Counting Our Chickens – The Great American Poultry Census[1]

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Introduction.

Rare and traditional poultry breeds are an important option for small farms, possessing traits such as foraging, maternal ability, disease and parasite resistance, and heat- or cold-tolerance that are beneficial to these niche farmers, especially those using extensive management systems. For example, standard bred turkeys were superior to commercial turkeys for non-specific T-cell stimulation, and were more resistant to challenge with hemorrhagic enteritis virus and *E. coli* (Gogal, R. , E.J. Smith, D. P. Sponenberg, and M. Bender, 2004, *unpublished results).* The status of these breeds is currently poorly documented, and if they are to serve future generations a first step is in understanding these breeds and their population dynamics.

The Livestock Conservancy (TLC), a non-profit organization founded in 1977, provides a framework for *in vivo* conservation of genetic diversity in farm animal species in the United States. It serves as an information clearing house for endangered livestock and poultry, trains and encourages breeders, and promotes rare breeds. The Conservancy also collaborates on cryoconservation projects with public and private partners. Through the work of The Livestock Conservancy, no breeds brought on to our Conservation Priority List have been lost in the United States.

Each year, The Livestock Conservancy publishes an updated Conservation Priority List (CPL) which classifies the livestock and poultry breeds that are in most need of conservation. Status on this list is determined by genetic uniqueness combined with census of breeding populations. The poultry census has different challenges than does that for mammalian livestock. Poultry require a much more extensive approach to get an accurate picture. With poultry, the Conservancy contacts hatcheries, known major breeders, and Conservancy members. TLC also sends out surveys through the American Poultry Association, breed clubs, and the Society for the Preservation of Poultry Antiquities. The goal is to reach as many people as possible.

Parameters of Poultry Breeds on the Conservation Priority List

Poultry breeds on the Conservation Priority List generally conform to certain genetic and numerical parameters.

1. The breed is from one of the four traditional U.S. poultry species (chickens, ducks, geese, and turkeys).
2. Bantam breeds are listed only if there is no large fowl counterpart.
3. The breed census satisfies numerical guidelines:
    - **Critical**: Fewer than 500 breeding birds in the United States, with five or fewer primary breeding flocks (50 birds or more), and estimated global population less than 1,000.
    - **Threatened**: Fewer than 1,000 breeding birds in the United States, with seven or fewer primary breeding flocks, and estimated global population less than 5,000.
    - **Watch**: Fewer than 5,000 breeding birds in the United States, with ten or fewer primary breeding flocks, and estimated global population less than 10,000. Also included are breeds with genetic or numerical concerns or limited geographic distribution.
    - **Recovering**: Breeds that were once listed in another category but that have exceeded Watch category numbers. They are still in need of monitoring.
    - **Study**: Breeds of potential interest but that lack definition, or genetic or historical documentation.
4. The breed is a true genetic breed (when mated together, it reproduces the breed type.)
5. The breed has had an established and continuously breeding population in North America since 1925. Or, if imported or developed since 1925,
    - The foundation stock is no longer available.
    - Must meet numeric guidelines for inclusion.
    - Must have at least five breeders in different locations in the United States.

[1] Significant portions of this article appeared in Martin, A. 2016. *Conserving Rare Breeds of Poultry*. In: Proceedings of the 2016 Poultry Breeders Roundtable, edited by U.S. Poultry and Egg Association, 20-30.

- The global population is threatened and the United States population is making a contribution to conservation of the breed.

Breeds not meeting all of these criteria may be placed in the "Study" category and monitored.

A Need for Information.

The Livestock Conservancy conducted a census focusing on all Large Fowl Standard Bred poultry in 2015. This was accomplished in partnership with the American Poultry Association (APA), Mother Earth News, the Heritage Poultry Conservancy, The Society for the Preservation of Poultry Antiquities, and Tractor Supply Company. This census included the few bantam breeds that do not have a large fowl counterpart. Of most interest were the original genetic breeds upon which many other recent breeds are based. The term “standard bred” is important; it signifies that the emphasis was on birds that are being raised to meet the breed standards of the APA. A few breeds outside of the APA’s lists are also considered as important as genetic resources and were included.

The census project was funded through a generous donation by Murray McMurray Hatchery in recognition of the importance of understanding how poultry populations are faring in North America. Many of the breeds surveyed are historically significant and represent irreplaceable genetics crucial to their species and to the future of agriculture. Even as backyard poultry keeping has become enormously popular in the past decade, many less common or more challenging breeds continue to diminish and are now in real danger of extinction. Exhibition breeders and small hatcheries often serve as important genetic reserves for such breeds.

Poultry Census.

