

The Atlas for the End of the World

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with Claire Hoch and Chieh Huang

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Seen from 28,000 miles away, the earth is beautiful. But its beauty is deceptive. We don't see the 5 billion tons of surplus carbon we pump into the atmosphere every year, our toxic waterways or our sprawling megacities and the vast fossil fueled monocultures of cattle and corn that feed them. Most importantly, we don't see the global archipelago of protected areas into which the world's genetic biodiversity is now huddled. On this Earth Day, 2017 we are launching a new atlas dedicated to examining this archipelago in detail. It's called the *Atlas for the End of the World*.

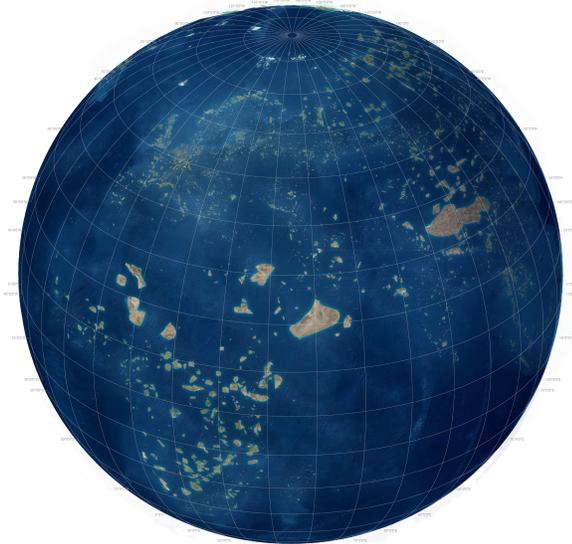


Fig 1. What's left of the world's biodiversity in protected areas.

The first atlas, the *Theatrum Orbis Terrarum* (The Theater of the World) was published in 1570 by the famous book collector and engraver from Antwerp, Abraham Ortelius.¹ With his maps Ortelius laid bare a world of healthy – we can now say “Holocene” – ecoregions ripe for colonization and exploitation. Lauded for its accuracy, the *Theatrum* quickly became a best seller.

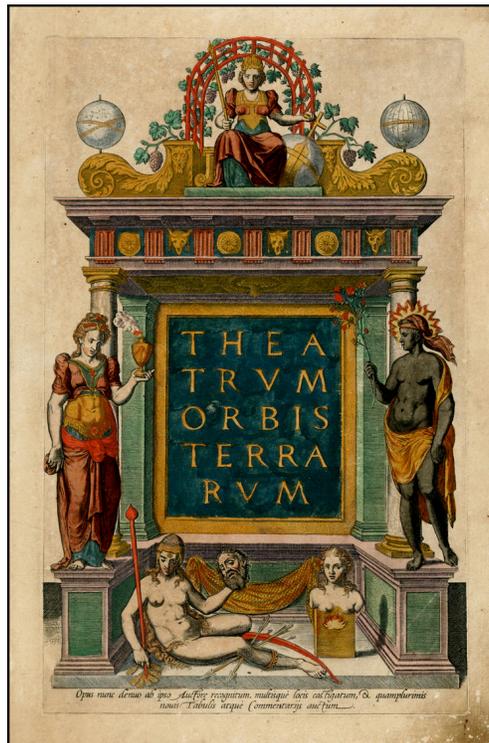


Fig 2: Frontispiece of the *Theatrum Orbis Terrarum* (Theater of the World) – the world’s first Atlas by Abraham Ortelius.

Despite its apocalyptic title, our new Atlas is not about the end of the world per se; it is about the end of Ortelius’ world, the end of the world as a God-given and unlimited resource for human exploitation and its

¹ Paul Binding, *Imagined Corners: Exploring the World’s First Atlas* (London: Headline Book Publishing, 2003).

concomitant myths of progress. On this, even the Catholic Church is now clear: “we have no such right” says Pope Francis.²

At face value, atlases are just books of maps. The maps in the *Atlas for the End of the World* are however, quite specific. They specifically show the difference between the United Nations Convention on Biological Diversity targets for achieving 17% (global terrestrial) protected area by 2020 and what is actually today protected in the 398 ecoregions which comprise the world’s 36 biodiversity hotspots.³

The so-called hotspots are regions agreed upon by the scientific and conservation communities as the most important and the most threatened biological places on earth.⁴ They are also places of exceptional linguistic diversity, much of which is also predicted to disappear by century’s end—suggesting perhaps, that the fate of nature and the fate of culture is one and the same. Many of the hotspots are also bedeviled by poverty, violence and corruption.

