Barry's Bar Napkin Parasite Genetics

John Janovy, Jr. September 11, 2014

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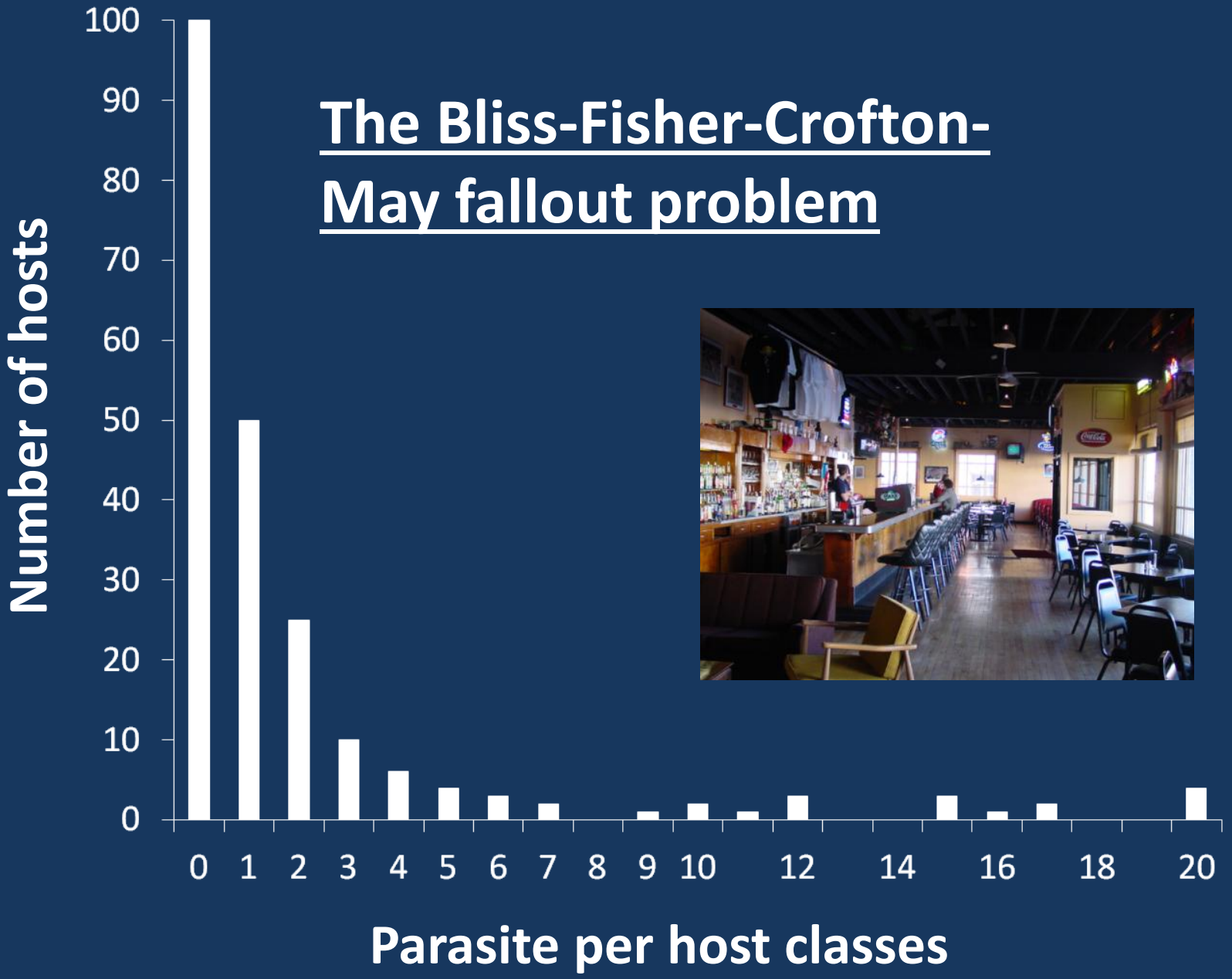
- The Bliss-Fisher-Crofton-May fallout problem
- The parasite community problem
- The complex life cycle problem
- The Red Queen problem

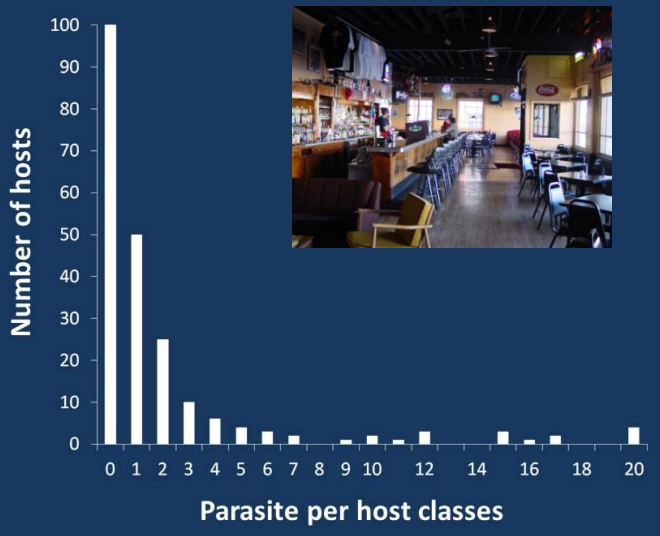


The Bliss-Fisher-Crofton-May fallout problem



Why am I calling this general principle a problem in bar napkin parasite genetics?

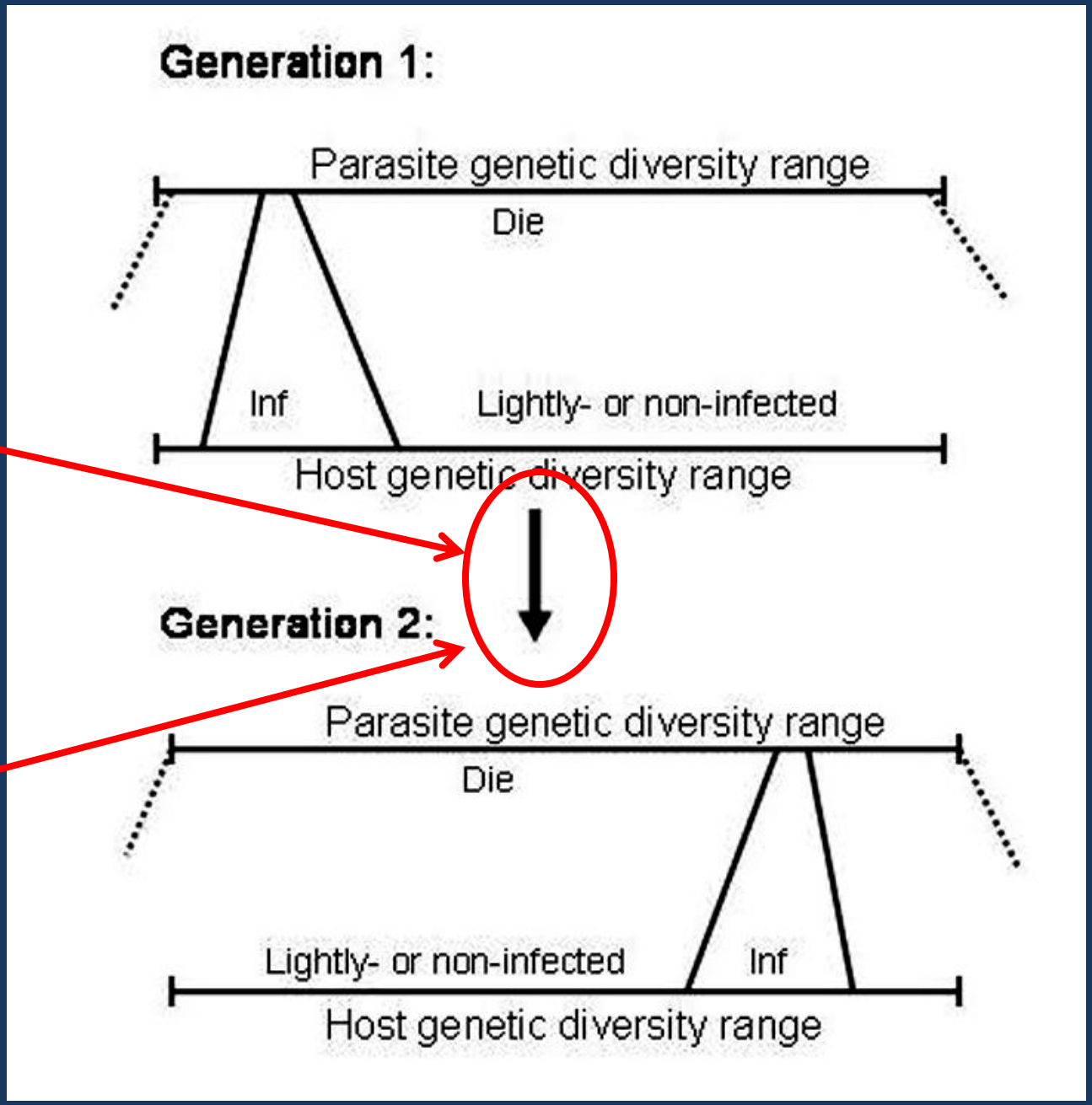
A: Because it focused so much research attention on what human beings wanted to believe instead of what nature was telling them to study.