The census of chickens, turkeys, ducks and geese began in the spring of 2015 and was completed a year later in 2016. The last censuses were conducted in 2000 (waterfowl), 2004 (chickens), and 2006 (turkeys). Through our partners and several media outlets, more than 4 million poultry enthusiasts were reached and asked to participate in the census. As a result, we received completed censuses from approximately 1500 private breeders, 48 hatcheries, and 8 universities.

Table 1. Status of endangered poultry breeds in the United States (based on 2015 census)

Number of breeds	Chickens	Ducks	Geese	Turkeys*	Criteria
More secure	15	5	3	1	Higher category than previous census
Less secure	6	0	0	2	Lower category than previous census
Critical	11	2	4	1	< 500 breeding birds
Threatened	11	4	3	3	< 1,000 breeding birds
Watch	21	6	4	4	< 5,000 breeding birds
Recovering	6	1	0	0	<10,000 breeding birds

*Varieties rather than breeds.

The status of poultry breeds improved overall, with 26% of breeds more numerous than when last censused (Table 1). More than half of all poultry breeds had more than 1000 breeding birds, making them far more secure than in the previous census. Changes in ducks were especially encouraging, because fewer farms raise waterfowl than chickens and turkeys and therefore the inherent risks to duck breeds are higher. However, six chicken breeds and two turkey varieties were less numerous, and 21% of poultry breeds had fewer than 500 breeding birds.

Popularity of backyard chickens in recent years is well documented (Block, 2011; Lucas, 2014), and undoubtedly has been an important factor in improvements to the status of chicken breeds. Not all breeds have benefited from this phenomenon. Popularity of dual purpose breeds has grown, including many breeds in the American and English classes (Table 2). Brahma and Cochin birds also gained in popularity. Breeds that lost ground were of more extreme phenotype and temperament, most notably Old English Game, Malay, and Aseel. These breeds are not popular for egg or meat

production and the need to keep male birds separated from each other is not desirable on many small farms. Houdan, La Fleche, and Sebright bantams are also less numerous than in 2004. A surprising finding is the relative lack of popularity of Mediterranean class birds. Although they are excellent layers and efficient at feed conversion, their nervous temperament and white eggs may make these breeds less popular for small farms and backyards that tend to focus on breeds that are more calm and personable and that lay brown eggs.

Table 2. Popularity of chicken breeds by class in 2015 poultry census.

Breed Class	Breeding population (Mean breeding birds per breed)	Private Breeders (%)	Hatcheries (%)
American	6740	22	78
English	5910	18	82
Asian	5129	23	77
Continental	2347	25	75
All Other Standard Breeds	1890	28	72
Mediterranean	1876	26	74

Two chicken breeds graduated from the Conservation Priority List with the results of this census, Orpington (English class) and Wyandotte (American class). Both breeds have benefited greatly from the popularity of small flocks for backyard egg production. Orpingtons have proven especially popular with families due to their gentle temperament, while Wyandottes have many appealing color varieties.

American game birds were included in the census for the first time. Game birds are a unique genetic resource, distinct in many ways from nearly all standardized breeds and often with pedigrees dating back centuries. The reported numbers indicate the breed is endangered but it is believed that this was due to a very low percentage of these birds being reported. It is planned to study them further at a later date.

The 2015 census points to continued overall success for heritage turkeys. The first census of turkeys, conducted in 1997, found only 1335 breeding heritage turkeys. The Livestock Conservancy then launched a recovery project to recruit more breeders, and partnered with a number of organizations to develop a seasonal market for heritage turkeys as a high-quality, high-value option for the holiday table. In 2006, breeding turkeys had risen to 10,404, and in 2015 to 14,502. The population of Heritage turkeys is much more stable now, however, conservation is still necessary. Attention to varieties ensures diversity within this breeding population, and varieties that represent differences in size and conformation are especially important (Royal Palm, Beltsville Small White, and Midget White). Two varieties, Black and Royal Palm, declined in number since 2006.

In 2000, six breeds of ducks had fewer than 500 breeding birds; in 2015, this fell to only two breeds of ducks. Although not nearly as popular as chickens, ducks have benefited from the trends for poultry rearing, especially for egg production. There are only a handful of commercial hatcheries raising waterfowl, and 37% of censused breeding ducks are in private breeder hands, compared with 25% of censused breeding chickens. In recent years, ducks have established a foothold in the marketplace for local meat and eggs.

Breeding numbers of geese, on the other hand, declined overall. The number of hatcheries advertising domestic ducks and geese in 2015 was about 1/3 of what it was in 2000, and this may have been an important factor in the decline of geese. Three breeds of geese, Pilgrim, Pomeranian, and American Buff were more numerous in 2015 than in 2000. African and Chinese geese, however, while still in the Watch category, had about 50% fewer breeding birds than found in the previous census. This mixed outlook for geese warrants more conservation attention.

