Except from A Conservation Breeding Handbook:

Chapter 1.

The Breed Concept: What is a "Breed"?

"Breed" is an important concept, and its definition must be appreciated before purebred breeding or conservation has much meaning. The best definition of a breed in the genetic sense is based on a concept put forward by Juliet Clutton-Brock: a breed is a group of animals selected to have a uniform appearance that distinguishes them from other groups of animals within the same species. When mated together, members of a breed consistently reproduce this same type.

The creation of breeds took place over a long period of time, and the process pro-duced genetic consistency. Each breed, while containing some diversity within, is uniform and predictable, having a unique combination of genetic traits. Stefan Adalsteinsson refers to this as the "genetic heritage of survival," meaning that each breed's history is embedded in its genetic makeup.

This is why breed conservation is important. The conservation of many distinct breeds is the best way to protect genetic diversity within each domestic species. The species themselves (such as cattle, chickens, sheep, etc c.) are not endangered, but the extinction of breeds within the species can cause a species to lose some of its characteristics, adaptability, and utility.

The American Livestock Breeds Conservancy has as its mission the conservation of endangered livestock and poultry breeds in the United States. While this work is usually described as genetic conservation, it goes beyond the protection of individual genes. There are approximately 100,000 genes in the genome of each domestic species, and most of these have multiple variations. These variations can be housed in many different combinations. The specific combinations that characterize breeds took millennia to form. Breed conservation is, therefore, more accurately termed genomic conservation, since it protects both genes and gene combinations from loss.

Some have proposed that genetic conservation can be accomplished by mixing all of the genes of many breeds into a crossbred soup. Theoretically, specific genes and combinations could then be recovered if and when they were needed. This method would be time consuming and expensive, if indeed it is possible. In contrast, the conservation of living breeds proven for specific tasks and environments protects genetic resources in an accessible form. The combinations already present as breeds are the genetic resources most easily studied, used, and conserved.

As a final note, some livestock and poultry populations that are named, recognized, and registered, as breeds do not really fit the genetic definition of a breed. In most of these, crossbreeding has eliminated the genetic consistency and predictability that is characteristic of a true breed. Such populations are not of conservation interest.

Types of Breeds in North America

Four types of livestock and poultry breeds occur in North America: landraces, standardized breeds, industrial stocks, and feral breeds. These differ according to their history and selection, the relative level of uniformity versus variability, and the presence or absence of a

formal structure to organize and promote them. Figure 1.1 provides an illustration. While the majority of North American breeds (and endangered breeds) are standardized, a discussion of the different types is useful in explaining how breeds were developed and how each should be conserved.

Landrace breeds

Landraces (not to be confused with the Swedish Landrace swine breed) are local populations of animals that are consistent enough to be considered breeds, but are more variable in appearance than are standardized breeds. They also lack the formal definition and organizational structure that is typical of standardized breeds.

Individual landrace breeds are unique due to founder effect, isolation, and environ-mental adaptation. Founder effect refers to the accidents of history that led to introduction of certain types of animals to new areas. These "founders" are the sole genetic base of descendant populations. For example, Texas Longhorn, Florida Cracker, and Piney Woods cattle of the U.S. (as well as the sister criollo breeds of Latin America) were all founded by a few hundred Spanish cattle brought to the New World beginning in 1493, and this fact forever defines these populations. Coupled with founder effect, and difficult to separate from it, is the action of isolation. Even given identical founders, populations that are isolated from one another will eventually diverge over time. The differences today between Texas Longhorn, Cracker, and Piney Woods cattle are an example of the divergence that occurs due to many centuries of isolation.

A combination of natural and human selection has shaped the evolution of landrace breeds. Natural selection and geographical isolation have created genetic consistency and adaptation to the local environment. Traits such as parasite and disease resistance, reproductive efficiency, and longevity have also resulted. Human selection is of somewhat less importance. In fact, human selection in one part of a landrace population may be counteracted by different human selection in another part. Color is one example. The Holt line of Piney Woods cattle is usually white park or colorsided roan with black ears, while the Conway line is red and white in various combinations. Both individual herds have lost some color variants (gaining uniformity of color in the process), but the landrace breed has not.

Landrace breeds generally lack the formal support of a breed association, and they survive as distinct populations due to geographic and cultural isolation. If communication among breeders increases, and a network of breeders is organized, the landrace may benefit by greater geographical distribution and more secure numerical status. This process can, however, result in selection for greater uniformity across the population and diminish the presence of some of the original variants. If, instead, there is careful cultivation of the diversity within breed parameters, the genetic integrity of the landrace can be protected even as it becomes a standardized breed.

