

The Mystery Snail Color Genetics Project v2.0

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The MSCGP **v2.0** is a crowdsourced effort to understand the inheritance of color polymorphism in *Pomacea diffusa*, the commercially-popular “mystery snail” common in home aquariums worldwide. The project is coordinated by Dr. Rob Dillon, a genetics professor who retired from the College of Charleston in 2016 to dedicate the remainder of his pathetically-nerdy life to freshwater gastropods. Dr. Dillon has over 50 years of research experience working with the genetics, ecology, and evolutionary biology of mollusks.

The project germinated in 2018, but barely grew and bore no fruit whatsoever in its first seven years, primarily because, in retrospect, the suggested methodology was impractical for home application. Hit [\[this link\]](#) to download an archival copy of the original MSCGP v1.0 website, if you’re perversely curious about what didn’t work.

The present Version 2.0 of the Mystery Snail Color Genetics Project went online in February of 2026 with revised techniques guaranteed to be more practical for aquarium hobbyists. **Would you like to join us?** Membership is open to everybody! All you need is:

- At least some experience in the home culture of mystery snails, and a willingness to learn.
- At least one female* mystery snail of the color form usually called “ivory,” and one female* mystery snail of the color usually called “brown” or “black.” More would be better. Lots more would be lots better. Ivory mystery snails can be recognized by their completely unpigmented body and shell. Brown/black are exactly the opposite. See the photos below. Notice the asterisk by that modifier, “female.” See Point #5 in the section entitled “[Reproductive Biology](#)” for more.
- Or newly-hatched babies from an ivory mother and newly-hatched babies from a brown/black mother in your home aquarium right now. If you are at that stage, you’re way ahead of most of us. Go directly to “[Methods, Phase \(2\)](#).”
- At least two aquaria dedicated to the culture of mystery snails. More would be better. Lots more would be lots better. You can set these aquaria up according to your personal preferences – size, water quality, temperature, filtration method, and so forth. Feed your snails whatever diet you prefer. I recommend that you not culture fish together with your mystery snails. Plants are OK. And (honestly) other species of snails (like *Physa*) are also OK. Not ideal, but we can live with them.
- You will need a camera or smartphone to photograph any offspring you may be able to hatch. Everybody likes baby pictures!



- I will need your name and email address. We will communicate among ourselves via email. Your intrepid coordinator does not text, twitter, tweet, instachat or snapgram. He barely understands Facebook and does not understand what “IM” means, at all. Please email DillonR@fwgna.org if you need to communicate with me or call 843-670-8002 during regular business hours. I only understand complete English sentences correctly spelled, capitalized, and punctuated.

Ready to get started?

Read the next six sections – Study organism, Reproductive biology, Genetics, Hypothesis, Phase (1) methods, and FAQs. Contact me. And go!

Our Study Organism

It is important to be clear, from the very beginning, that we will be working exclusively *with Pomacea diffusa*, the snail almost-universally marketed as a “mystery snail” by aquarium shops and big-box pet stores like PetCo and PetSmart. Prior to the mid-2000s they were often identified as “*Pomacea bridgesii*” until the systematic confusion in their native South America was sorted out by our good friend Ken Hayes and his colleagues. An alternate common name for the mystery snail is the “spike-topped apple snail.”

Mystery snails reach adulthood at around 2 cm standard shell length, and very rarely reach much more than 4 cm. They will not eat your aquarium plants. They can be purchased in a variety of color forms, for about \$3.00 each, last time I checked. They are active and interesting pets, easily reared in your home aquarium.



Several larger species of *Pomacea* are also occasionally available on the market, called “channeled apple snails,” or “Peruvian apple snails” or “giant golden mystery snails” or something similar. These include *Pomacea maculata*, which has been introduced into ponds and drainage ditches the southeastern United States, *Pomacea canaliculata*, which has become a terrible pest in Asian rice cultivation, and the native Floridian *Pomacea paludosa*. These larger species are more challenging to keep as pets, and will eat your aquarium plants, and anything else too slow to get out of their way. They are not supposed to be sold commercially, and **we are not working on their genetics.**

The best way to recognize *P. diffusa* is by its spire angle, as shown on Bill Frank's photomontage above. If you're still worried that your pet might not be a bona fide mystery snail, *Pomacea diffusa*, visit Stijn Ghesquiere's applesnail.net website. Stijn has lots of good info on all the various species of ampullariid snails worldwide, not just *P. diffusa* but every other type of *Pomacea* you might run across, and ways to tell them apart.

