Biotechnolgy as a Tool for Conserving Animal Genetic Resources in the Philippines

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Scientists identify top ten priority regions for climate adaptation funding to secure food security and biodiversity

Tue, Sep 17, 2013

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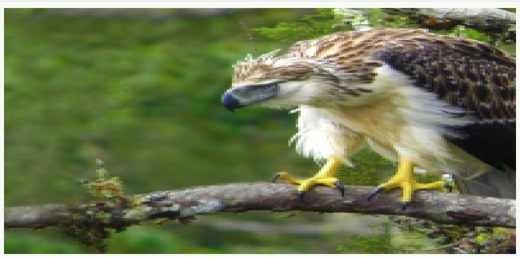


Philippine Eagle: The Philippines are one of the top 10 regions identified (Rich Lindie;worldsrarestbirds.com)

A new study investigating the impacts of climate change has identified 10 global priority regions where targeted funding for building resiliency and adapting to the impacts of climate change would provide the greatest benefits to both people *and* the natural ecosystems that support life on Earth.

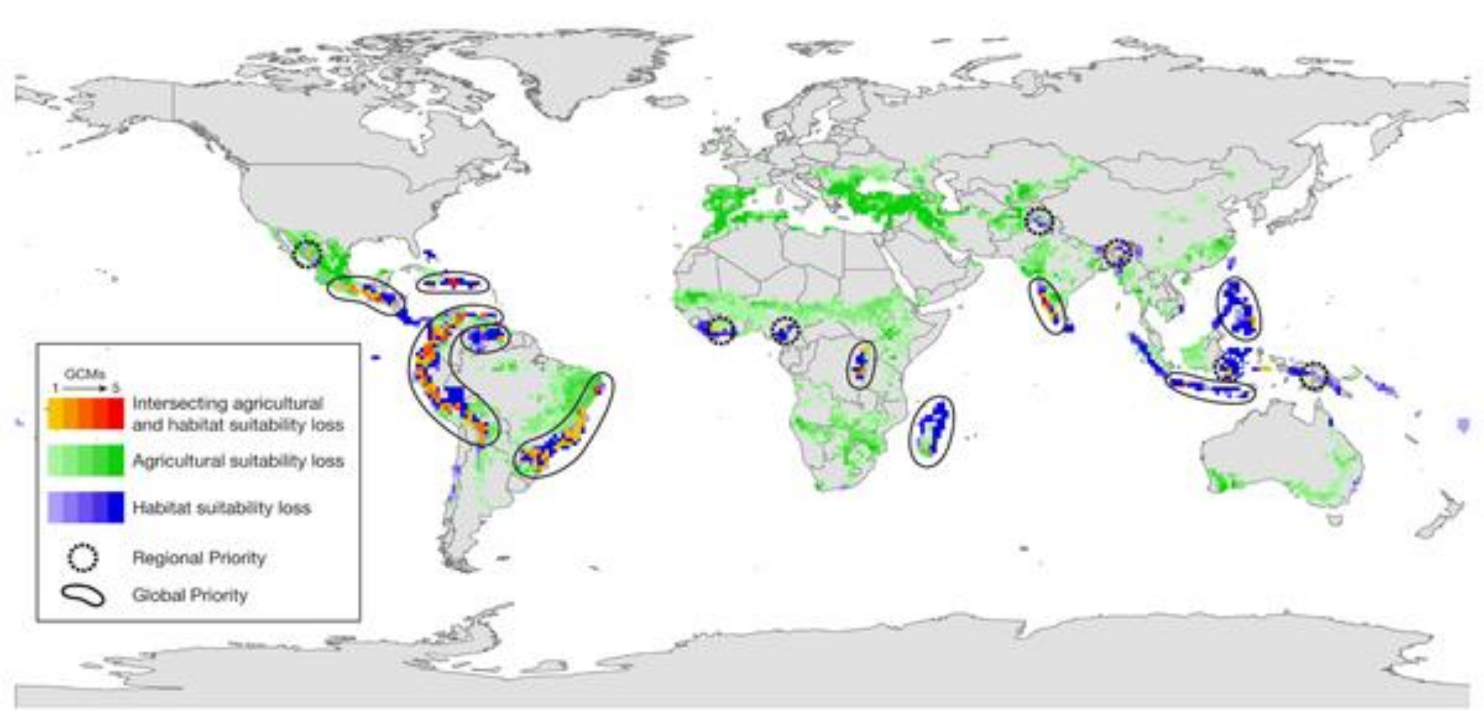
The regions identified in the study, ranging from Africa to South America, to Central Asia and the Asia-Pacific region, are areas where small-scale farmers will be most affected by climate change and where Biodiversity Hotspots are also located.

The 10 priority regions with the greatest potential benefits to humanity include:

- **Central America** – Mexico, Guatemala, Honduras, Nicaragua
- **Caribbean** – Jamaica, Haiti, Dominica, Puerto Rico, Venezuela
- **Andes (South America)** – , Colombia, Ecuador, Peru, Bolivia, Argentina
- **Guiana Highlands** – Venezuela
- **Atlantic Coast of Brazil (South America)** – Brazil
- **Albertine Rift** – Zaire, Burundi, Tanzania, Uganda
- **Madagascar** – Madagascar
- **Ghats** – India
- **Philippines** – Philippines
- **Java** – Indonesia

Published in the journal PLOS ONE, *Global Climate Change Adaptation Priorities for Biodiversity and Food Security* represents the first global study to combine assessments of the impacts of climate change on both agriculture and biodiversity, in order to identify joint priorities.

Figure 1. Global and regional priorities for adaptation of agriculture and biodiversity in the face of climate change.



Hannah L, Ikegami M, Hole DG, Seo C, et al. (2013) Global Climate Change Adaptation Priorities for Biodiversity and Food Security. PLoS ONE 8(8): e72590. doi:10.1371/journal.pone.0072590
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0072590

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Neonauclea connicalycina: a new myrmecophytic species of Naucleeae (Rubiaceae) from Cebu, Philippines

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Abstract

The new myrmecophytic species, *Neonauclea connicalycina*, from Carmen, Cebu, Philippines closely resembles *N. formicaria*, which also occurs in Philippines, but differs from that by its smaller mature flowering heads, fusiform apical portions of the calyces, longer and sharply pyramidal calyx summits that are pallid brown when dry, calyx lobes that are connate for 1–2 mm and fall off together in a unit, and smaller, more slender corollas. Description, illustration and ecological comments about the new species are provided.

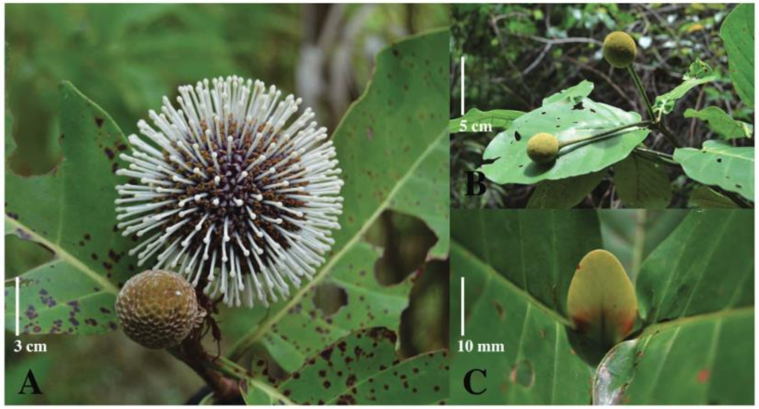


FIGURE 1. *Neonauclea connicalycina* live morphology. **A.** Flowering and fruiting heads. **B.** Immature flowering heads. **C.** Terminal vegetative bud enclosed by adpressed stipules. Photos taken by *A.J. Taradji*.

Farmers managing …

Farmers managing genes

Farmers managing species

Bukidnon Farmer with her Native Cow

Farmers managing ecosystems

Ecological economics:

What is the total economic value of associated biodiversity in agricultural systems?

TEV = [Use values] + [Option values] + [Non-use values]
Use (instrumental) values include direct and indirect economic values
Non-use values include existence and strategic values

Total economic value (TEV)

Present use values

Direct economic values
- Food resources
- Species for specialised markets (dDelicatessen)

Indirect economic values
- Ecosystem services
- Recreation & tourism
- Education

Existence and strategic values
- Protecting biodiversity
- Maintaining culture of local people
- Continuing ecological and evolutionary processes

Option values Future products:
- Food resources
- Genetic resources
- Medicines

Increasing difficulties of economic estimation

After Primack (2000)

Monetary Value of Marine Ecosystems

Azanza et al (2017) examined the economic and social activities in relation to the seas and coastal areas, and provided updated estimates of the real value of the country's marine ecosystems' goods and services (in total ***annual indirect and other benefits****).*

Marine ecosystems can contribute a conservative monetary value of about ***US$970 billion up to US$1.5 trillion per annum*** *to the economy* (in PPP US$ billion, 2007 prices) .

Total monetary value associated with coral reefs, seagrass, and mangroves estimated to be PPP US$98.298B or PhP1.553T (in 2007 prices), which is ***almost at par with the contribution of the manufacturing sector*** *to the country's nominal GDP in 2007 (PhP1.568T).*

Mendoza, 2017

6,300

1,350

1

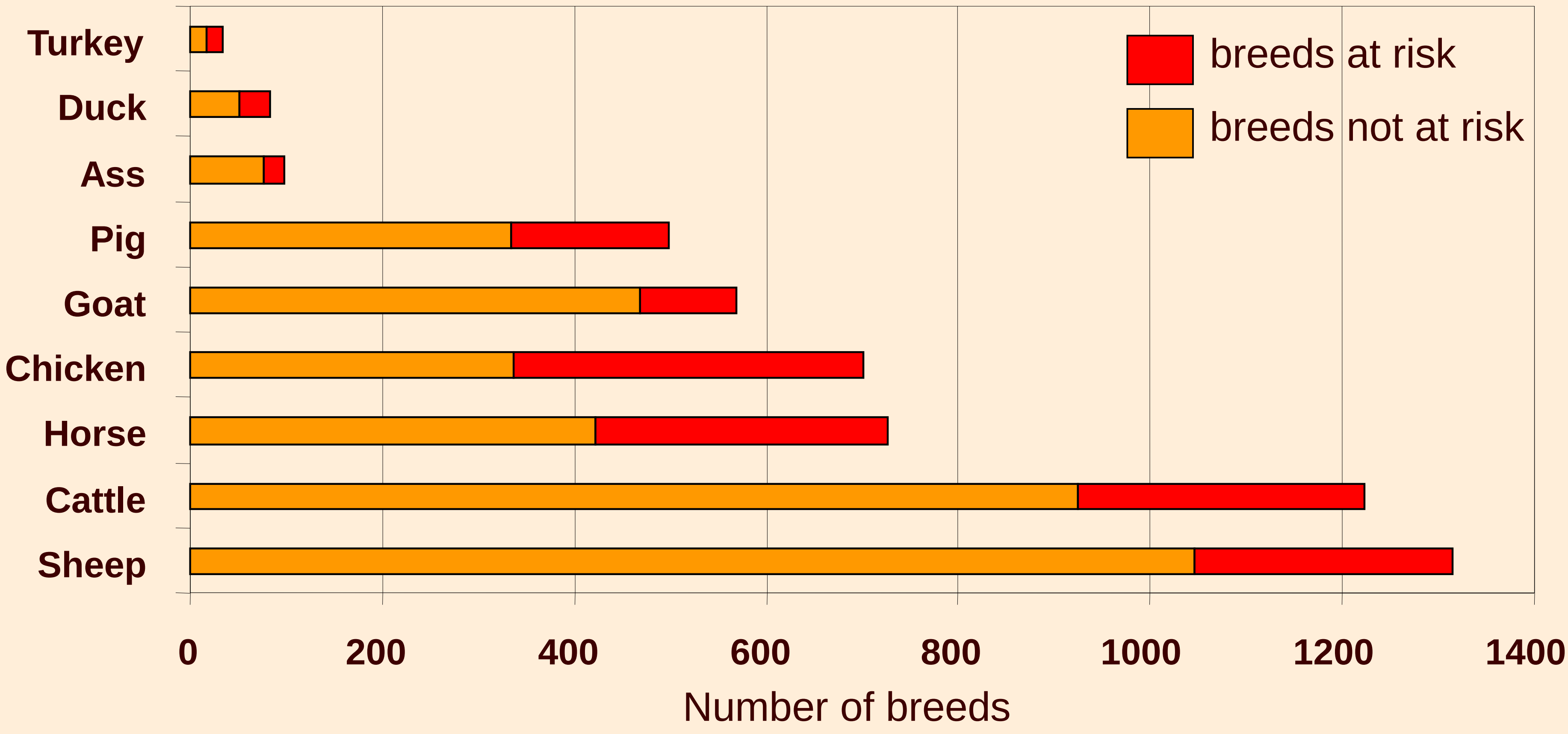
List of animal species used for food and agriculture

Widespread species	
Species	*No. of breeds*
Pig	350
Goat	320
Sheep	850
Cattle	815
Buffalo	70
Horse	350
Donkey/Ass	70
Dromedary	50
Bactrian Camel	6

List of animal species used for food and agriculture

Widespread species	
Species	*No. of breeds*
Llama	2
Alpaka	2
Chicken	>300
Turkey	>30
Duck	>65
Muscovy Duck	None
Domestic goose	>60
Guinea Fowl	10 varieties
Japanese Quail	>6
Pigeon	150
Ostrich	4 races

Domestic animal breeds at risk around the world



Largest diversity in developing countries

Background to AnGR Issues

- Livestock provide 30% of total human requirements for food and agriculture
- 70% of world's poor depend on livestock
- 16% of breeds lost over last 100 years
- 32% of remainder at risk
- 70% of remainder located in developing countries where extinction risk is highest

Why conserve diversity?

