The Role of Genetics in Pigeon Racing

Seminar for the 2010 Spring Break 300 One Loft Race - Beaver, Utah

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Our Biases

- Mine -
  - Degree is in genetics.
  - Animal breeding and consulting for over 40 years in dozens of species including swine, sheep, rabbits and racing pigeons.
  - Strong opinions based on these two frames of reference.
  - Here just to share and not to win converts - you can and should do it any way you want.
  - Pigeon Racing is a hobby – keep it relevant to what *you* enjoy.

Our Biases

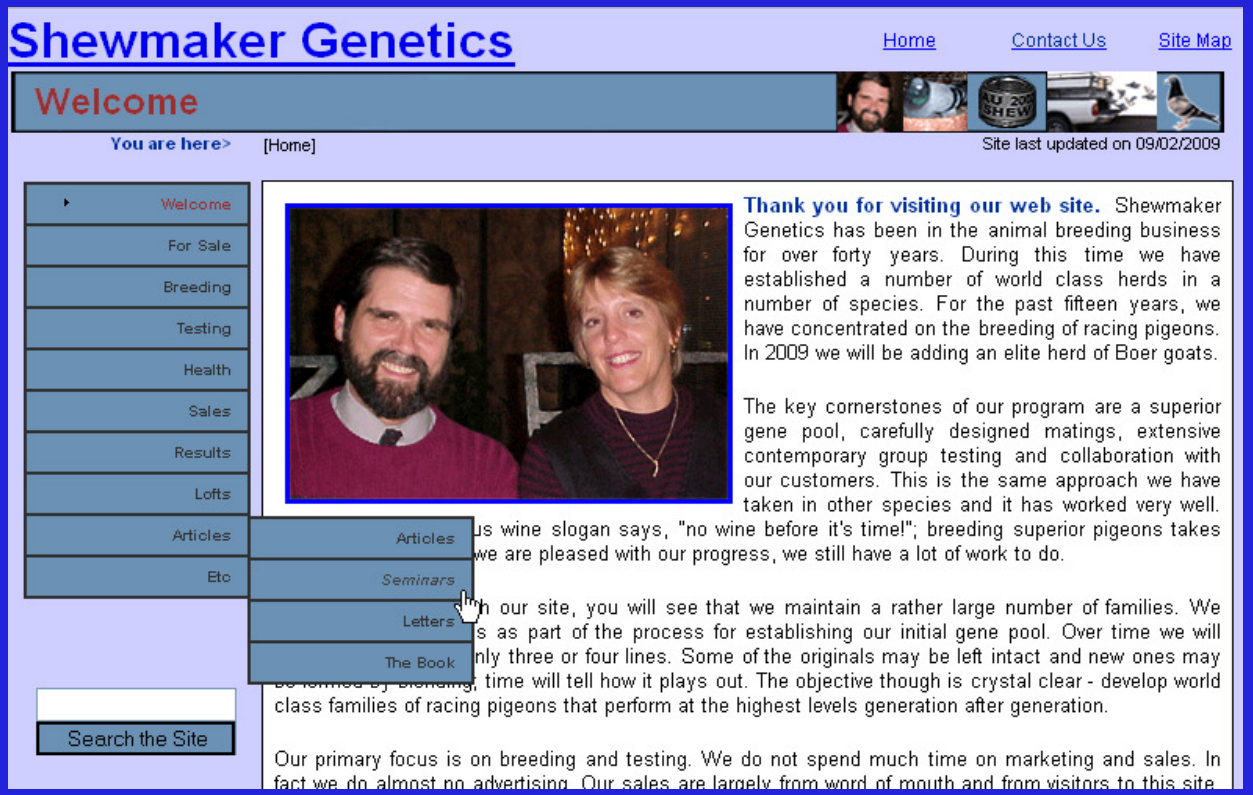
- Yours -
  - You each have your own frames of reference based on your particular life experiences.
  - Everyone in this room has developed their own unique set of filters through which passes everything their brain receives.
  - Two of the keys to effective learning are to look at things from a new perspective and without our usual filters.

Our Biases

- Ours -
  - “If we keep doing what we have always done, we will keep getting the same results that we have always gotten.” (paraphrasing Albert Einstein)
  - Most of us are still making the same mistakes today that we were making when we were 20.

Some Background Information

- My web site (www.shewmaker.com) has some additional information that you may find helpful in sorting out some of the ideas we are going to talk about today.



Some Background Information

- The site has -
  - Articles
    - “A Genetic Breeding Program for Racing Pigeons”
    - 5 others that present some of the same basic information but with slightly different perspectives and in smaller chunks.
  - Seminars
    - 5 other seminars presented over the past 15 years that present in slightly different views what will be discussed today.

The Rule of Seven

- There are seven factors which determine how well you and your birds will perform in pigeon racing.
- One is beyond your control.
- Five are so well perfected within the sport that they have become essentially pass/fail. You either cover them competently or you are virtually eliminated from the winning positions even before the race starts.
- One has almost no limit to its potential and is largely unrealized by most fanciers.

The Rule of Seven

1) Beyond our control – **luck**. Good luck, bad luck, hawks, wires, wind direction, basket position on the truck, bad weather along the course, good weather along the course when we entered a tough weather bird, and on and on and on. It affects us all and so we should just get over it and move on to what we can control.

2) **Condition** (pass/fail)

3) **Training** (pass/fail)

4) **Fuel** (pass/fail)

5) **Motivation** (pass/fail)

The Rule of Seven

6) **Health** (pass/fail though too many flyers are still failing on this one. We could have a week of seminars just on this topic alone.)