Overall, the results from the 2015 census of poultry indicate favorable trends, and provide the evidence base for conservation decisions in coming years.

Poultry Conservation – What is a Breed?

Since the mid-19th century, poultry breeding practices have diverged from those of livestock, and these differences pose important considerations for conservation of genetic diversity. The dual influences of exhibition breeding and commercial hatchery production have emphasized phenotype over genotype without necessarily including the steps of foundation, isolation, and selection. In many poultry breeds the result has been that varieties within breeds, and flocks within varieties, do not share histories of foundation, isolation and selection with one another. For example, White, Buff, and Partridge Chantecler chickens each come from a different foundation, even though the final products resemble each other in all but color.

Two long established practices of poultry breeding confound expectation of "what is a breed". The first is the extensive use of outcrossing and backcrossing. It is not unusual for breeders to cross out to other breeds (rather than to other lines within the same breed) in order to bring in desired traits, followed by a few to several generations of backcrossing to fix the trait in question. This is done with some degree of phenotypic selection during the backcross generations. Poultry breeders also place tremendous emphasis on color, and colors are maintained as separate varieties within the various breeds. When breeders outcross, it is often the case that they will cross out to other breeds rather than to color varieties within the same breed, for fear of confounding the fine details of color as demanded by the standard for the variety. The paradox of this breeding philosophy is that outcrosses are accomplished to introduce new qualities into a flock, while at the same time the breeders claim to be raising a pure and original breed. Unless carefully monitored and managed, outcrosses can fundamentally change the birds going by the same breed name.

Thus selection plays a dominant role in poultry breeding, with foundation and isolation often playing minor roles, and in many situations playing no role at all. At one extreme many breeders remain devoted to the concept and practice of pure breeding, and select for performance within the original genetic pool as defined by foundation and isolation. An opposite extreme are those breeders that outcross birds to other breeds and then use rigorous selection within the highly variable progeny to achieve birds that superficially resemble the original breed. At the extremes, these two breeding philosophies yield quite different genetic products, and yet these go by identical names. One of these is purebred and predictably reproduces the breed type, the other is genetically mixed and can lack the predictability of production typical of pure breeds.

Selection metrics and goals also differ among breeders, with an especially sharp division between hatcheries and exhibition breeders. The former may place greater emphasis on egg production (addressing their economic needs) and the latter a greater emphasis on morphology (addressing the requirements of exhibition). Nearly all these breeders utilize outcrossing from time to time to introduce or strengthen specific traits, especially egg production, and less expert breeders may rely excessively on outcrossing and backcrossing.

These breeding practices do change the underlying genetic importance of the breed, and have a fundamental impact on conservation decisions. In isolated genetic breeds, complex genetic interactions such as epistasis (interactions between genetic loci of a gene's DNA sequence on the chromosome) and linkage can have a proportionally greater influence on phenotype. This is due to the genetic uniformity of a pure breed allowing these complex genetic units to be targeted for selection. Outcrossing disrupts these complex units, and this is perhaps most important for adaptive traits that are so highly important for sustainable and extensive systems.

When poultry breeds are subject to frequent outcrossing, is "breed" the right unit for conservation of genetic diversity? In the absence of a defined foundation followed by isolation, the population generally also lacks a shared history and genotype. In this situation conservation may be reduced to single genes such as those associated with feather type and color that are so essential to breed standards. Other traits such as conformation, egg production and egg shell character may also be among the single genes targeted in such populations.

Breed value.

At least part of the value of breed conservation in poultry resides in breeds with extreme phenotypes. Breeds such as Sumatra, Cornish, Brahma, and Langshan have phenotypes that would be so affected by crossbreeding as to make it difficult to return to the original phenotype by backcrossing. There is likely to be more genetic diversity between such breeds than between breeds of more intermediate phenotypes, such as popular dual purpose breeds within American and English classes that all share reasonably similar phenotypes.

Landrace breeds represent another aspect of genetic diversity of high value for conservation, and don't fit readily into the mainstream focus on recognized and standardized breeds. For example, Icelandic chickens imported in this century come from a hardy landrace that is being conserved in its native Iceland. Phenotypic differences in comb type, color, and even partial crests on some birds may disturb breeders accustomed to standardized breeds. Yet, these birds resemble each other more than any other breed, not only in appearance, but in traits prized on the small farm such as foraging, brooding, caring for chicks, and cold hardiness.

Waterfowl present a different breeding model than chickens. Geese are more likely to be maintained as purebred populations, due in part to their long-term monogamous behavior. Duck breeds are less frequently crossbred than chicken breeds. Thus conservation of breeds remains a viable model for ducks and geese.

