

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

Required text:

Roderic D. M. Page and Edward C. Holmes. Molecular Evolution, A Phylogenetic Approach. Blackwell. 1998

M. F. Strathmann (1987) Reproduction and Development of Marine Invertebrates of the Northern Pacific Coast. Univ. Washington Press. (Royalties to FHL scholarships).

Recommended Text:

S. F. Gilbert & A. M. Raunio, eds (1997) Embryology, Constructing the Organism. Sinauer

Readings for discussions

Metazoan phylogeny

Aguinaldo, A. M. A., J. M. Turbeville, L. S. Linford, M. C. Rivera, J. R. Garey, R. A. Raff, and J. A. Lake. 1997. Evidence for a clade of nematodes, arthropods and other moulting animals. *Nature* **387**:489-493.

Halanych, K. M., J. D. Bacheller, A. M. A. Aguinaldo, S. M. Liva, D. M. Hillis, and J. A. Lake. 1995. Evidence from 18S ribosomal DNA that the lophophorates are protostome animals. *Science* **267**:1641-1643.

Adoutte, A., G. Balavoine, N. Lartillot, and R. de Rosa. 1999. Animal evolution: the end of the intermediate taxa? *Trends in Genetics* **15**:104-108.

Acoels

Berney, C., J. Pawlowski, and L. Zaninetti. 2000. Elongation factor 1-alpha sequences do not support an early divergence of the Acoela. *Mol. Biol. Evol.* **17**:1032-1039.

Ruiz-Trillo, I., M. Riutort, T. J. Littlewood, E. A. Herniou, and J. Bagueña. 1999. Acoel flatworms: Earliest extant bilaterian metazoans, not members of platyhelminthes. *Science* **283**:1919-1923.

Sutton, M. D., D. E. Briggs, and D. J. Siveter. 2001. An exceptionally preserved vermiform mollusc from the Silurian of England. *Nature* **410**:461-463.

T Brachyury

Arendt, D., U. Technau, and J. Wittbrodt. 2001. Evolution of the bilaterian larval foregut. *Nature* **409**:81-85.

Fossils

Bengston, S., and Y. Zhao. 1997. Fossilized metazoan embryos from the earliest Cambrian. *Science* **277**:1645-1648.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

Xiao, S., Y. Zhang, and A. H. Knoll. 1998. Three-dimensional preservation of algae and animal embryos in a Neoproterozoic phosphorite. *Nature* **391**:553-558.

Embryos and Larva

Peterson, K., R. Cameron, and E. Davidson. 2000. Bilaterian Origins: Significance of New Experimental Observations. *Developmental Biology* **219**:1-17.

McEdward, L. R., and D. A. Janies. 1993. Life cycle evolution in Asterioids: What is a larva? *Biol. Bull.* **184**:255-268.

References for Swalla Lectures

Revisions in Deuterostome Phylogeny

Bromham, L. D. & Degnan, B. M. (1999) Hemichordates and deuterostome evolution: robust molecular support for a hemichordate + echinoderm clade. *Evol. Dev.* 1: 166-171.

Cameron, C. B., Swalla, B. J. & Garey, J. R. (2000) Evolution of the chordate body plan: New insights from phylogenetic analyses of deuterostome phyla. *Proc. Natl. Acad. Sci.* 97: 4469-4474.

Castresana, J. Feldmaier-Fuchs, G., Yokobori, S., Satoh, N. & Pääbo, S. (1998) The mitochondrial genome of the hemichordate *Balanoglossus carnosus* and the evolution of deuterostome mitochondria. *Genetics* 150, 1115-1123.

Christen, R. and Braconnot, J. C. (1998) Molecular phylogeny of tunicates. A preliminary study using 28S ribosomal RNA partial sequences: Implications in terms of evolution and ecology. In *The Biology of Pelagic Tunicates*, (ed. Q. Bone), pp. 265-271. Oxford: Oxford University Press.

Halanych, K. M., Bacheller, J. D., Aguinaldo, A. M., Liva, S. M., Hillis, D. M. and Lake, J. A. (1995) Evidence of 18S ribosomal DNA that the lophophorates are protostome animals. *Science* 267: 1641-1643.

Halanych, K. (1996a) Convergence in the feeding apparatuses of lophophorates and pterobranch hemichordates revealed by 18S rDNA: An interpretation. *Biol. Bull.* 190: 1-5.

Halanych, K. (1996b) Testing hypotheses of chaetognath origins: long branches revealed by 18S rDNA. *Syst. Biol.* 45: 223-246 .