- Exotic genetic resources not sustainable
- Indiscriminate crossbreeding
- Genetic resources for future needs

Farmers, their animals and the environment

Local animal genetic resources for…

Food security

Local animal genetic resources for...

Insurance Policy

Local animal genetic resources for...

Cultural heritage

A Charge of Carabaos. This postcard was sourced from Ambeth Ocampo, one of our leading historians.

Next steps

Desirable commitments by governments

- Include stakeholders in decision-making
- Identification of sources of funding
- Support breeder associations
- Strengthen extension services

Regional and Global Networking

- Strengthen regional network
- Advice NGOs, bilateral and multilateral cooperation

Implementing the Global Plan of Action for Animal Genetic Resources

Opportunities for collaboration

Opputinities for Collaborations

- What we do?
- Examples of collaboration
- Potential future collaboration

Livestock keepers manage animal genetic resources







Global Plan of Action for Animal Genetic Resources

Priority Areas

1. Characterization, inventory & monitoring of trends and associated risks
2. Sustainable use & development
3. Conservation
4. Policies, institutions & capacity building

Strategic Priorities for Action provide agenda for action

Global Plan of Action for the Conservation and Sustainable Use of PGRFA

Priority Activity Areas

***In Situ* Conservation and Development**

1. **Surveying and Inventorying of PGRFA**
2. **Supporting On-farm Management and Improvement of PGRFA**
3. **Assisting Farmers in Disaster Situations to Restore Agricultural Systems**
4. **Promoting *in situ* Conservation of Wild Crop Relatives and Wild Plants for Food production**

also

Ex situ conservation.....

Capacity building and Institutional cooperations.....

What is a "native" animal?

Synonyms: local, traditional, indigenous

- **Definition** (*Valdez et al., 2004*)

- "are animals which are being kept under local environmental conditions without following any conventional breeding system and exhibit no resemblance with the external characteristics of known exotic purebreeds and upgrades "

MORPHOMETRIC CHARACTERIZATION OF NATIVE CHICKENS (*Gallus gallus domesticus* L.) IN SAMAR, PHILIPPINES

Traditional chickens?

✓ non-descript , indigenous type
✓also called "native", "indigenous"
✓ no studies on morphometric and molecular characterization (FAO 2012)

What has been done so far to characterize the Philippine native chicken?

✓Lambio et al., (2000), review paper – 4 genetic groups of Philippine native chickens
✓Cabarles et al., (2012) – Western Visayas (Region 6)
✓Bejar et al., (2012) – Western Samar

BREEDS OF PHILIPPINE NATIVE CHICKEN

	MALE	FEMALE
1. Bolinao		
2. Banaba		
3. Camarines		
4. Darag		
5. Paroakan		

In Situ Conservation and Development

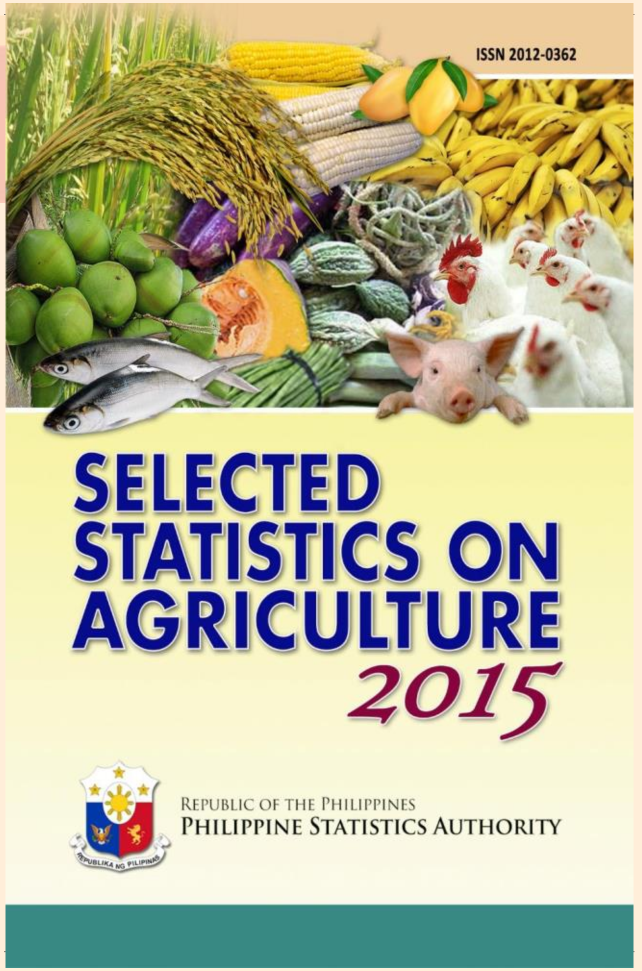
Fig. 1. A flock of free-range native chicken.

LIVESTOCK AND POULTRY: INVENTORY BY TYPE, PHILIPPINES, AS OF JANUARY 1, 2010-2015

ITEM	2010	2011	2012	2013	2014	2015P
LIVESTOCK ('000 head)						
Carabao	3,270	3,075	2,964	2,913	2,847 R	2,855
Dairy	13.9	14.7	15.7	15.4	16.8	17.3
Cattle	2,571	2,518	2,493	2,498	2,512 R	2,534
Dairy	16.9	17.4	19.3	21.1	21.6	22.5
Hog	13,398	12,303	11,863	11,843	11,802	12,000
Goat	4,178	3,882	3,715	3,694	3,696 R	3,674
Dairy	1.2	1.4	1.6	1.6	1.9	2.0
POULTRY ('000 birds)						
Chicken	158,984	162,813	164,192	166,386	167,671	176,469
Broiler	52,213	54,754	57,284	59,196	61,582	66,617
Layer	28,639	31,444	31,524	32,003	30,007	31,254
Native [1/]	78,132	76,615	75,384	75,188	76,082	78,598
Duck	10,268	10,126	10,011	10,135 R	9,886 R	10,066

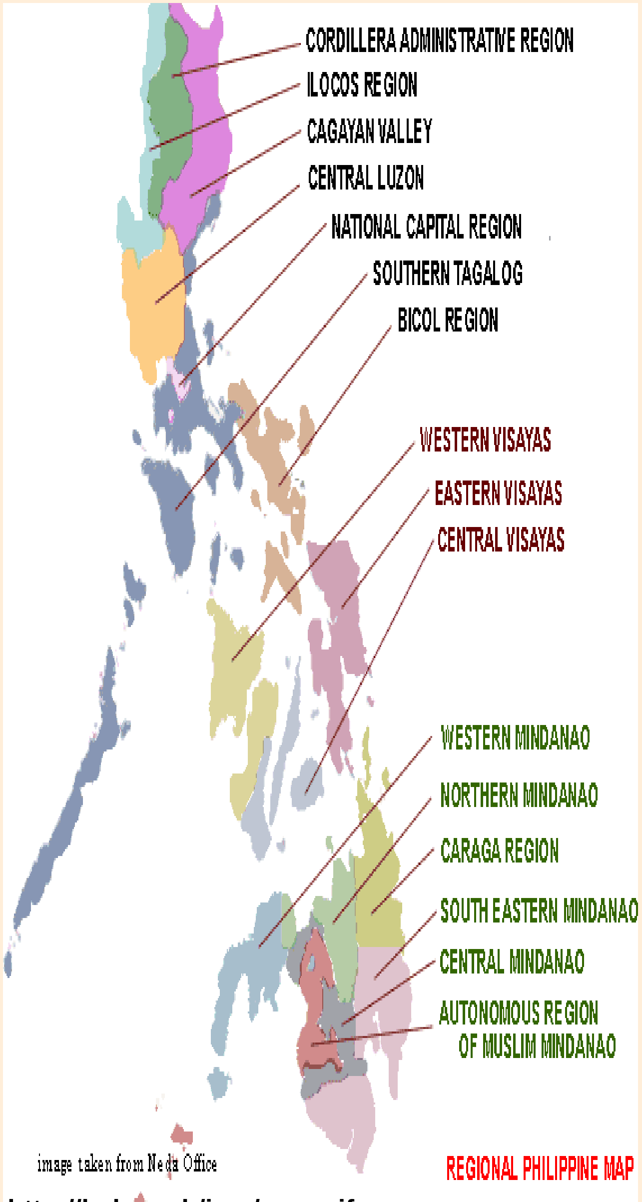
1/ Includes gamefowls in the backyard

Source: PSA



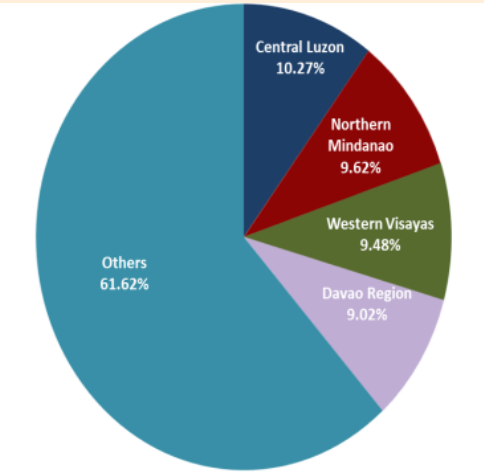
In 2015 data:

43 % are native chickens



http://bahay.ph/img/map.gif

Distribution of Native/Improved Chicken Inventory by Region, Philippines, as of January 1, 2016 (preliminary)



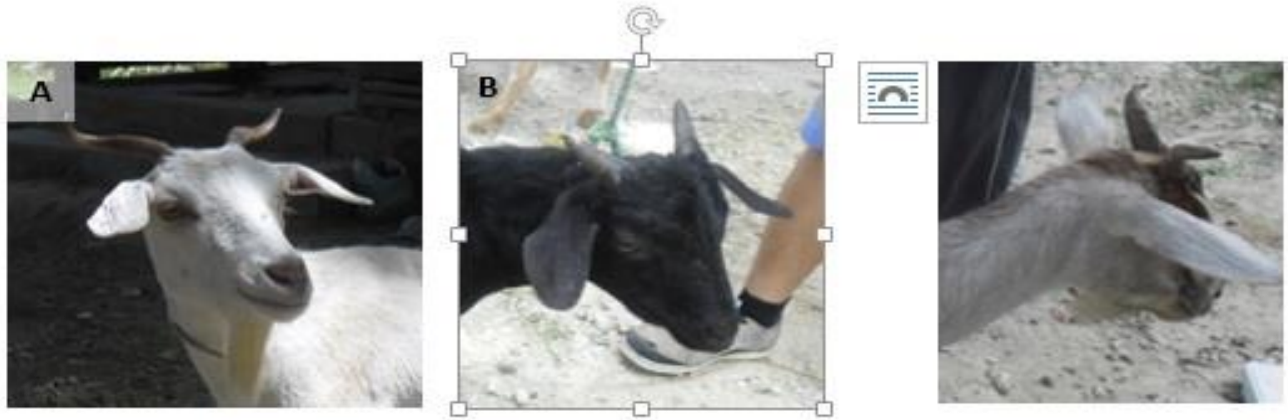
Chicken Inventory by Classification, Philippines, as of January 1, 2014-2016P

