

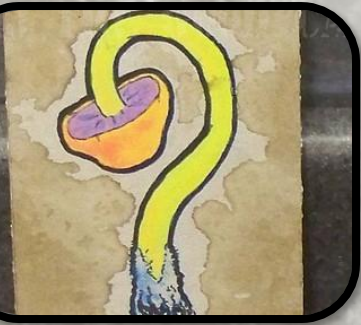
Les Stephens Presents...

Mycoremediation of PCB's

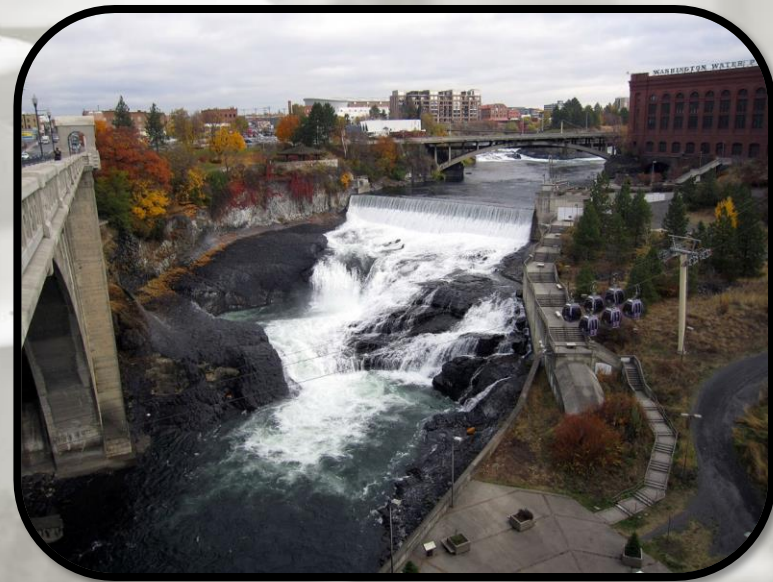
THE LANDS COUNCIL 25 W. MAIN, STE 222 SPOKANE, WA 99201 (509) 209-2851

TLC's Hypothesis

Can fungi detoxify PCBs that threaten the Spokane River?

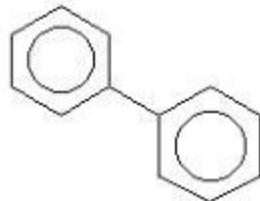


- Different perspective
 - Maybe nature knows more...
- Green technology



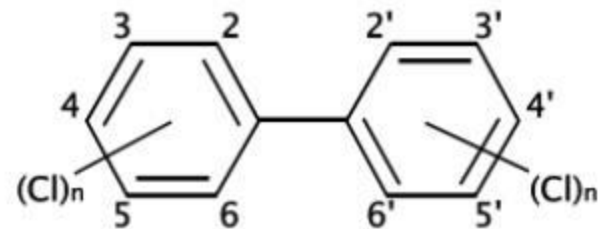
Polychlorinated Biphenyls (PCBs)

Biphenyl:



PCBs have Cl substituents at any site on the biphenyl structure

→ 209 possible unique structures – “congeners”