Mackey, L. Y., Winnepeninckx, B., De Wachter, R., Backeljau, T., Emschermann, P. & Garey, J. R. (1996) 18S rRNA suggests that entoprocta are protostomes, unrelated to ectoprocta. *J. Mol. Evol.* 42: 552-559.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Swalla, B.J., Cameron, C.B., Corley, L.S. and Garey, J.R. (2000) Urochordates are monophyletic within the deuterostomes. *Systematic Biology* 49: 122-134.
- Turbeville, J. M., Schulz, J. R. & Raff, R. A. (1994) Deuterostome phylogeny and the sister group of the chordates: Evidence from molecules and morphology. *Mol. Biol. Evol.* 11: 648-655.
- Wada, H. & Satoh, N. (1994) Details of the evolutionary history from invertebrates to vertebrates, as deduced from the sequences of 18S rDNA. *Proc. Natl. Acad. Sci.* 91: 1801-1804 .
- Winchell, C.J., Sullivan, J., Cameron, C.B., Swalla, B. J. and Mallatt, J. (2001) Evaluating hypotheses of deuterostome phylogeny and chordate evolution with new LSU and SSU ribosomal DNA data. *Mol. Biol. Evol.* (in press)

***T brachyury* and its role in metazoan development**

- Agulnik, S. I., Ruvinsky, I. and Silver, L. M. (1997). Three novel T-box genes in *Caenorhabditis elegans*. *Genome* 40, 458-64.
- Arendt, D., Technau, U. and Wittbrodt, J. (2001). Evolution of the bilaterian larval foregut. *Nature* 409, 81-5.
- Bassham, S. and Postlethwait, J. (2000). Brachyury (T) expression in embryos of a larvacean urochordate, *Oikopleura dioica*, and the ancestral role of *T*. *Dev Biol* 220, 322-32.
- Galliot, B. (2000). Conserved and divergent genes in apex and axis development of cnidarians. *Curr Opin Genet Dev* 10, 629-37.
- Harada, Y., Yasuo, H. and Satoh, N. (1995). A sea urchin homologue of the chordate *Brachyury (T)* gene is expressed in the secondary mesenchyme founder cells. *Development* 121, 2747-54.
- Holland, P., Koschorz, B., Holland, L. Z., and Herrmann, B. G. (1995). Conservation of *Brachyury (T)* genes in amphioxus and vertebrates: developmental and evolutionary implications. *Development* 121, 4283-4291.
- Hotta, K., Takahashi, H., Asakura, T., Saitoh, B., Takatori, N., Satou, Y. and Satoh, N. (2000). Characterization of Brachyury-downstream notochord genes in *the Ciona intestinalis* embryo. *Dev Biol* 224, 69-80.
- Knezevic, V., De Santo, R., and Mackem, S. (1997). Two novel chick T-box genes related to mouse *Brachyury* are expressed in different, non-overlapping mesodermal domains during gastrulation. *Development* 124, 411-419.
- Muller, C. W., and Herrmann, B. G. (1997). Crystallographic structure of the T domain-

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- DNA complex of the *Brachyury* transcription factor. *Nature* 389, 884-888.
- Nishino, A., Satou, Y., Morisawa, M. and Satoh, N. (2001). *Brachyury* (*T*) gene expression and notochord development in *Oikopleura longicauda*. (Appendicularia, Urochordata). *Dev Genes Evol* 211, 219-31.
- Papaioannou, V. E., and Silver, L.M. (1998). The T-box gene family. *Bioessays* 20, 9-19.
- Peterson, K. J., Cameron, R.A., Tagawa, K., Satoh, N., and Davidson, E.H. (1999) A comparative molecular approach to mesodermal patterning in basal deuterostomes: the expression pattern of *Brachyury* in the enteropneust hemichordate *Ptychodera flava*. *Development* 126, 85-95.
- Peterson, K. J., Harada, Y., Cameron, R. A. and Davidson, E. H. (1999). Expression pattern of *Brachyury* and *Not* in the sea urchin: comparative implications for the origins of mesoderm in the basal deuterostomes. *Dev Biol* 207, 419-31.
- Satoh, G., Harada, Y. and Satoh, N. (2000). The expression of nonchordate deuterostome *Brachyury* genes in the ascidian *Ciona* embryo can promote the differentiation of extra notochord cells. *Mech Dev* 96, 155-63.
- Schulte-Merker, S., van Eeden, F. J. M., Halpern, M. E., Kimmel, C. B., and Nusslein-Volhard, C. (1994). *no tail (ntl)* is the zebrafish homologue of the mouse *T* (*Brachyury*) gene. *Development* 120, 1009-1015.
- Shoguchi, E., Satoh, N. and Maruyama, Y. K. (1999). Pattern of *Brachyury* gene expression in starfish embryos resembles that of hemichordate embryos but not of sea urchin embryos. *Mech Dev* 82, 185-9.
- Smith, J. (1999). T-box genes: what they do and how they do it. *Trends Genet* 15, 154-8.
- Tagawa, K., Humphreys, T. and Satoh, N. (1998). Novel pattern of *Brachyury* gene expression in hemichordate embryos. *Mech Dev* 75, 139-43.
- Technau, U. and Bode, H. R. (1999). *HyBra1*, a *Brachyury* homologue, acts during head formation in Hydra. *Development* 126, 999-1010.
- Wattler, S., Russ, A., Evans, M., and Nehls, M. (1998). A combined analysis of genomic and primary protein structure defines the phylogenetic relationship of new members of the T-box family. *Genomics* 48, 24-33.
- Woollard, A. and Hodgkin, J. (2000). The *Caenorhabditis elegans* fate-determining gene *mab-9* encodes a T-box protein required to pattern the posterior hindgut. *Genes Dev* 14, 596-603.
- Yasuo, H., and Satoh, N. (1994). An ascidian homolog of the mouse *Brachyury* (*T*) gene is expressed exclusively in notochord cells at the fate restricted stage. *Development Growth and Differentiation* 36, 9-18.

