The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Predator-Prey Dynamics in Demand Destruction and Oil Prices

Posted by jeffvail on August 26, 2008 - 11:01am
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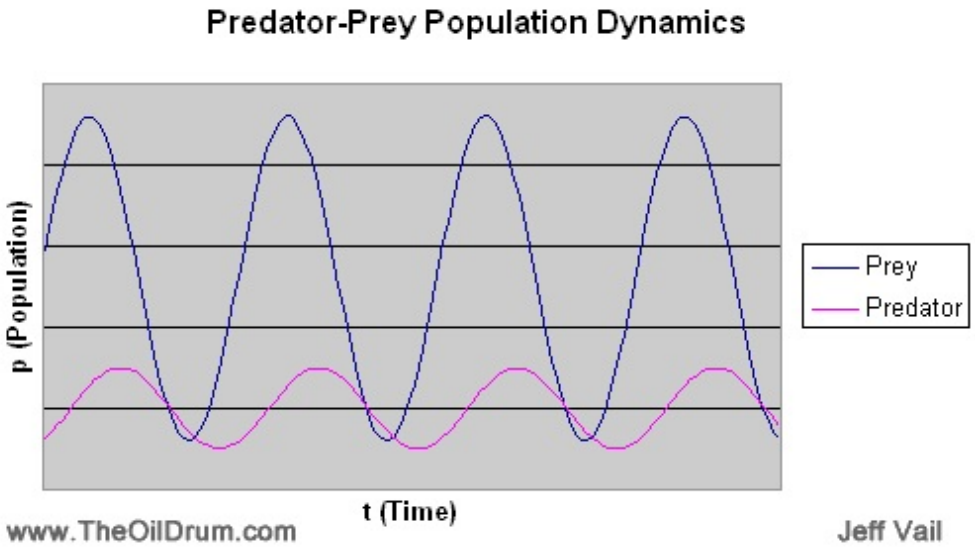
One of the classic ecological modeling problems is the oscillating populations of predators and their prey in an ecosystem--as prey population rises, predator population follows suit until prey population begins to fall off, resulting in a subsequent drop in predator population (illustrated below). The same dynamic also applies, to some degree, to the relationship between oil price (prey) and marginal production/demand destruction/energy policy (predator). This post will explore that relationship and its ability to help us avoid poor energy policy choices.



The prey-predator dynamic has been mentioned in the context of peak oil occasionally on The Oil Drum (1 and 2), but usually in the context of human population and carrying capacity. Both oil price and demand destruction can be modeled, at least in theory, as a predator-prey system. Here, I would like to look specifically at the relationship between demand destruction, marginal production, and price through the predator-prey lens.

Classic predator-prey system

The simplest predator-prey dynamic is described by the Lotka-Volterra system of differential equations. The exact values obtained by this system of equations is predicated on several

assumptions--such as exponential growth of a prey population when a predator is absent and that predators can consume infinite quantities of prey. I don't propose that these assumptions apply to oil, nor that the Lotka-Volterra equations can accurately predict either oil price or production. Instead, I propose that the relationship dynamic is analogous between the general predator-prey model and the behavior of oil price, demand destruction, marginal production, and energy policy choices.

Seeing Oil as a Predator-Prey System

When oil price rises, there is an increasing incentive to 1) reduce elastic demand, 2) produce more oil, and 3) make public policy choices that mitigate the impact of high oil prices (or at least use it as a lever to pander to a voting population or enrich oneself). Likewise, to the extent that each of these three results bears out, it exerts downward pressure on oil price due to relatively greater production and relatively lower demand. Lower prices, in turn, remove the incentive to reduce demand and to produce more oil--especially where the lower price impacts the economic viability of marginal production.

Since there is an uncertain lag time between rising prices and reducing demand/increasing marginal production, it seems likely to me that the sequential corrections in price and demand/production will overshoot and create oscillations similar to the Lotka-Volterra predator prey model. This may not be the case if oil production potential and cost was a constant (as well as human population, economic growth, etc.), but the uncertainty created by a background environment of peak oil will make it very difficult for these oscillations to eventually settle at an equilibrium.

To some extent, we are seeing exactly this effect in America today. As prices rose steadily from $110/barrel to $147/barrel in early Summer, national attention zeroed in on "America's Oil Crisis," as a perpetual counter on CNBC labeled it. The stage for much of today's Presidential contest was set during this period. As oil prices dropped, and CNBC's "Oil Crisis" ticker unceremoniously disappeared, I've actually heard more than one person comment that "I guess I don't have to sell the SUV." While the macroeconomic situation adds a complicating wrinkle to the simplified predator-prey chart above, we may have already entered the phase where ramped up production plans are being scrapped, efficiency measures postponed, and political will to enact bold energy policy measures fade.

