Appendix II. Previously recommended cnidarian 'model species' and their justification from peer-reviewed literature.

Anthozoans

Plesiastrea versipora was recommended by (Ritchie et al. 1997): "*Plesiastrea versipora* (Lamarck, 1816) is a hardy scleractinian coral that can be maintained for long periods in the laboratory even without feeding. After removal of tissue, it shows considerable powers of regeneration and, following recovery, can be reused in later experiments. The rates of respiration, photosynthesis and translocation of photosynthate from algae to animal recover to normal levels and the regenerated animal tissue has host release factor activity. We have also shown that small pieces broken off the colony will survive and grow slowly to form clones of the parent colony."

Acropora spp. was recommended by Miller and Ball (2000): "The diploblastic Cnidaria form one of the most ancient metazoan phyla and thus provide a useful outgroup for comparative studies of the molecular control of development in the more complex, and more often studied, triploblasts. Among cnidarians, the reef building coral *Acropora* is a particularly appropriate choice for study. *Acropora* belongs to the Anthozoa, which several lines of evidence now indicate is the basal class within the phylum Cnidaria, and has the practical advantages that its reproduction is predictable, external and accessible and that the base content of its genome is not strongly biased. The *Acropora* system has already provided insights into ancestral linkages of homeobox genes and the evolution of the Pax genes, and has the potential to provide further new perspectives on the age, role in development, and evolution of these and other gene families."

Frank et al. (2001) also recommended *Acropora* as a model scleractinian species: "Scleractinians are of great value in various ecological studies, in particular those related to bleaching, global warmth, CO_2 household, etc. In addition, they may serve as a model system for certain questions in evolutionary developmental biology, given their basal position within the Cnidaria. Scleractinians are also good model organisms to study biomineralization. However, the cultivation of reef corals outside their natural habitats (which is inaccessible for most researchers outside the tropics) is very difficult. The generation time of corals is measured in years and their growth rate is extremely low. Embryos are available only a few days a year in *Acropora*, or a few months in other genera. Finally, reef corals are all protected by international law and the exchange of samples between laboratories is likely to be associated with legal problems."

The anemone *Nematostella vectensis* was recommended by Darling et al. (2005): *N. vectensis* is a gonochoric anemone that has been cultured through its entire life cycle (Fautin 2002; Hand and Uhlinger 1992). "In recent years, a handful of model systems from the basal metazoan phylum Cnidaria have emerged to challenge long-held views on the evolution of animal complexity. The most-recent, and in many ways most-promising addition to this group is the starlet sea anemone, *Nematostella vectensis*. The remarkable amenability of this species to laboratory manipulation has already made it a productive system for exploring cnidarian development, and a proliferation of molecular and genomic tools, including the currently ongoing *Nematostella* genome project, further enhances the promise of this species. In addition, the facility with which *Nematostella* populations can be investigated within their natural ecological context suggests that this model may be profitably expanded to address important questions in molecular and evolutionary ecology. In this review, we explore the traits that make *Nematostella* exceptionally attractive as a model organism, summarize recent research demonstrating the utility of *Nematostella* in several different contexts, and highlight a number of developments likely to further increase that utility in the near future."

Hydrozoans

Frank et al. (2001) recommended *Hydractinia echinata* and *H. symbiolongicarpus*: "The Cnidaria represent the most ancient eumetazoan phylum. Members of this group possess typical animal cells and tissues such as sensory cells, nerve cells, muscle cells and epithelia. Due to their unique phylogenetic position, cnidarians have traditionally been used as a reference group in various comparative studies. We propose the colonial marine hydroid, *Hydractinia*, as a convenient, versatile platform for basic and applied research in developmental biology, reproduction, immunology, environmental studies and more. In addition to being a typical cnidarian representative, *Hydractinia* offers many practical and theoretical advantages: studies that are feasible in Hydra like regeneration, pattern regulation, and cell renewal from stem cells, can be supplemented by genetic analyses and classical embryology in *Hydractinia*. Metamorphosis of the planula larva of *Hydractinia* can be used as a model for cell activation and communication and the presence of a genetically controlled allorecognition system makes it a suitable model for comparative immunology. Most importantly, *Hydractinia* may be manipulated at most aspects of its (short) life cycle. It has already been the subject of many studies in various disciplines, some of which are discussed in this essay."