7) **Genetics**

When Louis Van Loon was asked “What methods do you use to get those kind of results?” he looked sternly at the gentleman and said, “Remember this, there is only one thing that is important – good pigeons, nothing else.”

Simple Genetics

- Pigeons have 40 pairs of unique chromosomes for a total of 80 chromosomes.
- During fertilization, each parent contributes one chromosome of each of the 40 pairs.
- On the chromosomes reside genes. You can think of them as being like beads on a string. The individual beads are the genes and a particular string of these genes is a chromosome.
- The genes are the precise blueprint for every trait of an individual.

Simple Genetics

- These traits range from what we can easily observe (like the color of the eye) to less discrete and intangible things like mental attitude.
- Each trait is coded for by one or more pairs of genes.
- A given gene resides on a specific location of a specific chromosome. This location is known as a locus (the plural form is loci.)
- While an individual will have exactly two genes for each locus (one coming from each parent), there are multiple versions of that gene within the gene pool (the breeding population). Each different version is known as an allele.

Simple Genetics

- For example, one aspect of feather color pattern we see in pigeons is “Check” and “Bar”. We also see “Barless” and “Dark Check”.
- All four of these phenotypes are coded for by a single pair of genes on one of the chromosome pairs. If the parents both contributed the “Bar” gene (+) the resulting pigeon will have a Bar color pattern. However, if both parents contributed the “Check” gene, the resulting pigeon will have a Check color pattern.
- When genes for a given pair are of the same type (allele) the pair is said to be homozygous. If the pair consists of two different alleles the pair is said to be heterozygous.

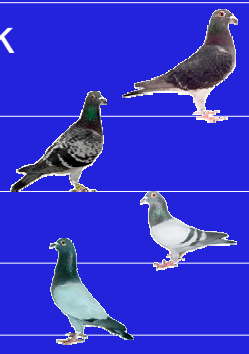
Simple Genetics

- When heterozygous, there are two possible ways the trait might be expressed (though it will always be expressed the same way for a particular gene pair).
  - Complete dominance is when one allele determines the phenotype (dominant) and the other allele is completely masked (recessive) as if it didn't even exist. What we see is the phenotype and what is actually there in the genes of the cells is known as the genotype.
  - Incomplete dominance is when the gene expression is intermediate in the heterozygous state (the gene locus for Grizzle is one example).

Simple Genetics

- Lets look at an example. We will consider the pair of genes that codes for feather color pattern. There are four possible alleles.

Allele Symbol		Expression
C^T	(known as the T-pattern check)	Dark Check
C	(Uppercase)	Check
+		Bar
c	(lowercase)	Barless

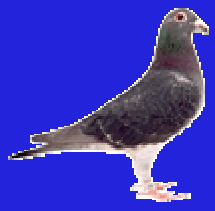


- C^T **>** C **>** + **>** c or in other words -
  - Dark Check is dominant over Check, Bar and Barless
  - Check is dominant over Bar and Barless
  - Bar is dominant over Barless

Simple Genetics

These are all the possible ways the alleles can be paired up.

Genotype	Phenotype
$C^T\ C^T$	Dark Check
$C^T\ C$	Dark Check
$C^T\ +$	Dark Check
$C^T\ \underline{c}$	Dark Check
$C\ \ C$	Check
$C\ \ +$	Check
$C\ \ \underline{c}$	Check
$+\ \ +$	Bar
$+\ \ \underline{c}$	Bar
$\underline{c}\ \ \underline{c}$	Barless



Simple Genetics

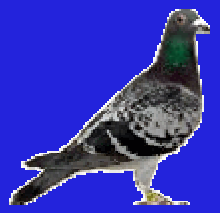
- This is why you can't get a Check or a Dark Check when you mate two Bars together. If you see such a situation in a pedigree you know there is a mistake somewhere.

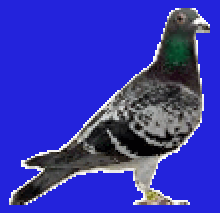
Sire / Dam	+	+
+	+ + 	+ + 
+	+ + 	+ + 

Example of a Bar cock with the ++ genotype mated to a Bar hen also with the ++ genotype. The mating will produce 100% Bars.

Simple Genetics

- But you can get Bars from the mating of two Checks.



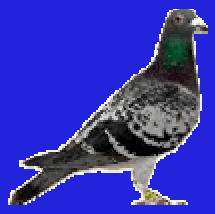


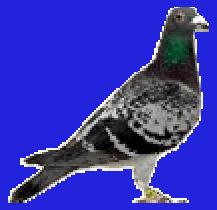
Dam \ Sire	C	+
C	C C	C +
+	+ C	+ +

Example of a Check cock with the C+ genotype mated to a Check hen also with the C+ genotype. The mating should produce 75% Checks and 25% Bars.

Simple Genetics

- Though some Checks when mated will not ever produce a single Barred offspring.





Dam \ Sire	C	C
C	C C	C C
C	C C	C C

Example of a Check cock with the CC genotype mated to a Check hen also with the CC genotype. The mating will produce 100% Checks.

Simple Genetics

- One interesting variation on this theme deals with a small set of traits that reside on one particular pair of chromosomes known as the sex chromosomes.
- Every chromosome pair is morphologically different, but the two chromosomes of each pair are morphologically identical (with one exception – the pair that determines the sex of the individual).
- For example, one morphological difference among the various pairs is length. Chromosome pair #3 might be short, pair #17 very long and pair #31 a more medium length. – However, in every pigeon, each of the two #3 chromosome are both short and each one has exactly the same genes (not alleles!) at exactly the same loci on each of the two chromosomes.

