VAST challenge 2018 Mini Challenge 2 Data Visualisation with JavaScript

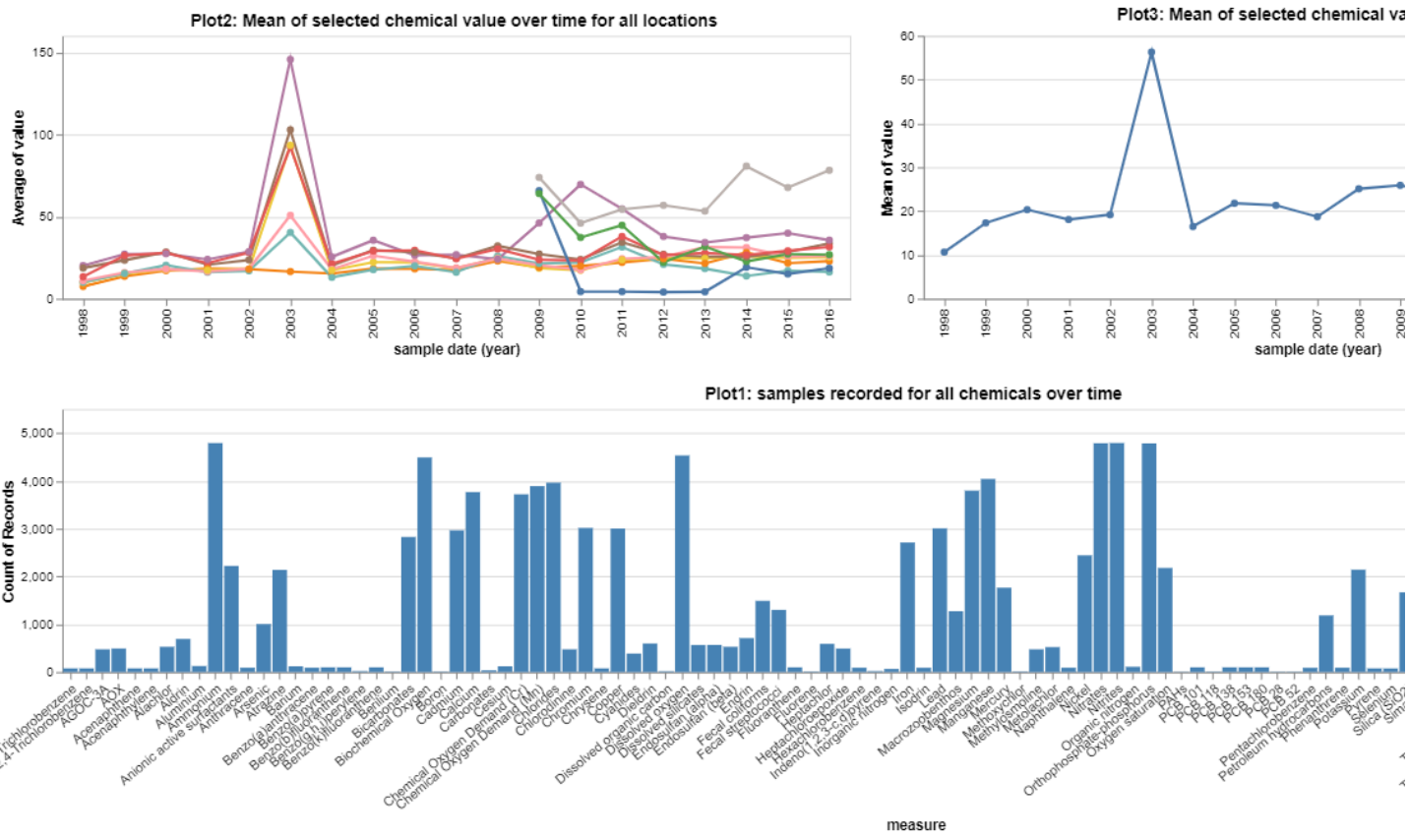
Question No. 1: Characterize the past and most recent situation with respect to chemical contamination in the Boonsong Lekagul waterways.

Finding (Pattern over time and location)

Below interactive dashboard shows one bar plot and two line plot. Plot1 shows bar chart of the total number of chemicals recorded over the time. Plot2 shows line chart for mean value of selected chemical for all locations over time.Plot3 which is also line chart shows average value for selected chemical over time. We can clearly see from plot1 shows there is no consistency at all in recording all chemicals. So, It isvery difficult to compare all chemicals for their contamination in water over time
Plot 2 and plot there is pattern of slighly high and low for all chemicals on all locations
However, Tansanee, Kohsoom and Achara shows abrupt peaks and low after 2009.
It also shows that sampling started at Tansanee, Achara and Decha in 2009.
There is strange peak which can be seen in Plot2 and Plot 3 for all locations from 2002-2004 except Boonsri.

1. Narrowing down on chemicals with interesting findings

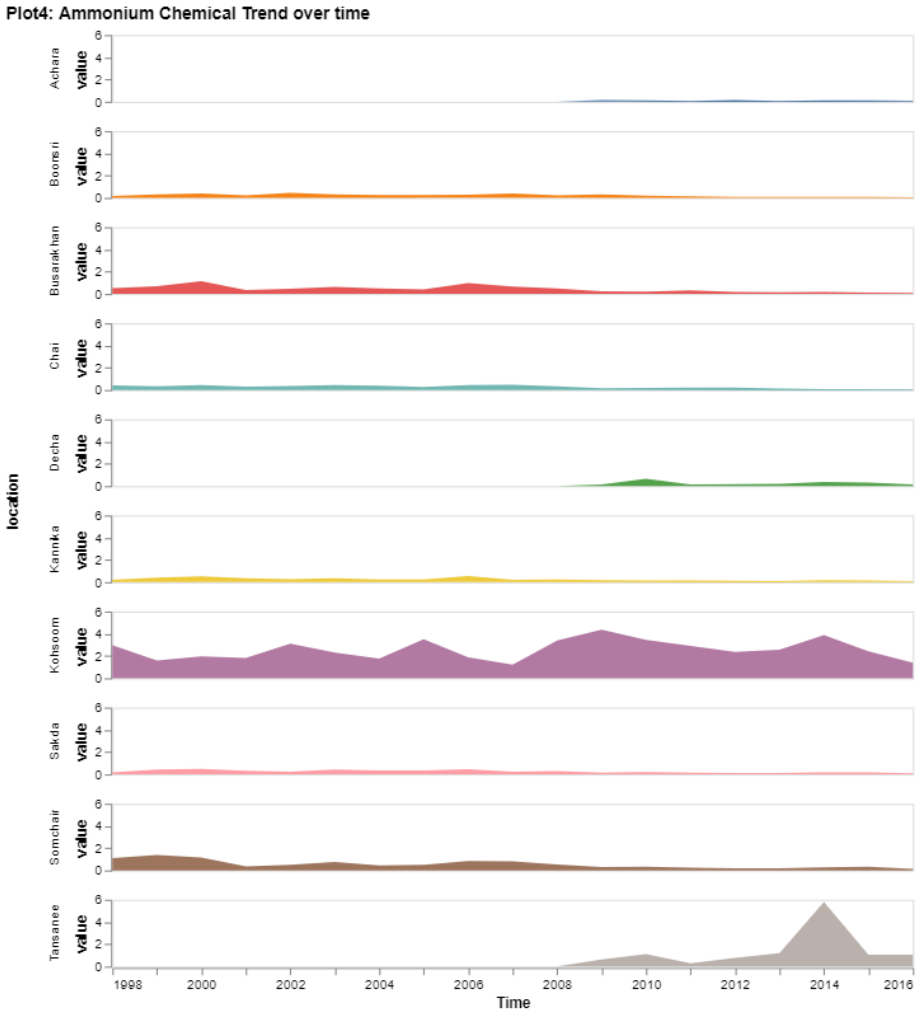
AmmoniumPlot3 shows decreasing pattern over time for Ammonium.
Arsenic On selecting Arsenic on plot1, Plot3 shows increasing pattern for Arsenic suffered highest peak very recently in 2015.
Lead Lead shows very sharp increase in 2000 recording highest peak. After 2000, It decreased suddenly from average value 30 to around 3 by the end of period.
Nitrates: Overall there is decreasing pattern comparing start and end of period.
Orthophosphate-phosphorus: Overall this chemical decreased but suffered highest peak between 2005 and 2015. Kohsoom and Boonsri shows abrupt increase and decrease for this chemical over time.Kohsoom having highest peak in 2014. Achara saw huge decrease in Orthophosphate-phosphorus.
Water Temperature: Overall there is slight increase in the temperature at the end as compared to start value.

