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Education and Experience

Biology. B.A., University of California, Los Angeles, 1977. (Summa Cum Laude, and Phi Beta Kappa, Rick Vance, mentor)

Engineering, Systems Science. M.S., University of California, Los Angeles, 1981.

Evolutionary Biology. Ph.D., University of Chicago, 1985 (Russ Lande, major professor).

Applied Math. Postdoctoral Fellow, Department of Applied Mathematics, Weizmann Institute of Science, Israel, 1985-1986 (with the late Lee Segel).

Population Biology, Ecology and Evolutionary Biology. Assistant and Associate Professor, Dept. of Zoology, University of Texas at Austin, 1986-1998.

Science, Law and Policy. Professor of Science and Law, Environmental Law Center, Vermont Law School, 1998-present.

Science and Law

I write the Science and Law column for the Environmental Forum, a publication that reaches several thousand environmental attorneys and policymakers, published by the Environmental Law Institute. Those columns come out six times each year. Here are some representative Science and the Law columns. (Full list appended below).

Science: It's not about Rules and Process but, rather, about Anarchy. March/April 2018.

TSCA Reform: Wherein Science Gets Written Into a Federal Statute. July/August 2017.

Built Infrastructure and Climate Change in the American Southwest. November/December 2016.

Bad Actors in a Chemical Society. November/December 2015.

The Supremes Play "To Tell the Truth" September/October 2015.

Enclosing the DNA Commons. March/April 2013.

Aliens Live in Our Brains!!! January/February 2013.

The Weight of the Evidence. September/October 2012.

Its Owls All the Way Down. May/June 2009.

A Stone Wall or a Stonewall? May/June 2008.

See below for a complete list of my Science and the Law columns.

Science

Philosophy

My scientific research is at the interface of theory, empiricism, and ecological management. The details of particular ecological data sets and specific management challenges force one to develop relevant theory. Theory allows more efficient and effective gathering and analysis of data, and of ecological management.

Some conclusions of my mathematical population biology research

> Yellowstone grizzly bears have a source/sink population structure; source bears are wary of humans, and sink bears are habituated to humans.
>
> The strength of density dependence in a perennial grass varies greatly from year-to-year; in some years the population grows exponentially and unregulated, and the carrying capacity changes greatly across years, with a skewed distribution.
>
> Because of sampling biases, the apparent decline in the extinction rates of fossil taxa over geologic time is not real.

Some scientific publications (complete list appended)

N. L. Fowler and C.M. Pease. 2010. Temporal variation in the carrying capacity of a perennial grass population. American Naturalist 175: 504-512.

Pease, C.M. and D.J. Mattson. 1999. Demography of the Yellowstone grizzly bears. Ecology 80: 957-975.

Pease, C.M. and J.A. Grzybowski. 1995. Assessing the consequences of brood parasitism and nest predation on seasonal fecundity in passerine birds. Auk 112: 343-363.

Pease, C.M. 1988. Biases in the per-taxon origination and extinction rates of fossil taxa. Journal of theoretical Biology 130: 9-30.

Pease, C.M., R. Lande, and J.J. Bull. 1989. A model of population growth, dispersal and evolution in a changing environment. *Ecology* 70: 1657-1664.

Teaching

Philosophy. Undergraduate non-majors science education

Undergraduates should learn about the scientific method using a systematic curriculum devoted specifically to this task, not via anecdotes and sidebars in a watered-down course for biology majors, asking students to memorize facts. Facts are abundant and often cheap. What is scarce is the ability to analyze facts, draw useful conclusions from them, and take effective action based on them.

Philosophy; Teaching science to law students

Environmental attorneys must be able to effectively collaborate and communicate with scientists. Yet it is unrealistic to train lawyers to be scientists. There are advantages to teaching law students general scientific principles, as opposed to teaching them scientific facts that will soon be outdated, and that will not, in any event, be the ones they will need when they start practicing. It is to the advantage of science that lawyers understand the essence of scientific institutions and thinking, as they are typically in a better position to influence public policy than are scientists.

Curricular innovation

Science for Business, Law and Journalism. I developed this undergraduate non-majors course while on the UT Austin faculty, in collaboration with Jim Bull. We typically had enrollment of over 100 in each section.

