

Sex Chromosome Evolution

Exploring the Biological Contributions to Human Health Institute of Medicine 2001-07-02 It's obvious why only men develop prostate cancer and why only women get ovarian cancer. But it is not obvious why women are more likely to recover language ability after a stroke than men or why women are more apt to develop autoimmune diseases such as lupus. Sex differences in health throughout the lifespan have been documented. Exploring the Biological Contributions to Human Health begins to snap the pieces of the puzzle into place so that this knowledge can be used to improve health for both sexes. From behavior and cognition to metabolism and response to chemicals and infectious organisms, this book explores the health impact of sex (being male or female, according to reproductive organs and chromosomes) and gender (one's sense of self as male or female in society). Exploring the Biological Contributions to Human Health discusses basic biochemical differences in the cells of males and females and health variability between the sexes from conception throughout life. The book identifies key research needs and opportunities and addresses barriers to research. Exploring the Biological Contributions to Human Health will be important to health policy makers, basic, applied, and clinical researchers, educators, providers, and journalists-while being very accessible to interested lay readers.

[Sex Chromosome Evolution of Papaya: Dynamic Structural and Expression Changes and Identification of Associated Traits](#) 2014

[Comparative Analysis of the Chicken Z Chromosome](#) Rami Stiglec 2007

Splitting the Sexes Aivars Cirulis 2022 The evolution of gonochorism from hermaphroditism can be gradual by increasing investment in one sex role while decreasing in the other, or rapid through the fixation of sex-role sterility mutations, eventually leading to the evolution of sex chromosomes. It is expected that the transition will involve a temporary state of gynodioecy or androdioecy as the mutations are not expected to take place at the same time. If the first mutation is a dominant female-sterility mutation, later accompanied by a recessive male sterility mutation, then an XY sex chromosome system evolves, while the opposite combination of mutations will result in a ZW system. Later on sexually antagonistic (SA) genes can be linked to the newly established sex-determining regions on the sex chromosomes. This is followed by recombination arrest in the region, so that the inheritance pattern is sex-limited for all these sex-specific genes. However, the lack of recombination leads to degeneration of the genetic content on the sexlimited chromosomes, since recombination is important for repairing mutations. Nevertheless, recombination arrest does not necessarily mean a dead-end for the sex-limited chromosomes. As our understanding of the very early stages of sex chromosome evolution is mainly based on theory and comparative evidence, we developed a system which we hoped would make it possible to observe in real time what happens after the acquisition of a new sex-determining gene. We used a previously established green fluorescent protein (GFP) line of the simultaneous hermaphrodite *Macrostomum lignano*. We used the GFP locus as a dominant sterility mutation, which is inherited in a Mendelian fashion. By allowing the GFP allele to be inherited only through sperm, we created male-limited selection lines (resembling the early stages in XY chromosome evolution), and by allowing the GFP allele to be inherited only through egg cells, we created female-limited selection lines (resembling the early stages in ZW chromosome evolution). We also created control lines, where the inheritance pattern was equally mixed. After tens of generations, we investigated how these lines have responded on the level of the genome, the transcriptome, and the phenotype. We sequenced genomes and analysed changes in SNP frequency and structural variant (SV) distribution in pairwise comparisons to see changes across the genome, but particularly on the scaffold where the GFP is located. We also sequenced transcriptomes and performed pairwise comparisons to detect differentially expressed genes, and analysed significant GO terms and KEGG pathways to see how the gene regulation has changed. Besides genomic

analyses, we also looked at how mating behaviour (copulation frequency and duration, as well as probability of post-copulatory sucking behaviour) and sexual anatomy (gonad size and morphology of the male copulatory organ called stylet) has changed. We observed that the female-selected lines seemed to have responded the most at the genomic level. For example, the number of significantly differentially expressed transcripts was largest between the female-selected lines and the control lines. These changes seemed to involve downregulation of testes-biased genes. In addition, we observed the highest number of SVs in the female-selected lines, which could be related to changes in recombination rate. In contrast, the male-selected lines seemed to have responded the most at the phenotypic level, since we observed a decrease in the ovary size and body size in the male-selected lines, as well as behavioural changes that may be related to changes in the ejaculate. Both sex-specific selection regimes showed evidence of alterations in the shape of the stylet. Based on these results, we can conclude that our worms have indeed responded to the sex-limited selection in a way that is generally consistent with our expectations from other young sex chromosome systems. The evidence of a decrease in the testes function in the female-selected lines resembles adaptation towards gynodioecy, and the evidence of a decrease in the ovary size in the male-selected lines resembles adaptation towards androdioecy.

