

Using High-Tech to Attack Environmental Perils

The End of the World as We Know It?



William F. Laurance

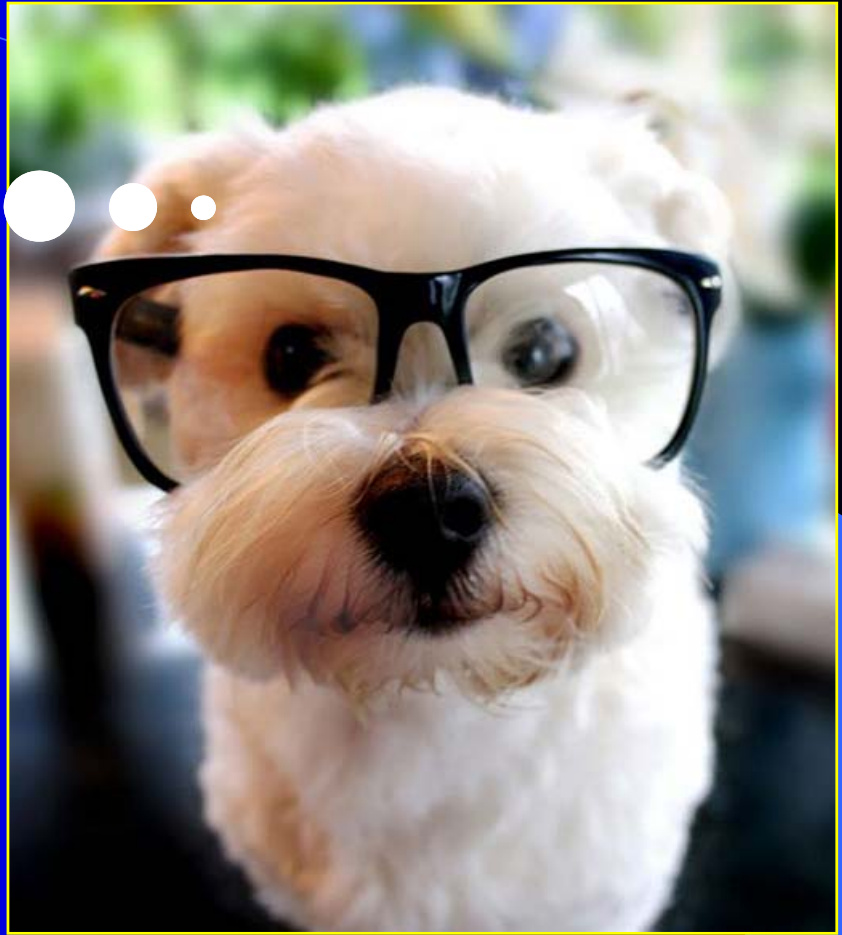
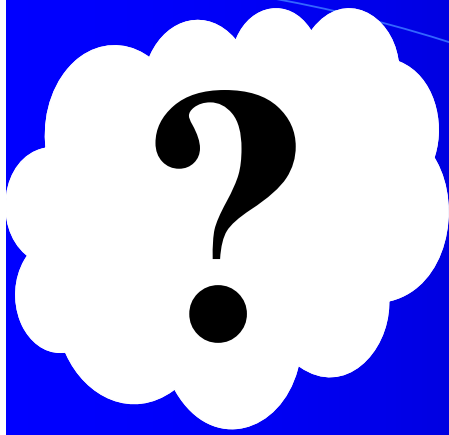
Centre for Tropical Environmental
and Sustainability Science (TESS)

