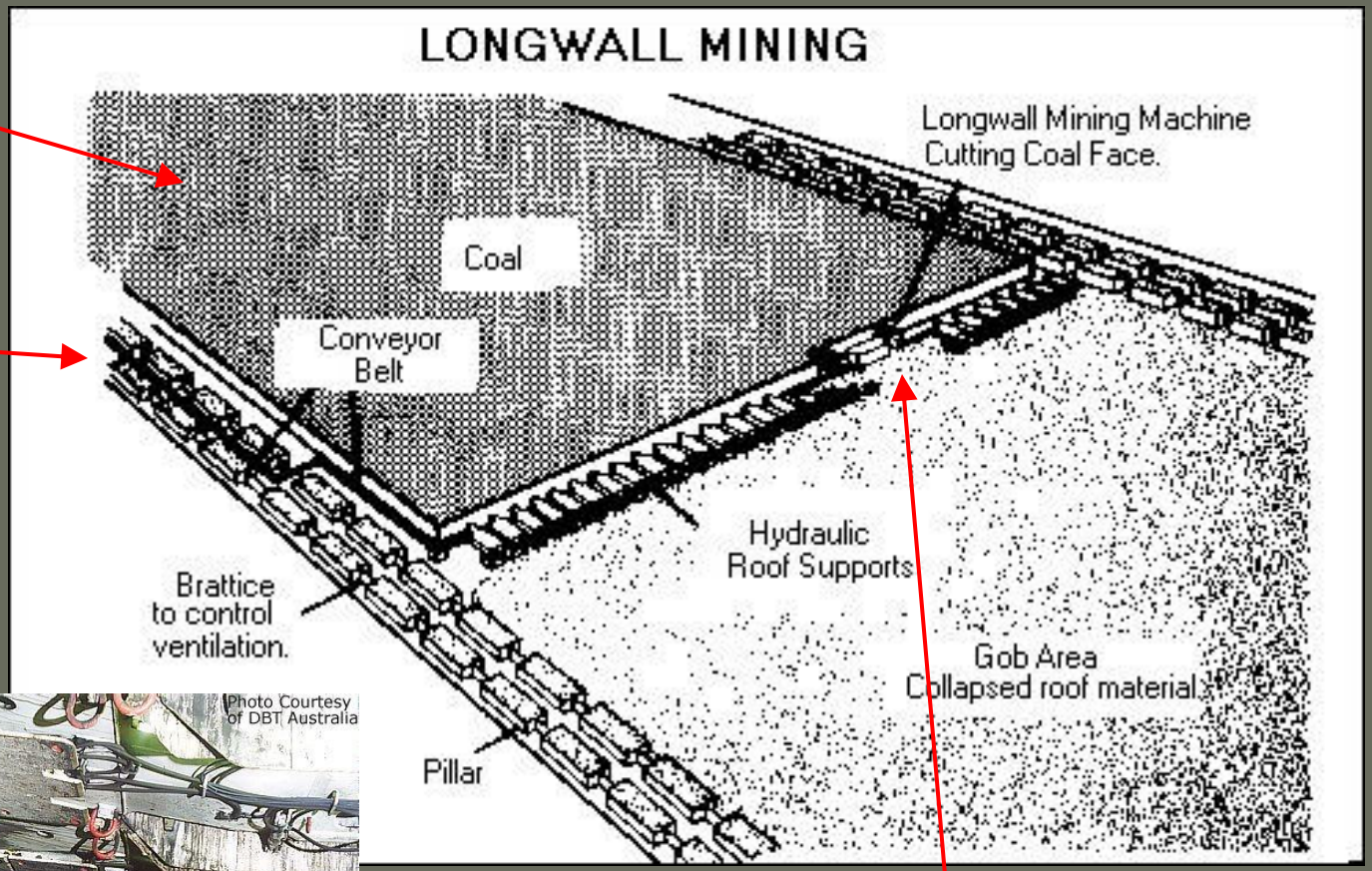
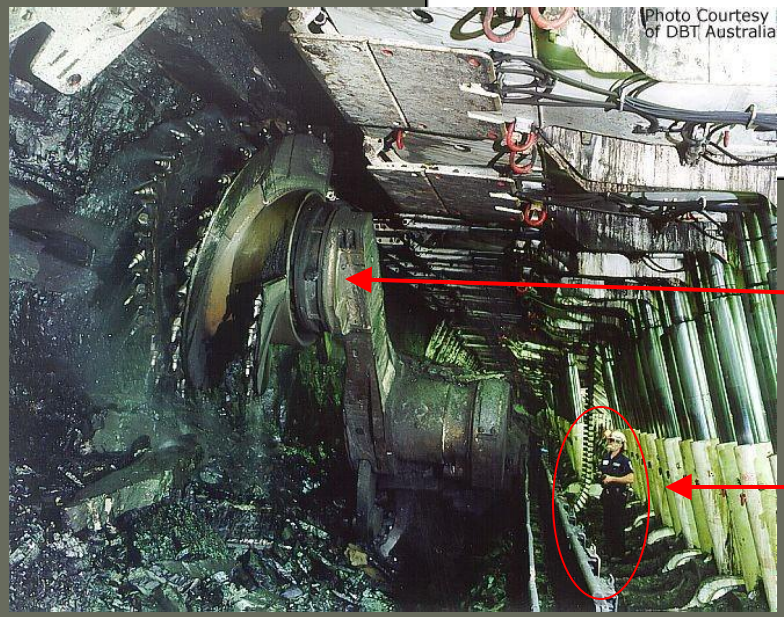
The purpose of this study was to measure the extent of longwall mining impacts on headwater streams.