This course teaches general principals of scientific inference and critical thinking, using common examples already familiar to the students. The scientific method is analogous to car repair, and cooking from a recipe. Models from outside science, such as a sweater knitting pattern, are similar to scientific models such as rats and mathematical equations. The peanut butter and jelly sandwich helps illustrate what a correlation is, and drinking and driving explicates correlation and causation. Not everyone wins when science advances; certain corporate and ideological interest groups sometimes lose when scientific knowledge advances. Thus, certain individuals and institutions have an incentive to slow scientific progress, and they do so, for example by promoting and pursuing poor research designs, either deliberately or unconsciously.

Some novel features of this course: (1) We use several simple templates to provide a framework for the scientific method, our lectures, exam questions, and homework problems. These templates include such topics as models, data, errors of various sorts, bias, research design, correlations, confounding, etc. (2) Many lectures feature in-class demonstrations. (3) Our homework problems ask the students to explicitly relate the course templates to contemporary issues in newspaper articles. (4) The lectures draw on case studies (including DNA forensics, alcohol drinking and pregnancy, cotton farming, and condom testing) to illustrate how the course themes, as codified by the templates, play out in particular cases. (5) We developed a novel machine-graded exam format that tests critical thinking skills.

Teaching law students science with real scientific papers, by extending the approach in Science for Business, Law and Journalism. In the first several weeks of the Science for Environmental Law course I teach at VLS, we work through two scientific papers on dioxin and cancer. In those classes, I take the templates and concepts for scientific thinking in the course notes for Science for Business, Law and Journalism, and apply those ideas to the specifics of these scientific papers on dioxin and cancer. The concepts are themselves quite simple, at least in some incarnations---I recently illustrated a key statistical concept with an impromptu demonstration, using a large handful of used chalk, and a student's hat. In another class on mercury, a recent demonstration involves a lump of coal, and a florescent light bulb. Yet working through real scientific papers also help tease out all sorts of complexities and subtleties in the Science for Business, Law and Journalism material. In essence, one can think of these classes as being somewhat like what happens when a scientific lab group works through a technical paper, except that I use a more structured approach, and sometimes devote up to several weeks to one or two scientific papers.

After discussing dioxin science, the dioxin case study then turns to the use of dioxin science in policy and law, with a couple weeks on torts, statutes, regulation, litigation, risk assessments, and cost-benefit analysis. There is a definite structure to those classes on the interface of science with law and policy, and a definite set of concepts, though it is rather novel, and not so easy to communicate crisply in a paragraph.

Then the case study turns back to dioxin science, looking at the ways in which the research design of key dioxin scientific papers was biased, and the economic and political forces that tempt scientists to bias their study designs.

I follow the dioxin case study with shorter case studies on climate change, and human population and resource use. For the last third or so of the course, I have created six case studies, each containing one scientific paper, and one legal case or policy document (GM rice, endocrine disrupting plastics, Flammulated owls, etc.) We devote one class period to each case study, having a panel discussion (typically, there are multiple students on the same case study), and each student also writes a short paper. The final exam is based on a case study consisting of a scientific paper, legal case and associated policy documents that I provide to the students at least a month before the exam, most recently ground-level ozone science, law, regulation and politics.

The mini-thesis: Making graduate education more effective and efficient. Graduate education in the US, though second to none in the world in quality, is also at some levels terribly inefficient. At the core of that inefficiency is the apprenticeship model used to train graduate students to undertake novel and technically sound research. Additionally, while graduate science education trains students to do research, there are few jobs in pure research; rather what society needs is scientific professionals who can solve environmental problems, and that is where the jobs are, even if that is not the typically the focus of systematic study in graduate science education. As Graduate Advisor at UT Austin, I had a first-hand look at how graduate education grounded on one-on-one approaches to learning can produce great results, but alas can also sometimes be inefficient and produce inferior results. Thus, it seems to me that there is an opportunity and need for new approaches to graduate education, at least in some contexts, for some students, while retaining the best of current approaches.

