Environmental protection, plant health and sustainability – pies and doughnuts

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Plant health and environmental protection

Outline

- The context
- The need for a broad approach, linking plant health, environmental protection and sustainability
- The continuing loss of biodiversity across the world at an alarming rate
- Planetary sustainability and the human footprint
- The main drivers of biodiversity loss
- Protecting the environment
- The impacts of global change

Plant health and environmental protection: the context

The sustainability of our planet depends on maintaining healthy, functioning and diverse ecosystems and agroecosystems.

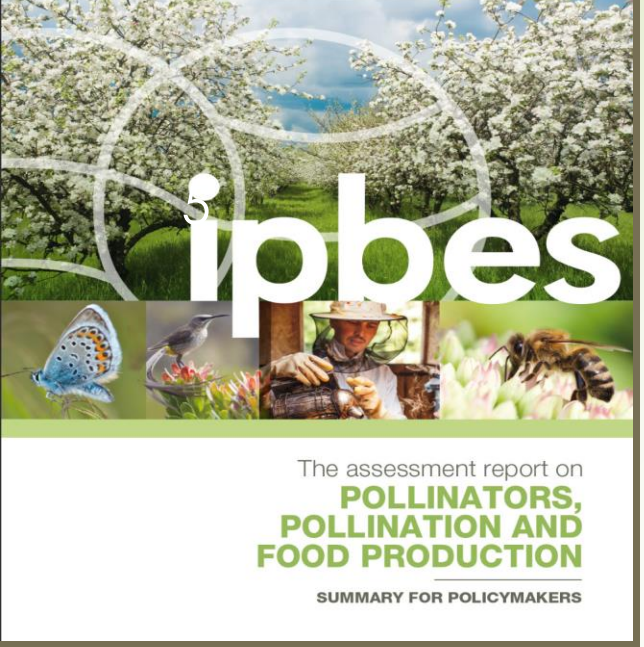
The health of our crops is closely linked with the health of wild ecosystems and their component species.

Biodiversity, in particular plant diversity, is both the provider of goods and services on which we depend and a planetary resource that we must protect.

The IPPC recognizes that 'the natural world is not an optional "luxury" – but an essential foundation for human well-being and sustainable development'.

It allows for:

- the conservation or protection of natural ecosystems; and
- the protection of food security, improved livelihoods and sustainable plant production through the protection of the environment and biodiversity in both natural and agricultural production systems.



Complex interactions –the example of pollinators

Pollinators play a key role in crop production but at the same time many of them, especially bees and butterflies, are under threat and declining in numbers.

The recent IPBES Thematic Assessment of Pollinators, Pollination and Food Production indicates that:

- More than three quarters of the leading types of global food crops rely to some extent on animal pollination for yield and/or quality.
- Pollinator-dependent crops contribute to 35 per cent of global crop production volume.
- 75% of the world's food crops depend at least in part on pollination.
- The annual value of global crops directly affected by pollinators is US$235 billion–US$577 billion
- Almost 90% of wild flowering plants that depend to some extent on animal pollination.

but

- Regional and national assessments indicate high levels of threat, particularly for bees and butterflies.
- Their decline is primarily due to changes in land use, intensive agricultural practices and pesticide use, alien invasive species, diseases and pests, and climate change.
- The assessment found that pesticides, including neonicotinoid insecticides, threaten pollinators worldwide, although the long-term effects are still unknown.
- 60% of birds rely on insects as a food source and many bird species are also at risk because of pesticide use.

Biodiversity crisis – the latest assessments

Despite the massive investments and efforts that have been made to conserve plant diversity across the world during the past few decades, our current strategies and actions are not sufficiently effective to prevent the continuing decline in biodiversity, as recent assessments clearly indicate.

- Habitats continue to be lost or degraded,
- Threatened species' lists continue to grow,
- The world's governments fail to meet their commitment to achieve biodiversity conservation goals such as the Aichi Targets and those of the Global Strategy for Plant Conservation.
- Clearly, we are failing in our attempts to conserve biodiversity on a sufficient scale.
- The reasons for this are complex, including scientific, technical, sociological, economic and political factors.

The latest assessments by IPBES

- The IPBES Regional assessments of biodiversity and ecosystem services (March 2018) indicate that biodiversity continues to decline in every region of the world, significantly reducing nature's capacity to contribute to people's well-being. This alarming trend endangers economies, livelihoods, food security and the quality of life of people everywhere
- The planet's biodiversity is being lost faster than it recovers, with developing regions expected to bear the brunt of future soil degradation.
- Forty per cent of the biodiversity in the Americas will be lost by 2050.
- The CBD Executive Secretary, comments 'These assessments are sobering. … if the current trends on biodiversity loss and ecosystems destruction are not reversed, the prospects for life on our planet become quite grim. At the current rate of destruction not only will it be difficult to safeguard life on Earth, but will jeopardize the prospects for human development and well-being'.

'While solutions to climate change remain elusive, at least the world's policymakers have demonstrated an understanding for the risks posed by rising temperatures. Unfortunately, there is no similar awareness of the threat posed by biodiversity loss – a shortcoming that scientists are urgently seeking to rectify.

Many policymakers … have yet to recognize that biodiversity loss is just as serious a threat as rising sea levels and increasingly frequent extreme weather events.' R.T. Watson (2018).