BIRD TYPE	YEAR			Percent Change	
	2014	2015	2016P	15/14	16/15
(1)	(2)	(3)	(4)	(5)	(6)
CHICKEN	***167.67***	***176.47***	***178.77***	***5.25***	***1.30***
Broiler*	61.58	66.62	65.71	8.18	(1.36)
Layer*	30.01	31.25	32.20	4.16	3.04
Laying Flock	24.20	25.52	26.21	5.44	2.70
Growing Flock	4.20	4.38	4.71	4.08	7.54
Day-Old Layer	1.60	1.36	1.29	(15.11)	(5.22)
Native/Improved[1/]	76.08	78.60	80.85	3.31	2.87

P-Preliminary
*Foreign Strain resulting from importation of GP and PS DOC breeders

Phenotypic characterization of native goats (*Capra hircus* Linn.) in the Cebu, Philippines

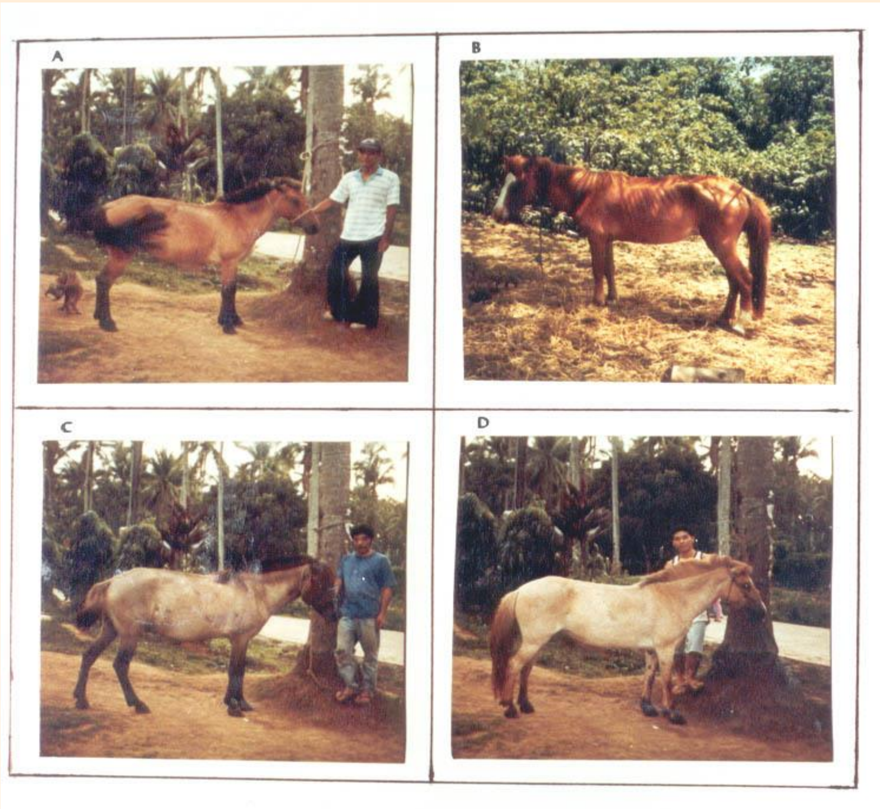
Varying horn shape of goats (*C. hircus*) (A: scurs, B: curved, C: straight).



Varying horn orientation of goats (*C. hircus*) (A: oblique, B: back, C: up)


NAVY
SOCCER CLUB
2014/01/28 09:52

GENETIC VARIATION OF NATIVE HORSES (*Equus caballus* Linn.) IN THREE LOCALITIES OF LAGUNA, PHILIPPINES BASED ON PROTEIN/ISOZYME AND MORPHOMETRIC ANALYSES



Valdez, et al., (2004)

PNAD

PHILIPPINE NATIVE ANIMALS DEVELOPMENT PROGRAM

my wealth, my pride.

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PNAD seeks to develop policies and initiatives for **sustainable conservation, production, and marketing of native animals.** It envisions to provide **“pride, health, and wealth”** to local raisers of native livestock.




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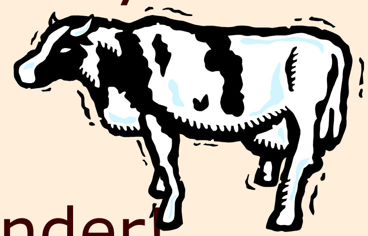
ROADMAP

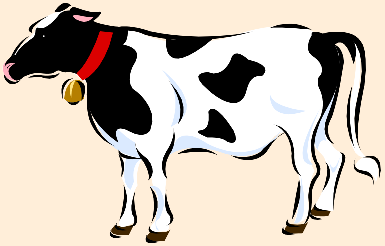
			2012	2013	2014		
1) Description of production system		X	X				
2) Valuation of traits		X	X				
3) Identification of population size & structure		X	X				
b) Measurement of genetic diversity			X	X	X		
1) Morphological characterization			X	X			
2) Molecular characterization			X	X	X		
c) Appreciation of the native animal's uniqueness			X				
1) Genetic basis of adaptability			X				
2) Physiological and genetic markers for growth and reproduction			X				

Picardal et al., (2013)

DNA-marker technologies can identify genetically superior animals

- HD 50K for Angus
- GeneStar® MVP ® feed efficiency, marbling, tenderness, as well a meat quality palatability index and homozygous black.
- GeneStar ® Black homozygous black
- GeneStar ® EliteTender ® guaranteed tender!
- SireTRACE ® DNA fingerprint
- SureTRAK ® Product verification
- Genetic Conditions Testing





Other animal health companies involved

Pfizer Animal Health   http://www.pfizeranimalgenetics.com/

Future Prospects

Scientific com
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(*Gallus dom*
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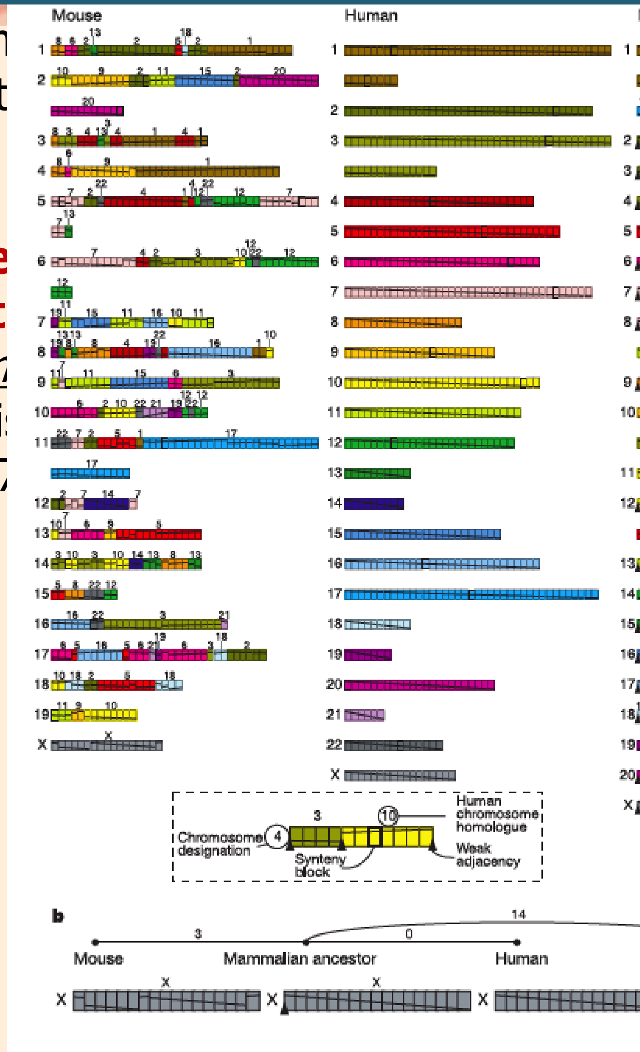
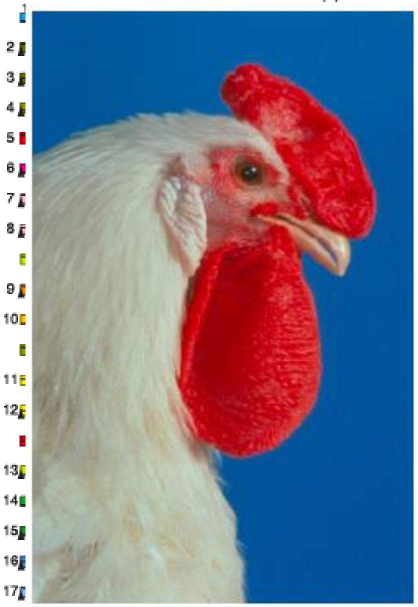


Figure 12 Putative mammalian ancestor recovered by GRIMM and MGR using the human, mouse, rat (not shown) and chicken genomes. **a**, Each genome is represented as an arrangement of 586 synteny blocks each drawn as one unit, regardless of its length in nucleotides. Each human chromosome is assigned a unique colour, and a diagonal line is drawn through the whole chromosome. In other genomes, this diagonal line indicates the



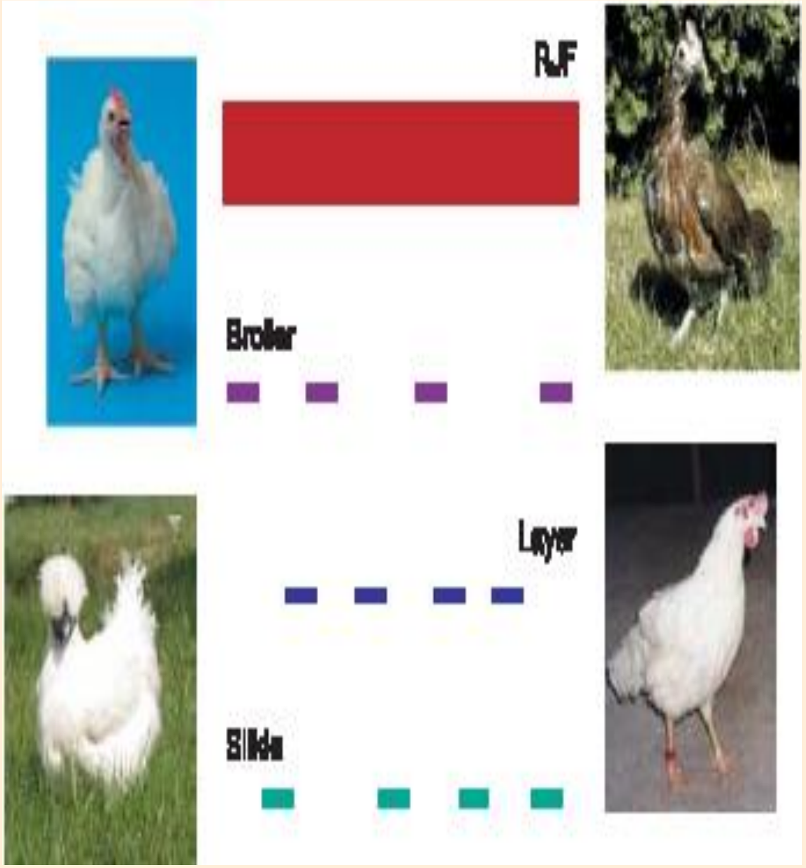
Clockwise from above:

- White Leghorn rooster from UCD 003, a highly inbred stock that serves as genetic background to a number of congenic chicken stocks.
- Red Jungle Fowl rooster from UCD 001, a highly inbred stock derived from the wild chicken progenitor species.
- Hybrid rooster from cross between Red Jungle Fowl (UCD 001) and White Leghorn (UCD 003). Offspring from the cross of this rooster and a White Leghorn hen were used as a reference population in developing the chicken genome map.

(Photographs courtesy of J. Clark, University of California–Davis.)

Front cover: Chicken, turkey, and quail eggs. (Photograph courtesy of J.M. Pisenti, University of California–Davis)

Future Prospects



SNP discovery experiment. Three domestic chickens are sampled at one-quarter coverage each and compared the resultant sequence to the 6.6£ draft genome of red jungle fowl (RJF).