Vasa and germ cell determination

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Fujimura, M. and Takamura, K. (2000). Characterization of an ascidian DEAD-box gene, Ci-DEAD1: specific expression in the germ cells and its mRNA localization in the posterior-most blastomeres in early embryos. *Dev. Genes Evol.* 210, 64-72.
- Mochizuki, K., Nishimiya-Fujisawa, C. and Fujisawa, T. (2001). Universal occurrence of the *vasa*-related genes among metazoans and their germline expression in *Hydra*. *Dev. Genes Evol.* 211, 299-308.
- Tsunekawa, N., Naito, M., Sakai, Y., Nishida, T. and Noce, T. (2000). Isolation of chicken *vasa* homolog gene and tracing the origin of primordial germ cells. *Development* 127, 2741-2750.
- Yoon, C., Kawakami, K. and Hopkins, N. (1997). Zebrafish *vasa* homologue RNA is localized to the cleavage planes of 2- and 4-cell-stage embryos and is expressed in the primordial germ cells. *Development* 124, 3157-3166.

Nodal and left-right asymmetry in chordates

- Campione, M., Steinbeisser, H., Schweickert, A., Deissler, K., van Bebber, F., Lowe, L. A., Nowotschin, S., Viebahn, C., Haffter, P., Kuehn, M. R. et al. (1999). The homeobox gene *Pitx2*: mediator of asymmetric left-right signaling in vertebrate heart and gut looping. *Development* 126, 1225-34.
- Capdevila, J., Vogan, K. J., Tabin, C. J. and Izpisua Belmonte, J. C. (2000). Mechanisms of left-right determination in vertebrates. *Cell* 101, 9-21.
- Feldman, B., Gates, M. A., Egan, E. S., Dougan, S. T., Rennebeck, G., Sirotkin, H. I., Schier, A. F. and Talbot, W. S. (1998). Zebrafish organizer development and germ-layer formation require nodal- related signals. *Nature* 395, 181-5.
- Jones, C. M., Kuehn, M. R., Hogan, B. L., Smith, J. C. and Wright, C. V. (1995). Nodal-related signals induce axial mesoderm and dorsalize mesoderm during gastrulation. *Development* 121, 3651-62.
- Schier, A. F. and Shen, M. M. (2000). Nodal signalling in vertebrate development. *Nature* 403, 385-9.
- Schumpert, B., Keefer, A., Wright, C.V.E., and Swalla, B.J. (1999). Evolution of left-right asymmetry: expression of ascidian nodal. [abstract]. *American Zoologist* 39, 77A.
- Yasui, K. e. a. (2000). Left-right asymmetric expression of *BbPtx*, a *Ptx*-related gene, in a lancelet species and the developmental left-sidedness in deuterostomes. *Development (Cambridge, U.K.)* 127, 187-195.
- Yost, H. J. (2001). Establishment of left-right asymmetry. *Int Rev Cytol* 203, 357-81.
- Zhou, X., Sasaki, H., Lowe, L., Hogan, B. L. and Kuehn, M. R. (1993). Nodal is a novel TGF-beta-like gene expressed in the mouse node during gastrulation. *Nature* 361, 543-7.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

