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# **CHAPTER FOUR (4)**

## **4.0 RESULT**

### 4.1 Identification of fish species present in river Wiwi

KINDLY ADD THE IDENTIFICATION TABLE I SPOKE TO YOU ABOUT. THAT WILL BE ALL FOR THE CHAPTER FOUR (4) TO BE COMPLETE

### 4.2 Relative abundance and distribution patterns of fish species in river Wiwi

#### 4.2.1 Relative abundance of fish in each of the streams

The graph presents data on the abundance of three fish species—Oreochromis aureus, Oreochromis niloticus, and Clarias gariepinus—in upstream, midstream, and downstream sections of a water body. In the upstream section, Oreochromis aureus is the most abundant with 129 individuals, followed by Oreochromis niloticus with 5 individuals, and Clarias gariepinus with 7 individuals. In the midstream section, Oreochromis aureus remains the most abundant with 44 individuals, while Oreochromis niloticus is absent, and Clarias gariepinus has a count of 3 individuals. In the downstream section, Oreochromis aureus again is the most abundant with 35 individuals, Oreochromis niloticus has 2 individuals, and Clarias gariepinus has 7 individuals. This data indicates a significant predominance of Oreochromis aureus across all sections, with the highest abundance observed in the upstream section.

Figure 1: RELATIVE ABUNDANCE OF FISH IN EACH OF THE STREAMS

#### 4.2.2 Relative abundance of each fish in the streams

The graph below shows the total count of three fish species: Oreochromis aureus, Oreochromis niloticus, and Clarias gariepinus. Oreochromis aureus is the most abundant species, with a total count of 208 individuals. Clarias gariepinus follows with 17 individuals. Oreochromis niloticus has the lowest count, with only 7 individuals. This data indicates a significant predominance of Oreochromis aureus in the streams compared to the other two species.

Figure 2: RELATIVE ABUNDANCE OF FISH IN EACH OF THE STREAMS

#### 4.2.3 Total abundance of fish in the streams

The graph below shows the total count of the three fish species in the various streams. Upstream has the most abundant species, with a total count of 141 individuals. Midstream follows with 47 individuals. Downstream has the lowest count, with only 44 individuals. This data indicates a significant predominance of Upstream compared to the other two streams.

Figure 3: TOTAL ABUNDANCE OF FISH IN EACH OF THE STREAMS

#### 4.2.4. Mean and Standard Deviation of fish distribution

The data provided represents the mean and standard deviation of the count of fish species per stream at three different stream locations: upstream, midstream, and downstream. For the upstream section, the mean number of fish species is 2.00 with a mean count per stream of 15.667 and a standard deviation of 17.2192, indicating high variability in fish counts. In the midstream section, the mean number of fish species remains 2.00, but the mean count per stream decreases to 5.222 with a standard deviation of 7.2246, suggesting less variability compared to upstream but still noticeable. Downstream, the mean number of fish species is again 2.00, with the mean count per stream further reducing to 4.889 and the lowest standard deviation of 4.8074 among the three sections, indicating the least variability in fish count per stream. Overall, the total mean number of fish species is 2.00, and the total mean count per stream is 8.593 with a standard deviation of 11.8492, showing considerable variability, likely influenced by the high variability observed upstream. The data suggests a pattern where the count of fish per stream tends to decrease from upstream to downstream, with the high variability upstream potentially indicating fluctuating environmental conditions or sampling inconsistencies, while the downstream section shows more consistent but lower fish counts, possibly reflecting more stable but less favorable conditions for higher fish populations. This analysis highlights the need for further investigation into the ecological or environmental factors influencing fish populations across these stream sections which could include water quality, habitat structure, pollution levels, or other anthropogenic effects.

Table 1: MEAN and STANDARD DEVIATION

|  |  |  |  |
| --- | --- | --- | --- |
| **MEAN and STANDARD DEVIATION** | | | |
| Stream | | Fish species | Count per Stream |
| UPSTREAM | Mean | 2.00 | 15.667 |
| Std. Deviation | 1.000 | 17.2192 |
| MIDSTREAM | Mean | 2.00 | 5.222 |
| Std. Deviation | 1.000 | 7.2246 |
| DOWNSTREAM | Mean | 2.00 | 4.889 |
| Std. Deviation | 1.000 | 4.8074 |
| Total | Mean | 2.00 | 8.593 |
| Std. Deviation | .961 | 11.8492 |

#### 4.2.5 ANOVA

The ANOVA (Analysis of Variance) table provided analyzes the differences in fish species and their counts across different stream sections (upstream, midstream, and downstream). The table includes the sum of squares, degrees of freedom (df), mean squares, F-values, and significance levels (Sig.).