Too many demands on the environmental pie

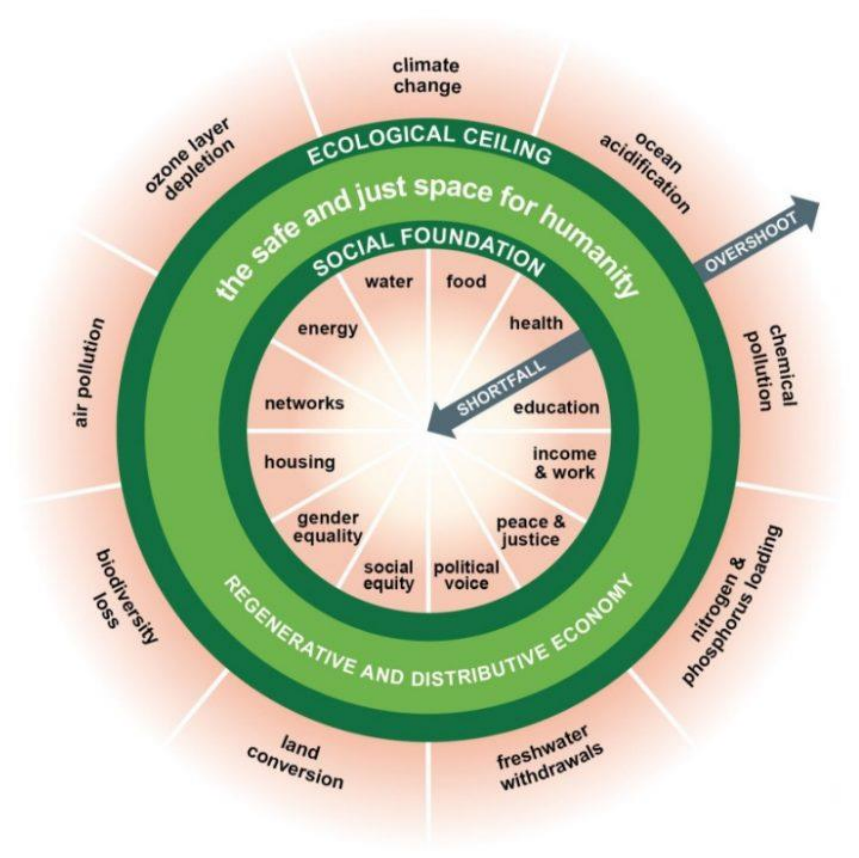
- If we consider the earth's resources as a pie, and given that the size of the pie is limited, it has been obvious for some time that we are trying to cut too many slices from it.
- In terms of planetary sustainability and the human footprint, today no country meets basic needs for its citizens at a globally sustainable level of resource use and it has been calculated that providing a high quality of life for everyone on the planet would require two to six times the natural resources that are actually available

A Doughnut for the Anthropocene

Doughnut economics was introduced by the economist Kate Raworth. The Doughnut combines two concentric radar charts to depict the two boundaries – social and ecological – that together encompass human wellbeing.

- The inner boundary is a **social foundation**, below which lie shortfalls in wellbeing, such as hunger, ill health, illiteracy, and energy poverty. Its twelve dimensions and their illustrative indicators are derived from internationally agreed minimum standards for human wellbeing, as established in 2015 by the UN Sustainable Development Goals.

- The Doughnut's outer boundary is an **ecological ceiling**, beyond which lies an overshoot of pressure on Earth's life-supporting systems, such as climate change, ocean acidification, and biodiversity loss. Its nine dimensions and their indicators are defined by the **planetary boundaries framework**, the environmental limits within which humanity can safely operate Between these two sets of boundaries lies an ecologically safe and socially just space in which all of humanity has the chance to thrive.



