RLP-BIOB · RLP Biology B — Ecosystems, Evolution and Human Impact

Unit 2: Stability, Change and Human Impact: Engineering for Missouri Ecosystems

Practice Workbook. The same problems, in the same order, as the Practice sections of the online lessons.

Name _____ Period _____

Lesson 2.1 — Phenomenon: From Open Glade to Cedar Thicket

FLUENCY

1. Write the food chain that links glade grasses, grasshoppers and collared lizards, with arrows pointing in the direction energy flows.

2. Define a keystone species, and name the keystone process on Ozark glades.

3. Fire scars from a southern Missouri glade show a fire about every 3.2 years from 1630 to 1870 and about every 22 years after 1870. By what factor did the interval between fires grow?

APPLICATION

4. The Missouri Fire Needs Assessment estimates that Missouri should burn at least 2,635,008 acres a year to match its historical fire pattern, but burns about 125,000 to 150,000 acres a year. What percentage of the minimum is being burned?

5. After the first landscape-scale burn on Stegall Mountain, grasshoppers increased by 650 percent in the burned units. If an unburned unit held 20 grasshoppers per sweep-net sample (illustrative), how many would a 650 percent increase give? By what factor is that?

6. Explain why fire suppression and continuous livestock grazing together had a bigger effect on Ozark glades than either would have alone.

CHALLENGE

7. Evaluate the claim: “Now that prescribed burning is back, overgrown glades will recover on their own.” Use the idea of a regime shift.

REVIEW

8. Producers in an ecosystem capture 25,000 kJ of energy. Using the 10% rule, about how much energy reaches the secondary consumers?

Lesson 2.2 — Salt and Survival: Brine Shrimp Hatching Across Salinities

FLUENCY

1. How many grams of salt make 200 mL of a 35 ppt solution?

2. How many grams of salt make 500 mL of a 10 ppt solution?

3. How many grams of salt make 250 mL of an 80 ppt solution?

4. 41 of 50 cysts hatched at 35 ppt. What is the hatching success?

APPLICATION

5. 1 L of 35 ppt seawater is mixed with 1 L of fresh water. What is the salinity of the mixture? What if 3 L of seawater is mixed with 1 L of fresh water?

6. Snowmelt water at one Hinkson Creek site in Columbia held 1,252 mg/L of chloride. (a) How many times the EPA chronic criterion of 230 mg/L is that? (b) Chloride is about 60.7% of the mass of sodium chloride. If all of it came from road salt, about how many ppt of salt is that?

7. Using the illustrative hatching curve (82% at 35 ppt, 60% at 50 ppt, 18% at 80 ppt), predict the effect on birds that feed on brine shrimp if a lake's salinity rises from about 50 to about 80 ppt.

CHALLENGE

8. A student claims brine shrimp “prefer” 35 ppt. Design a follow-up experiment that tests survival of hatched nauplii (not just hatching) across salinities, naming the variables and the data you would collect.

REVIEW

9. (Unit 1) Mark-recapture: 50 brine flies are marked; a later sample of 80 includes 10 marked. Estimate the population.

Lesson 2.3 — The Pallid Sturgeon Debate: Causes, Criteria and Constraints

FLUENCY

1. Classify as a criterion or a constraint for a Missouri River side-chute project: (a) increase insect food in the chute; (b) must not flood nearby farmland; (c) budget of $20 million; (d) increase survival of young pallid sturgeon.

2. Name four factors linked by evidence to the decline of the pallid sturgeon.

3. Why does a pallid sturgeon population recover slowly once its numbers fall?

APPLICATION

4. With weights effectiveness 0.40, cost 0.20, habitat benefit 0.25 and community support 0.15, compute the weighted totals for option A (3, 4, 3, 5) and option B (5, 2, 4, 3).

5. Evaluate the claim: “Releasing hatchery-raised sturgeon will fully restore the pallid sturgeon.”

6. Rewrite this vague criterion so it can be measured: “make the Missouri River better for sturgeon.”

CHALLENGE

7. In the weighted matrix above, option B wins. How would the result change if community support were weighted 0.35 and effectiveness 0.20 (cost 0.20, habitat 0.25)? What does this show about decision matrices?

REVIEW

8. A population of 1000 grows exponentially with a per-capita rate of 0.2 per year (continuous). Estimate its size after 7 years.

Lesson 2.4 — Fire in the Forest: Testing Solutions With Prototypes and Simulations

FLUENCY

1. A bare tray lost 420 g of soil and a straw-mulched tray lost 95 g. Find the percentage reduction.

2. A tray with wattles lost 160 g compared with 420 g for bare soil. Find the percentage reduction.

3. In the NetLogo Fire model, what happens to the percentage of forest burned as density rises from 50% to 70%?

APPLICATION

4. Straw for one tray costs $2.00 and wattles cost $3.00 (illustrative). Using the soil saved compared with the bare tray (420 g), find the grams of soil saved per dollar for each.

5. Name two things the NetLogo Fire model leaves out that matter for real Missouri woodlands, and explain how one could change the model's conclusion about thinning.

6. Explain why burning an Ozark glade every few years helps it, but the same schedule may not suit every Missouri ecosystem.

CHALLENGE

7. Break the problem “restore an overgrown Ozark pine-oak woodland and protect it from severe wildfire” into three sub-problems, and say which could be tested with the Fire model and which needs a different test.

REVIEW

8. Producers in an ecosystem capture 50,000 kJ of energy. Using the 10% rule, about how much energy reaches the primary consumers?

Unit 2 checkpoint

1. A stable ecosystem is best described as one in which:
   A. No individuals are born or die
   B. Numbers and kinds of organisms stay roughly consistent over time despite births and deaths
   C. Only one species lives
   D. Conditions never change
2. Why do many overgrown Ozark glades stay cedar thickets even after fire returns?
   A. Cedars cannot burn
   B. The thicket is a stable state: big cedars survive fire and their shade removes the grass that carries it
   C. Collared lizards eat the grass
   D. Cedars all die at once
3. True or false: Removing a keystone species usually has only a small effect on a community.
4. To make 400 mL of a 35 ppt salt solution you need _____ g of salt.
5. Which is the best explanation for the pallid sturgeon's decline?
   A. Channelization alone
   B. Commercial fishing alone
   C. Several factors acting together, including dams, channelization, mistaken harvest and invasive species
   D. Natural old age of the species

6. Which is a constraint?
   A. Increase native glade wildflower cover by 50%
   B. Raise survival of young sturgeon
   C. The project must cost less than $5 million
   D. Increase plankton

7. With weights 0.5 and 0.5, an option scoring 4 and 2 has a weighted total of _____.

8. True or false: Breaking a complex environmental problem into smaller sub-problems makes it easier to design and test solutions.

9. What is the main value of running a simulation such as the Fire model before acting?
   A. It proves the solution works
   B. It lets you test how a proposed change affects outcomes cheaply and safely, while noting what the model leaves out
   C. It replaces field data
   D. It has no value

10. A treatment reduced soil loss from 500 g to 150 g, a reduction of _____%.

11. Why should a design brief for a Missouri ecosystem consider social and cultural effects?
   A. They are not relevant to science
   B. Solutions affect people such as landowners, farmers, river towns and tribal nations, and a design that ignores them may fail or cause harm
   C. Only cost matters
   D. Engineers are required to ignore them

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