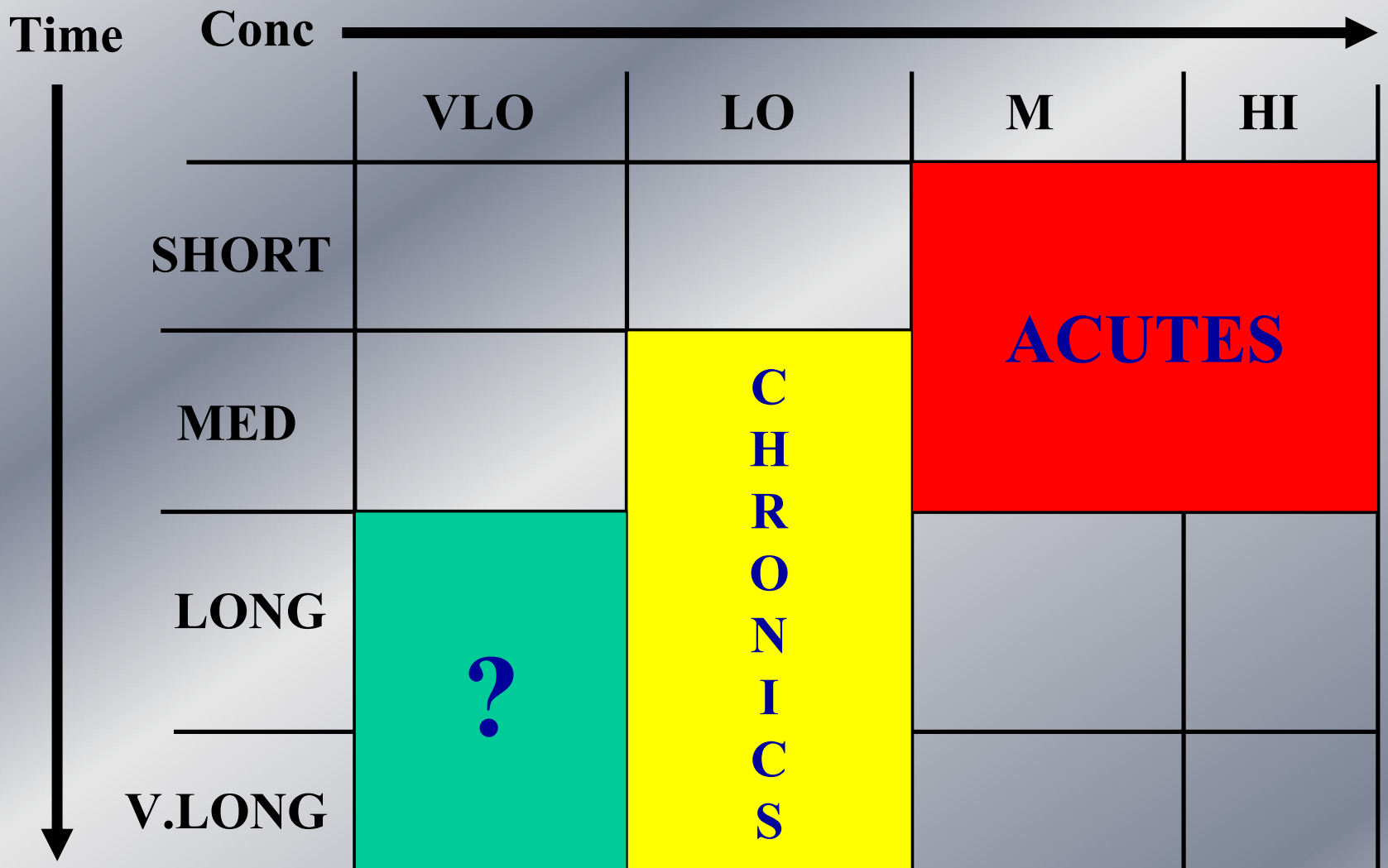
Peter Calow

University of Sheffield

Definition

- **Substances/mixtures that alter function(s) of the endocrine system and consequently cause adverse effects…**

- **But why do we treat EDs differently?**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Head start
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Frogs put in the gender blender by America's favourite herbicide

Rex Dalton, Berkeley

Low levels of the most widely used herbicide in the United States have been found to disrupt the sexual development of frogs. The finding will heighten concerns about the persistence of endocrine-disrupting chemicals in the environment — and throws the spotlight on another potential factor involved in the global decline of amphibian populations.

