

# CURRICULUM VITAE

## PAUL H. YANCEY, Ph.D.

Professor of Biology

Carl E. Peterson Endowed Chair of Sciences  
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### EDUCATION AND DEGREES

- 1978 Scripps Institution of Oceanography, University of California at San Diego  
**Ph.D.**, Marine Biology (Physiology/Biochemistry; mentor George Somero)
- 1973 California Institute of Technology  
**B.S.**, Biology, with Honors

### PROFESSIONAL EXPERIENCE AND FELLOWSHIPS

- 1997-present **Carl E. Peterson Endowed Chair of Sciences**, Whitman College
- 2009-2011 Special Volunteer, Nat'l Inst. Health, Laboratory of Kidney & Electrolyte Metabolism
- 1981/86/92- Assistant, Associate, and Full **Professor of Biology**, Whitman College
- Summer 2004 Invited Pauley Summer Program fellow at Hawai'i Inst. Marine Biology, Coconut I, Oahu HI
- Fall 2003 Visiting Scientist, Hopkins Marine Station and Monterey Bay Aquarium Research Institute
- 1999-02 **Chair** of Basic Sciences and Mathematics Division, Whitman College
- 1999-01 Director of Howard Hughes Medical Institute Grant to Whitman College
- Fall 1998 University of Otago Postgraduate Medical Society Visiting Professorship, New Zealand
- Summer 1998 Visiting Professor, Louisiana State University Biological Sciences
- Summer 1994 William Evans Visiting Fellowship, University of Otago, Dunedin, New Zealand
- Summer 1990 Pew Summer Research Fellowship, Mt. Desert Island Biological Lab., Maine
- 1988-1991 **Chair** of Biology Department, Whitman College
- 1987-1988 Visiting Research Scientist, National Institutes of Health
- Summer 1985 Visiting Research Associate, Oregon State University
- Summer 1984 Visiting Scholar, Scripps Institution of Oceanography
- 1978-1980 NATO **Postdoctoral** and Leverhulme Fellowships, Physiology, University of St. Andrews
- 1977-78 Carl Hubbs-Seaworld Fellowship for graduate work at Scripps Inst. Oceanography
- 1973 California State Graduate Fellowship for graduate work at Scripps
- 1973-1978 Research Assistant with Drs. G.N. Somero, J.R. Beers, D. Epel, T.J. Chow, Scripps Inst.
- 1971-1973 Research Assistant with Drs. E.H. Davidson, B. Hough, Calif. Institute of Technology

### ACADEMIC AWARDS and other DISTINCTIONS

- 2003 G. Thomas Edwards Award for **Excellence in Teaching and Scholarship** (Whitman College)
- 2002 Whitman College **Alumni Association Award** for distinguished service
- 1997 Designated as the first **Carl E. Peterson Endowed Chair of Sciences** (renewed in 2004, 2009)
- 1994 Dr. A. E. Lange Award for **Teaching Excellence in Science** (Whitman College)
- 1993 Washington State Region IV Higher Education **Science Teacher of the Year**
- 1992 Recognition (by the Institute for Scientific Information, Inc.) of our 1982 Science paper (see Publications) as a **Science Citation Classic** (now > 2000 citations). Noted in Current Contents as the 2nd-most cited paper in all sciences with co-author from a liberal arts college, 1982-1992.
- 1988 Paul Garrett Fellowship (Whitman College) for excellence in teaching and research
- 1979 Eckart Dissertation Prize, Scripps Institution of Oceanography, \$1000 + travel: Award for **best doctoral thesis** of 1978-79, based on originality and significance of research and clarity of writing

### PROFESSIONAL SOCIETIES & SERVICE

**Member:** Amer. Physiol. Soc (APS).; Sigma Xi, the Scientific Research Honor Soc.; Soc. Integr. Compar. Biol. (SICB); Council on Undergraduate Research (CUR)

#### Offices held:

- 2012 Nominating Committee of Comparative Section of Soc. Integr. Compar. Biol.
- 2006-07 Co-Chair of 2007 **Gordon Research Conference on Cellular Osmoregulation** (elected); conference, for which I raised most of the funding (from NIH) in Aussois, **France**
- 2004-06 Secretary, SICB, Div. Compar. Biochem. Physiol. (by national election)

- 1999-02 Vice-President and Secretary of local Sigma Xi chapter  
 1995-16 Institutional Liaison for Council on Undergraduate Research  
 1992-94 Member, Electorate Nominating Committee, AAAS (by national election)