Reproductive Biology

I'm beginning with the assumption that all MSCGP volunteers are familiar with the basics of mystery snail biology, including (especially) their unique reproductive adaptations. The husbandry of egg laying and hatching are not trivial in *Pomacea*, but the reason I have advertised this project to groups already enthusiastic about mystery snails is that, I trust, you can handle them. See Stijn Ghesquiere's applesnail.net page if you need a refresher.

Six important points to keep in mind:

- (1) Sex ratios are not necessarily balanced in *Pomacea* populations. In fact, field surveys generally find wild (or naturalized) populations of *Pomacea* biased toward the females. There's been some fascinating research on introduced Asian populations of *Pomacea canaliculata* that suggests multigenic inheritance of sex, rather than the typical XY chromosomal system everybody is familiar with. So takeaway point #1 is that, although I don't know of any good study, I wouldn't be surprised if most of the mystery snails in the home aquarium today are female.
- (2) Essentially all invertebrates with internal fertilization store sperm, typically for their entire lifetimes. Some model organisms, like fruit flies, are effectively inseminated just once. The situation is not well studied in gastropods, but multiple insemination is often reported. Whether the sperm of the first partner prevails, or the last partner, or some combination, is generally not known.
- (3) It's a good bet that all the mystery snails in all our home aquaria are already inseminated, possibly by multiple partners, when they arrive in the pet shops. I ran a brief FB poll that returned 14 cases of mixed-phenotype sibships, and only 2 cases of pure-phenotype sibships, from mystery snail egg clutches hatched in the home aquarium. This implies that the breeders do not keep snail stocks that they mean for the retail market segregated by color, but rather mix them sometime around maturation, perhaps in a calculated effort to block the development of pure lines by competitors. And (to be fair) it's more fun for hobbyists who might be able to hatch egg masses from females obtained at the retail level if they obtain mixed-phenotype progeny.
- (4) Controlled crosses require virgin snails. So, since there is no good way to predict when maturity might be reached, the only really reliable way to do a genetic experiment is to isolate snails in pairs shortly after they are hatched and rear them in pairs. We'll use a work-around for this problem in Phase (2), but we're stuck in Phase (3).

- (5) *It is possible, although deceptively difficult, to determine the gender of adult mystery snails. The penis arises as an evagination of the mantle, at the posterior aperture edge, which you can see (sometimes) if you pull a male *Pomacea* out of the water and hold him aperture up. There are some helpful illustrations on the web to show you how to do this.



The problem is that if you can see a penis, you know your snail is a male, but if you cannot see a penis, you don't know anything. Your snail could be immature, or sick. Or the lighting might be bad, or you might be holding him wrong. That is an especially big problem in photographs, as demonstrated by the photomontage above from Ms. Roberta Rose (Snails, Snails, Snails 1Oct18).

The situation is similar with behavioral cues. If your mystery snail is in an aquarium with other mystery snails, and you see him on top of a partner, attempting to copulate, you can infer that he is a male. But if you do not see that behavior, you don't know anything.

I would recommend that you do your best to determine the gender of the mystery snail or snails you are considering for use as parents. Pull them out of the water and flip them over and watch as they struggle. If you can clearly see a penis, that's a disqualification. Otherwise, keep it and we'll see.

- (6) The bottom line. You'll need a teaspoon of luck and a bushel of persistence to participate in the MSCG Project. The more snails you start with, the more likely you are to have a healthy females.

A Two-minute Refresher on Genetics

Almost everybody has been exposed to some genetics, at some point in their lives. I feel pretty sure you all remember that most organisms of all sorts, including people and snails, are **diploid**, which means that they have two sets of **chromosomes**, one from mom and one from dad. And that the genes are on the chromosomes. So that (simplifying a bit) all diploid organisms have two sets of genes.

The complete set of all the genes held by an organism is called its **genotype**. The appearance of an organism is called its **phenotype**. Some fraction of an organism's phenotype is controlled by its genotype. Trying to figure out the details of that (deceptively simple) term "some fraction" is basically what geneticists have done since 1866 and what continues to be our main job today.

But one of the more irritating things about Genetics, which I taught at the college level for 35 years, is that the meaning of the word "gene" has become confused. The term is used in several different ways, to mean several different things, even by professional geneticists. So, let's clarify.