BA search using “negative,” “binomial,” and “parasit*” = 439 hits, 1951-2014.

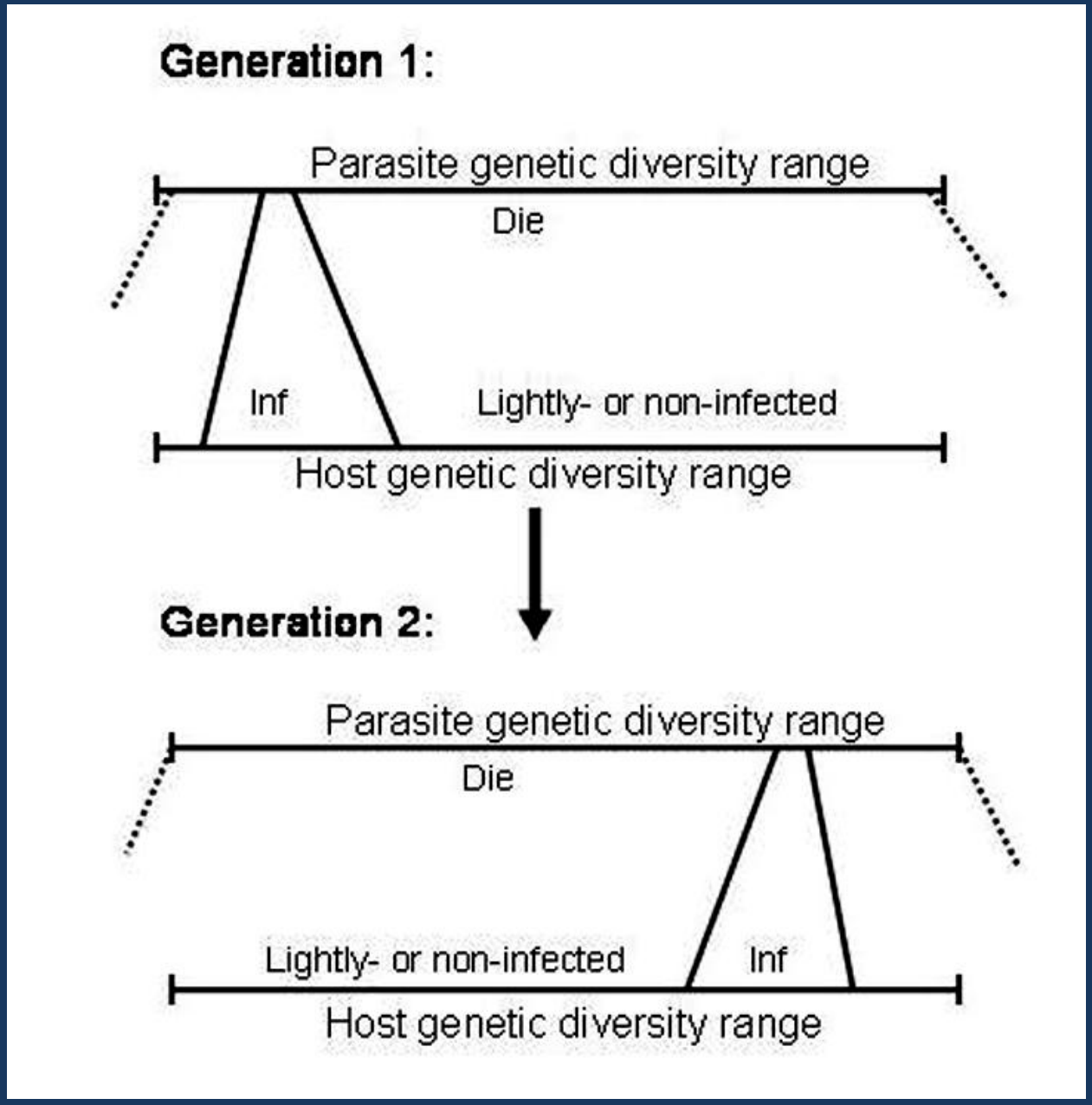
The genetic implications

The really important part of this diagram is this arrow and what it means.



The genetic implications

BA search using "negative," "binomial," and "host genot*" = 1 hit (1951-2014) and that paper Is:

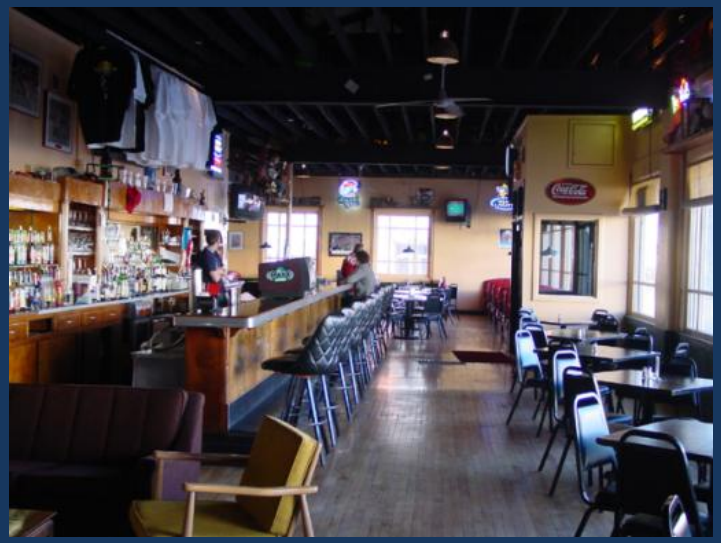


Latronico, F., A. Moodley, S. S. Nielsen, and L. Guardabassi. 2014. Enhanced adherence of methicillin-resistant *Staphylococcus pseudintermedius* sequence type 71 to canine and human corneocytes. *Veterinary Research* (Les Ulis) Vol. 45. Article No.: 70

