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The features marked with a star (*) are based entirely on material taken straight from standard research (and other Official and Therefore Always Correct) literature. Many of the other articles are genuine, too, but we don't know which ones.

Special Section: Ducks

Improbable Research Reviews

News & Notes

The Improbable Research podcast is back!

https://www.improbable.com/category/the-weekly-improbable-research-podcast/

Where There's More

There's always new improbable — it's not what you expect! — stuff on the **Improbable Research blog** at IMPROBABLE.COM

ANNALS OF IMPROBABLE RESEARCH

On the Front Cover

Artist's rendition of two photographs from the study "Elaborate Vaginas and Long Phalli: Post-copulatory Sexual Selection in Birds." (See page 26) Artwork by Nan Swift.

Some Coming Events

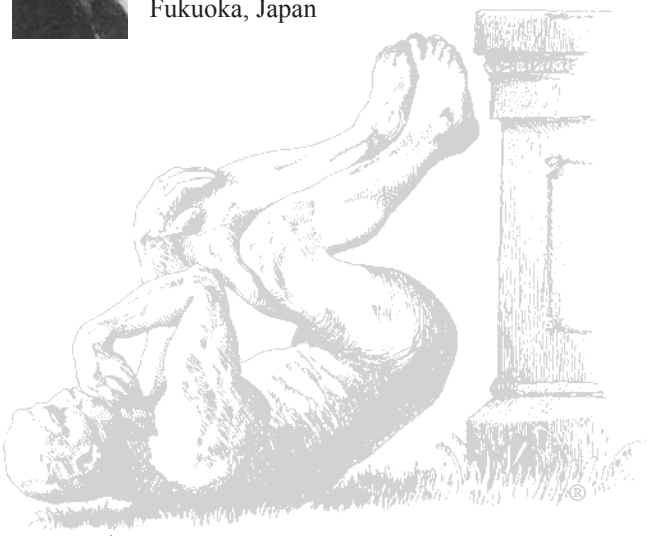
The Covid-19 pandemic has introduced excitingly boundless uncertainty as to whether, when, where, and how various public activities will happen in the near future. In 2021 some will happen teledistantly.

See IMPROBABLE.COM for details of these and other events:

August 14, 2021
Readercon, Boston, MA USA [online]

September 9, 2021
The 31st First Annual Ig Nobel Prize Ceremony and Webcast

September 10-November 3, 2021
Ig Nobel Museum Exhibition, Fukuoka, Japan



Duck Body Parts

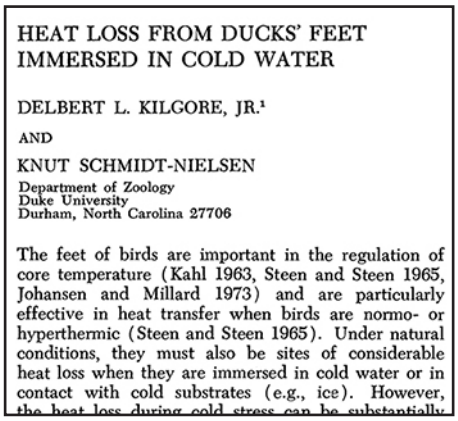
Insights about parts of ducks

compiled by Philo-Irina C. Egbit-Ka, Improbable Research staff

Ducks' Cold Feet

"Heat Loss from Ducks' Feet Immersed in Cold Water," Delbert L. Kilgore, Jr. and Knut Schmidt-Nielsen, *The Condor*, vol. 77, no. 4, Winter 1975, pp. 475-478. The authors, at Duke University, report:

> The feet of birds are important in the regulation of core temperature…. Under natural conditions, they must also be sites of considerable heat loss when they are immersed in cold water or in contact with cold substrates (e.g., ice)….
>
> We… used calorimetric measurements to determine the exact amount of heat lost from the feet of Mallards (*Anas platyrhynchos*) when their feet are immersed in fluids at low and subfreezing temperatures….
>
> [We found that at] temperatures between 0°C and 20°C, heat loss from the feet of Mallards was minimal (0.42 kcal hr^{-1})…. Below 0°C, however, heat loss from the feet and metabolic heat production both increased substantially…. The observed increase in blood flow to the feet apparently serves to keep their temperatures above freezing and to prevent freezing damage to the tissues.