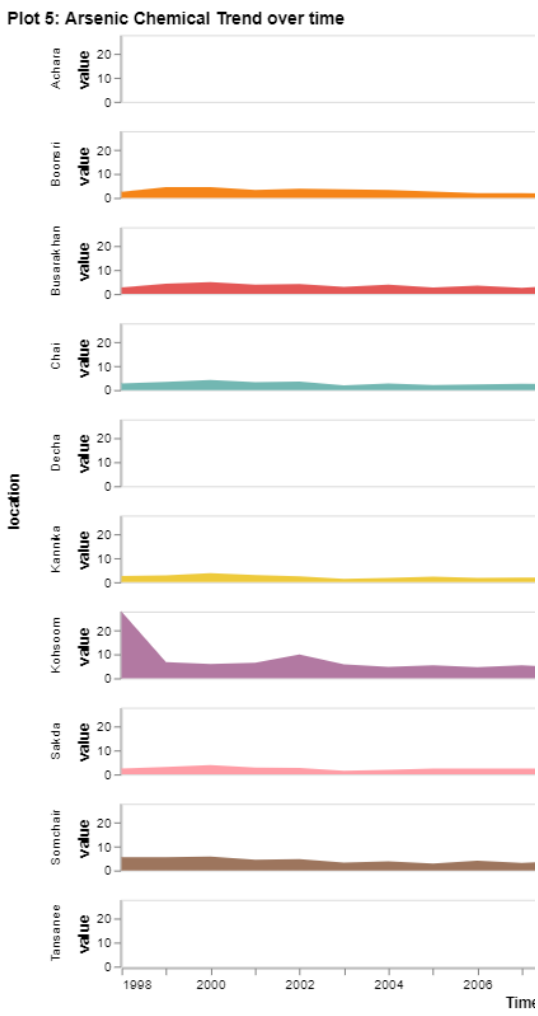


2. Narrowing down on chemicals across location

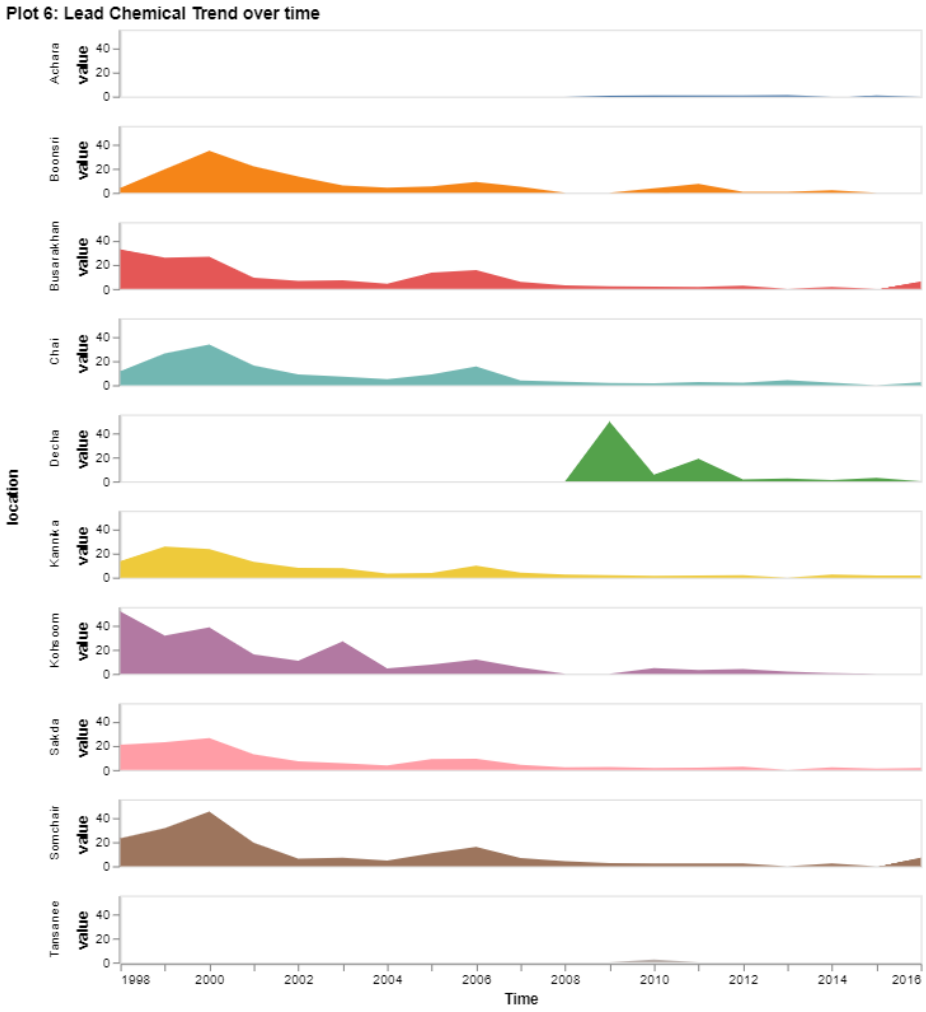
Faceting (Trellis Area) advanced feature has been used to display multiple plots for subgroups of same data with different location.

