NO BONES
NEWSLETTER

is published bimonthly by the
Section of Invertebrate Zoology
Department of Systematic Biology
National Museum of Natural History
Smithsonian Institution

CONTENTS: PAGE:

Through the Looking Glass....Situs Inversus Viscerum in Sea Urchins

by Dave Pawson

How would you feel if your appendix was on the left side of your abdomen instead of the right, the apex of your heart in the right side of your chest, and your liver on the left side of your abdomen? You'd probably feel fine. You'd have Situs Inversus Viscerum (SIV), which means that your body is a mirror image of the usual condition. Today, about 1 person in 15,000 worldwide has SIV. In itself, SIV does not adversely affect people's lives - but if you have SIV and appendicitis, it would probably help to tell your surgeon where to make the incision!

SIV is found throughout the animal kingdom, from forams through fishes to humans. In the sea urchins it is difficult to spot externally, but it has dramatic manifestations elsewhere in the body. A SIV sea urchin has the anus positioned anteriorly rather than posteriorly in the anal field (Figure 1). Internally, the last loop of the intestine coils in an anti-clockwise direction rather than clockwise, and perhaps most amazing of all, David Raup and Emery Swan discovered that the crystallographic axes of the single-crystal calcite skeletal plates are reversed! The SIV effects in these animals are profound and pervasive.

Most sea urchins shed their eggs and sperms into the seawater, and the fertilized egg develops into a planktonic larva (Figure 2); the young urchin grows on the left side of the larva, then breaks away from the larval body and drops to the seafloor. As you might expect, SIV sea urchins grow from larvae in which the young urchin develops on the *right* side of the larva, instead of the left. This was suspected by Swan in 1966, postulated by Raup and Swan in 1967, and finally proven experimentally by Nancy Marcus in 1981.

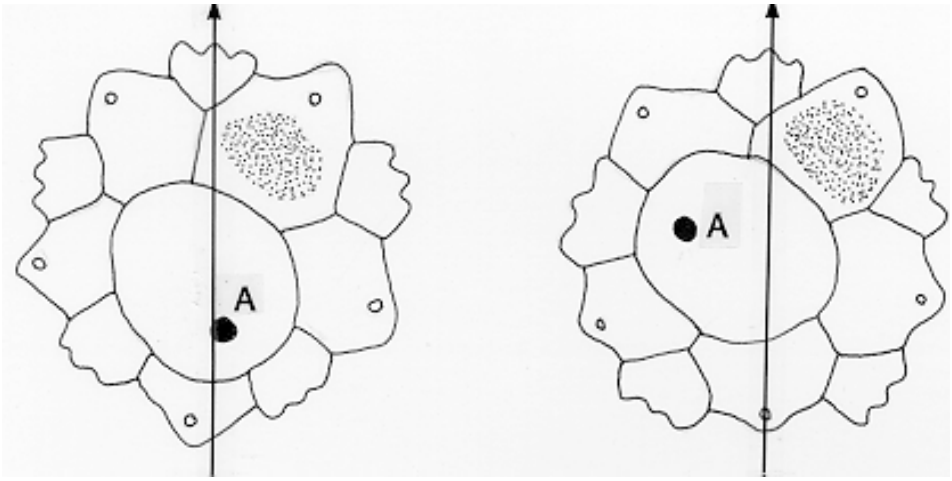

Figure 1-Outline of upper body of sea urchin, showing antero-posterior axis. Left, in normal individual anus A is in posterior end of anal field. Right, in SIV individual anus A is in anterior end of anal field.

continued on page 2

COVER STORY CONT.

Over the past several years I have been sporadically studying SIV urchins, in an attempt to answer some questions. We now know that SIV adult urchins are derived from SIV larvae - so, where do the SIV larvae come from? Do they come from SIV eggs fertilized by SIV sperms? Or from SIV eggs fertilized by normal sperms? Or from normal eggs fertilized by SIV sperms? Or from all of these?

