In Brief

Oil hazards for first wild-hatched California condor

No California condor has reproduced successfully in the wild for 18 years. The species is here today because, in 1985, an ambitious US$35 million captive-breeding program was used to rebuild numbers and to release captive-bred birds back into the wild. There are now 63 condors living in the wild in California and Arizona, and 122 more in captivity. But it was not until this spring that any condor chick had hatched in the wild (http://www.defenders.org/wildlife/birds/calcondor.html).

The first to do so has been watched carefully, and made national news when it got its head and feathers covered with oil from its father, who had stuck his head in a puddle of crude oil near an oil well in the area. Biologists believe that the chick will be fine, and take further hope in noting there appear to be other wild nests with eggs ready to hatch. But when a species is down to a handful of individuals, every little environmental insult becomes a major threat. *PK*

Planning requirements of the UN Convention on Biodiversity

As signatories to the United Nation's Convention on Biodiversity, >175 countries are required to prepare national plans for biodiversity protection (http://www.biodiv.org; 24 April 2002). Not surprisingly, the business of large-scale conservation planning has become a major activity for conservation NGOs and government agencies worldwide. Ten years ago, agreement about how to proceed would have been impossible to find. Now, a recent article in *Bioscience* (June 2002) authored by scientists from The Nature Conservancy, Defenders of Wildlife, Wildlife Conservation Society, US Geological Survey, and the President-elect for the Society of Conservation Biology reveals a cohesive approach with a wide range of adherents. Other major conservation organizations are also coalescing behind a common vision for conservation planning – creating the unusual situation of scientists organizing themselves so effectively that they are ready to deliver exactly what is needed when it is needed. *PK*

What do Americans think about biodiversity?

More Americans are aware of biodiversity than ever before (30% in 2002 compared with 19% in 1996). Americans are especially receptive to arguments for protecting biodiversity that emphasize leaving a legacy for future generations (58%) and an appreciation of the beauty of nature (53%). Interestingly, for every single specific environmental threat queried (air pollution, water pollution, toxic waste, climate change, loss of rain forests, overconsumption, habitat loss and extinction), a smaller percentage felt these were severe threats in 2002 than in 1996, although when asked about environmental quality in a general sense, more people felt it was 'somewhat worse' than did previously (25% in 2002 compared to 19% in 1996).

When it comes to personal actions for biodiversity protection, reducing home pesticide use scores highest. In general, this poll, which had a sample size of 1500 and a sampling error of 2.5% is compelling reading because it reveals a curious match between the messages of scientists and how the public thinks about biodiversity and threats to that diversity (http://www.biodiversityproject.org/). *PK*

Buying carbon credits in Brazil

Even though the Kyoto protocol has not been ratified, investments are being made to sponsor carbon-cutting projects in countries such as Brazil. One of the bigger projects is a US$5 million World Bank investment in a Brazilian pig-iron smelter that uses charcoal from an environmentally certified forest as opposed to coke (this will reduce carbon emissions by 20 million metric tons over the next two decades). A small project, but one that should ring close to home for all scientists, is Environment Canada's decision to buy US$7700 of carbon credits (by investing in a Brazilian biomass energy producer) to offset the greenhouse-gas emissions of air and ground transportation to one of its environmental conferences. In the age of the internet, one has to wonder how necessary all the travel and conferencing done 'for the sake of the environment' is, whether it be by government agencies, scientists, or the many conservation NGOs. At least Environment Canada is admitting to the hidden costs of all those conferences that we so often attend, although they did not figure in the 'hot air' input when estimating how many carbon credits to purchase (http://www.ecoamericas.com/; May issue). *PK*

Indonesia now deforestation leader?

Each year ~2 million ha of forest are destroyed in the archipelago-nation of Indonesia, according to the World Resources Institute. If this estimate is accurate, Indonesia would now be the world's deforestation leader – overtaking Brazil, which lost an average of 1.9 million ha annually from 1995 to 2000.

Over the past 50 years, Indonesia has lost 40% of its forest cover – a total of 64 million ha. Deforestation has been especially rampant in Sumatra and Kalimantan (Indonesian Borneo), where forests outside reserves will largely vanish within the next 5–10 years, according to the World Bank. Logging, slash-and-burn farming and conversion of forests for oil-palm and pulpwood plantations are the biggest drivers of forest loss.

With her nation losing forest at a rate equal to seven football fields a minute, Indonesian President Megawati Sukarnoputri recently called for a temporary moratorium on logging. In addition, environmental organizations are lobbying North American corporations, such as Citigroup, Boise Cascade and Georgia Pacific, to reduce their extensive investments and trade in Indonesian palm-oil, pulp and timber products. *WFL*

Pew Oceans Commission raises the issue of human settlement patterns

It is widely known that people like to live near coasts, and that growing coastal populations are a major threat to marine environments worldwide. For example, over half of the US population lives in the area categorized as coastal. But a recent Pew report argues that we are missing crucial practical opportunities for conserving our oceans by simplifying everything to 'population growth' (http://www.pewoceans.org/oceanfacts/). Specifically, the report emphasizes that the percentage of a watershed that is impervious material and the amount of nitrogen contamination correlate highly with roads and travel patterns, which in turn is dictated by our affection for suburban sprawl as opposed to high-density settlement. For example, some coastal areas are consuming land for development at ten times the rate that they are actually adding people. The connection between local zoning and development patterns and conservation or biodiversity protection is too rarely made. The report identifies a new arena that conservation biologists should enter if they hope to mitigate the impacts of human population expansion. *PK*