1100’ wide panel of coal

Gateway (manways, air shafts, beltways)





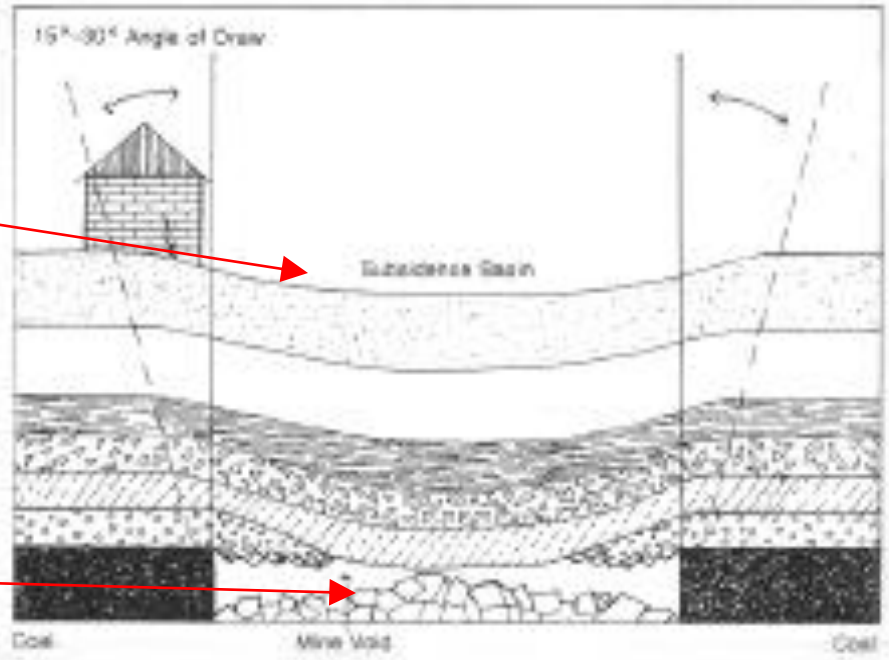
Longwall mining shear, 3-400 feet below Earth’s surface.