Sex Chromosomes and Sex-determining Genes Ken Reed 1993 The emphasis throughout is on the genetic determinants of sex. The major issues addressed are sex chromosome differentiation, X-chromosome inactivation and the role of the Y-linked gene SRY in gonad differentiation. A combination of authoritative reviews and original articles drawn from experiment and observation on a variety of systems is complemented by the editors thoughtful introductions. 'Sex is compelling in its benefits, elegant in its conception, startling in its manifestations.' So begins this timely and thoughtful review of the most fascinating property of life. For centuries we have puzzled over the differences between males and females but only recently have we begun to understand the genetic switches that trigger the dramatic differences in form and function between the sexes. This book brings together contributions from many of the scientists who have been responsible for recent stunning advances in our understanding of sex determination and sexual differentiation. The editors have

Sex-chromosome Evolution of Palearctic Tree Frogs in Space and Time Christophe Dufresnes 2015 Thèse. Biologie. Médecine. 2015

[The Evolution of Sex-chromosome Systems in Stickleback Fishes](#) Joseph A. Ross 2008

Avian Retroposons - Windows Into the Past of Avian Sex Chromosome Evolution and Early Bird Phylogeny Alexander Sang-Jae Suh 2012

Evolution of Sex Determining Mechanisms James J. Bull 1983

Sex Determination and Sex-chromosome Evolution in the Common Frog, "Rana Temporaria" Nicolas Rodrigues 2017 Thèse. Biologie. Médecine. 2017

Chromosomal Evolution in Plants Martin A. Lysak 2021-09-28

The Evolution of Suppressed Recombination in the Sex Chromosomes of Microbotryum Jessica Lee Abbate 2007

[Studies in Spermatogenesis \(Part 1 of 2\)](#) Nettie Maria Stevens 2020-08-12 Reproduction of the original: Studies in Spermatogenesis (Part 1 of 2) by Nettie Maria Stevens

Evolution of Sex Chromosomes in Birds and Reptiles Swathi Shetty 2001 DMRTI, is the putative sex determining gene in birds and perhaps snakes, was also cloned and localised to the emu Z chromosome but was absent from the W, as expected if this gene is the conserved bird sex determining gene acting via a dosage sensitive mechanism. It also revealed an intron segment that has been highly conserved between the emu and humans which might be an important regulatory element or a sex-specific exon.

CHROMOSOMES IN EVOLUTION OF EUKARYOTIC GROUPS Arun Kumar Sharma 1983

Sex Chromosome Evolution in Blow Flies Anne Amarila Andere 2020 Chromosomal mechanisms of sex determination vary greatly in phylogenetically closely related species, indicative of rapid evolutionary rates. Sex chromosome karyotypes are generally conserved within families; however, many species have derived sex chromosome configurations. Insects display a plethora of sex chromosome systems due to rapid diversification caused by changes in evolutionary processes within and between species. A good example of such a system are insects in the blow fly family Calliphoridae. While cytogenetic studies observe that the karyotype in blow flies is highly conserved (five pairs of autosomal chromosomes and one pair sex chromosome), there is variation in sex determining mechanisms and sex chromosome structure within closely related species in blow flies. The evolutionary history of sex chromosomes in blow fly species have not been fully explored. Therefore, the objective of this research was to characterize the sex chromosome structures in four species of blow flies and investigate the selective forces which have played a role in shaping the diverse sex chromosome system observed in blow flies. The blow fly species used in this study are *Phormia regina*, *Lucilia cuprina*, *Chrysomya rufifacies* and *Chrysomya albiceps*. *Phormia regina*, and *Lucilia cuprina* have a heteromorphic sex chromosome system and are amphogenic (females produce both male and female offspring in equal ratio). In contrast, *Chrysomya rufifacies* and *Chrysomya albiceps*, have a homomorphic sex chromosome system, are monogenic (females produce unisexual progeny), have two types of females (arrhenogenic females - male producers and thelygenic females - female producers), and sex of the offspring is determined by the maternal genotype. To accomplish these tasks, a total of nine male and female individual draft genomes for each of the four species (including three individual draft genomes of *Chrysomya rufifacies* - male, and the two females) were sequenced and assembled providing genomic data to explore sex chromosome evolution in blow flies. Whole genome analysis was utilized to characterize and identify putative sex chromosomal sequences of the four blow fly species. Genomic evidence confirmed the presence of genetically differentiated sex chromosomes in *P. regina* and *L. cuprina*; and genetically undifferentiated sex chromosomes in *C. rufifacies* and *C. albiceps*. Furthermore, comparative analysis of the ancestral Dipteran sex chromosome (Muller element F in *Drosophila*) was determined to be X-linked in *P. regina* and *L. cuprina* contributing to sex chromosome differentiation but not sex-linked in *C. rufifacies* and *C. albiceps*. Evolutionary pressures are often quantified by the ratio of substitution rates at non-synonymous (dN) and synonymous (dS) sites. Substitution rate ratio analysis (dN/dS) of homologous genes indicated a weaker purifying selection may have contributed to the loss of sex-linked genes in Muller element F genes of the undifferentiated sex chromosome as compared to the differentiated sex chromosome system. Overall, the results presented herein greatly expands our knowledge in sex chromosome evolution within blow flies and will reinforce the study of sex chromosome evolution in other species with diverse sex chromosome systems.