Day and Lenhoff (1981), Koizumi (2002) and Shimizu and Fujisawa (2003) also recommended *Hydra* as a model animal of cnidarians:

- As a model of developmental neurobiology (Koizumi 2002): "Hydra belongs to the class Hydrozoa in the phylum Cnidaria. Hydra, is a model animal, who's cellular and developmental data are the most abundant among cnidarians. The hydra nerve net is a mosaic of neural subsets expressing a specific neural phenotype. The developmental dynamics of the nerve cells are unique. Neurons are produced continuously by differentiation from interstitial multi-potent stem cells. These neurons are continuously displaced outwards along with epithelial cells and are sloughed off at the extremities. However, the spatial distribution of each neural subset is maintained. Mechanisms related to these phenomena, i.e., the position-dependent changes in neural phenotypes, are proposed… By large-scale screening of peptide signal molecules, peptide molecules related to nerve-cell differentiation have been identified... The neurons in the nerve ring show little turnover, although nerve cells in all other regions turn over continuously. These associations and quiet dynamics lead me to think that the nerve ring has features similar to those of the central nervous system in higher animals."

- As a classical model in evolutionary developmental biology (Hemmrich et al. 2007): *Hydra* phylogenetic relationships "reveal fundamental principles that underlie development, differentiation, regeneration and also symbiosis."
- As receptor-based models with hysteresis for pattern formation (Marciniak-Czochra 2006): "The properties of the model demonstrate a range of stationary and oscillatory spatially heterogeneous patterns, arising from multiple spatially homogeneous steady states and switches in the production rates" of diffusible biochemical molecules.
- As a model of stem cell morphogenesis (Wittlieb et al. 2006): "Transgenic *Hydra* allow *in vivo* tracking of individual stem cells during morphogenesis."
- As an evolutionarily conserved model system for regeneration (Holstein et al. 2003):
  "They (*Hydra*) can regenerate any amputated head or foot, and when dissociated into single cells, even intact animals will regenerate from reaggregates. This extensive regeneration capacity is mediated by epithelial stem cells, and it is based on the restoration of a signaling center, i.e., an organizer. Organizers secrete growth factors that act as long-range regulators in axis formation and cell differentiation."
- As a model of heart formation (Shimizu and Fujisawa 2003): The "peduncle of *Hydra* and the heart of higher organisms share a common ancestral origin. The heart is assumed to have evolved as the organ for pumping blood. Here we report a pumping phenomenon in Hydra, a member of the phylum Cnidaria. We find that the peduncle, lower quarter of the body column, stores most of the gastrovascular fluid when the animal is an elongate form. Upon contraction of the polyp, the peduncle contracts and transfers the fluid into the rest of the cavity. We also find that Hydra RFamide III, a homolog of cardioexcitatory RFamide neuropeptides in higher organisms, elevates this transfer activity. Further, CnNk-2, a homolog of a cardiomuscular tissue marker Nkx-2.5, is expressed in the endodermal tissue of the peduncle. These observations indicate that the transfer of fluid by the peduncle has a similar neurological and genetic basis to the pumping of blood by the heart, suggesting that the Hydra peduncle and the heart of higher organisms share a common ancestral origin."
- As a model for investigating epithelial cell--basement membrane interactions (Day and Lenhoff 1981): "*Hydra* mesoglea served as a suitable substrate for the attachment and spreading of hydra cells *in vitro*, irrespective of the species tested."

Appendix III. Coral Model Species Supplementary Information

The CoralZoo Project (for further information see the following web site: http://www.ist-world.org/ProjectDetails.aspx?ProjectId=cd19d34b169247f4a3e907f1a178b772) claims to be the first comprehensive approach that makes use of molecular biology, mathematical, toxicological and nutritional tools for the development of unique breeding protocol for corals in captivity. The goal is to enable the SMEs to establish large stocks of coral colonies (the asexual approach) that represent a high genetic variability (the sexual approach) and exhibit natural growth forms.

In order to achieve the main deliverables, research will focus on the following topics:

(1) sexual and asexual breeding of corals in captivity, including breeding and feeding techniques and induction of natural coral colony morphogenesis

(2) coral husbandry: development of generic bioassays to evaluate biotic and abiotic husbandry parameters and to monitor coral health, elaboration of methods for identification and treatment of coral diseases and optimization of transport and acclimation procedures.

The consortium members bring complementary expertise to the project. Researchers at Wageningen University have experience in water recirculation systems and the culturing of marine organisms. Microbiologists specializing in coral diseases are based at the Italian Consortium for Marine Sciences, while coral biologists at the Israel Oceanography and Limnology Research Institute are primarily investigating nutritional aspects. Finally, a group at the Technical University of Dresden is modeling the data obtained from the other research partners, to predict how corals will perform under particular aquarium conditions. The academic competences are complemented by the applied aquarist's research skills of the SME partners.