**Range of Tolerance**

Graphing Activity

Steelhead trout, otherwise known as rainbow trout, have seen a population decline in the Western United States over the last several decades. There are a wide variety of conditions that are threatening the population, including pollution, climate change, and invasive species. This activity will look at the effects of varying two specific abiotic factors on a controlled population of trout.

Graph the range of tolerance data below for steelhead trout. Each graph should be completed separately. Water temperature and dissolved oxygen are independent variables, and should be graphed on the x-axis. The number of fish, a dependent variable, should be on the y-axis.

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| **Water Temp. (°C)** | **http://btc.montana.edu/CERES/html/Wobble/images/wobblesimage8.jpgNumber of Fish Counted** |
| 0  | 0 |
| 1 | 1 |
| 2 | 2 |
| 3 | 5 |
| 4 | 7 |
| 5 | 10 |
| 6 | 15 |
| 7 | 21 |
| 8 | 24 |
| 9 | 20 |
| 10 | 17 |
| 11 | 14 |
| 12 | 12 |
| 13 | 10 |
| 14 | 8 |
| 15 | 5 |
| 16 | 3 |
| 17 | 2 |
| 18 | 1 |
| 19 | 1 |
| 20 | 0 |

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1. The **optimal range** is the amount of an abiotic factor that produces the highest possible population. For water temperature, this would be about 6-10°C. Label this area on the graph.
2. The **zone of physiologic stress** occurs when an abiotic factor exists at levels that are too high or low to support normal biotic potential. This would be 3-5°C and 11-16°C.
3. The **zone of intolerance** occurs when a population is absent (or in this case, nearly absent). This occurs at either extreme of our water temperature graph, below 3°C and above 16°C.

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| **Dissolved Oxygen (mg/L)** | **http://btc.montana.edu/CERES/html/Wobble/images/wobblesimage8.jpgNumber of Fish Counted** |
| 0  | 0 |
| 1 | 0 |
| 2 | 2 |
| 3 | 3 |
| 4 | 3 |
| 5 | 5 |
| 6 | 8 |
| 7 | 11 |
| 8 | 15 |
| 9 | 18 |
| 10 | 22 |
| 11 | 24 |
| 12 | 23 |
| 13 | 20 |
| 14 | 18 |
| 15 | 15 |
| 16 | 12 |
| 17 | 10 |
| 18 | 6 |
| 19 | 3 |
| 20 | 1 |
| 21 | 0 |

**Conclusion**

1. Label the optimal range, zones of physiologic stress, and zones of intolerance on the graph above.
2. Biological indicator species are those whose overall health and population numbers can offer a signal of the overall health of an ecosystem. Explain why fish, specifically steelhead trout, would be an effective indicator species.