Provided by Michael von Luttwitz

e contrary, there is a

decrease in the gene pool of

There is now a struggle to maintain living stocks, and efforts towards new chicken lines has virtually diminished

poultry phenotypic variants due to

tary constrains

Gone is the scleroderma line, an experimental model for an incurable disease, estimated to affect 300,000 people in the United States

Provided by Michael von Luttwitz

Gone is the collection of color strains and mutant turkey lines held by Oregon State University


provided by Mike Walters


provided by Mike Walters


provided by Mike Walters

Gone is a cleft palate line that showed simple genetic control of a complex trait found in many mammals and the fourth most frequent human congenital disorder with 1 in 700 newborns affected

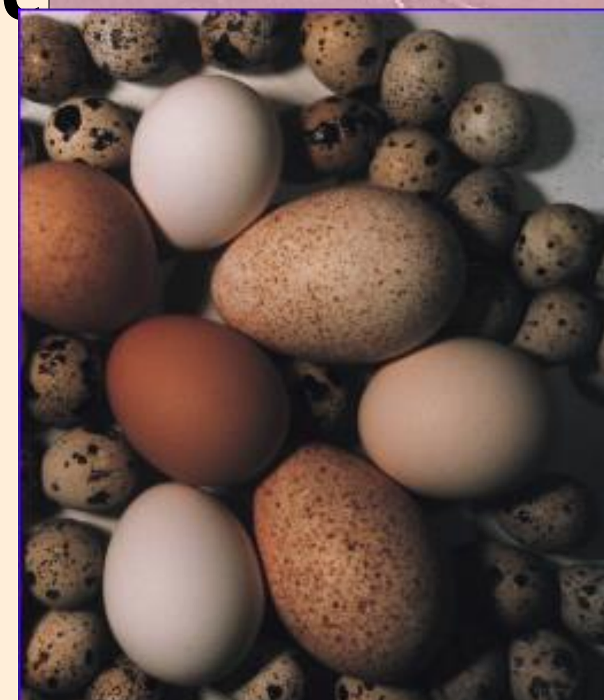
An entire collection of quail, which is an excellent avian laboratory model because of its small size, prolificacy, and early on set of sexual maturity, is on the brink of elimination held by the University of British Columbia

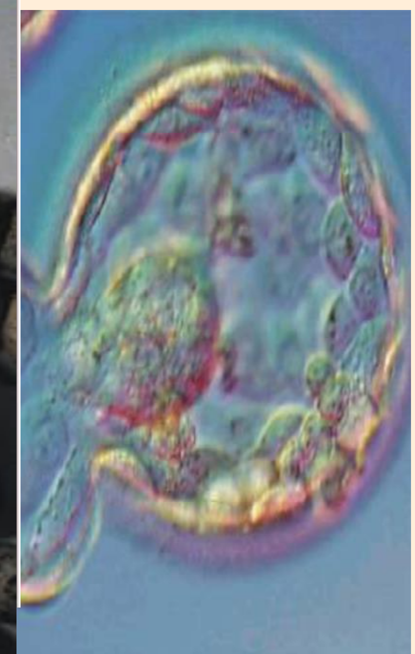
Cryopreservation Limitations

Semen is only marginally capable of fertilization after a freeze/thaw cycle

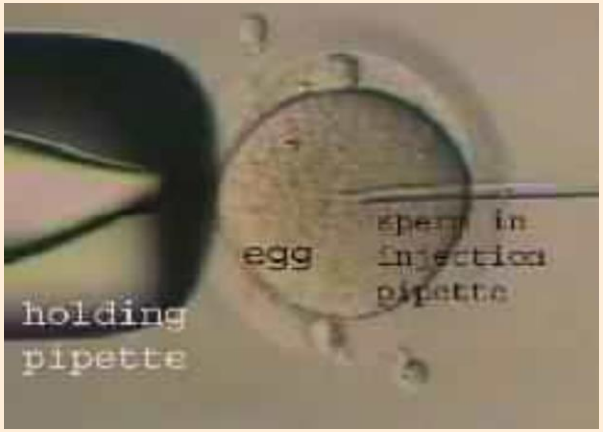
Large yolky avian ovum cannot be frozen, thus, the female side of the cryopreservation equation is absent for successful resurrection

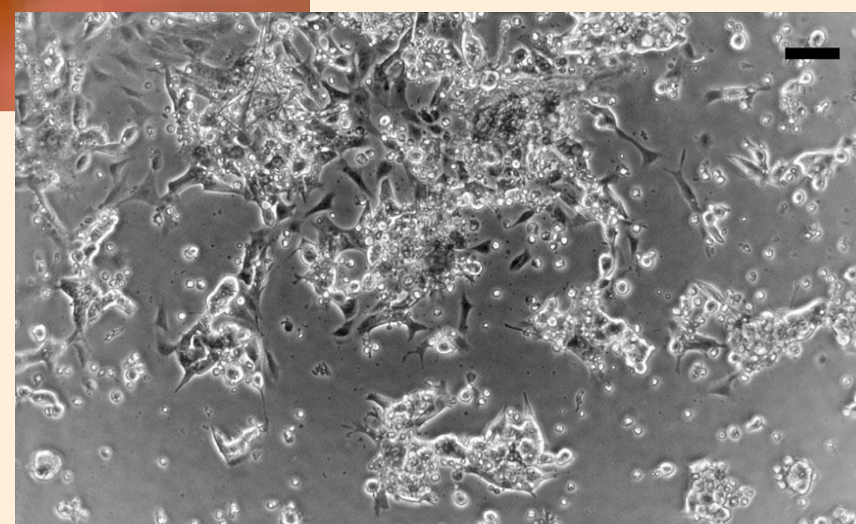
Although several methods of germplasm preservation are available for chicken, there are severe limitations in terms of practicality, efficiency, and success rate





There is an urgent call for germplasm conservation initiative to preserve poultry resources and long term, sustainable solution are essential





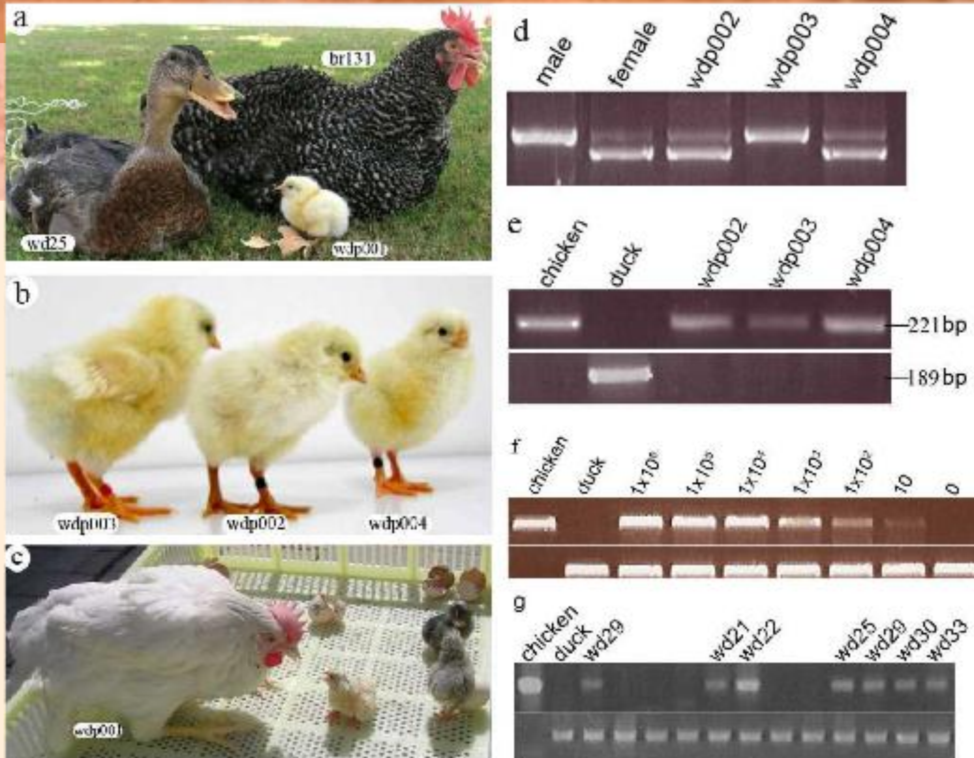


FIG. 4. The chicken offspring produced by chimeric male ducks. **a**) The chimeric duck (Wd25), female chicken (BR131), and their chicken offspring (wdp001). **b**) Three chicken offspring (wdp003, wdp002, wdp004) from male chimeric ducks. **c**) The progenies of a chimeric duck-derived chicken (wdp001) after being inseminated with BR rooster semen. **d**) Molecular sexing test of chicken PGC-derived offspring (wdp002, wdp003, and wdp004). **e**) Species identification of the offspring with chicken-specific (upper) and duck-specific (lower) primers. **f**) PCR sensitivity test on detecting chicken sperm from a mixture of chicken and duck semen. **g**) Detection of chicken sperm from chimeric duck semen with chicken-specific (upper) and duck-specific (lower) primers.

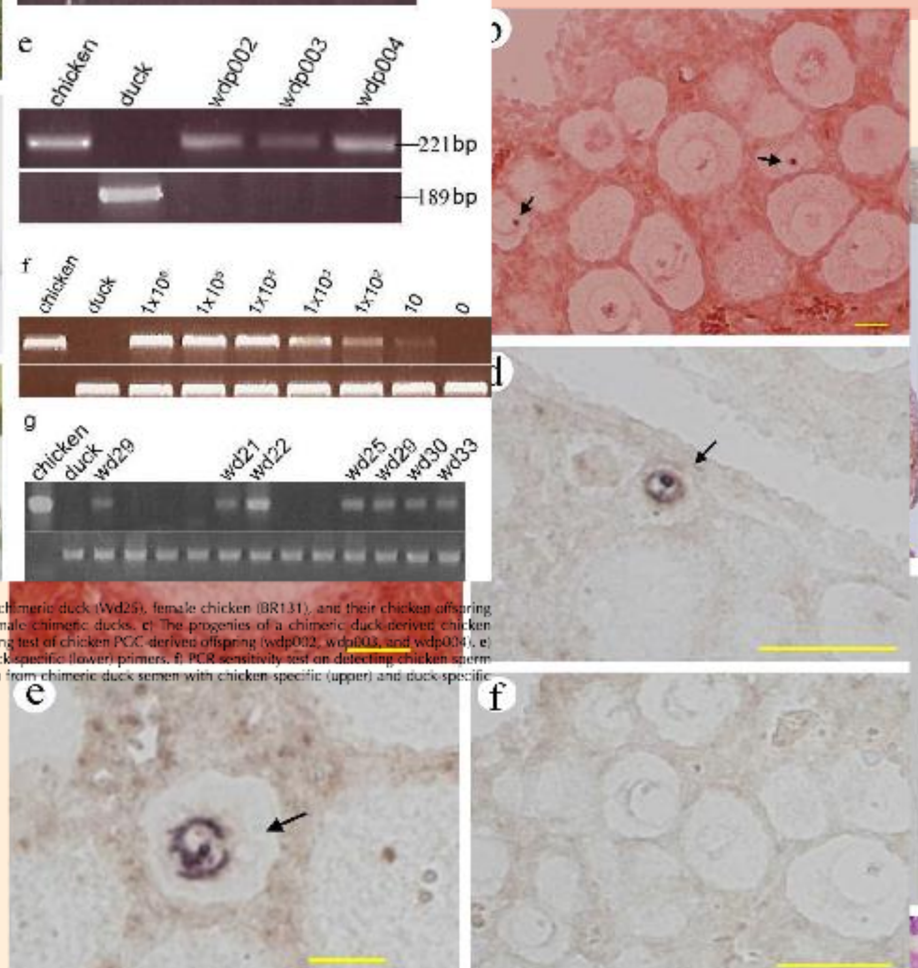
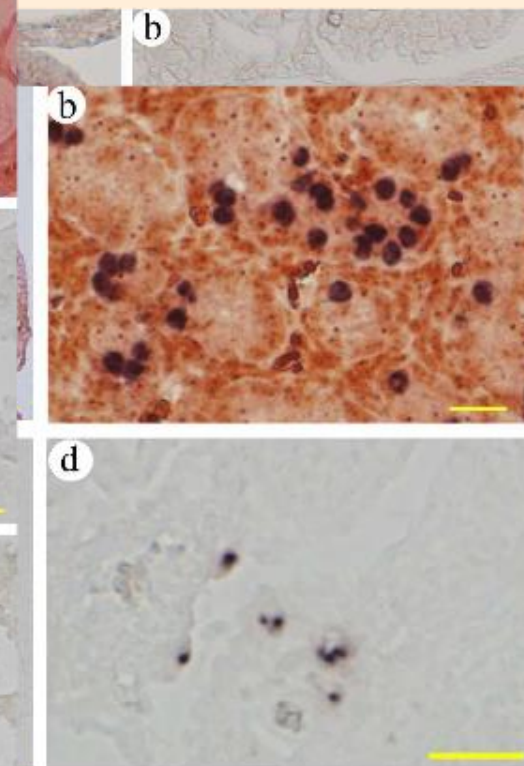
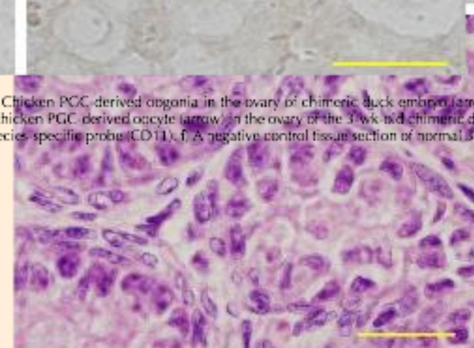