School of Marine and Tropical
Biology

James Cook University
Cairns, Australia

It's great to be here





**Conference
organisers**



Laurance Lab: Active Research Sites



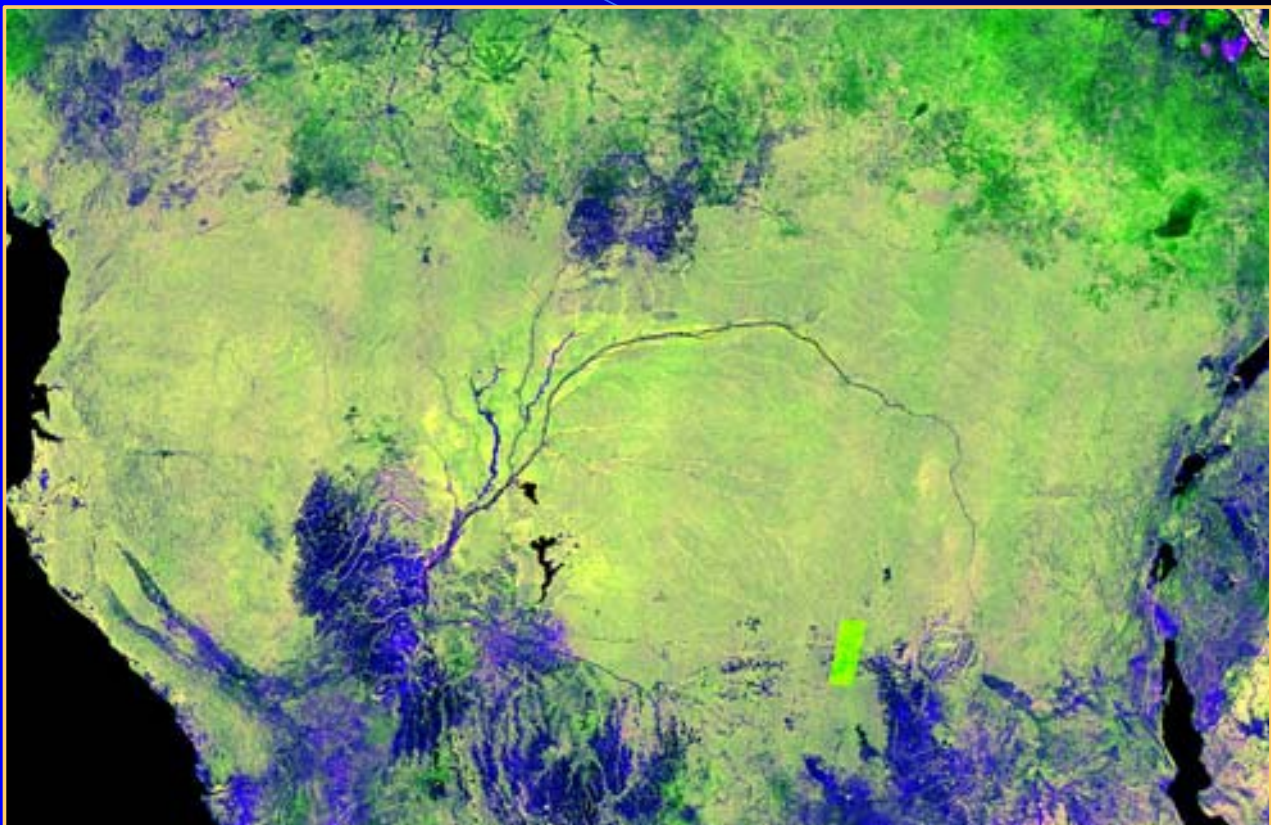
1) Remote Sensing

- Big improvements
 - Spatial resolution
 - Spectral range
 - Frequency
- Specialized sensors & algorithms

