The devil in the (demographic) detail

The Dispatches piece “Infectious cancer decimates Tasmanian devils” (Front Ecol Environ 2006; 4(2): 65) and the Nature articles on which it was based (Dennis 2006; Pearse and Swift 2006) highlight current research aimed at saving the endemic Tasmanian devil (Sarcophilus harrisii) from the deadly facial lesions known as devil facial tumor disease (DFTD). Researchers have committed considerable time and effort to determining the agent responsible for the disease, with new evidence pointing to transmission via allograft of infectious cells between combative individuals (Pearse and Swift 2006). However, the suggestions of imminent extinction and the speculation regarding the role of toxins or deforestation in instigating and promulgating DFTD are unsupported by empirical evidence and ignore the fundamental dynamics of the devil population.

Regardless of the agent involved, the high transmission rates between individuals fighting over scavenged food resources must be investigated within a framework of population dynamics. Previous modelling of the devil population (Bradshaw and Brook 2005) supports the strongly density dependent nature of DFTD transmission and this, along with historical and anecdotal information, suggests that the devil population in Tasmania has undergone (and subsequently recovered from) at least three catastrophic declines due to disease in the past two centuries. Indeed, there is evidence that populations expanded considerably following agricultural deforestation, when livestock carcasses became a common feature of the landscape (Bradshaw and Brook 2005). A classic pattern of extreme fluctuation in abundance generally emerges when the transmission dynamics of the pathogen or agent responsible is density dependent (eg Davis et al. 2004) – the disease has a lower rate of infection when the contact rate between individuals declines (Lafferty and Gerber 2002). As such, we argue that this scavenging carnivorous marsupial is adapted to cope with a high prevalence of disease due to the strong selective pressure exerted by its immunologically challenging feeding strategy, evolving a surprisingly early age of senescence for a mammal of its size (up to 11 kg).

While this built-in resilience does not necessarily nullify the risk of extinction, given the possibility of other new mortality sources and Allee effects at low densities (Bradshaw and Brook 2005), it does cast doubt on the more ominous predictions of imminent extirpation. We suggest that while attempts to establish disease-free zones (Dennis 2006) could reduce disease prevalence and provide added conservation safeguards, a potentially more efficient approach would be to reduce densities immediately by removing infected individuals from the entirety of the species’ range. This would have the dual benefit of reducing the likelihood that individuals will encounter diseased conspecifics and mitigating intraspecific competition induced by conflict over limited shared resources. Thus, once exposure probabilities are pushed below a certain threshold, “extinction” of the infectious agent becomes more likely.

Current pilot studies aimed at reducing densities in small disease-free refugia (Dennis 2006) may only provide a temporary solution, given the possible maintenance of the disease outside these zones. We therefore recommend a research program that measures the degree to which transmission rates are modified by population density. This could be achieved by the comparison of disease dynamics in (1) areas receiving no density reduction (controls), (2) areas where only deceased devils are removed, and (3) areas where density is reduced through the random removal of individuals. An experiment of this scope and magnitude would provide information essential to parameterize spatially explicit models that could identify the areas most in need of manipulation.

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Extreme climatic events in ecological research

Alterations in the magnitude and frequency of extreme events (IPCC 2001) pose new challenges to ecosystem resilience and socioeconomic systems. It is not surprising, therefore, that the debate about climate change has expanded from an analysis of trends to an interest in extreme events. However, neither the “event”-character of climatic processes nor the quantification of “extremeness” is well established in this debate.

In a recent article, Holmgren et al. (Front Ecol Environ 2006; 4(2): 87–95) associate extreme climatic events with the El Niño Southern Oscillation, although they are aware
of its relative predictability with return intervals between 3 and 6 years (McPhaiden 2004). The recurrent nature of this oscillation immediately raises the question: What should be considered extreme? As a disturbance ecologist interested in ecosystem dynamics, I would argue that we need to clarify the concepts of event and extremeness, in order to collectively profit from event-based ecological research dealing with several orders of magnitude in the life spans of response communities.

