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GUEST EDITORIAL

Secrets for Producing High-Quality Working Dogs

The IWDBA recently concluded its 6th bi-annual conference in Ieper, Belgium. It was the most successful and best attended IWDBA conference to date, with 71 papers presented and 273 people from 25 countries attending. A recurring theme I heard from attendees was how helpful it is to periodically have an opportunity to talk with others who are working toward similar objectives.

As I reflect back on the papers presented at the 6th conference, the wealth of knowledge amassed by the presenters and attendees is impressive. It is invaluable to have an opportunity to learn from others who work in our special niche of producing high-quality working dogs. The single most important role the IWDBA can play is to facilitate sharing ideas, knowledge and experience. Over the next six years, the IWDBA intends to increase the number of educational opportunities offered around the world, thus adding value to your membership.

Knowledge that is not used is lost. Knowledge used can be improved upon thereby helping us reach even greater heights in our specialized field. I used the word "secrets" in the title of this editorial because I am convinced that knowledge about how to breed high-quality working dogs has been lost over time. As demands for efficient, effective production systems become even greater, we can learn from those who have gone before us and utilize breeding principles that have worked so well for genetic improvement in other species such as livestock. Many may be surprised to learn how long basic "secrets" for producing high quality working dogs have been available to us. The father of modern animal breeding, Prof. Jay L. Lush, published the first edition of his classic text 72 years ago (Lush, 1945). In it, he provided many details for genetically improving a population. Many of his techniques have been improved in the intervening years, but Dr. Lush's textbook still contains many gems of wisdom applicable to genetically improving working dogs today.

To illustrate how lost knowledge can result in steps backward, I want to share with you a story from The Seeing Eye's history. A few years ago, I learned about a paper published by a former Seeing Eye employee entitled "Mental Tests" for Shepherd Dogs (Humphrey, 1934). In this paper, the author describes complex tests and detailed physical measurements made on German Shepherd Dogs. They studied and had learned a great deal about correlations between physical attributes, mental or behavior characteristics, and the dog's overall ability to perform a task. This speaks to my point that knowledge can be lost because this paper was published in 1934. As I began asking then-current employees about the paper, it became clear that its contents had not been passed down through the intervening years. As I read the paper, it also became clear to me that the author and others working for The Seeing Eye in the 1930's understood basic animal breeding principles as I now understand them. Later, I learned that this same team had written an entire book (Humphrey and Warner, 1934) about genetic studies undertaken at Fortunate Fields in Switzerland. Between the end of their employment and the beginning of my involvement with the breeding program, control of the breeding colony resided with people who, although well-meaning, must not have been so well schooled in genetic principles. Over a period of 20 or more years, the primary goal was to maintain a closed colony, in the hopes of building a genetically more perfect Seeing Eye dog. Unfortunately, this led to increased inbreeding followed by a severe decline in reproduction, manifest by low conception rate and small litter size. Eventually, the population disappeared, having become unable to perpetuate itself. When I first learned about The Seeing Eye in the mid-1970's, they were acquiring dogs from many sources, and were starting over with a new breeding colony unrelated to the old lines. I hope I am successful in passing on my knowledge to someone else who will carry forward the current breeding colony for another 50-100 years.

To reinforce the theme of sharing knowledge that could be useful to others, some very basic lessons I have learned over my 35 years of involvement with breeding working dogs are noted below. I'm calling these lessons "secrets" because I've never written down the entire list for others to read, nor do I see them widely used by others engaged in

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breeding high-quality working dogs, which implies to me that they must be "secrets". Granted, many places breeding working dogs implement some of these secrets, but there are very few places where all the secrets are implemented. These secrets are a composite of study in the principles of animal breeding woven together with my experience in breeding dogs for use by the U.S. Army in the Bio-Sensor Research (Super-Dog) project (Battaglia, 2009), and The Seeing Eye since 1977 including being full-time responsible for selecting all replacement breeders since 1994.

Secret 1: Organizations training more than 20 dogs per year should breed their own dogs. It is possible to acquire a small number of training candidates from shelters or private breeders, but that is simply an unsustainable model for organizations required to produce larger numbers of trained dogs year after year.

Secret 2: Organizations producing fewer than 20 litters of a single breed per year should join or form a breeding cooperative. A breeding cooperative is a group of organizations with a similar goal who agree to work together for genetic improvement of all their dogs by sharing germplasm among members of the group.