Hox Gene Clusters and Anterior-Posterior Patterning in Metazoans

- Aerne, B. L., C.D. Baader, and V. Schmid. (1995). Life stage and tissue- specific expression of the homeobox gene *Cnox1-Pc* of the Hydrozoan *Podocoryne carnea*. *Developmental Biology* 169, 547-556.
- Arenas-Mena, C., Martinez, P., Cameron, R.A., and Davidson, E.H. (1998). Expression of the *Hox* gene complex in the indirect development of a sea urchin. *Proceedings of the National Academy of Sciences, U.S.A.* 95, 13062-13067.
- Duboule, D., ed. (1994). *Guidebook to the Homeobox Genes*. Oxford: Oxford University Press.
- de Rosa, R., Grenier, J.K., Andreeva, T., Cook, C.E., Adoutte, A., Akam, M., Carroll, S., and Balavoine, G. (1999). *Hox* genes in brachiopods and priapulids and protostome evolution. *Nature* 399, 772-776.
- Holland, P. W. H. (1992). Homeobox genes in vertebrate evolution. *Bioessays* 14, 267-273.
- Irvine, S. Q. a. M., M.Q. (2000). Expression patterns of anterior *Hox* genes in the polychaete *Chaetopterus*: Correlation with morphological boundaries. *Developmental Biology* 217, 333-351.
- Locascio, A., Aniello, F., Amoroso, A., Manzanares, M., Krumlauf, R., and Branno, M. (1999). Patterning the ascidian nervous system: structure, expression and transgenic analysis of the *CiHox3* gene. *Development* 126, 4737-4748.
- Peterson, K. J., Arenas-Mena, C., and Davidson, E.H. (2000). The A/P axis in echinoderm ontogeny and evolution: evidence from fossils and molecules. *Evolution & Development* 2, 93-101.
- Peterson, K. J., Irvine, S. Q., Cameron, R. A. and Davidson, E. H. (2000). Quantitative assessment of Hox complex expression in the indirect development of the polychaete annelid *Chaetopterus* sp. *Proc Natl Acad Sci U S A* 97, 4487-92.
- Popodi, E., J.C. Kissinger, M.E. Andrews, and R.A. Raff. (1996). Sea urchin *Hox* genes: Insights into the ancestral Hox cluster. *Molecular Biology and Evolution* 13(8), 1078-1086.
- Prince, V. E., Joly, L., Ekker, M., and Ho, R.K. (1998). Zebrafish *Hox* genes: genomic organization and modified colinear expression patterns in the trunk. *Development* 125, 407-420.
- Wada, H., Garcia-Fernandez, J., and Holland, P.W.H. (1999). Colinear and segmental expression of *Amphioxus Hox* genes. *Developmental Biology* 213, 131-141.

Ascidian Metamorphosis and Coloniality

- Cloney, R. A. (1982). Ascidian larvae and the events of metamorphosis. *Amer. Zool.* 22, 817-826.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Cloney, R. A. (1978). Ascidian metamorphosis: Review and analysis. In *Settlement and metamorphosis of Marine Invertebrate Larvae*, (ed. F. S. Chia and M. E. Rice). New York: Elsevier.
- Davidson, B. and Swalla, B. J. (2001). Isolation of genes involved in ascidian metamorphosis: epidermal growth factor signaling and metamorphic competence. *Dev Genes Evol* 211, 190-4.
- Degnan, B. M., Souter, D., Degnan, S. M. and Long, S. C. (1997) Induction of metamorphosis with potassium ions requires development of competence and an anterior signalling centre in the ascidian *Herdmania momus*. *Development, Genes and Evolution* 206, 370-376.
- Eri, R., Arnold, J. M., Hinman, V. F., Green, K. M., Jones, M. K., Degnan, B. M. and Lavin, M. F. (1999). *Hemps*, a novel EGF-like protein, plays a central role in ascidian metamorphosis. *Development* 126, 5809-5818.
- Hinman, V. F., Becker, E. and Degnan, B. M. (2000). Neuroectodermal and endodermal expression of the ascidian Cdx gene is separated by metamorphosis. *Development, Genes and Evolution* 210, 212-216.
- Hinman, V. F. and Degnan, B. M. (2000). Retinoic acid perturbs *Otx* gene expression in the ascidian pharynx. *Development, Genes and Evolution* 210, 129-139.
- Hirano, T. and Nishida, H. (1997). Developmental fates of larval tissues after metamorphosis in ascidian *Halocynthia rotetzi*. *Developmental Biology* 192, 199-209.
- Panganiban, G., Irvine, S. M., Lowe, C., Roehl, H., Corley, L. S., Sherbon, B., Grenier, J. K., Fallon, J. F., Kimble, J., Walker, M. et al. (1997). The origin and evolution of animal appendages. *Proc Natl Acad Sci U S A* 94, 5162-6.
- Van Name, W. G. (1921). Budding in the compound ascidians and other invertebrates, and its bearing on the question of the early ancestry of the vertebrates. *Bulletin of The American Museum of Natural History* 44, Article 15, 275-282.

Ascidian Development & Phylogeny

- Conklin, E. W. (1905). Organization and cell-lineage of the ascidian egg. *Journal of the Academy of Natural Sciences of Philadelphia Series 2, Vol. XIII, 1-119 + XII plates.*
- Hadfield, K. A., Swalla, B. J. and Jeffery, W. R. (1995). Multiple origins of anural development in ascidians inferred from rDNA sequences. *J Mol Evol* 40, 413-27.
- Huber, J. L., da Silva, K. B., Bates, W. R. and Swalla, B. J. (2000). The evolution of anural larvae in molgulid ascidians. *Semin Cell Dev Biol* 11, 419-26.
- Riemer, D., Wang, J., Zimek, A., Swalla, B. J. and Weber, K. (2000). Tunicates have unusual nuclear lamins with a large deletion in the carboxyterminal tail domain.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

Gene 255, 317-25.