For the sake of the remainder of this section, we will substitute the (more precise) word "locus" for the (ambiguous) word "gene." A **locus** is a place on a chromosome that encodes a trait. Then to re-state the fourth sentence in the first paragraph, all diploid organisms have two sets of loci.

And let's introduce a second (more precise) word, "allele." An **allele** is one of at least two alternative messages at a locus. I'll bet that you all remember that an organism with two matching alleles is called a **homozygote**. And an organism with two mismatched alleles is called a **heterozygote**. You probably also remember that alleles can be **recessive** (two copies required for the organism to manifest a trait) or **dominant** (only one copy required.)

So since the birth of our science, geneticists have had a problem. Suppose an organism shows the dominant phenotype. Is that organism homozygous dominant, or is it heterozygous? The way we have always answered that question is with a test cross.

A **test cross** is, simply, crossing an organism that shows a dominant phenotype to an organism that shows a recessive phenotype. If all the offspring of the dominant-phenotype parent also manifest the dominant phenotype, that parent must have been homozygous. If the parent with the dominant phenotype has babies with both the dominant and recessive phenotypes, that parent must have been heterozygous. The ratio of the dominant and recessive phenotypes in the offspring in the latter case is expected to be 1:1.



Here in the MSCG Project, we will work out the inheritance of color polymorphism in *Pomacea diffusa* using test crosses. If we get all the way to the end of Phase (3) we'll be using a trihybrid testcross, one of the most powerful experiments of classical genetics, from which we will expect a 1:1:1:1:1:1:1:1 ratio.

You'll also find little bit of additional jargon on this website, and in correspondence with me, regarding generation times. I'm calling the snail that you start with the "**mother**" snail. Her babies are called the **F1** generation. And let's call all babies born from a single egg mass an F1 **sibship**. (A sibship is a clutch of brothers and sisters.) In Phase (2) of the MSCG Project, we're planning to rear and intercross specially-selected subsets of F1 offspring. We'll call the offspring from a pair of F1 snails the **F2** generation.

Hypothesis

At the risk of sounding even more like your high school biology teacher than I already do, **science** is the construction of testable hypotheses about the natural world. We can't just cluelessly cross every mystery snail with every other mystery snail and hope to figure out the inheritance of shell and body pigmentation from the results. We must start with an hypothesis.

For quite a few years, hobbyists have informally suggested that color polymorphisms in mystery snails are controlled by three genetic loci, each with two alleles. I don't know who first offered this hypothesis, but it has been featured on Stijn Ghesquiere's applesnail.net for a long time. This hypothesis would lead to eight discrete color phenotypes, which jives with general (although not universal) experience.

Let us call locus **A** body color. And let us hypothesize two alleles, the dominant A, which encodes dark pigment, and the recessive a, which does not. Homozygous recessive aa snails have unpigmented bodies.

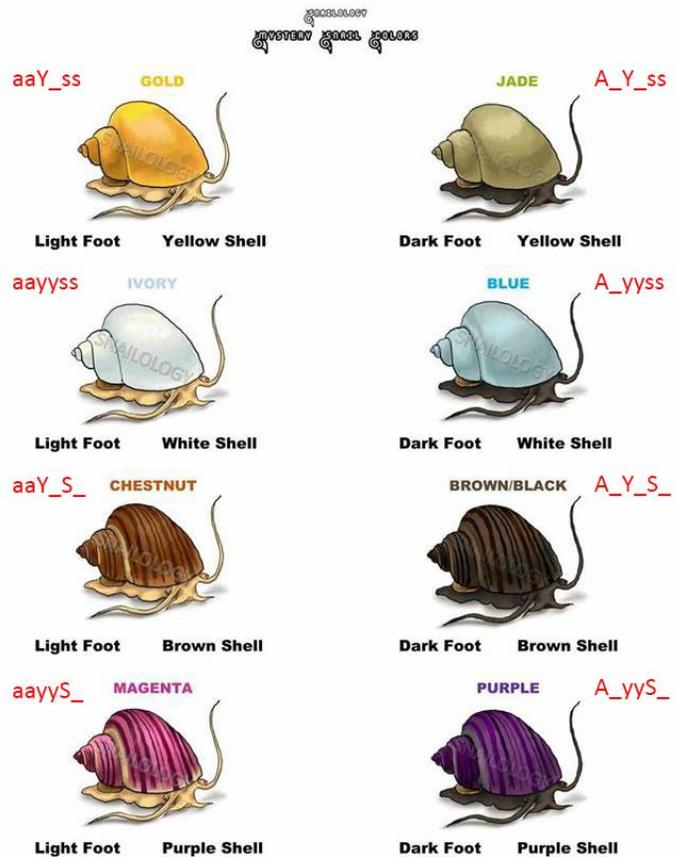
Locus **Y** controls shell background color. Again, we hypothesize two alleles, the dominant Y encoding the deposition of a yellow background pigment on the shell, and the recessive y not. And again, homozygous recessive yy snails have no background shell color.