First, a discrete event is distinguished from a continuous process by its abruptness, no matter whether the event is recurrent, expected, or normal (White and Jentsch 2001). Abruptness of an event is a function of magnitude over duration, which is best described relative to the life cycles of the organisms in focus. Thus, El Niño events may be perceived as climate driven weather events by many higher organisms in the relevant ecosystems. Their life spans range from weeks to centuries, so that some members of the system experience the event only once and others several times. The concept of discrete events suggests that they are abrupt relative to growth rate and succession of the ecosystems in which they occur. Using such relative currency to express frequency allows comparison among ecosystems.

Second, I believe that extremeness of events can be determined by statistical extremity with respect to a historical reference period (extreme value theory). However, predicting future climatic scenarios, we are faced with two different qualities of extremeness; (1) an increase in the probability of occurrence of a maximum or minimum of a given climatic parameter (frequency of multi-event), such as temperature, and (2) a novel crossing of the observed minimum or maximum of a climatic parameter (magnitude of single event), such as length of drought period in a given area. In this context, extremeness of an event is described independent of its effects on organisms. Thus, the question remains, whether a particular El Niño-caused event such as cold, heavy rainfall, or drought meets either of the two criteria of extremeness.

Remarkably, the farther back we look in time, the more extremes we observe. The definition of extreme is therefore historically contingent. Also, the Earth had periods of relative stability and relative change, and there were periods of rapid resetting of “extremeness”. Are we now in a period that is even more rapid in that resetting? An organism’s range of tolerance is the only condition that would answer this question, and it might be different for different organisms.

Science and society urgently need to advance research on extreme events and their consequences for ecosystems by collecting evidence on their effects through long-term observations and short-term experimental studies in various ecosystems and on various scales of time and magnitude.

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Stop Cau lerpa sales on eBay

Walters et al. (Front Ecol Environ 2006; 4(2): 75–79) eloquently highlight the need to limit internet sales of Cau lerpa species and specifically call for online marketplace eBay to halt sales of this potentially invasive genus. We would like to offer a bit of background on our work in this area.

In the summer of 2004, Sea Studios Foundation (SSF) began working with eBay to limit trafficking of invasive species as part of National Geographic’s Strange Days on Planet Earth series (www.pbs.org/strange days). SSF approached eBay for a number of reasons. With more than 6 million listings added daily, this marketplace reaches an enormous domestic and international audience, making every home a potential port of entry for invasive species. Until the Strange Days initiative, eBay had no policy for curtailing the trafficking of invasive species, but was happy to work with experts in the field to address this issue.

SSF established a productive dialogue and working relationship between eBay’s Trust and Safety Department and the USDA’s Animal and Plant Health and Inspection Service (APHIS). Together, the group wrote and posted new invasive species trafficking policies for the eBay website (eg http://pages.ebay.com/help/policies/plan tsandseeds.html).

In addition, APHIS compiled for eBay an ongoing list of federally regulated invasive species most likely to be found for sale on the internet. The site then developed, field-tested, and fine-tuned methods to halt the listing of these species. For example, we included Caulerpa taxifolia on the list and, as Walters et al. point out, this particular species listing is not available on eBay. Other prohibited species include giant Salvinia spp, giant hogweed (Heracleum mantegazzianum), cape tulip (Homeria spp), Hydrilla, Chinese water spinach (Ipomoea aquatica), and mosquito fern (Azolla pinnata). In addition, APHIS has recently completed a reassessment of the genus Caulerpa, identifying the risks that its 84 species (and assorted infraspecific taxa) present to ecosystems.

One of the great challenges in halting the internet trafficking of invasive species is the myriad names...
given to particular species. As we
continually augment our lists, we
welcome research such as that con-
ducted by Walters et al. We thank
the authors for bringing attention
to this issue and for highlighting ad-
tional species to consider for federal
regulation and addition to our exist-
ing Caulerpa filters. With continued
vigilance, we can all be part of the
solution.