In the United States, about 27,000 tonnes of atrazine are applied each year to fields used to grow crops such as maize, sorghum and sugar cane. It is also used in 80 other nations, making it one of the world's most important herbicides. But concerns about atrazine's potential ability to disrupt sex hormones, and the presence of residues in drinking water, have led it to be banned in Germany, France, Italy, Sweden, Norway and Switzerland.

Tyrone Hayes and his colleagues at the University of California, Berkeley, exposed tadpoles of the African clawed frog (*Xenopus laevis*) to water containing different levels of atrazine throughout their larval development. Levels as low as 0.1 parts per billion (p.p.b.) caused males to develop ovaries in addition to testes. And at concentrations above 1 p.p.b., male frogs' larynges — used to call for mates — failed to develop normally. Hayes reports in a paper published on 16 April (T. B. Hayes *et al. Proc. Natl Acad. Sci. USA* **99**, 5476–5480; 2002).

In addition, when the researchers put adult males in water containing 25 p.p.b. of atrazine, their testosterone levels plummeted. And in preliminary, unpublished research, Hayes has found similar reproductive anomalies in wild leopard frogs (*Rana pipiens*) at six locations in the midwestern United States with high levels of atrazine.

"It is obviously affecting frogs," says Hayes, who suspects that atrazine boosts production of the enzyme aromatase, which catalyses the conversion of testosterone into oestrogen. "We need to ask: what are the environmental costs of using atrazine?" he says.

Although previous studies have suggested that atrazine is an endocrine disrupter, these have mostly used much higher doses. Hayes's study is causing alarm because he has observed effects at concentrations that reflect those found in the environment. "Hayes's work is some of the best to show how a contaminant affects amphibian reproduction," says Andrew Blaustein, who studies amphibians at Oregon State University in Corvallis.

J. MACKINNEY/CORBIS

Do environmental levels of atrazine cause sexual defects in leopard frogs in the US midwest?

"This is not a worst-case scenario where animals are exposed to mega-doses," says Louis Guillette, a zoologist at the University of Florida in Gainesville. "These are concentrations we know wild amphibians are exposed to." Indeed, atrazine is routinely found at

Scripps to trawl sea-microbe data

Jonathan Knight, San Francisco

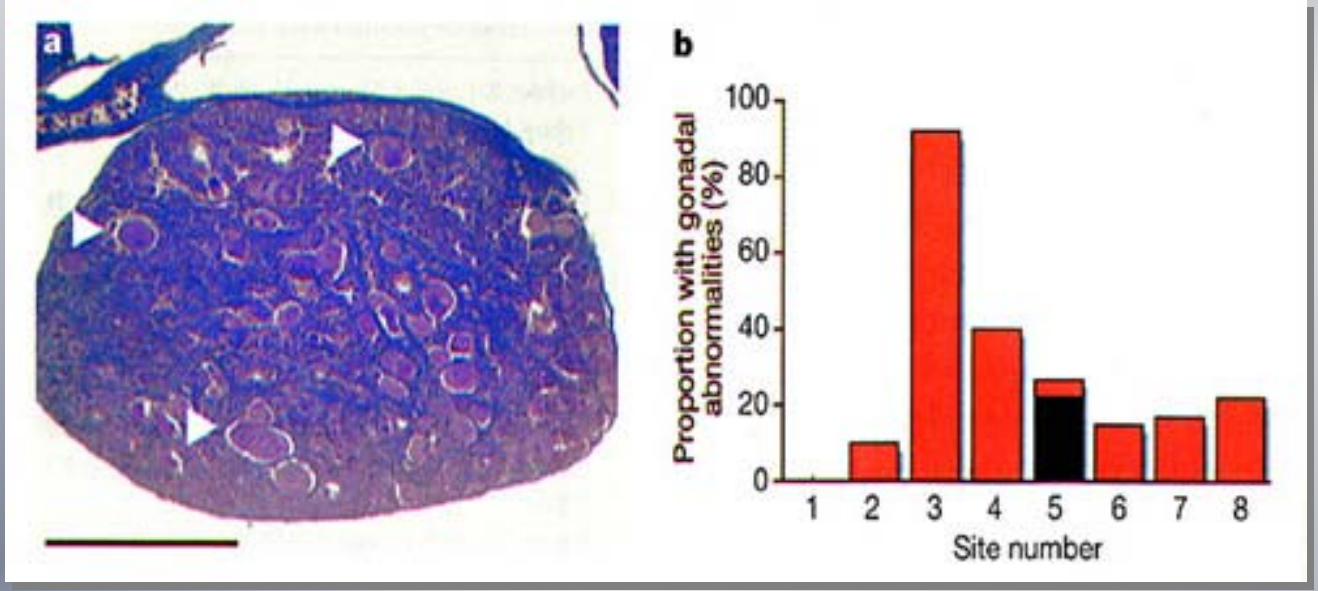
The genomic secrets of the ocean's microbes are set to be revealed by the world's first centre devoted to marine bioinformatics. The Scripps Institution of Oceanography in La Jolla, California, plans to establish the facility within the next few months.