HEAT LOSS FROM DUCKS' FEET IMMERSED IN COLD WATER

DELBERT L. KILGORE, JR.[1]

AND

KNUT SCHMIDT-NIELSEN

Department of Zoology
Duke University
Durham, North Carolina 27706

The feet of birds are important in the regulation of core temperature (Kahl 1963, Steen and Steen 1965, Johansen and Millard 1973) and are particularly effective in heat transfer when birds are normo- or hyperthermic (Steen and Steen 1965). Under natural conditions, they must also be sites of considerable heat loss when they are immersed in cold water or in contact with cold substrates (e.g., ice). However, the heat loss during cold stress can be substantially

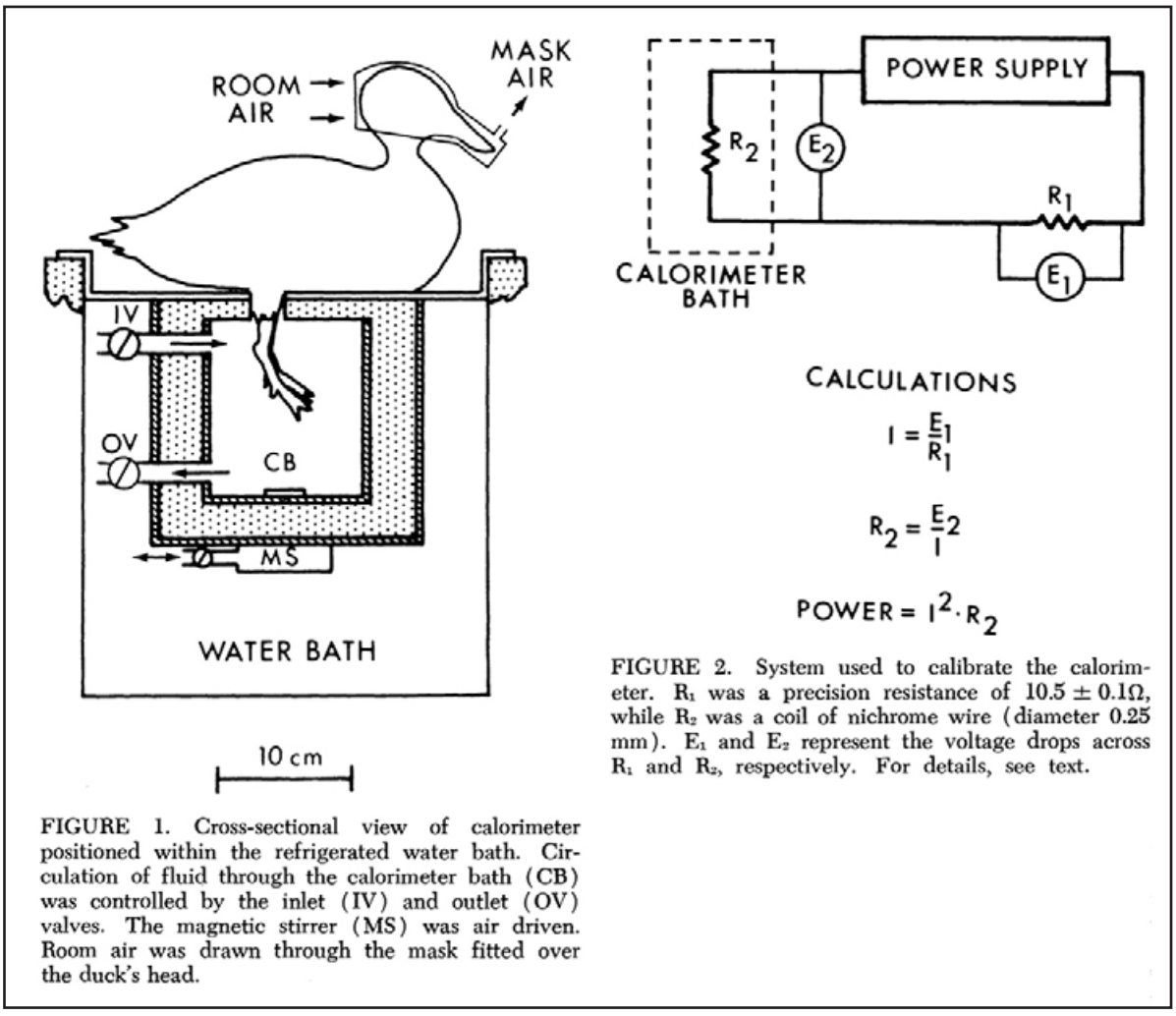


FIGURE 1. Cross-sectional view of calorimeter positioned within the refrigerated water bath. Circulation of fluid through the calorimeter bath (CB) was controlled by the inlet (IV) and outlet (OV) valves. The magnetic stirrer (MS) was air driven. Room air was drawn through the mask fitted over the duck's head.

FIGURE 2. System used to calibrate the calorimeter. R_1 was a precision resistance of $10.5 \pm 0.1\Omega$, while R_2 was a coil of nichrome wire (diameter 0.25 mm). E_1 and E_2 represent the voltage drops across R_1 and R_2, respectively. For details, see text.

Detail from the study "Heat Loss from Ducks' Feet Immersed in Cold Water."

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Some Ducks Grow Bigger Penises in Some Social Circumstances