Source Kate Raworth,
http://www.thelancet.com/planetary-health
vol. 1 May 2017

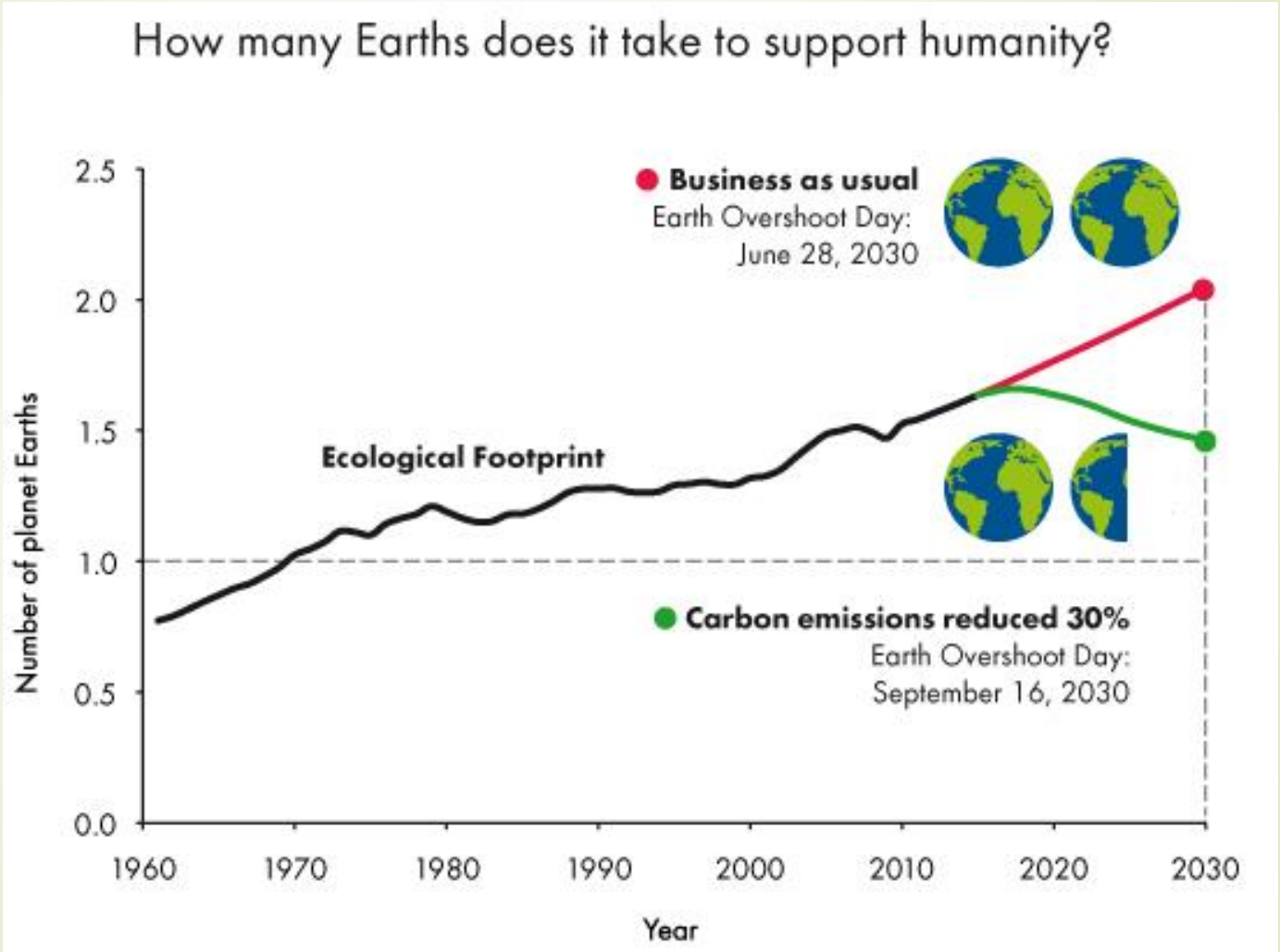
Humanity's ecological footprint

- According to the Global Footprint Network, today humanity uses the equivalent of 1.7 planets to provide the resources we use and absorb our waste. This means it now takes the Earth about one year and six months to regenerate what we use in a year.
- Moderate UN scenarios suggest that if current population and consumption trends continue, by the 2030s, we will need the equivalent of two Earths to support us. And of course, we only have one.
- The dilemma we face is how to live sustainably and keep within the Planetary Boundaries framework – all the critical, interacting processes on Earth (including biodiversity health and integrity) that contribute to the stability and resilience of the Earth system as a whole – and at the same time provide us with the necessary resources.

Earth Overshoot Day

- **Earth Overshoot Day**, also known as **Ecological Debt Day**, is the day on the calendar when humanity has used up the resources that it takes the planet the full year to regenerate.
- Earth Overshoot Day has moved from early October in 2000 to August 2nd in 2017.
- In other words, humanity is currently using nature 1.7 times faster than ecosystems can regenerate. This is akin to using 1.7 Earths.

https://www.footprintnetwork.org/2017/06/27/earth-overshoot-day-2017-2/


How many Earths does it take to support humanity?
Business as usual
Earth Overshoot Day:
June 28, 2030
Ecological Footprint
Carbon emissions reduced 30%
Earth Overshoot Day:
September 16, 2030
Number of planet Earths
2.5
2.0
1.5
1.0
0.5
0.0
1960
1970
1980
1990
2000
2010
2020
2030
Year

The main drivers of biodiversity loss

- Habitat loss, degradation, simplification
- Global change
- Invasive species
- Overexploitation of resources
- Pollution

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Threats to biodiversity and plant health