**Fish Species vs. Stream Sections**

For the fish species count across the stream sections, the sum of squares between groups (combined) is 0.000 with 2 degrees of freedom, resulting in a mean square of 0.000. The sum of squares within groups is 24.000 with 24 degrees of freedom, leading to a mean square of 1.000. The total sum of squares is 24.000 with 26 degrees of freedom. The F-value for this comparison is 0.000 with a significance level of 1.000, indicating that there is no significant difference in the number of fish species across the stream sections.

**Fish Count vs. Stream Sections**

For the count of fish per stream across different sections, the sum of squares between groups (combined) is 676.074 with 2 degrees of freedom, resulting in a mean square of 338.037. The sum of squares within groups is 2974.444 with 24 degrees of freedom, leading to a mean square of 123.935. The total sum of squares is 3650.519 with 26 degrees of freedom. The F-value for this comparison is 2.728 with a significance level of 0.086. Although the F-value suggests a difference between groups, the p-value (0.086) is greater than the conventional threshold of 0.05, indicating that this difference is not statistically significant at the 95% confidence level.

**Interpretation**

The ANOVA results indicate that there is no significant difference in the number of fish species across upstream, midstream, and downstream sections, as evidenced by the high p-value (1.000) for the fish species comparison. Regarding the count of fish per stream, although the F-value (2.728) suggests some variation between the stream sections, the p-value (0.086) indicates that this variation is not statistically significant at the 95% confidence level. Thus, any observed differences in fish counts per stream section are not sufficient to reject the null hypothesis that the means are equal across the different stream sections.

Table 2: ANOVA Table

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ANOVA Table** | | | | | | | |
|  | | | Sum of Squares | df | Mean Square | F | Sig. |
| Fish Stream | Between Groups | (Combined) | .000 | 2 | .000 | .000 | 1.000 |
| Within Groups | | 24.000 | 24 | 1.000 |  |  |
| Total | | 24.000 | 26 |  |  |  |
| Count Stream | Between Groups | (Combined) | 676.074 | 2 | 338.037 | 2.728 | .086 |
| Within Groups | | 2974.444 | 24 | 123.935 |  |  |
| Total | | 3650.519 | 26 |  |  |  |

### 4.3 Physiochemical parameters of Wiwi river in Kumasi, Ghana.

#### 4.3.1 Measurement of the physiochemical parameters

The physiochemical parameters of the Wiwi River in Kumasi, Ghana, exhibit variations across different sections of the river (upstream, midstream, and downstream), which have significant implications for fish distribution.

The temperature of the river varies slightly, with upstream at 31.7°C, midstream at 27.86°C, and downstream at 31.9°C. Temperature influences metabolic rates and reproductive cycles in fish; thus, areas with more stable temperatures may support more diverse fish populations.

Turbidity, measured as the cloudiness of the water due to suspended particles, shows higher levels upstream (35.366 NTU) and midstream (92.217 NTU) compared to downstream (17.42667 NTU). Higher turbidity can reduce light penetration, affecting photosynthesis and thereby the availability of food for fish.

The depth of the river increases from upstream (0.5 meters) to midstream (0.62667 meters) and downstream (1.03 meters). Greater depth downstream can offer more habitat variety and protection for fish, potentially supporting a larger and more diverse fish population.

Water velocity, which affects sediment transport and habitat structure, is higher downstream (0.52797 m/s) compared to upstream (0.431 m/s) and midstream (0.36 m/s). Different species of fish may prefer different flow conditions, with some thriving in fast-flowing sections and others in slower areas.

Dissolved oxygen, crucial for fish respiration, is highest upstream (9 mg/L) and midstream (7.83338 mg/L), but significantly lower downstream (8.76667 mg/L). Adequate oxygen levels are essential for fish survival; thus, areas with higher dissolved oxygen are more likely to support healthy fish populations.

Total nitrate levels, indicative of nutrient pollution, are highest upstream (7.067 mg/L) and decrease towards downstream (0.967 mg/L). Excessive nitrates can lead to eutrophication, reducing oxygen levels and affecting fish health.

Total phosphate levels are higher downstream (2.42 mg/L) compared to upstream (1.1 mg/L) and midstream (1.1667 mg/L). Similar to nitrates, high phosphate levels can promote algal blooms, which can harm fish by depleting oxygen in the water.