"Evidence of Phenotypic Plasticity of Penis Morphology and Delayed Reproductive Maturation in Response to Male Competition in Waterfowl," Patricia L.R. Brennan, Ian Gereg, Michele Goodman, Derek Feng, and Richard O. Prum, *The Auk*, vol. 134, 2017, pp. 882–893. The authors, at Mount Holyoke College, MA; Yale University; and Livingston Ripley Waterfowl Conservancy, Litchfield, CO, report:

> Here we examined whether penis morphology is affected by social environment. We found experimental evidence that in a male-biased social environment, consisting of several males and fewer females, the penis in Lesser Scaup (*Aythya affinis*) grew longer in 2 separate years, than in males housed in pairs, as predicted if male–male competition influences penis morphology. In Ruddy Ducks (*Oxyura jamaicensis*), males instead showed evidence of reproductive delays that were explained both by a male's size and his social environment: most males in social groups exhibited shorter penises, variable onset and duration of genital maturation, and faster penis growth rate.

Patricia Brennan, co-author of "Evidence of Phenotypic Plasticity of Penis Morphology and Delayed Reproductive Maturation in Response to Male Competition in Waterfowl," "Elaborate Vaginas and Long Phalli: Post-copulatory Sexual Selection in Birds," "Explosive Eversion and Functional Morphology of the Duck Penis Supports Sexual Conflict in Waterfowl Genitalia," and numerous other studies about duck genitalia. Brennan is seen here delivering a 24/7 Lecture at the 2016 Ig Nobel Prize ceremony. Photo by Mike Benveniste.