Simple Genetics

- Remember that for each of these chromosome pairs, one originated from the sire and the other from the dam.
- Here is the really interesting twist. One of the sex chromosomes (W) has no genes. Using our original analogy, it is a thread without any beads.
- The other type chromosome of the sex pair is known as the Z chromosome and it has a full set of beads (genes).
- Pigeons whose sex chromosome pair is W and Z are hens.
- Birds with two Z chromosomes are cocks.

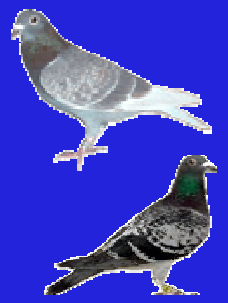
Simple Genetics

- I get a half dozen calls and emails a year from people suggesting that this explains why cocks are the better breeders in a loft. I guess the inference is that these people think the statement about cocks being better breeders is true and it must be because they have a second functional Z chromosome. NOT TRUE.
- I don't usually win this debate until I point out that in mammals we have basically the same situation except that the two sex chromosomes are known as the X and the Y. The “empty” chromosome is the Y with the male being XY and the female XX. Since this debate is usually started by a male pigeon flyer, my raising this point just about always ends the discussion.

Simple Genetics

- Now lets look at an example of a gene “pair” that resides on the sex chromosomes.
- We will consider the locus that codes for the Black and Ash Red feather colors. There are other alleles, but we are just going to look at these two. These code for what we commonly refer to as “Blues” and “Reds”.

Allele Symbol	Expression
B^A	Ash Red
+	Black



- B^A **>** + or in other words, Ash Red is dominant over Black

Simple Genetics

- Can you see why a pair of Blues can never produce an Ash Red? (there is another kind of Red for which this is not true that is known as “recessive red”. It is seen frequently in birds down from the original Meulemans pigeons among others – this is a completely different situation and the locus is NOT on the sex chromosomes)

Dam \ Sire	+	+
	+	+
+	+ +	+ +

Example of a Blue cock with the ++ genotype mated to a Blue hen with the + (-) genotype. The mating will produce 100% Blues.

Simple Genetics

- Can you see why an Ash Red hen mated to a Blue cock will always produce youngsters whose sex can be determined by just looking at the color?

Sire / Dam	+	+
	+	+ ← Hens
B^A	B^A +	B^A + ← Cocks

Example of a Blue cock with the ++ genotype mated to an Ash Red hen with the + genotype. The mating will produce 100% Blue hens and (Ash) Red cocks.

Simple Genetics

- But this isn't what I came to talk to you about.
- It is very interesting (and lays a very good foundation), but it really won't help you breed better racing pigeons and that is what I want to address today.
- If you like this aspect (remember this is a hobby and we should go down the path that interests us) here is a great book that goes into the genetics of all kinds of visible traits in pigeons:
  - Breeding and Inheritance in Pigeons
    by Axel Sell published by Schober Verlags-GmbH, ISBN 3-88620-034-5

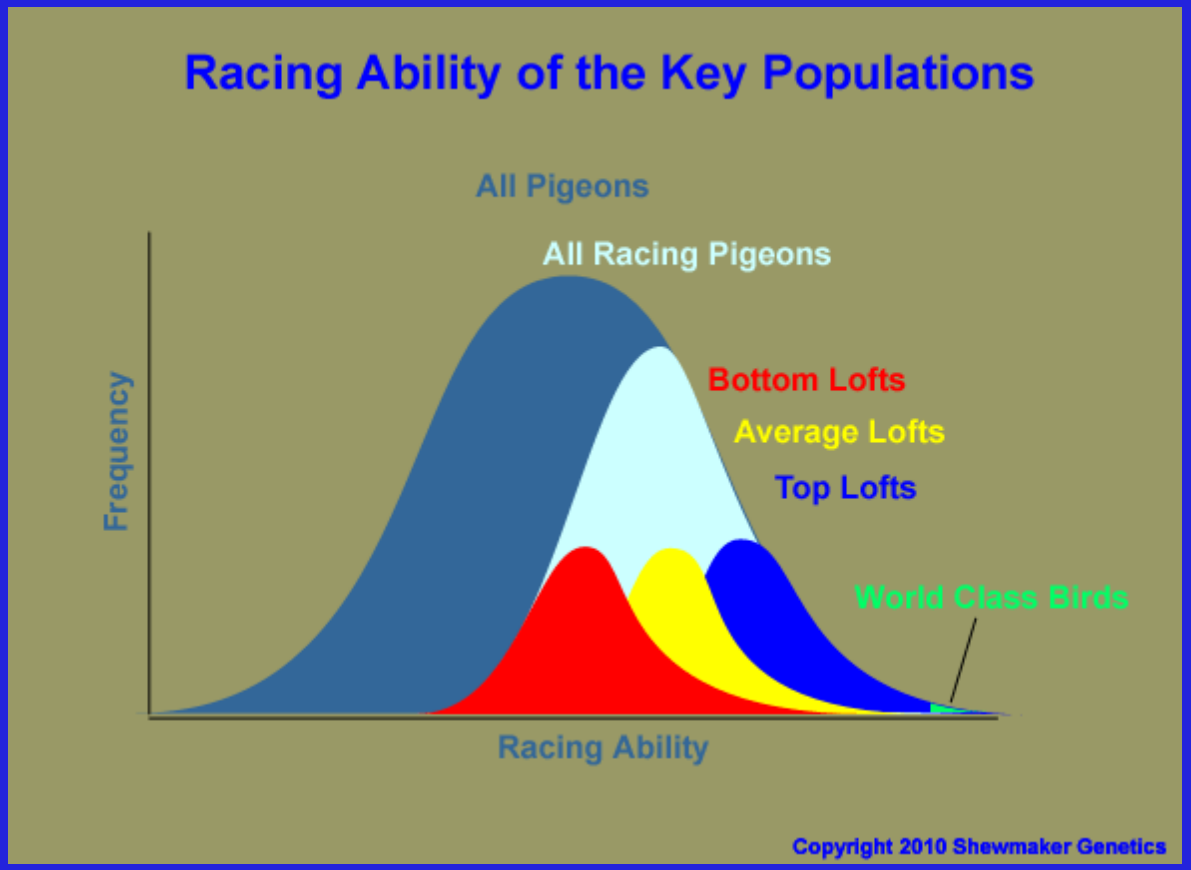
But Its Not That Simple!