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Letters

Survival and anisogamy

Randerson and Hurst [1] claim that the disruptive selection theory for the evolution of anisogamy detailed by Parker, Baker and Smith (PBS) [2] requires 'an unusual and unverified assumption regarding the relationship between zygote size and fitness'. We disagree that the form of relationship between the fitness f of a zygote and its size, S, required by PBS is unusual, and show that if two mistakes are corrected in Randerson and Hurst's interpretation of the work of Levitan [3], we in fact obtain the kind of $f(S)$ relation that is required by PBS.

Levitan [3] suggests that the relationship between the time, T, taken for a facultative planktotroph larva to develop to maturity and the size of the zygote, S, is of the form (Eqn 1)

$$T = a + b/S \qquad \text{[Eqn 1]}$$

From this, Randerson and Hurst assume the fitness of the zygote to be given by its probability of survival to maturity, and claim that if there is a constant mortality, p, the fitness will be (Eqn 2)

$$\begin{aligned} f(S) &= 1 - pT, \quad & T < 1/p \\ f(S) &= 0, & T > 1/p \end{aligned} \qquad \text{[Eqn 2]}$$

This fitness function is shown in Fig. 1 with the parameter values used by Randerson and Hurst. They observe that, above the cutoff point $S = 0.00012$, fitness is a decelerating function of zygote size, contrary to the requirement of PBS, and conclude that 'it seems unlikely that the relationship between egg size and developmental time will rescue the untested assumption of the PBS model'.

There are two mistakes in this analysis. First, the correct form of the fitness function should be (Eqn 3)

$$f(S) = e^{-pT} \qquad \text{[Eqn 3]}$$

as Levitan proposes, after Vance [4]. This is approximated by Eqn 2 when pT is small, but not otherwise. It has the correct form to generate anisogamy with any parameter values, because it is an accelerating function of zygote size near the origin.

Although Randerson and Hurst have used an incorrect formula in Eqn 2, it is interesting to consider whether anisogamy will evolve with this type of fitness function, which might sometimes be appropriate (e.g. if a minimum amount of yolk were needed to permit embryonic development). Using the formulation of PBS in [1] (Box 1), it can be shown that there is an anisogamous equilibrium with microgametes having zero size (in practice, the minimum size δ for viability as gametes) and macrogametes having size S satisfying Eqn 4:

$$f'(S) = f(S)/S \qquad \text{[Eqn 4]}$$

(The fitness of a female producing M/S eggs each of size S is $Mf(S)/S$, whose maximum value satisfies Eqn 4.) This is a version of the Smith and Fretwell [5] result for the optimal balance between number and size of offspring. It can be represented graphically by plotting the tangent from the origin to the curve $f(S)$ and finding the value where they meet (Fig. 1, which is similar to the graphical derivation of Charnov's [6] marginal value theorem). In this example, the optimal egg size is $S^* = 0.00024$. (We have ignored the fact that $\delta > 0$, because $S^* \gg \delta$.)

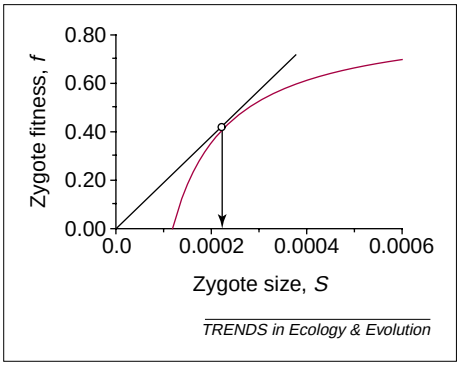

Fig. 1. Plot of $f(S)$ from Eqn 2 with $a = 13$, $b = 0.0103$, $p = 0.01$, as used by Randerson and Hurst [1]. The tangent from origin to curve gives the optimal egg size when sperm make no contribution.

This anisogamous strategy is an ESS, because sperm of minimal size are the optimal response to eggs of size 0.00024 and vice versa. There is also an isogamous strategy with both eggs and sperm of size $S/2$, where S satisfies Eqn 5:

$$f'(S) = 2f(S)/S \qquad \text{[Eqn 5]}$$

In the example, both eggs and sperm are of size 0.000089, giving a zygote size less than that under anisogamy. This strategy is an ESS, but it is continuously unstable [7] in the sense that the system will diverge from it after a perturbation. If both eggs and sperm are exactly of size 0.000089, they will stay there, balanced on a knife-edge. But if eggs are of size 0.0001, sperm will decrease in size to 0.000065, in response to which eggs will increase to 0.000133, which allows sperm to decrease to their minimal possible size, followed by an increase in egg size to 0.00024. Thus, the anisogamous strategy is the only continuously stable ESS.

Isogamy, with both types of gamete having their minimum size δ, is only