The research plan has been as follows: during the sea urchin breeding season, study a large sample of live animals under the microscope (the incidence of SIV in a normal urchin population is about 0.1% - 1 in 1,000 specimens), pick out some SIV and some normal individuals, then take them to the laboratory and induce them to spawn. With undying optimism, hope that the SIV animals (if there happens to be more than one) include both males and females, and that they're in spawning condition. If the animals can be persuaded to spawn, fertilize normal eggs with normal sperms (control), SIV eggs with normal sperms, normal eggs with SIV sperms, and SIV eggs with SIV sperms. Then, rear the larvae in the laboratory, and watch what happens. Cultures of the embryos and larvae must be kept alive for a few weeks until the young sea urchins begin to develop on the larvae. Cultures can die inexplicably. If the feeding regimen of microalgae is not exactly right, if the chemistry, temperature, and movement of the seawater are not just right, the larvae will die.

These experiments are fraught with difficulty. One must use urchins that are easily accessible from the shore, so they can be studied under a land-based microscope. The best urchins to sample are small ones,

Figure 2-16-day-old larva of sea urchin Lytechinus variegatus, from normal egg X SIV sperm. Developing young urchin is dark colored mass on lower left side of the larva.

continued on page 3

NEWSLETTER STAFF

Kristian Fauchald
head, IZ

Marsha Sitnik
editor
sitnik.marsha@nmnh.si.edu

Geoff Keel
production
keel.william@nmnh.si.edu

Molly Kelly Ryan
design

Bob Skarr
library
skarr.robert@silib5.si.edu

Please submit news or articles via email or disk by the 15th of the month prior to publication.

Publication in this newsletter does not constitute publication in a taxonomic or any other scientific context

COVER STORY CONT.

so we study *Lytechinus variegatus* at St. Joseph's Bay on the Florida panhandle. They have a very short breeding season in late March-early April, and the water at that time is around 60 degrees F - so it is very uncomfortable if you're spending many hours wading or swimming around searching for 2,000 or more urchins. My research associate Doris Vance and her sister Joyce McCullough have twice endured this shiverry situation with me, in 1993 and again in March of this year.

Why should we undertake these risky experiments? I wanted to determine how this SIV is transmitted. And we now have some answers, after more than 20 years of trying. In some experiments at the Bermuda Biostation for Research I was able to show that in SIV eggs fertilized with normal sperm, the larvae become SIV larvae, and then SIV adults. In our most recent Florida expedition, we collected a single SIV urchin, a male. And, wonder of wonders, we got it to spawn in the laboratory at the Smithsonian Marine Station at Fort Pierce. We fertilized normal eggs with SIV sperms, and normal eggs with normal sperms, and transported the embryos back to my lab at NMNH. After almost three anxiety-filled weeks all of the lovely little larvae in the control culture, AND in the SIV culture (Fig. 2), showed sea urchins developing on the left, i.e. normal, side of the larvae, as I had hoped and predicted.

So, we have some answers. Into the first or F1 generation, the SIV characteristics of sea urchins are carried *only* by the egg, and not by the sperm. These so-called "maternal effects", where the female parent dictates the morphology of the offspring, are being intensely studied today in several animal groups. Maternal effects seem to be under the control of nuclear gene products present in the cytoplasm of the egg; the phenotype of the offspring depends upon the genotype of the female parent. Two genes, *lefty-1* and *lefty-2* have recently been suggested as a molecular mechanism controlling left-right asymmetry in mice. Is this true for sea urchins also? An alternative but not exclusive hypothesis proposed by some developmental biologists is that the directional action of the beating of certain cilia in developing embryos may cause developing organs to bend in a certain direction, thereby dictating the positioning of the organs. This seems less convincing for sea urchins, where even the crystallographic axes of the skeleton are reversed. We believe that SIV in sea urchins is certainly under genetic control, and unaffected by environmental constraints. We will graciously allow the developmental biologists to find the controlling mechanism!

What else do these experiments tell us? In our studies of sea urchin characteristics that are genetically transmitted, and not affected by environmental influences, we have made some important steps forward. Next year we will reinforce our findings with DNA analyses. There are some other avenues to follow - at present we're looking at some sand dollars from off Fort Pierce Florida, in the genera *Mellita* and *Encope*. Some rare hybrids between these two genera have been found, and they look more like *Mellita* than *Encope*. I would predict, based on what we have learned, that these hybrids show maternal effects - that they were derived from *Mellita* eggs fertilized by *Encope* sperms. So, we can't wait to test some ideas with crossbreeding experiments during the short periods of time when both genera are simultaneously in the spawning mode.

