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Studies over the last 20 years by Estes and colleagues (*Science* 200:403–411; *Science* 245:170–172) reveal that the otters change entire ecosystems. Their impact hinges on the fact that sea otters eat sea urchins and lots of them. Sea urchins, left uneaten, consume kelp.

Around islands in the Aleutians where the otters have not been hunted to local extinction, sea urchins are minor elements of the subtidal invertebrate community. The otters keep them in check. Without abundant sea urchins, the undersea kelp forests flourish and become a major contributor to the basic productivity of these near-shore waters. With higher primary productivity, the entire ecosystem is richer with life—more species and more individuals of those species.

This impact carries all the way through the food chain, including fish-eating birds, such as Bald Eagles, and fish-seeking people.

Around islands without sea otters, the opposite prevails. Sea urchins become so abundant that they devastate the kelp forest. Their impact cascades through the ecosystem, impoverishing the life of Aleutian waters by reducing diversity and lowering abundance. The net result is an environment less valuable to wildlife and to people.

I thought about these Aleutian rivets a lot as the Valdez oil spill spread. A large number of the sea otters in Prince William Sound perished. At the time I wondered how you fix a price per oiled sea otter, a fair value whose amount

would reflect the profound role they play in the ecosystem. Exxon knew how to deal with it. They ignored it altogether.

I am on a plane as I write, and can report that no rivet poppers cluttered the wing as I boarded. I wouldn't have left San Francisco had they been there. Our common tragedy is that we cannot say the same for the planet. Folks are out there popping the rivets of biodiversity every day, at a pace and scale the likes of which Earth has not experienced for at least 65 million years.

True, biodiversity recovered its splendor after that last mass extinction at the end of the Cretaceous. Mankind lives off that accumulated capital today. But the recovery took over 10 million years.

A prospect of restoration 10 million years in the future affords me no solace. Nor can we look for an excuse in the fact that during the earth's last 600 million years, life has experienced at least five mass extinctions. The dinosaurs neither caused their demise nor knew how to prevent it. We are causing it and we do know how to prevent it. The next time you see a Lucy blithely popping rivets, nail that sucker to the wall. ■

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RETORTS, REFLECTIONS, AND THOUGHTFUL REFUTATIONS

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