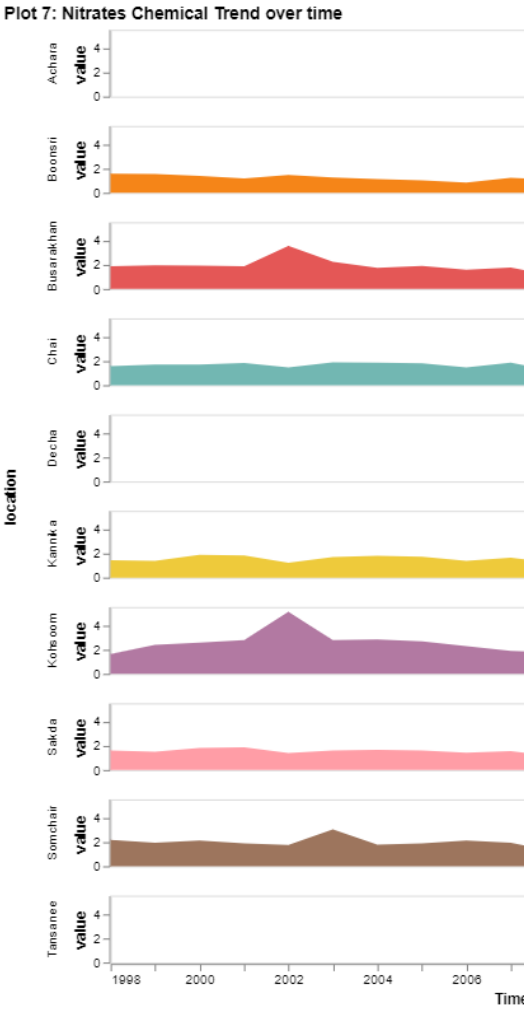
Ammonium: Plot4 shows Ammonium contamination had highest spike for Tansanee in 2014 and Kohsoom shows ups and down over the time.
Arsenic: Plot5 shows also decreasing pattern for this chemical on all location however, Tansanee has highest spike by the end of period in 2016.



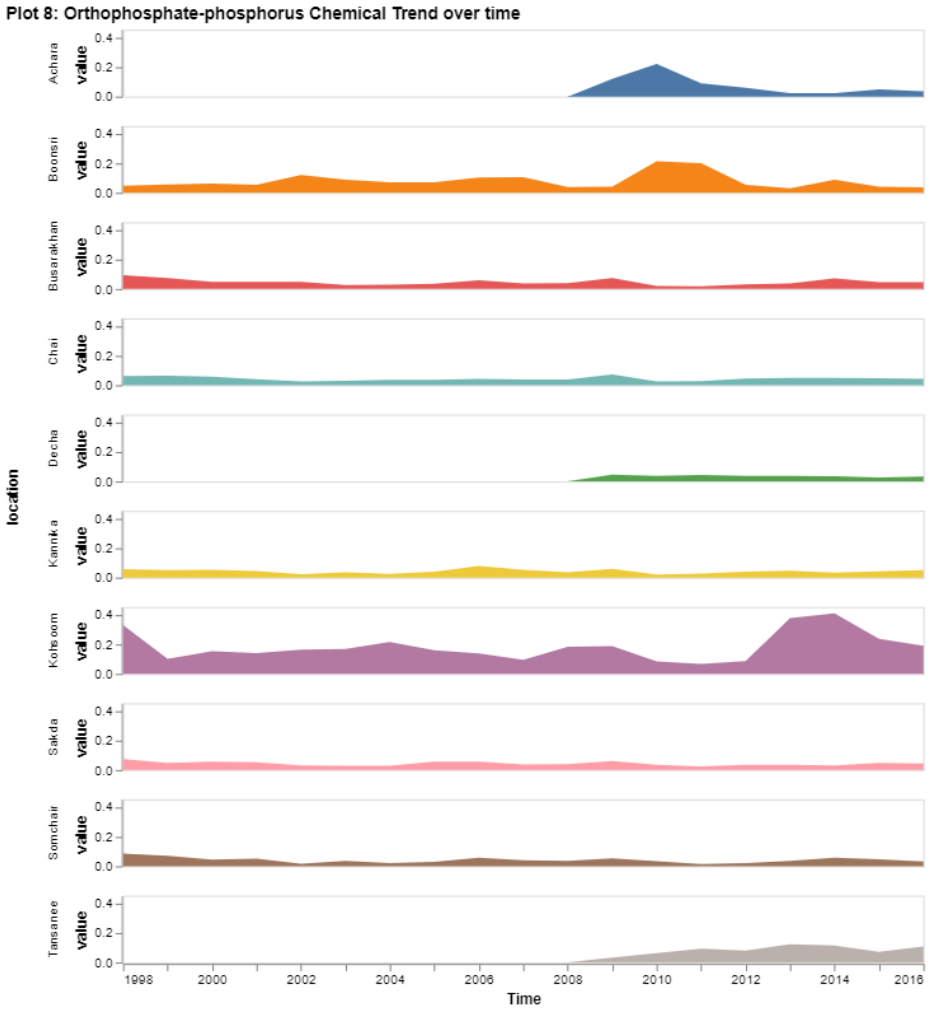


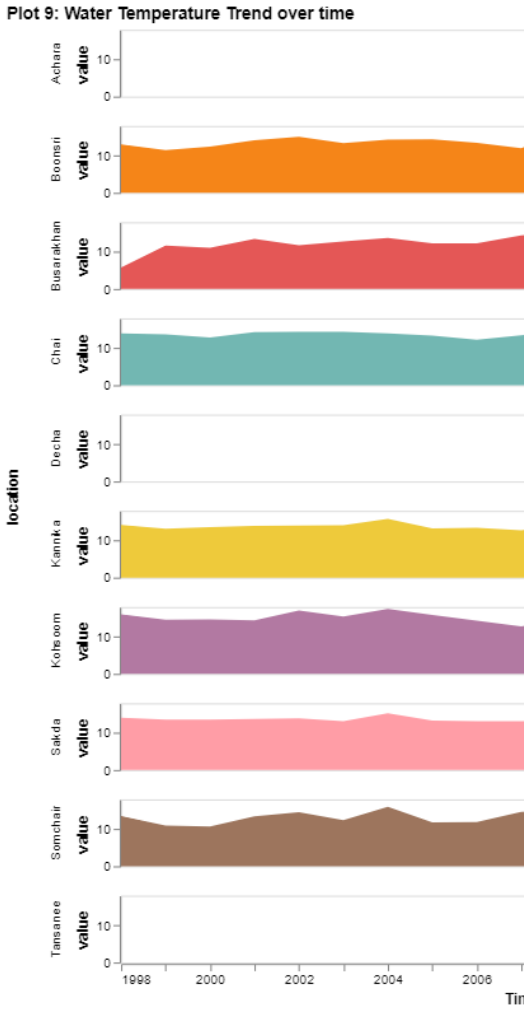
Lead: ALL location shows decreasing pattern for Lead. However, Busarakhan and Somchairr shows slightly increase by the end of period in 2016
Nitrates: Highest value of Nitrates is observed at Kohsoom. However, Kohsoom, Busarakhan, Somchair has spikes during 2001-2004 and Tansanee shows high spike in 2014





Orthophosphate-phosphorus: Kohsoom shows highest value for this chemical over the time recorded highest peak from 2012-2014. Kohsoom and Tansanee shows increase in value by the end of period. Achara and Boonsri had peaks 2008-2012
Water temperature: Overall there is very slight increase in water temperature on all locations.