(63 years)

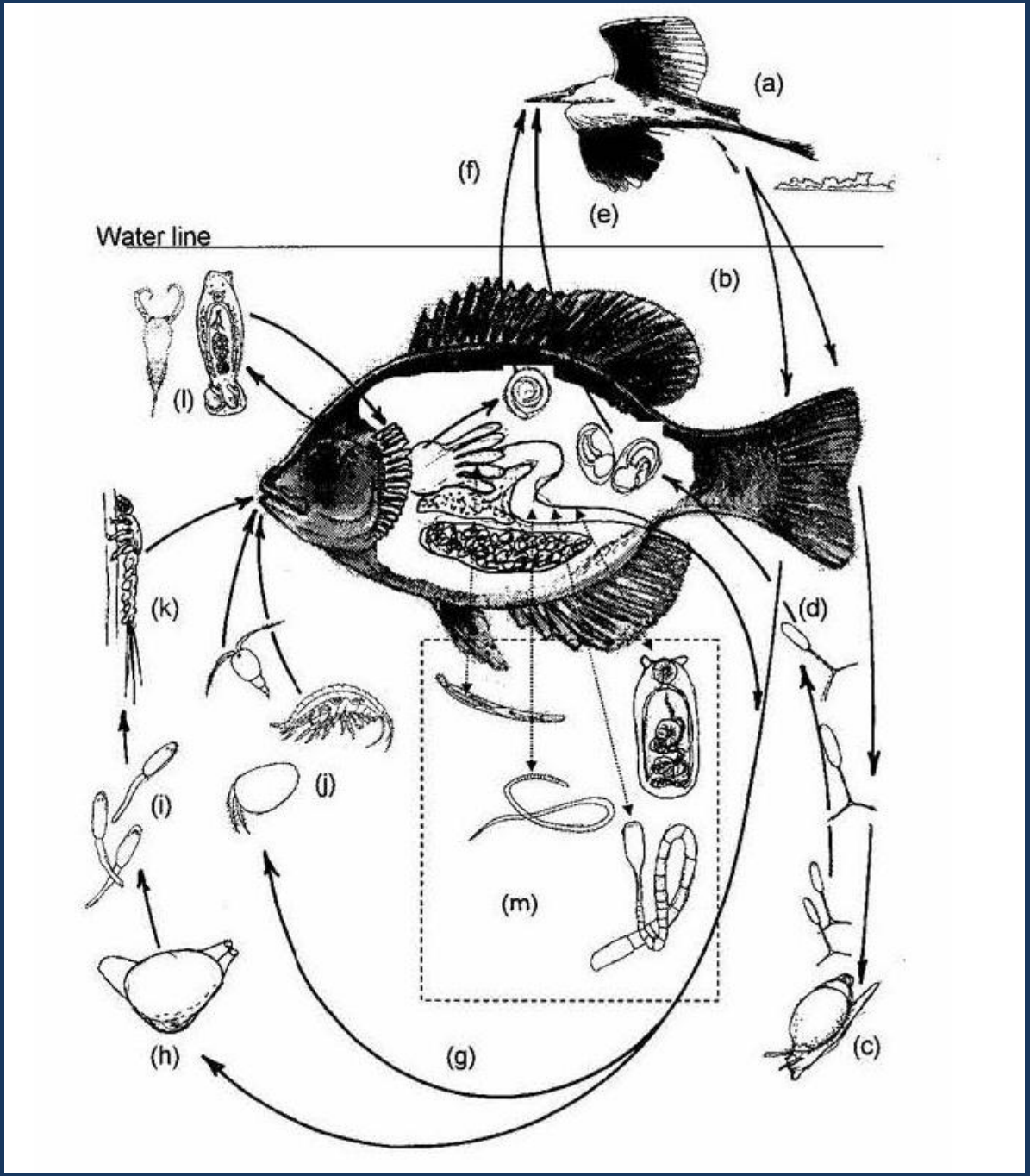
+ "host death" = 4
+ "population regulation" = 9
"aggregated," "distribution," "population regulation" = 13

JJ's relatively unsupported conclusion: the hope that this focus on parasite population distributions, and especially the aggregated ones, would confirm our beliefs about the effects of parasites on host populations is not fulfilled.



The Parasite Community Problem

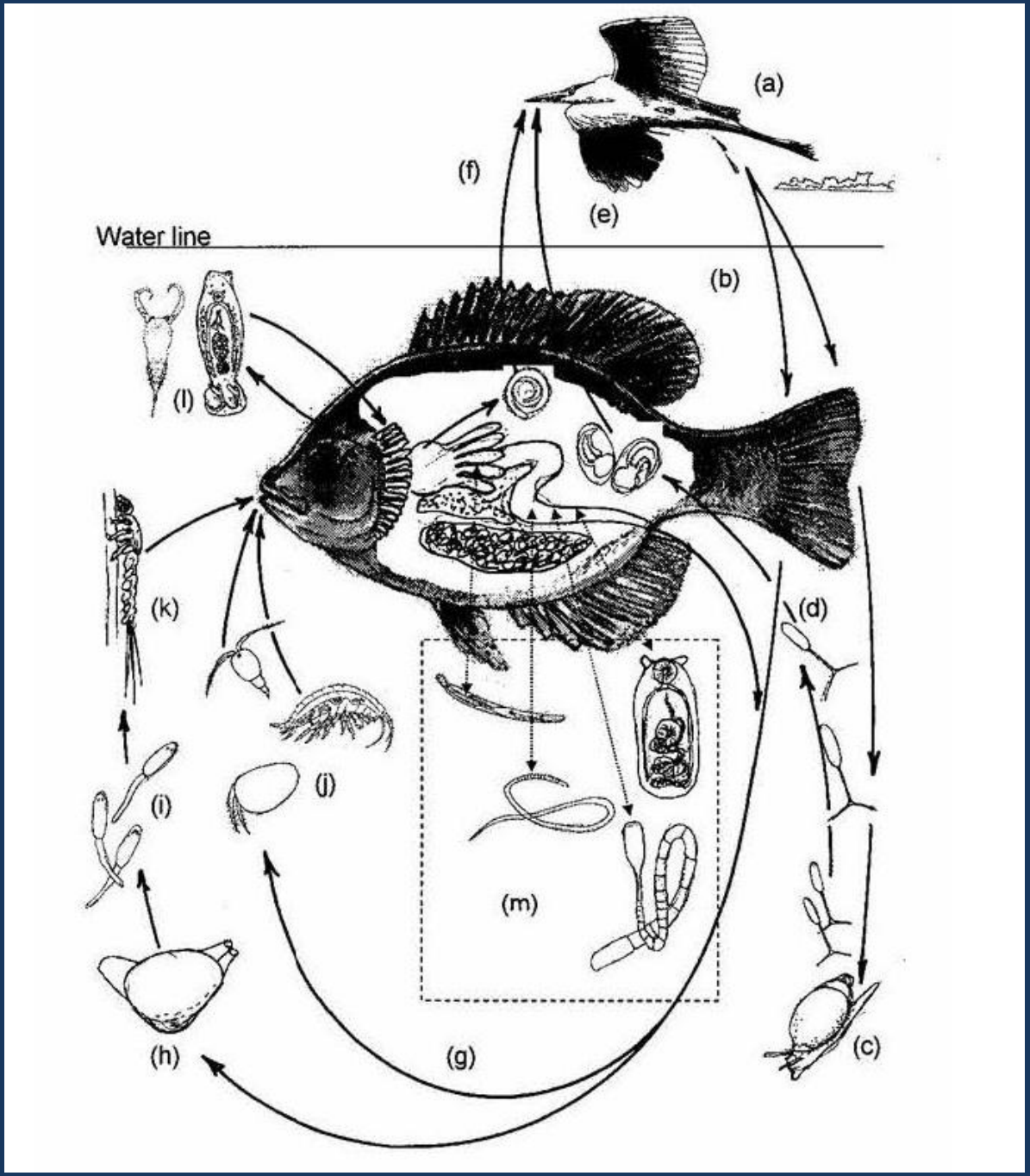
Do animals respond to foreign proteins?