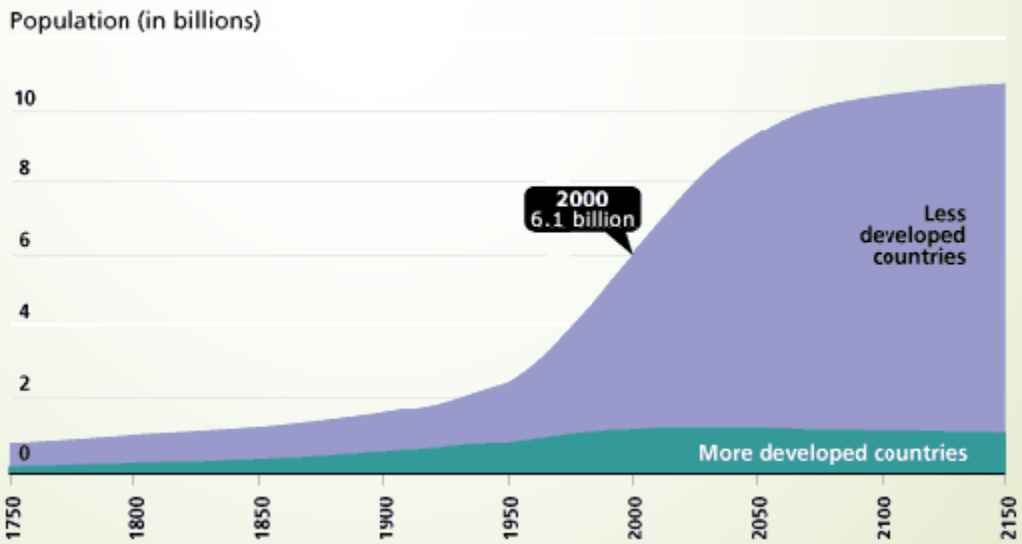
- At least two of the main threats to biodiversity – pollution and biological invasions – directly affect plant health.
- Plants are both the background and structure of most terrestrial ecosystems and provide habitats for other organisms, as well making a vital contribution to human nutrition and our rural economies and providing other important ecosystem goods and services.
- Thus concerted effective actions to control these threats are paramount.

The elephant in the room: human demographic growth

- With a global population today of 7.6 billion, expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100, pressure on biodiversity through habitat loss, land use change, overexploitation of resources, and climate change, as well as biological invasions and pollution, will inevitably increase if we are to meet the basic needs of such a demographic expansion, let alone aspirations for a generally better quality of life.
- Population growth acts as a multiplier of the threats to biodiversity

According to the *UN World Population Prospects*, 2017 revision, the current **world population** of 7.6 billion is expected to reach 8.6 billion in 2030, 9.8 billion in 2050 and 11.2 billion in 2100.

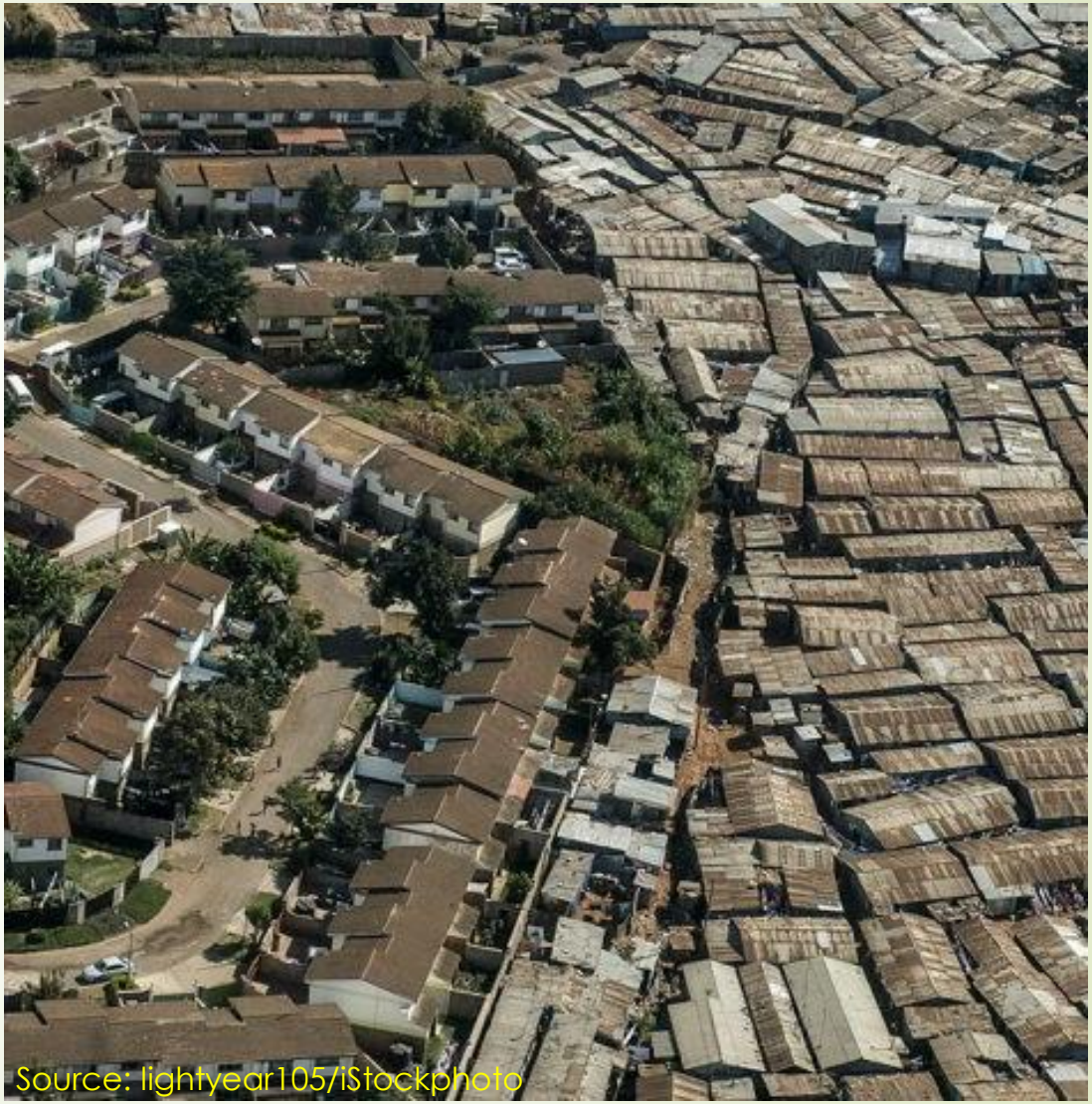
World Population Growth, 1750–2150




WORLD POPULATION HITS 7 BILLION!!
LET'S CELEBRATE!
POP!
©2011
FLORIDA TODAY
CAGLECARTOONS.COM
UM... THERE MAY NOT BE ENOUGH FOR EVERYONE...
Earth's Resources