Evolutionary Mechanisms in Sex Determination Stephen S. Wachtel 1989 Based on the International Conference on Developmental Biology, "Evolutionary Mechanisms in Sex Determination," held in Memphis, May 4-8, 1987.

Silene Latifolia (Caryophyllaceae) Sex Chromosome Evolution Nicolas Blavet 2012

Recombination Restriction, Degeneration and Population Divergence on Plant Sex Chromosomes Felix E.G. Beaudry 2020 This dissertation investigates patterns of sex chromosome evolution in the dioecious plant *Rumex hastatulus*, an annual species with two distinct largely allopatric sex chromosome cytotypes (females XX and males XY or XYY). My thesis addresses three general observations often associated with sex chromosome evolution, which are summarized in Chapter 1: i) the degeneration of the Y chromosome, ii) the lower rates of recombination between the X and Y chromosomes compared with the rest of the genome, and iii) the finding that sex chromosomes contribute disproportionately to population genetic divergence. In Chapter 2, I demonstrate that in *R. hastatulus* the loss of gene expression precedes gene deletion from the Y, suggesting that the loss of constraint allowed by lowered expression is a prerequisite for gene loss on the Y chromosome. In Chapter 3, I show that pollen-expressed genes

are significantly less likely to be lost from the Y chromosome during degeneration with important implications for selection during the haploid phase of the life cycle. In Chapter 4, construction of a linkage map revealed that the sex chromosomes probably arose in a pericentromeric region and population-level analyses estimated very low rates of recombination across this region prior to sex chromosome evolution. These findings are consistent with the hypothesis that low rates of recombination predate the origin of sex chromosomes and likely facilitated their evolution. In Chapter 5, my studies of demographic history revealed that during a historic period of reduced gene flow between the cytotypes of *R. hastatulus*, both the X and Y played a more significant role in genetic divergence than autosomes. My demographic modelling also suggests an X-A fusion event occurred at roughly the same time as the loss of gene flow between the cytotypes. Finally, in Chapter 6, I detect reduced gene flow around the fused region of the X chromosome in *R. hastatulus* and show biased segregation of the fused X in an F2 cross implicating the presence of a selfish transmission advantage. My thesis research highlights that even in plants, where sex chromosomes are rare, the sex chromosomes are of outsized evolutionary importance in species that bear them.

New Insights on Plant Sex Chromosomes Rafael Navajas-Pérez 2012 One of the most important topics in evolutionary biology concerns the origin and evolution of sex-determining systems and sex chromosomes. Certain plant species display younger sex-chromosome systems in different evolutionary stages. It is thought that the same evolutionary forces described for animals are operating in plants. However, in opposition to the situation in animals, sex-determining mechanisms seem to be more flexible, and most species with separate sexes have evolved directly from ancestors with both sex functions. These features make plants excellent models for studies on sex determination. In this context, early evolved plant-sex chromosomes have given rise to many studies in recent years. In this book, the most recent findings are highlighted and reviewed, focusing specifically on model species, including *Carica papaya*, *Fragaria virginiana*, *Silene latifolia* and *Rumex acetosa*

Sex Chromosome Evolution of Papaya Jennifer Han (Ph. D.) 2014 Sex chromosomes are found throughout many diverse lineages across the animal and plant kingdom. Most of the sex chromosomes that have been studied are well established and have already experienced many evolutionary forces, making it difficult to reconstruct the dynamic changes involved in the evolution of sex chromosomes. Sex chromosomes are evolved from a pair of autosomes with closely linked sex determining genes that have stopped recombining. Papaya has many qualities that make it attractive for studying sex chromosome genetics. It is trioecious (male, female, and hermaphrodite) with sex determined by a pair of nascent sex chromosomes approximately 7 million years old. The genome is relatively small (442.5 Mb) and the sex determining region of the sex chromosomes is small and well characterized; the hermaphrodite and male specific region of the Yh and Y chromosome respectively is 8.1 Mb and the corresponding X is 3.5 Mb. These sex specific regions of the X and Y chromosomes not only contain the genes that control sex type, but they also have genes associated with the different sexes. While the vegetative forms of the three sexes are phenotypically identical, the reproductive structures are unique. In stark contrast to female and hermaphrodite flowers on male plants are borne on long pendulous peduncles (60-90 cm) at the leaf axis. Female and hermaphrodite flowers are borne on short peduncles (0-4 cm). Gynodioecious varieties SunUp, SunUp Diminutive mutant and dioecious AU9 were used to test the response of papaya to gibberellic acid (GA3). Gibberellic acid is a hormone known to cause elongation of stems throughout the plant kingdom. It is also known as a masculinizing hormone. Exogenous applications of GA3 on female and hermaphrodite papaya did not yield any sex reversals but there was a significant increase in peduncle length and inflorescence branch number in all treated plants. There was an increase in plant height for all treated plants except SunUp Diminutive mutant, suggesting that the mechanism causing the dwarf phenotype is independent of gibberellins. Gibberellin metabolism genes were identified in the papaya genome, none of which mapped to the sex-determining region of either the male- or hermaphrodite-specific region of papaya Y or Yh chromosome. We hypothesize that a trans-acting regulatory element that enhances