The Parasite Community Problem

Do animals respond to foreign proteins?

BA search
using parasit*
and immunol* =
31,545 hits



Do animals respond to foreign proteins?

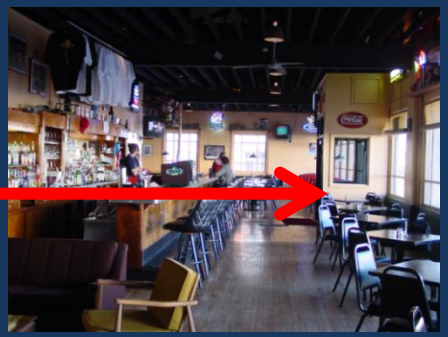
Yes, and such response alters the environment for other animals (parasites) that might enter or attach to the first animal (host).

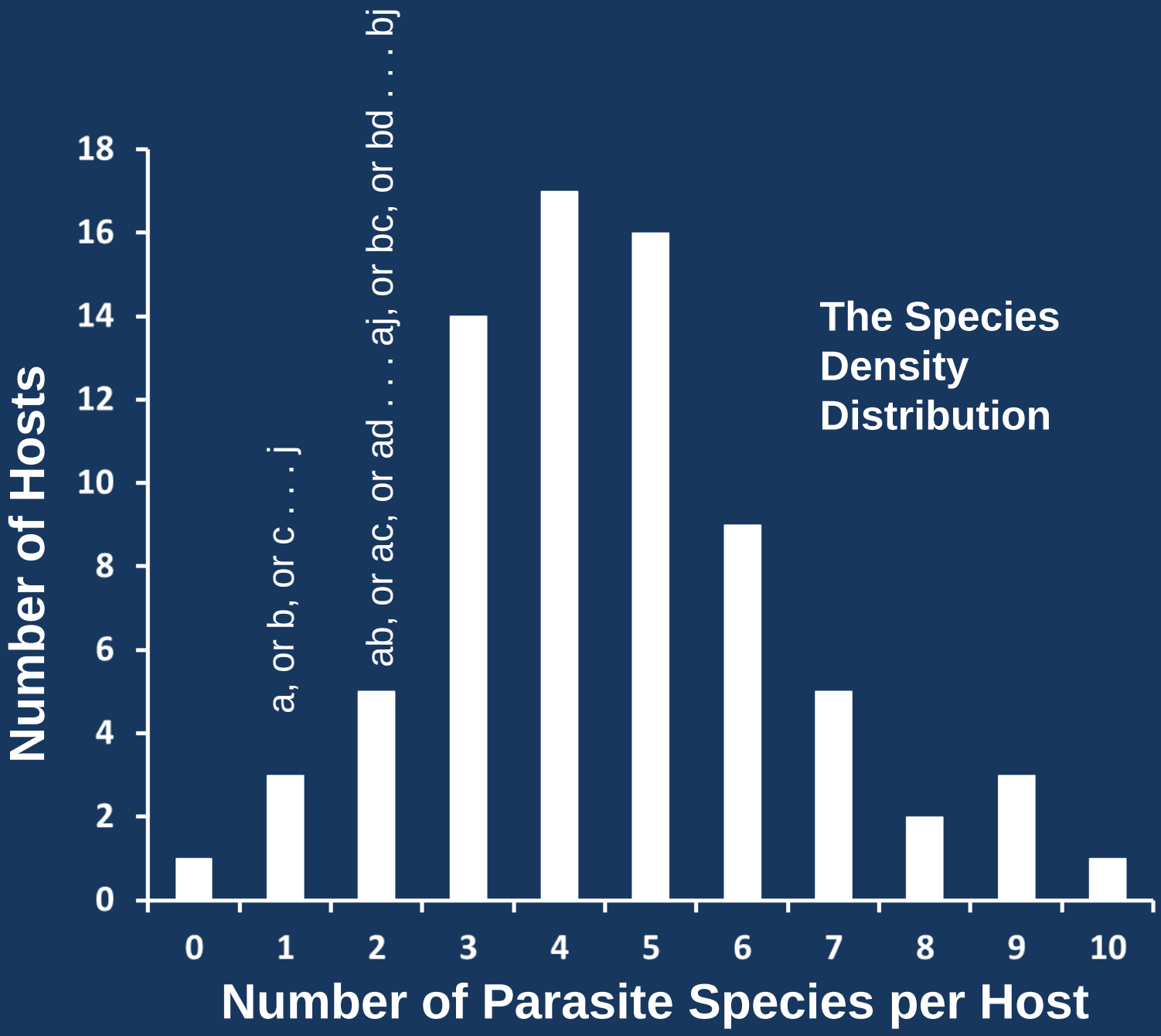
Yes, and such response has no effect whatsoever on the environment occupied by subsequent colonizers.

Or - - -

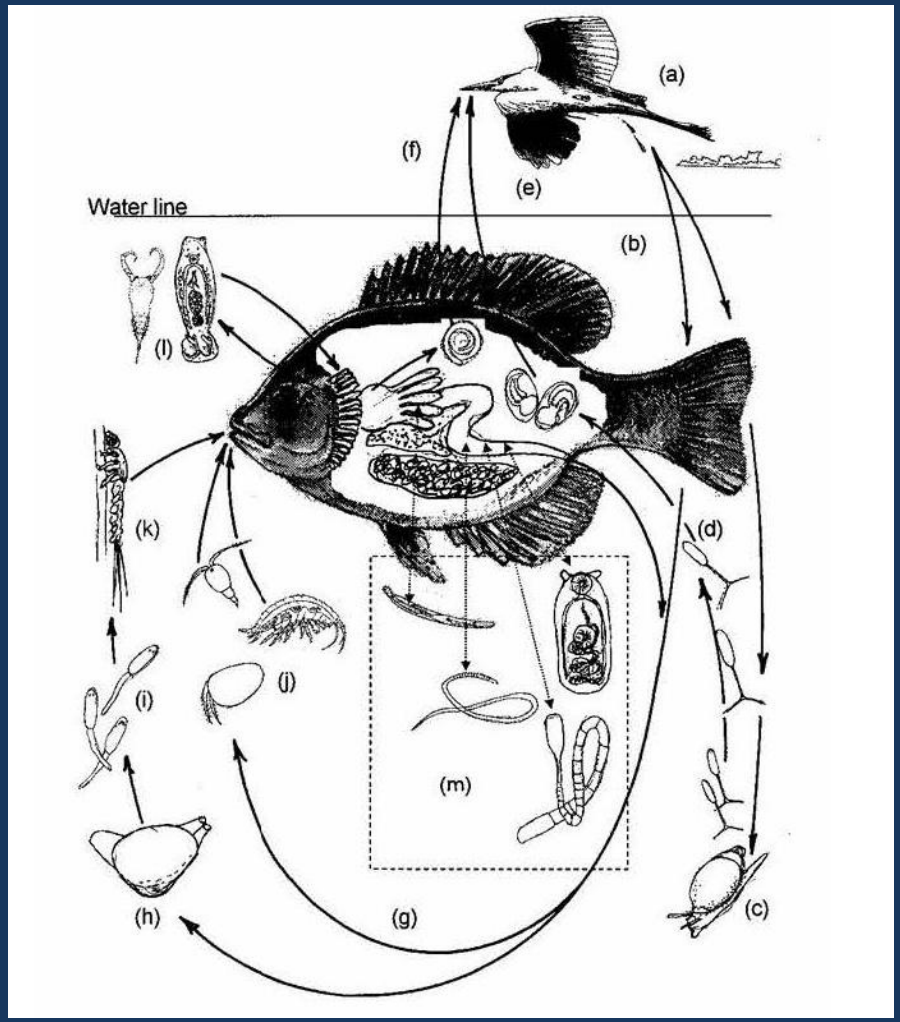
$$\sum_{i=1}^{i=n} \sum_{j=1}^{j=n} \frac{n!}{x!*(n-x)!} p_i^x * q_j^{n-x}$$

What does this equation imply (assert)?