- On the one hand, Genetics is much much more complicated than understanding simple pairs of genes.
- However, there is a very important trick to dealing with complicated and complex systems and if you take advantage of that key trick, it can be fully and effectively understood in very simple terms.
- Here is the key – don't think in terms of individual genes, individual chromosomes or even individual birds. Everything should be approached from the point of view of the *population* of racing pigeons – specifically those in your loft and those in the rest of the sport.

The Bell Curve

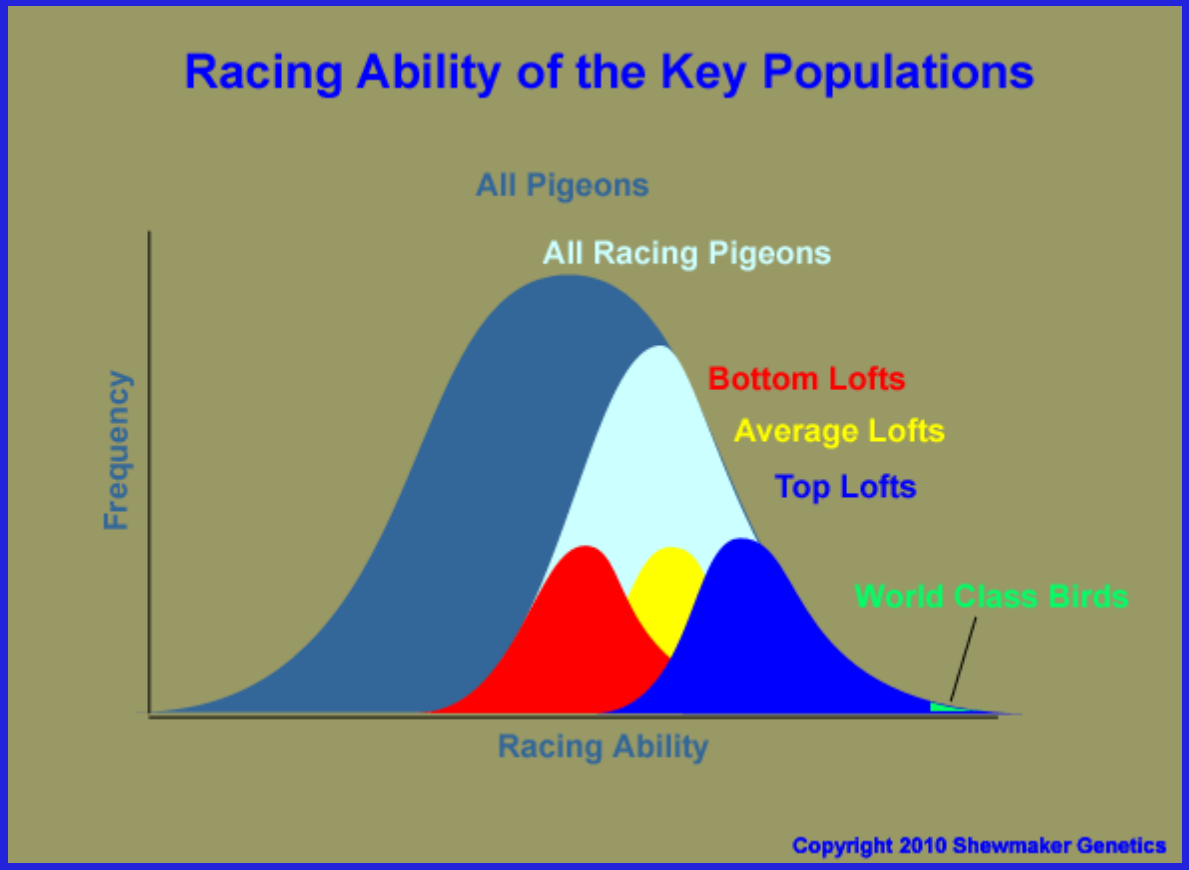
- For many traits, the genetic expression is actually determined not by the action of a single pair of genes but multiple pairs – two, three, dozens and perhaps even hundreds for those non-discrete traits like “height” or “body weight” or in our case “racing ability”.
- If you do the math and graph outcomes of various matings using many genes, instead of a box where 75% are Checks and 25% are Blues (as on Slide 18), we get a distribution that is known as a bell curve.
- The next four slides are really the whole seminar

The Bell Curve



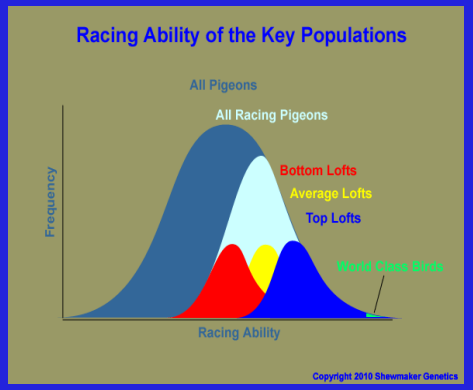
- Notice that the “Bottom Lofts” and most of the “Average Lofts” may not even have the necessary genes in their pool to breed world class birds.