Locus **S** controls shell striping. The dominant allele S encodes dark, purplish stripes on the surface of the shell, and the recessive s does not. Again, homozygous recessive ss snails have no striping.

Then using a blank underline to designate any second allele, the eight phenotypic classes will be:

- Brown **A_Y_S_**
- Jade **A_Y_ss**
- Purple **A_yyS_**
- Blue **A_yyss**
- Chestnut **aaY_S_**
- Gold **aaY_ss**
- Magenta **aayyS_**
- Ivory **aayyss**

OK, that's science. We have constructed a testable hypothesis about the natural world. Now let's test it.



Methods, Phase (1)

Assuming the hypothesis advanced in the previous section, all the mother snails demonstrating the ivory phenotype in the pet shops and in our home aquaria are homozygous recessive at all three loci. But we can only halfway determine the genotypes of the brown/black snails in our home aquaria. And any females in our home aquaria are (probably) already inseminated. And we (probably) do not know the father. So, Phase (1) of the MSCG Project is simple:

(1.1) Isolate your ivory snail(s) and your brown/black snail(s) in dedicated tanks.

(1.2) Separate any clutches of eggs laid from their mothers and hatch them. If you're using a big aquarium, it is best to remove any egg masses from the walls, or wherever they've been laid, and hatch them in a separate container. You can find plans for several styles of hatcheries on the web, for example the ones depicted by Ms. Beverly Laborgini below. Or if you are using a smaller, simpler container for your mother snail, like a krittter-keeper, you might just move the mom into a new container, leave the eggs attached to the wall where she laid them, and change the water.



(1.3) Count the viable F1 hatchlings immediately and separate them by any color phenotypes you are able to distinguish.

(1.4) Rear the F1 to at least pea size, count again and verify phenotype. We are trying to allay two concerns here. First, it is not clear at what size the color phenotype of a juvenile mystery snail can be reliably determined. And second, the color forms may demonstrate differential survivorship. We are trying to get a handle on both these unknowns with that (deceptively simple) term "pea size" above. We'll see.

(1.5) Report your results to me by email, with attached photograph or photographs for documentation. If all your babies look the same, you could just send one photo and say, "My ivory mother had 27 F1 babies that all looked ivory, like this." Or if your mother snail had a mixture of babies showing two phenotypes, you would send a couple photos, saying, "My ivory mother had 13 blue F1 babies that looked like photo #1 and 18 ivory F1 babies that looked like photo #2." I'm counting on you to document your results clearly and completely and report them to me.

If your ivory mother has a pure-ivory clutch of offspring, great! Save those for Phase (2). If your ivory mother has a mixed clutch, we'll be looking for that signature 1:1 ratio of phenotypes. It is possible, depending on all the daddies of all the F1 clutches born by all the ivory mothers in the world, that we might confirm our entire model of the inheritance of color polymorphism in mystery snails at Phase (1) of the MSCG Project.

The situation with the offspring of your brown/black mother is more complicated, but the bottom line is the same. Save all brown/black offspring for Phase (2).

Frequently Asked Questions

Q: Can you tell me if my mystery snail is ivory, brown/black, or some other color?

A: Probably. Send me a photo.

Q: Can I participate in the MSCGP with color phenotypes other than ivory and brown/black?

A: Well, yes, I suppose. But whatever results you obtain will not be as interesting or important, and you may find me rather slow to respond to your emails.

Q: Can you tell me if my mystery snail is a female?

A: No. It's just too hard to do that from photos. See Point #5 in the section on Reproductive Biology.

Q: My (Phase 1) parental-generation ivory snail is not laying eggs. What should I do?