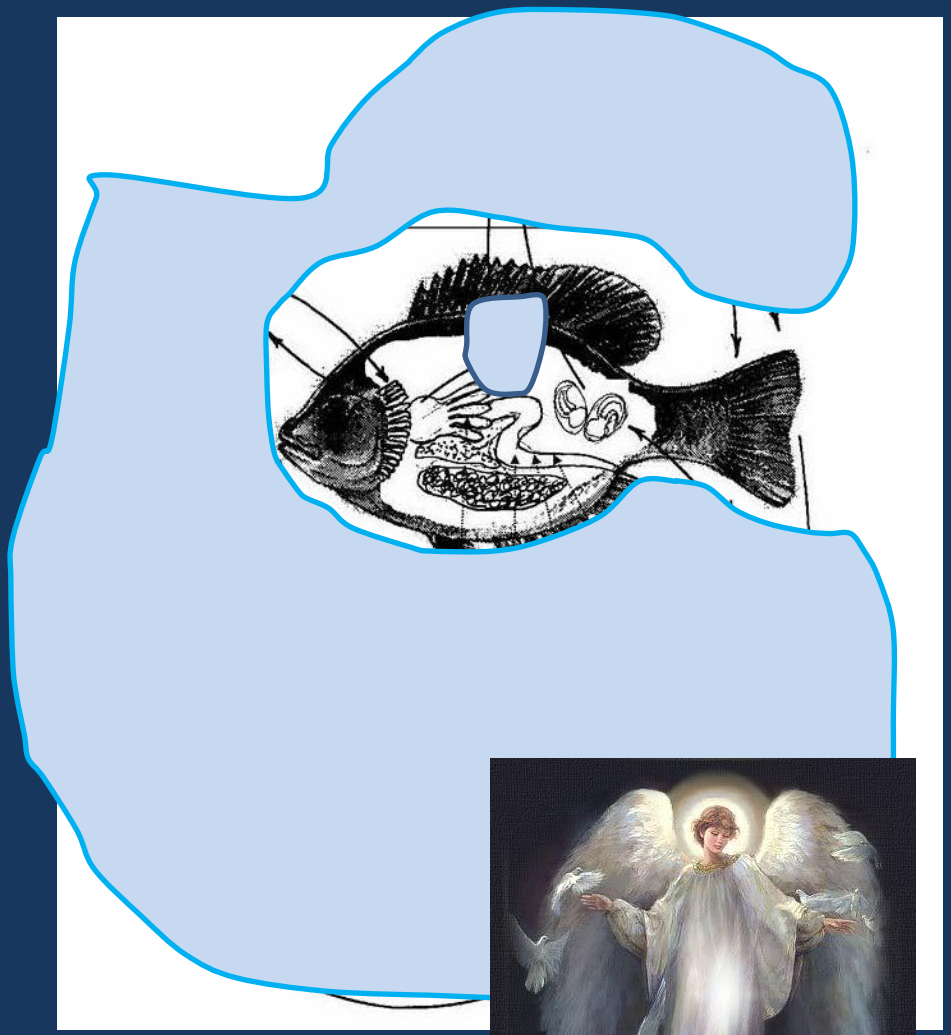

Number of Hosts
18
16
14
12
10
8
6
4
2
0
a, or b, or c . . . j
ab, or ac, or ad . . . aj, or bc, or bd . . . bj
The Species Density Distribution
0
1
2
3
4
5
6
7
8
9
10
Number of Parasite Species per Host

For X number of parasite species, disregarding infrapopulations, there are n!/((x!(n-x)!) combinations, each distinct based on the parasite species involved, of possible effects of co-occurring parasite species on the fate of a potential colonizer.



(We have just defined the doctoral problem from hell.)

For X number of parasite species, disregarding infrapopulations, there are n!/((x!(n-x)!) combinations, each distinct based on the parasite species involved, of possible effects of co-occurring parasite species on the fate of a potential colonizer.



(We have just converted the doctoral problem from hell into the ecologists' dream problem because it seems to give parasites a role in nature consistent with the ecologists' perceptions.)

The Complex Life Cycle Problem:

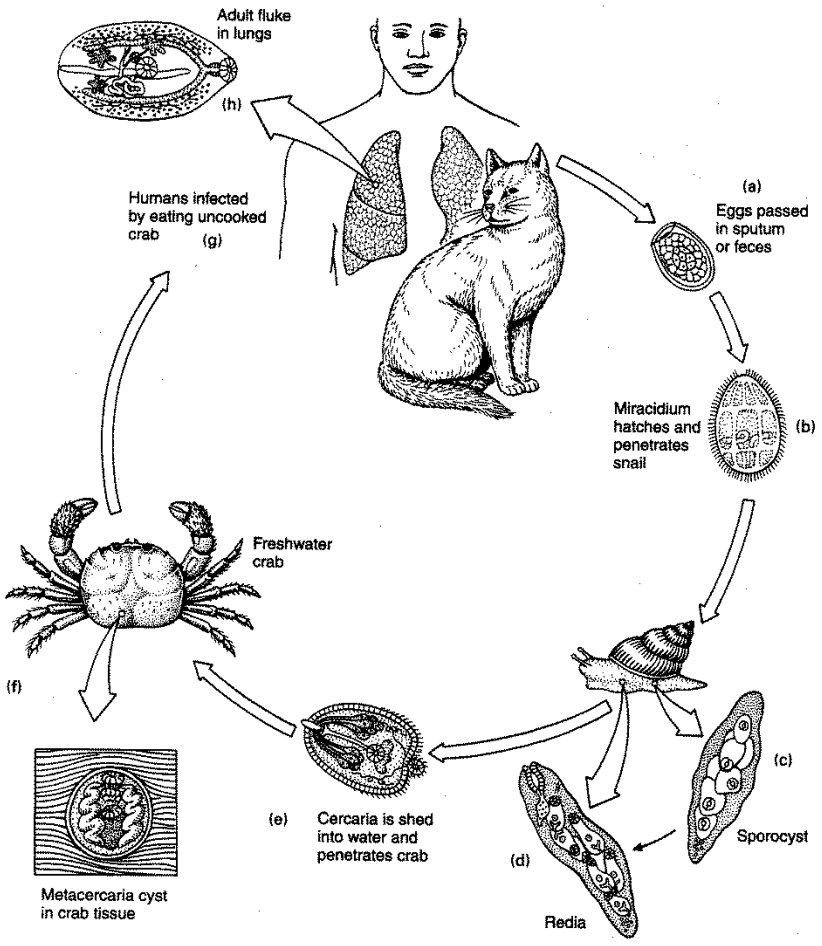
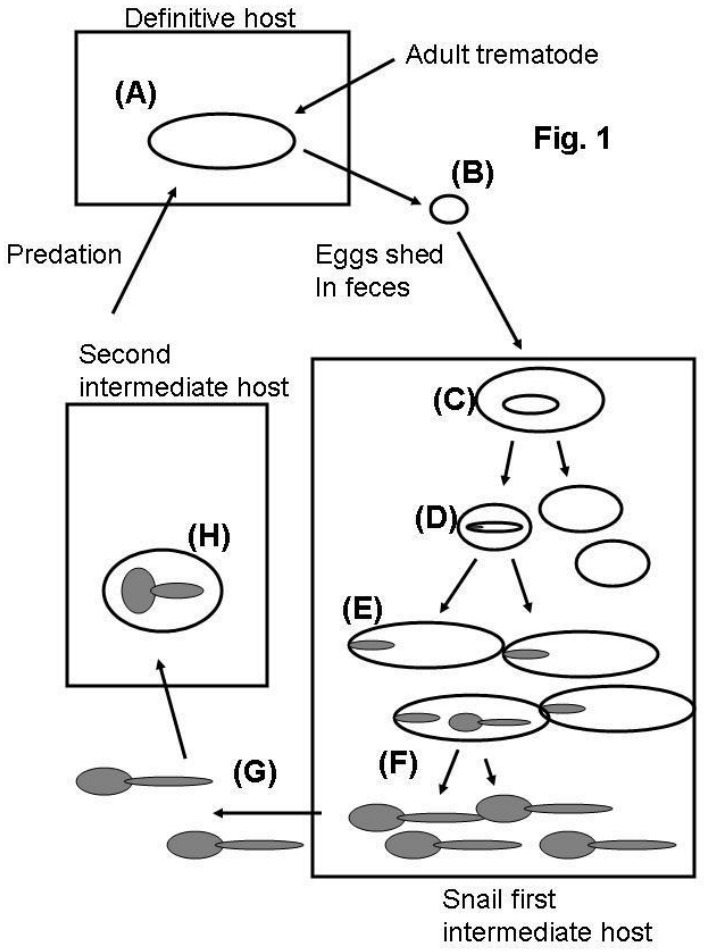
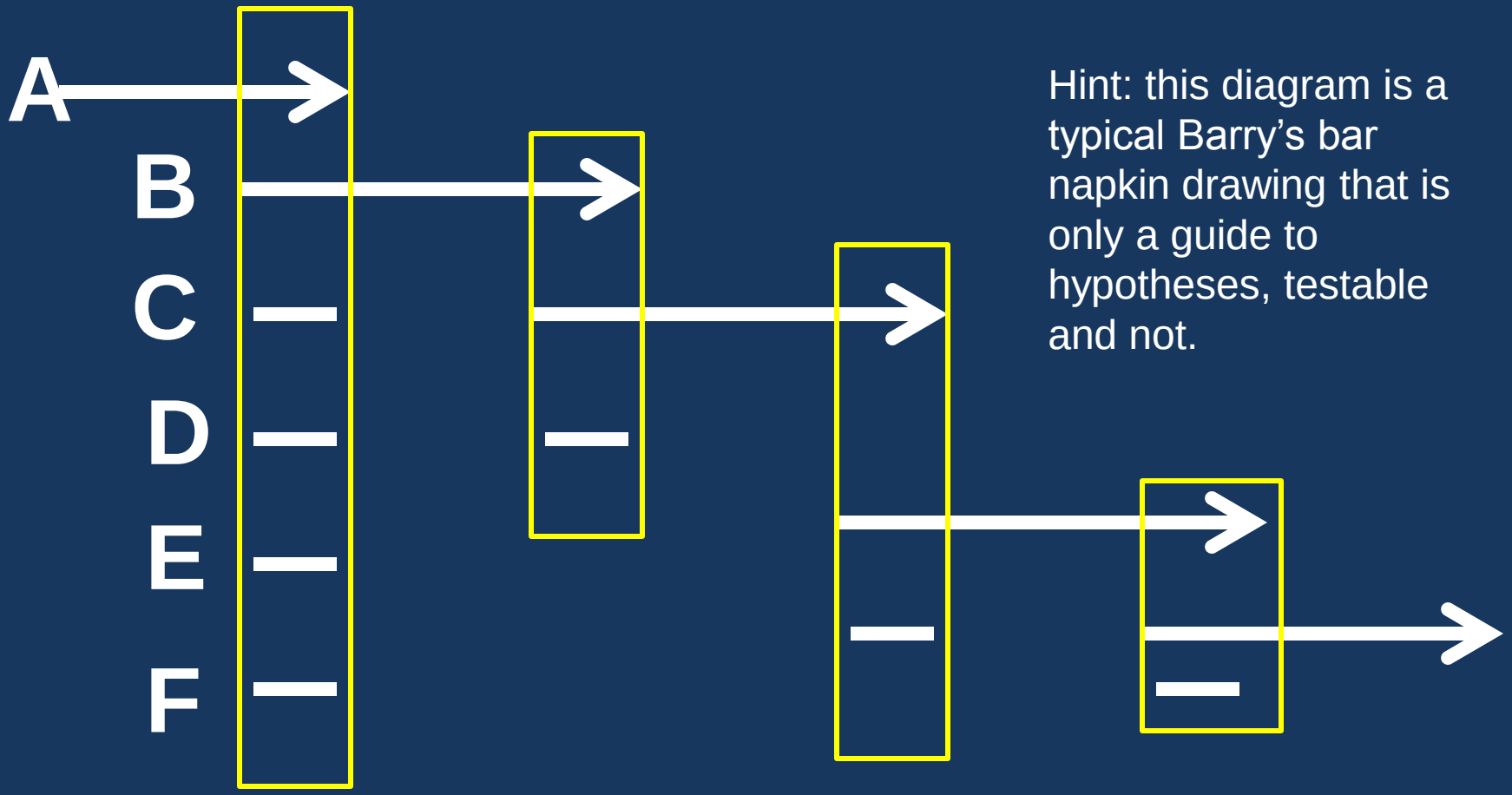


Figure 18.8 Life cycle of *Paragonimus westermani*.
(*a*) Shelled embryo passed in feces or sputum. (*b*) After development miracidium hatches spontaneously and penetrates snail. (*c*) Sporocyst. (*d*) Redia. (*e*) Cercaria is shed into water and penetrates crab. (*f*) Metacercarial cyst in tissue of freshwater crab. (*g*) Cats or humans infected by eating uncooked crab. (*h*) Adult fluke in lungs.
Drawing by William Ober and Claire Garrison.