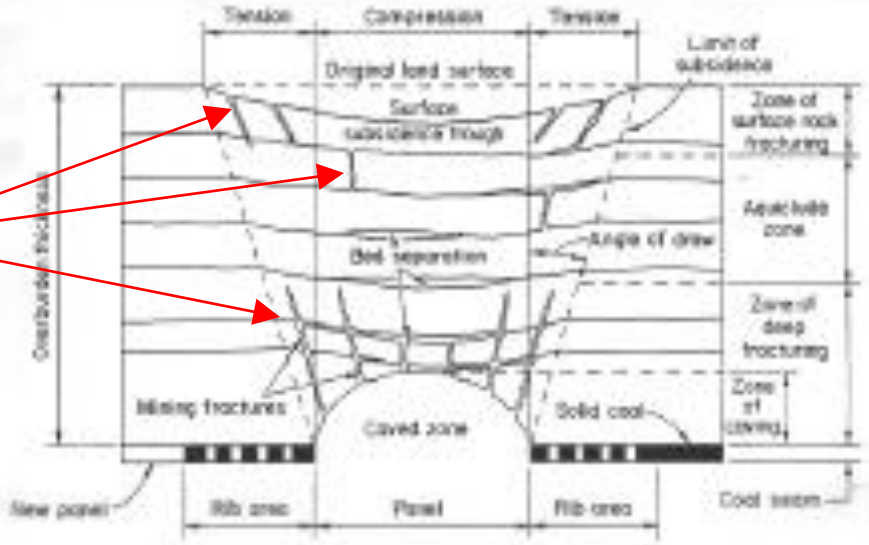
Shear operator

Surface subsidence from longwall mining

Fully extracted coal seam

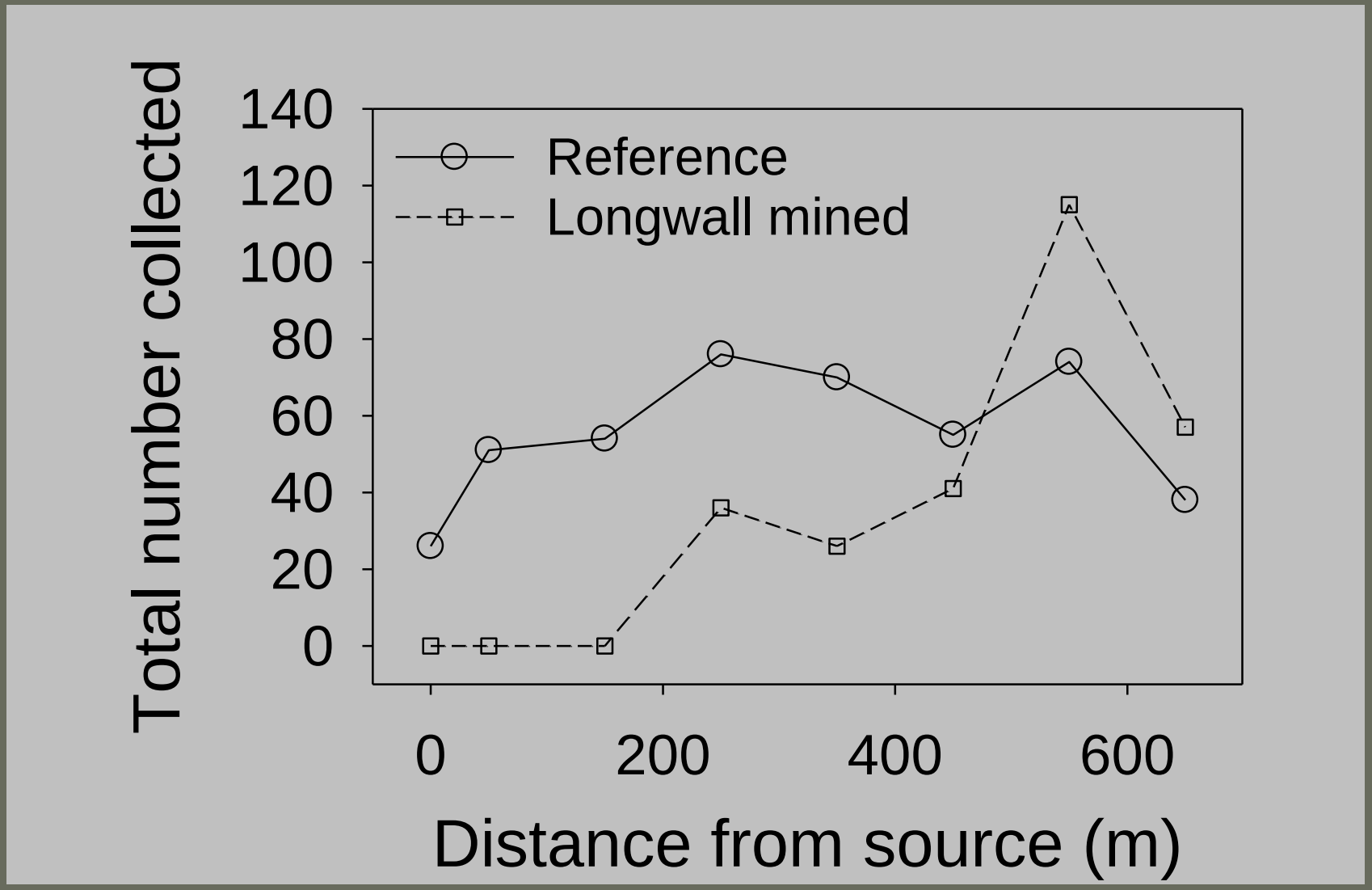
Rock fractures cause stream subsidence

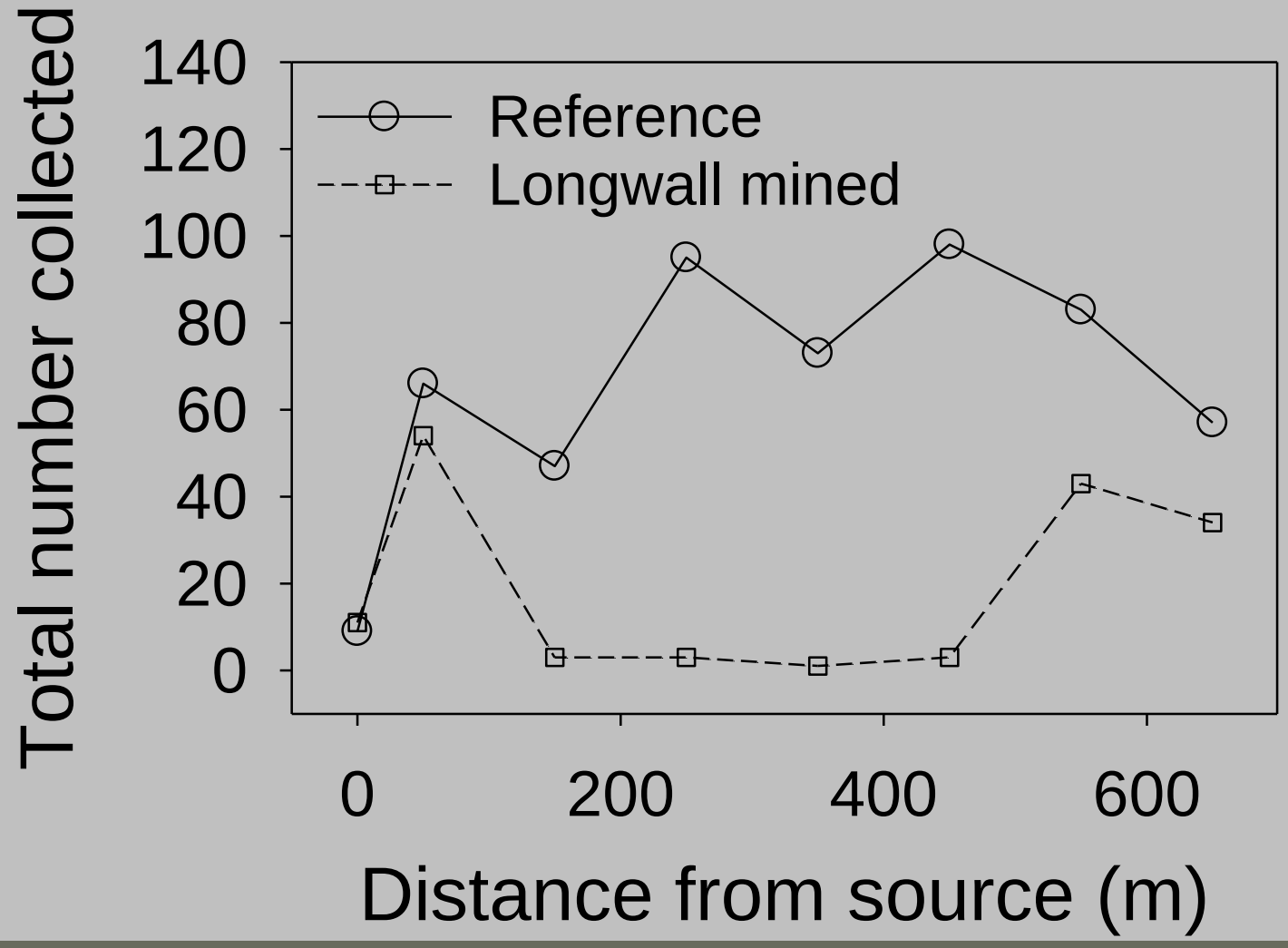




Reference

Longwall mined