The Bell Curve



- But also notice that in the “Top Lofts”, few of the birds are “World Class” and many are on a par with the “Low” and “Average” lofts.

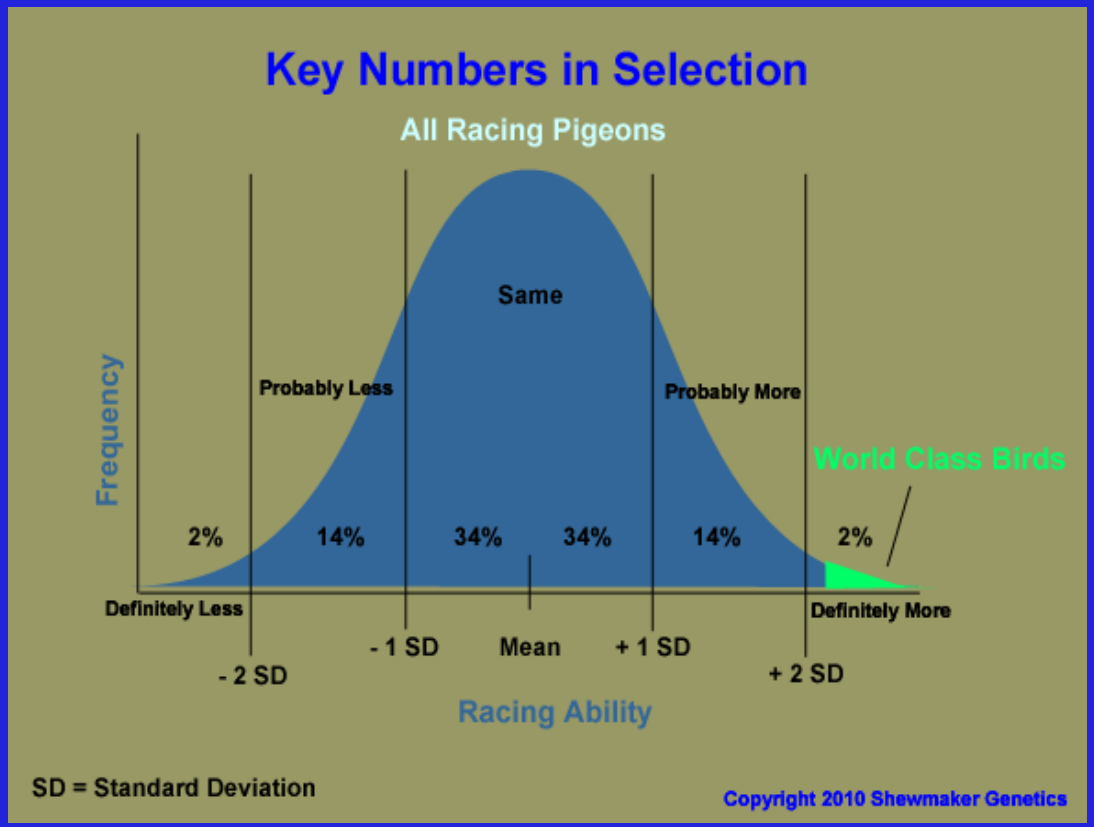
The Bell Curve – The Rule of Ten



- Here is the hard cold fact – most of our pigeons are not genetically up to our assumptions and expectations.
- ***IF*** you have a "Top Loft" complete with a few "World Class" pigeons, you ***MIGHT*** produce **1 in 10** birds which should be kept to breed the next generation.
- If you are in the "Average Loft" category it is probably closer to 1 in 100 and in the "Bottom Lofts" it is closer to 1 in 1000.

The Bell Curve

- And apart from this “Rule of Ten”, if you aren't selecting at least the top 16% *you probably aren't selecting at all*.



- If you really want to make progress you need to be selecting in at least the top 2%.

Progress is a function of Selective Pressure & Time

- Your ability to make genetic progress and the speed at which you make this progress is **absolutely** related to these three factors:
  - The **accuracy** of your selection
    - *So if you think toe color is related to superior racing and this is what you select for, you are probably not really doing any selection at all with respect to racing ability. In my view the most accurate selection criteria (by a wide wide margin) are race results to the same loft. Nothing else comes close.*
  - The **intensity** of your selection
    - *Selecting from the top 16% is far less intense than selecting from the top 2% which in turn is far less intense than selecting from the top 1%*
  - The **time** interval over which you do the selection
    - *One season is not enough, but two or three will surprise you. Changing to a new fad every few years will doom any real progress.*

Progress is a function of Selective Pressure & Time

- The message here is not to make it seem impossible, but to emphasize that most of the pigeons we produce and keep are not suitable for moving the flock forward.
- So, test them hard and sort out the good ones.
- Don't get attached to the pretty ones or the expensive ones or even the ones with a single win. If the results aren't repeatable, they probably aren't statistically significant from a genetic perspective.
- And this is really important – don't assume you have to go buy new birds. While we all probably need to cull out most of what we have, the American Racing Pigeon Gene Pool is very deep and until you conduct a fair test you really can't say you don't have the right genes.