Swalla, B. J. (1993). Mechanisms of gastrulation and tail formation in ascidians. *Microsc Res Tech* 26, 274-84.

Tailless Ascidians

Huber, J. L., da Silva, K. B., Bates, W. R. and Swalla, B. J. (2000). The evolution of anural larvae in molgulid ascidians. *Semin Cell Dev Biol* 11, 419-26.

Jeffery, W. R. and Swalla, B. J. (1992). Evolution of alternate modes of development in ascidians. *Bioessays* 14, 219-26.

Jeffery, W. R., Swalla, B. J., Ewing, N. and Kusakabe, T. (1999). Evolution of the ascidian anural larva: evidence from embryos and molecules. *Mol Biol Evol* 16, 646-54.

Kusakabe, T., Swalla, B. J., Satoh, N. and Jeffery, W. R. (1996). Mechanism of an evolutionary change in muscle cell differentiation in ascidians with different modes of development. *Dev Biol* 174, 379-92.

Swalla, B. J. and Jeffery, W. R. (1990). Interspecific hybridization between an anural and urodele ascidian: differential expression of urodele features suggests multiple mechanisms control anural development. *Dev Biol* 142, 319-34.

Swalla, B. J. and Jeffery, W. R. (1996). Requirement of the *Manx* gene for expression of chordate features in a tailless ascidian larva. *Science* 274, 1205-8.

Swalla, B. J., Makabe, K. W., Satoh, N. and Jeffery, W. R. (1993). Novel genes expressed differentially in ascidians with alternate modes of development. *Development* 119, 307-18.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

Halanych Lectures

Character Mapping

- Cunningham, C. W. 1999. Some limitations of ancestral character-state reconstruction when testing evolutionary hypotheses. *Syst. Biol.* **48**:665-674.
- Cunningham, C. W., K. E. Omland, and T. H. Oakley. 1998. Reconstructing ancestral character states: a critical reappraisal. *TREE* **13**:361-366.
- Wray, G. A. 1996. Parallel evolution of nonfeeding larvae in echinoids. *Syst. Biol.* **45**:308-322.