The LL.M. is a one year post-J.D. degree. At VLS, I teach the LL.M. Seminar, which is the only required course in our LL.M. curriculum. In that seminar, each student writes a 2000 word mini-thesis. I have developed a series of 8 assignments that captures the essence of doing a standard graduate-level thesis (e.g., these assignments include: write 10 potential questions, critique your 10 mini-thesis questions, write a proposal, write a draft, critique a classmate's draft, present and defend your mini-thesis orally in a symposium, etc.) I believe the mini-thesis reduces faculty workload, and has also improved the quality of student research.

Courses taught

Law school courses. At VLS, I teach Science for Environmental Law, Scientific Controversies, Risk Assessment and Ecology of Food and Agriculture. The latter three courses are broadly similar to Science for Environmental Law, but use different case studies (vioxx and heart attacks, gun control, mercury toxicity, and GMOs and cancer). Basically, in these four courses, I teach the same fundamental concepts and use similar course structures, using different examples.

At VLS, I also teach the LL.M. Seminar, both in residence and online.

Undergraduate non-majors science course. Science for Business, Law and Journalism.

Graduate science courses. Mathematical ecology, and Research design in biology.

Publications

Course notes

Coauthored with J.J. Bull. Science for Business, Law and Journalism. Notes for a non-majors undergraduate course in scientific thinking. The notes present key scientific concepts, such as models, data, problems with data (measurement error, sampling error, human error, bias), good research design to minimize error (explicit protocol, replication, randomization, standards, blind), evaluation of data including experiments vs. observational studies, and correlations, control and treatment groups, confounding, controlled for, and causation. The notes illustrate these concepts with non-scientific examples such as car repair and condoms, and scientific examples that resonate with undergraduates, such as illicit drug testing. About 100 pages.

At VLS, I have extended the approach in these notes. Currently my teaching pairs these notes with real scientific papers of relevance to law students. In this way I walk law and policy students through real scientific papers on human epidemiology, testing pharmaceuticals for safety and effectiveness, gun control, mercury toxicity, genetically modified organisms and cancer, etc.

Scientific articles

Fowler, N. L., and C. M. Pease. 2013. Temporal variation in density dependence in an herbaceous community. Pages 123-139 *In* Temporal Dynamics and Ecological Process. C. K. Kelly, M.G. Bowler and G.A. Fox, eds. Cambridge University Press.

Fowler, N.L. and C.M. Pease. 2010. Temporal variation in the carrying capacity of a perennial grass population. 175 The American Naturalist 504-512.

Fowler, N.L., R. D. Overath, and C.M. Pease, 2006. Detection of density dependence requires density manipulations and calculation of λ. 87 Ecology 655–664.

Grzybowski, J.A., C.M. Pease and M. Brittingham. 2005. Renesting determines seasonal fecundity in songbirds: What do we know? What should we assume? Auk 122: 280-291.

Mattson, D.J., S. Herrero, R.G. Wright, C.M. Pease. 1996. Designing and managing protected areas for grizzly bears: How much is enough? Pages 133-164 *In* National Parks and Protected Areas: Their Role in Environmental Protection. R. G. Wright ed., Blackwell Science.

Grzybowski, J.A. and C.M. Pease. 2000. Comparing the relative effects of nest predation and brood parasitism on seasonal fecundity in passerine birds. Austin Cowbird Symposium. University of Texas Press.

Pease, C.M. and D.J. Mattson. 1999. Demography of the Yellowstone grizzly bears. *Ecology* 80: 957-975.

Grzybowski, J.A. and C.M. Pease. 1999. A model of the dynamics of cowbirds and their host communities. Auk 116: 209-222.

Brewer, L., C.M. Pease and J.L. Larimer. 1998. Consistency of interneuronal group formation in response to simulation of identified cells. Journal of Comparative Physiology A. 182: 509-519.

Pease, C.M. and N.L. Fowler. 1997. A systematic approach to some aspects of conservation biology. Ecology 78: 1321-1329.

Mattson, D.J., S. Herrero, R.G. Wright, and C.M. Pease. 1996. Science and management of Yellowstone grizzly bears. Conservation Biology 10: 1013-1025.