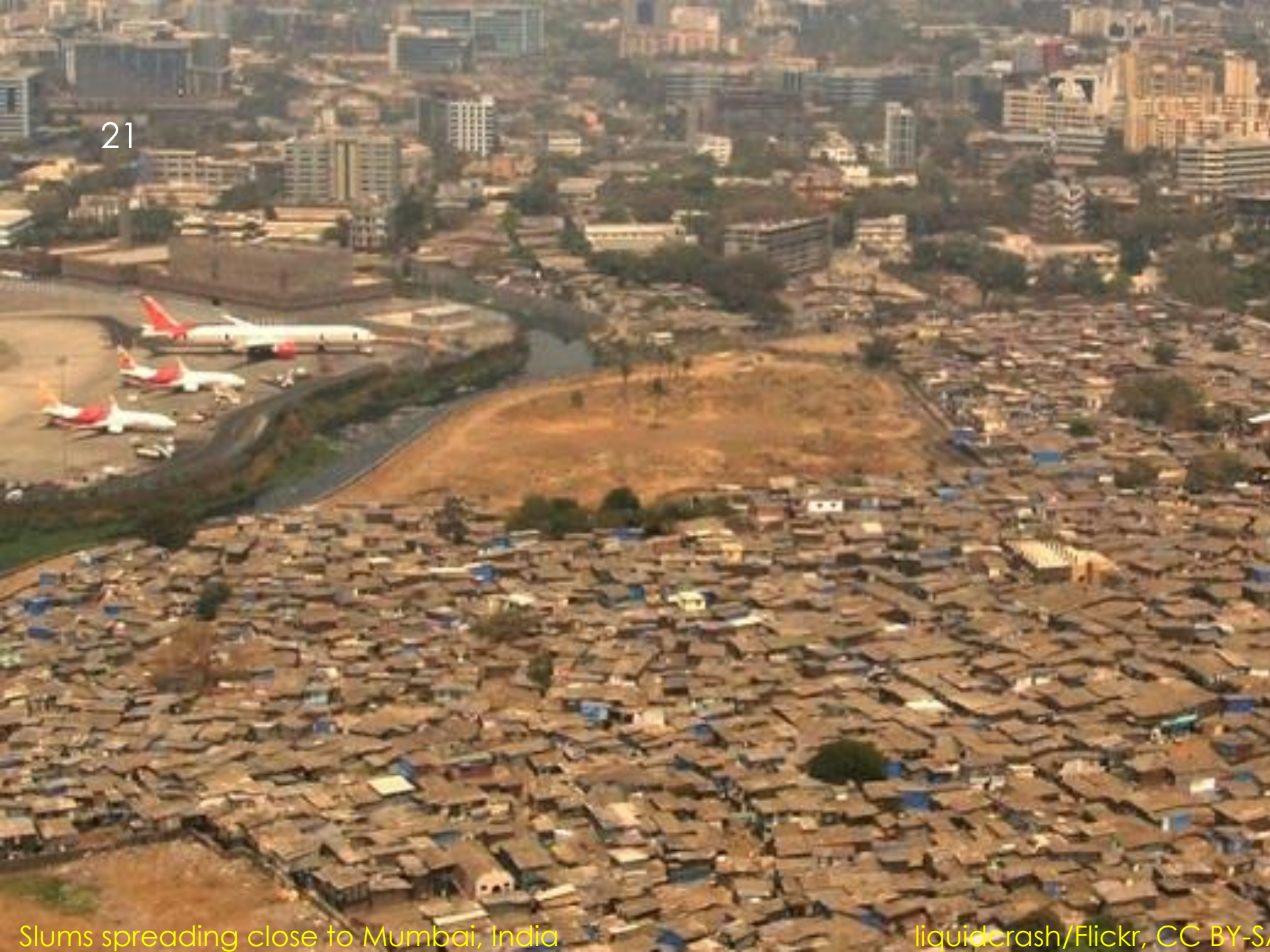
Demographic growth – the elephant in the room

- 'By 2030, 1.1 billion more people will live on Earth — bringing the total to about 8.5 billion. Most of them will arrive in dense Asian and African cities, exacerbating pollution and resource shortages,' Forman & Lu (2016)
- 'The true danger posed by our exploding population is not our absolute numbers but the inability of our environment to cope with so many of us doing what we do', Paul Chefurka



Rich and poor neighbourhoods in Nairobi, Africa

The Fifth Face – New York city
Photo Illustration by Hubert Blanz, 2010



Slums spreading close to Mumbai, India

Protecting the environment: conservation approaches

Area-based

- Protected areas,
- Biosphere reserves
- Community reserves
- Off-reserve

Species-based *ex situ*

- Genebanks
- Field genebanks
- Botanic garden living collections

Species-based *in situ*

- Recovery
- Reintroduction
- Other translocations

Ecological/habitat restoration

The impacts of global change

'Global change is much more than climate change. It is real, it is happening now and it is accelerating',

Steffen & al. (2004) *Global Change and the Earth System: a Planet under Pressure*.