Total number collected
140
120
100
80
60
40
20
0
Reference
Longwall mined
0
200
400
600
Distance from source (m)


Total number collected
140
120
100
80
60
40
20
0
Reference
Longwall mined
0
200
400
600
Distance from source (m)

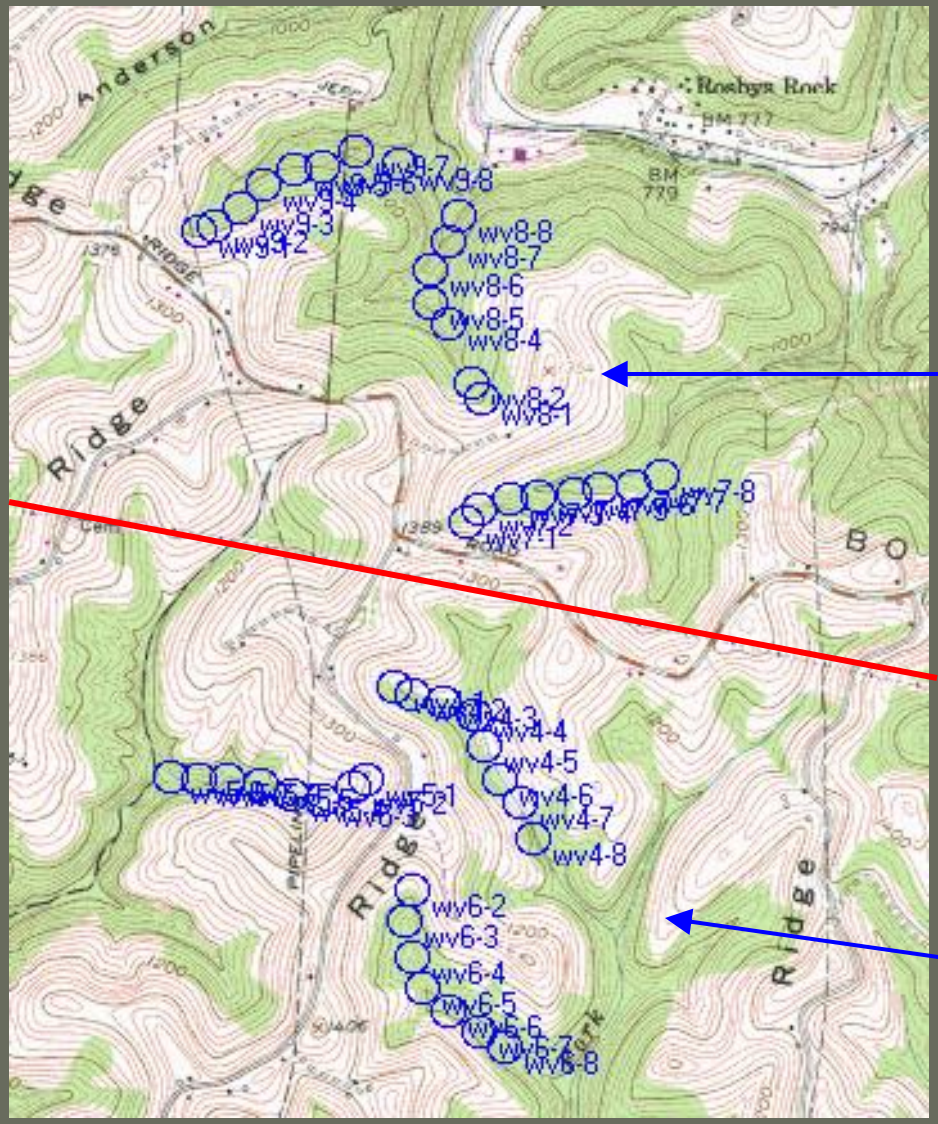
3 study objectives:

1)Test for overall physical, chemical, or biological impacts at the watershed-ecosystem level.

2) Test for spatial impact/recovery along the longitudinal profile, or stream gradient.

3) Test for temporal impact/recovery over time since mining occurred.

Experimental design:



2 unmined, old growth reference streams, Ohio University Forest, 26km NW

3 reference streams, room and pillar mined

Northward extent of longwall mine

3 streams longwall mined 4 - 6 years prior to study

Experimental design (cont.):

Unmined reference stream

5 streams longwall mined 8-12 years prior to sampling

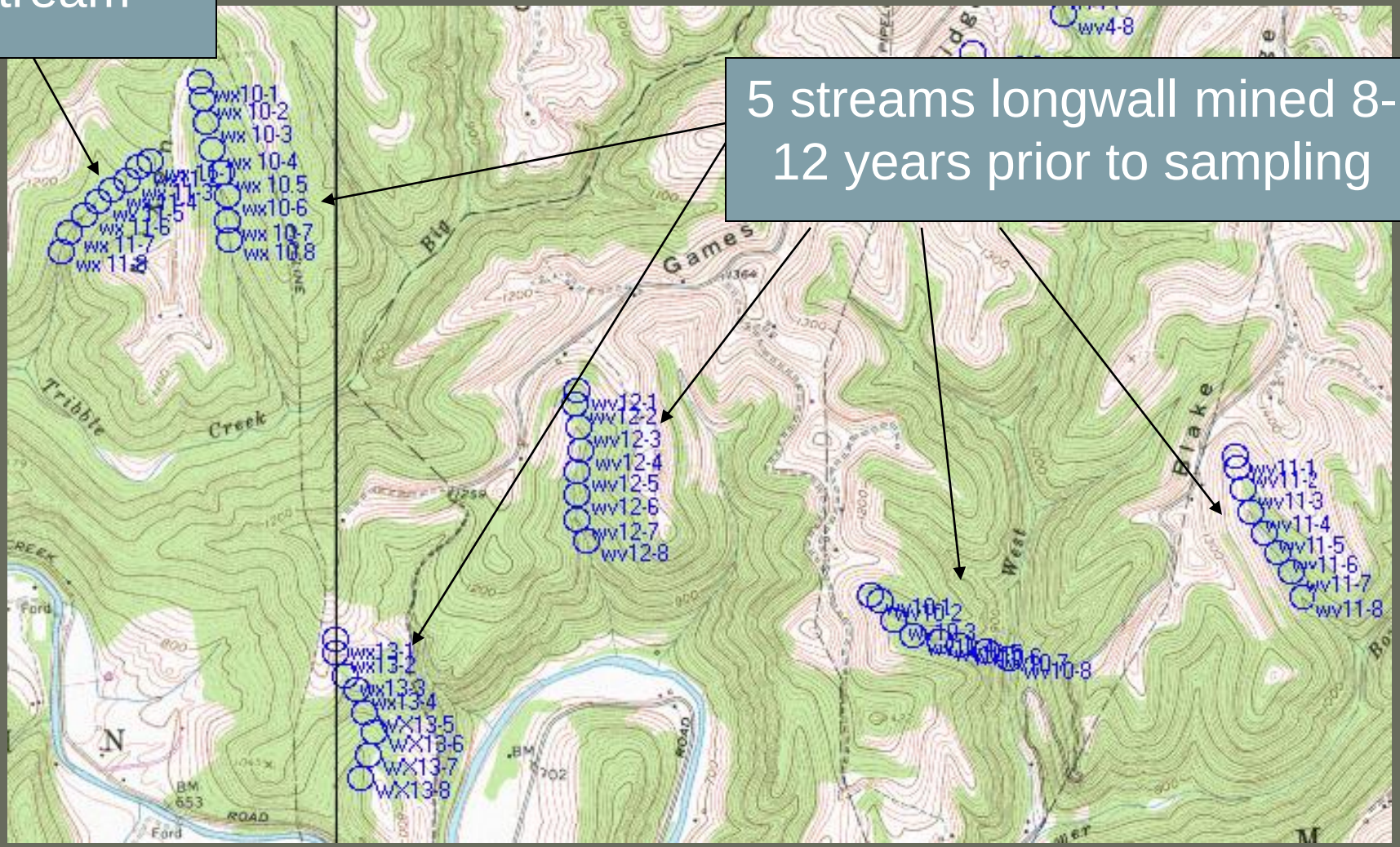


Table 1. Mean (and 1 standard error) physical characteristics of streams and probability of no significant physical difference in samples from longwall mined (N=88) versus reference streams (N=79), (ANOVA, Dunnett's Test ,*p<0.05).