gibberellin biosynthesis plays a role in the extreme length of the male papaya peduncle Sex chromosomes experience several evolutionary forces. To further study the structure of the sex chromosomes, a mapping population was created to generate a high density genetic map. A female AU9 was crossed with a hermaphrodite SunUp, the resulting offspring was backcrossed to the hermaphrodite SunUp. Fifty-one individuals derived from this cross were used to create restriction-site associated DNA sequencing (RAD-seq) libraries. A total of 228 RAD-seq markers were mapped to 9 major and 2 minor linkage groups. Previous studies have shown that the Y chromosome experiences severe recombination suppression along the sex determining region. The resulting map from this study showed that the X chromosome is not experiencing recombination suppression. Additionally, possible centromere locations were identified for the other chromosomes. Sex chromosomes also undergo degeneration of genetic material. The effective population size of the sex chromosomes is reduced compared to the autosome. The lack of recombination, especially for the Y chromosome also increases the rate of degeneration. RNA seq data was generated using flower and leaf tissue from females, males, and hermaphrodite individuals to determine the rate at which the Y chromosome is experiencing degeneration. Expression levels were compared between the X and Y linked alleles in males and hermaphrodites. If there is no Y degeneration, then the expression levels between the sex linked alleles should be equal. Expression of male leaf tissue had significantly less expression of the Y allele compared to the X allele. This was not found in hermaphrodites and in all flower tissue. Dosage compensation is a phenomenon utilized by many organisms with sex chromosomes to account for the heterogametic sex having only one allele for many of the genes on the sex chromosome. While many organisms compensate expression levels in the heterogametic sex, this is not true of all animals. Very few studies have been conducted to determine if plants undergo the same evolutionary forces as animals and also evolve dosage compensation. There was no detectable dosage compensation in the primitive papaya sex chromosome.

The Evolution of Sex Chromosomes in Papaya (Carica Papaya) Laura A. Weingartner 2010 The sex chromosomes of the tropical crop papaya (*Carica papaya*) are young and consequently allow for the examination of evolutionary forces that affect early sex chromosome formation. We sequenced four X/Y gene pairs from a collection of natural papaya populations and examined the data for molecular signatures of selection and other evolutionary forces that govern sex chromosome formation. In most sex chromosome systems, the Y chromosome displays significantly reduced polymorphism levels while the X chromosome maintains a level of polymorphism that is comparable to autosomal loci. However, the four papaya sex-linked loci that we examined display diversity patterns that are opposite to this trend. The X alleles exhibit significantly reduced polymorphism levels while the Y alleles maintain expected or greater than expected levels of diversity. We hypothesize that the X chromosome has recently undergone a selective sweep while elevated Y polymorphism is due to population structure.

Polyploidy and Genome Evolution Pamela Soltis 2012-10-03 Polyploidy - whole-genome duplication (WGD) - is a fundamental driver of biodiversity with significant consequences for genome structure, organization, and evolution. Once considered a speciation process common only in plants, polyploidy is now recognized to have played a major role in the structure, gene content, and evolution of most eukaryotic genomes. In fact, the diversity of eukaryotes seems closely tied to multiple WGDs. Polyploidy generates new genomic interactions - initially resulting in "genomic and transcriptomic shock" - that must be resolved in a new polyploid lineage. This process essentially acts as a "reset" button, resulting in genomic changes that may ultimately promote adaptive speciation. This book brings together for the first time the conceptual and theoretical underpinnings of polyploid genome evolution with syntheses of the patterns and processes of genome evolution in diverse polyploid groups. Because polyploidy is most common and best studied in plants, the book emphasizes plant models, but recent studies of vertebrates and fungi are providing fresh perspectives on factors that allow polyploid speciation and shape polyploid genomes. The emerging paradigm is that polyploidy - through alterations in genome structure and gene regulation - generates genetic and phenotypic novelty that manifests itself at the chromosomal, physiological, and organismal

levels, with long-term ecological and evolutionary consequences.