Mattson, D.J., S. Herrero, R.G. Wright, and C.M. Pease. 1996. Designing and managing protected areas for grizzly bears: How much is enough? *In* National Parks and Protected Areas: Their Role in Environmental Protection. Blackwell Science. Cambridge MA. R.G. Wright, ed.

Bull, J.J. and C.M. Pease. 1995. Why is the polymerase chain reaction resistant to in vitro evolution? Journal of Molecular Evolution 41: 1160-1164.

Pease, C.M. and R. Lande. 1995. Population Viability Analysis. Pages 203-212 *In* The Encyclopedia of Environmental Biology. Academic Press.

Ryan, M.J., C.M. Pease and M.R. Morris. 1992. A genetic polymorphism in the swordtail Xiphophorus nigrensis: Testing the prediction of equal fitness. American Naturalist 139: 21-31.

Pease, C.M. 1992. On the declining extinction and origination rates of fossil taxa. *Paleobiology* 18: 89-92.

Larimer, J.L. and C.M. Pease. 1990. Unexpected divergence among identified interneurons in different abdominal segments of the crayfish, Procambarus clarkii. Journal of experimental Zoology. 25: 20-29.

Taber, S.W. and C.M. Pease. 1990. Paramyxovirus phylogeny: tissue tropism evolves slower than host specificity. Evolution 44: 435-438.

Bull, J.J. and C.M. Pease. 1989. Combinatorics and variety of mating-type systems. *Evolution* 43: 667-671.

Pease, C.M., R. Lande, and J.J. Bull. 1989. A model of population growth, dispersal and evolution in a changing environment. Ecology 70: 1657-1664.

Bull, J.J. and C.M. Pease. 1988. Estimating relative parental investment in sons versus daughters. Journal of Evolutionary Biology 1: 305-315.

Larimer, J.L. and C.M. Pease. 1988. A quantitative study of command elements for abdominal positioning behavior in the crayfish, Procambarus clarkii. Journal of Experimental Zoology 247: 45-55.

Pease, C.M. and J.J. Bull. 1988. A critique of methods for measuring life history trade-offs. Journal of Evolutionary Biology 1: 293-303.

Pease, C.M. 1988. On comparing the geologic durations of easily versus poorly fossilized taxa. Journal of theoretical Biology 133: 255-257.

Pease, C.M. 1988. Biases in the survivorship curves of fossil taxa. *Journal of theoretical Biology* 130: 31-48.

Pease, C.M. 1988. Biases in the per-taxon origination and extinction rates of fossil taxa. Journal of theoretical Biology 130: 9-30.

Pease, C.M. 1988. Biases in the total extinction rates of fossil taxa. *Journal of theoretical Biology* 130: 1-7.

Pease, C.M. 1987. Lyellian curves and mean taxonomic durations. *Paleobiology* 13: 484-487.

Pease, C.M. 1987. An evolutionary epidemiological mechanism, with applications to type A influenza. Theoretical Population Biology 31: 422-452.

Pease, C.M. 1985. Biases in the durations and diversities of fossil taxa. *Paleobiology* 11: 272-292.

Pease, C.M. 1985. A coevolutionary isomorphism applied to laboratory studies of competition. Evolution 39: 444-450.

Pease, C.M. 1984. On the evolutionary reversal of competitive dominance. *Evolution* 38: 1099-1115.

Science and Law columns

These are the columns I have written for the Environmental Forum. All of my columns are available here.

Extremes in Temperature — and in the Handling and Use of Science. May/June 2018.

Science: It's Not About Rules and Process But, Rather, About Anarchy. March/April 2018.

Geoengineering & Hubris: Altering Gargantuan Natural Flows of Energy. November/December 2017.

The War Against Logic, Evidence, and Free Market of Scientific Ideas. September/October 2017.

TSCA Reform: Wherein Science Gets Written Into a Federal Statute. July/August 2017.

Waste-to-Energy Plants Are Not the Elixir to Solve Power Problem. March/April 2017.

Environmental Protection Grinds to Halt With Neonicotinoid Pesticides. January/February 2017.

Built Infrastructure and Climate Change in the American Southwest. November/December 2016.