## GRANTS

- 2015-17 **BBSRC (Biotechnology and Biological Sciences Research Council) UK**, international **collaborator** on grant to Dr Gordon Cramb, University of St. Andrews, Scotland, "Hypoxanthine metabolism in salmon: roles in osmoregulation and the innate immune response," 2015-17.
- 2014-15 **Schmidt Ocean Institute** grant: "*Studying the Ecology and Geology of the Mariana Trench – The Deepest Place on Earth.*" **Co-P.I.** on this grant led by Jeffrey Drazen and Patty Fryer of U. Hawai'i. SOI lets researchers use their ship *Falkor* for free.
- 2011-15 **National Science Foundation** grant (BioOce; \$93,000 for my part): **HADES (Hadal Ecosystem Studies) Project**: "*Collaborative Research: Controls on Hadal Megafaunal Community Structure: A Systematic Examination of Pressure, Food Supply, and Topography.*" **Co-P.I.** with Timothy Shank, Woods Hole, and Jeffrey Drazen, U. Hawai'i; ecology and physiology of life in the deepest ocean trenches, using the *Nereus* ROV; with several UK/New Zealand biologists, Nat'l Geographic Society and James Cameron's DEEPSEA CHALLENGE team as collaborators.
- 2012-14 **NERC (Nat'l Envir. Research Council) UK**, international **collaborator** on grant to Gordon Cramb, U. St. Andrews, Scotland: "*Inositol Metabolism in Euryhaline Fish and Effects of Pesticides*"; environmental effects on inositol and other osmolytes of European eels, salmon, tilapia; travel and supply funds for me at about \$3500/year.
- 2011-16 **Danisco-Dupont** grants: "*Effect of Betaine Supplementation on Brain-Cell Osmotic Balance and Potentiation.*" **Co-P.I.** with Leena Knight, Whitman, in collaboration with Drs Stuart Craig and Kirsti Tiihonen, Danisco; testing an osmolyte-based sports-drink additive on memory functions and osmotic stress in neurons.
- 2009 **National Science Foundation-R.O.A.** grant (BioOce; \$36,797): "*An Absence of Sharks in the Abyss: Ecological or Physiological Limitations?*" Research on metabolic and pressure adaptations of cartilaginous fishes, with Jeffrey Drazen, U. Hawai'i.
- 2007 **National Institutes of Health** grant (\$8000) to support **Gordon Research Conference** (above)
- 2004 **Keck Foundation-Whitman** grant for summer research on deep-sea pressure adaptations
- 1982-11 **11 Sally Ann Abshire and Perry** (internal college) Awards (1985, '86, '90, '94, '96, '99, '00, '03, '06, '07, '11), including funds for about 30 undergraduates and me to participate in deep-sea research expeditions, including robotic submersibles, and the *Alvin* manned submersible.
- 1999-01 **M. J. Murdock Charitable Trust** Life Sciences Grant (\$28,000): "*Effects of Organic Osmolytes from Deep-Sea Animals on Perturbations by Hydrostatic Pressure.*" **P.I.**
- 1996-01 **Howard Hughes Medical Institute** grant: Assisted committee in obtaining funds for summer research (beginning 1997) and adding multimedia and project-learning to curriculum.
- 1995-97 **M. J. Murdock Charitable Trust** grant: Assisted committee in obtaining funds for sophomores and juniors to work summers on- and off-campus. Awarded to Whitman Science Division, 3 years. Summers 1995, 1996: \$26,000 total grants from this for me and 7 students.
- 1992-94 **M. J. Murdock Charitable Trust** Award of **Research Corporation: Partners-in-Science** grant (\$13,000, 2 summers for high school teacher in my lab): "*Effects of aldose reductase inhibitor on renal osmoregulation in galactosemic (diabetic-like) rats*"
- 1991-94 **M.J. Murdock Charitable Trust** grant: Assisted committee in obtaining \$400,000 for 3 years for Whitman Science Division; 1992-4: \$11,000 grants for me and two students every summer.
- 1991 **National Science Foundation** grant: Assisted committee in obtaining "*Computer Based Science Laboratory*" funding for Whitman Science Division (\$64,000).
- 1988-93 **Howard Hughes Medical Institute** grant. Assisted committee in obtaining funds for Biology and Chemistry Departments; \$400,000, 5 years. Summers 1989-93: \$7,000 grants from this for me and two students every summer.
- 1987-88 **National Institutes of Health** Intergovernmental Personnel Act research award (\$11,000): "*Organic osmolytes in mammalian kidneys: contents, effects on cultured cells, role in diabetes.*" For sabbatical work at NIH's Laboratory of Kidney & Electrolyte Metabolism.
- 1986 **Research Corporation-Hewlett Foundation** Grant (\$7600, 1 summer, including stipend for one student): "*Organic osmolytes in kidneys of desert rodents*"; **P.I.**
- 1985 **National Science Foundation-R.O.A.** (Regulatory Biology) DCB-8544475, at Oregon State

- University with Dr. J. Siebenaller: "*Biochemical adaptation to the deep sea*".
- 1984 **Sigma Xi** Grant-in-Aid of Research: "*Myosin content of muscles in mesopelagic fishes having reduced protein contents*"; **P.I.**
- 1971 **National Science Foundation** Undergraduate Research Grant at Caltech (2 months).