Evolutionary History of Recombination on Sex Chromosomes and of Sex-biased Gene Expression Iulia Darolti 2019 Males and females within a species are often under different selection pressures, which can affect both gene sequence and expression. Sex differences in selection are predicted to precipitate sex chromosome formation, and the rate of recombination on sex chromosomes varies greatly across taxa. Examining the extent of recombination suppression on sex chromosomes across closely related species can offer insight into the forces shaping sex differences and sex chromosome evolution over time. Additionally, sex-biased genes are thought to encode sexually dimorphic traits and are therefore a useful way to examine the effect of sex-specific selection across the genome. In this thesis, I use whole genome and transcriptome sequencing data to characterise the structure and conservation of sex chromosome systems across related species. I combine this with patterns of sex-specific single nucleotide polymorphisms to uncover the degree of recombination suppression and divergence across poeciliid sex chromosomes, as well as explore the consequences of recombination arrest on gene expression patterns. Finally, I investigate the selective dynamics driving the expression and rate of sequence evolution of sex-biased genes.

Molecular Analysis of Sex Chromosome Evolution in Papaya 2012

Gene Mapping in Marsupials Andrew H. Sinclair 1988

Novelty and Conservation in Sex Chromosome Evolution in Light of Speciation of East African Cichlid Fishes Erin Nicole Peterson 2021

The X in Sex David. BAINBRIDGE 2009-06-30 A tiny scrap of genetic information determines our sex; it also consigns many of us to a life of disease, directs or disrupts the everyday working of our bodies, and forces women to live as genetic chimeras. The culprit--so necessary and yet the source of such upheaval--is the X chromosome, and this is its story. An enlightening and entertaining tour of the cultural and natural history of this intriguing member of the genome, *The X in Sex* traces the journey toward our current understanding of the nature of X. From its chance discovery in the nineteenth century to the promise and implications of ongoing research, David Bainbridge shows how the X evolved and where it and its counterpart Y are going, how it helps assign developing human babies their sex--and maybe even their sexuality--and how it affects our lives in infinitely complex and subtle ways. X offers cures for disease, challenges our cultural, ethical, and scientific assumptions about maleness and femaleness, and has even reshaped our views of human evolution and human nature. Table of Contents: Prologue 1. Making a Difference Interlude: What Is It, Exactly? 2. The Duke of Kent's Testicles Interlude: How Sexy Is X? 3. The Double Life of Women Epilogue: The Chosen One Further Reading Glossary Index Reviews of this book: The author of *Making Babies* takes a lively, witty tour of the X chromosome, creator of "a delicious symmetry between men and women"...Entertaining and informative...A fine demonstration of science made accessible. --Kirkus Reviews Reviews of this book: A well-written, well-researched, easy-to-read study that explains what has been learned about the X and Y chromosomes using DNA sequencing and other molecular biology techniques. British biologist Bainbridge...has pulled together historical and current scientific research about how the X and Y chromosomes affect us and what the genes on these chromosomes actually do, like causing sex-linked diseases and color blindness...An excellent example of good science writing...Recommended. --Margaret Henderson, *Library Journal* Reviews of this book: Bainbridge is an essentialist, interested in understanding what aspects of gender are biologically driven, and why...He has a central question he wants to answer. The question is not so much why men and women are different (a worn topic that's the subject of too many Mars-and-Venus bestsellers) but, far more specific and far more interesting: Why are men and women more different than they need to be? --Liza Mundy, *Washington Post* Reviews of this book: Bainbridge summarizes our knowledge of the genetic information that determines one's sex by recounting the ancients' speculations about the genesis of gender, following with modern biologists' discovery of the X and Y chromosomes about a century ago, and of the sex-determining gene Sry in the 1990s. In a