Turkeys present yet another scenario, because breeds as such are not recognized. Indeed, genetic diversity in turkeys is low, and standard bred (Heritage) varieties are more closely related to each other than to commercial varieties (Kamara et al., 2007; Aslam et al., 2012). The division of "heritage" versus "commercial", rather than breeds or varieties, provides the most useful distinction for conservation, because standard bred turkeys are much less numerous than commercial broad-breasted varieties.

Conclusions.

Breeds remain relevant as a unit of conservation for ducks, geese, landrace chicken breeds, and probably for chicken breeds with extreme phenotypes. In the sense that standard bred turkeys may be considered to be a distinct breed from broad-breasted commercial turkeys, breed is also relevant to turkey conservation. For these breeds, the conservation model that has worked well for livestock may be applied, and recommendations for poultry conservation summarized roughly as:

- Save the really rare stuff
- Save the really old stuff
- Save landraces
- Save extreme phenotypes
- Save non-industrial turkeys, ducks and geese
- Keep tabs on all of it

Breeding strategies for rare breeds need to maintain genetic diversity. This is best accomplished by maintaining genetically purebred flocks. Using more males than are strictly needed for fertility, long term strategies such as "spiral breeding', and alternating roosters from within strain and across strains all serve to maintain genetic variability within the flock (Sponenberg & Bixby 2006). Selection to improve productivity and adaptive traits can be combined with conservation breeding which enhances the value of these birds on small farms, bearing in mind that the need to conserve diversity may slow selection progress. At the breed level, maintaining different bloodlines within a breed, usually on different farms, also ensures diversity.

The conservation picture for chicken breeds of intermediate phenotype remains complicated. They are sufficiently different from broilers and commercial leghorns to be of conservation interest, yet the breeding strategies employed lead the geneticist to wonder whether these breeds differ significantly at the genetic level. Together, they fit a similar ecological niche and can serve as a reservoir of rare alleles while also filling a niche for backyards and small homesteads.

The next step is to conduct genetic distance studies. The Livestock Conservancy has joined with numerous scientists to collect DNA samples to address these questions. The main target of these studies is to document the relationships of the various breed types to one another, and the depth of the differences among them. These might then lead to investigations of the genetics of adaptation, behavior, and other traits that make heritage breeds useful to their owners.

Cryoconservation represents another important facet of breed conservation. By building a library of conserved breeds, and then adding to this library at future intervals, evolving changes in poultry genetics are preserved for future research as well as being a source of genes or gene regions. Reconstitution of individual birds has been demonstrated (Song and Silversides, 2007a; ibid 2007b), and additional progress in understanding the obstacles to frozen semen recovery have been made (Long, 2016), but much work remains to be done before we can rely upon frozen conservation for reconstitution of poultry breeds, and *in vivo* conservation will always be needed in parallel as breeds change and adapt to current needs.