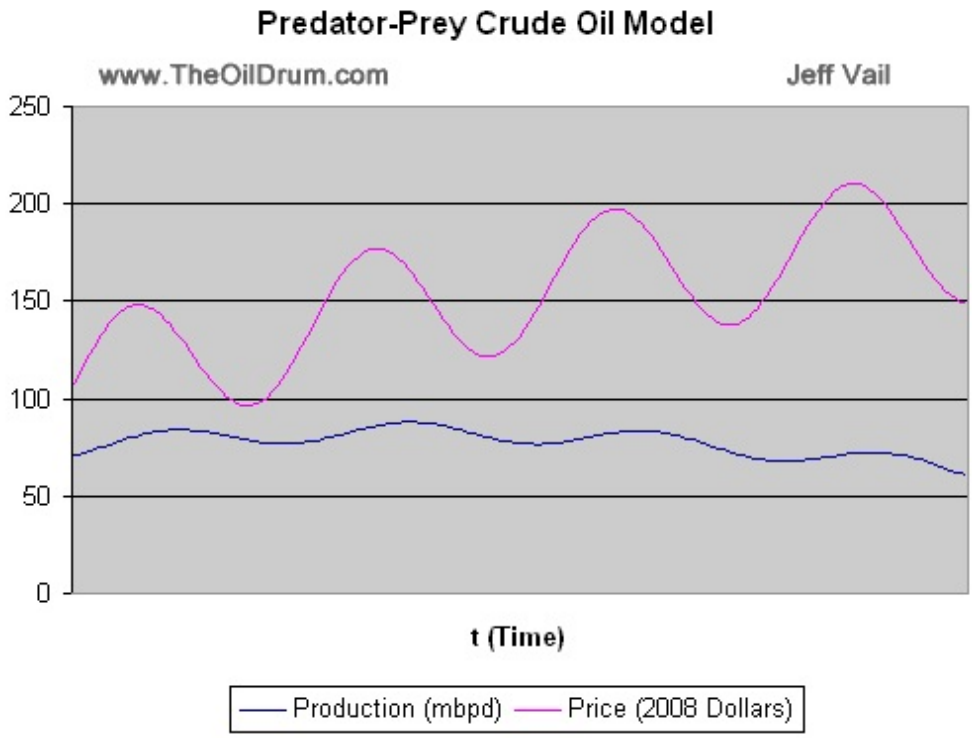


Figure 2: The predator-prey oscillations of price increases and demand destruction/production increases superimposed on top of a geological depletion scenario--note how the volatility fo the predator-prey dynamic works to conceal the underlying geological and geopolitical trends.

Conclusion

At the end of the day, this is a very crude model. It is not intended to predict actual price or production, but rather to illustrate how production and price may interact similarly to predator and prey populations in an ecosystem. The importance of this analogy is that it may help us to avoid certain policy mistakes (or at least be aware of them). When the oscillations of price and demand/production are superimposed on top of geological depletion and geopolitical feedback loops, the resulting volatility effectively masks the underlying fundamentals (see Figure 2, above). This presents several problems, each of which may be more avoidable if the medium-term fluctuations in price, production, and demand are seen as oscillations on top of a very worrying underlying trend of peak oil.

At the risk of invoking the problematic "awareness" issue, the problem of peak oil cannot be effectively mitigated through political or economic choices until it is understood. (how effective this mitigation can be, even if the problem is fully understood, is debatable, but at least some mitigation is possible.) Awareness of the underlying problem, in turn, is being masked by the oscillations of the price/demand/production "predator-prey" dynamic. If individual consumers realize that price drops (at least relative to purchasing power) are temporary in an environment of geological depletion, and if policy makers learn to effectively communicate this point, then we will be positioned to best mitigate the effects of peak oil on a personal, regional, and global scale.

If, on the other hand, we do not see through the fog of these predator-prey oscillations, then we may miss our best opportunity to adapt to the long-term energy reality. Technophiles may be right--efficiency gains and high-tech substitutes may allow us to continue "business as usual" indefinitely. While I don't share their optimism, my overriding concern is that the lure of their sales pitch--especially in an environment like today's where prices are dropping and production is

(arguably) rising--will convince us not to make the difficult choices about changing "business as usual" now and force us to make much more difficult choices later.