Two years ago, federal biologists concluded that commercial fishers catching pollock and other groundfish posed a serious threat to the sea lion's recovery, and they imposed major restrictions on Alaska's $1 billion fishery. That alarmed Senator Ted Stevens (R–AK) and other members of Congress, who ordered the academies' study.

In a preliminary report issued 4 December, a panel led by zoologist Robert Paine of the University of Washington, Seattle, concludes that fishing probably isn't the major cause of recent population losses. But it says that commercial catches can't be ruled out as a significant problem. In hopes of resolving the issue, the committee recommends setting up four experimental zones in Alaskan waters. Fishing would be banned for up to 50 nautical miles around two sea lion breeding colonies and permitted near two others. Biologists would then compare sea lion population trends. The experiment "is the only approach that directly tests the role of fishing in the decline" while controlling for other factors, such as climate change, the panel says.

Fishing industry representatives appear relieved that the academies didn't put the blame squarely on them. And ecologists are pleased by a renewed call for what they say would be one of the biggest real-world ecological experiments ever, albeit a tardy one. "It should have been done 10 years ago; it's a shame we've waited this long," says Andrew Trites, a marine mammal specialist at the University of British Columbia, Vancouver.

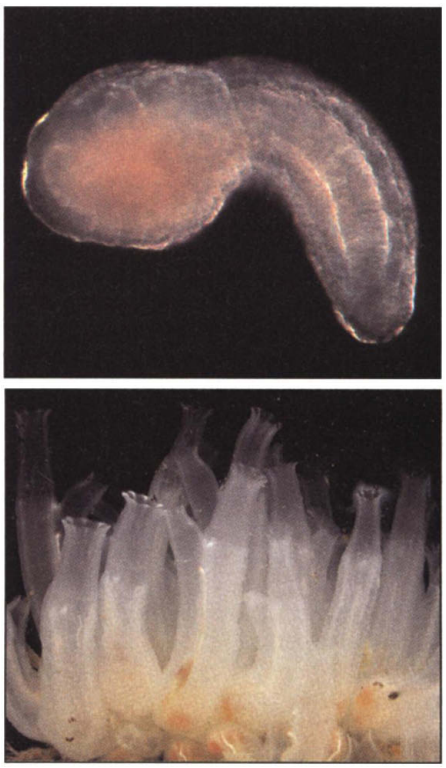
The National Marine Fisheries Service must approve any test, and no decision is expected until sometime next year. The panel will shortly release a final version of its report. –DAVID MALAKOFF

COMPARATIVE GENOMICS

Tunicate Genome Shows a Little Backbone

This week, researchers are unveiling the DNA code of one of the most unusual creatures sequenced to date: the sea squirt. These tiny marine animals have long captivated biologists because even though the adults are typical, squishy invertebrates, their larvae might be modern doppelgängers of the ancestor to the vertebrates.

The genome sequence of the sea squirt *Ciona intestinalis* "will help us unzip several evolutionary changes that occurred at the transition between invertebrates and vertebrates," says Paolo Sordino of the Zoological Station in Naples, Italy. *Ciona*'s branch on the evolutionary tree puts it closer to humans than are other invertebrates whose genomes have been sequenced, such as nematodes and fruit flies, but farther away than mice are. As such, it offers a different view of the history of human DNA.



Telltale tunicate. Vertebrate-like traits in the sea squirt larva (*top*) prompted the sequencing of its genome.

Sea squirts have puzzled biologists for more than a century. The adults live attached to pilings, rocks, and boat bottoms. Their bodies are cloaked in a leathery sheath, or tunic—hence their scientific name, tunicates. Charles Darwin thought they were relatives of mollusks. In the mid-1800s, Russian biologist Alexander Kowalevsky countered that the mobile tunicate tadpole, with its dorsal cartilaginous column resembling a spine, should be grouped with vertebrates and not clams and snails—even though tunicates never develop a backbone. His view stuck: Now any species that even temporarily possesses a dorsal nerve cord, notochord, primitive brain, and a few other traits is considered a chordate, a member of the phylum that includes vertebrates.

Some evolutionary biologists once argued that tunicates gave rise to backboned critters. That view has been abandoned in favor of a history in which the two simply share a common ancestor. Nonetheless, this sequence "is an opportunity to peek into the [early] chordate condition from a genomic point of view," says Sean Carroll, an evolution and development (evo-devo) researcher at the University of Wisconsin, Madison.