### INVITED PRESENTATIONS

- Apr. 2017 **Williams College**: "*Life in the Trenches: How Animals Cope with High Pressure in the Ocean's Greatest Depths*".
- July 2017 **9th Internat'l High Pressure Biosci. & Biotech. Conf.; Toronto**, July 24-29; "*Piezolytes Protect Proteins under Pressure; or: Trimethylamine oxide and other potential piezolytes in fish and amphipods of the Mariana and Kermadec Trenches: counteracting hydrostatic pressure effects on proteins and role in depth limits.*"
- Jan. 2017 **At Sea on *Shinyo Maru***: Talk on my research to 24 Japanese cadets, for NHK-TV documentary *Deep Oceans* (see EDUCATIONAL/OUTREACH section below).
- Oct. 2016 **Whitman College -- Arthur REMPEL Public Lecture**, "*Life in the Trenches: Animals of the Ocean's Greatest Depths and How They Survive*"; and **Rempel Seminar for students**: "*Adapting to environmental and physiological stress: the importance of osmolytes.*"
- Oct. 2015 **EWU-Cheney**: "*Life in the Trenches: How do Animals Cope under High Pressure? A Report from the HADES Project*"
- May 2015 **Oregon Inst. Marine Biol.**: "*Life in the Trenches: How do Animals Cope under High Pressure? A Report from the HADES Project*"
- Jan. 2015 **Scripps Inst. Oceanography**: "*Life under Pressure: How Deep Can Fish Go?*"
- May 2011 **Canadian Soc. Zoology, Ottawa**: "*Small nitrogenous solutes in deep-sea animals: counteracting hydrostatic pressure and detoxifying hydrogen sulphide*"
- 1982-2011 **Invited departmental seminars**: Washington State, Portland State, Walla Walla, Louisiana State, and San Francisco State Universities; University of British Columbia; Nat'l. Inst. Health
- July 2008 **International Congress of Fish Biology**, Portland, OR; **Plenary opening talk**: "*Trimethylamine oxide as a protein stabilizer in elasmobranch and deep-sea fishes*"
- Oct. 2006 **APS Comparative Physiology Meeting**, Virginia Beach: "*Cytoprotective roles of compatible and counteracting solutes*"
- Sept. 2006 **4th Internat'l High Pressure Biosci. & Biotech. Conf, Tsukuba, Japan**: "*Adaptations to pressure in protein structure and organic osmolytes in deep-sea animals*"
- Apr. 2006 **Annual Mead-Johnson Clinical Scholars' Program**, Sedona, AZ: 2 talks on osmolyte research
- Aug. 2004 **VI International Congress on Biology of Fish**, Manaus, **Brazil**: "*Trimethylamine oxide as an organic osmolyte in deep-sea fishes: correlations with depth and stabilization of proteins under pressure.*"
- June 2004 **Pauley Summer Program at Hawai'i Inst. Marine Biology**, Coconut Island (Oahu): "*Organic osmolytes and related solutes in animals from hydrothermal vents and cold seeps*" and "*Organic osmolytes from sharks to deep-sea fishes to the mammalian kidney*"
- Aug. 2003 **Keynote opening talk, Gordon Conference** on Cellular Osmoregulation, Rogers Williams Univ., Rhode Island: "*Lessons from nature: protecting proteins with osmolytes in habitat stresses from the Dead Sea to the deep-sea.*"
- July 2002 **V International Congress on Biology of Fish**, Vancouver, **Canada**: "*Nitrogenous solutes as pressure-counteracting osmolytes in deep-sea fishes.*"
- July 2000 **Protein Stability Conference**, Breckenridge CO: "*'Deep insights' into properties of stabilizing osmolytes: counteraction of hydrostatic pressure effects on proteins.*"
- Apr. 2000 **Experimental Biology 2000**, San Diego: "*Osmolytes and pressure effects in deep-sea animals.*"
- Jan. 2000 **Keynote opening talk, SICB Symposium on Osmoregulation**, Atlanta: "*Water stress and proteins.*"
- July 1999 **1<sup>st</sup> Internat'l High Pressure Biosci. & Biotech. Conf.**, Honolulu: "*Effects of osmolytes of deep-sea animals on enzyme function and stability under high hydrostatic pressure.*"
- Nov. 1998 **University of Otago, Dunedin, NZ**; **Keynote talks**: "*Organic osmolytes from the deep sea to mammalian development*" and "*Water stress from the deep sea to medicine: role of organic osmolytes.*"
- Oct. 1996 **XII Intern. Congress of Eye Research, Yokohama, Japan**; **Keynote talk**: "*Compensatory changes in rat renal and lenticular osmolytes induced by polyol perturbations.*"

- July 1994 **University of Otago Medical School, Dunedin, New Zealand:** "*Living with water stress: organic osmolytes from sharks to humans*" and "*Water and osmolytes.*"
- Apr. 1992 **FASEB92, Anaheim, CA:** "*Evolutionary significance of organic osmolytes in marine organisms and mammalian kidneys.*"
- Sept. 1990 **10th Internat'l Conf. on Comp. Physio., Crans-sur-Sierre, Switzerland:** "*Compatible and counteracting aspects of organic osmolytes in mammalian kidney cells in vivo and in vitro.*"
- June 1988 **Workshop on Cell Volume Regulation, Buffalo:** "*Organic solutes in volume regulation.*"
- Aug. 1984 **1st International Congress of Compar. Physiol. and Biochem., Liege, Belgium:** "*Organic osmotic effectors in cartilaginous fishes.*"
- Jan. 1983 **Winter Conference on Brain Research, Keystone, CO:** "*Organic osmolytes in water regulation within the central nervous system.*"

## RESEARCH

Details at [people.whitman.edu/~yancey](http://people.whitman.edu/~yancey)

### CURRENT and RECENT WORK: Occurrences and Roles of ORGANIC OSMOLYTES

- 1) **Organic osmolytes as piezolytes = PRESSURE counteractants in deep-sea animals;** collaboration with:
  - i) Jeffrey Drazen, Mackenzie Gerring, Univ. Hawai'i; Tim Shank, Woods Hole; Alan Jamieson, U. Aberdeen; A. Rowden, NIWA New Zealand; Doug Bartlett, Scripps Inst. Oceanography & James Cameron's DEEPSEA CHALLENGE project; and NHK-TV and BBC-TV -- **HADES Project** ([www.who.edu/hades](http://www.who.edu/hades))
- 2) **Organic osmolytes as cytoprotectants against temperature, sulfide in hydrothermal-vent and hydrocarbon-seep animals.** Collaboration with Ray Lee, WSU; Peter Gurguis, Harvard U., Lisa Levin, Scripps.
 