The laboratory work for these SIV studies could not have been done without the help of the wonderful people at our Smithsonian Marine Station at Fort Pierce, and a steady supply of microalgae from the aquaculture staff at Harbor Branch Oceanographic Institution, Fort Pierce, Florida, and from Tim Coffer in our Department.

PUBLICATIONS

Hakenkamp, C.C., S.G. Ribblett, M.A. Palmer, C.M. Swan, **J.W. Reid** and M.R. Goodison. 2001. The impact of an introduced bivalve (Corbicula flaminea) on the benthos of a sandy stream. Freshwater Biology 46: 491-501

Ivanenko, V.N., **F. Ferrari**, & A. V. Smurov. 2001. Nauplii and copepodids of Scottomyzon gibberum (Copepoda: Siphonostomatoida: Scottomyzontidae, new family), a symbiont of Asterias rubens (Asteroidea). - Proceedings of the Biological Society of Washington 114:237-261.

Kensley, B. and T.Y. Chan. 2001. Two new species of deep-sea flabelliferan isopods from Taiwan (Crustacea: Peracaridae: Aegidae, Anuropidae). Journal of Natural History 35(4):481-496.

Kensley, B. and N.L. Bruce. 2001. Redescription of Dynameniscus carinatus (Richardson, 1900) (Crustacea: Isopoda: Sphaeromatidae) Proceedings of the Biological Society of Washington 114(1):188-196.

continued on page 6

POINT OF VIEW

On hovering in mid-air

I assume you all, without too much strain can figure out what I am writing about. We have actually become pretty good at it by now: It must be three years ago we were in the middle of the review which was going to lead to all sorts of changes. Since that time we have had alarms and excursions galore. I have not really done a count, but I believe the frequency has become at least one set of dire "news" (= rumors) per two weeks. Some of it is rank speculation, other rumors may be trial balloons to see what reaction develops. However, some of the stories are now settling in, outlining what might become major features of the reorganization.

For example we are part of a Department of Systematic Biology; one of the largest grouping of systematists the world has ever seen. Certainly so, if the associated agencies are included. While we may lose some freedom as invertebrate zoologists, this fusion is not a bad idea: as systematic biologists we have much in common; as collections managers and researchers using the collections, we share a great interest in seeing to it that what we are doing is maintained as a focus of the Institution.

And, that leads me to what I believe is truly important at this juncture: We MUST convince the Powers That Be that systematic biology is important, important for Society, but also intellectually challenging and with potentially some of the most forward-looking features being done in biology today. We are comparative biologists: Increasingly we are using all kinds of evidence to explore the relationships among our favorite study objects. We are also in the situation that we can develop predictive systematics. Based on our phylogenetic studies overlaid with all the other knowledge that has been accumulated, we may predict what properties we expect to find in an understudied group of organisms, be they ecological, physiological or biochemical. All genetically fixed features are grist for our mills, not only the static descriptions of morphological features at any level from overall morphology to molecular properties, but also the properties that can be studied only on live organisms. The knowledge base exists, scattered over hundreds of thousands of published papers. Granted we have to reach out for all information available about our organisms, but I believe that by doing so, we will be able to demonstrate what a highly dynamic science systematic biology can be. The presence of the collections, as vouchers for all kinds of studies, give us the evidence we need for future studies, be they new ways of sampling the organisms or the presence of a given species in a particular time and place.

We may be hovering in mid-air at this point, but let us take advantage of the position and bring ourselves down to where we believe the Institution should be: a major focus for systematic biology for the country and the world.

Kristian Fauchald
Section Head, IZ

LIBRARY

INVERTEBRATE ZOOLOGY LIBRARIES NEW TITLES

Becker, Gerhard. **Verkieselte Ostracoden vom Thuringer Okotyp aus den Devon/Karbon-Grenzschichten....**Frankfurt am Main: Senckenbergische Naturforschende Gesellscahft, 1999. qQE728.B43 1999 Ent

Blake, James A. et al, eds. **Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and the Western Santa Barbara Channel. Volume 7, The Annelida, Part 4, Polychaeta: Flabelligeridae to Sternaspidae**. Santa Barabara: Santa Barbara Museum of Natural History, 2000. QL164.T39 1993x v.7 Invz