In early 2001, sea squirt researchers Nori Satoh of Kyoto University in Japan and Michael Levine and Daniel Rokhsar of the University of California, Berkeley, convinced the sequencers at the Department of Energy

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ScienceScope

Mass Protest The rectors of Italy's 77 state universities resigned en masse this week to protest government plans to cut budgets and freeze hiring. The dramatic move came as Parliament debated plans to cut spending at some universities and research institutions by up to one-third.

The resignations—which can still be withdrawn—are "a consequence of a policy of dismantling research and university culture," says Flaminia Saccá of Rome University, who also handles research policy for Italy's largest opposition party, the "Democrats of the Left." The protesters want lawmakers to restore budget increases promised by previous governments or to at least minimize cuts.

Italy's finance ministry called the move "impetuous," because lawmakers are still hammering out the final budget. But the rectors say the risky gesture was necessary to call attention to academia's financial plight. As *Science* went to press, researchers said the issue could be resolved soon.

Chain Reaction Saddled with legal bills, a Japanese researcher once accused of industrial espionage is suing a former friend for $770,000. Hiroaki Serizawa, a biologist at the University of Kansas Medical Center in Kansas City, has told a Tokyo court that he was deceived by Alzheimer's researcher Takashi Okamoto, who allegedly asked him to hold biological materials taken from the Cleveland Clinic in Ohio (*Science*, 18 May 2001, p. 1274).

Last year, U.S. prosecutors charged the two scientists with conspiring to export "trade secrets." They later dropped the espionage charges against Serizawa, who remains in the United States, but they are still seeking to extradite Okamoto from Japan for trial in Ohio. Serizawa is prepared to testify against Okamoto, says Serizawa's attorney, Patrick McLaughlin of McLaughlin & McCaffrey in Cleveland. In the meantime, he needs to pay legal fees—and he is suing Okamoto for help. The Tokyo court will start hearing the case next week. Okamoto's attorney could not be reached.

Serizawa is also job hunting after being denied tenure by the University of Kansas. But that task has been complicated by his decision to plead guilty to one count of giving the FBI false information. It's difficult, says McLaughlin, "to recover from damage like that to one's professional reputation."

Contributors: Pallava Bagla, Andrew Lawler, Leigh Dayton, Jocelyn Kaiser, Alexander Hellemans, Dennis Normile

Joint Genome Institute in Walnut Creek, California, to take on the creature. Eighteen months later, about 50 biologists and bioinformaticists spent a week poring over the newly assembled draft genome. They identified as many genes as they could and compared the sea squirt sequence to existing genome information, focusing on how various types of genes had changed through time. The results of this effort are reported on page 2157.

The sea squirt's 117 million bases sequenced include 16,000 genes. Among the genes are single and double copies of genes that have multiplied several times in the mouse and human genomes. The sea squirt shares about 60% of its genes with the nematode and fruit fly, whereas about 5% have matches only in the human, mouse, and puffer fish genomes. And about 20% seem unique to *Ciona*, including several involved in the production of a stiff starch called cellulose, the main ingredient in its tunic.

"Every genome is like a history book," explains Peter Holland, an evo-devo biologist at the University of Oxford, U.K. "But the problem is [that] there don't seem to be any dates" for when different genes appeared over the course of evolution. The new sequence, however, should enable biologists to distinguish which genes arose in vertebrates and which predate the split between vertebrates and sea squirts. For example, *Ciona* lacks many vertebrate neural genes and certain immune system genes, suggesting that these came after the split between tunicates and early vertebrates. These additions, says Levine, made possible "probably the most spectacular [vertebrate] innovations": the complex nervous and immune systems.

To Holland, the fact that many genes have multiplied in vertebrates but not in *Ciona* "suggests that something dramatic happened to vertebrates" that caused this great expansion. Take *Smad* genes, which typically help regulate bone development. *Ciona* has five; mice have eight. This change in gene number is "a recurring theme in the analysis of the *Ciona* genome," Rokhsar points out.

Some genes' origins can be pinpointed to a time when the common ancestor to vertebrates and sea squirts thrived. For example, thyroid hormones and receptors are not found in other invertebrates but are present in *Ciona*. "We don't know what they are doing," says Rokhsar, but he suspects that they are involved in the transition from tunicate tadpole to sedentary adult, as they are in frogs' metamorphosis.