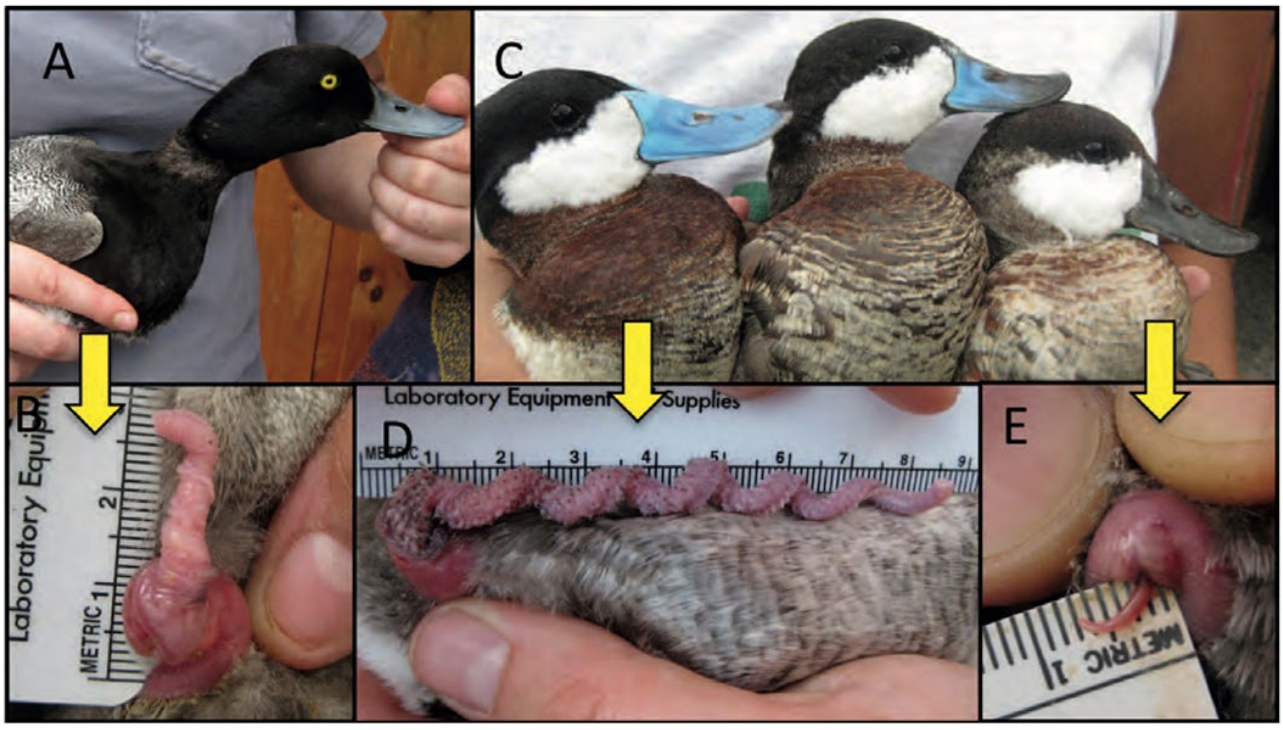

FIGURE 1. Genital morphology and plumage characteristics of males in the study. Arrows connect males with their genital morphology. (**A**) Male Lesser Scaup experience intermediate intrasexual competition during the breeding season, and (**B**) their penis is typically short with a smooth surface. (**C**) Ruddy Duck males experience high competition. On the left a male in breeding condition with ruddy body, blue bill, and a well-developed penis (**D**). (**C**) Male in center is beginning to develop breeding plumage, and on the right a male that delayed reproduction with gray body, black bill, and an undeveloped penis (**E**).

Detail from the study "Evidence of Phenotypic Plasticity of Penis Morphology and Delayed Reproductive Maturation in Response to Male Competition in Waterfowl."

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Duck Body Parts [continued]