'Globally accelerating trends in societal development and human environmental impacts since the mid-twentieth century are known as the Great Acceleration and have been discussed as a key indicator of the onset of the Anthropocene epoch',

Steinbauer et al. (2018)

The main components of Global Change

Population change

- Human population movement/migrations
- Demographic growth
- Changes in population pattern

Changes in land use and disturbance regime

- Deforestation
- Degradation, simplification or loss of habitats
- Loss of biodiversity

Climate change (IPPC definition)

- Temperature change
- Atmospheric change (greenhouse gases: carbon dioxide, methane, ozone, and nitrous oxide)

Other climate-related factors

- Distribution of Nitrogen deposition
- Global dust deposition (including brown dust and yellow dust)
- Ocean acidification
- Air pollution in mega-cities

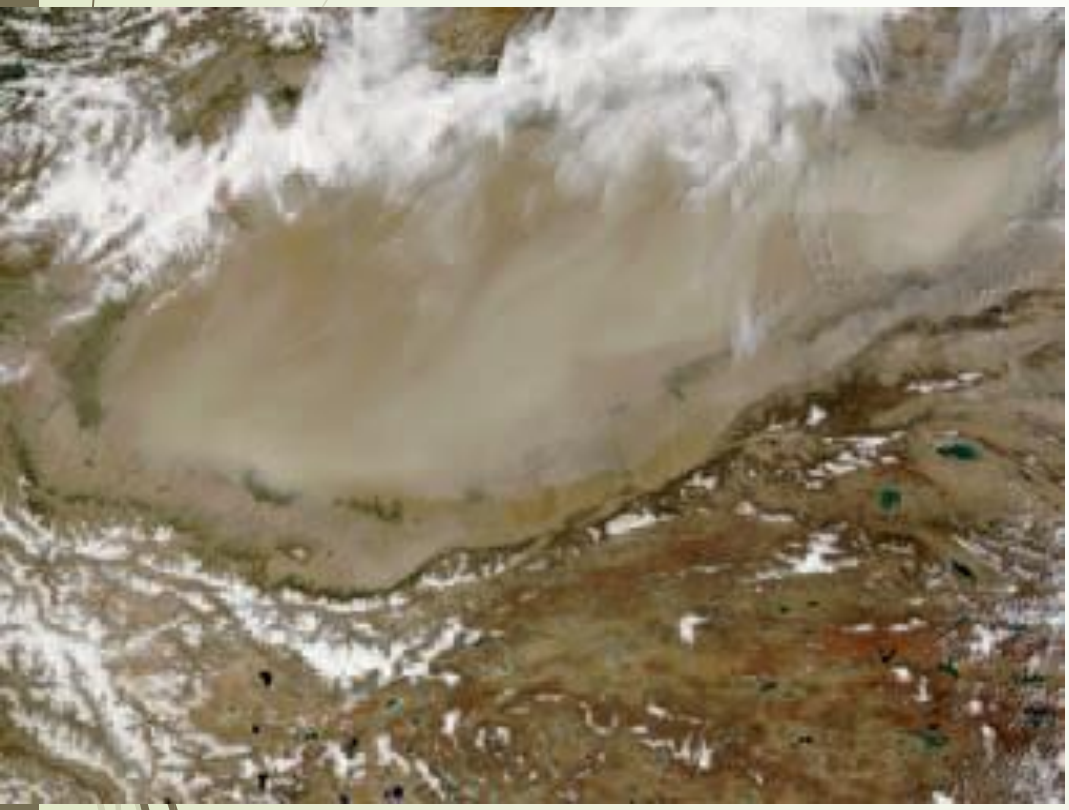
Global change factors of particular relevance to the IPPC

- Climate change
- Pollution, including dust and brown clouds
- Biological invasions
- Soil and land degradation
- Environmental refugees

The impacts of climate change on biodiversity

- Climate change will affect much of plant diversity, especially those species that cannot adapt quickly enough, including species of importance for agriculture and forestry.
- Those species that cannot adapt will be forced to migrate or risk becoming extinct.
- Many species will have difficulties in tracking their preferred climate space across an often increasingly fragmented landscape, both in terms of the rate of movement required and any natural or anthropogenic obstacles to movement.
- As the impacts of climate change are felt, current protected areas under their present management regimes are unlikely to be able to respond effectively to climate change in maintaining the viability of the biodiversity they contain.
- The impact of global and in particular climate change, has not yet been fully factored into many of our conservation approaches.