discussion rich with history, evolution, and philosophy, Bainbridge points out the dramatic effect that gender selection has on people's lives...A fascinating, often humorous analysis of the science of sexuality. --Gilbert Taylor, Booklist Reviews of this book: In *The X in Sex*, David Bainbridge explains the far-reaching effects of X. Bainbridge...moves with ease between straightforward accounts of biology and historical stories about its effect, like the chapter describing the progression of hemophilia through the royal houses of Europe. Bainbridge discusses cultural history as well as natural history, and his wit enlivens every page. --Christine Kenneally, New York Times Book Review Reviews of this book: There are many literary stars (such as Stephen Jay Gould, Richard Dawkins and Matt Ridley) in the firmament of writers on evolution, and to a man they write with dash and persuasive logic. David Bainbridge is one such and in his latest book he takes the reader through the glories of the X chromosome at a cracking pace. --Miriam Stoppard, Times Higher Education Supplement (UK) Reviews of this book: The truth is that the behaviours of [chromosomes] X and Y are inextricably linked. Bainbridge explores this link in a compelling tale that takes in how the sex chromosomes became sex chromosomes, and the very different consequences of this for women and men. Along the way we encounter the Duke of Kent's testicles, calico cats and non-identical identical twin girls. His story weaves science, history and the history of science (with a little religion for good measure) in a straightforward, anecdotal fashion that will appeal to scientists and non-scientists alike. --Mark T. Ross, New Scientist (UK) Reviews of this book: In his structure/function analysis of the X chromosome, Bainbridge provides a tongue-in-cheek, yet informative, description of one of the two human sex chromosomes. --R. Adler, Choice Reviews of this book: If you have ever been intrigued by some of the puzzles of genetics--why boys tend to get haemophilia or colour blindness while girls are more likely to have an identical twin or to develop rheumatoid arthritis later in life--then *The X in Sex* is for you. --Chris Tyler-Smith, Times Literary Supplement David Bainbridge takes us on a fascinating tour of X chromosomes and explains what the possession of these intricately folded, infinitesimally narrow, two-inch long strings of genetic codes weighing almost nothing, means for their bearers--that is for each one of us, male and female. History and personal anecdotes are woven together with up-to-date summaries of the science, punctuated with Bainbridge's zany--and very British--humor, so that this information-packed book is pure pleasure to read. --Sarah Blaffer Hrdy author of *Mother Nature: A History of Mothers, Infants, and Natural Selection* *The X in Sex* is absolutely fascinating, so intriguing, in fact, that I found myself unwilling to put it down. David Bainbridge surveys an astonishing amount of new information from recent genomic studies of the X chromosome, clearly explaining the findings in a way the average person can easily follow. The science is presented via amusing and highly appropriate metaphors and clever turns of phrase, all of which serve to brighten the prose and present the reader with catchy ways to think about complex ideas. This is an informative, authoritative, and thoroughly enjoyable read: one of the best books I have read in recent years. --Jane Lancaster, University of New Mexico This is wonderful stuff--beautifully written, clear, jargon-free, with anecdotes sure to hold the attention. --other hupauthor Tim Birkhead, author of *Promiscuity: An Evolutionary History of Sperm Competition*

The Evolution of a Sex Chromosome in Asparagus Alex Edward, Harkess 2016 The overwhelming majority of flowering plants reproduce through the production of hermaphroditic flowers. A small percentage of angiosperm species instead are dioecious, producing either male or female flowers on individual plants. Dioecy can be mediated at the molecular level by a sex chromosome that genetically differentiates males and females. Sex chromosomes evolve from autosomes, and this conversion is hypothesized to involve mutations in one or more linked genes that determine sex. Given the complexities of anther and ovule development, the full suite of sex determination genes has not been described for any dioecious plant. Here we explore the conversion from autosome to an XY sex chromosome using garden asparagus (*Asparagus officinalis*), an ideal model system for studying the earliest events in sex chromosome evolution given that it recently evolved a sex chromosome pair. Focusing first on broad trends, genomic characterization of several hermaphroditic and dioecious species across the *Asparagus* genus revealed an increase in retrotransposon content

coincident with the evolution of dioecy. To identify putative sex determination genes on this Y chromosome, we then explore the timing of male and female sterility events in garden asparagus, hypothesizing that anther sterility in females likely occurs before pollen microsporogenesis. Finally, we assemble and annotate a high quality reference genome for garden asparagus, and perform a suite of mutant analyses to identify two genes in a non-recombining region of the Y that are ultimately responsible for sex determination.

Sex Chromosome Evolution in a Hermaphrodite Anna K. Nordén 2017

*An Investigation Into the Evolution of the Neo-Y Chromosome in *Oncorhynchus Nerka** Joshua Faber-Hammond 2012

Dissecting the Evolutionary Forces Shaping Sex Chromosome Evolution in Papaya 2014

Comparative Genomics and Novel Bioinformatics Methodology Applied to the Green Anole Reveal Unique Sex Chromosome Evolution