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War of the roses: towards a
holistic view of invasive
species management

I read with interest Larson’s recent
article (Front Ecol Environ 3(9):
495–500) on a thought-provoking ini-
tiative that introduces the concept of
responsibility through demilitarizing
the language that is commonly used in
invasive species research and control.

The review challenges managers,
researchers, and theorists interested in
this topic to accept that, as Larson
rightly points out, humans also need
to be managed as they are an integral
part of the problem. This is achieved
by illustrating how military metaphors
commonly used in discussing invasive
can lead to (1) inappropriate
perceptions of invasives and (2) loss of
scientific credibility. By demilitarizing
the language used in the debate and
management of invasive species,
Larson is proposing that we “de-demo-
nize” the invasive species in question,
because by demonizing them we are
effectively distancing ourselves from
any blame. Indeed, in many instances,
distancing ourselves as integral com-
ponents of ecosystems has led directly
to the conservation problems associ-
ated with invasive species that we
now face.

However, the debate is not a sim-
plistic, one-way, mechanistic process
where one action leads to a specific
outcome (Yodzis 2000). Therefore,
hearing in mind the complexity of
these issues, it may be imprudent to
dismiss entirely the use of military
metaphors in the debate. This is
because there are instances where
invasive species have been controlled
using a militaristic approach in the
design, implementation, and publica-
tion of the results, and have been
removed from sensitive ecosystems
(Bester et al. 2002). For instance, in
the Marion Island ecosystem, the
invaders (feral cats) were directly
responsible for the extinction of
native species and therefore a reduc-
tion in biodiversity (Bester et al.
2002). The success of the cat eradica-
tion program on Marion Island can be
attributed to a militaristic approach
that included a staged process of high-
level research (reconnaissance),
experimentation with different con-
rol measures (planning), and imple-
mentation of the methods (execution).
Consequently, while I agree
that removing military metaphors
from the language of invasive species
management promotes an inclusive
and novel approach to the debate, I
feel that the complete eradication of a
military philosophy may not be entirely useful in such cases.

In order to embrace a more holistic
approach to invasive species manage-
ment, it seems prudent that in our
ultimate bid to conserve as much bio-
diversity as possible we, as conserva-
tionists and ecologists, should not dis-
miss the contribution that military
metaphors have made in the success of
management programs. Instead, both
philosophies should be integrated into
the debate. In fact, debate is of vital
importance in understanding those
processes that are threatening biodi-
versity, because with debate comes the
airing and recognition of contrary
views which, with a little luck and
perseverance, may lead to compromise
and understanding from the extreme
sides of that debate. Such collabora-
tion must (hopefully) lead to all par-
ties pooling their resources (in this
instance intellectual) towards the
common goal of biodiversity conser-
vation.

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Bester MN, Bloomer JP, van Aarde RJ, et
al. 2002. A review of the successful
eradication of feral cats from sub-
Antarctic Marion Island, Southern
Yodzis P. 2000. Diffuse effects in food

Erratum

Messing RH and Wright MG. Front
credits for Figure 5 were reversed:
Figure 5a should be “Courtesy of R
Heu” and Figure 5b should be
“©Jack Jeffrey”.

Hodder et al. Front Ecol Environ
4(3): 162–63. There was an error in
Box 3 of Panel 1. The calcium car-
bonate formation/dissolution equa-
tion is not one of equilibrium as
shown. The statement that calcium
carbonate is dissolved is incorrect;
rather, reduced pH and lower car-
bonate saturation in the ocean
means that fewer carbonate ions are
available to build skeletons. A cor-
rected version of Panel 1 is available
at www.first2.org

Briggs JM, et al. Front Ecol Environ
4(4): 180–88. In the legend to
Figure 7, the third sentence should
read: Maize pollen was found in this
layer (see Table 1).

Dodds W. Front Ecol Environ
4(4): 211–17. In Figure 2, the dotted line
should be “mineralization” and the
dashed line should be “net uptake”.
The lower left graph in Figure 3 does
not use data from the Atchafalaya
River. Corrected graphs are available
in the online version of this page.