Quiz 6 - Interaction Strengths

My name is: _____

One of the simplest non-pathological models of a predator-prey interactions adds only logistic prey growth to the classic (pathological) Lotka-Volterra model:

$$\frac{dR}{dt} = bR\left(1 - \frac{R}{K}\right) - aRC \qquad \frac{dC}{dt} = eaRC - dC\,.$$

An empirical ecologist measuring the effect of a predator on a prey species might measure values reflecting any of the following terms: a, aR, aC, and aRC. Indeed, all four terms could be (and have been) called measures of the "interaction strength" between the two species (i.e. the top-down effect of the predator on the prey). But clearly tthey are not equivalent.

1) *Why* aren't these measures equivalent? Answer by interpreting each for an empiricist and by defining it in terms of its units.

a – per capita attack rate; encounter rate; effect of one predator individual on one prey individual.
Units: number of prey (eaten) per predator per prey (available) per time.

aR – rate at which individual predators feed on prey population; functional response; effect of prey population on one predator individual.
Units: number of prey (eaten) per predator per time.

aC – rate at which individual prey are consumed by predator population; individual prey vulnerability.
Units: number of prey (eaten) per prey (available) per time.

aRC – rate at which prey are consumed by predator population.
Units: total number of prey (eaten) per time.

2) Which measure(s) would an empirical ecologist prefer to measure if they want to compare the "interaction strength" that different predator species have on one common prey species? Why?

Could use either a or aR, since R would be constant across all comparisons. Either measure standardizes by predator population size, allowing the effects of different predator species with different population sizes be contrasted on a common basis.

3) Which measure(s) would they best measure if they want to compare different pairs of predator-prey species across an entire food web? Why?

Use a, since it standardizes the effect-measure by both prey and predator population size, allowing the effects between different predator-prey pairs with different populations sizes to be contrasted on a common basis.

3) Which measures(s) would a theoretical ecologist hoping to parameterize their mathematical models with empirical data prefer to have the empiricist estimate? Why?

Would prefer a. Both R and C are dynamic state variables, whereas a is a fixed-valued parameter. Measures of aR, aC, or aCR would not allow them to parameterize their simulations (as easily).