Tibetan dust bowl



Large dust storms in Tibet could be heating the region and influencing the development of the Indian monsoon

The dust plumes recorded reached up to 10 km, with typical thicknesses of 3 to 7 km

Brown cloud solar absorption

'Atmospheric brown clouds are mostly the result of biomass burning and fossil fuel consumption. They consist of a mixture of light-absorbing and light-scattering aerosols and therefore contribute to atmospheric solar heating and surface cooling...**We found that atmospheric brown clouds enhanced lower atmospheric solar heating by about 50 per cent.** Our general circulation model simulations, suggest that **atmospheric brown clouds contribute as much as the recent increase in anthropogenic greenhouse gases to regional lower atmospheric warming trends**'.

Source: Warming trends in Asia amplified by brown cloud solar absorption, Ramanathan *et al.* 2007 (Nature 448:575–578)

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Biological invasions

- Globally, invasive alien species are acknowledged as one of the major threats to biodiversity, second only to habitat loss and degradation.
- In South Africa, invasive alien plant species are considered the single biggest threat to the country's biological biodiversity and now cover more than 10.1 million ha, threatening indigenous plants. http://www.dwaf.gov.za/wfw/

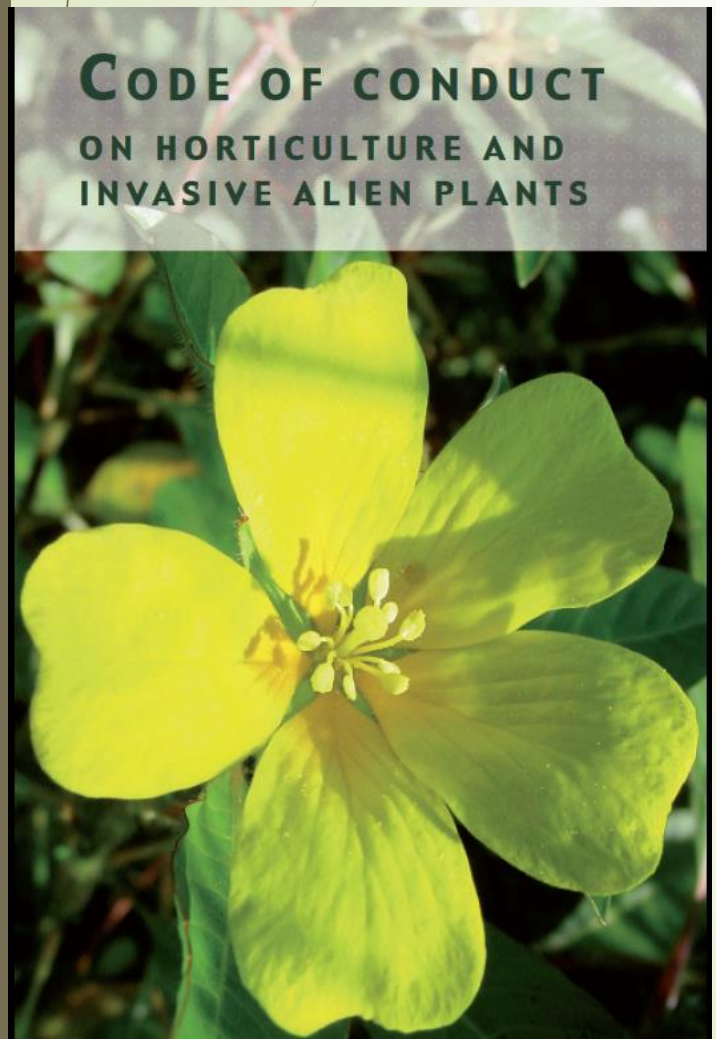
Melaleuca invading south Florida, USA

Melaleuca quinquenervia native to Australia and New Guinea is increasing its invasive range in south Florida by some 35 acres each day, replaces cypress and other native plants and provides poorer habitat for numerous animals. In many regions in and near the Everglades, it forms vast, dense monocultures where no other plant can grow.

IAS pathways

- '*Most invasive plants have been introduced for horticultural use by nurseries, botanical gardens, and individuals*' (Reichard & White 2001)
- In Europe it is thought that 80% of invasive alien species originate through horticulture or agriculture.
- A balance, therefore, has to be struck between the advantages of new introductions and the risks of them becoming invasive.