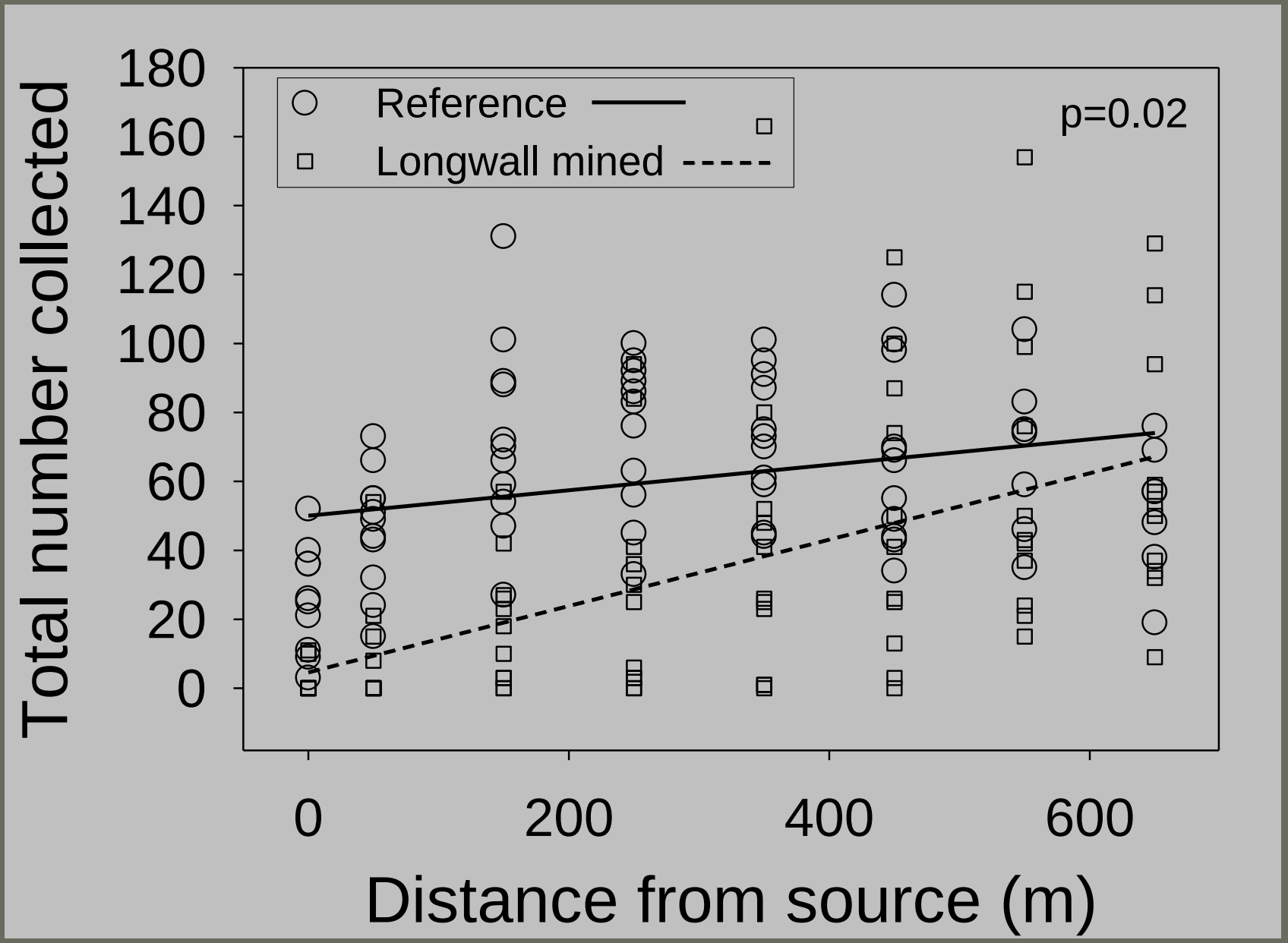
	Reference streams		Longwall mined streams		
Physical measurement	Mean	(SE)	Mean	(SE)	Probability
Watershed area (acres)	41.5	(3.8)	43.8	(3.6)	0.646
Elevation (feet)	1091	(11)	1093	(10)	0.924
Stream slope (%)	12.1	(0.8)	10.9	(0.8)	0.277
Compass heading (degrees true N)	184	(9.3)	173	(8.8)	0.364
Median stream width (meters)	0.93	(0.06)	0.64	(0.05)	0.000*
Water temperature (°C)	16.9	(0.2)	16.1	(0.3)	0.022*