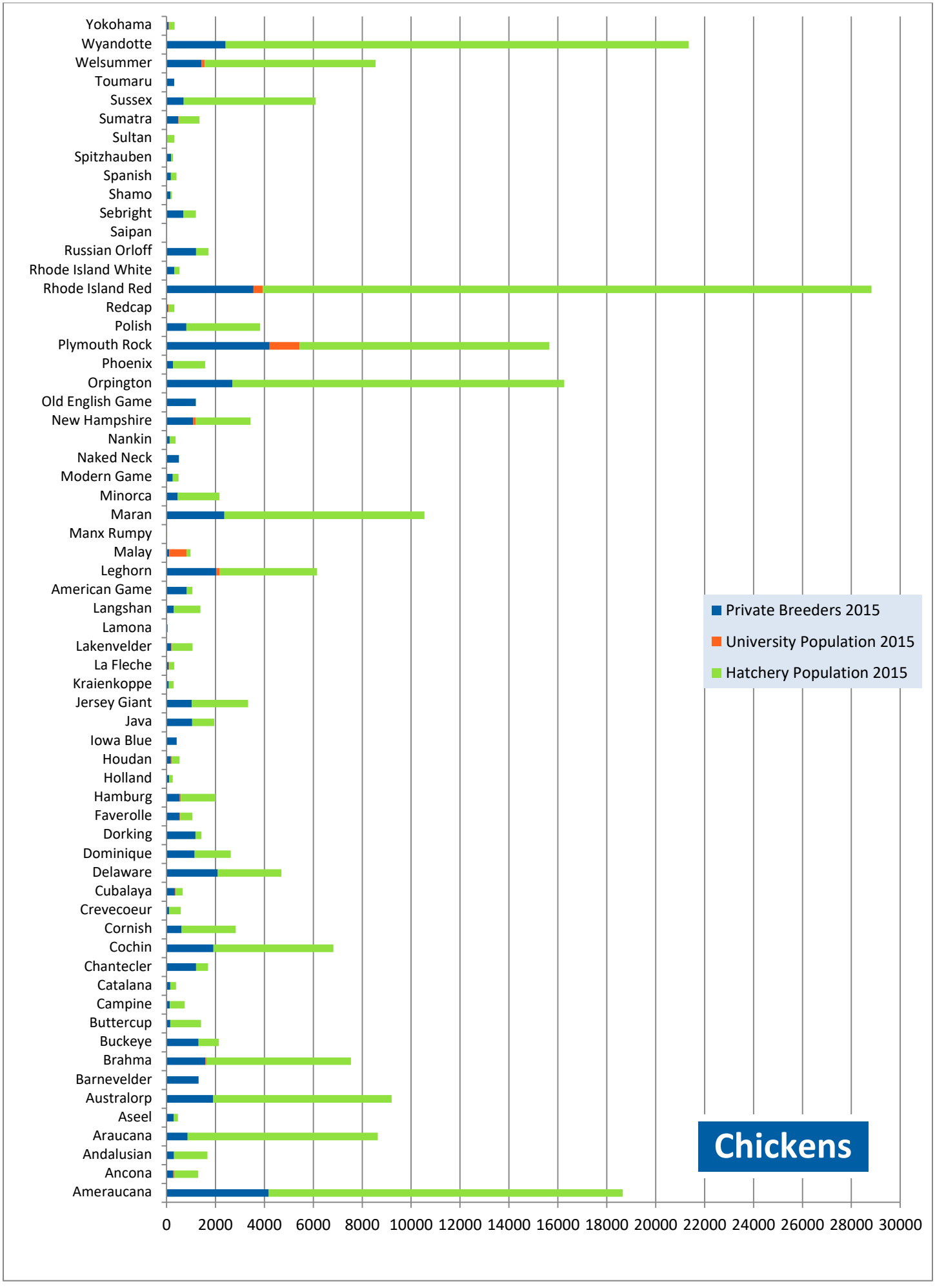
Conservation of poultry genetic resources maintains genetic diversity, which serves as an insurance policy against future changes in environment, production systems, or consumer preferences. Determining the best way to effectively conserve genetic diversity is challenging. Presently the most realistic strategy is to target breed conservation, despite some drawbacks to this approach based on the breeding practices around these breeds.

Acknowledgments.

The Livestock Conservancy would like to recognize the efforts of all of our partners for reaching poultry producers across the country. These include the American Poultry Association, Mother Earth News, Tractor Supply Company, The Heritage Poultry Conservancy, The Society for the Preservation of Poultry Antiquities, and the numerous breed clubs, poultry associations and web-based poultry enthusiast groups that helped gather data for the project. We would also like to give special thanks for financial support to Murray McMurray Hatchery, without whom the census would not have been possible. And finally a thanks to the "boots on the ground" effort of TLC staffer Ches Stewart, who worked on reaching out to all those that provided information for this study and the collection of all the raw data used to produce this report.

Census charts.