The centre's main focus will be microbial genomics, says Ron Burton, director of marine biology at Scripps. Most of the marine genomes sequenced so far have been microorganisms — yet their biochemistry and ecology remains poorly understood, despite their crucial role in the global cycling of carbon and nitrogen (see *Nature* 415, 572–574; 2002).

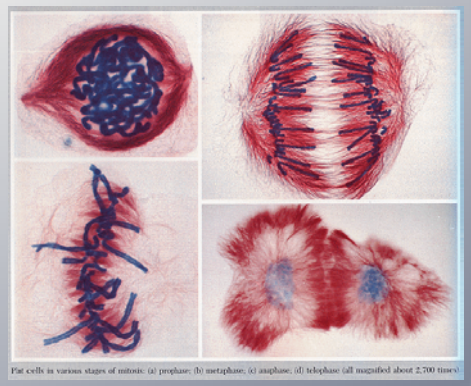
The Scripps centre will not itself sequence marine genomes, Burton says. That work will continue at places such as the Joint Genome Institute in Walnut Creek, California, where a number of marine microbes have so far been sequenced. Rather, the new facility's emphasis will be on teasing information about ocean life from the sequence databases.

For example, Brian Palenik's laboratory at Scripps has already started to apply bioinformatics techniques to learn how microbes relate to their ocean environment. Traditionally, biologists have probed this question by studying microorganisms in laboratory flasks. But genomics can help to reveal the factors that contribute to a microbe's survival. Palenik has discovered several overlooked metabolic pathways in cyanobacteria, photosynthetic microbes that are responsible for 80% of the carbon fixed from the atmosphere in the open ocean.

The new division will eventually consist of about 10 faculty members, and will cost upwards of $20 million to establish. A director has yet to be appointed, but the leading candidate is said to be a well-known figure in the bioinformatics field.



Evidence of exposure?	**Yes**
Critical limits exceeded?	**Yes - but**
Correlation?	**Yes and no**
Make scientific sense?	**Some say yes – others no**
Field manipulations?	**Not yet**
Agent specific effects?	**None as yet**



In vitro

In vivo

In eco

Wildlife	ED	Effect leading to pop decline	Weight of Evidence
Marine snails	TBT	Masculin-isation	Good
Fish	Natural/synth. oestrogens	Feminisation	Goodish
Frogs	Atrazine	Feminisation	Equivocal
Alligators	DDT, dioxins PBBs	Impaired reproduction	Reasonably convincing
Birds	DDE	Shell thinning	Mechanism equivocal
Marine mammals	PCBs	Health	Reasonably convincing

Bottom line

- There are some relevant and potentially serious effects
- BUT don’t jump to conclusions