Secret 3: A breeding population that produces at least 20-25 litters per year of a single breed can be self-sustaining for at least 15-20 years. The dogs within the breeding population can be under the control of a single organization or multiple organizations working together in a breeding cooperative.

Secret 4: Genetic selection works (Bourdin, 2000), but the organization must avoid the temptation to make selection or mating decisions by committee. Remember, it takes at least 2-3 generations to produce measurable genetic improvement. Put one person in charge, and then give them a chance to prove their approach. The shortest generation interval possible to obtain in working dogs is about 2.5 years. If breeding animals remain active to older ages, the generation interval becomes longer, so it will take at least 5 years to pass through two generations of selection.

Secret 5: Implement a systems approach to the canine production process. Such a system will address four main points: 1. Definition of goals, 2. Choice of a production method (purebred vs. crossbred), 3. Implementation of a record keeping system, and 4. Definition of selection criteria for choosing replacement breeders. Organizations with a large breeding colony need to employ someone formally trained to implement such a production system. This person should be responsible for selecting replacement breeders and for making mating decisions. Most people with this type of training will be agricultural graduates, preferably with advanced training in genetics applied to livestock production. Within an animal science department, these people are known as the animal breeders.

Secret 6: Use estimated breeding values (EBV) as part of your system to help identify the litters most likely to produce outstanding replacement breeders (Mrode, 2005). Calculating EBV's can appear complex and difficult, but animal breeders know how to do these calculations. The IWDBA can help an organization learn where to look for these people.

Secret 7: Use a selection index to make genetic improvement simultaneously in more than one trait. The selection index was theoretically described 66 years ago (Hazel, 1943). If you don't know how to implement the use of such an index, seek help from an experienced animal breeder. They can help you set-up your system and perform periodic analyses.

Secret 8: Attend training workshops to learn more about how to implement animal breeding techniques for the production of high-quality working dogs. Among managers of working dog breeding colonies, many people came up through the ranks of their organization, starting first as either a dog trainer or as a veterinary technician. A few of these people have formal training in animal science, but most do not. The IWDBA is the ideal organization to provide periodic workshops and training seminars where these people can learn about modern animal breeding techniques. Managers who lack training in production systems and animal breeding are often in a position to hire a young person with that training to work as their assistant. Although having a veterinarian manage the breeding colony may seem like a good solution, remember that there is a fundamental difference between looking at working dogs as individual animals and looking at them collectively as a population. Because of their specialized training, veterinarians focus on dog health and are not usually trained to evaluate the population as a whole entity.

Secret 9: It is absolutely essential to collect accurate, consistent data, so progress of the breeding program can be monitored. To manage these data, an organization must use an electronic record keeping system built around a relational database (Russenberger and Havlena, 2009). Ideally the person responsible for managing a breeding program has training and preferably experience in how to implement a record keeping system. They will also know how to use statistics to help understand the data being generated by the breeding colony. If hiring a breeding manager, seek someone with a Master's degree level or higher training in animal breeding.

Secret 10: Installing an electronic record keeping system requires a commitment of time and money. To be effective, the system needs to be loaded with historical data. Although loading historical data is tedious, boring, and time consuming, it is essential because the data can be used by an animal breeder to learn what part of the variation observed in important traits is under genetic control (heritability) passed from parents to their offspring. The working dog community will soon have access to Rel-Dog Lite, a free software system that runs under *Microsoft Access* (Russenberger and Havlena, 2009). It is a good place to start in your quest for a record keeping system designed specifically to help manage the records of a working dog breeding colony.

Secret 11: Limit the number of offspring produced by any single breeder. This will help control the rate of increase in inbreeding. For a production system yielding 20-25 litters per year of a particular breed, a male should be limited to 8-10 matings in that population. For females, a functional protocol is to breed them on every heat cycle from the time they enter breeding until they reach four years of age; then, retire them from breeding. This pays huge reproductive benefits to the females, because they are most fertile in their youth. It also pays an animal welfare benefit because the females are not destined to produce litters into their older years. Organizations that skip cycles thinking that is best for the reproductive health of the female are simply not looking at the whole picture. By adopting these protocols for limiting the number of offspring produced by any single breeder, the rate of increase in inbreeding can be held to under 2% per generation. Following this protocol will also reduce the generation interval in the breeding colony, allowing genetic change made per year to be maximized. (Falconer and Mackay, 1996; Bourdon, 2000).

Secret 12: A genetically sound protocol for deciding which male will be the mate of a female in season is to choose the male that will produce the least inbred litter. If that male has already mated with this female, then choose the next best male, using this criterion. This will ensure the maintenance of as much genetic diversity as possible within the breeding colony, while also giving each male a sample cross-section of the females as mates.