#1,2 involve many **research cruises** on the R/Vs *Wecoma*, *Pt. Sur*, *K-O-K* with trawl nets, *Pt. Lobos* with ROV *Ventana*; R/V *Atlantis* with HOV *Alvin*; R/V *Thompson* with landers and hROV *Nereus*; R/Vs *Falkor* and *Shinyo-maru* with landers, including 2 explorations of the **Mariana Trench**
- 3) **Organic osmolytes in corals:** (i) osmotic composition in Hawai'an coral larvae and adults, and potential use in cryopreservation of larvae (to create a "gene bank" of endangered species), in collaboration with Mary Hagedorn, Smithsonian Inst./Univ. Hawai'i; (ii) adaptations of corals in low-salinity acidic waters of Yucatan ojos, in collaboration with Elizabeth Derse and Adina Payton, UCSC; and Mario Rebolledo-Vieyra and Laura Hernandez, Centro de Investigacion Cientifica de Yucatan.
- 4) **Organic osmolytes in mammals/humans:** Renal osmolytes in (i) cystic fibrosis and (ii) CLN3 disease, with M. Howard and W. Welch, UCSF, and Colleen Stein, U. Iowa. (iii) **Betaine as a sports drink:** effect on neurons in exercise-like conditions, with Leena Knight, Whitman Coll., Stuart Craig, Danisco/DuPont
- 5) **Organic osmolytes in farmed salmon and [endangered] European eels:** with Gordon Cramb, University of St Andrews.

## PUBLICATIONS

[undergraduate co-authors indicated by \* = work in my lab and † = work elsewhere after graduation]

### TEXTBOOKS

**ANIMAL PHYSIOLOGY: FROM GENES TO ORGANISM** BY LAURALEE SHERWOOD, HILLAR KLANDORF (WEST VIRGINIA UNIVERSITY), AND PAUL H. YANCEY (WHITMAN COLLEGE); Cengage;. 2005; 2013 2<sup>nd</sup> edition.

**BIOLOGY: THE DYNAMIC SCIENCE** BY RUSSELL ET AL.; Thomson/Brooks-Cole; 2008. Author of four "Unanswered Questions" box features (authors of which are shown with pictures and short biographies).

### RESEARCH ARTICLES and REVIEWS

1. **Hough, B.R., P.H. Yancey\*, E.H. Davidson** (1973). Persistence of maternal RNA in *Engystomops* embryos. *J. Exp. Zool.* **185**: 357-368
2. **Somero, G.N., T.J. Chow, P.H. Yancey, C.B. Snyder** (1977). Lead accumulation rates in tissues of the estuarine teleost *Gillichthys mirabilis*: salinity and temperature effects. *Arch. Envir. Contam. Toxicol.* **6**: 337-346
3. **Somero, G.N., P.H. Yancey, T.J. Chow, C.B. Snyder** (1977). Lead effects on tissue and whole organism respiration of the estuarine teleost *Gillichthys mirabilis*. *Arch. Envir. Contam. Toxicol.* **6**: 346-354
4. **Yancey, P.H., G.N. Somero** (1978). Temperature dependence of intracellular pH: its role in the conservation of pyruvate apparent Km values of vertebrate lactate dehydrogenases. *J. Comp. Physiol.* **125**:

5. **Yancey, P.H., G.N. Somero** (1978). Urea-requiring lactate dehydrogenases of marine elasmobranch fishes. *J. Comp. Physiol.* **125**: 135-141
6. **Somero, G.N., P.H. Yancey** (1978). Evolutionary adaptations of  $K_m$  and  $k_{cat}$  values: fitting the enzyme to its environment through modifications in the amino acid sequences and changes in the solute environment of the cytosol. *Symp. Biol. Hungar.* **21**: 249-276
7. **Yancey, P.H., G.N. Somero** (1979). Counteraction of urea destabilization of protein structure by methylamine osmoregulatory compounds of elasmobranch fishes. *Biochem. J.* **182**: 317-323
8. **Yancey, P.H., G.N. Somero** (1980). Methylamine osmoregulatory compounds in elasmobranch fishes reverse urea inhibition of enzymes. *J. Exp. Zool.* **212**: 205-213
9. **Altringham, J.D., I.A. Johnston, P.H. Yancey** (1980). A sensitive positional feedback transducer for investigating the force-velocity relationship of actomyosin threads. *J. Physiol.* **9/12**: 17P-18P
10. **Altringham, J.D., P.H. Yancey, I.A. Johnston** (1980). Limitations in the use of actomyosin threads as model contractile systems. *Nature* **287**: 338-340
11. **Altringham, J.D., P.H. Yancey, I.A. Johnston** (1982). The effects of osmoregulatory solutes on tension generation by dogfish skinned muscle fibres. *J. Exp. Zool.* **96**: 443-445
12. **Yancey, P.H., I.A. Johnston** (1982). Effect of electrical stimulation and exercise on the phosphorylation state of myosin light chains from fish skeletal muscle. *Pflugers Archiv.* **393**: 334-339
13. **Yancey, P.H., M.E. Clark, S.C. Hand, R.D. Bowlus, G.N. Somero** (1982). Living with water stress: evolution of osmolyte systems. *Science* **217**: 1214-1222. **I.S.I. CITATION CLASSIC** (>2000 citations)
14. **Siebenaller, J.F., P.H. Yancey** (1984). The protein composition of white skeletal muscle from mesopelagic fishes having different water and protein contents. *Mar. Biol.* **78**: 129-137
15. **Yancey, P.H.** (1985). Organic osmotic effectors in cartilaginous fishes. IN: *Transport Processes, Iono- and Osmoregulation* (R. Gilles, M. Gilles-Ballien, eds), pp 424-436; Berlin: Springer-Verlag
16. **Yancey, P.H., J.F. Siebenaller** (1987). Coenzyme binding ability of homologs of  $M_4$ -lactate dehydrogenase in temperature adaptation. *Biochim. Biophys. Acta* **924**: 483-491.
17. **Yancey, P.H.** (1988). Osmotic effectors in kidneys of xeric and mesic rodents: cortico-medullary distributions and changes with water availability. *J. Comp. Physiol.* **158B**: 369-380
18. **Wolff, S., P.H. Yancey, T.S. Stanton, R. Balaban** (1989). A simple HPLC method for quantitating the major organic solutes of the renal medulla. *Amer. J. Physiol.* **256**: F954-956
19. **Yancey, P.H., M.B. Burg** (1989). Distributions of major organic osmolytes in rabbit kidneys in diuresis and antidiuresis. *Amer. J. Physiol.* **257**: F602-607
20. **Yancey, P.H., R. Lawrence-Berrey\*, M. D. Douglas\*** (1989). Adaptations in mesopelagic fishes. I. Buoyant glycosaminoglycan layers in species without diel vertical migrations. *Mar. Biol.* **103**: 453-459
21. **Yancey, P.H., M.B. Burg, S.M. Bagnasco** (1990). Effects of NaCl, glucose and aldose reductase inhibitors on cloning efficiency of renal cells. *Amer. J. Physiol.* **258**: C156-163
22. **Yancey, P.H., M.B. Burg** (1990). Counteracting effects of urea and betaine on colony-forming efficiency of mammalian cells in culture. *Amer. J. Physiol.* **258**: R198-204
23. **Yancey, P.H., R.G. Haner\*, T. Freudenberger\*** (1990). Effects of an aldose reductase inhibitor on osmotic effectors in rat renal medulla. *Amer. J. Physiol.* **259**: F733-F738
24. **Yancey, P.H., J. Ruble\*, J.D. Valentich** (1991). Effect of chloride secretagogues on cyclic AMP formation in cultured shark (*Squalus acanthias*) rectal gland epithelial cells. *Bull. Mt. Des. I. Biol. Lab.* **13**: 51-52
25. **Yancey, P.H.** (1992) Compatible and counteracting aspects of organic osmolytes in mammalian kidney cells in vivo and in vitro. In: *Water and Life: A Comparative Analysis of Water Relationships at the Organismic, Cellular, and Molecular Levels*; Somero, G.N., C.B. Osmond, C.L. Bolis (eds); Springer-Verlag
26. **Peterson\*, D.P., K.M. Murphy\*, R. Ursino\*, K. Streeter\*, P.H. Yancey** (1992). Effects of dietary protein and salt on rat renal osmolytes: co-variation in urea and GPC contents. *Amer. J. Physiol.* **263**: F594-F600
27. **Yancey, P.H., T. Kulongoski\*, M.D. Usibelli\*, R. Lawrence-Berrey\*, A. Pedersen\*** (1992). Adaptations in mesopelagic fishes. II. Protein contents of various muscles and actomyosin contents and structure of swimming muscle. *Comp. Biochem. Physiol.* **103B**: 691-697
28. **Edmands\*, S., P.H. Yancey** (1992). Effects on rat renal osmolytes of extended treatment with an aldose reductase inhibitor. *Comp. Biochem. Physiol.* **103C**: 499-502