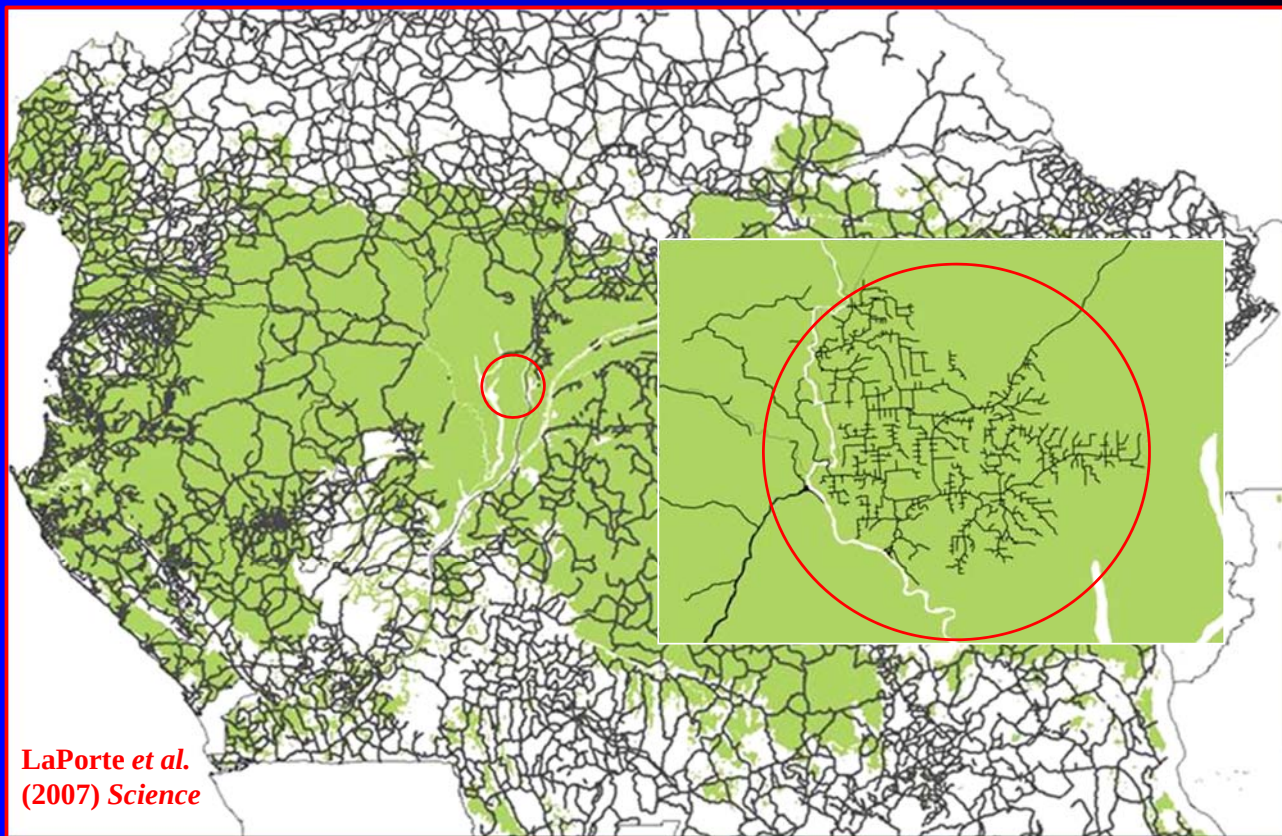
Roads & hunting



Greater Congo Basin



Congo Roads Today



Shining light in dark places

- **Brazilian Amazon**

- Government claimed $\sim 3,000 \text{ km}^2$ forest logged annually
- Greg Asner showed $\sim 22,000 \text{ km}^2$ logged annually