A: My first thought is that it might be a male. I'd pull it out of the water and inspect it very closely for a penis. If I didn't see a penis, I'd re-examine my culture technique. Am I taking good care of her? Have I fed her regularly and kept her water fresh? Is she healthy, does she seem to be growing? And if my culture technique is fine, my third thought would be that she might not be inseminated. So, I would pair her with another adult snail (ideally, of course, one I had reason to think is a male) for a couple days, and then isolate her again. And I would prefer that her potential suitor not be ivory, but any other color form. Brown would be nice.

Q: Do you have culture tips for mystery snails? Do you have recommendations about food, water quality, temperature, lighting, filtration, and so forth? Do you have any ideas on how to promote egg laying? Can you recommend methods to harvest egg masses and hatch babies?

A: Sorry, I'm pretty clueless in that regard. Most of you have way more experience with home aquariums than I do. If I were going to do this study myself, I'd use lab culture techniques that aren't practical for the home.

Q: Why did you start the MSCG Project?

A: I'm a recently-retired college professor who is bored. And I'm intellectually fascinated by the ecology, evolution, and genetics of mollusks.

Q: What do you hope to get out of it?

A: Our results will certainly be published. We're aiming for a paper in the peer-reviewed scientific literature. But the quality of the publication depends on the quality of the data we ultimately generate.

Q: When it is published, can I be a coauthor?

A: I will certainly acknowledge all contributors by name, with their permission. But it's too early to talk about coauthorship at this point.

Q: How long will the project take?

A: That's difficult to estimate. Gregor Mendel's experiments took seven years. That's about how long the MSCGP project has been in existence, at the date of this Version 2.0 document you're reading right now (25Feb26). I used to walk into the lab and ask my students, "How's the snail research going?" And they would answer, "Slow."

Q: Years, are you kidding? Can I get results sooner?

A: Yes, absolutely. We're all working together. I will collect all your email addresses and send periodic updates on our progress, including all interim results may have been sent to me. I'll also post periodic updates on the MSCG Project "[News and Announcements](#)" page.

Q: Can I remain anonymous?

A: No and Yes. I must have (at minimum) your full name and email address, and I would also be interested to hear anything else about yourself that you'd like to share, including your actual physical address, background, interests, and so forth. We're colleagues. That's called "collegiality." But if you don't want me to share your info with anybody else, I'll respect your privacy.

Q: Why email?

A: I do not understand social media, probably because I am not social. I would actually feel most comfortable conducting this entire study by old-fashioned snail-mail, with stamps. Email is as far as I can go.

And I hate gadgets of all sorts. I finally had to purchase a smart phone in 2021, when I dropped my flip phone in the pond. But I will always prefer a digital camera to take photos, and a desktop computer to connect with the internet. If I want to listen to music, I have a CD player, and if I want to watch movies, I go to the theater. And I have no desire whatsoever to google-up factoids to contradict my spouse at the supper table. I cannot for the life of me understand why anybody would want to do all of those things, worse, with an expensive, fragile, awkward little box that pinches in the pocket.

Q: Why must I correspond in complete English sentences, with correct spelling, grammar, and punctuation?

A: My friends tell me that I can be a nice guy, sometimes. But when it comes to science, I am an arrogant jerk. I am demanding, and I am critical, and one of the (many) things I will not tolerate is sloppiness.

So, the way you express yourself tells me a lot about you. If you are so careless and inattentive to detail that you cannot communicate in complete, correct English sentences, I will not trust any scientific data you might be able to gather. And there's no point in your participating in this project.

Q: Why is the MSCG Project website so ugly?

A: Ouch, that's harsh, man. First, this is a research project. And form must follow function. But second, any volunteers out there with web skills are invited to contact me!

Methods, Phase (2)

If you have found your way to this page, you have sibships of juvenile mystery snails from both an ivory mother and a brown/black mother, probably from egg masses that you hatched yourself. If you have just completed Phase (1), you have already sent me a photo (or photos) documenting what this sibship looks like. If you skipped directly here without passing through Phase (1), on the other hand, I'd appreciate your sending me a photo or photos of whatever babies you've already got before going further.

(2.1) Mix your ivory babies together with your brown/black babies in equal proportions. Initially, this could be done in a single aquarium. As they grow, you may need to expand to additional aquaria.

(2.2) Keep track of mortality, keep the ratios of phenotypes even. That's going to be a pain, especially when the snails are small, if you're using a large aquarium full of pretty plants and sunken pirate ships and so forth. For that reason, if I were conducting this experiment myself, I'd be using smaller containers with simple gravel bottoms, like one-gallon "Kritter Keepers." The point here is to maximize the likelihood of an ivory x brown/black mating, which hits 50% when the two phenotypes are in equal frequencies.