2. Marks and Channels

1. Plot1:Bar chart: **Mark** 1D Line **Channel**:
Position (Horizontal position: categorical, Vertical position (quantitative)) and length**Why Effective?**
Becuause the purpose was to find the total samples recorded for each column.Its is discrete analysis and clearly shows count for different chemicals.
2. Plot2 and Plot3: Line Chart **Mark**
1D:Line, Points **Channel**
Size (length) and Color(Categorical Attribute)
Why Effective? To find increasing or decreasing pattern, line chart is best option considering temporal variable at x-axis. Its suitable to look for trend over time
3. Plot 4-9: Trellis Area **Mark**
2D: Area **Channel**
color (Location) and Size Area (value attribute)
Why effective Used area chart to instead of line chart to see the clearly the shaded area to check the average value of each chemical measured on locations.

3. Advanced Features

1. Interactive Dashboard with crosshighlight Plot1, 2, 3 uses Dashbaord to horizontally concatenate two line charts and one bar chart vertically. Dashboard uses selection of one bar and also changes other two line charts.
2. Tooltip to display values on place mouse.
3. Facets (Trellis Area) Plot 4- 9 uses repeat area chart for all locations

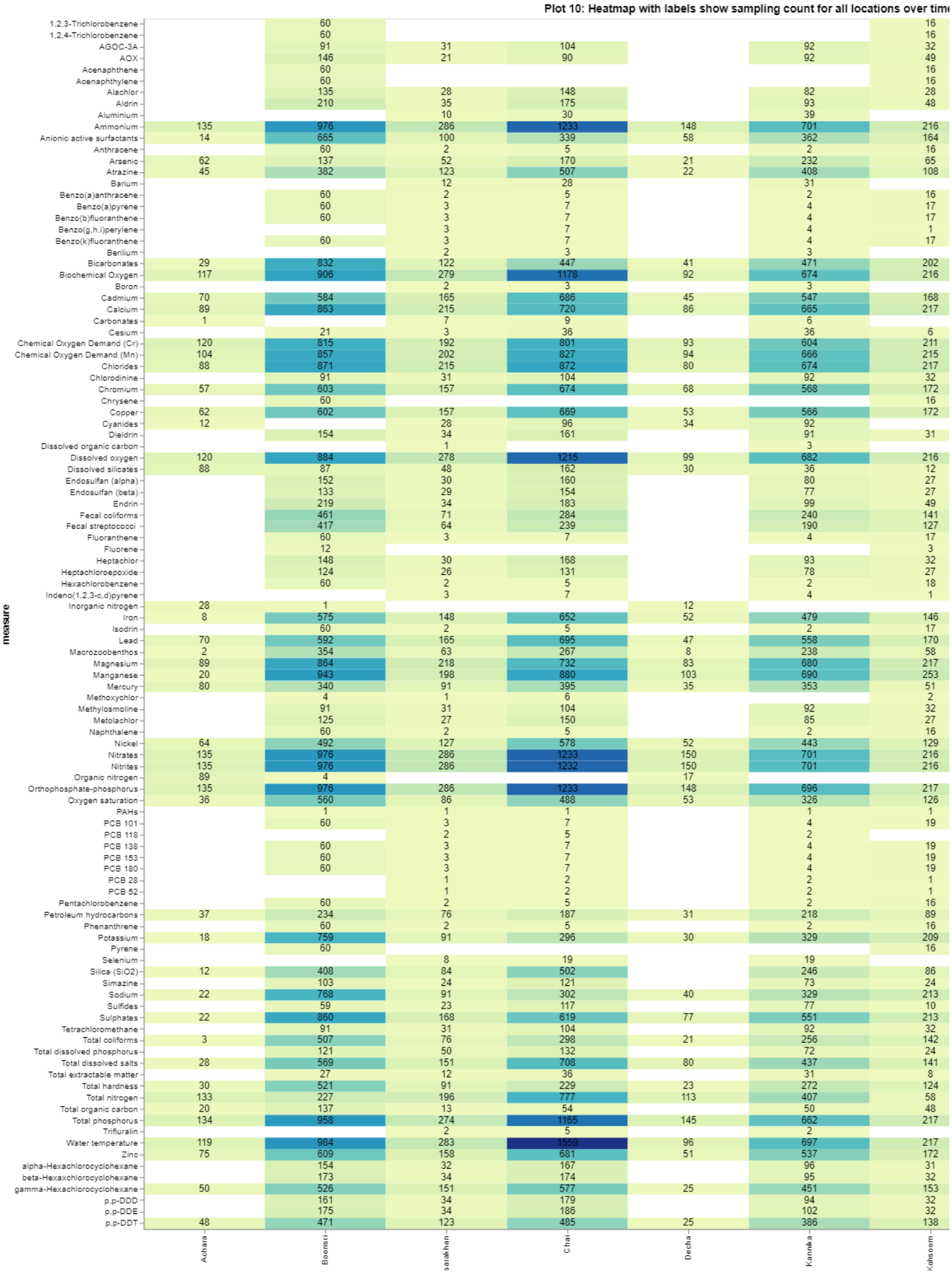
Question#2 Anomalies

What anomalies do you find in the waterway samples dataset? Is the Hydrology Department collecting sufficient data to understand the comprehensive situation across the reserve?