The following charts include the census numbers subdivided into total population, private breeder, hatchery, and university numbers.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Lakenvelder
La Fleche
Kraienkoppe
Jersey Giant
Java
Iowa Blue
Houdan
Holland
Hamburg
Faverolle
Dorking
Dominique
Delaware
Cubalaya
Crevecoeur
Cornish
Cochin
Chantecler
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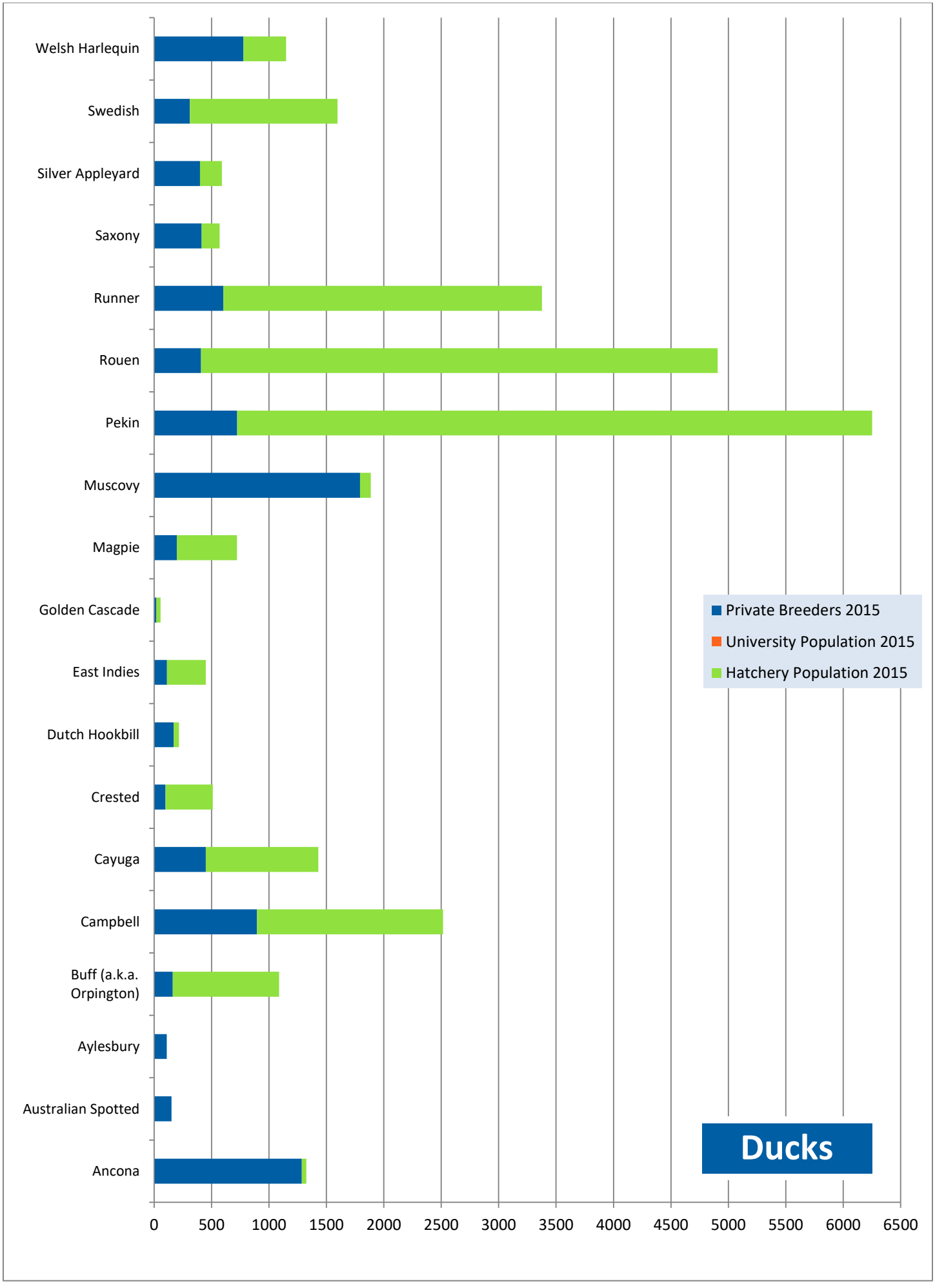