Meanwhile, *Ciona*'s unique genes for making cellulose "come out of nowhere," Carroll points out; they have not been found in other animals. Levine sees the genes as "very compelling evidence for remarkable horizontal gene transfer between bacteria and *Ciona*," as the sea squirt seems to have adopted bacterial enzymes needed to use cellulose.

Even more genomes must be sequenced before researchers can say whether Levine is right about the horizontal transfer. And the more genomes the better, evolutionary biologists argue. "As each complete genome unfolds," says Carroll, "we are getting a bigger and better picture of patterns of gene evolution and of gene families." –ELIZABETH PENNISI

RESEARCH INFRASTRUCTURE

NSF Urged to Boost Spending on Facilities

Nobody's talking about changing the National Science Foundation's (NSF's) name to Need to Support Facilities. But the foundation must spend a larger share of its $5 billion budget on research infrastructure to maintain U.S. leadership in science, declares a new report from its oversight body.

An internal survey of NSF's disciplinary offices yielded a wish list of almost $2 billion a year through 2012 for scientific tools ranging from computing networks and research vessels to telescopes and synchrotrons (see table). That's double NSF's current spending level. "The need is greater than we can address with our normal budget mechanisms, and it won't go away," says John White, chancellor of the University of Arkansas, Fayetteville, and chair of the National Science Board task force that produced the 41-page draft report posted this week (www.nsf.gov/nsb; 02-190).

A DECADE OF NEEDED FACILITIES

Price range (in millions)	Total
$1–$10	3950
$10–$50	5400
$50–$250	6800
$250–$500	1700
$500+	1000
TOTAL	**18,850**

Midsized crisis. There's a growing need for moderately priced facilities.

The top spending priority, according to the board, should be advanced cyberinfrastructure —not just more powerful computers but also better storage, analysis, visualization, and distribution tools—to benefit the entire scientific community. This is a broad program, "not just bigger machines at a few places," says board member Anita Jones of the University of Virginia, Charlottesville. But certain disciplines also have big needs, the board says. NSF would have to triple its annual spending on large research facilities—to $350 million—just to eliminate a backlog of detectors, telescopes, and other projects that the board has approved but Congress has yet to fund (*Science*, 14 September 2001, p. 1972). There's also a problem with "mid-sized" facilities—those costing tens of millions of dollars—that are too pricey for individual programs yet too small to rank as a major research installation.

NSF now spends 22% of its budget on tools, a fraction that "is too low," according to the report. The task force would like to see it grow to about 27%, says board member Robert Richardson, vice provost for research at Cornell University. The report, 2 years in the making, expresses the hope that a growing NSF budget will provide "the majority of these additional resources." That's a reference to a projected doubling of NSF's budget over 5 years, a concept that Congress endorsed last month in passing a bill that reauthorizes NSF's programs.

Should the pie not expand rapidly enough, however, NSF officials might have to revisit the thorny issue of striking the right balance between "big" and "little" science. "I think that the PI [principal investigator] community could see it as a threat," says one science policy analyst who had not yet seen the report. At the same time, a university lobbyist speculates that the needs outlined in the report could be used by some federal legislators to help push for a broader economic stimulus package.

The board hopes for feedback from the community before issuing a final version of the report this winter. "The proposed changes are not radical, but they are significant," Richardson told board members before they signed off on the draft report. "And I think people should pay attention." –JEFFREY MERVIS

PATENTING LIFE

Canadian High Court Rejects OncoMouse

OTTAWA—Canadian researchers don't have to worry about paying licensing fees for the use of transgenic animals. The nation's top court ruled last week that higher life forms aren't patentable.

In a 5–4 decision, the Supreme Court of Canada ended Harvard University's 17-year quest to obtain Canadian patent protection for its OncoMouse, ruling that the cancer-prone rodent can't be owned. The court said that OncoMouse, developed by Philip Leder of Harvard Medical School in Boston, isn't an invention under a 1869 Canadian law that protects "any new and useful art, process, machine, manufacture or composition of matter."

Although the court prohibited the patenting of OncoMouse, it did allow Harvard to proceed with applications to protect the process by which the animal is engineered. "We're going to do our best to squeeze all the protection we can out of this judgment,"