The pH level, which affects fish physiology and the availability of nutrients and toxins, is slightly acidic upstream (7.79), becoming more neutral midstream (7.67) and slightly acidic again downstream (7.43). Most fish prefer a pH range of 6.5-9, and deviations can stress fish populations.

Conductivity, reflecting the water's ability to conduct electricity and the presence of ions, is relatively stable with a slight increase downstream (152.6 μS/cm) compared to upstream (151.96667 μS/cm) and midstream (149 μS/cm). Variations in conductivity can indicate changes in water quality, influencing fish distribution and abundance.

Overall, these parameters collectively impact the habitat suitability for different fish species, influencing their distribution and abundance throughout the Wiwi River.

Figure 4: TEMPERATURE MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 5: TURBIDITY MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 6: DEPTH MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 7: VELOCITY MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 8: DISSOLVED OXYGEN MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 9: TOTAL NITRATE MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 10: TOTAL PHOSPHATE MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 11: pH LEVEL MEASUREMENT ACROSS THE STREAMS OF THE RIVER

Figure 12: CONDUCTIVITY MEASUREMENT ACROSS THE STREAMS OF THE RIVER

#### 4.3.2 Mean and Standard Deviation

The table below represents the mean and standard deviation of various environmental parameters (temperature, turbidity, depth, velocity, and dissolved oxygen) across three different stream locations: upstream, midstream, and downstream. Here is a detailed summary in paragraph form:

For the upstream section, the mean temperature is 31.70°C with a standard deviation of 0.70°C, indicating relatively stable temperatures. Turbidity has a mean value of 35.37 NTU with a standard deviation of 18.22 NTU, suggesting moderate variability. The mean depth is 0.50 meters with a standard deviation of 0.15 meters, showing consistent shallowness. Velocity has a mean of 0.431 m/s with a low standard deviation of 0.009 m/s, indicating uniform flow speed. Dissolved oxygen shows a high mean of 97.83% with a standard deviation of 1.27%, suggesting excellent and consistent oxygen levels.

In the midstream section, the mean temperature drops to 27.87°C with a standard deviation of 0.25°C, indicating stable temperatures. Turbidity increases significantly with a mean of 292.20 NTU and a high standard deviation of 223.11 NTU, indicating substantial variability and likely high particulate presence. The mean depth is 0.63 meters with a standard deviation of 0.03 meters, indicating slightly deeper but consistent waters. Velocity has a mean of 0.36 m/s and a standard deviation of 0.02 m/s, showing some variability in flow speed. Dissolved oxygen has a mean of 81.70% with a large standard deviation of 37.51%, indicating considerable variability in oxygen levels.

For the downstream section, the mean temperature rises to 31.90°C with a higher standard deviation of 2.54°C, indicating more variable temperatures. Turbidity drops to a mean of 17.43 NTU with a standard deviation of 13.98 NTU, suggesting clearer water with moderate variability. The mean depth increases to 1.03 meters with a standard deviation of 0.60 meters, showing greater depth and variability. Velocity has a mean of 0.528 m/s with a standard deviation of 0.047 m/s, indicating a faster and more variable flow. Dissolved oxygen decreases significantly with a mean of 38.77% and a large standard deviation of 37.58%, indicating highly variable and lower oxygen levels.

Overall, combining all stream sections, the total mean temperature is 30.49°C with a standard deviation of 2.37°C. Turbidity has a total mean of 115.00 NTU with a standard deviation of 174.07 NTU, reflecting high overall variability. The mean depth across all sections is 0.72 meters with a standard deviation of 0.39 meters, showing moderate variability in depth. Velocity has a total mean of 0.440 m/s with a standard deviation of 0.077 m/s, indicating some variability in flow speed. Dissolved oxygen has a total mean of 72.77% with a standard deviation of 37.48%, reflecting significant overall variability.

This analysis highlights that environmental conditions vary significantly across different stream sections, with the upstream section having the most stable conditions, the midstream section showing high turbidity variability, and the downstream section having the most variable and generally less favorable conditions for aquatic life.