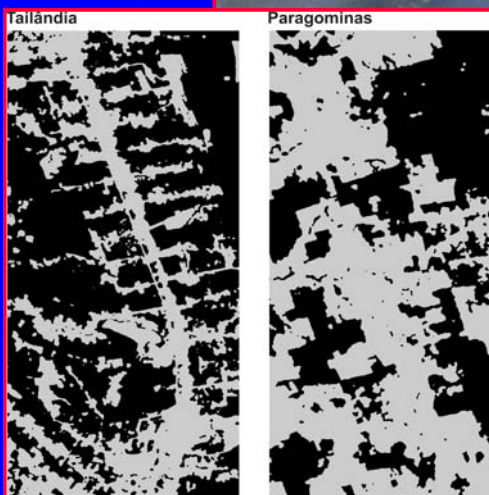


● Interoceanic Highway route, Peruvian Amazon

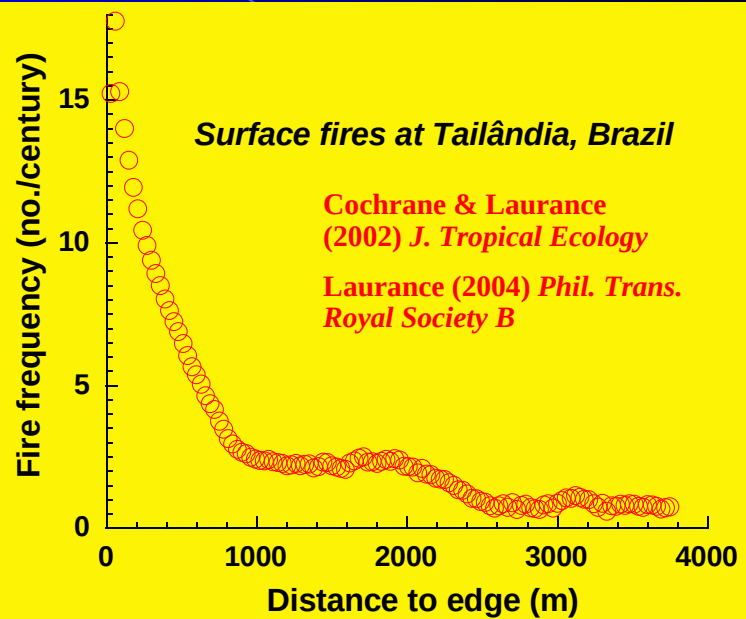
- Government estimated ~ 5,000 illegal gold mines
- Asner found *far more*



Forest fragmentation & fire



Sub-pixel linear-mixture modeling



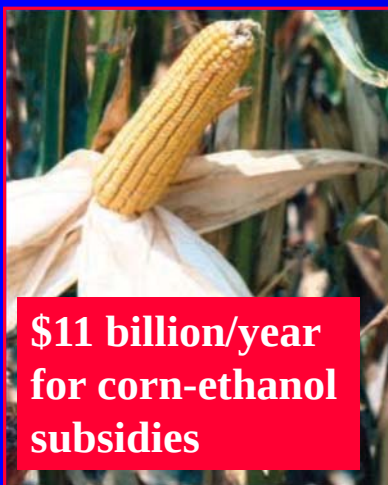
Aftermath of recurring surface fires



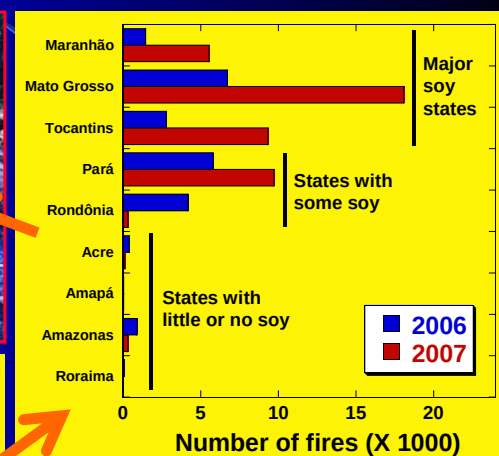
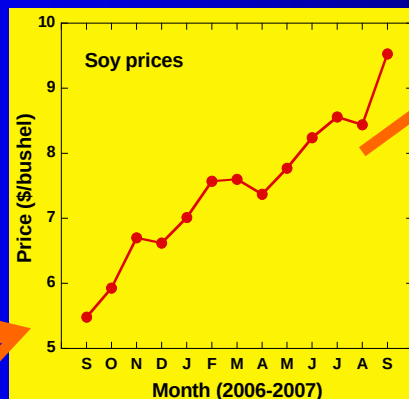
Monitoring fires in real time