29. **Yancey, P.H.** (1994). Compatible and counteracting solutes. In: *Cellular and Molecular Physiology of Cell Volume Regulation*, Strange, K. (ed.), CRC Press, Boca Raton; pp. 81-109
30. **Edmands\*, S.D., K.S. Hughs\*, S. Lee\*, S.D. Meyer\*, E. Saari, P.H. Yancey** (1995). Time-dependent aspects of osmolyte changes in rat kidney, urine, blood and lens with sorbinil and galactose feeding. *Kidney Int.* **48**: 344-353
31. **Trachtman, H., P.H. Yancey, S.R. Gullans** (1995). Cerebral cell volume regulation during hypernatremia in developing rats. *Brain Res.* **693**: 155-62
32. **Somero, G.N., P.H. Yancey** (1997). Osmolytes and cell volume regulation: physiological and evolutionary principles. In: *Handbook of Physiology, Sec. 14*; Hoffman, J. F, J.D. Jamieson (eds). Oxford University Press
33. **Fuery, C.J., P.V. Attwood, P.C. Withers, P.H. Yancey, J. Baldwin, M. Guppy** (1997). Effects of urea on M<sub>4</sub>-lactate dehydrogenase from elasmobranchs and urea-accumulating Australian desert frogs. *Comp. Biochem. Physiol.* **117B**: 143-150
34. **Gillett\*, M.B., J.R. Suko\*, F.O. Santoso\*, P.H. Yancey** (1997). Elevated levels of trimethylamine oxide in muscles of deep-sea gadiform teleosts: a high-pressure adaptation? *J. Exp. Zool.* **279**: 386-391 (Rapid Communication)
35. **Bedford, J.J., J.L. Harper, J.P. Leader, P.H. Yancey, R.A.J. Smith** (1998). Tissue composition of the elephant fish, *Callorhynchus milli*: Betaine is the principal counteracting osmolyte. *Comp. Biochem. Physiol.* **119B**: 521-526
36. **Kelly\*, R.H., P.H. Yancey** (1999). High contents of trimethylamine oxide correlating with depth in deep-sea teleost fishes, skates, and decapod crustaceans. *Biol. Bull.* **196**:18-25
37. **Rohr\*, J.M., T. Hong\*, S. Truong\*, P.H. Yancey** (1999). Effects of ascorbic acid, aminoguanidine, sorbinil and zopolrestat on sorbitol and betaine contents in cultured rat renal cells. *Exp. Biol. Online* **4**:3; <http://link.springer.de/link/service/journals/00898/bibs/9004001/90040003.htm>
38. **Yancey, P.H., J.F. Siebenaller** (1999). Trimethylamine oxide stabilizes teleost and mammalian lactate dehydrogenases against inactivation by hydrostatic pressure and trypsinolysis. *J. Exp. Biol.* **202**:3597-3603. Featured in Science News.
39. **Miller\*, T.J., R.D. Hanson\*, P.H. Yancey** (2000). Developmental changes in organic osmolytes in prenatal and postnatal rat tissues. *Compar. Biochem. Physiol.* **125**: 45-56.
40. **Yancey, P.H., R.H. Kelly\*, A.L. Fyfe-Johnson\*, M.T. Auñón\*, V.P. Walker\*, J. F. Siebenaller** (2000). Effects of osmolytes of deep-sea animals on enzyme function and stability under high hydrostatic pressure. In: *Science and Technology of High Pressure: Proceedings of AIRAPT-17* (Manghnani, M.H., W.J. Nellis, M.T. Nicol, eds). Universities Press, Hyderabad, India,, pp 328-30.
41. **Yin, M., H.R. Palmer, A.L. Fyfe-Johnson\*, J.J. Bedford, R.A. Smith, P.H. Yancey** (2000). Hypotaurine, N-methyltaurine, taurine, and glycine betaine as dominant osmolytes of vestimentiferan tubeworms from hydrothermal vents and cold seeps. *Phys. Biochem. Zool.* **73**: 629-637.
42. **Yancey, P.H., A.L. Fyfe-Johnson\*, R.H. Kelly\*, V.P. Walker\*, M.T. Auñón\*** (2001). Trimethylamine oxide counteracts effects of hydrostatic pressure on proteins of deep-sea teleosts. *J. Exp. Zool.* **289**: 172-176.
43. **Yancey, P.H.** (2001). Nitrogenous solutes as osmolytes. *Fish Physiology* Vol. 20: *Nitrogen Excretion* (P. Wright, P. Anderson, eds). Academic Press, pp 309-341 (invited chapter).
44. **Yancey, P.H.** (2001). Protein, osmolytes and water stress. *Amer. Zool.* **41**: 699-709.
45. **Leader, J.P., J. Schofield, P.H. Yancey, J.J. Bedford** (2002). The effects of hypoosmotic infusion on the composition of renal tissue of the Australian brush-tailed possum *Trichosurus vulpecula*. *Comp. Biochem. Physiol.* **132B**: 645-652.
46. **Yancey, P.H., W. Blake\*, J. Conley\*** (2002). Unusual organic osmolytes in deep-sea animals: Adaptations to hydrostatic pressure and other perturbants. *Comp. Biochem. Physiol.* **133A**: 667-676
47. **Fieess\*, J.C., J.R. Hom\*, H.A. Hudson\*, C. Kato, P.H. Yancey** (2002). Phosphodiester amine, taurine and derivatives, and other osmolytes in vesicomid bivalves: correlations with depth and symbiont metabolism. *Cahiers Biol. Mar.* **43**: 337-340.
48. **Yancey, P.H., W. Blake\*, J. Conley\*, R.H. Kelly\*** (2002). Nitrogenous solutes as protein-stabilizing osmolytes: counteracting the destabilizing effects of hydrostatic pressure in deepsea fish. *Proceedings of the 2002 International Congress on Fish Biology* (Wright, P., D. MacKinlay, eds). Amer. Fisheries Society.
49. **Yancey, P.H.** (2003). Proteins and counteracting osmolytes. *Biologist* **50**: 126-131 (invited review).