FIG. 3. The chicken PGC-derived oocyte in the chimeric duck ovary. **a**) Chicken PGC-derived oogonia in the ovary of chimeric duck embryo (arrows) detected by ISH with W chromosome DNA probe. **b** and **c**) Follicles with chicken PGC-derived oocyte (arrow) in the ovary of the 3-wk-old chimeric duck. **d** and **e**) Follicles with chicken PGC-derived oocyte (arrow) detected by species-specific probe (CD11). **f**) A negative control tissue section of normal 3-wk-old duck ovary. Bars = 30 μm (**a**), 50 μm (**d**, **f**), and 20 μm (**b**, **c**, **e**).

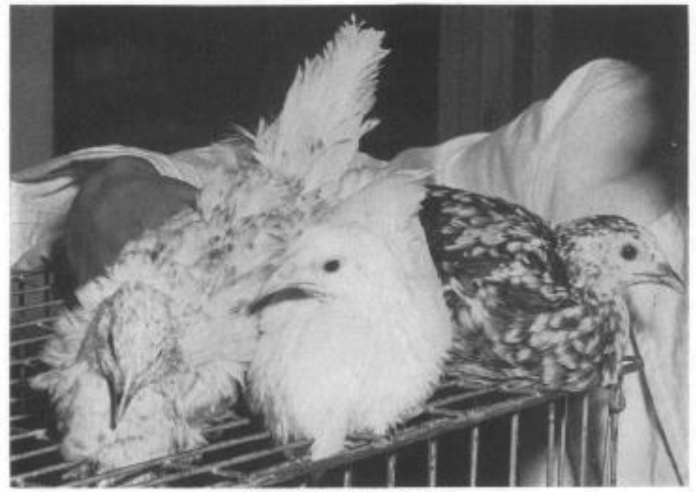




STRANGE PARTNERS

Figure 14

Adult quail hen atop an adult Flightless cock.



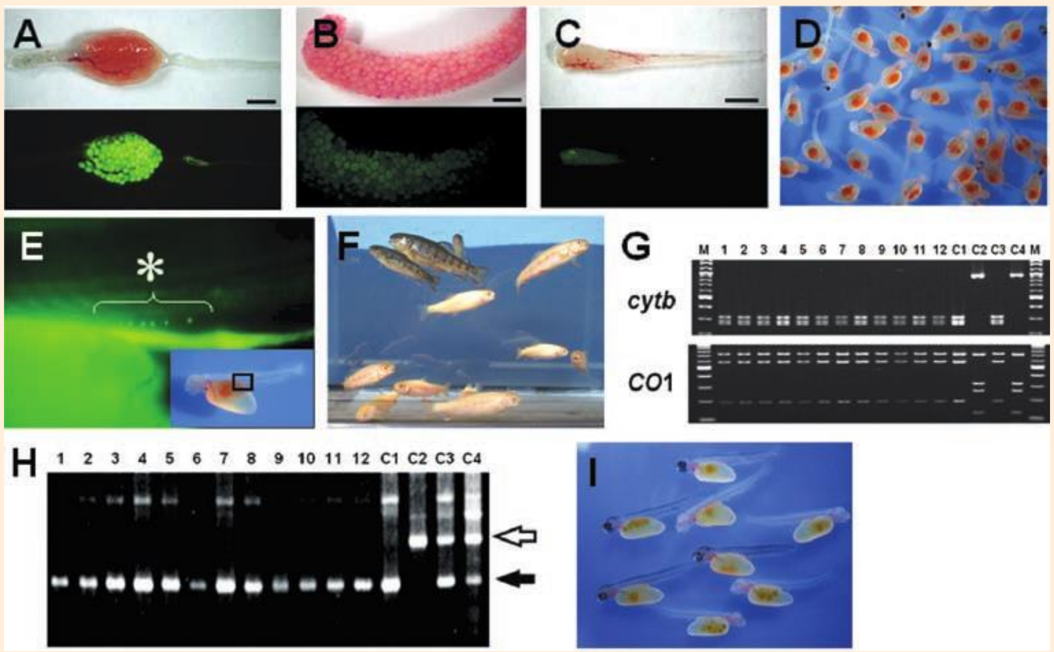
CHICKEN QUAIL HYBRIDS

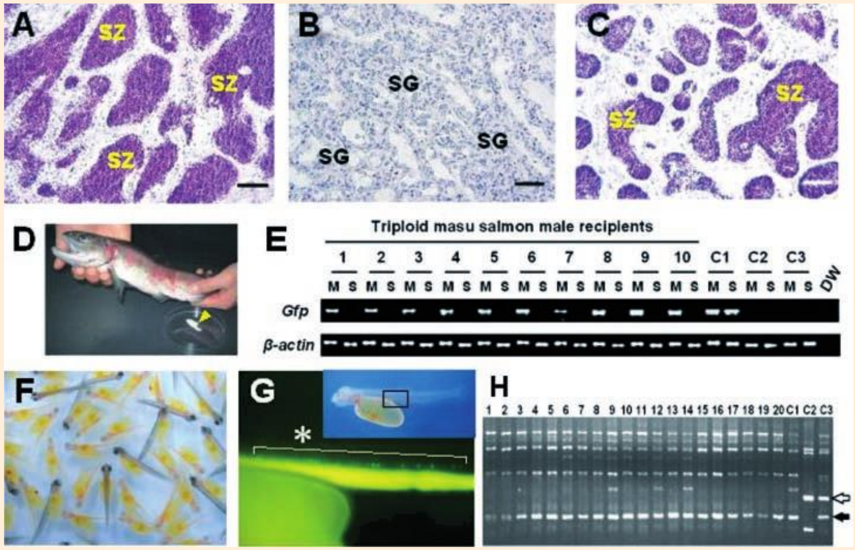
Figure 15

From left to right, hybrids from Flightless, White Leghorn, and Dark Cornish males at three to four and one half months of age.

Wilcox and Clark, 1965

Spermatogonial Transplantation in Fish: Production of Trout Offspring from Salmon Parents



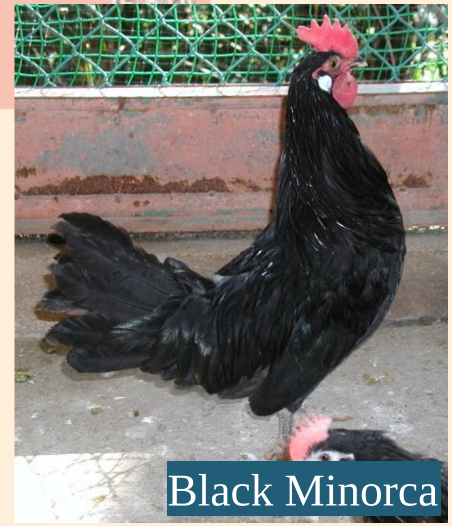


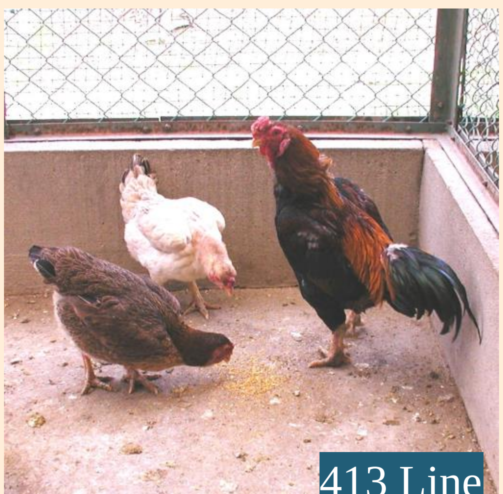
Okutsu et al., 2008

Shimada et al., 2007; Valdez *et al*., 2007; 2010


Australorp


Brown Leghorn


Black Minorca


413 Line


Cal Line

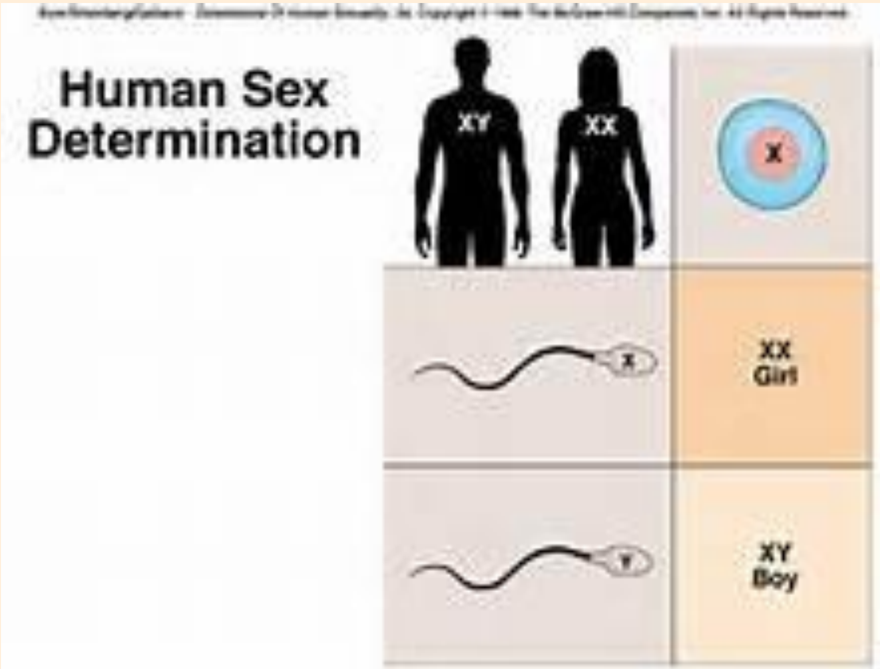

Nagoya Line

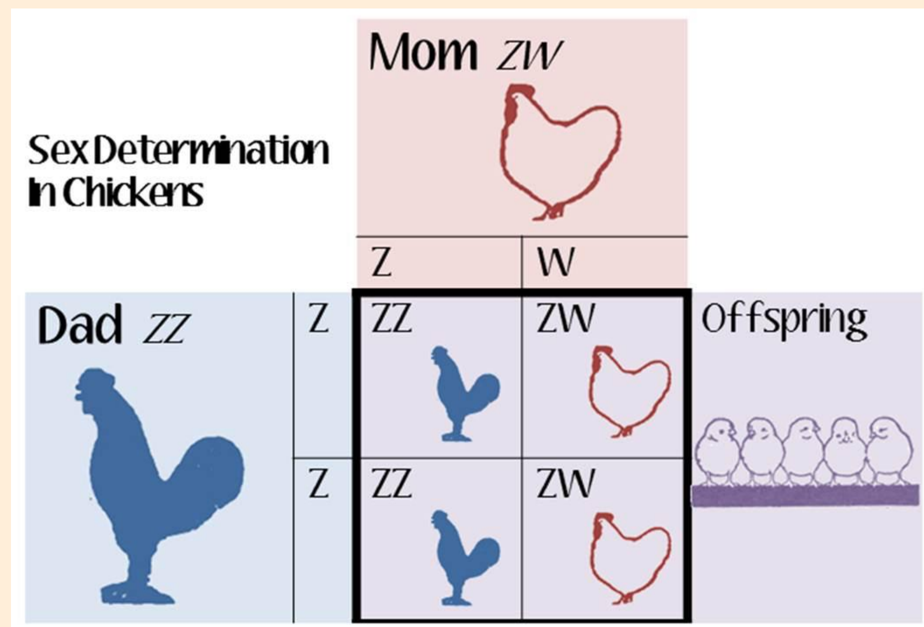
www.agr.nagoya-u.ac.jp/~abrc/abrc-E/index.html