Table 3: MEAN and STANDARD DEVIATION of some PHYSIOCHEMICAL PROPERTIES

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **MEAN and STANDARD DEVIATION** | | | | | | |
| Stream | | Temperature | Turbidity | Depth(m) | Velocity | Dissolved Oxygen(%) |
| UPSTREAM | Mean | 31.70000 | 35.36667 | .50000 | .43100 | 97.83333 |
| Std. Deviation | .700000 | 18.218763 | .151327 | .008544 | 1.274101 |
| MIDSTREAM | Mean | 27.86667 | 292.20000 | .62667 | .36000 | 81.70000 |
| Std. Deviation | .251661 | 223.108315 | .028868 | .020000 | 37.513331 |
| DOWNSTREAM | Mean | 31.90000 | 17.42667 | 1.03000 | .52797 | 38.76667 |
| Std. Deviation | 2.535744 | 13.981421 | .599250 | .047009 | 37.584084 |
| Total | Mean | 30.48889 | 114.99778 | .71889 | .43966 | 72.76667 |
| Std. Deviation | 2.370888 | 174.067170 | .391358 | .077477 | 37.475492 |

The table below represents the mean and standard deviation of various water quality parameters (total nitrate, total phosphate, pH level, distance, and conductivity) across three different stream locations: upstream, midstream, and downstream. Here is a detailed summary in paragraph form:

In the upstream section, the mean total nitrate concentration is 7.067 mg/L with a standard deviation of 0.0577 mg/L, indicating very low variability. The mean total phosphate concentration is 1.1000 mg/L with a standard deviation of 0.82614 mg/L, suggesting moderate variability. The mean pH level is 7.79000 with a standard deviation of 0.085440, indicating slightly alkaline water with low variability. The mean distance is 20.81000 units with a standard deviation of 2.245462 units, showing some variability in measurement distance. Conductivity has a mean of 151.96667 µS/cm with a standard deviation of 18.986662 µS/cm, suggesting moderate variability.

In the midstream section, the mean total nitrate concentration decreases to 3.100 mg/L with a standard deviation of 0.1000 mg/L, indicating low variability. The mean total phosphate concentration is slightly higher at 1.1667 mg/L with a standard deviation of 0.27538 mg/L, indicating less variability than upstream. The mean pH level is 7.60000 with a standard deviation of 0.100000, showing slightly acidic conditions with low variability. The mean distance is 11.24333 units with a very low standard deviation of 0.456107 units, indicating consistent measurements. Conductivity has a mean of 140.00000 µS/cm with a higher standard deviation of 46.349218 µS/cm, indicating substantial variability.

For the downstream section, the mean total nitrate concentration further decreases to 0.967 mg/L with a standard deviation of 0.1155 mg/L, showing low variability. The mean total phosphate concentration increases significantly to 2.4200 mg/L with a standard deviation of 0.90205 mg/L, indicating considerable variability. The mean pH level is 7.43000 with a standard deviation of 0.445758, indicating slightly acidic conditions with higher variability. The mean distance is 15.63667 units with a standard deviation of 3.171519 units, showing greater variability. Conductivity has a mean of 165.83333 µS/cm with a high standard deviation of 72.274085 µS/cm, indicating significant variability.

Overall, combining all stream sections, the total mean nitrate concentration is 3.711 mg/L with a standard deviation of 2.6821 mg/L, reflecting high overall variability. The mean total phosphate concentration is 1.5622 mg/L with a standard deviation of 0.89873 mg/L, indicating moderate variability. The mean pH level across all sections is 7.60667 with a standard deviation of 0.279866, showing slightly acidic conditions with moderate variability. The mean distance is 15.89667 units with a standard deviation of 4.585346 units, indicating some variability. Conductivity has a total mean of 152.60000 µS/cm with a standard deviation of 45.369896 µS/cm, showing significant overall variability.

This analysis indicates that water quality parameters vary significantly across different stream sections, with upstream having higher nitrate concentrations and more alkaline pH, midstream showing moderate levels with consistent measurements, and downstream having lower nitrate but higher phosphate concentrations and more acidic pH. Conductivity and distance measurements also show varying degrees of variability across the sections.

Table 4: MEAN and STANDARD DEVIATION of some PHYSIOCHEMICAL PROPERTIES

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **MEAN and STANDARD DEVIATION** | | | | | | |
| Stream | | Total Nitrate | Total Phosphate | pH Level | Distance | Conductivity |
| UPSTREAM | Mean | 7.067 | 1.1000 | 7.79000 | 20.81000 | 151.96667 |
| Std. Deviation | .0577 | .82614 | .085440 | 2.245462 | 18.986662 |
| MIDSTREAM | Mean | 3.100 | 1.1667 | 7.60000 | 11.24333 | 140.00000 |
| Std. Deviation | .1000 | .27538 | .100000 | .456107 | 46.349218 |
| DOWNSTREAM | Mean | .967 | 2.4200 | 7.43000 | 15.63667 | 165.83333 |
| Std. Deviation | .1155 | .90205 | .445758 | 3.171519 | 72.274085 |
| Total | Mean | 3.711 | 1.5622 | 7.60667 | 15.89667 | 152.60000 |
| Std. Deviation | 2.6821 | .89873 | .279866 | 4.585346 | 45.369896 |