Finding(Inconsisteny in data collection)

1. Number of samples for all chemical on all locations

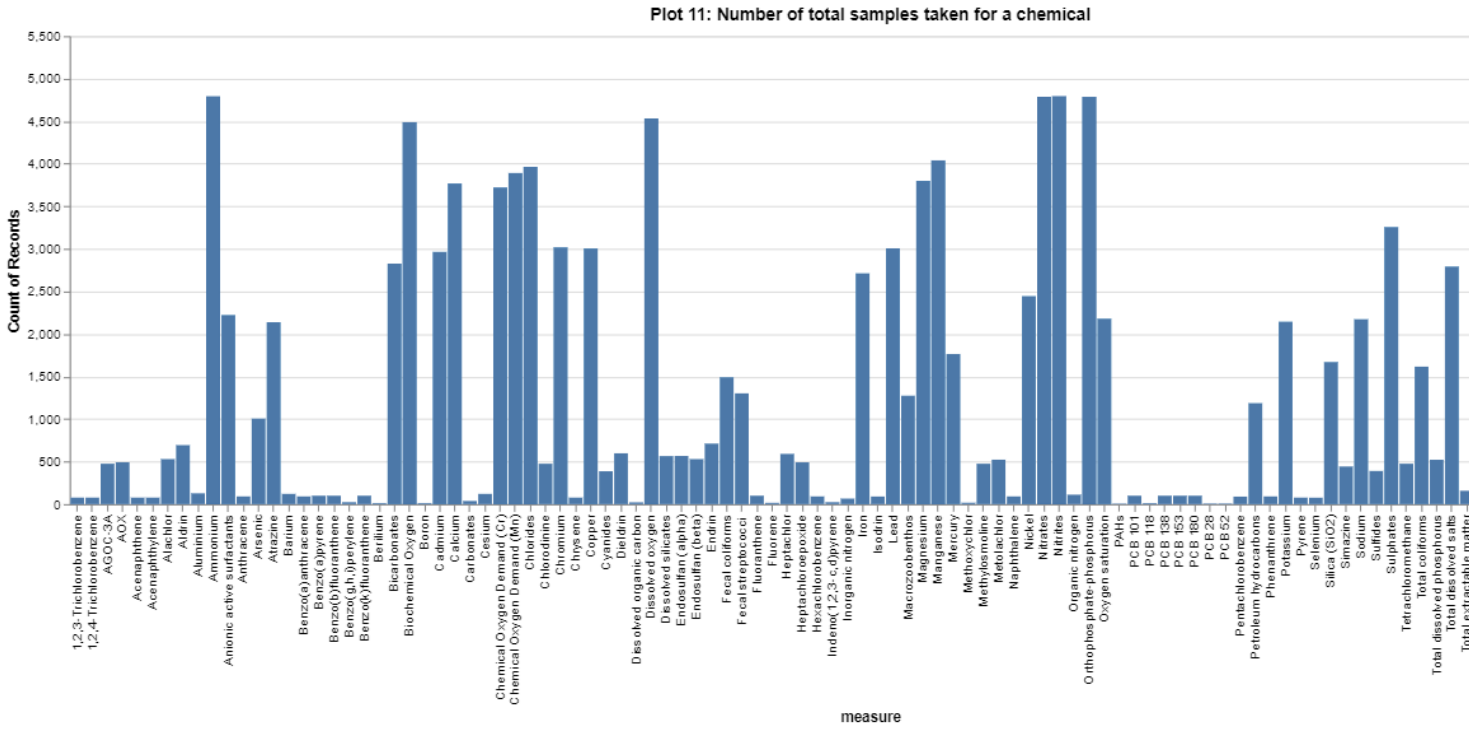
The below heatmap shows inconsistency in taking chemicals samples on different locations.Achara, Decha and Tansanee shows more white space for all chemicals which indicates the hydrology department didn't take samples on thses location for most of chemicals. To check contamination of chemicals in water, the censors on all should take samples consistently of all chemicals.


Plot 10: Heatmap with labels show sampling count for all locations over time
measure
1,2,3-Trichlorobenzene 60 16
1,2,4-Trichlorobenzene 60 16
AGOC-3A 91 31 104 92 32
AOX 146 21 90 92 49
Acenaphthene 60 16
Acenaphthylene 60 16
Alachlor 135 28 148 82 28
Aldrin 210 35 175 93 48
Aluminium 10 30 39
Ammonium 135 976 286 1233 148 701 216
Anionic active surfactants 14 665 100 339 58 362 164
Anthracene 60 2 5 2 16
Arsenic 62 137 52 170 21 232 65
Atrazine 45 382 123 507 22 408 108
Barium 12 28 31
Benzo(a)anthracene 60 2 5 2 16
Benzo(a)pyrene 60 3 7 4 17
Benzo(b)fluoranthene 60 3 7 4 17
Benzo(g,h,i)perylene 3 7 4 1
Benzo(k)fluoranthene 60 3 7 4 17
Berilium 2 3 3
Bicarbonates 29 832 122 447 41 471 202
Biochemical Oxygen 117 906 279 1178 92 674 216
Boron 2 3 3
Cadmium 70 584 165 686 45 547 168
Calcium 89 863 215 720 86 665 217
Carbonates 1 7 9 6
Cesium 21 3 36 36 6
Chemical Oxygen Demand (Cr) 120 815 192 801 93 604 211
Chemical Oxygen Demand (Mn) 104 857 202 827 94 666 215
Chlorides 88 871 215 872 80 674 217
Chlorodinine 91 31 104 92 32
Chromium 57 603 157 674 68 568 172
Chrysene 60 16
Copper 62 602 157 669 53 566 172
Cyanides 12 28 96 34 92
Dieldrin 154 34 161 91 31
Dissolved organic carbon 1 3
Dissolved oxygen 120 884 278 1215 99 682 216
Dissolved silicates 88 87 48 162 30 36 12
Endosulfan (alpha) 152 30 160 80 27
Endosulfan (beta) 133 29 154 77 27
Endrin 219 34 183 99 49
Fecal coliforms 461 71 284 240 141
Fecal streptococci 417 64 239 190 127
Fluoranthene 60 3 7 4 17
Fluorene 12 3
Heptachlor 148 30 168 93 32
Heptachloroepoxide 124 26 131 78 27
Hexachlorobenzene 60 2 5 2 18
Indeno(1,2,3-c,d)pyrene 3 7 4 1
Inorganic nitrogen 28 1 12
Iron 8 575 148 652 52 479 146
Isodrin 60 2 5 2 17
Lead 70 592 165 695 47 558 170
Macrozoobenthos 2 354 63 267 8 238 58
Magnesium 89 864 218 732 83 680 217
Manganese 20 943 198 880 103 690 253
Mercury 80 340 91 395 35 353 51
Methoxychlor 4 1 6 2
Methylosmoline 91 31 104 92 32
Metolachlor 125 27 150 85 27
Naphthalene 60 2 5 2 16
Nickel 64 492 127 578 52 443 129
Nitrates 135 976 286 1233 150 701 216
Nitrites 135 976 286 1232 150 701 216
Organic nitrogen 89 4 17
Orthophosphate-phosphorus 135 976 286 1233 148 696 217
Oxygen saturation 36 560 86 488 53 326 126
PAHs 1 1 1 1 1
PCB 101 60 3 7 4 19
PCB 118 2 5 2
PCB 138 60 3 7 4 19
PCB 153 60 3 7 4 19
PCB 180 60 3 7 4 19
PCB 28 1 2 2 1
PCB 52 1 2 2 1
Pentachlorobenzene 60 2 5 2 16
Petroleum hydrocarbons 37 234 76 187 31 218 89
Phenanthrene 60 2 5 2 16
Potassium 18 759 91 296 30 329 209
Pyrene 60 16
Selenium 8 19 19
Silica (SiO2) 12 408 84 502 246 86
Simazine 103 24 121 73 24
Sodium 22 768 91 302 40 329 213
Sulfides 59 23 117 77 10
Sulphates 22 860 168 619 77 551 213
Tetrachloromethane 91 31 104 92 32
Total coliforms 3 507 76 298 21 256 142
Total dissolved phosphorus 121 50 132 72 24
Total dissolved salts 28 569 151 708 80 437 141
Total extractable matter 27 12 36 31 8
Total hardness 30 521 91 229 23 272 124
Total nitrogen 133 227 196 777 113 407 58
Total organic carbon 20 137 13 54 50 48
Total phosphorus 134 958 274 1165 145 662 217
Trifluralin 2 5 2
Water temperature 119 984 283 1559 96 697 217
Zinc 75 609 158 681 51 537 172
alpha-Hexachlorocyclohexane 154 32 167 96 31
beta-Hexaxchlorocyclohexane 173 34 174 95 32
gamma-Hexachlorocyclohexane 50 526 151 577 25 451 153
p,p-DDD 161 34 179 94 32
p,p-DDE 175 34 186 102 32
p,p-DDT 48 471 123 485 25 386 138
Achara
Boonsri
sarakhan
Chai
Decha
Kannika
Kohsoom