Metazoan Phylogeny

- Adoutte, A., G. Balavoine, N. Lartillot, and R. de Rosa. 1999. Animal evolution: the end of the intermediate taxa? *Trends in Genetics* **15**:104-108.
- Adoutte, A., G. Balavoine, N. Lartillot, O. Lespinet, B. Prud'homme, and R. de Rosa. 2000. The new animal phylogeny: Reliability and implications. *Proceedings of the National Academy of Sciences, USA* **97**:4453-4456.
- Aguinaldo, A. M. A., and J. A. Lake. 1998. Evolution of multicellular animals. *Amer. Zool.* **38**:878-887.
- Aguinaldo, A. M. A., J. M. Turbeville, L. S. Linford, M. C. Rivera, J. R. Garey, R. A. Raff, and J. A. Lake. 1997. Evidence for a clade of nematodes, arthropods and other moulting animals. *Nature* **387**:489-493.
- Balavoine, G. 1996. Identification of members of several homeobox genes in a planarian using a ligation-mediated polymerase chain reaction technique. *Nucleic Acids Res.* **24**:1547-1553.
- Balavoine, G. 1997. The early emergence of platyhelminths is contradicted by the agreement between 18S rRNA and Hox genes data. *C. R. Acad. Sci* **320**:83-94.
- Balavoine, G. 1998. Are platyhelminthes coelomates without a coelom? An argument based on evolution of *Hox* genes. *Amer. Zool.* **38**:843-858.
- Balavoine, G., and A. Adoutte. 1998. One or three Cambrian Radiations? *Science* **280**:397-398.
- Balavoine, G., and M. J. Telford. 1995. Identification of planarian homeobox sequences indicates the antiquity of most Hox/homeotic gene subclasses. *Proc. Natl. Acad. Sci. USA* **92**:7227-7231.
- Ballard, J. W. O. e. a. 1992. Evidence from 12S ribosomal RNA sequences that onychophorans are modified arthropods. *Science* **258**:1345-1348.
- Boore, J. L. 1999. Animal mitochondrial genomes. *Nucl Acid Res* **27**:1767-1780.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Boore, J. L. In preparation. The echiuran *Urechis caupo* has a mitochondrial gene arrangement similar to those of annelid worms.
- Boore, J. L., and W. M. Brown. 1994. Mitochondrial genomes and the phylogeny of mollusks. *Nautilus Suppl.* **2**:61-78.
- Boore, J. L., and W. M. Brown. 1998. Big trees from little genomes: mitochondrial gene order as a phylogenetic tool. *Curr Opin Genet Dev* **8**:668-674.
- Boore, J. L., and J. L. Staton. in press. The mitochondrial genome of the sipunculid *Phascolopsis gouldii* supports its association with Annelida rather than Mollusca. **Mol. Biol. Evol.**
- Bromham, L. D. & Degnan, B. M. (1999) Hemichordates and deuterostome evolution: robust molecular support for a hemichordate + echinoderm clade. *Evol. Dev.* **1**: 166-171.
- Cameron, C. B., Swalla, B. J. & Garey, J. R. (2000) Evolution of the chordate body plan: New insights from phylogenetic analyses of deuterostome phyla. *Proc. Natl. Acad. Sci.* **97**: 4469-4474.
- Conway Morris, S., and J. S. Peel. 1995. Articulated halkieriids from the lower cambrian of north greenland and their role in early protostome evolution. *Philosophical Transactions of the Royal Society of London, Biology* **347**:305-358.
- de Rosa, R., J. K. Grenier, T. Andreeva, C. E. Cook, A. Adoutte, M. Akam, S. B. Carroll, and G. Balavoine. 1999. HOX genes in brachiopods and priapulids and protostome evolution. *Nature* **399**:772-776.
- Eeckhaut, I., D. McHugh, P. Mardulyn, R. Tiedemann, D. Monteyne, M. Jangoux, and M. C. Milinkovitch. 2000. Myzostomida: a link between trochozoans and flatworms? *Proc. R. Soc. Lond. B* **267**:1383-1392.
- Eernisse, D. J. 1997. Arthropod and annelid relationships re-examined. Pages 43-56 in R. A. Fortey and R. H. Thomas, editors. *Arthropod Relationships*. Chapman and Hall, London.
- Eernisse, D. J., J. S. Albert, and F. E. Anderson. 1992. Annelida and Arthropoda are not sister taxa: a phylogenetic analysis of spiralian metazoan phylogeny. *Systematic Biology* **41**:305-330.
- Eernisse, D. J., and A. G. Kluge. 1993. Taxonomic congruence versus total evidence, and amniote phylogeny inferred from fossils, molecules, and morphology. *Molecular Biology and Evolution* **10**:1170-1195.
- Erwin, D., J. Valentine, and D. Jablonski. 1997. The origin of animal body plans. *Amer. Sci.* **85**:126-137.
- Erwin, D. H. 1991. Metazoan phylogeny and the Cambrian radiation. *TREE* **6**:131-134.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Field, K. G., G. J. Olsen, D. J. Lane, S. J. Giovannoni, M. T. Ghiselin, E. C. Raff, N. R. Pace, and R. A. Raff. 1988. Molecular phylogeny of the animal kingdom. *Science* **239**:748-753.
- Giribet, G., D. L. Distel, M. Polz, W. Sterrer, and W. C. Wheeler. 2000. Triploblastic relationships with emphasis on the acoelomates and the position of Gnathostomulida, Cycliophora, Plathelminthes and Chaetognatha: A combined approach of 18S rDNA sequences and morphology. *Syst. Biol.* **49**:539-562.
- Halanych, K. M. 1995. The phylogenetic position of the pterobranch hemichordates based on 18S rDNA sequence data. *Mol. Phylogen. Evol.* **4**:72-76.
- Halanych, K. M. 1996. Convergence in the feeding apparatuses of lophophorates and pterobranch hemichordates revealed by 18S rDNA: An interpretation. *Biol. Bull.* **190**:1-5.