University Population 2015
Hatchery Population 2015
Chickens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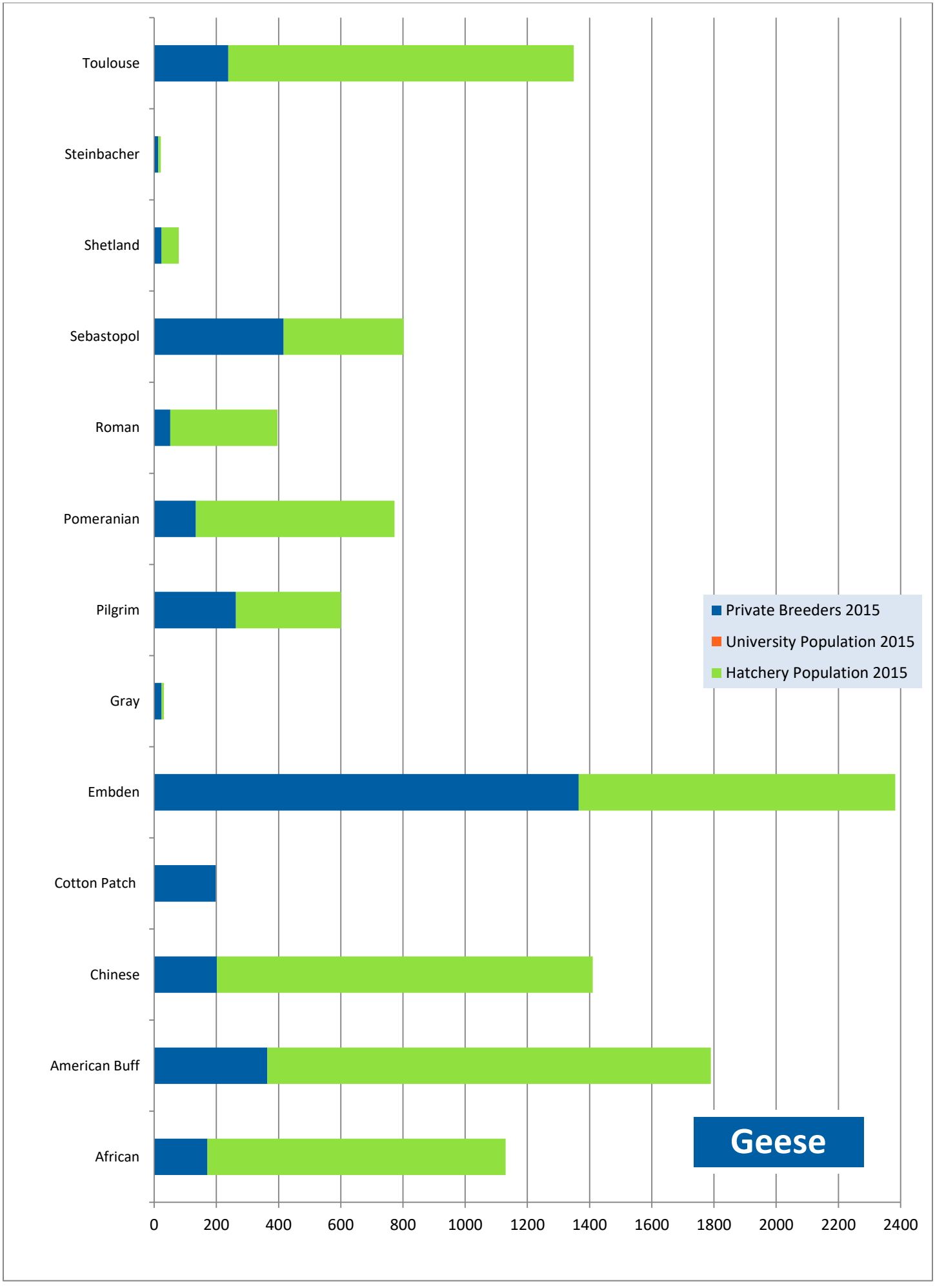
University Population 2015
Hatchery Population 2015
Ducks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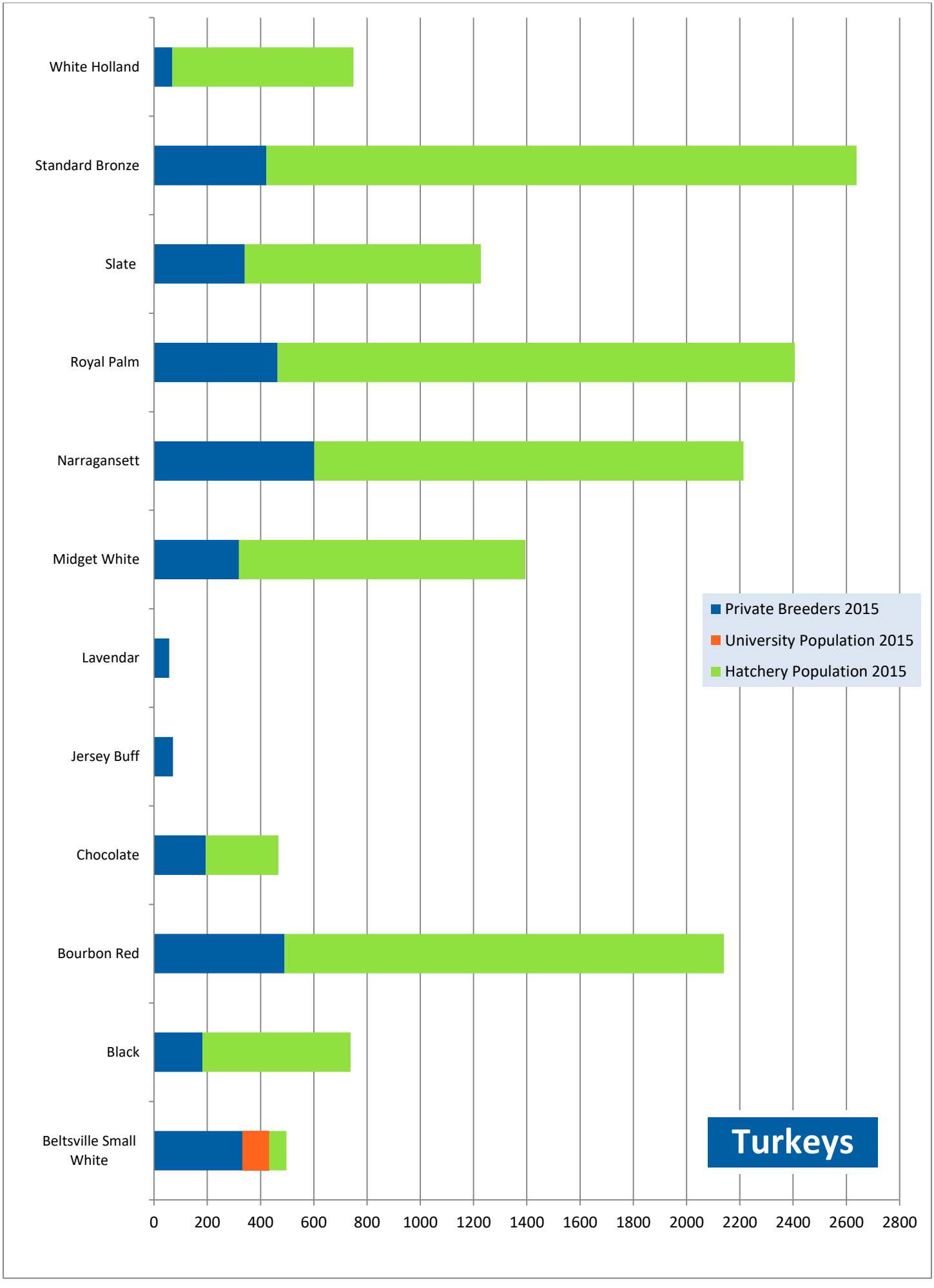
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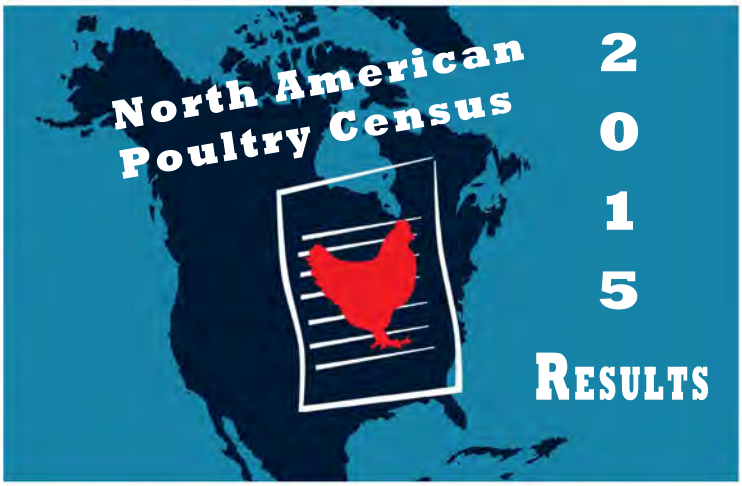
University Population 2015
Hatchery Population 2015
Turkeys