Myths

- The cock is a bigger genetic contributor to the offspring than the hen. There are only two aspects of this issue that have merit:
  - The total genetic contribution of a cock to a population can be greater since we can polygamously breed the cock and produce as many as 100 x the number of birds over the complete reproductive life as compared to a hen.
  - In many areas the cocks are raced more than the hens. In such a situation, the cocks that are selected for breeding may have been selected more accurately than the hens.

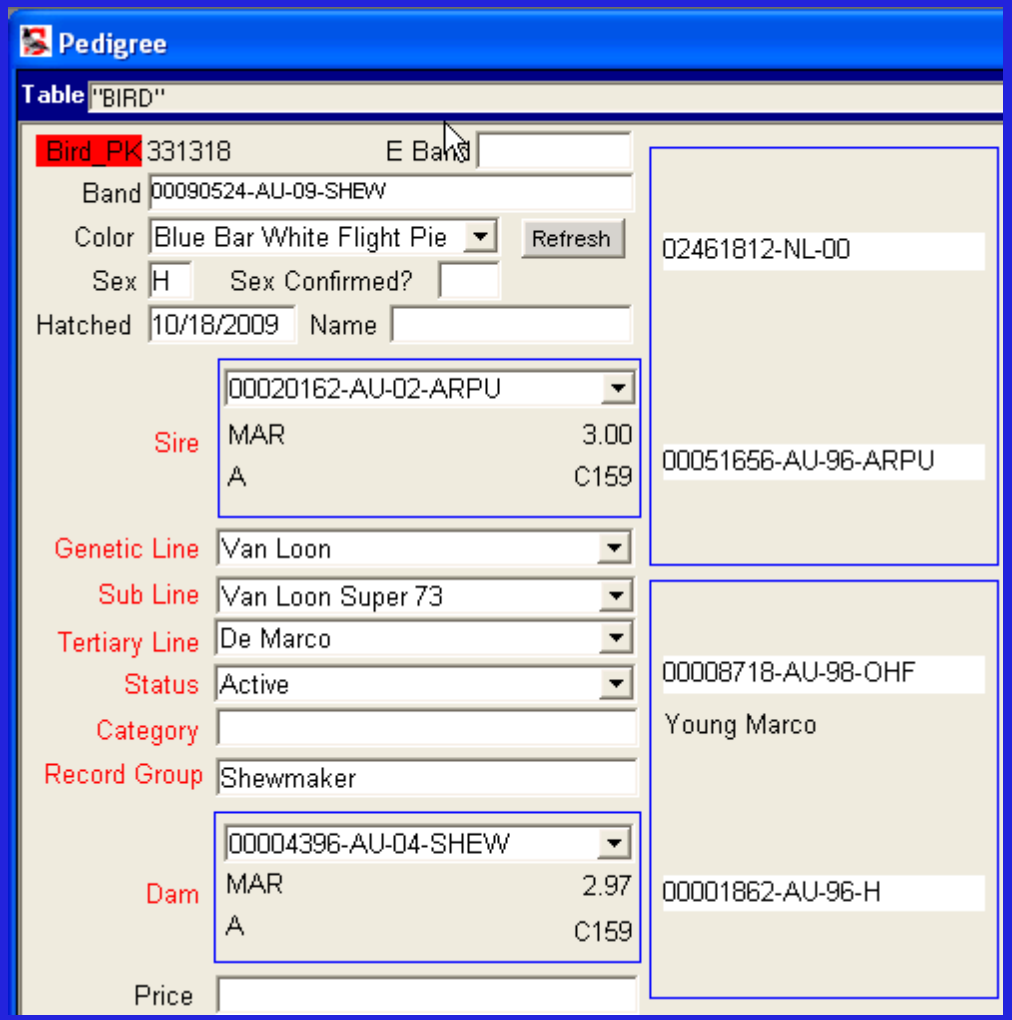
Myths

- The pedigree is just a worthless piece of paper.
  - There is tremendous value in an accurate pedigree. It can give great insight into the potential contribution to the gene pool the bird might make.
  - It isn't an absolute, of course, since almost no pedigrees are completely accurate if you go back for more than a few generations. Why? Most people pen breed and there is about a 10% “cheating” factor going on amongst the birds in the loft. Still it can be a very valuable guide.

Myths

- The pedigree is just a worthless piece of paper.

