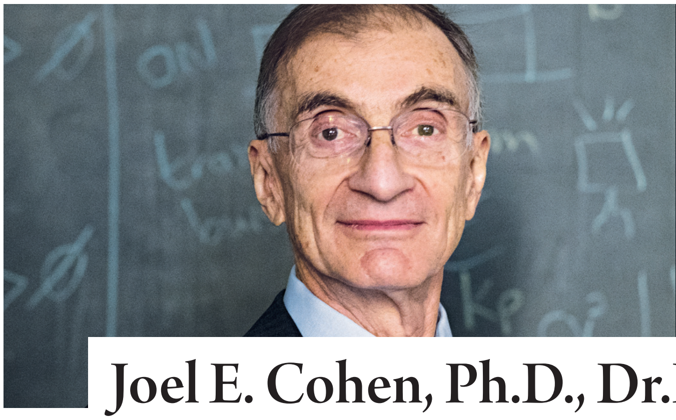

Joel E. Cohen, Ph.D., Dr.P.H.

ABBY ROCKEFELLER MAUZÉ PROFESSOR, LABORATORY OF POPULATIONS

Living populations have "ensemble properties," such as birth rates, death rates, and growth rates, that are not characteristics of any individual. Cohen develops concepts helpful for understanding ensemble properties of human and non-human populations, and tests these concepts in applications to human fertility, mortality, and migration; farms, fisheries, forests, wildlife, and weather patterns; infectious diseases; and food webs.

The human species is a node in a network of feeding relationships, known as a "food web," with thousands of other species. Species that humans eat are conventionally studied as part of agriculture. Species that eat humans, which are often the agents or vectors of infectious diseases, are studied in epidemiology and human microbiome research. Humans, the species humans eat, and the species that eat humans are nodes in a global food web, studied in ecology. The global food web includes many species not directly linked to humans by feeding and strongly interacts with the physical and chemical environment.

Cohen and his colleagues aim to offer insights that can help manage local and global food webs for the well-being of humans and other species. They combine the perspectives of demography, agriculture, epidemiology, ecology, and environmental sciences. Their work uses concrete problems to develop new concepts for understanding populations and aims to crystallize these concepts into mathematical, statistical, and computational tools applicable to scientific and practical problems.

For example, Cohen and colleagues study Chagas disease (also called American trypanosomiasis), an insect-borne chronic infectious disease that affects children in Latin America and eventually kills many young adults in their prime years of work and family rearing. No vaccine is currently available to prevent infection because the affected people are poor and commercial incentives to develop a vaccine are weak. The drugs available for treatment are toxic. Cohen collaborates with Argentine colleagues who conduct field studies of Chagas disease to understand the ecology of disease transmission in poor rural villages in northwest Argentina. Based on data from these field studies, they develop mathematical models of the relations among humans; domestic animals like dogs, cats, chickens, and goats; the insects that transmit infection; and the trypanosome that causes disease. Their findings lead to specific recommendations of low-technology, low-cost interventions to prevent infection of people at risk.

Cohen's lab also views weather events as a population. Cohen and colleagues showed that severe tornado outbreaks became more common during the last half century. Both the average and variance of tornadoes per outbreak increased, and the variance increased more than four times as fast as the mean. Hence outbreaks with an extreme number of tornadoes have become more likely. The relationship between the average and variance in this case follows a power law known in population ecology as Taylor's law.

This same power-law relation of variance to mean occurs under other names in other fields of science, and has provided insights into many systems. Cohen and colleagues are studying Taylor's law theoretically and empirically in COVID-19, bacteria, trees, fish, voles, humans, and other species, including the insects that transmit Chagas disease, and are exploring its practical applications to sampling, projection, and management.

EDUCATION

A.B. in applied mathematics, 1965
A.M. in applied mathematics, 1967
Ph.D. in applied mathematics, 1970
M.P.H., 1970
Dr.P.H., 1973
Harvard University

POSITIONS

Assistant Professor, 1971–1972
Associate Professor, 1972–1975
Harvard University

Professor, 1975–
The Rockefeller University

Professor, 1995–
Columbia University

AWARDS

MacArthur Fellow, 1981

Fred L. Soper Award, Pan American Health and Education Foundation, 1997

Tyler Prize, University of Southern California, 1999

Golden Goose Award, American Association for the Advancement of Science, 2015

HONORARY SOCIETIES

National Academy of Sciences

American Academy of Arts and Sciences

American Philosophical Society

Council on Foreign Relations

Fellow, American Association for the Advancement of Science

SELECTED PUBLICATIONS

Cohen, J. E. et al. COVID-19 cases and deaths in the United States follow Taylor's law for heavy-tailed distributions with infinite variance. *Proc. Natl. Acad. Sci. U.S.A.* 119, e2209234119 (2022).

Yang, Y. et al. Temporal and spatial Taylor's law: application to Japanese subnational mortality rates. *J. R. Stat. Soc. A* 1–28 (2022).

Abel, G.J. and J. E. Cohen. Bilateral international migration flow estimates updated and refined by sex. *Sci. Data* 9, 173 (2022).

Brown, M. et al. Taylor's law of fluctuation scaling for semivariances and higher moments of heavy-tailed data. *Proc. Natl. Acad. Sci. U.S.A.* 118, e2108031118 (2021).

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