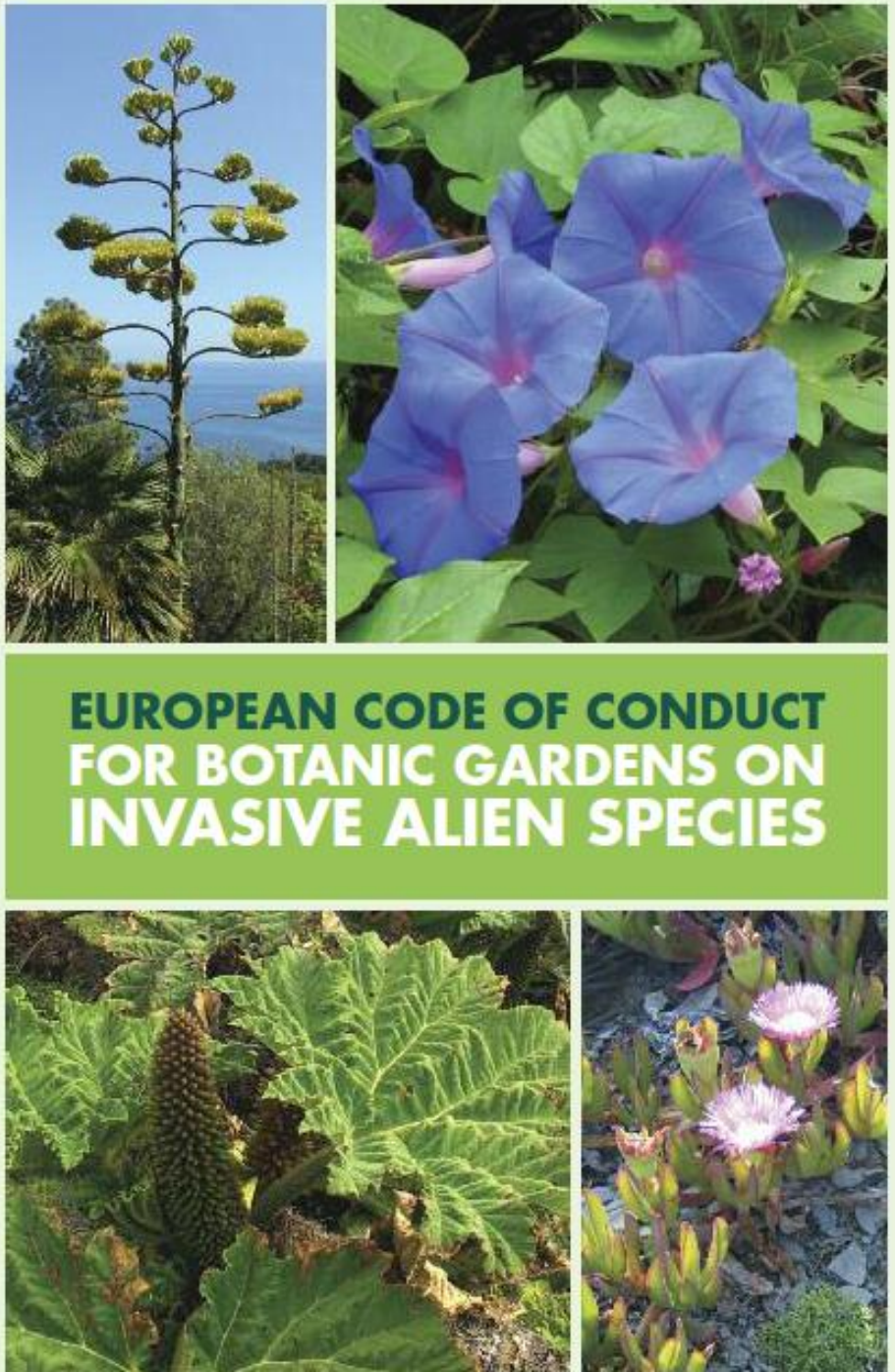
Council of Europe/EPPO Code of conduct on horticulture and invasive alien plants



As part of its activities on invasive organisms, the Council of Europe commissioned a Code of conduct on horticulture and invasive alien plants, in collaboration with the European and Mediterranean Plant Protection Organization (Heywood and Brunel, 2009, 2011).

The Code is available in English, French and Spanish, in hard copy and on the Internet. Czech, Italian and Polish and versions have also been prepared.

Many IAS have been introduced directly by or through botanic gardens. BGCI and the Council of Europe have produced a Code of Conduct for Botanic Gardens (Heywood, 2013).



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Land and soil degradation

- Land degradation is a problem that affects all regions, not only the drylands and developing countries.
- About one third of all agricultural land is either highly or moderately degraded. Drylands are more vulnerable to natural and human destruction due to the small water containment in soil.
- Soil erosion is a major factor in land degradation and has severe effects on soil functions - such as the soil's ability to act as a buffer and filter for pollutants, its role in the hydrological and nitrogen cycle, and its ability to provide habitat and support biodiversity.
- About 2 000 million ha of soil, equivalent to 15 per cent of the Earth's land area (an area larger than the United States and Mexico combined), have been degraded through human activities.

Environmental refugees

- Parts of the world are filling up with **environmental refugees**...people fleeing excruciating, often fatal, environmental conditions. Their tragedy is triggered by forces or combinations of forces that are predominantly elemental (such as earthquakes, extreme weather events and climate trends) or artificial, i.e., caused by humans (such as forest clearing, industrialization, urbanization, mining, erosive agriculture, and warfare).

- In 2001, there were about 20 million uprooted people worldwide. Some 12 million were refugees and 5 million were "internally displaced persons"—people forced to flee their homes, but still living in their original country (UNHCR 2002).

- According to a new World Bank a report - *Groundswell – Preparing for Internal Climate Migration*, the worsening impacts of climate change in three densely populated regions of the world – Sub-Saharan Africa, South Asia, and Latin America – could see over 140 million people move within their countries' borders by 2050.

- Their effects on biodiversity could be serious in that they will move into territories not able to support or feed them without large scale disruption.

Migrants arriving at the Greek island of Lesbos, September 2015

Conclusions

- The relationships between plant health and environmental protection are highly complex.
- To avoid adverse unforeseen consequences, a holistic approach to plant protection is desirable.
- Plant protection *sensu* the IPPC depends on plant protection *sensu* the CBD.

Weeds or crop wild relatives?

Potato cultivation at 4000m in Morochata, Bolivia, 6.XII.2008. Photo VHH