The Plight of the Bugs, and the Failure of the Laws of Humans. September/October 2016.

Knot Good: How Climate Change Harms Rich, Industrial Economies. July/August 2016.

Climate Changing: The Alchemy (and Science) of Ice, Heat, and Sun. March/April 2016.

Fracking's Enhanced Oil and Gas Recovery Means More Earthquakes. January/February 2016.

Bad Actors in a Chemical Society. November/December 2015.

The Supremes Play "To Tell the Truth." September/October 2015.

Drought, Flooding, and Fossil Fuels. July/August 2015.

Melting Ice and Civilization. May/June 2015.

Coal Burning: A Fly in the Ash. March/April 2015.

An Old Scourge, and a Modern One. January/February 2015.

A Critique of Impure Reason. November/December 2014.

Investigating the Temperature Trend. September/October 2014.

Humans are Plastic Fantastic Lovers. July/August 2014.

Climate Sensitivity on the Increase. May/June 2014.

Agriculture Doth Protest Too Much. March/April 2014.

Typhoons, Heat Waves, Climate. January/February 2014.

A Science and Policy Smog. November/December 2013.

Carbon Capture Gambit Declined. September/October 2013.

More Carbon, Less Science July/August 2013.

Chesapeake Bay—RIP or TMDL? May/June 2013.

Enclosing the DNA Commons. March/April 2013.

Aliens Live in Our Brains! January/February 2013.

Humanity's Beef With Bacteria. November/December 2012.

The Weight of the Evidence. September/October 2012.

Fish Story: A Tale of Toxicity. July/August 2012.

The Keystone Pipeline EIS. May/June 2012.

Fracking: Turning Money Into Data. March/April 2012.

When Science Evaluates Judges. January/February 2012.

TSCA: Economic Limits to Science. November/December 2011.

A Conspiracy of Climate Science? September/October 2011.

Attorney/Expert Communications. July/August 2011.

The New Scientific Integrity Guidelines. May/June 2011.

A Tale of Pesticides Then and Now. March/April 2011.

An International Perspective. January/February 20111

Climate Change Political Paralysis. November/December 2010.

The Hazards on Your Dinner Plate. September/October 2010.

Outsourcing Science and Engineering. July/August 2010.

Mixing Smelt, Salmon and People. May/June 2010.

Habitat Loss and Bird Extinctions. March/April 2010.

A Tale of Two GM Organism Cases. January/February 2010.

Costs, Benefits and Malthus' Mistake. November/December 2009.

Toxicity: You Can't Dial C for Cancer. September/October 2009.

Too Much Lobster (And Too Little Cod). July/August 2009.

Its Owls All the Way Down. May/June 2009.

How Might We Cool the Earth? March/April 2009.

Do Cell Phones Cause Cancer? January/February 2009.

Strong Evidence of a Small Harm. November/December 2008.

Will "Peak Coal" Limit Warming? September/October 2008.

Land Use: You Can't Argue With the Data. July/August 2008.

A Stone Wall or a Stonewall? May/June 2008.

A Climate of Uncertainty. March/April 2008.

The Absurdity of Individual Harm. January/February 2008. (Reprint of 2005 BioScience publication.)

Reports, letters and book reviews

Pease, C.M. 2005. A pro-business bias in environmental law at Frontiers? Frontiers in Ecology and the Environment 3: 131-132

Pease, C.M. 2005. In defense of N > 1. BioScience 55:100.

Grzybowski, J.A. and C. M Pease. 1999. Cowbirds: Villans or scapegoats? Birding 31: 448-450.

Pease, C.M. and J.J. Bull. 1992. Is science logical? BioScience 42: 293-298.

Pease, C.M. and J. Grzybowski. 1991. Protecting biodiversity in Texas. Conservation Biology 5: 7-8.

Pease, C.M. and L.G. Gingerich. 1990. The habitat requirements of the black-capped vireo and golden-cheeked warbler populations near Austin, Texas. City of Austin, Dept. of Environmental Protection.

Pease, C.M. 1990. Is evolutionary taxonomy science? Systematic Zoology. 39: 301-303.

Pease, C.M. 1988. Models of evolution. BioScience 38: 352-354.