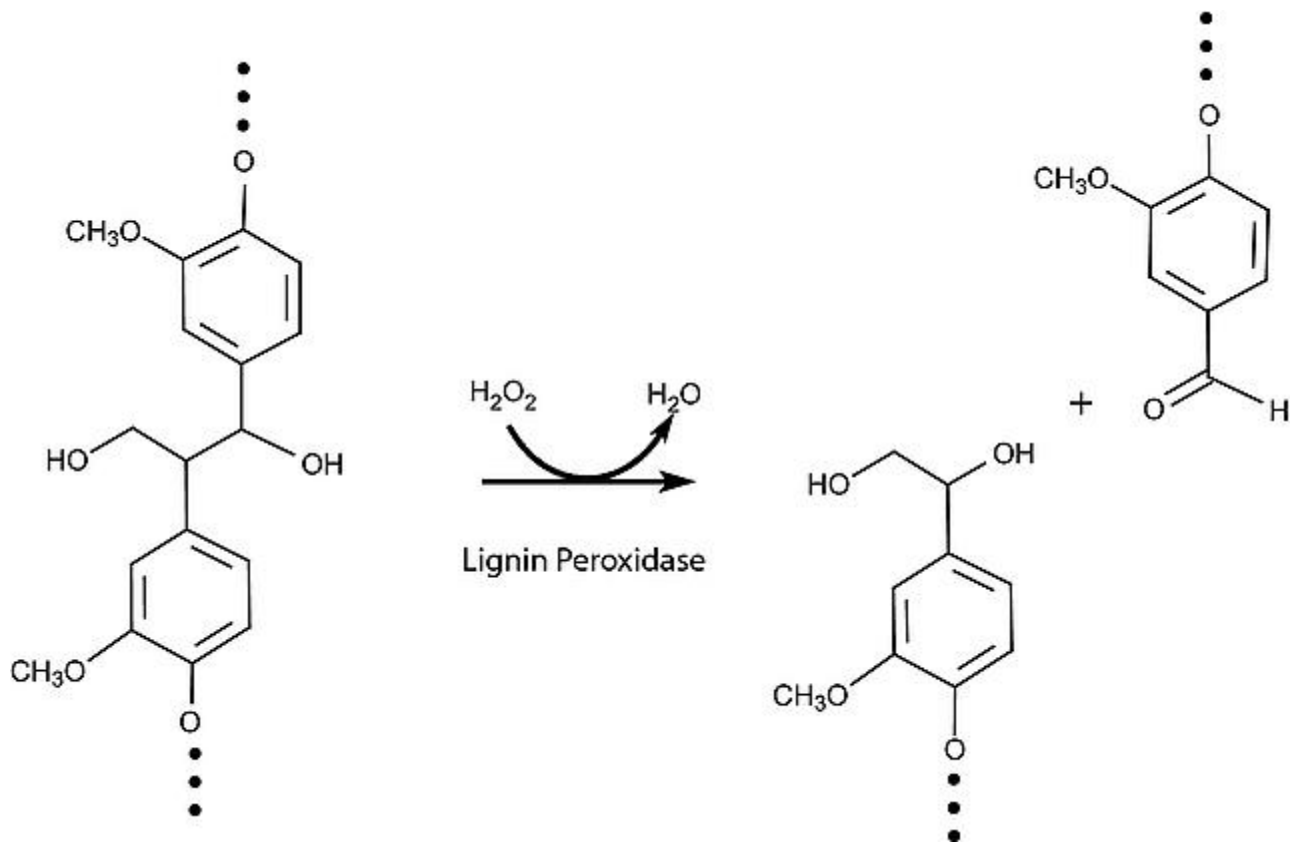


Mixtures produced commercially under different trade names,
with different compositions

E.g., Monsanto: “Aroclor”;

General Electric: “Pyranol”