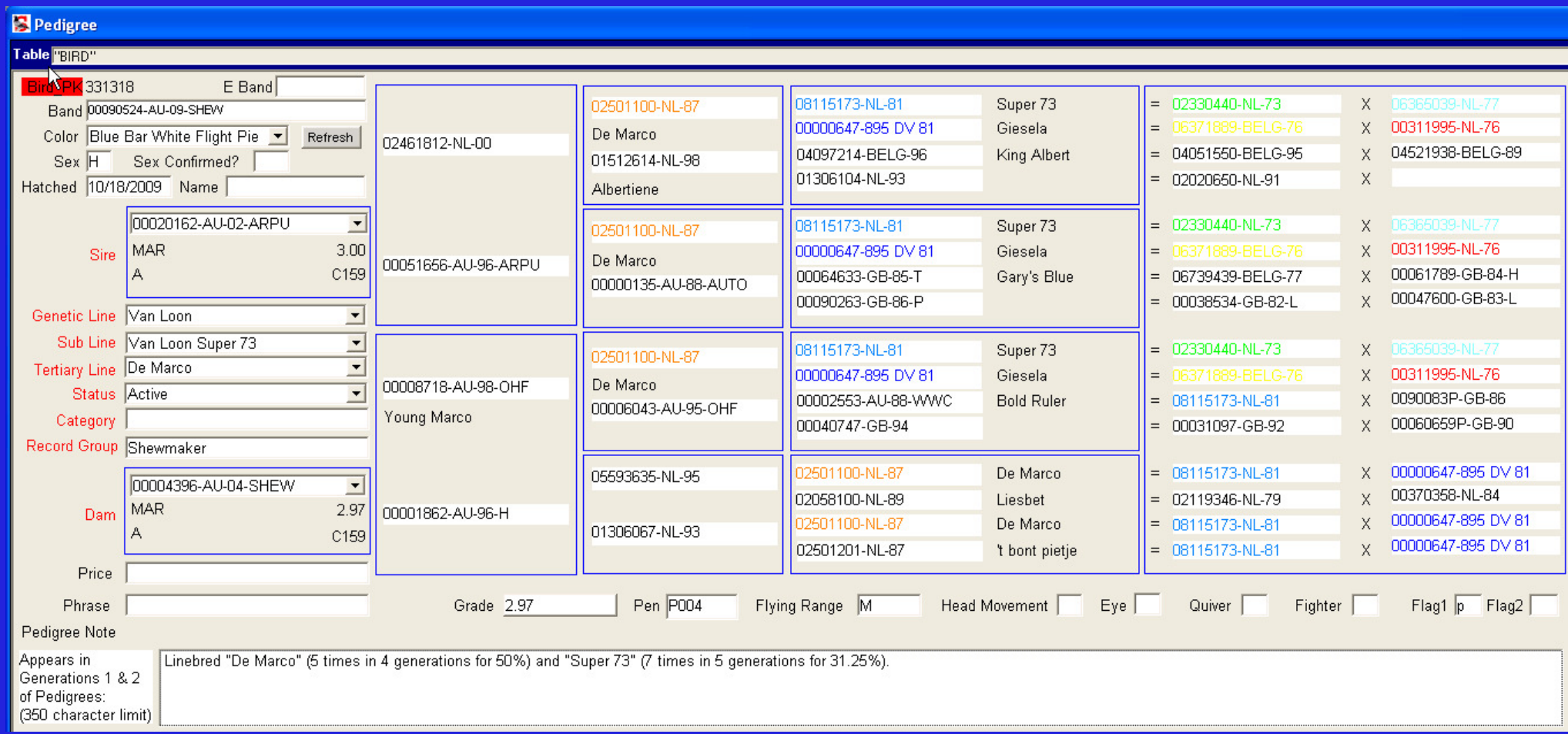
Consider this . . .



Myths

- The pedigree is just a worthless piece of paper.

  Now consider this . . .



Myths

- A bird with a great pedigree is a valuable breeder.
  - While the pedigree is an indicator of potential value in the bird as a breeder, at the end of the day though it is the actual (true) value of that bird that is the only thing that matters.
  - No question though, a loft with a well maintained family with accurate pedigrees and records going back several years, has a distinct advantage in breeding better racing pigeons.

Myths

- Birds of a family must be “pure” without any outcrossing in the pedigree.
  - The tools for breeding better racers are the means to that end, not the end in and of themselves.
  - As will be shown later (Slide 47), outcrossing is actually a key part of any effective inbreeding program.
  - Even more importantly though, we are after birds with a superior genetic ability to produce birds which win races (and breed birds which produce birds which win races). Birds like this are exceedingly rare. When one comes along, we really don't care about anything else.

Myths

- Breeding “Best to Best” is a better strategy than breeding within a family.
  - Be careful here. I didn't say “Best to Best” wasn't a smart thing to do. What I am saying is that it isn't mutually exclusive with maintaining a family and getting all of those additional advantages as well.
  - Its harder to do, but the very best strategy is to maintain two families, test them hard, breed the best to best for replacement breeders and cross best to best for the futurities.
  - Bad Program < Random < Best to Best < Best to Best with families

Myths

- The genetic value of a breeder decreases with age.
  - Older birds may not raise birds that are as good at Young Bird or Futurity racing due to the environmental influences older breeders bring into play (not as good pumping, depleted egg yolks, etc), but it has absolutely no impact on the genetic value that is passed along with each fertile egg.

Truths

- Inbreeding decreases vitality and can affect race performance. Further, the more generations you inbreed, the more pronounced this affect becomes.
  - Inbred birds can win. I have won several futurity races with father x daughter matings, but the birds clearly were racing with a handicap.
  - In lofts which practice intense inbreeding, there comes a point where the birds are not competitive.
  - Contemporary Group Testing is an incredibly powerful tool. One of its best applications is in the testing of inbred birds.

Truths

- 100% of the vitality lost to inbreeding can be recovered immediately by crossing.
  - The phenomenon of “Hybrid Vigor” (also known as Heterosis) is very real, has an impact on racing performance and is manifest in the offspring of two completely unrelated parents.
  - While all crosses will produce hybrid vigor, not all crosses will produce good racers. Very important point. The hybrid seed companies perform hundreds of test crosses in order to find the one that they will then produce commercially.

Truths

- Genes determine the potential. Environment limits how much of that potential is realized.
  - The really astute flyer recognizes that the first moment this environmental influence comes into play is at the moment of fertilization. The eighteen days of incubation are eighteen of the most important days in the race season of a young bird or futurity bird.
    - An ideal incubation period requires breeders that have been properly rested, fed an appropriate diet with correct vitamins and minerals, appropriately vaccinated, free of internal and external parasites and provided a nesting area that is dry, warm and well ventilated.
    - The best strategy in this regard may be young F1 hens mated to cocks of a third line.