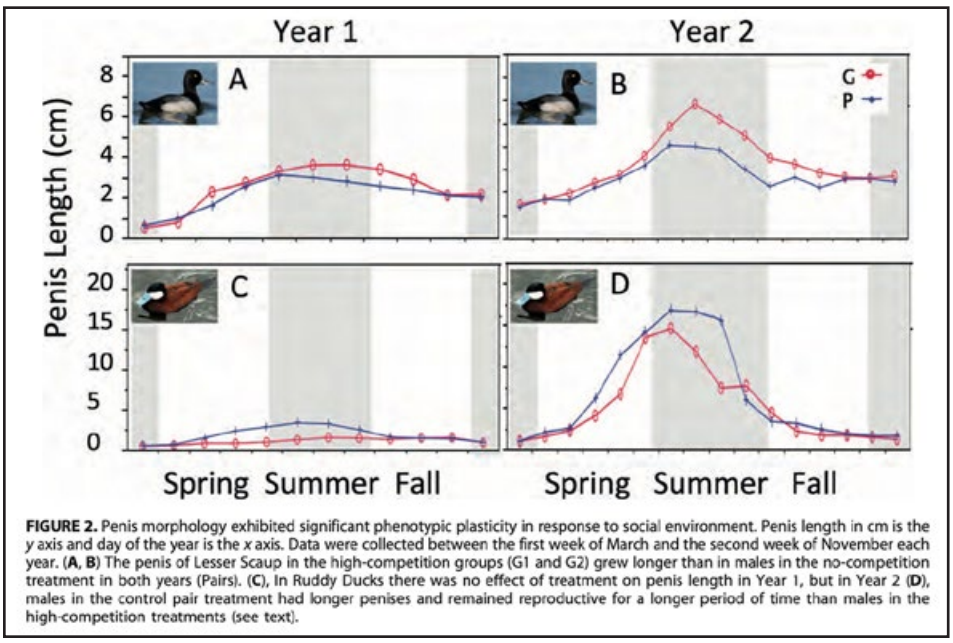

FIGURE 2. Penis morphology exhibited significant phenotypic plasticity in response to social environment. Penis length in cm is the *y* axis and day of the year is the *x* axis. Data were collected between the first week of March and the second week of November each year. (**A, B**) The penis of Lesser Scaup in the high-competition groups (G1 and G2) grew longer than in males in the no-competition treatment in both years (Pairs). (**C**), In Ruddy Ducks there was no effect of treatment on penis length in Year 1, but in Year 2 (**D**), males in the control pair treatment had longer penises and remained reproductive for a longer period of time than males in the high-competition treatments (see text).

Further detail from the study "Evidence of Phenotypic Plasticity of Penis Morphology and Delayed Reproductive Maturation in Response to Male Competition in Waterfowl."

Elaborate Vaginas and Long Phalli in Ducks

"Elaborate Vaginas and Long Phalli: Post-copulatory Sexual Selection in Birds," T.R. Birkhead and Patricia L.R. Brennan, *Biologist*, vol. 56, no. 1, February 2009, pp. 33-38. *(Thanks to Rosie Mestel for bringing this to our attention.)* The authors, at the University of Sheffield, UK, and the University of Massachusetts Amherst report:

> In 2001 the journal *Nature* published an extraordinary image of a male duck. The Argentine Lake Duck *Oxyura vittata*, is a little-known species, but this particular photograph would make it unforgettably famous because of the bird's gargantuan penis. Suspended from a loop of monofilament line, the bemused little bird hangs somewhat unnaturally, albeit with a brightly gleaming eye, with its 42.5 centimetre penis dangling beneath it.

Detail from the study "Elaborate Vaginas and Long Phalli: Post-copulatory Sexual Selection in Birds."

Figure 1. Argentine Lake Duck *Oxyura vittata* with its 42.5 cm penis. (Photo: Kevin McCracken.)

win's brilliant idea that sat alongside natural selection and explained why males and females often look and behave differently. Darwin's idea was that individuals that are better competitors or more attractive have greater reproductive success than others and leave more descendants. Darwin en-

Figure 2. A schematic of female waterfowl oviduct. (Artwork: T. R. Birkhead.)