Shawn Michael Rupp 2016 In species with highly heteromorphic sex chromosomes, the degradation of one of the sex chromosomes can result in unequal gene expression between the sexes (e.g., between XX females and XY males) and between the sex chromosomes and the autosomes. Dosage compensation is a process whereby genes on the sex chromosomes achieve equal gene expression which prevents deleterious side effects from having too much or too little expression of genes on sex chromosomes. The green anole is part of a group of species that recently underwent an adaptive radiation. The green anole has XX/XY sex determination, but the content of the X chromosome and its evolution have not been described. Given its status as a model species, better understanding the green anole genome could reveal insights into other species. Genomic analyses are crucial for a comprehensive picture of sex chromosome differentiation and dosage compensation, in addition to understanding speciation. In order to address this, multiple comparative genomics and bioinformatics analyses were conducted to elucidate patterns of evolution in the green anole and across multiple anole species. Comparative genomics analyses were used to infer additional X-linked loci in the green anole, RNAseq data from male and female samples were analyzed to quantify patterns of sex-biased gene expression across the genome, and the extent of dosage compensation on the anole X chromosome was characterized, providing evidence that the sex chromosomes in the green anole are dosage compensated. In addition, X-linked genes have a lower ratio of nonsynonymous to synonymous substitution rates than the autosomes when compared to other *Anolis* species, and pairwise rates of evolution in genes across the anole genome were analyzed. To conduct this analysis a new pipeline was created for filtering alignments and performing batch calculations for whole genome coding sequences. This pipeline has been made publicly available.

Sex Chromosome Evolution in the House Fly 2022

Evolution and Speciation William R. Atchley 1981-05-29 This 1981 collection focuses on a wide range of topics in the general field of evolutionary biology. The authors have all been associated with Professor M. J. D. White, who was the world authority on chromosomal evolution and speciation, to whom this volume was presented on his seventieth birthday.

RNA-based Gene Duplication Sheds New Light on Mammalian Sex Chromosome Evolution Lukasz Potrzebowski 2009

Vertebrate Sex Chromosomes Nobuo Takagi 2003 During the last two decades of the 20th century, the study of chromosomes was enormously stimulated by the availability of various biological resources, valuable databases and new genetic and molecular biological techniques including PCR and fluorescent in situ hybridization. The simultaneous development of new and effective systems for targeting genes and gene transfer led to astonishing advances also in the study of vertebrate sex chromosomes. We now have considerable insight into their evolution, the dosage compensation mechanisms in mammals that involve chromosome-wide chromatin remodeling triggered by noncoding Xist RNA, and the unique properties of the human X chromosome which comprises many genes important for sex determination and reproduction. This thematic issue of Cytogenetic and Genome Research presents an excellent and highly authoritative compilation of current research findings related to vertebrate sex

chromosomes. The contributions - all prepared by experts in the field - reflect both the technical advances and the enormous gain in knowledge achieved in recent years. Many of these papers also provide important historical perspectives while some contain insightful personal views of the authors. This special volume therefore represents a stimulating and critical state-of-the-art source of information for investigators and students in this fascinating field.

Sex Determination in Vertebrates 2019-04-16 Sex Determination, Volume 134, the latest release in the Current Topics in Developmental Biology series, contains current reviews in the field of vertebrate sex determination. It covers molecular pathways of sex determination in genetic and environmental species and encompasses both sex determination of somatic lineages and commitment of germ cells to male or female fate. Chapters in this new release cover, amongst other topics, Mapping the Sox9 Enhancer Elements, Epigenetic Regulation of Sex Determination, Evolution and Management of Sex Chromosomes, Regulation of Germ Cell Sex Identity in Medaka, Control of Sex Determination in Zebrafish, Sexually Dimorphic Germ Cell Identity in Mammals, and more. Contains reviews written by leading experts in each field Includes informative figures that illustrate principle points that are useful for teaching Written in a style that is clear and simple

Sex Chromosomes and Sex-Linked Genes Susumu Ohno 2013-06-29 Natural selection operates among individual organisms which differ in their genetic constitution. The degree of hereditary variability within a species is greatly enhanced by cross-fertilization. Indeed, the mechanism of sexual reproduction occurred very early in evolution, for it is seen today even in bacteria. In *Escherichia coli*, fertilization occurs by passage of the single chromosome from the male into the female bacterium (LEDERBERG, 1959). In multicellular organisms, the separation of germ from soma, and the production of haploid gametes became mandatory. The gametes were of two types. One, extremely mobile, was designed to seek out and penetrate the other, which loaded with nutrients, received the mobile gamete and initiated the development of a new individual. The foundation for true bisexuality was thus laid. In the primitive state of bisexuality, whether an individual is to be a sperm-producing male or an egg-producing female appears to be decided rather haphazardly. In the worm, *Banelia viridis*, the minute males are parasites in the female. Larvae that become attached to the proboscis of an adult female become males, while unattached larvae sink to the bottom and become females (BALTZER, 1935). The more sophisticated state of bisexuality was initiated by setting aside a particular pair of chromosomes for specialization and making either the male or the female a heterogametic sex. Sex chromosomes as we know them were thus born.