Standardized Breeds

Historically, most livestock breeds began as landraces and then became standardized. As breeders organized, they agreed upon a description (or "standard") of the breed and then began to select their animals toward this ideal. In practice, this meant greater uniformity in

appearance and performance. Genetic diversity may have been reduced, but predictability was gained. The Texas Longhorn is a good example of a landrace that is becoming a standardized breed.

Standardized breeds are what most people think of when they consider purebred livestock. Human selection has played the primary role in the development of standardized breeds, though natural selection has sometimes played a part as well. The breed standard defines the breed, and it is this criterion by which individual animals are evaluated. Breeding to a standard emphasizes a relatively narrow range of variation, usually less than the variation found in a landrace. Genetic isolation of the standardized breed is thus established by breeding practices rather than by the geographic or cultural isolation typical of landraces. For example, most standardized breeds limit inclusion to those animals with two registered parents. This serves to isolate standardized breeds genetically. It also allows breeds to function as isolated reproductive units even though herds may be widely separated geographically.

Conservation of standardized breeds (as well as landraces) requires that the purity of the breed be protected from crossbreeding. The diversity within the breed's genetic parameters must also be conserved. The two forces of predictability and variability tug against one another, and striking a balance between them is a goal of breed conservation.

It is often the case that certain color patterns or conformational traits have become hallmarks of standardized breeds. These traits are sometimes so distinctive that even casual observers can identify members of the breed. As a result, many people, even those in the livestock industry, have come to confuse a single, distinctive color or trait with breed status. Ironically, some of these traits—such as white belts, white faces, or polledness—can be readily imparted to crossbred offspring, so that they are actually among the least accurate indicators of purebred status. A group of animals must breed true to a distinguishing type to be a true breed.

Industrial Stocks

Industrial stocks originate from a small portion of a standardized breed (or a cross between two or more standardized breeds) that has subsequently been selected for maximum performance of a single task in a highly controlled environment. Examples are layer chickens, broiler chickens, white broad-breasted turkeys, and most commercial swine. Almost all of our chicken and eggs, much of our pork, and a growing proportion of milk and other animal products come from industrial stocks. "Industrial" refers to the highly organized production systems under which the animals are raised, and the general term "stocks" is used because industrial animals may be breeds or crosses between breeds.

These stocks are a superb example of limited genetic variability and supreme predictability, having been defined by relatively few founders and long isolated from other breeds. Human selection plays the major role and natural selection is minimal.

Industrial stocks (such as Cornish-Rock broiler chickens) are sometimes raised by individuals, but they are seldom if ever bred by individuals. Breeding stock is instead closely held by a few multinational corporations. The selection of these sticks is very complicated, and the environment in which they functions is likewise highly developed and organized. As a result, there is little role for the individual breeder in the maintenance

or conservation of industrial stocks. This is not to say that genetic loss does not occur in industrial stocks; it does. Bloodlines may become extinct following company mergers or changes in priority. The conservation of these genetic resources however, is primarily the responsibility of the corporations, which control them.

Feral animals are those domestic stocks which have escaped or been released from human ownership and returned to the wild. Feral populations which reproduce in the wild have thus reverted from human selection to natural selection. Most feral populations across North America are not breeds in the genetic sense; continual introduction of new animals has eliminated the genetic consistency characteristic of a true breed.

There are, however, a small number of feral populations which are considered breeds, as they have been created by distinct founders and isolated for a long period of time. The genetic significance of feral breeds includes environmental adaptations and relict traits not found in improved breeds. If the founders are now extinct, feral breeds assume even greater importance. Ossabaw Island swine and Santa Cruz sheep are among the feral breeds found in North America.

Management and conservation of feral breeds is a challenge. The most significant feral breeds have generally evolved in areas of geographical isolation (such as islands) which may also be home to genetically significant native animals and plants. It is often the case that feral populations must be removed or extirpated to protect the survival of the other organisms. In these situations, it is important that the feral stocks be evaluated to determine their genetic significance, so that those which warrant conservation can be protected elsewhere. The irony, however, is clear: how can environmental adaptation be conserved outside the habitat? Conservation of feral breeds done ex-situ (outside of the habitat) requires an intricate breeding protocol to maintain genetic variation and reduce additional human selection.