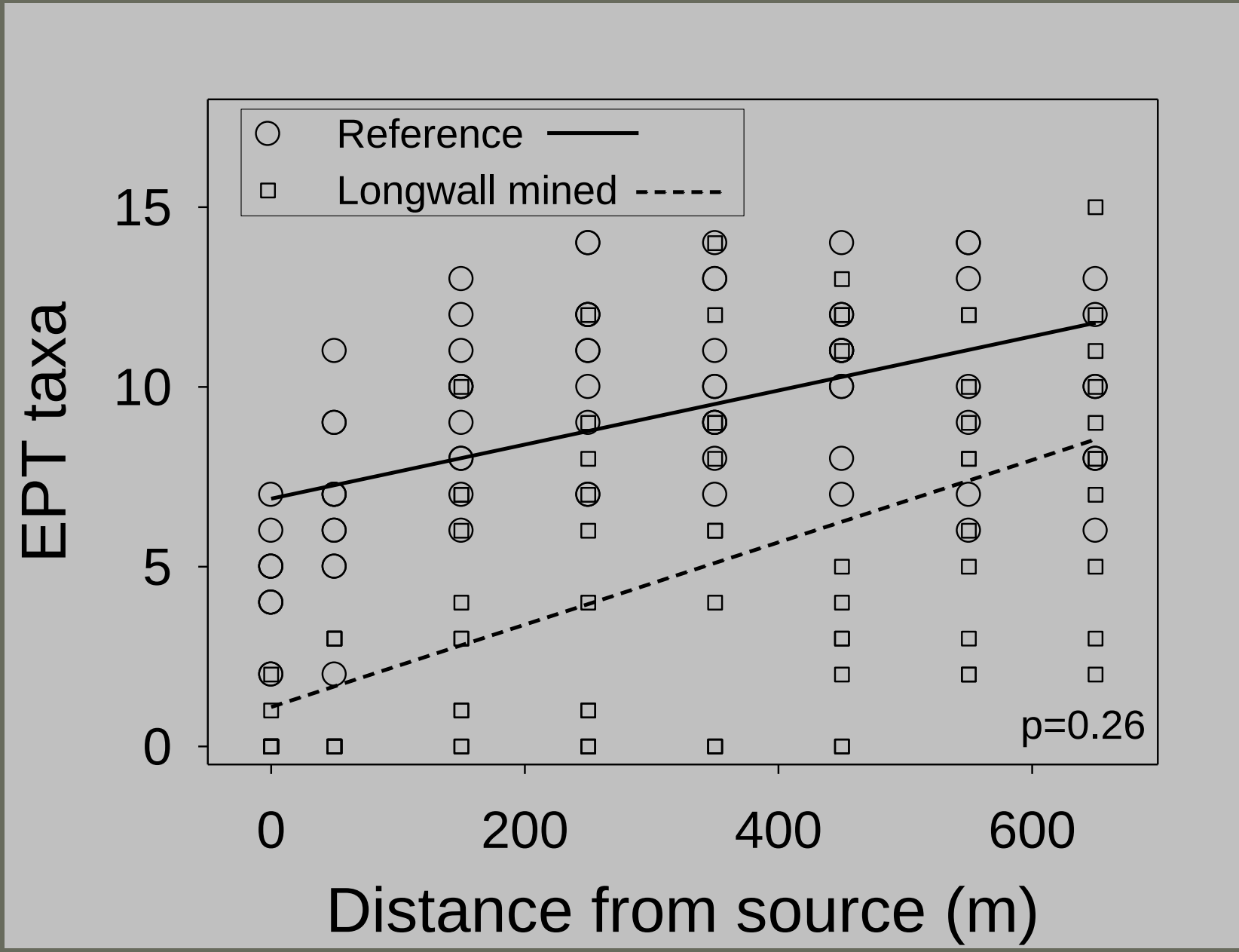
Table 2. Mean (and 1 standard error) chemical characteristics of streams and probability of no significant chemical difference in samples from longwall mined (N=72) versus reference streams (N=79), and (ANOVA, Dunnett's Test ,*p<0.05).

	Reference streams		Longwall mined streams		
Chemical measure	Mean	(SE)	Mean	(SE)	Probability
Ph	7.65	0.04	7.65	0.04	0.955
Conductivity (*u*mhos)	344.8	9.8	444.9	10.2	0.000*
Dissolved oxygen (percent saturation)	86.1	1.9	77.1	2.0	0.010*
Alkalinity (ppm)	134	5	198	5	0.000*
Hardness (ppm)	182	5	172	5	0.150

Table 3. Mean (and 1 standard error) biological characteristics of streams and probability of no significant biological difference in samples from longwall mined (N=88) versus reference streams (N=79), (ANOVA, Dunnett's Test ,*p<0.05).