'Corn connection' to Amazon deforestation



Corn production rises 25%, soy falls 19%



Laurance (2007) *Science*

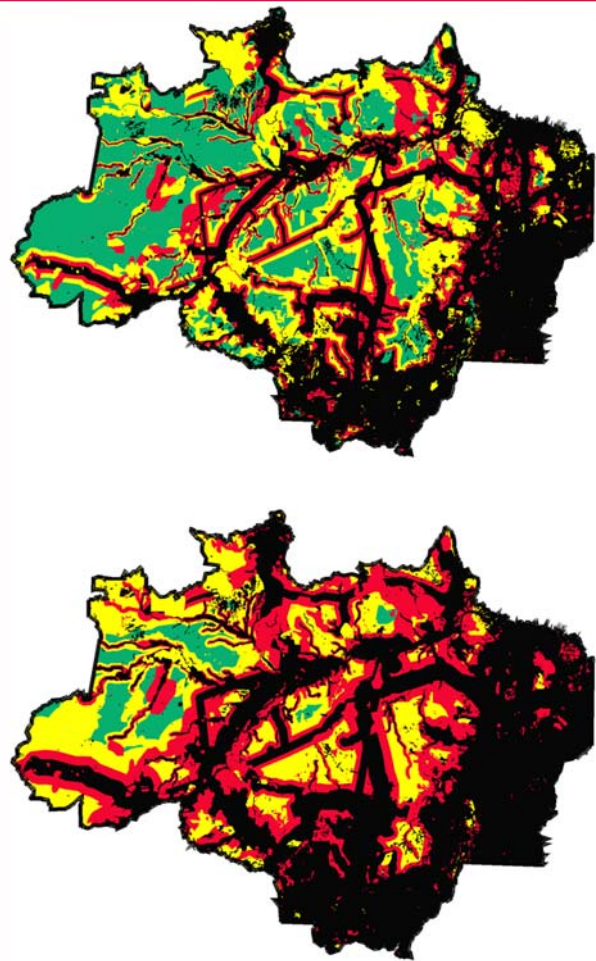
Laurance (2008) *New Scientist*

The Future of the Amazon?

Modeling studies suggest dramatic increases in forest loss, fragmentation, and degradation over next 20 years

- ◆ Deforested or heavily degraded
- ◆ Moderately degraded
- ◆ Lightly degraded
- ◆ Pristine

Laurance *et al.* (2001) *Science*
291:438-439



The cutting edge: Detailed forest inventories

Carnegie Airborne Observatory

- LIDAR with two spectrometers
- 3-D forest structure, biomass, topography, leaf spectra & chemistry
- Ultimate goal: identify tree species

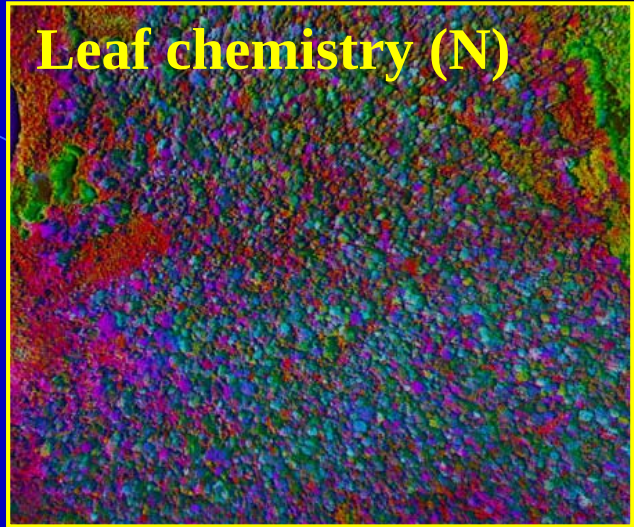


Greg Asner

Naked eye



Leaf chemistry (N)



Forest biomass



- Fantastic resolution (up to 10 cm)
- But limited coverage (500 km² per day) & very expensive