location

2. Number of samples taken for each chemical

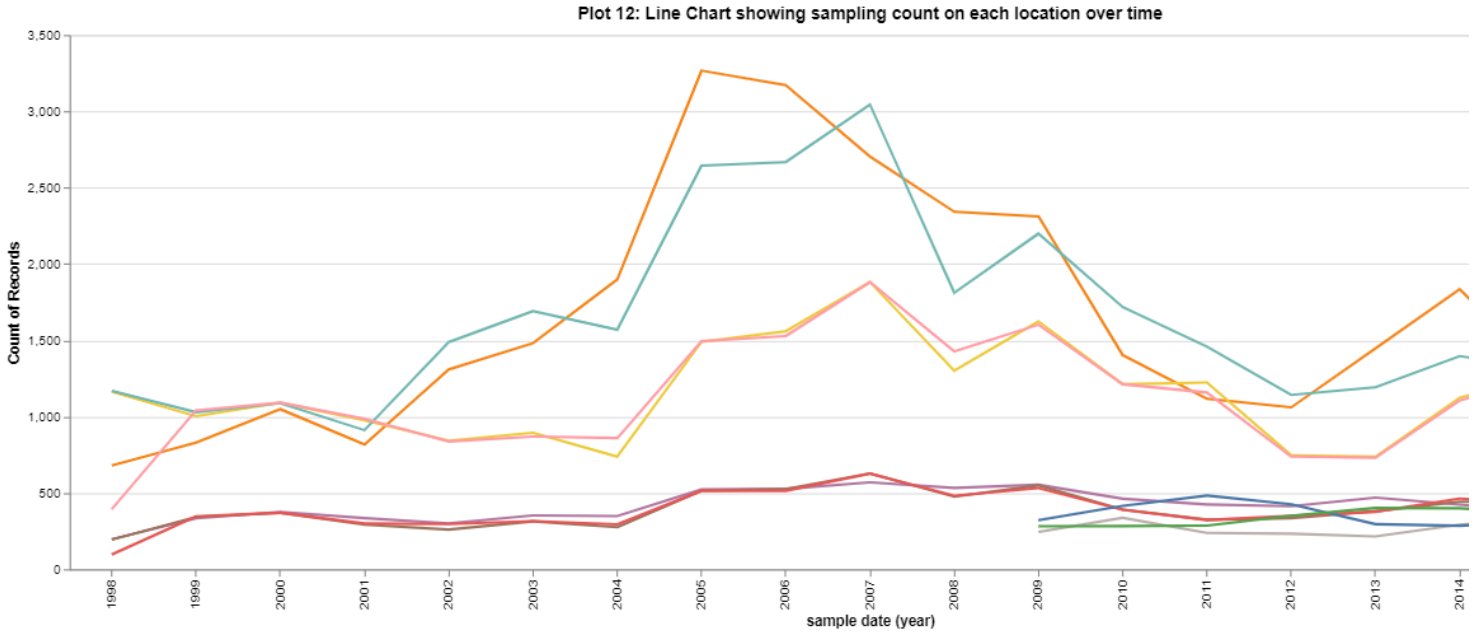
Bar plot below shows total number of samples collected for each chemical. This plot shows difference in number of samples collected for each chemical.
1.Minimum number of samples collected for a chemical= 7
2.Maximum number samples for one chemical=5031
3.For 18 chemicals, samples count >3000 have been collected
4.For 35 chemicals, samples count <100



locc_location null

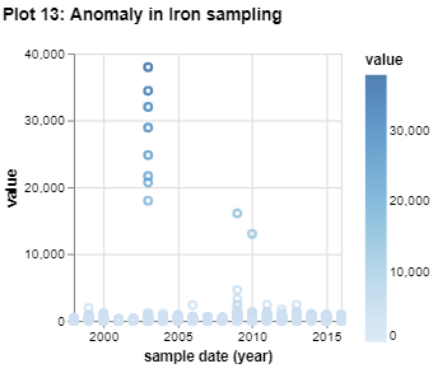
3. Number of samples recorded in a year on all locations

The line chart below shows the inconsistency of samples taken on each location.
1. Highest number of samples taken on Boonsri and chai during 2004-2009.
2. Almost same number of samples taken on Kannika and Sakda and highest number of samples taken during 2004-2011.
3. Somchair, Busarakhan and Kohsoom shows same samples count over the period having peak from 2005-2009
4. The hydrology department started sampling at Decha, Achara and tansanee in 2009 and the sample count is lowest as compared to other locations. The reason to start taking samples late could be because these three locations are far from dumping location.

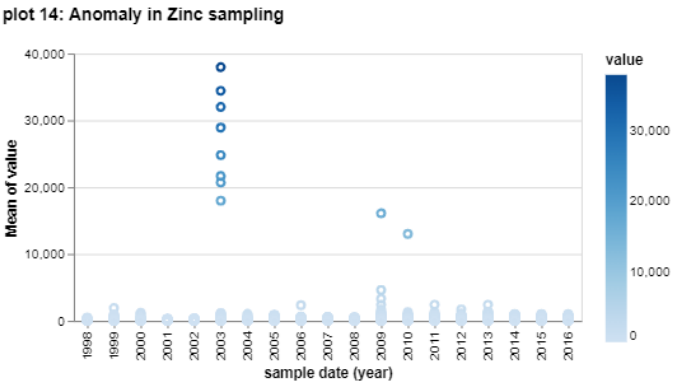


4. Strange Sampling of Chemicals during 2002-2004

The below dot plot13 and 14 with brushing to output data shows totally same values for two different chemicals Iron and zinc samples. The value is outlier as compared to other values , that might be happened because of sensors not working properly.
Happened on 15th Auguest, 2003 on Kohsoom, Chai, Somchair, Busarakhan, Kannika and Sakda.