- Halanych, K. M. 1996. Testing hypotheses of chaetognath origins: long branches revealed by 18S ribosomal DNA. *Syst. Biol.* **45**:223-246.
- Halanych, K. M. 1998. Phylogenetic Considerations for Metazoans. *American Zoologist* **38**:145-155.
- Halanych, K. M., J. D. Bacheller, A. M. A. Aguinaldo, S. M. Liva, D. M. Hillis, and J. A. Lake. 1995. Evidence from 18S ribosomal DNA that the lophophorates are protostome animals. *Science* **267**:1641-1643.
- Halanych, K. M., and Y. Passamanek. *in press*. A brief review of metazoan phylogeny and future prospects in Hox-research. *Amer. Zool.*
- Jägersten, G. 1972. The evolution of the metazoan life cycle.
- Kim, C. B., S. Y. Moon, S. R. Gelder, and W. Kim. 1996. Phylogenetic Relationships Of Annelids, Molluscs, and Arthropods Evidenced From Molecules and Morphology. *Journal Of Molecular Evolution*. Sep **43**:207-215.
- Kim, J., W. Kim, and C. W. Cunningham. 1999. A new perspective on lower metazoan relationships form 18S rDNA sequences. *Mol. Biol. Evol.* **16**:423-427.
- Knoll, A., and S. B. Carroll. 1999. Early animal evolution: Emerging views from comparative biology and geology. *Science* **284**:2129-2137.
- Lake, J. A. 1990. Origin of Metazoa. *Proc. Natl. Acad. Sci. USA* **87**:763-766.
- McHugh, D. 1997. Molecular evidence that echiurans and pogonophorans are derived annelids. *Proc. Natl. Acad. Sci. USA* **94**:8006-8009.
- McHugh, D. 2000. Molecular phylogeny of Annelida. *Can. J. Zool.* **78**:1873-1884.
- Nielsen, C. 1977. The relationships of Entoprocta, Ectoprocta, and Phoronida. *Amer. Zool.* **17**:149-150.
- Nielsen, C. 1985. Animal phylogeny in the light of the trochaea theory. *Biol. J. Linn. Soc.* **25**:243-299.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Nielsen, C. 1987. Structure and function of metazoan ciliary bands and their phylogenetic significance. *Acta Zool.* **68**:205-262.
- Nielsen, C. 1995. *Animal Evolution: Interrelationships of the Living Phyla*. Oxford University Press, Oxford.
- Nielsen, C., N. Scharf, and D. Eibye-Jacobsen. 1996. Cladistic analyses of the animal kingdom. *Biol. J. Linn. Soc.* **57**:385-410.
- Peterson, K. J., and D. J. Eernisse. 2001. Animal phylogeny and the ancestry of bilaterians: inferences from morphology and 18S rDNA gene sequences. *Evolution and Development* **3**:170-205.
- Raff, R. A., C. R. Marshall, and J. M. Turbeville. 1994. Using DNA sequences to unravel the Cambrian radiation of the animal phyla. *Annu. Rev. Ecol. Syst.* **25**:351-375.
- Rouse, G. W., and K. Fauchald. 1995. The articulation of annelids. *Zool. Scrip.* **24**:269-301.
- Rouse, G. W., and K. Fauchald. 1997. Cladistics and polychaetes. *Zoologica Scripta* **26**:139-204.
- Swalla, B.J., Cameron, C.B., Corley, L.S. and Garey, J.R. (2000) Urochordates are monophyletic within the deuterostomes. *Systematic Biology* **49**: 122-134.
- Telford, M. J. 2000. Turning Hox "signatures" into synapomorphies. *Evol. Devel.* **2**:360-264.
- Telford, M. J., and P. W. H. Holland. 1993. The phylogenetic affinities of the chaetognaths: a molecular analysis. *Mol. Biol. Evol.* **10**:660-676.
- Valentine, J. W. 1997. Cleavage Patterns and the Topology Of the Metazoan Tree Of Life. *Proceedings Of The National Academy Of Sciences Of The United States Of America* **94**:8001-8005.
- Wada, H., and N. Satoh. 1994. Details of the evolutionary history from invertebrates to vertebrates, as deduced from the sequences of 18S rDNA. *Proceedings of the National Academy of Sciences* **91**:1801-1804.
- Winnepenninckx, B., T. Backeljau, and R. De Wachter. 1995. Phylogeny of protostome worms derived from 18S rRNA sequences. *Mol. Biol. Evol.* **12**:641-649.
- Winnepenninckx, B., T. Backeljau, and R. De Wachter. 1996. Investigation of molluscan phylogeny on the basis of 18S rRNA sequences. *Mol. Biol. Evol.* **13**:1306-1317.
- Winnepenninckx, B., T. Backeljau, L. Y. Mackey, J. M. Brooks, R. De Wachter, S. Kumar, and J. R. Garey. 1995. 18S rRNA data indicate that Aschelminthes are polyphyletic in origin and consist of at least three distinct clades. *Mol. Biol. Evol.* **12**:1132-1137.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Winnepenninckx, B., G. Steiner, T. Backeljau, and R. De Wachter. 1998. Details of gastropod phylogeny inferred from 18S rRNA sequences. *Molecular Phylogenetics and Evolution* **9**:55-63.
- Winnepenninckx, B. M. H., T. Backeljau, and R. M. Kristensen. 1998. Relations of the new phylum Cycliophora. *Nature* **393**:636-638.
- Winnepenninckx, B. M. H., D. G. Reid, and T. Backeljau. 1998. Performance of 18S rRNA in littorinid Phylogeny (Gastropoda: Caenogastropoda). *J Mol Evol* **47**:586-596.
- Winnepenninckx, B. M. H., Y. Van de Peer, and T. Backeljau. 1998. Metazoan relationships on the basis of 18S sequences: A few years later... *Amer. Zool.* **38**:888-906.
- Zrzavy, J., S. Mihulka, P. Kepka, A. Bezdek, and D. Tiez. 1998. Phylogeny of the Metazoa based on morphological and 18S ribosomal DNA evidence. *Cladistics* **14**:249-285.
- Zrzavy, J., and P. Stys. 1995. Evolution of metamerism in Arthropoda: developmental and morphological perspectives. *Qtly. Rev. Biol.* **70**:279-295.

