Science Olympiad
Ecology FRQ Key
Seven Lakes Invitational

Team Name: _____**KEY**_____

Team Number: _____

Directions:

- Please write all answers clearly; illegible answers will not be scored.
- There is no penalty for wrong answers. Answer every question, even if you aren't sure if you're correct.
- You do not need to show work; however, partial credit will only be given if there is work that clearly shows your process.
- Round to three decimal places on any questions that require calculations. Remember that you are allowed a non-programmable, non-graphing calculator.
- Ties will be broken using free response questions #128, #113, #127, #125, #108 in that order. After this point, free response section score then first multiple choice question missed will be used to break ties.
- Good luck on the test!

For grading use only

Page:	2	3	4	5	Total
Points:	15	16	18	7	56
Score:					

101. (1 point) **Red-queen hypothesis**

102. (1 point) **Apparent competition**

103. (3 points)

Solution: Prevention, eradication, containment, management (1 for correct order, 1 for correctly naming all 4 [accept long term management or similar for the last stage as well]). Cost increases for each stage (1 for anything about how cost strictly increases)

104. (2 points)

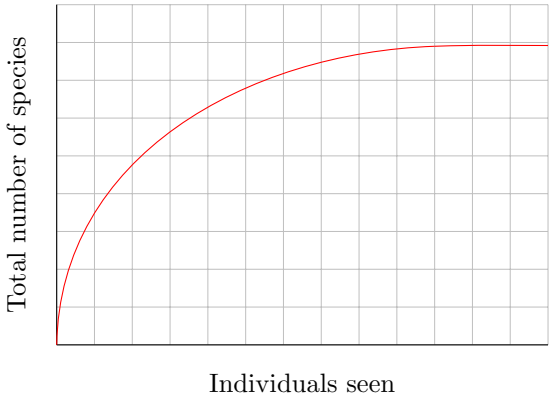
Solution: Refers to the migration of species from source populations into sink populations (1 for anything about migration/immigration into small populations) to sustain small populations that might otherwise go extinct by providing new genes or individuals (1 for something about how it sustains the low population/helps smaller populations)

105. (2 points)

Solution: In semelparity, an organism has a single reproduction event (1 point). In iteroparity, an organism has multiple reproduction events (1 point).

106. (1 point) **Tragedy of the Commons (1 point; also may write "Tragedy of Commons")**

107. (3 points)



Solution: As John walks, he will initially encounter many species; however, as he sees more of the common species, it will take more individuals seen to see each rarer species, causing this asymptotic behavior (1 point for anything similar).
Accept anything about how common species will be seen at a faster rate, total number of species is capped, or rare species take longer to find.
Graph: 1 point for drawing an increasing, nonlinear function, 1 point for a decreasing slope (second derivative is negative/concave down)

108. (2 points) (TB #5)

Solution: 438 or 439 (2 points, accept either)
$\frac{100}{N} = \frac{13}{57}$, $N = \frac{100 \cdot 57}{13}$ **so** $N = 438.462$. **If they got the answer wrong, give one point for any equivalent expression to the above.**

109. (1 point) **Type III**

110. (1 point) **58**

111. (1 point) **0.0833 (1/12)**

112. (1 point) **8**

113. (4 points) (TB #2)

Solution: 1.38889 (3 if they get this)
If they get any L_x values, which is the average of each column and the next one (61, 23 , 13, 11.5, 9.5, 5.5, 1.5), give 1 point
If they get any T_x values (125, 64, 41, 28, 16.5, 7, 1.5), also give 1 point unless they find specifically T_0 (125), in which case they earn 2 points.

114. (2 points)

Solution: Goats eat the roots of plants as well, preventing them from regrowing, whereas sheep do not (2 points for anything about goats eating roots of plants or preventing regrowth)

115. (2 points)

Solution: C3 requires open stomata during the day and lose more water, while CAM opens stomata during the night and loses less water (1, requires either)
CAM is favored (1)

116. (1 point) **Hyperaccumulator**

117. (2 points)

Solution: $SO_2 + H_2O \longrightarrow H_2SO_3$
$2\,H_2SO_3 + O_2 \longrightarrow 2\,H_2SO_4$

118. (1 point) **Mercury (Hg)**

119. (2 points)

Solution: Fires largely hinder the growth of trees because they kill off young saplings, while grasses can thrive after a fire because nutrients are replenished to the soil. (1 point for saying that fire makes it harder for trees to grow. 1 point for saying grasses are more tolerant or beneficiary of fires or able to regrow faster after fire)

120. (1 point) **Cellulose**

121. (2 points)

Solution: Switchgrass requires less land (1) and less energy (1) than corn

122. (3 points)

Solution: Sensitivity to rare species decreases as Hill number (q) increases (2 points, all or nothing)
5 (1, ${}^0D$ is species richness)

123. (2 points) **1.442 (accept 1.437-1.447, all or nothing)**

124. (2 points)

Solution:

$$J = \frac{-\sum_{i=1}^{S} p_i \cdot \ln p_i}{\ln S}$$

2 points; also accept log instead of ln. The $J =$ portion is not required for full credit. Give 1 point for $\frac{H}{H_{max}}$ because it is not in terms of the variables given.

125. (2 points) (TB #4) **0.896 (2, accept 0.891-0.901; all or nothing)**

126. (1 point) **5**

127. (3 points) (TB #3)

Solution: With replacement: $\left(\frac{n_1}{N}\right)^2$ (1 point)
Without replacement: $\left(\frac{n_1}{N}\right) \cdot \left(\frac{n_1-1}{N-1}\right)$ (1 point)
1 point for labeling correctly (cannot earn this point without having two different formulas)

128. (3 points) (TB #1)

Solution: With replacement: $\sum_{i=1}^{5}\left(\frac{n_i}{N}\right)^2$ **or** $\left(\frac{n_1}{N}\right)^2+\left(\frac{n_2}{N}\right)^2+\left(\frac{n_3}{N}\right)^2+\left(\frac{n_4}{N}\right)^2+\left(\frac{n_5}{N}\right)^2$ **(1 point)**
Without replacement: $\sum_{i=1}^{5}\left(\frac{n_i}{N}\right)\cdot\left(\frac{n_i-1}{N-1}\right)$ **or** $\left(\frac{n_1}{N}\right)\cdot\left(\frac{n_1-1}{N-1}\right)+\left(\frac{n_2}{N}\right)\cdot\left(\frac{n_2-1}{N-1}\right)+\left(\frac{n_3}{N}\right)\cdot\left(\frac{n_3-1}{N-1}\right)+\left(\frac{n_4}{N}\right)\cdot\left(\frac{n_4-1}{N-1}\right)+\left(\frac{n_5}{N}\right)\cdot\left(\frac{n_5-1}{N-1}\right)$ **(1 point)**
1 point for labeling correctly (cannot earn this point without having two different formulas)

129. (2 points) **Simpson index (2, also accept Simpson diversity index, 1 point for HHI/Herfindahl–Hirschman index)**

130. (2 points)

Solution: Represents the probability of an interspecific encounter (1); also accept probability of randomly choosing two individuals different species, probability that two random individuals are of a different species, or anything else equivalent
Higher values signifies higher diversity (1)