Location	sample date	value
Boonsri	Jan 11, 1998	2
Boonsri	Jan 11, 1998	9.1
Boonsri	Jan 11, 1998	0.33
Boonsri	Jan 11, 1998	0.01
Boonsri	Jan 11, 1998	1.47
Boonsri	Jan 11, 1998	0.06
Boonsri	Jan 11, 1998	0.09
Boonsri	Jan 11, 1998	13.9
Boonsri	Jan 11, 1998	3.5
Boonsri	Jan 11, 1998	52
Boonsri	Jan 11, 1998	9.7
Boonsri	Jan 11, 1998	19.2
Boonsri	Jan 11, 1998	36.7
Boonsri	Jan 11, 1998	4.95
Boonsri	Jan 11, 1998	0.01
Boonsri	Jan 11, 1998	21
Boonsri	Jan 11, 1998	22
Boonsri	Jan 11, 1998	17
Boonsri	Jan 11, 1998	0



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Boonsri	Jan 11, 1998	1.47
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Boonsri	Jan 11, 1998	0.09
Boonsri	Jan 11, 1998	13.9
Boonsri	Jan 11, 1998	3.5
Boonsri	Jan 11, 1998	52
Boonsri	Jan 11, 1998	9.7
Boonsri	Jan 11, 1998	19.2
Boonsri	Jan 11, 1998	36.7
Boonsri	Jan 11, 1998	4.95
Boonsri	Jan 11, 1998	0.01
Boonsri	Jan 11, 1998	21
Boonsri	Jan 11, 1998	22
Boonsri	Jan 11, 1998	17
Boonsri	Jan 11, 1998	0

2. Marks and Channels

1. Plot 10:Heatmap: **Mark** Area **Channel** : color saturation by quantitative attribute(count) and two categorical attribute (measure, location)
Why effective It is best suitable for more than two variables analysis as I used heatmap to show total samples count for all chemicals and for all locations as bar chart shows between one catgeorical and one quantitative.
2. Plot 11: Bar Chart **Mark** Line 1D**Channel** Length and size
Why effective Same as question No.1 bar chart plot
3. Plot 12: line chart **Mark** 1D: line **Channel** color (Location) and lenght is used to show trend for count of samples.
4. Plot 13 & 14: Dot plot **Mark** 0D :point **Channel** Vertical and horizontal position, Color Saturation(value)
Why effective? I used dot plot specifically to dispaly outliers in sampling for chemicals and using brushing to see data for these outliers.

3. Advanced Features

1. Layered plot(Labeling and Annotation) Plot 10 : Heatmap has layering of text which shows sampling count of a chemical for a location.
2. Tooltip to display values on place mouse.
3. Query Widget Plot 11 bar chart has Query Widget for selecting one location.
4. Brushing to output data in table Plot 13 and 14 is dot plot with brushing to show data in table form for anomlous data in the plot.

Question No. 3.

After reviewing the data, do any of your findings cause particular concern for the Pipit or other wildlife?

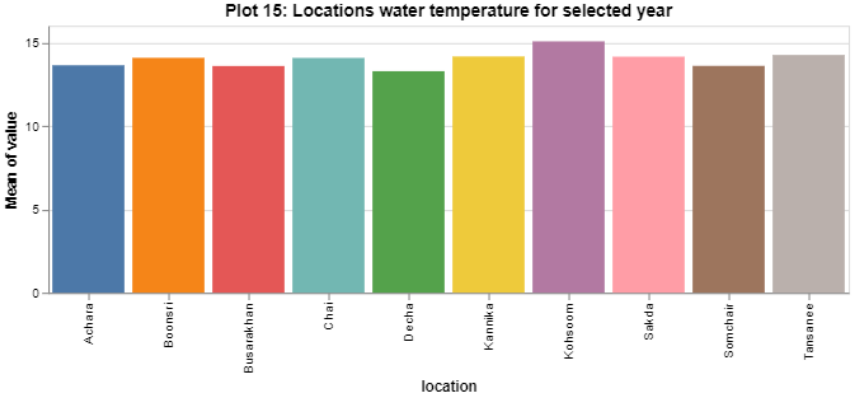
Finding(Concern for Wildlife)

There are some chemicals which are dangerous for wildlife.
Ammonium, Arsenic, Lead, Nitrites, Orthophosphate-phosphorus, Selenium and rising water temperature[1].
Ammonium , Lead, Nitrates, Orthophosphate-phosphorus decreased over time. So these are not concern.
However, water temperature, Arsenic and Selenium is of concern because they have increasing pattern and more pollutents for wildlife.

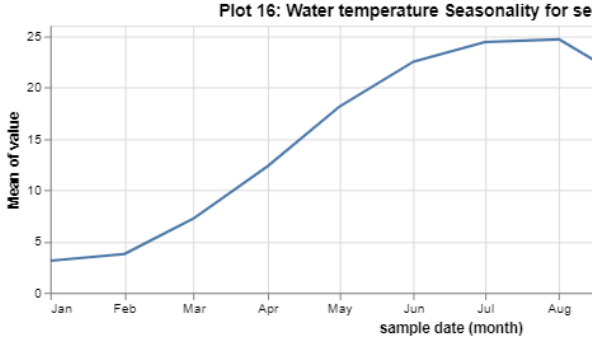
1. Rising temperature of water over time

Plot 17 shows higher average temperature recorded in 2003, 2004 and end of period in 2016.
Narrowing on 2016, plot 15 shows average temperature for all location in 2016. Boonsri, Achara, kohsoom and Tansanee shows average temperature above 15c.
For 2016, plot 16 shows the average temperature for all months. After feb, there is sudden increase in temperature recorded peak in august and decreased till december.
Plot 18: shows circle size to represent higher temperature value and color grouping locations based on temperature value.
Kohsoom is near dupping site, showing highest value for temperature in yellow color. Then, green, red, orange in order of large to small value.

