# New Medicines At Risk From Biodiversity Loss

Harvard Medical School. "New Medicines At Risk From Biodiversity Loss." ScienceDaily. ScienceDaily, 17 October 2003. <www.sciencedaily.com/releases/2003/10/031017073822.htm>.

In a letter published in the October 17th issue of Science, three scientists warn that biodiversity loss could have devastating consequences for drug discovery and the development of new medicines. "Tropical cone snails may contain the largest and most clinically important pharmacopoeia of any genus in Nature" says lead author of the study, Eric Chivian from the Harvard Medical School, "but wild populations are being decimated by habitat destruction and overexploitation. To lose these species would be a self-destructive act of unparalleled folly."

Approximately 500 species of cone snails inhabit shallow tropical seas. They defend themselves and paralyze their prey – worms, fish, and other molluscs – by injecting a cocktail of toxins through a hollow, harpoon-like tooth. Each species has its own distinct set of around 100 'conotoxins' (the venom of the cone snail), which like a gourmet chef it mixes in constantly changing proportions, thereby preventing evolution of resistance in their prey. Co-researcher Aaron Bernstein, also of Harvard, says "To date, only about 100 of the estimated 50,000 cone snail toxins have been characterized, and only a handful tested for pharmacologic activity. The results have extraordinary promise for the development of powerful new drugs."

With more than 2600 studies published in the last 20 years, there is much excitement about conotoxins in biomedicine. "Most conotoxins are a succinct ten to forty amino acids in length and are exquisitely selective about their receptor binding sites. This makes them powerful tools for understanding how cells work and a rich source for discovery of new medicines", said Bernstein. Among many discoveries, conotoxins that block key neurological pathways have been effective in the early detection and may also help treat small-cell lung cancer, one of the most devastating human cancers. A compound now in clinical trials has powerful anti-epileptic activity. Experiments suggest that conotoxins could treat muscle spasticity following spinal cord injury. They could prevent cell death when there is inadequate circulation, such as during strokes, head injuries or coronary bypass surgery. They could also be used to treat clinical depression, heart arrhythmias and urinary incontinence.

Conotoxin research has advanced farthest in treatment of pain. The synthetic drug Prialt is in extended Stage III clinical trials for the treatment of intractable pain (unremitting, severe, and essentially untreatable pain) and could soon be on the market. "Prialt may be 1000 times more potent than morphine. More importantly, it does not seem to lead to addiction or tolerance, where increasing doses are required to achieve the same effect" said Chivian. These problems have greatly limited the long-term effectiveness of the current mainstays of severe pain therapy, morphine and other opiates. Many millions of people suffer from intractable pain and have developed tolerance to opiates, so a potent painkiller like Prialt could represent an enormous therapeutic breakthrough.

Just as we are appreciating the remarkable potential of cone snails as a source of new medicines, they are coming under intense pressure in the wild. Their shallow tropical habitats are rapidly being destroyed and snails are being collected at alarming rates from the wild to supply the ornamental shell trade as well as for biomedical research.

Cone snails are exquisitely beautiful and have been coveted by collectors since at least the 16th Century. A rare cone snail shell was sold at an Amsterdam auction in 1796 for more than a Vermeer painting! Collectors still cherish these shells, and rates of capture from the wild are escalating rapidly. "Millions of cone snails are now sold annually for as little as a few cents each in shops all over the world. But we could not find any country that monitors this trade" said co-author Callum Roberts, of the University of York, "Nobody is looking out for them."

Alongside overexploitation, cone snail habitats are being degraded and destroyed by coastal development, overfishing, pollution, disease and global climate change. A quarter of the planet's coral reefs have already been seriously damaged or destroyed and half of the world's mangroves (trees that grow on beaches) cleared. The risk of global extinction is highest for species with narrow geographic distributions. The study found that one in five cone snail species had global ranges encompassing less than 3500km2 of reef, equivalent to a single medium sized atoll (a small island formed by a coral reef). For example, eight species are unique to the Philippines, the hub of the world's ornamental shell trade. People threaten 97% of Philippine coral reefs and extinctions are inevitable if impacts are not alleviated soon.

Habitat loss and escalating, uncontrolled exploitation make a lethal combination that today threatens with extinction cone snails and many other species of biomedical interest. "International markets can develop rapidly in the modern world, which means that wild populations can be decimated before regulatory agencies see any need to protect them." said Roberts. "For this reason, we believe all internationally traded organisms (whether alive or dead) must be monitored, regardless of whether they are currently listed as threatened. This would allow countries to identify emerging markets and act early enough to prevent depletion." This could be achieved, say the authors, by extending CITES (The Convention on International Trade in Endangered Species) to cover all wild-caught species. Meanwhile, at the earliest opportunity cone snails should be added to Appendix II of CITES, so requiring countries to monitor trade and prevent overexploitation.

"Wild nature has been the template for most of the medicines we use today but we have barely even begun to tap its potential", said Chivian, "If we fail to protect cone snails, the loss to future generations would be incalculable."

Questions:

1. By using context clues, what does pharmacopoeia mean?
2. From the first paragraph, why are cone snails an important animal to protect?
3. What are conotoxins?
4. Conotoxins have been used to treat many medical conditions. What are at least 5 medical conditions that conotoxins can be used to treat?P
5. In Paragraph 2, the author states that there are 500 different species each with a distinct set of around 100 conotoxins…only about 100 of the 50,000 toxins have been characterized. What might we gain if we were able to study more of the toxins?
6. What are 4 issues leading to the loss of the cone snail?
7. Did the author state that biomedical research was leading to the disappearance of the cone snail? Why is that an issue for the argument of the article?
8. Should it be important to maintain, not just the cone snail, all of the biodiversity on the planet? Why or why not?