1



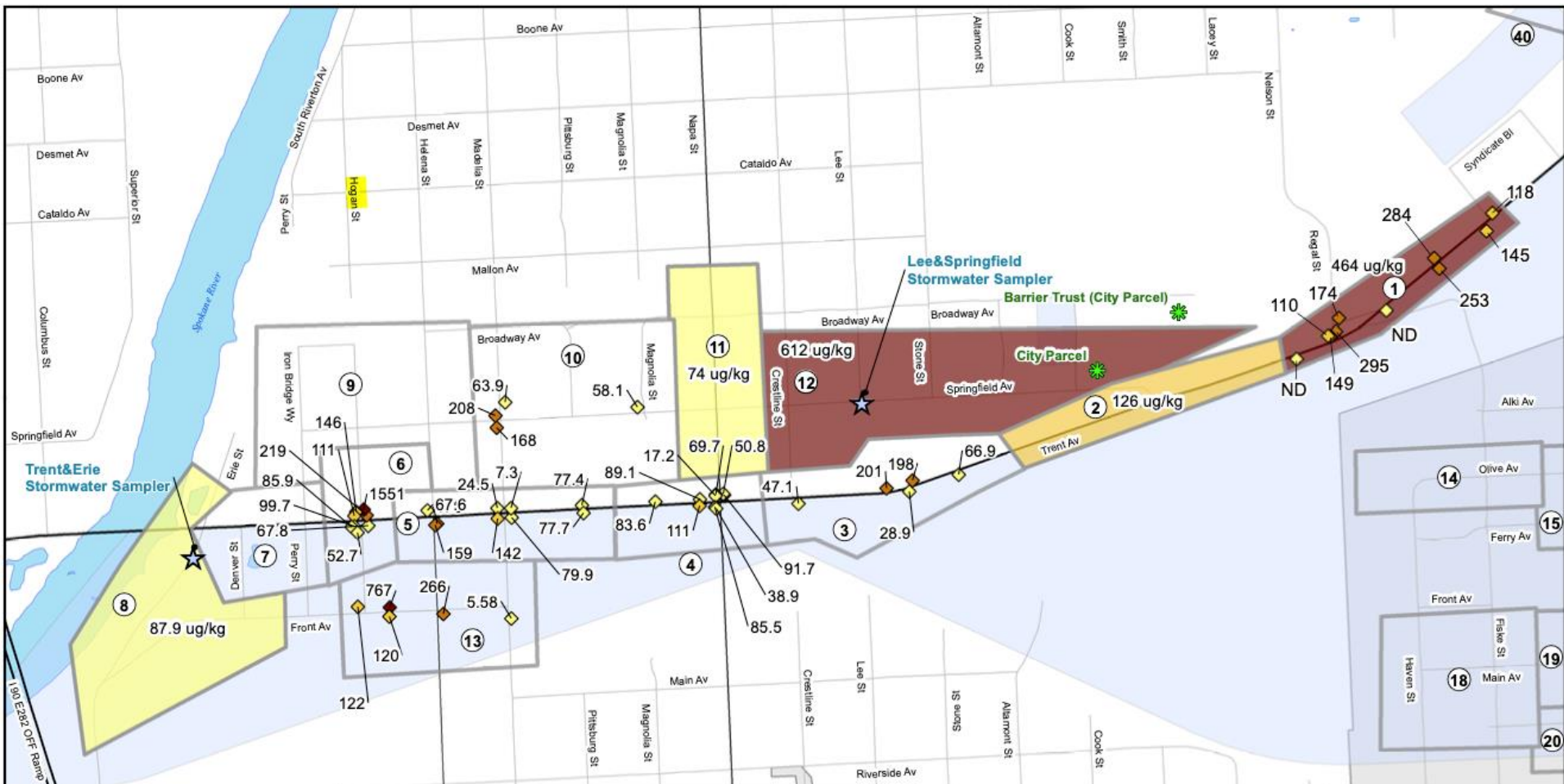


Figure 5
Union Basin
PCB Samples
2012
Congener Analysis
(Except Group 1 Individual Samples)

Legend

① Groups

2012 PCB Individuals (ug/kg)

- ◆ 5.58 - 100
- ◆ 100 - 150
- ◆ 150 - 300
- ◆ 300 - 1551

2012 PCB Composites (ug/kg)

- 74 - 100
- 100 - 150
- 150 - 300
- 300 - 612

ug/kg = ppb
 ug/kg: micrograms per kilogram
 ppb: parts per billion

Zoning

- Heavy Industrial
- CSO Basin
- CSO 34
- ★ Stormwater Sample Locations
- ✱ Ecology PCB Cleanup Sites

500 250 0 500 Feet

N
W E
S

Geographic Information System



THIS IS NOT A LEGAL DOCUMENT
 The information shown on this map is compiled from various sources and is subject to certain conditions. Information shown on this map should not be used to determine the location of facilities or structures in property lines, without their consent, etc.