Bouillon, J and T.J. Barnett. **The Marine Fauna of New Zealand: Hydromedusae (Cnidaria: Hydrozoa)**. Wellington: National Institute of Water and Atmospheric Research, 1999. QL337.H9B68 1999 Invz

Bradford-Grieve, J.M. **The Marine Fauna of New Zealand: Pelagic Calanoid Copepoda**. Wellington: National Institute of Water and Atmospheric Research. 1999. QL444.C72B725 1999 Invz

Conklin, William. **Inner Dimensions: The Radiographic World of William Conklin**. Waco: WRS Publishing, 1995. qQL404..C65 1995x Moll

del Rio, Claudia J., ed. **Moluscos Marinos Miocenos De La Argentina Y Del Uruguay**. Buenos Aires: Academia Nacional de Ciencias Exactas, Fisicas y Naturales, 1998. QE801.M75 1998x Moll

Forest, Jacques et al. **The Marine Fauna of New Zealand: Paguridea (Decopoda: Anomura) exclusive of the Lithodidae**. Wellington: National Institute of Water and Atmospheric Research, 2000. QL444.M33M37 2000 Invz

LIBRARY CONT.

Gonzalez Perez, Jose Antonio. **Catalogo De Los Crustaceos Decapodos De Las Islas Canarias: Gambas, Langostas, Cangrejos**. Santa Cruz de Tenerife: Turquesa, 1995. QL444.M3G65 1995x.

Izawa, Nobue and Keiji Matsuoka. **Catalogue of Shell Collection by Mr. Hiroshi Takakuwa Presented to Toyohashi Museum of Natural History, 2. Gastropoda (Part 1) Family Patellidae–Family Fissurellidae**. Toyohashi: Toyohashi Museum of Natural History, 1999. QL406.2.N75 1993 No.2 Pt.1 Moll

Kuznetsov, A.P. and O.N. Zezina, eds. **Benthos of the High Latitude Regions** (in Russian). Moscow: VNIRO Publishing House, 1998. QH91.8.B4B48 1998 Invz

_____. **Benthos of the Russian Seas and the Northern Atlantic: Collected Proceedings** (in Russian). Moscow: VNIRO Publshing House, 2000. qQH91.8.B4B46 2000 Invz

McCray, Erin Beatty. **Glass Snail, *Vitrina pellucida* (Muller) (Gastropoda: Pulmonata) in Colorado**. Natural History Inventory of Colorado, No. 20. Boulder: University of Colorado Musuem, 1999. QL430.5.Z6M35 1999x Moll

Polychaetes and Allies: The Southern Synthesis. Fauna of Australia, Vol. 4A. Collingwood, Australia: CSIRO, 2000. qQL338.F38 1987 v.4A Invz

Suzuki, Keiu. **Opisthobranchs of Izu Peninsula**.(In Japanese). Tokyo: TBS Buritanika, 2000. Ql430.4.S97 2000 Moll

VISITORS

Michael Gibson, University of Tennessee at Martin (4/27-4/30) worked with recent *Xenophora*. Sponsor: **Warren Blow**

Carlos Alvarez, Guadalupe Miranda and Hguadalope Miranda, Universidad Autonoma Metropolitana, Mexico (4/30-5/2) reviewed literature about copepoda to check organisms in the copepoda collection genus *Caligus* and *Cymbasoma*. Sponsor: **Frank Ferrari**

Jose Alberto Ocana, Escuela Nacional de Ciencias Biologicas, IPN, Mexico (4/30-5/2) checked organisms in the Copepoda collection in the genus *Caligus* and *Cymbasoma*. Sponsor: **Frank Ferrari**

Heather Herb, University of Florida (5/1-10/5) worked in the cephalopod collections. Sponsor: **Clyde Roper**

Alato Lindner and Alberto Lindner, Duke University (5/8-5/10) worked on Stylasterids. Sponsor: **Steve Cairns**

Elizabeth Boyle, University of Massachusetts at Boston (5/16-5/20) did a survey of Mollusks in the general collection for the genus Benthonella. Sponsor: **Jerry Harasewych**

David Heath, Wisconsin Department of Natural Resources (5/21-5/22) did a survey of freshwater clams from Wisconsin, with a specific interest in Margaritiferidae. Sponsor: **Bob Hershler**