Phylogeny References

- Felsenstein, J. 1985. Confidence limits on phylogenies: An approach using the bootstrap. *Evolution* **39**:783-791.
- Felsenstein, J. 1993. PHYLIP, Phylogenetic inference package. *in*. Department of Genetics, University of Washington, Seattle, Washington.
- Graybeal, A. 1998. Is it better to add taxa or characters to a difficult phylogenetic problem? *Syst. Biol.* **47**:9-17.
- Hillis, D. M., M. W. Allard, and M. M. Miyamoto. 1993. Analysis of DNA Sequence Data: Phylogenetic Inference. *Methods in Enzymology* **224**:456-487.
- Huelsenbeck, J. P., J. J. Bull, and C. W. Cunningham. 1996. Combining data in phylogenetic analysis. *TREE* **11**:152-158.
- Huelsenbeck, J. P., and K. A. Crandall. 1997. Phylogeny estimation and hypothesis testing using maximum likelihood. *Annual Review Of Ecology And Systematics* **28**:437-466.
- Huelsenbeck, J. P., D. M. Hillis, and R. Jones. 1996. Parametric bootstrapping in molecular phylogenetics: Applications and performance. Pages 19-45 *in* J. D. Ferraris and S. R. Palumbi, editors. *Molecular Zoology: Advances, strategies, and protocols*. Wiley-Liss, Inc., New York.
- Huelsenbeck, J. P., and B. Rannala. 1997. Phylogenetic methods come of age: Testing hypothesis in a phylogenetic context. *Science* **276**:227-232.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

- Poe, S. 1998. The effect of taxonomic sampling on accuracy of phylogenetic estimation: test case of a known phylogeny. *Molecular biology and evolution* **15**:1086-1090.
- Swofford, D. L. 2001. PAUP* 4.0 (Phylogenetic Analysis Using Parsimony). Sinauer, Sunderland, Massachusetts.
- Swofford, D. L., G. J. Olsen, P. J. Waddell, and D. M. Hillis. 1996. Phylogenetic Inference. Pages 407-514 *in* D. M. Hillis, C. Mortiz, and B. K. Mable, editors. *Molecular Systematics*. Sinauer Associates, Inc., Sunderland, Massachusetts.

Engrailed References (a primer)

- Averof, M., and N. H. Patel. 1997. Crustacean appendage evolution associated with changes in Hox gene expression. *Nature* **388**:682-686.
- Holland, L. Z., M. Kene, N. A. Willaims, and N. D. Holland. 1997. Sequence and embryonic expression of the amphioxus engrailed gene (AmphiEn): the metameric pattern of transcription resembles that of its segment-polarity homolog in Drosophila. *Development* **124**:1723-1732.
- Lans, D., C. J. Wedeen, and D. A. Weisblat. 1993. Cell lineage analysis of the expression of an engrailed homolog in leech embryos. *Development* **117**:857-871.
- Manzanares, M., R. Marco, and R. Garesse. 1993. Genomic organization and developmental pattern of expression of the engrailed gene from the brine shrimp Artemia. *Development* **118**:1209-1219.
- Patel, N. H. 1994. The evolution of arthropod segmentation: insights from comparisons of gene expression patterns. *Development* **1994**:201-207.
- Patel, N. H. e. a. 1989. Expression of engrailed proteins in arthropods, annelids, and chordates. *Cell* **58**:955-968.
- Shubin, N., C. Tabin, and S. Carroll. 1997. Fossils, genes and the evolution of animal limbs. *Nature* **388**:639-648.
- Telford, M. J., and R. H. Thomas. 1998. Expression of homeobox genes shows chelicerate arthropods retain their deutocerebral segment. *Proc Natl Acad Sci U S A* **95**:10671-10675.
- Webster, P. J., and T. E. Mansour. 1992. Conserved classes of homeodomains in *Schistosoma mansoni*, an early bilateral metazoan. *Mech. Dev.* **38**:25-32.
- Wray, C. G., and D. K. Jacobs. 1995. Engrailed sequence and expression in the Mollusca: a developmental and phylogenetic synthesis (abstr.). Pages 345 *in* H. R. Lasker, M. A. Coffroth, and E. Bermingham, editors. *Molecular approaches to marine ecology and evolution*, Santa Fe, New Mexico.

Evo-Devo Course 2001 References

K.M. Halanych and B. J. Swalla

Friday Harbor Laboratories

Wray, C. G., D. K. Jacobs, R. Kostriken, A. P. Vogler, R. Baker, and R. DeSalle. 1995.
Homologues of the engrailed gene from five molluscan classes. FEBS Letters
365:71-74.