50. **Howard, M., H. Fischer, J. Roux, B.C. Santos, S.R. Gullans, P.H. Yancey, W.J. Welch** (2003). Mammalian osmolytes and s-nitrosoglutathione promote  $\Delta F508$  cystic fibrosis transmembrane conductance regulator (CFTR) protein maturation and function. *J. Biol. Chem.* **278**: 35159-35167.
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#### **COMMENTARY ARTICLES**

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#### **PUBLISHED ABSTRACTS from presented talks and posters**

1. Yancey, P.H., W. Bement\*, M. Maier\* (1985). Temperature, pH and pressure effects on lactate dehydrogenases of vertically migrating midwater fishes. *Amer. Zool.* 25: 19A.
2. Yancey, P.H., R.G. Haner\*, T. Freudenberger\* (1990). Effects of an aldose reductase inhibitor on osmotic effectors in rat renal medulla. *Proc. Soc. Exp. Bio. Med.*, March: 238
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5. Yancey, P.H., S.D. Meyer\*, S.Y. Lee\*, T.A. Hong\*, S. Truong\* (1996). Compensatory changes in rat



- renal and lenticular osmolytes induced by polyol perturbations. *Exp. Eye Res.* **63**: S188. Invited talk, Congress of Eye Research, Yokohama, **Japan**
6. **Gillett\*, M.B., J.R. Suko\*, F.O. Santoso\*, P.H. Yancey** (1996). Elevated levels of trimethylamine oxide in muscles of deep-sea teleosts. *Amer. Zool.* **36**: 35A
  7. **Kelly\*, R.H., M.G. Gillett\*, P.H. Yancey** (1997). High levels of trimethylamine oxide in muscles of deep-sea fishes, squid and shrimp. *Amer. Zool.* **37**: 144A
  8. **Fyfe-Johnson\*, A.L., P.H. Yancey** (1998). Pressure inhibition of deep-sea grenadier lactate dehydrogenase and counteractions by trimethylamine oxide. *Amer. Zool.* **38**: 120A
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  10. **Yin, M., H.R. Palmer, J.J. Bedford, A. Fyfe-Johnson\*, F. Santoso\*, J. Suko\*, P.H. Yancey** (1999). Unusual osmolytes in deep-sea vestimentiferans, gastropods, and echinoderms. *Amer. Zool.* **39**: 65A
  11. **Yancey, P., M. Gillett\*, R. Kelly\*, A. Fyfe-Johnson\*, M. Auñón\*, V. Walker\*, J. Siebenaller** (2000). Co-evolution of deep-sea proteins and osmolytes: trimethylamine N-oxide counteracts inhibition by hydrostatic pressure. *FASEB J.* **14**: A440
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  13. **Fiess\*, J.C., J.R. Hom\*, H.A. Hudson\*, C. Kato, P.H. Yancey** (2001). Depth correlations of organic osmolytes in foot and mantle tissues of vesicomid bivalves. *Amer. Zool.* **41**:1442
  14. **Hudson\*, H.A., J.R. Hom\*, J.C.Fiess\*, C. Kato, P.H. Yancey** (2001). Correlations of hypotaurine and thiotaurine contents with sulfide metabolism in gills of vesicomid bivalves. *Amer. Zool.* **41**:1476
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  18. **Rosenberg\*, N.B., R.W. Lee, P.H. Yancey** (2003). Adaptation to environmental stresses with osmolytes: possible roles for betaine, hypotaurine and thiotaurine in gastropods from hydrothermal vents. *Comp. Biochem. Physiol.* **134**: S120. At ICCPB in Mt. Buller, **Australia**
  19. **Yancey, P.H.** (2003). Unusual organic osmolytes in deep-sea animals as adaptations to symbiont metabolism and hydrostatic pressure. *Comp. Biochem. Physiol.* **134**: S117.
  20. **Steele, S.L., Yancey, P.H., Wright, P.A.** (2003). Mechanisms of osmotic regulation in a marine elasmobranch in response to dilute seawater: a developmental perspective. *Comp. Biochem. Physiol.* **134A**:S11. International Fish Biology Congress, Vancouver **Canada**
  21. **Horak\*, R.V., N.K. Rosenberg\*, H.A. Hudson\*, R. Lee, P.H. Yancey** (2003). Occurrence of thiotaurine and hypotaurine in hydrothermal vents and cold seep species without endosymbionts. *Integr. Comp. Biol.* **43**: 1043.
  22. **Yancey, P.H., A.L. Samerotte\*, G.L. Brand\*, J.C. Drazen** (2004). Increasing contents of TMAO with depth within species as well as among species of teleost fish. *Integr. Comp. Biol.* **44**: 669.
  23. **Kunkel-Patterson\*, A., J.C. Fiess; L. Mathias\*; L. Riley; A. Samerotte\*; T. Hirano; P.H. Yancey** (2005). Effects of salinity and temperature on organic osmolytes in tilapia. *Integr. Comp. Biol.* **45**: 1156.
  24. **Yancey, P.H.** (2006). Cytoprotective roles of compatible and counteracting solutes. *The Physiologist* **49**: C1-40.

### **Selected Unpublished ABSTRACTS from Presentations (printed in meeting bulletins only)**

Other *international* presentations *published* and/or *invited* above

- **Yancey, P.H., S. Edmands\*, K. Seekamp\*, R. Haner\*** (1991). Organic osmolyte regulation in rodent kidneys subjected to various perturbations. *3rd Internatl. Cong. Comp. Physiol. Biochem.*, Tokyo, **Japan**.
- **Rohr\*, J.M., P.H. Yancey** (1997). Effects of aldose reductase inhibitors, ascorbic acid and amino-guanidine on sorbitol contents in primary renal cultures. Poster at the *33rd Internat'l Cong. Physiol. Sci.*, St. Petersburg, **Russia**, June 30-July 5.
- **Walker\*, V., M. Auñón\*, P.H. Yancey** (2000). Effects of osmolytes of deep-sea animals on enzyme function and stability under high hydrostatic pressure. Council on Undergraduate Research **Posters-On-The-Hill Meeting, Washington DC**: selected competitively as one of only 60 from the whole country. We listened to talks by a congressman and other officials on science funding; met with congressional aides for Senator Patty Murray and congressmen from the students' home districts (Oregon, Colorado): Ron Wyden, Gordon Smith,

and others (to discuss research funding). We presented our work at a poster session, in which several NSF and NASA officials and congressional aides specifically went over our poster in detail.