Duck Body Parts [continued]

Explosive Duck Genitalia, for Safety

"Explosive Eversion and Functional Morphology of the Duck Penis Supports Sexual Conflict in Waterfowl Genitalia," Patricia L.R. Brennan, Christopher J. Clark, and Richard O. Prum, *Proceedings of the Royal Society B*, vol. 277, no. 1686, 2010, pp. 1309-1314. *(Thanks to Jurjen N.E. Bos for bringing this to our attention.)* The authors, at Yale University, report:

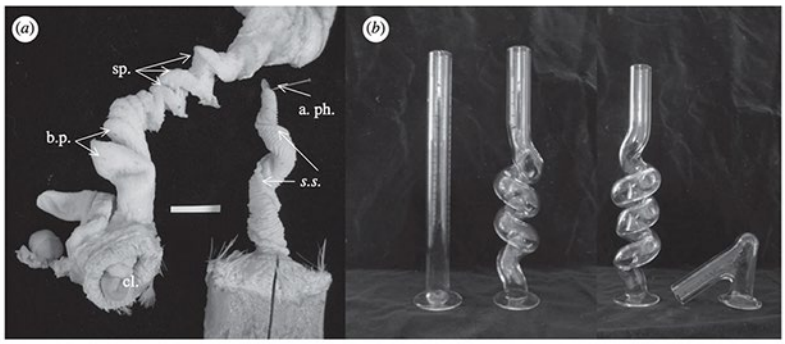

Figure 1. Duck genitalia and mechanical barriers. (*a*) Male and female genitalia in a Pekin duck (*Anas* sp.). The male phallus (right) spirals in a counterclockwise direction and the female oviduct (left) spirals in a clockwise direction. The female vagina has blind pouches (b.p.) proximal to the cloacal entrance, followed by a series of spirals (sp.). *s.s.*, *sulcus spermaticus*; a. ph., tip of the penis; cl, cloaca. Scale bar, 2 cm. (*b*) Diameter glass tubes (10 mm) of different shapes used to test male penis eversion; from left to right, straight, anticlockwise (male-like), clockwise and 135° bend (female-like).

Detail from the study "Explosive Eversion and Functional Morphology of the Duck Penis Supports Sexual Conflict in Waterfowl Genitalia."

> Coevolution of male and female genitalia in waterfowl has been hypothesized to occur through sexual conflict. This hypothesis raises questions about the functional morphology of the waterfowl penis and the mechanics of copulation in waterfowl, which are poorly understood. We used high-speed video of phallus eversion and histology to describe for the first time the functional morphology of the avian penis. Eversion of the 20 cm Muscovy duck penis is explosive, taking an average of 0.36 s, and achieving a maximum velocity of 1.6 m s21. The collagen matrix of the penis is very thin and not arranged in an axial-orthogonal array, resulting in a penis that is flexible when erect. To test the hypothesis that female genital novelties make intromission difficult during forced copulations, we investigated penile eversion into glass tubes that presented different mechanical challenges to eversion. Eversion occurred successfully in a straight tube and a counterclockwise spiral tube that matched the chirality of the waterfowl penis, but eversion was significantly less successful into glass tubes with a clockwise spiral or a 1358 bend, which mimicked female vaginal geometry.

Ducks With Short Penises Are the Most Influenza-Prone

"Prevalence of Avian Influenza and Sexual Selection in Ducks," Gergely Hegyia, Anders Pape Møller, Marcel Eens, and László Zsolt Garamszegie, *Behavioral Ecology*, vol. 20, no. 6, 2009, pp.1289-1294. *(Thanks to Peter Milner for bringing this to our attention.)* The authors, at Eötvös Loránd University, Hungary; Université Paris Sud, France; Center for Advanced Study, Oslo, Norway; University of Antwerp, Belgium; and Estación Biológica de Doñana-CSIC, Spain, report:

> [W]e show that morphological adaptations associated with copulation frequency in both male and female hosts strongly explain differences in low-pathogenic influenza prevalence among wild duck species. Prevalence is negatively related to male phallus length and female vaginal complexity… This pattern suggests a hitherto unrecognized transmission route of the virus via copulation and subsequent mother–offspring transfer. Due to a relationship between forced copulations and the expression of white wing covert patches, male covert patch expression and sexual dichromatism in covert patch expression are positively related to influenza prevalence. Our results suggest that the arms race between male and female reproductive tracts had epidemiological consequences.