2) Automated Aircraft

Lian Pin Koh





**Emphasis on
low cost &
ease of use**



**Rhinos in
Chitwan N.P.,
Nepal**



**Orangutan nests
in Sumatra**



**Illegal deforestation
in Kalimantan**



Arducopter—fully
autonomous



Generation 3.0



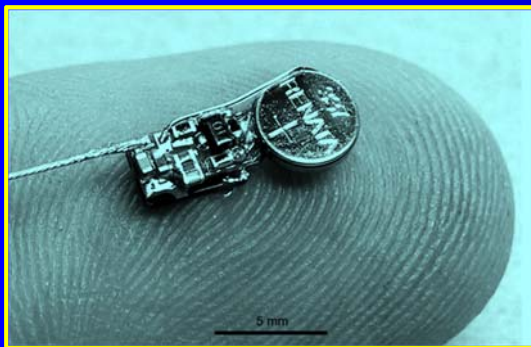
Conservationdrones.org

3) Micro-telemetry

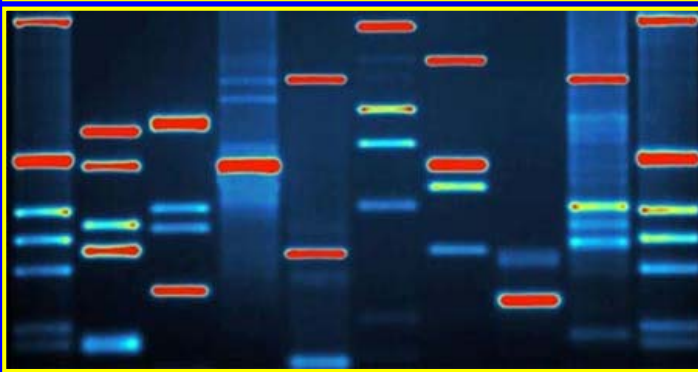




Martin Wikelski



4) Molecular genetics



How many species on Earth?

- Non-microbial diversity could range from 2 million to over 50 million species
- Huge unknowns in numbers of insects, fungi, nematodes, deep-sea organisms





Scheffers *et al.* (2012) *Trends in Ecology & Evolution*

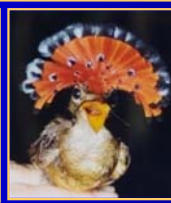
DNA barcoding



Astraptes fulgurator complex

- Morphology often misleading
- Barcoding uses 1-2 fast-evolving genes (usually in mitochondria or chloroplasts) to discriminate species
- Very powerful with advances in DNA sequencing speed
- Revealing many 'cryptic species'— 60% of those now described

Surveying biodiversity



Environmental DNA sampling

- Sample water
- Use PCR to amplify traces of DNA
- Use DNA barcodes to identify species



Using leeches to track down endangered species



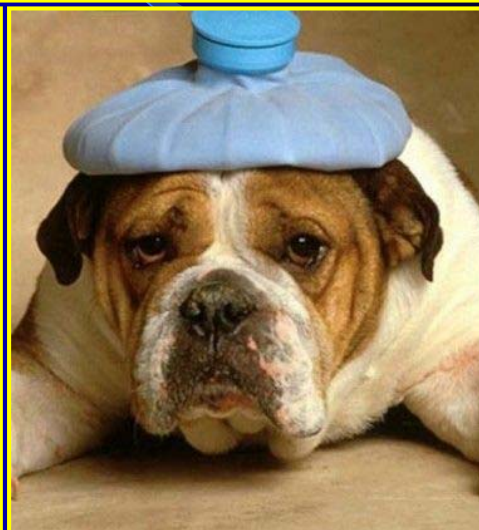
- Tom Gilbert (2012) *Current Biology*
- Sampled 25 leeches in a Vietnam forest
- Found many rare species, including a rare rabbit not detected in 2000 camera-trap nights

5) Communication



Averting biodiversity collapse in tropical forest protected areas

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"You're right... I just don't get it.
And I recall a time, not so very long ago,
when you loved that about me!"