	Reference streams		Longwall mined streams		
Biological measure	Mean	(SE)	Mean	(SE)	Probability
Total number collected	60.4	3.8	34.1	3.6	0.000*
Taxa richness	12.8	0.6	6.8	0.5	0.000*
EPT taxa	9.0	0.4	4.6	0.4	0.000*
Semivoltine taxa	2.7	0.2	1.3	0.2	0.000*
Mayfly taxa	3.0	0.2	1.7	0.2	0.000*
Stonefly taxa	3.6	0.2	1.7	0.2	0.000*
Caddisfly taxa	2.4	0.2	1.1	0.1	0.000*


Total number collected
180
160
140
120
100
80
60
40
20
0
Reference
Longwall mined
p=0.02
0
200
400
600
Distance from source (m)


Reference
Longwall mined
EPT taxa
15
10
5
0
0
200
400
600
Distance from source (m)
p=0.26

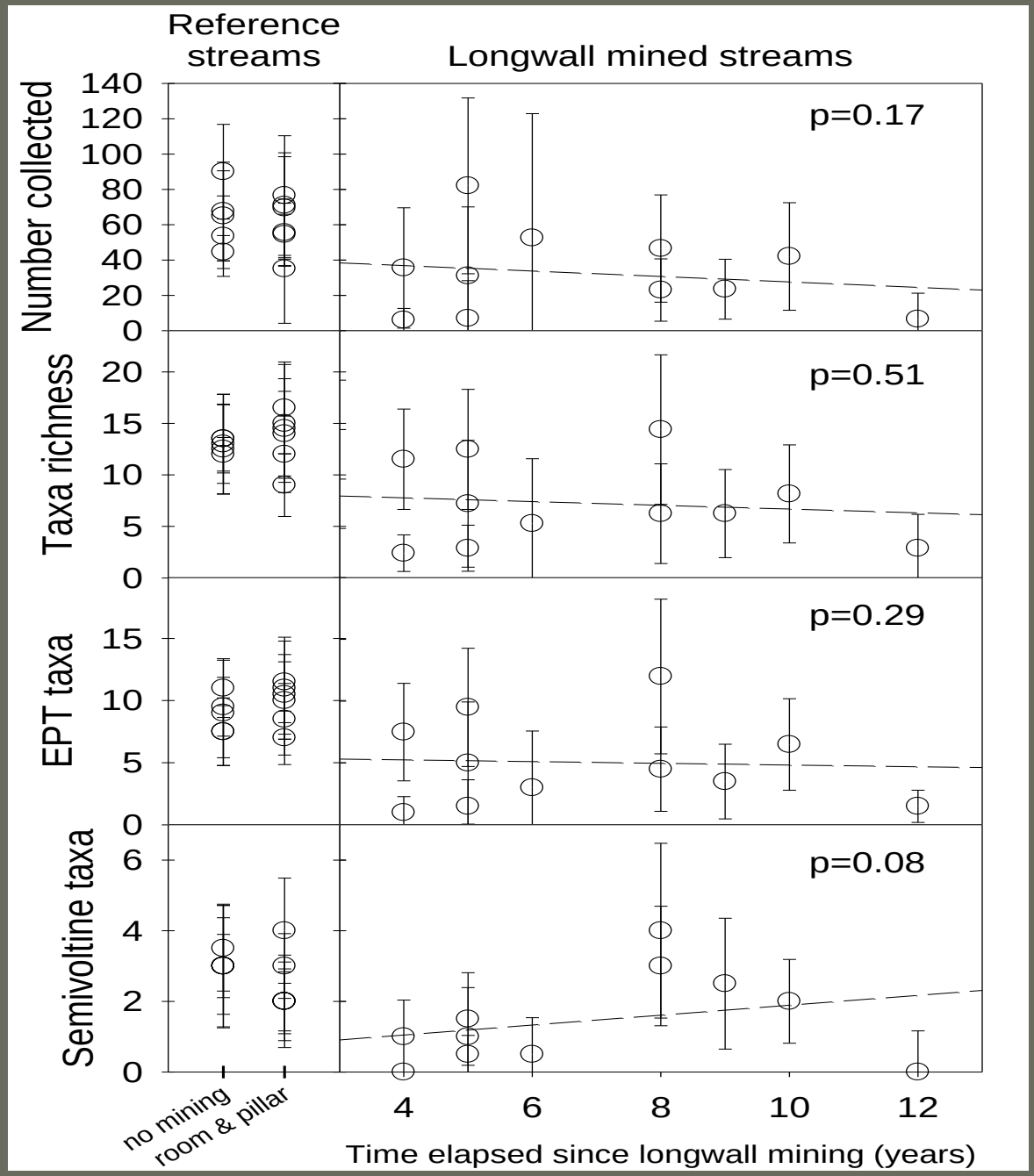
Temporal analysis of Biological measures

<u>Indicates if streams</u>:

Recovered ↑

Stayed the same →

Declined ↓



Update from 2011 field season

	Reference	Longwall mined
Stream width (m)	1.19	0,79*
Temperature (^{0}C)	17.9	18.5
Conductivity (uS/cm)	419	465
Dissolved oxygen (% sat.)	97.6	87.9*
pH	7.34	7.26
Total number (#/sample)	36.9	26.7*
Taxa richness (taxa/sample)	11.3	6.3*
EPT taxa (per sample)	7.7	3.2*
Leaf shredders (% totalN)	29	41
Collectors (%)	35	40
Algae grazers (%)	15	11
Predators (%)	21	8*
Semi-voltine taxa	2.6	1*

Conclusion:

Do central Appalachian headwater streams recover from longwall mining impacts?

No evidence of recovery over space or time.