The Evolution of Sex Determination Leo Beukeboom 2014-06-12 Sexual reproduction is a fundamental aspect of life. It is defined by the occurrence of meiosis and the fusion of two gametes of different sexes or mating types. Sex-determination mechanisms are responsible for the sexual fate and development of sexual characteristics in an organism, be it a unicellular alga, a plant, or an animal. In many cases, sex determination is genetic: males and females have different alleles or different genes that specify their sexual morphology. In animals, this is often accompanied by chromosomal differences. In other cases, sex may be determined by environmental (e.g. temperature) or social variables (e.g. the size of an organism relative to other members of its population). Surprisingly, sex-determination mechanisms are not evolutionarily conserved but are bewilderingly diverse and appear to have had rapid turnover rates during evolution. Evolutionary biologists continue to seek a solution to this conundrum. What drives the surprising dynamics of such a fundamental process that always leads to the same outcome: two sex types, male and female? The answer is complex but the ongoing genomic revolution has already greatly increased our knowledge of sex-determination systems and sex chromosomes in recent years. This novel book presents and synthesizes our current understanding, and clearly shows that sex-determination evolution will remain a dynamic field of future research. *The Evolution of Sex Determination* is an advanced, research level text suitable for graduate students and researchers in genetics, developmental biology, and evolution.

Sex Chromosome Evolution

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of the shadow victor i stoichita sniper elite one way trip scott mcewen snake hips anne thomas soffee singing games in early modern italy paul schleuse sidewalk art and games andrea labat skilling up vietnam christian bodewig single kid seeks dad linda wisdom six moon summer sm reine sleep and health risk jorg h peter smart policies for workplace technologies lisa guerin smoky mountain reunion lynnette kent small scale turbulence and mixing in the ocean jcj nihoul should we use someone elses sermon scott m gibson slow cooker cooking lora brody sighing woman tea mark daniel seiler slipping through the cracks margaret c simms ski town apr s ski jennie iverson sight word tales liza charlesworth shoeleb joe black betsy phil bildner sicstus prolog user s manual 4 3 mats carlbon shona customary law j f holleman smart guide to starting a small busineb lisa rogak single variable calculus vo 1 early transcendentals james stewart slang and its analogues past and present vol 4 john stephen farmer small store survival arthur andersen sledding in avalanche terrain bruce jamieson smarhelp for good n angry kids frank jacobelli shredded heat rub howe pti should the church teach tithing rubell earl kelly six months to live ms margot maurice signing in fourteen languages claude o proctor single with children arlene james sketches from the history of medicine ancient and modern sleep and mental illneb s r pandi perumal silent night easiest piano sheet music traditional german carol slick2d game development jacob bevilacqua smart cities and homes mohammad s obaidat slimy underbelly kevin j anderson sittengesetz und freiheit jens timmermann slaves and warriors in medieval britain and ireland david r wyatt slow cooking for 2 don orwell size and scaling in primate biology william j jungers snarling at the moon zenina masters sir dominick ferrand henry james sketches of travel in normandy and maine william holden hutton small businebes acceb to capital united states; congreb; house busineb silver and salt rob thurman sing me a loveaby bil keane simmel and since routledge revivals

david frisby singing the gospel christopher boyd brown sinleb in sin city david t fiske six years in the bush thomas need smile and succeed for teens kirt manecke sit solve travel crobwords frank longo snapshots of autism jennifer overton silence and confebions susan easton sinatra the entertainer arnold shaw siblings and the family busineb stephanie brun de pontet silicon photonics m jamal deen smog baggage of eternal night lisa morton simply allergy free elizabeth gordon silviculture of south asian priority bamboos ratan lal banik ski and snowboard guide to whistler blackcomb brian finestone sitting still like a frog eline snel silver ravenwolfs teen witch kit silver ravenwolf sing a song all year long connie walters shopping our way to safety andrew szasz small hydroelectric engineering practice bryan leyland small animal paediatric medicine and surgery giselle hosgood snatched into paradise 2 cor 12 1 10 james buchanan wallace sleep with slander dolores hitchens showtime for billie and coco tor freeman six protocols of it transformation patrick lesandrini signs in the blood vicki lane simple machine projects chris oxlade simplify your life de cluttering and de junking gaurav jain six bedrooms tegan bennett daylight signs for an exhibition kentridges eliza sims symptoms in the mind femi oyebode small busineb big money online alex harris slaying the giants in your life david jeremiah slips trips mibteps and their consequences gary m bakken singularities of differentiable maps volume 1 vi arnold smart boys fast girls contemporary young adult romance stephanie rowe smart answers to tricky interview questions rob yeung singapore math practice level 1a grade 2 frank schaffer publications smart discipline r larry koenig smart grid planning and implementation clark gellings

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