Ex situ conservation

Differential Development of Sex-related Characters of Chickens from the GSP and PNP/DO Inbred Lines after Left Ovariectomy

Sex Determination





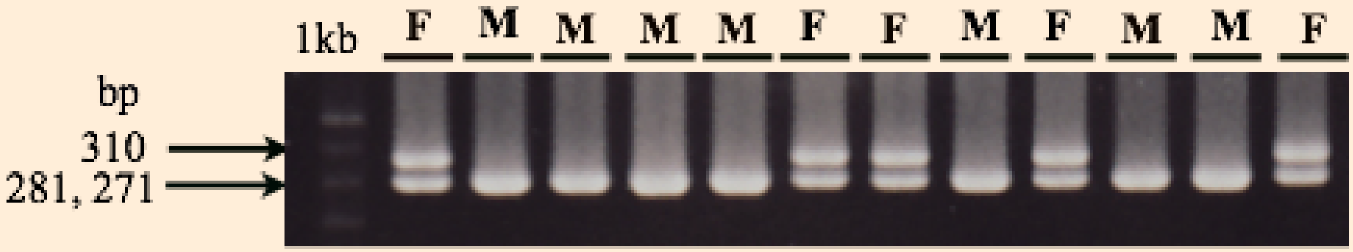


Fig. 1. DNA sex identification of day old chicks using PCR with a single set of primers, CHD1 and CHD2. The identified sex of each individual is indicated; those birds with two bands are females (F), and those with one band are males (M). 1kb is the size marker (ØX174 DNA III digest), and the base-pair sizes that are indicated to the left of the figure.

Valdez *et al*., 2010

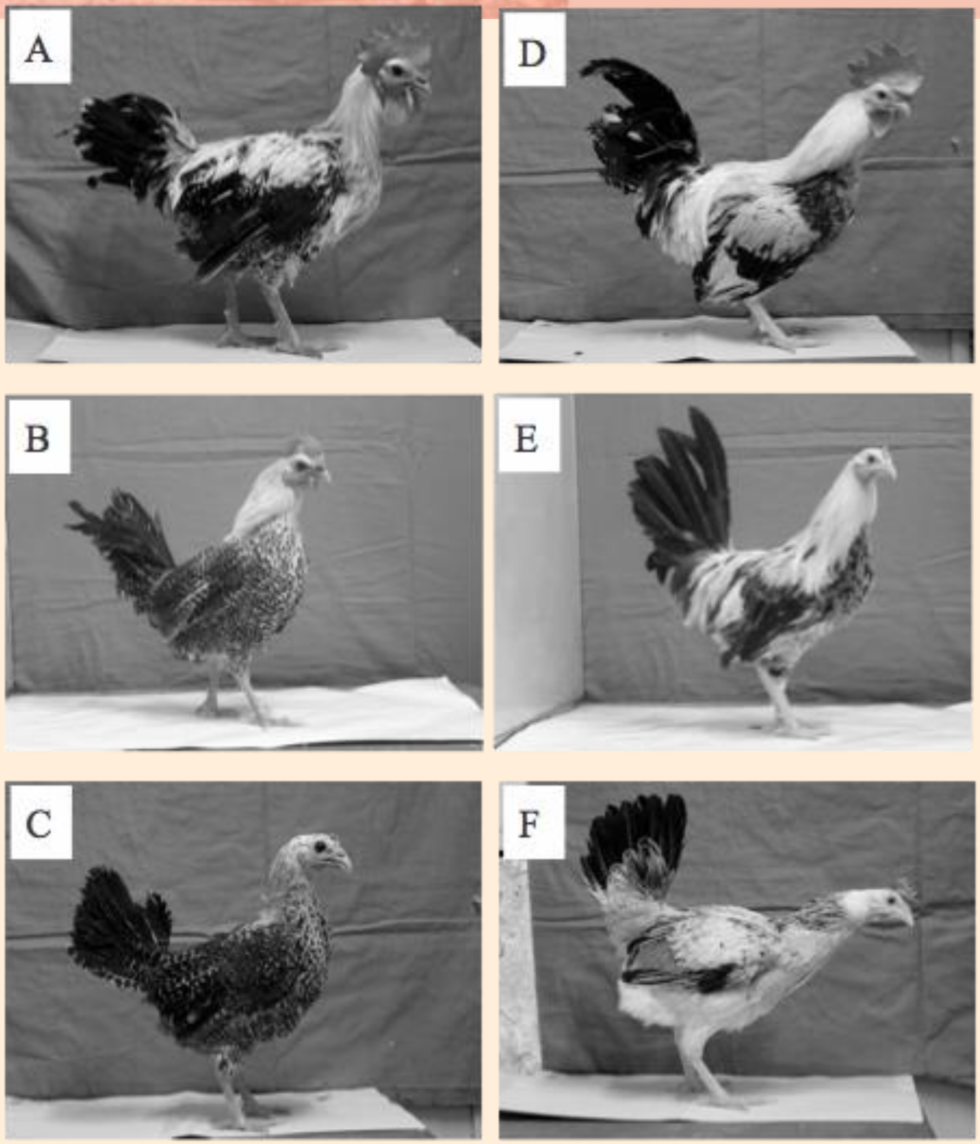


Fig 2. Observed secondary sex characteristics of chickens within inbred lines GSP (A, B and C) and PNP/DO (D, E and F) at one year of age. Normal males – A and D; Ovariectomized females – B and E; Normal females – C and F.

- combs and wattles were found to be significantly bigger in the GSP ovx compared with the PNP/DO ovx chickens, although male plumage patterns were more pronounced in the PNP/DO ovx **Valdez *et al*., 2010**

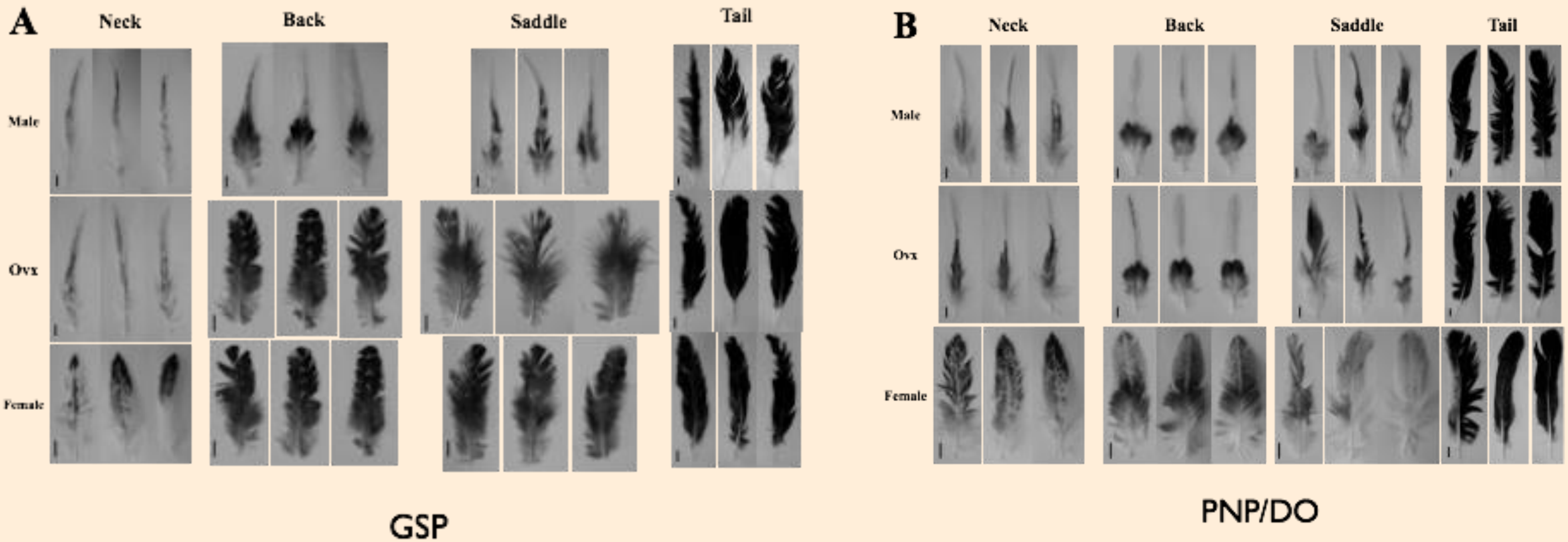


Fig 3. Morphology of feathers from males, females and ovariectomized chickens observed at one year of age. Feather samples were taken from representative samples at different body parts [33]. Bar = 0.5 cm for GSP males, PNP males and ovx (tail); Bar = 1 cm for GSP, PNP males and ovx (neck, back, saddle), GSP ovx (neck, tail), GSP and PNP females (tail); Bar = 2 cm for GSP and PNP females (neck, back, saddle), GSP ovx (back and saddle).

Valdez *et al*., 2010

- GSP ovx chicken feather plumage patterns were unchanged except for the neck feathers, on the other hand, the morphological characters of the PNP/DO ovx chicken feathers were completely changed to the male plumage pattern, showing distinctly extended and tapering tips