(2.3) What we are looking for at this step is ivory females laying clutches that include at least some pigmented babies. Exactly how we get to that result will be up to you. Ideas:

- Maybe you can catch an ivory female laying a clutch and isolate that individual female and rear her babies.
- Maybe you prefer to wait until egg masses start showing up in the group tanks, and then isolate all the apparently-mature ivory snails in smaller tanks as potential mothers.

(2.4) Separate all clutches of eggs laid by ivory mothers, hatch and rear them following the techniques outlined in step **(1.2)**.

(2.5) Count and score all juveniles using the technique outlined in [Phase I](#) steps **1.3 – 1.5**. Although we are focusing on clutches that include at least some pigmented offspring, save pure ivory clutches as well.

Again, we will learn a lot together if we get this far in the experiment. But in the best of all possible outcomes, what we are looking for is a pure brown/black sibship born from an ivory mother. Under our hypothesis, those snails will be AaYySs triple heterozygotes. Which takes us to [Phase 3](#).

Methods, Phase (3)

If you have gotten this far in the experiment, **congratulations, I am very impressed!** You have apparently been able to rear two generations of mystery snails and cross them under rather controlled conditions. So (ideally) you now have AaYySs brown/black babies, and ivory aayyss babies to testcross them with. This step cannot be done in mass culture. This must be done pairwise. Let's do it!

(3.1) You can certainly rear both of your batches of baby snails in a single aquarium while they are still juveniles.

(3.2) I don't know at what age or size maturity occurs. But at some point safely before that, your juvenile snails must be removed from joint culture and paired.

(3.3) Pair single brown/black juveniles with single ivory juveniles, making as many pairs as you've got vessels to keep them in.

(3.4) Again, I'm not trying to tell you how to do your job, but from a practical standpoint, you will probably want smaller aquaria, like those one-gallon critter keepers I mentioned in Phase II.



(3.5) Rear pairs to adulthood, replacing (or combining) parents as necessitated by mortality.

(3.6) Remove egg masses laid using the techniques outlined in step **(1.2)**. Record the phenotype of the mother, if you can catch her in the act.

(3.7) But wait. Even in the best of all possible scenarios (a 50:50 sex ratio, everybody mature and healthy) only half of those pairs will be male x female. Which means that at least 50% of your pairs will not have yielded offspring.

- Maybe you can sex them at this point, and swap them around accordingly?
- Or just swap partners randomly, true by phenotype, of course.

(3.8) Count and score all the juveniles born from any successful Phase 3 cross you are able to complete and report those results to me, using the technique outlined in [Phase I](#) steps **1.3 – 1.5**.

If we get all the way to the end of this entire experiment together, we will have completed a trihybrid test cross, one of the classic experiments of 20th century genetics. Learn more [\[here.\]](#) In addition to confirming the hypothesis as outlined on this website, we will be able to detect linkage among our three loci, if it occurs. **Well done, laurels all 'round!** Nobel prizes in malacology are awarded annually on December 10. Go ahead and buy your ticket to Stockholm.

An Open Letter to the breeders and suppliers of mystery snails worldwide:

First, I must confess that I'm a big fan. I would love to know how you initially developed all your keen Pomacea color variants, and how you currently cultivate them and bring them to market at such large scales.

Second, it seems likely to me that you already have enough data for a good peer-reviewed publication, or (in any case) could easily gather it. Much more easily than I.

But **third**, I understand why you might be reluctant to share details regarding the genetics of color polymorphism in your valuable product. You consider this information proprietary. It is one of your "trade secrets."

Fourth, I mean you no harm. I have no plans to start my own mystery snail business. Nor do I have any grant support, nor am I struggling to get tenure at some big-time research university. If I was, this would be a terrible way to get it. I'm just a retired college professor who is intellectually fascinated by the genetics of freshwater snails. And I would like to see this information available to the larger scientific community. And, in all honesty, it doesn't look as though it will be terribly hard to figure out.

So **fifth**, the bottom line. Please contact me. If you've got immediate plans to publish, I don't want to scoop you. I will, of course, be interested to see your manuscript, or in any case, your data. If you've been considering a publication, but have not moved forward for some reason (experimental design? data analysis? English composition?) I would be happy to collaborate.