Truths

- Genes determine the potential. Environment limits how much of that potential is realized.
  - One of the key challenges in “selection” is distinguishing what part of a great race result is the result of an environmental advantage and what part is due to a genetic advantage.
  - Best way to do this is to only compare race results where the environmental factors are the same for all of the birds being compared. In other words, the only results you can really use with confidence, are race results to a single loft. This would include young bird loft results, old bird loft results, contemporary group tests and one loft futurity races.

Strategies

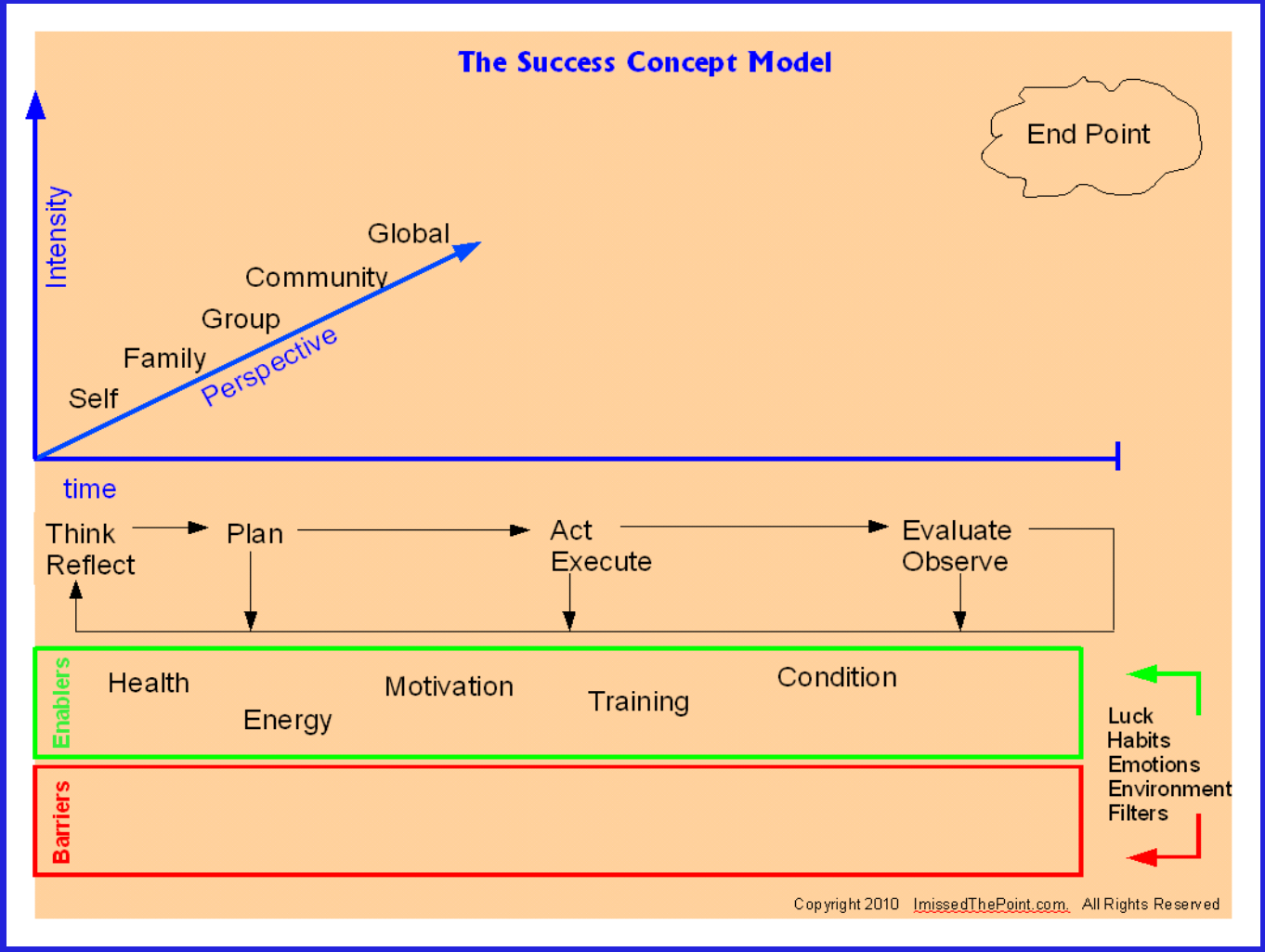
- **Linebreeding** to stack the deck
- **Inbreeding** to improve consistency
- **Cross breeding** to maximize performance
- **Outcrossing** to raise the bar
- **Selection** to shift the bell curve
- **Testing** to validate selection
- **Contemporary group testing** to minimize the environmental factors

Strategies

- Use real data – make evidence based decisions
  - *3 or more individual results and/or*
  - *5 or more results of close relations*
- Have a clear understanding of the end point
  - *Breeders of breeders of great flyers*
- Avoid “Bred for Stock”
  - *If you really must, be sure to go back and retain/cull after fully testing the progeny*
- Breed “Best to Best” ← This is good
- *And* maintain two families ← This is great

Closing Thoughts

- If you continue to do what you have always done …
- The formula for success for our birds is very similar to the one for us



Closing Thoughts

- Figure out what *you* are trying to accomplish
- Remember it is a hobby and it is *your* hobby
- Keep it fun