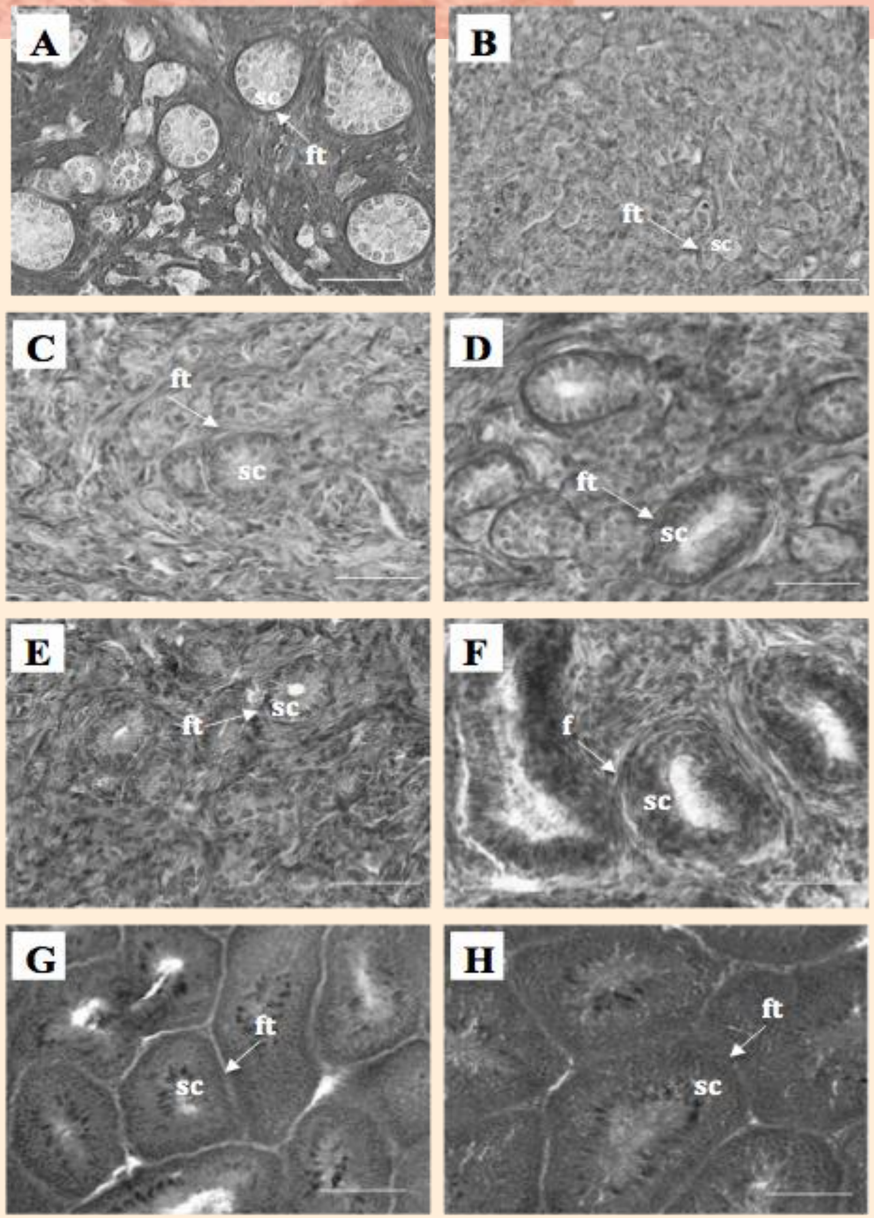
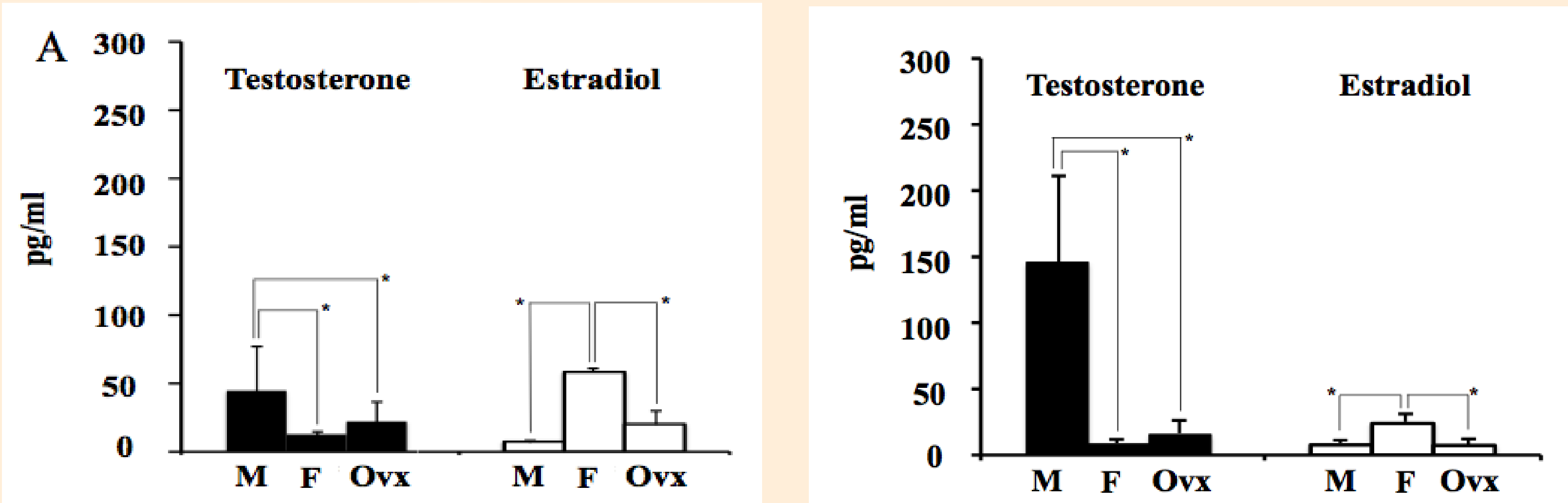


Fig 4. Histology of the right gonad and testicular tissues. A and B – 3-month-old, C and D – 7- month-old, E and F – 1-year-old ovariectomized GSP and PNP/DO chickens, respectively. G and H – histology of a 1-year-old normal GSP and PNP/DO male, respectively. sc: seminiferous cords. ft: fibrous tissues. Bar = 100 ⌠m.

Valdez *et al*., in press

- apparent differences in the phase of development and degree of differentiation of the right gonad were observed between the GSP and PNP/DO ovx chickens

- PNP/DO inbred line which exhibits a persistent right oviduct might be a contributing factor for the observed difference



GSP

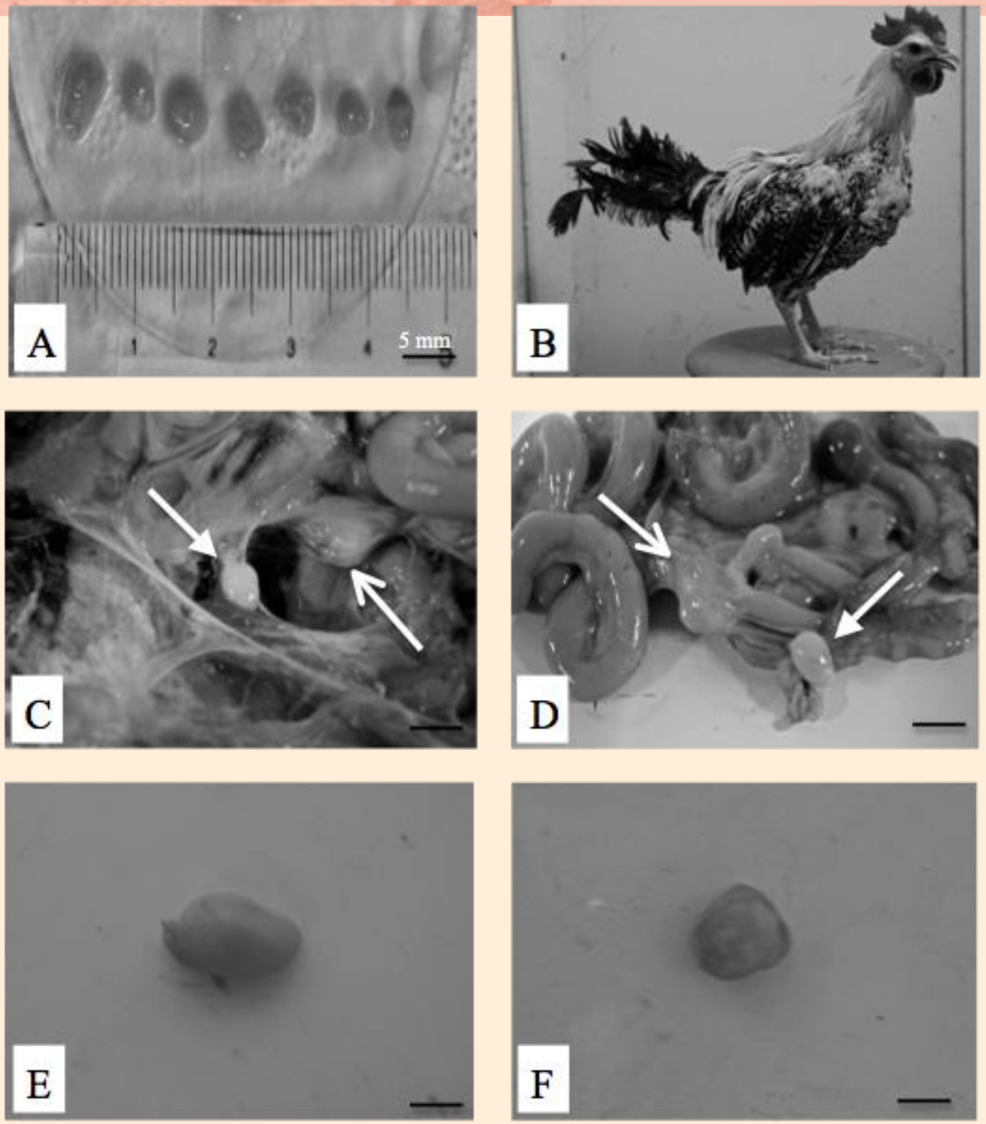
PNP/DO

Fig 5. Concentrations of testosterone and estradiol at one year in the blood plasma of males (M), females (F) and ovariectomized (Ovx) chickens in the GSP and PNP/DO inbred lines. All values are expressed as means±SD of testosterone and estradiol. Asterisks indicate significant differences between groups of chickens ($P<0.05$) in each of hormone.

Valdez *et al*., 2010

- hormone analysis of the GSP ovx chickens showed a small difference in testosterone and estradiol, which may have inhibited complete transformation of the feathers into the male plumage pattern and other sexual traits

Development of the Right Gonad from Ovariectomized Female Fowls Transplanted in Castrated Male Chickens



Valdez *et al*., accepted

Fig 1. Transplantation of right gonadal tissues from a sex reversed chick to a male castrated male chick. **A**) dissected and cut right gonad tissues from a sex reversed 2-month-old chick; **B**) male host after 10 mo of transplantation; **C**) gonad grafts (indicated by the arrows) grown inside the abdominal cavity **D**) same gonad grafts attached to the intestine of the male host from **C**; **E and F)** same gonad grafts from **C**.

- the development of gonad grafts in side the abdominal cavity suggest that these gonad grafts may also have heat shock proteins (HPSP70 and umbiquitin)

- these results demonstrate that the right gonad obtained from a sex reversed chicken maintains the structural integrity and physiological characters when transplanted into a castrated male host even without the original vascularization

Table 1. Transplantaion of gonad tissues from ovariectomized chickens to casrated male chicks.

Site of gondal tissue transplant	No. of chicks receiving transplant	No. of transplanted gonad tissues	No. of chiken containing trasnplanted gonad tissues	No. of transplanted gonad collected
Abdominal cavity	5	27	2	3
Back Skin	5	30	0	0

Valdez *et al*., in preparation

- around 10% of the total grafts were collected inside the abdominal cavity with more than 50% increase in volume, however there are no gonad grafts that developed under the skin

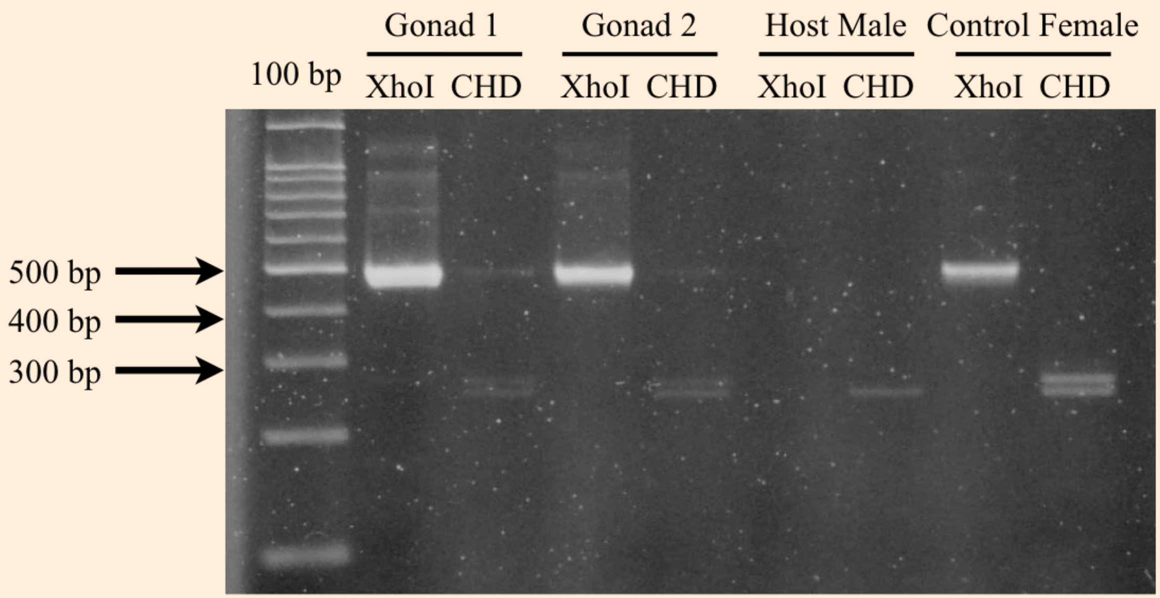


Fig 2. DNA sex identification of the male host, gonad grafts and control female using PCR with a single set of primers CHD and XhoI. The identified sex of each individual is indicated; for XhoI: one band are genetic female and with no band are genetic male and for CHD: two bands are genetic female and with one band are genetic male. 100kb is the size marker providing the base-pair sizes that are indicated to the left of the figure.