Map Produced: 06/12/2014 LMS

City of Spokane Map



Legend

-  City of Spokane Boundary
-  Parcel

E. Front Ave & Hogan St
Wednesday, November 20th
9:00 am

City of Spokane GIS



THIS IS NOT A LEGAL DOCUMENT:
The information shown on this map is compiled from various sources and is subject to constant revision. Information shown on this map should not be used to determine the location of facilities in relationship to property lines, section lines, streets, etc.

Client Sample Results

Client: Les Stephens
Project/Site: Land Council/Bioremediation

Job ID: 590-14040-1

Client Sample ID: 8082A

Date Collected: 10/12/20 13:00

Date Received: 10/12/20 12:57

Lab Sample ID: 590-14040-1

Matrix: Solid

Percent Solids: 77.2

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
PCB-1221	ND		13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
PCB-1232	ND		13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
PCB-1242	ND		13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
PCB-1248	ND		13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
PCB-1254	2000		130		ug/Kg	☉	10/26/20 13:02	10/26/20 17:36	10
PCB-1260	ND	F1	13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
PCB-1268	ND		13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
PCB-1262	ND		13		ug/Kg	☉	10/26/20 13:02	10/26/20 16:12	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
Tetrachloro-m-xylene	76		22 - 131				10/26/20 13:02	10/26/20 16:12	1
Tetrachloro-m-xylene	63		22 - 131				10/26/20 13:02	10/26/20 17:36	10
DCB Decachlorobiphenyl (Surr)	72	p	32 - 133				10/26/20 13:02	10/26/20 16:12	1
DCB Decachlorobiphenyl (Surr)	75		32 - 133				10/26/20 13:02	10/26/20 17:36	10

Client Sample ID: NWTPH

Date Collected: 10/12/20 13:00

Date Received: 10/12/20 12:57

Lab Sample ID: 590-14040-2

Matrix: Solid

Percent Solids: 75.9

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics (DRO) (C10-C25)	230		130		mg/Kg	☉	10/14/20 11:24	10/14/20 13:20	10
Residual Range Organics (RRO) (C25-C36)	1700		330		mg/Kg	☉	10/14/20 11:24	10/14/20 13:20	10
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
o-Terphenyl	81		50 - 150				10/14/20 11:24	10/14/20 13:20	10
n-Triacontane-d62	101		50 - 150				10/14/20 11:24	10/14/20 13:20	10

Client Sample Results

Client: Les Stephens
Project/Site: Land Council/Bioremediation

Job ID: 590-14438-1

Client Sample ID: Bin B

Lab Sample ID: 590-14438-1

Date Collected: 01/04/21 09:00

Matrix: Solid

Date Received: 01/04/21 14:00

Percent Solids: 79.7

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1221	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1232	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1242	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1248	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1254	520		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1260	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1268	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
PCB-1262	ND		12		ug/Kg	*	01/17/21 11:09	01/17/21 13:16	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
Tetrachloro-m-xylene	83		22 - 131				01/17/21 11:09	01/17/21 13:16	1
DCB Decachlorobiphenyl (Surr)	105		32 - 150				01/17/21 11:09	01/17/21 13:16	1

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics (DRO) (C10-C25)	ND		240		mg/Kg	*	01/06/21 10:37	01/06/21 14:13	20
Residual Range Organics (RRO) (C25-C36)	1700		610		mg/Kg	*	01/06/21 10:37	01/06/21 14:13	20
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
o-Terphenyl	82		50 - 150				01/06/21 10:37	01/06/21 14:13	20
n-Triacontane-d62	88		50 - 150				01/06/21 10:37	01/06/21 14:13	20