North American Poultry Census 2015 Results



No Longer Endangered!

People Reached
4 Million+

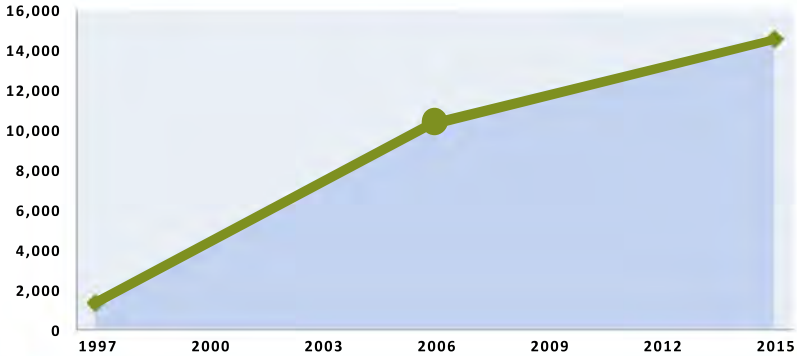
Breeds Counted

Turkeys	Ducks	Geese	Chickens
11	18	14	70

Conservation of poultry genetic resources maintains genetic diversity, which serves as an insurance policy against future changes in environment, production systems, or consumer preferences.

# Breeds					Criteria
More Secure	1	5	3	15	Higher Than Previous Census
Less Secure	2	0	0	6	Lower Than Previous Census
Critical	1	2	4	11	< 500 Breeding Birds
Threatened	3	4	3	11	< 1,000 Breeding Birds
Watch	4	6	4	21	< 5,000 Breeding Birds
Recovering	0	1	0	6	< 10,000 Breeding Birds

Heritage Turkey Population 1997-2015



Project Partners

Mother Earth News

Murray McMurray Hatchery

Tractor Supply Co. TractorSupply.com

Rare Breeds Canada

Heritage Poultry Conservancy

- 22% of breeds better off
- # of duck breeds critically endangered: 6 in 2000; 2 in 2015
- HALF of all poultry breeds now have more than 1000 breeding birds
- 21% of poultry breeds remain critically endangered

Read the Full Report at LivestockConservancy.org

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