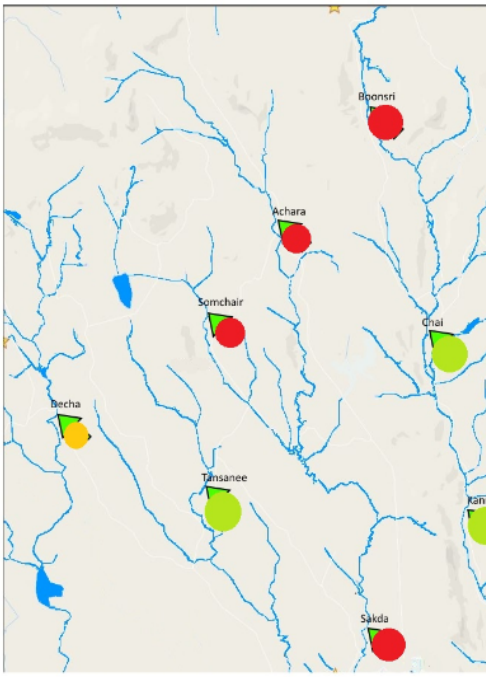
Plot 15: Locations water temperature for selected year



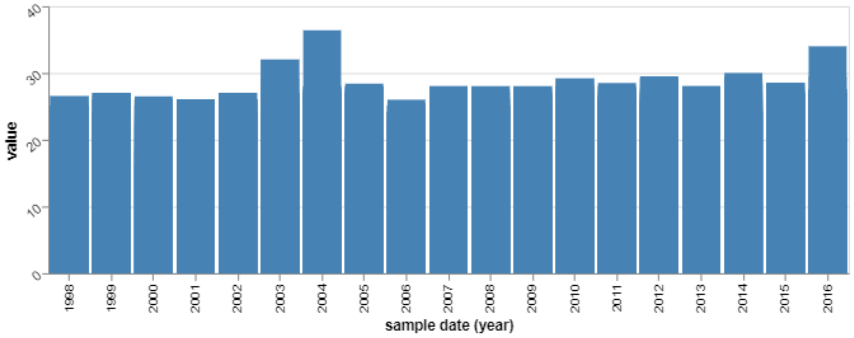
Plot 16: Water temperature Seasonality for se



Plot 18: Water Temperature on Map



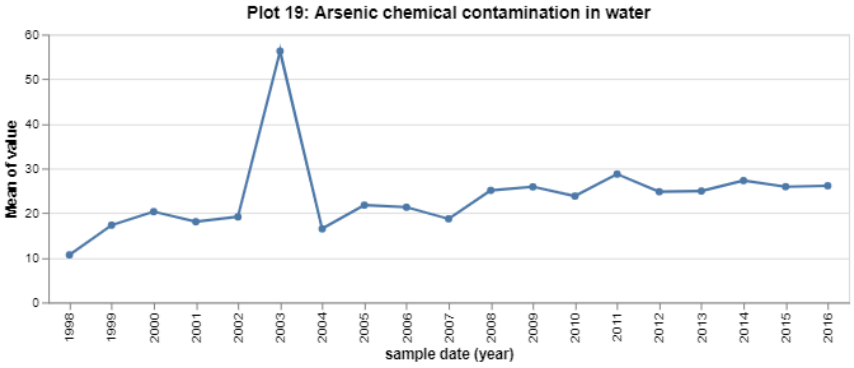
Plot 17: Average water temperature over the time

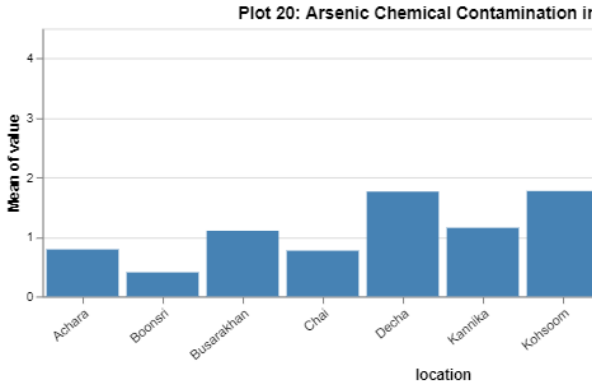


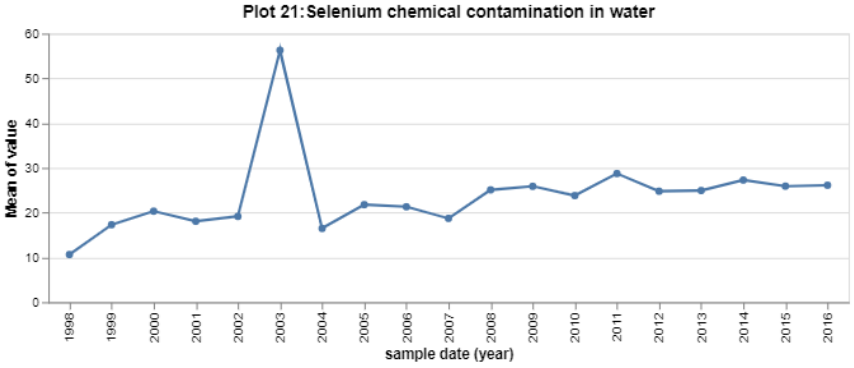
y 0

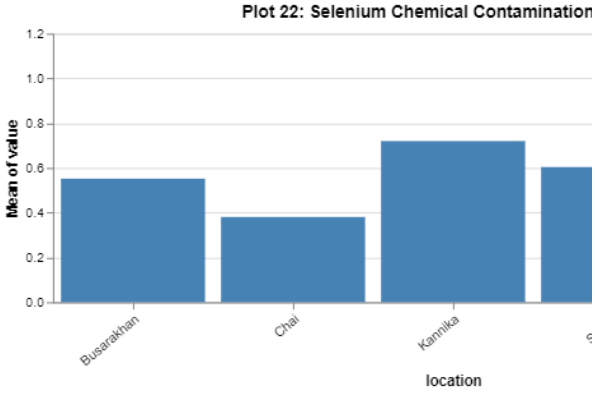
2. Arsenic and Selenium increased contamination in Water

As mentioned above Arsenic is concern for wildlife. Its contamination should be reduced.
Plot 19 shows Arsenic value has slightly increased from start by the end of period.
Plot 20 shows that Tansanee has highest value above 4 which is the location of concern.
Plot 21 shows slight increase by the end of the period in Selenium value. plot 22 shows Somchair shows highest contamination of this chemical. This chemical is recorded orobserved only on five locations









2. Marks and Channels

1. Plot 15, 17, 20, 22: Bar Chart **Mark** Line 1D**Channel** Length and size,color is used for because of one categorical and one quantitaive data.
2. Plot 12: line chart **Mark** 1D: line **Channel** lenght is used to show trend for chemicals and water temperature seasonality.
3. Map image display for showing the locations which has high temperature are near dumping location.

3. Advanced Features

1. Interactive dashboard with selection Plot 15, 16, 17 uses dashboard with crossfilter.
2. Tooltip to display values on place mouse.
3. Filtering Plot 19-22 uses filter the two chemicals out of all.

Conclusion

1. After detailed analysis, the first question raise more concerns for Kohsoom and Tansanee which are having high contamination of chemicals as compared to other locations.
2. The inconsistency in taking the samples of chemicals on different locations. On all locations sampling should be done in sequence with the flow of water in the reserve.
3. There is decreasing pattern in some dangerous chemicals level for wildlife but some new dangrous are increasing in pattern leaving concern for wildlife.
4. Sampling should be taken first on location near dumping and then where it flows to other location to check contamination for same chemical.

Reference1. https://www.sepa.org.uk/media/120299/chemistry-of-water-pollution.pdf 2. http://www.vacommunity.org/VAST+Challenge+2018+MC2