- **Yancey, P.H., W. Blake\*, J. Conley\*** (2001). Protective properties of organic osmolytes in deep-sea fish and vestimentiferans. Talk at *How Animals Work Conference*, Chobe Nat'l Park, **Botswana**, Aug. 18-24.
- **Fiess\*, J., J.R. Hom\*, H.A. Hudson\*, P.H. Yancey** (2001). Phosphodiester amine, taurine and derivatives, and other osmolytes in vesicomimid bivalves from cold seeps: correlations with depth and symbiont metabolism. At 2<sup>nd</sup> Internat'l Symposium Hydrothermal Vents Cold Seeps, Brest, **France**.
- **Yancey, P.H.** (2004). Trimethylamine oxide as an organic osmolyte in deep-sea fishes: Correlations with depth and stabilization of proteins under pressure. *Internat'l Cong. Biology Fish Biology*, Aug 1-5, Manaus, **Brazil**.
- **Brand\*, G.L., R.V. Horak\*, N. LeBris, S.K. Goffredi, S.L. Carney, B. Govenar, P.H. Yancey** (2005). Hypotaurine and thiotaurine as indicators of sulfide exposure in bivalves and vestimentiferans from hydrothermal vents and cold seeps (2005). 3rd Internat'l Symp. Hydrothermal Vents Cold Seeps, La Jolla
- **Laxson\*, C.J., N. Condon, J.C. Drazen, P.H. Yancey** (2010). Decreasing urea:methylamine ratios with depth in chondrichthyan fishes: a physiological depth limit? *12<sup>th</sup> Internat'l Symp. Deep-sea Biology*, Reykjavik, **Iceland** June 5-11.
- **Chavez\*, K., R.G. Waller, P.H. Yancey**. Organic osmolytes in deep-sea corals. *12<sup>th</sup> Internat'l Symp. Deep-sea Biology*, Reykjavik, **Iceland** June 5-10.
- **Gerringer\*, M., A. Jamieson, A. Rowden, J. Drazen, P.H. Yancey** (2012). High trimethylamine oxide contents in hadal snailfish (Liparidae) indicate a depth limit for teleost fishes. *13<sup>th</sup> Internat'l Symp. Deep-sea Biology*, Wellington, **New Zealand**, Dec. 2-7.
- **Downing\*, A.B., G.T. Wallace\*, C.L. Weinstock\*, P.H. Yancey** (2015) Trimethylamine oxide, scyllo-inositol and other potential piezolytes (pressure counteractants) correlating with depth in hadal fishes and amphipods. *14<sup>th</sup> Internat'l Symp. Deep-sea Biology*, Aveiro, **Portugal**, Aug. 30-Sept. 4.

### **EDUCATIONAL/OUTREACH Materials**

- **Yancey, P.H.** (1999). Self-test questions on the **website** for the 1999 edition of *Marine Biology* by Castro and Huber (a major college text by McGraw Hill). Posted on the web in 6/99.
- **Yancey, P.H.** (1997-present). [people.whitman.edu/~yancey/deepsea.html](http://people.whitman.edu/~yancey/deepsea.html): **Educational DEEP-SEA WEB SITE** designed in 1997, and continuously updated with new deep-sea research. It is cited in at least 3 marine science texts, and is used by many people around the world; I receive many emails each week from a variety of sources, e.g., reporters, writers, students, teachers seeking information on the deep sea. In 2002, the site was selected by the Nat'l Sci. Teachers Assoc., under strict NSF guidelines, as an online science resource for K-12 and higher education. In 2011, the Marine Education Society of Australasia adopted my entire site (embedded in their site: [http://www.mesa.edu.au/deep\\_sea/biblioPY.asp](http://www.mesa.edu.au/deep_sea/biblioPY.asp) )
- **DIRECTOR OF DEEP SEA for MARINEBIO.ORG** (2011-present): <http://marinebio.org/oceans/deep/> Appointed to this position by David Campbell, webmaster of this growing new site dedicated to "sharing the wonders of the ocean realm to inspire science education, marine conservation, research, and a sea ethic." Duties are to manage the deep-sea page of this site and advise on other features of the entire site. I wrote a long overview of deep-sea biology, which has received many positive comments online by users.
- **DEEP OCEANS Documentary -- NHK-TV & Tokyo Univ. Mar. Sci. & Tech. = TUMSAT:** My HADES colleagues and I were invited by Japanese scientists and filmmakers from NHK (Japanese equivalent of BBC) to be filmed on a TUMSAT expedition for their **DEEP OCEANS** TV series. We were filmed/interviewed on expedition aboard the *Shinyo Maru*, Jan. 20 to Feb. 3, at the Mariana Trench, and I was later interviewed in my lab at Whitman, May 28. **DEEP OCEANS** premiered in Japan Aug. 27, 2017. English version, narrated by Sir David Attenborough to come in 2018; I helped with wording for Sir Attenborough's dialogue on my work.
- **BBC BLUE PLANET II Documentary, Nov. 2017:** featuring footage from our Mariana Trench expedition in 2014, narrated by Sir Attenborough; I provided the key footage to the BBC.