Client Sample ID: Bin C

Date Collected: 01/04/21 09:00

Date Received: 01/04/21 14:00

Lab Sample ID: 590-14438-2

Matrix: Solid

Percent Solids: 81.3

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1221	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1232	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1242	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1248	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1254	750		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1260	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1268	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
PCB-1262	ND		12		ug/Kg	☼	01/17/21 11:09	01/17/21 13:37	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
<i>Tetrachloro-m-xylene</i>	72		22 - 131				01/17/21 11:09	01/17/21 13:37	1
<i>DCB Decachlorobiphenyl (Surr)</i>	98		32 - 150				01/17/21 11:09	01/17/21 13:37	1

Method: NWTPH-Dx - Northwest - Semi-Volatile Petroleum Products (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics (DRO) (C10-C25)	240		240		mg/Kg	☼	01/06/21 10:37	01/06/21 14:33	20
Residual Range Organics (RRO) (C25-C36)	1600		610		mg/Kg	☼	01/06/21 10:37	01/06/21 14:33	20



Analysis of Mycoremediation of Soil Pollutants

Jenna Janke, Nick Heimbigner, Rachel Harwood | Daniel Shay | North Central Institute of Science and Technology



RESEARCH QUESTION

What are the specific adaptations and qualities of the soil consortium that lead to more efficient mycoremediation of soil pollutants?

BACKGROUND

- Mycoremediation: utilization of fungal lignin-degrading enzymes for the breakdown of soil pollutants.
- Fungi possess oxidative peroxidases and other ligninolytic enzymes that can degrade a diverse range of toxic xenobiotics. (e.g. PAHs, chlorophenols, PCBs, synthetic dyes) in addition to lignin.
- Hydrocarbon pollutants pose a considerable threat to human health and the Spokane watershed.

HYPOTHESES

- We predict that there are native fungal species capable of hydrocarbon degradation.
- As the total quantity of remediators present in the soil increases as indicated by a rise in total soil DNA, the extent of pollutant reduction will increase.

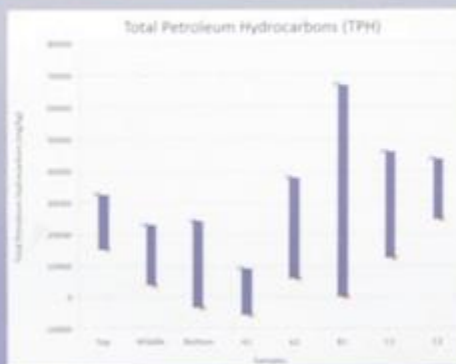


METHODS



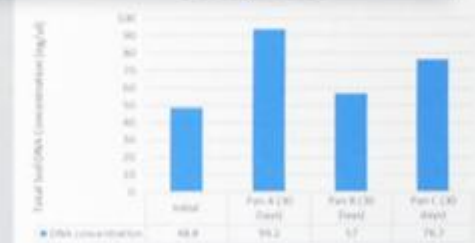
- TPH values were statistically analyzed with a one-sample t^* interval.

RESULTS



- Total petroleum hydrocarbons over the 30-period
- TPH value falls within range with 95% certainty

North Central High School students' poster describes their scientific process.



- Total soil DNA concentration over the 30-day period

CONCLUSIONS AND FURTHER RESEARCH

- There is a possible correlation between rise in total soil DNA and reduction in total petroleum hydrocarbons.
- At this time, we are not able to definitively conclude that there has been a reduction in total petroleum hydrocarbons from the initial extract to the 30-day period.
- There is no data suggesting that the nitrogen or inoculant increased the reduction of TPH.
- Further research will explore the connection between total soil DNA concentration and extent of hydrocarbon reduction.
- We intend to implement several design changes:
 - Larger sample size (more GC data)
 - One extraction per pan
 - Larger starting soil volume
 - Determine margin of error derived from GC detection sensitivity

ACKNOWLEDGEMENTS

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- Steve Fisk, NCHS
- Kaiser Aluminum

Questions



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