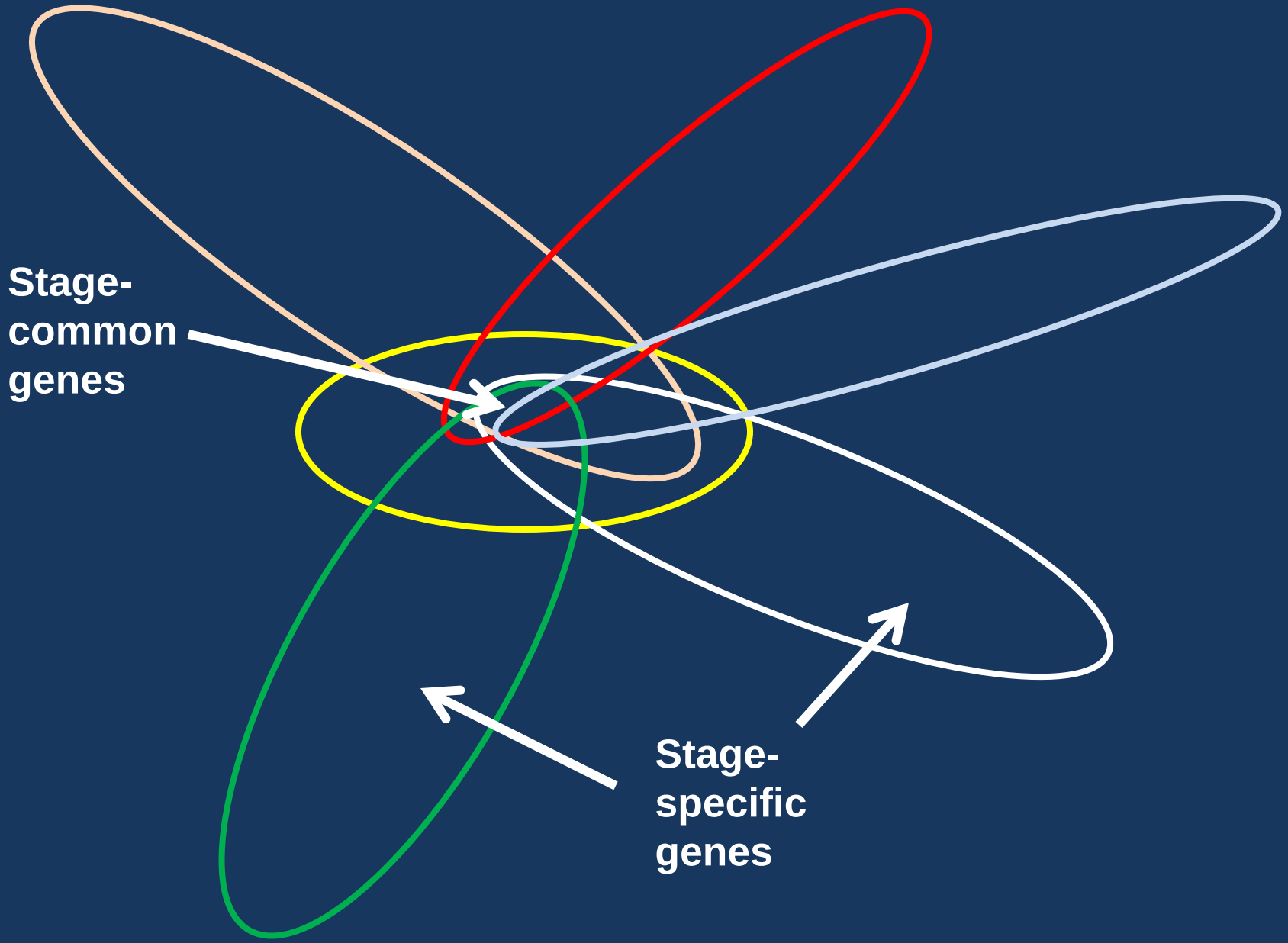
Hint: this diagram is a typical Barry's bar napkin drawing that is only a guide to hypotheses, testable and not.

The Complex Life Cycle Problem

A – F = distinct life cycle stages

— = Shared genetic information

→ = Developmental events


Stage-
common
genes
Stage-
specific
genes

There's actually a reasonable amount of published research on stage-specific proteins and gene expression, especially in schistosomes.

Somebody should assimilate this information for a seminar later in the semester – I'm guessing you'll find some interesting gaps, which will actually be great doctoral dissertation problems.

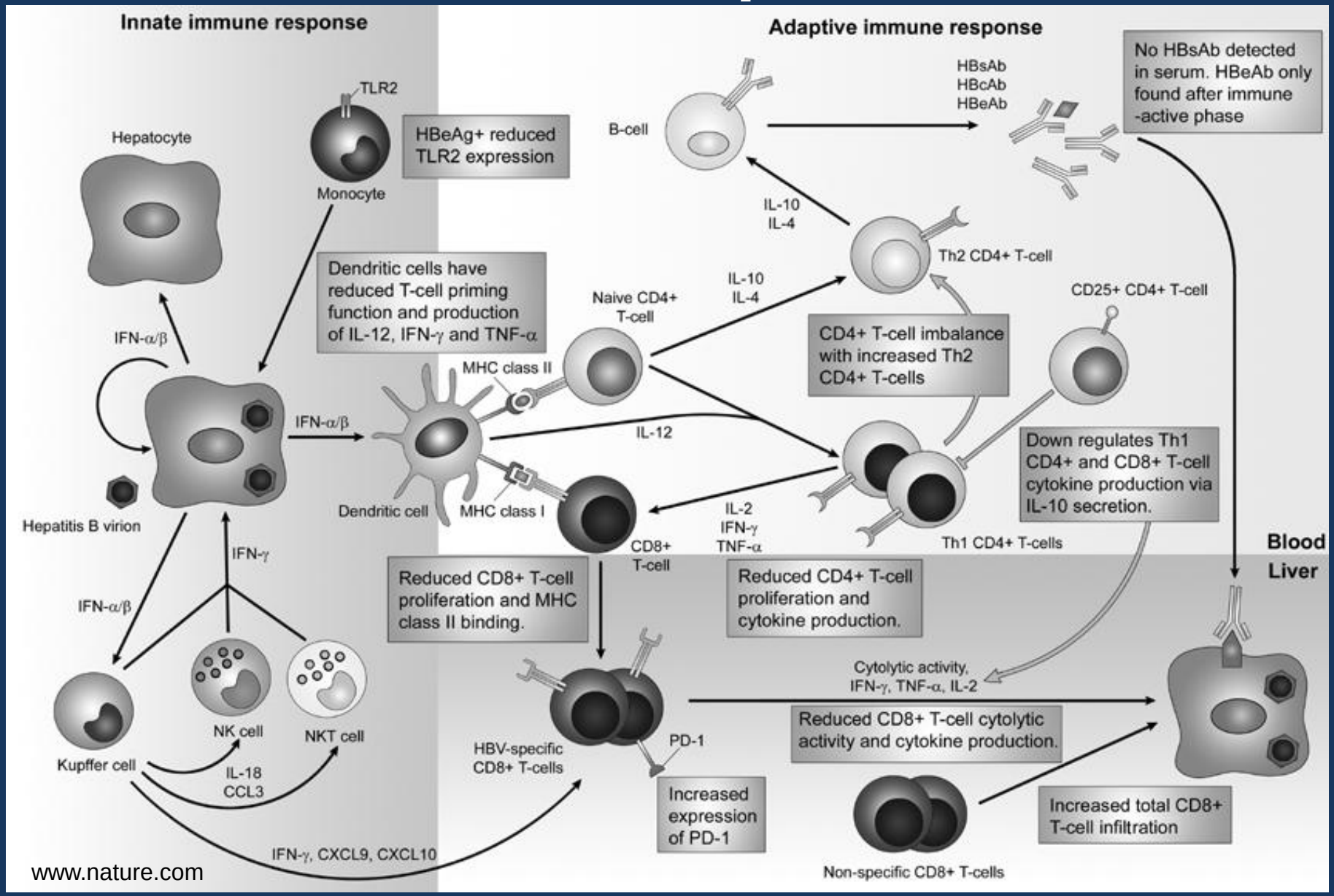
The Red Queen Problem:

The Red Queen hypothesis, also referred to as Red Queen's, Red Queen's race or The Red Queen Effect, is an evolutionary hypothesis which proposes that organisms must constantly adapt, evolve, and proliferate not merely to gain reproductive advantage, but also simply to survive while pitted against ever-evolving opposing organisms in an ever-changing environment. The Red Queen hypothesis intends to explain two different phenomena: the constant extinction rates as observed in the paleontological record caused by co-evolution between competing species[1] and the advantage of sexual reproduction (as opposed to asexual reproduction) at the level of individuals.[2] The phenomenon's name is derived from a statement that the Red Queen made to Alice in Lewis Carroll's *Through the Looking-Glass* in her explanation of the nature of Looking-Glass Land:

Now, *here*, you see, it takes all the running you can do, to keep in the same place.[3]

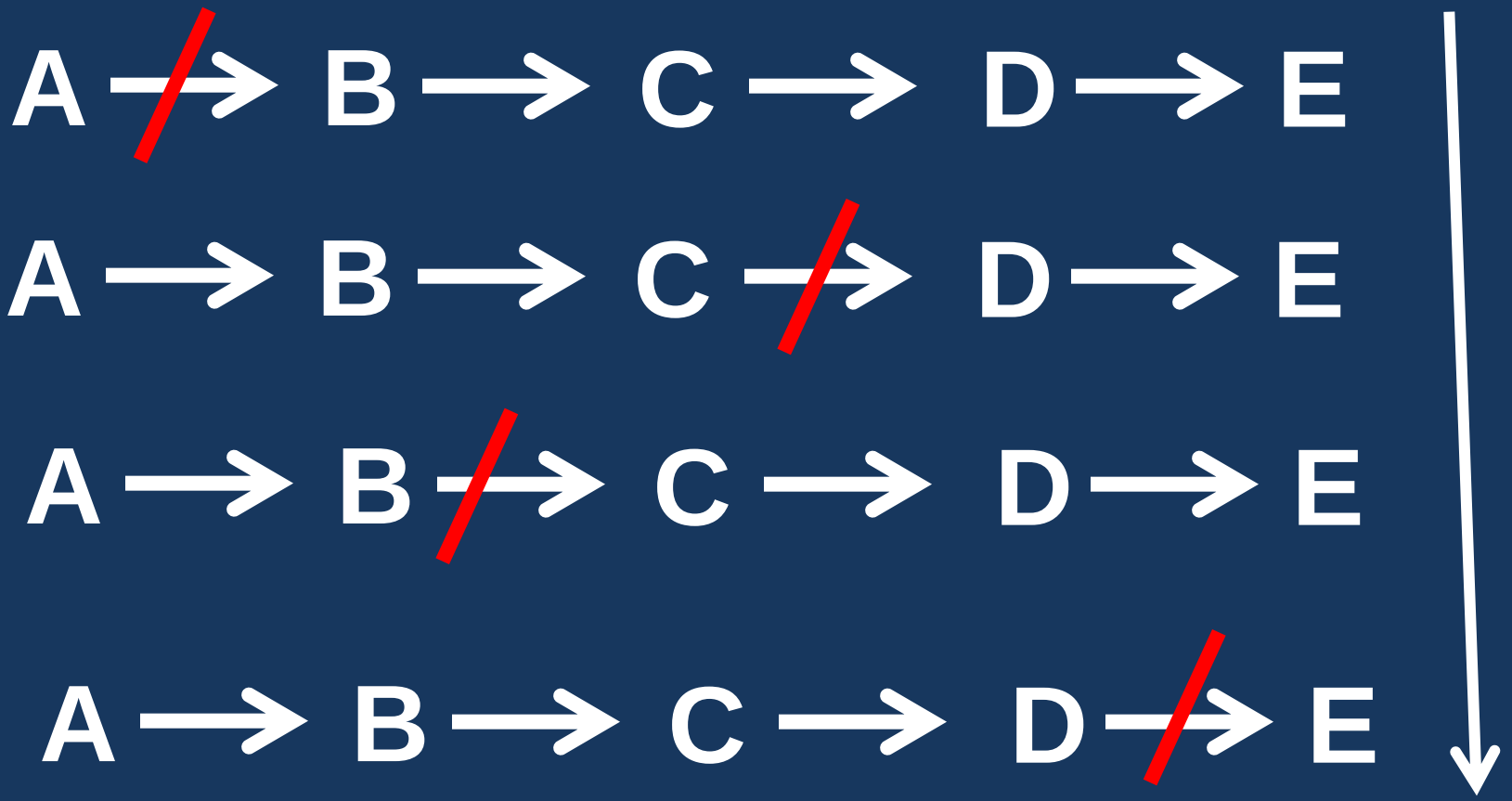
(Directly from Wikipedia)

Cellular immune response:

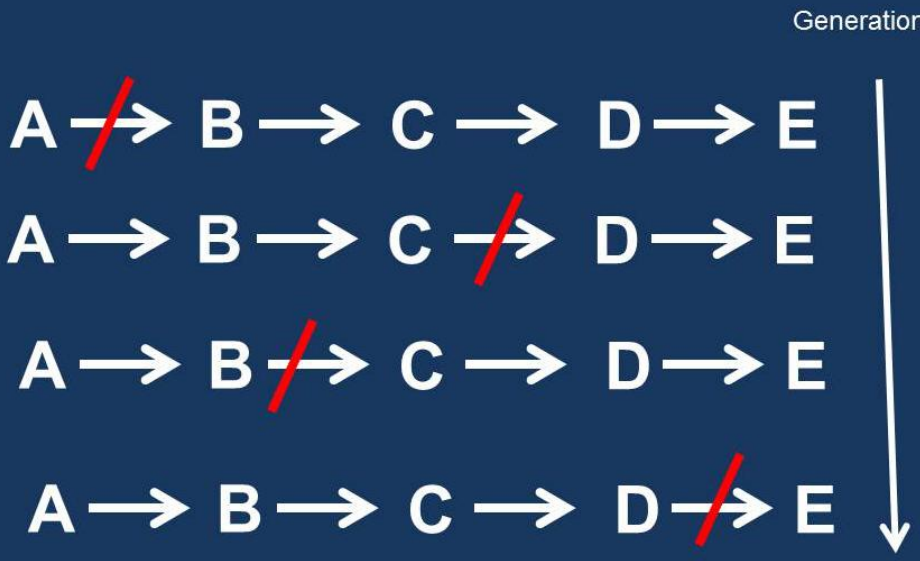


www.nature.com

Cellular immune response (greatly simplified = bar napkin):



The point is: a genetic event resulting in either host susceptibility or host resistance can occur in a variety of places, and you can't necessarily predict which of those places the lesion (or resistance change) will occur. So with a multiple-cause system, it's not entirely clear that the Red Queen scenario can in fact occur. That is, it could easily be a statistical impossibility if there are more than four or five potential sites of causality.



Red Queen + parasit* papers in Biol Abstracts

Start year	End year	# Papers (BA)
1929	2014	130
1961	2014	128
1970	2014	127
1990	2014	125
2000	2014	96
2010	2014	50*

***9 with Lively listed as an author**

Somebody needs to do a really complete, and neutral, philosophy of science project on the Red Queen hypothesis.

The Take-Home:

- It's always an interesting exercise to examine the way deeply-held beliefs direct our research agenda.
- The relationship between technology (what can be done) and the way things are (what should be done) is always a compromise tainted with intellectual politics.


Barry’s Bar and Grill may be the best place to discuss parasite genetics, but BIOS 915P is a close second.