Todd Oakley, University of Chicago (5/21-5/22) examined female *Euphilomedes* Ostracods. Sponsor: **Elizabeth Nelson and Lou Kornicker**

Jose Manuel Guerra Garcia, University of Seville, Spain (5/21-6/7) studied Antarctic Caprellid Amphipods and discovered a new genus and several new species. Sponsor: **Bill Moser and Elizabeth Nelson**

Tito Lotufo and Sergio Rodriguez, Universidade de Sao Paulo, Brazil (5/25-6/15) examined tunicated in the USNM collections for comparisons in preparation for a paper to be published in the near future. Sponsor: **Linda Cole**

Nechama Ben-Eliahu, Hebrew University, Israel (5/29-5/30) worked on Polychaetes. Sponsor: **Kristian Fauchald**

Joana Zanol, University of Rio de Janeiro, Brazil (5/30-6/30) is working on Eunicid polychaetes. Sponsor: **Kristian Fauchald**

Igor Smirnov, Russian Academy of Sciences, Zoological Institute, St. Petersburg, Russia (6/1-7/1) is working on identification of Antarctic ophiuroids for an interactive database including a taxonomic key. Sponsor: **Cindy Ahearn**

Pam Roe, California State University-Stanislaus (6/12-6/29) will be working on pelagic nemertean taxonomy. Sponsor: **Jon Norenburg**

Vasily Radashevsky, Federal University of Curibita, Brazil (7/15-7/30) will be visiting to work on polychaetes. Sponsor: **Kristian Fauchald**

Christina Bruno, Everglades National Park (7/16-7/20) will work on descriptions of new species of copepods from southern Florida. Sponsor: **Jan Reid**

ANNOUNCEMENTS

Honors

The Conservation Alliance of St. Lucie County selected Dr. Mary E. Rice, Director of Smithsonian Marine Station at Fort Pierce as "Conservationist of the Year". There was an awards ceremony held on Saturday, May 5 presenting this award to Mary. (See photo at right)

Marsha Sitnik has been appointed to the new NMNH Communications Board chaired by Robert Fri. Members of the Board represent all aspects of the Museum community and are charged with facilitating information flow between units and publishing the NMNH Newsletter bi-monthly. Publicizing your news has never been easier, and she welcomes your input, comments and suggestions.

Interns

Abigail Knee – May 28, 2001 SI intern, doing cladistic analysis on a genus of scale worms.

Lisa Whiteman, George Washington University (5/29-8/23) 13 week collection management internship to satisfy degree requirements for GWU MS in museum studies. Working with Bright/Fauchald.

Carlyn McFeeley (July 9-August 3) Staff photos for updated Web site and CCRE assistance. Working with Sitnik, Web Committee and CCRE.

OUTREACH

International Outreach

Klaus Ruetzler and Marsha Sitnik recently signed an agreement with the Government of Belize, a landmark which promises to improve information flow and the conduct of research there.

Bob Hershler will conduct field work at Casas Grandes, Chihuahua, Saltillo, Delicias June 10-17.

The first two weeks of July, Fauchald will be in Iceland, first week to participate in the 7th International Conference on Polychaetes, giving one paper, chairing a session and so forth; the second week he will give lectures in a class on Cladistics and the Polychaeta mainly given by two former post-docs, Greg Rouse, South Australian Museum, Adelaide and Fredrik Pleijel, Musee di'histoire Naturelle Paris. Michael Gutknecht will also attend the meeting, demonstrating a new nomenclator to the polychaetes of the world.

Rafael Lemaitre and Chris Tudge will be traveling to Melbourne, Australia, to attend and present papers at the Fifth International Crustacean Congress, July 9-13. They are also the organizers of a Symposium on the Systematics and Biology of the Anomura, the first ever symposium dedicated to this important group of decapod crustaceans. More than 400 carcinologists will attend this Congress.

PUBLICATIONS CONT.

Ferrari, F. 2001. The Work of Thomas Elliot Bowman III. - Crustacean Issues 13:1-16.

Schotte, Marilyn. 2001. Mayflies: 24 Hours As An Adult. Walleye In-sider 12(4): 66-67.

BIRTHDAYS

June

Valorie Barnes
Duane Hope
Tyjuana Nickens

July

Kristian Fauchald
Paul Greenhall
Marilyn Schotte
Mike Sweeney