Secret 13: In managing a breeding colony, the hardest decision to make is to decide to keep a dog for breeding. There always are at least some reasons to reject any dog as a breeding candidate. To have puppies to choose from next year, bite the bullet and keep the best breeder candidates you can identify, consistent with the number of puppies your organization needs to have born per year.

Secret 14: Select replacement breeders from among the offspring born into your colony or breeding cooperative. Bring in breeding stock from outside sources only when absolutely necessary. When it has been decided to bring in germplasm from outside your colony, look first among other working dog organizations where the breeding goals are similar to yours. Resign yourself to the fact that breeding stock brought in from elsewhere will likely bring with them undesirable health issues not currently present within your own colony.

Secret 15: The best bred dogs in the world will not reach their full genetic potential unless they are raised in a proper environment from birth to maturity. Call heavily upon the dog trainers and behavior specialists available to your organization to get this very important component properly implemented. Much evidence is accumulating to indicate that the first four months of a puppy's life is one of the most important periods in their development.

Secret 16: The Canine Genome Project offers great promise, but organizations cannot afford to wait for DNA-based selection techniques to be developed. Some day, marker assisted selection techniques will be available to help identify the best dogs available for selection, but to develop those techniques, one needs the same data needed now to calculate estimated breeding values. Begin now, using EBV's and a selection index to identify the superior breeding candidates with the knowledge that this simpler approach can be refined in the future, as new tools become economically and physically available. There is a place for DNA-based tests for single gene defects and there will be some DNA-based tests developed in the years ahead for some aspects of genetically more complex traits. These tests should be used judiciously, when they make sense, but one should not wait for them to be developed before introducing genetic selection into a breeding program that has a mission-critical need to produce high-quality working dogs now.

Secret 17: In choosing replacement breeders, one **MUST STILL TAKE THE WHOLE DOG**. No techniques exist to support designing a perfect dog by taking the best parts of several dogs and reassembling them into a new animal. By consistently applying the genetic principles of response to selection, you can direct genetic change to improve the dogs produced by your organization. Applying these techniques does not require that the entire DNA sequence of each dog be known before a selection decision is made. The selection principles proven to work in livestock breeding also work in dogs, if they are correctly and consistently applied.

As you read the abstracts of papers presented at the 6th conference, I think you will find that most papers present some theme, hypothesis, or idea that fits into one or more of these "secrets". As time passes and animal breeding techniques are integrated into more working dog breeding programs around the world, I hope these "secrets" will become a part of the general working knowledge passed among IWDBA members across time. I would like to think that some young person reading this editorial 50 years from now could say that some of these "secrets" are then common knowledge.

I look forward to seeing you at the upcoming educational events now being organized. The IWDBA intends to schedule these events in all parts of the world where the IWDBA is welcome, and we intend to present them in languages other than English when that will best serve the target audience. If you have comments, questions, or suggestions for locations of future events, please let me know by sending an e-mail through the secure e-mail form on the IWDBA web-site (http://www.iwdba.org). E-mail is our primary means for communicating with you, the members. Please be sure to keep your contact information current through the web-site.

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References

Battaglia, C.L., 2009. Periods of early development and the effects of stimulation and social experience in the canine. J. Vet. Behav. Clin. Appl. Res. 4, 203-210.

Bourdon, R.M., 2000. Understanding Animal Breeding. Prentice-Hall, Inc, New Jersey. 17-27 and 198-222.

Falconer, D.S., Mackay, T.F.C., 1996. Introduction to Quantitative Genetics, 4th Edition. Addison Wesley Longman Ltd., 1996.

Hazel, L.N., 1943. The genetic basis for constructing selection indexes. Genetics. 28, 476-490.

Humphrey, E.S., 1934. "Mental Tests" for Shepherd Dogs. J. Heredity. 25(4), 129-136.

Humphrey, E.S., Warner, L., 1934. Working Dogs. The Johns Hopkins Press.

Lush, J.L., 1945. Animal Breeding Plans, 3rd Edition. Iowa State College Press.

Mrode, R.A., 2005. Linear Models for the Prediciton of Animal Breeding Values, 2nd Edition. CABI Publishing, Cambridge, MA, 1-23.

Russenberger, J.E., Havlena, B., 2009. Open source database for dog breeding organizations. J. Vet. Beh. Clin. Appl. and Res. 4(6), 247.