Valdez *et al*., accepted

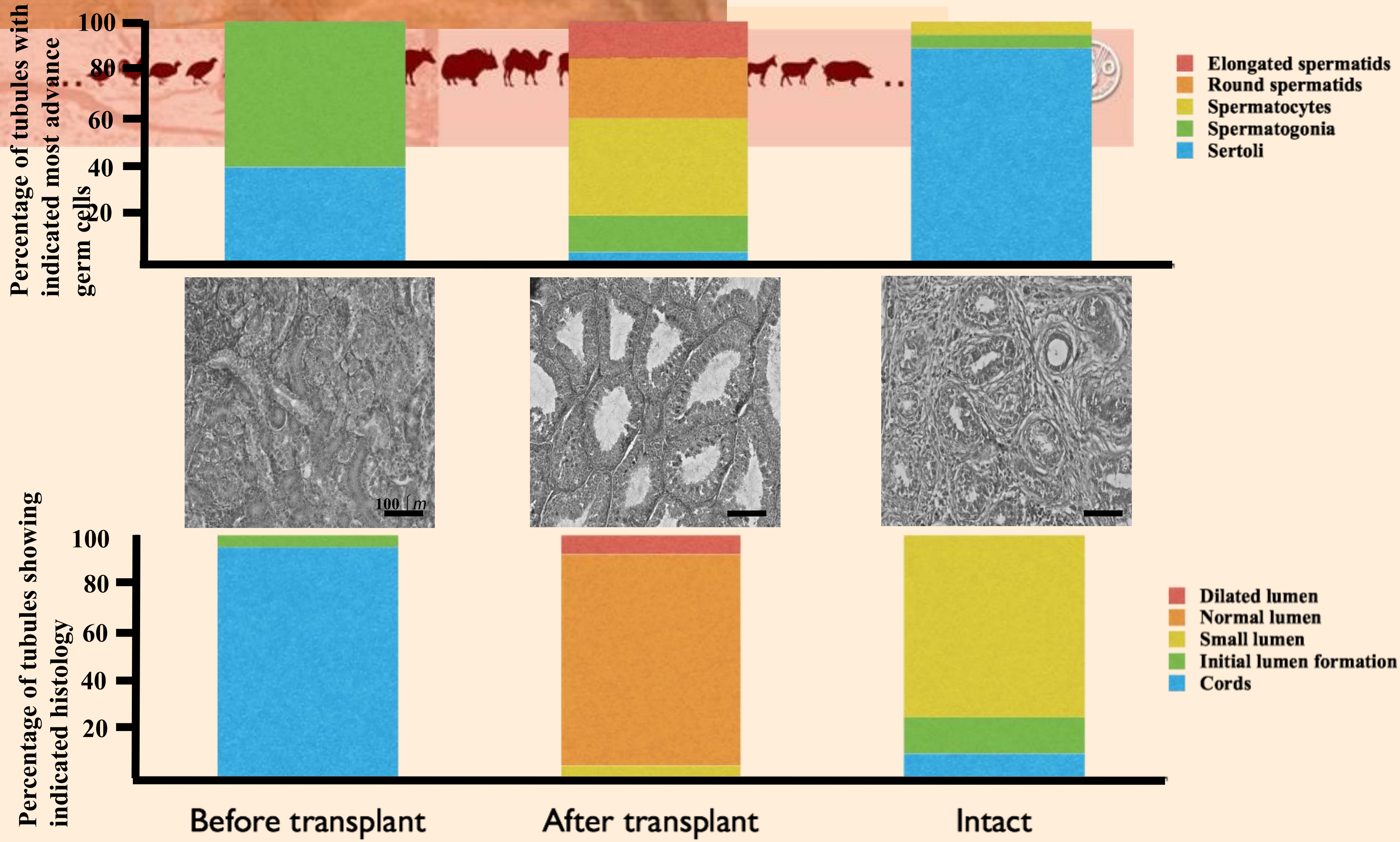


Fig 3. Histological evaluation of the development of the gonad grafts from the sex reversed chick inside the abdominal cavity. Top, relative abundance of seminiferous tubules containing the indicated germ cells as the most advance stage. Middle, representative micrographs of the gonad from sex reversed chick before transplantation, 10 mo of development after transplantation and an intact right gonad of a 1-year-old ovariectomized female chiken. Bottom, developement of the immature cords to fully differentiated seminiferous tubule showing the various degrees of lumen formation.

Valdez *et al*., accepted

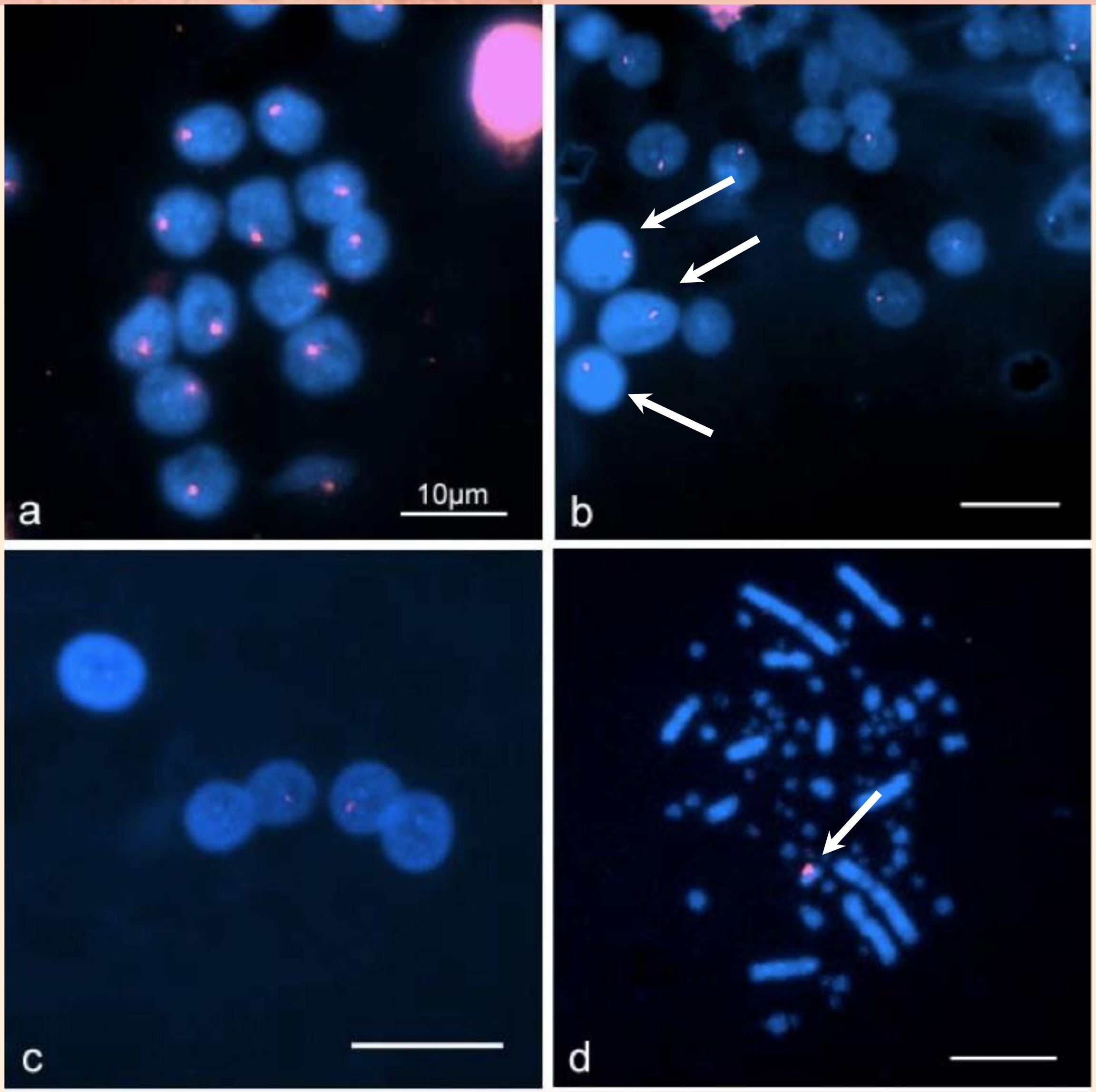


Fig 4. FISH signals (red color) observed in the dispersed germs cells from the gonad transplant. a) primary spermatoctyes carrying the W chromosome; b) spermatogonia (bigger cells indicated by arrows) with adjacent round spermatids (smaller cells); c) round spermatids bearing the W chromosome (with red signals) and Z chromosome (no red signals); d) W chromosome signal (indicated by an arrow) in a metaphase spread of fibroblastic cell culture from a known female chicken hybridized with the same probe.

Valdez *et al*., accepted

- FISH analysis revealed numerous spermatids with fluorescent signals bearing the W chromosome indicating that the second meiosis occurred normally

HSP gene molecular characterization of different native animals in the Philippines

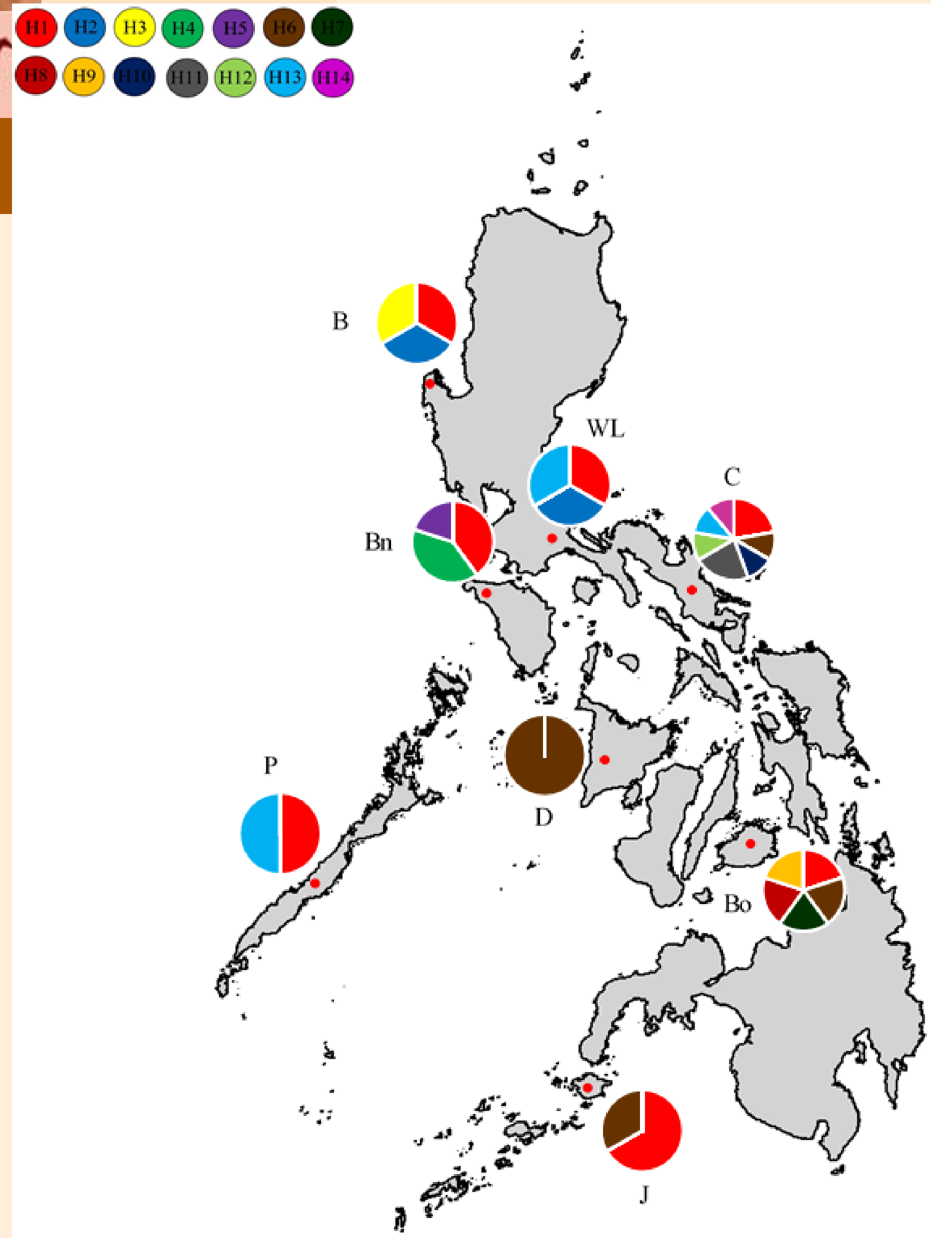


Figure 1. Relative frequencies of haplotypes and geographic distribution of 14 haplotypes in 5'UTR-exon. The fourteen haplotypes H1-H14 are presented by different colors (see legend).

No agricultural diversity without domestic animal diversity

Picardal *et al.*, (2013)

Thank you for your attention !