#### 4.3.3 ANOVA

The ANOVA table provided analyzes the differences in various environmental parameters (temperature, turbidity, depth, velocity, dissolved oxygen, total nitrate, total phosphate, pH level, and conductivity) across different stream sections (upstream, midstream, and downstream). The results show that for temperature, the ANOVA indicates a significant difference between stream sections (p = 0.030), suggesting that temperature varies significantly across the different sections. For turbidity, the ANOVA result indicates no significant difference between stream sections (p = 0.072), although the F-value suggests some variation, it is not statistically significant at the 95% confidence level. The ANOVA result for depth shows no significant difference between stream sections (p = 0.244), indicating that depth does not vary significantly across the different sections. Velocity, on the other hand, shows a highly significant difference between stream sections (p = 0.001), suggesting that flow velocity varies significantly across upstream, midstream, and downstream sections. For dissolved oxygen, the ANOVA result indicates no significant difference between stream sections (p = 0.127), although the F-value suggests some variation, it is not statistically significant at the 95% confidence level. The ANOVA result for total nitrate indicates a highly significant difference between stream sections (p = 0.000), suggesting that nitrate levels vary significantly across the different sections. For total phosphate, the ANOVA result indicates no significant difference between stream sections (p = 0.115), although the F-value suggests some variation, it is not statistically significant at the 95% confidence level. The ANOVA result for pH level shows no significant difference between stream sections (p = 0.328), indicating that pH levels do not vary significantly across the different sections. Lastly, the ANOVA result for conductivity indicates no significant difference between stream sections (p = 0.828), suggesting that conductivity does not vary significantly across upstream, midstream, and downstream sections. In summary, the ANOVA results indicate significant differences in temperature, velocity, and total nitrate levels across the stream sections, suggesting that these parameters vary significantly between upstream, midstream, and downstream locations. However, turbidity, depth, dissolved oxygen, total phosphate, pH level, and conductivity do not show significant differences between the stream sections, indicating that these parameters are relatively consistent across the different locations.

Table 5: ANOVA Table

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ANOVA Table** | | | | | | | |
|  | | | Sum of Squares | df | Mean Square | F | Sig. |
| Temperatue Stream | Between Groups | (Combined) | 31.002 | 2 | 15.501 | 6.659 | .030 |
| Within Groups | | 13.967 | 6 | 2.328 |  |  |
| Total | | 44.969 | 8 |  |  |  |
| Turbidity Stream | Between Groups | (Combined) | 141785.589 | 2 | 70892.795 | 4.228 | .072 |
| Within Groups | | 100609.447 | 6 | 16768.241 |  |  |
| Total | | 242395.036 | 8 |  |  |  |
| Depth(m) Stream | Between Groups | (Combined) | .460 | 2 | .230 | 1.801 | .244 |
| Within Groups | | .766 | 6 | .128 |  |  |
| Total | | 1.225 | 8 |  |  |  |
| Velocity Stream | Between Groups | (Combined) | .043 | 2 | .021 | 23.850 | .001 |
| Within Groups | | .005 | 6 | .001 |  |  |
| Total | | .048 | 8 |  |  |  |
| Dissolved Oxygen(%) Stream | Between Groups | (Combined) | 5592.427 | 2 | 2796.213 | 2.973 | .127 |
| Within Groups | | 5642.873 | 6 | 940.479 |  |  |
| Total | | 11235.300 | 8 |  |  |  |
| Total Nitrate Stream | Between Groups | (Combined) | 57.496 | 2 | 28.748 | 3234.125 | .000 |
| Within Groups | | .053 | 6 | .009 |  |  |
| Total | | 57.549 | 8 |  |  |  |
| Total Phosphate Stream | Between Groups | (Combined) | 3.318 | 2 | 1.659 | 3.166 | .115 |
| Within Groups | | 3.144 | 6 | .524 |  |  |
| Total | | 6.462 | 8 |  |  |  |
| pH Level Stream | Between Groups | (Combined) | .195 | 2 | .097 | 1.351 | .328 |
| Within Groups | | .432 | 6 | .072 |  |  |
| Total | | .627 | 8 |  |  |  |
| Conductivity Stream | Between Groups | (Combined) | 1002.847 | 2 | 501.423 | .195 | .828 |
| Within Groups | | 15464.573 | 6 | 2577.429 |  |  |
| Total | | 16467.420 | 8 |  |  |  |