² Pope Francis, *Laudato Si: On Care for Our Common Home* (Vatican Press, 2015), 33.

³ Convention on Biological Diversity, “List of Parties,” <https://www.cbd.int/information/parties.shtml> (accessed June 1, 2016).

196 nations are party to the Convention on Biological Diversity. 28 of these have not yet signed the Convention so as to make its terms legally binding.

⁴ In 1988, Norman Myers first identified 10 global hotspots featuring exceptional concentration and endemism of plant species under unusual threat of destruction. According to Myers, E.O. Wilson has said hotspots were “the most important contribution to conservation biology of the last century”. As found in Norman Myers & Russell A. Mittermeier, “Impact and Acceptance of the Hotspots Strategy: Response to Ovadia and to Brummitt and Lughadha,” *Conservation Biology* 17, no. 5 (2003): 1449-1450.

There are now 36 recognized hotspots. Together, these areas contain at least 50% of the world’s total plant species and 42% of the world’s terrestrial vertebrates as endemic. The original and unique habitat in these hotspots is at least 70% depleted and is under imminent threat of total destruction due to habitat fragmentation related to urbanization, agriculture, and related economic activities. Originally representing 16% of the Earth’s surface, (excluding the 35th hotspot in North Eastern Australia which was added in 2010 and the 36th hotspot – the North American Coastal Plain which was added in 2016) the unique habitat of the hotspots has diminished to just 2.3%. As found in Russell A. Mittermeier, et al., *Hotspots Revisited: Earth’s Biologically Richest and Most Endangered Terrestrial Ecoregions* (Washington DC: Conservation International and Cemex, 2004).

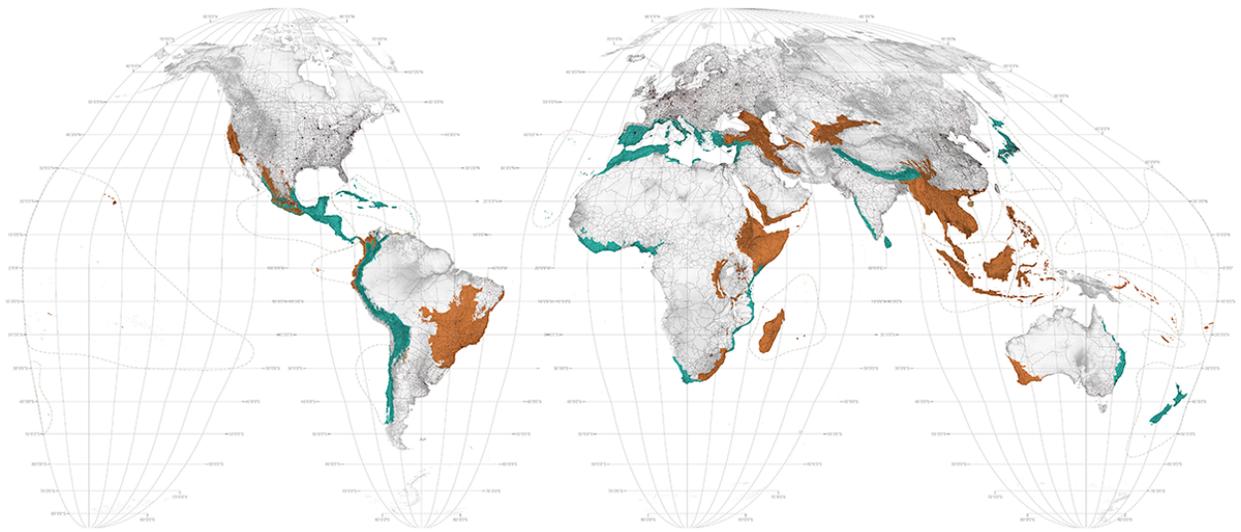
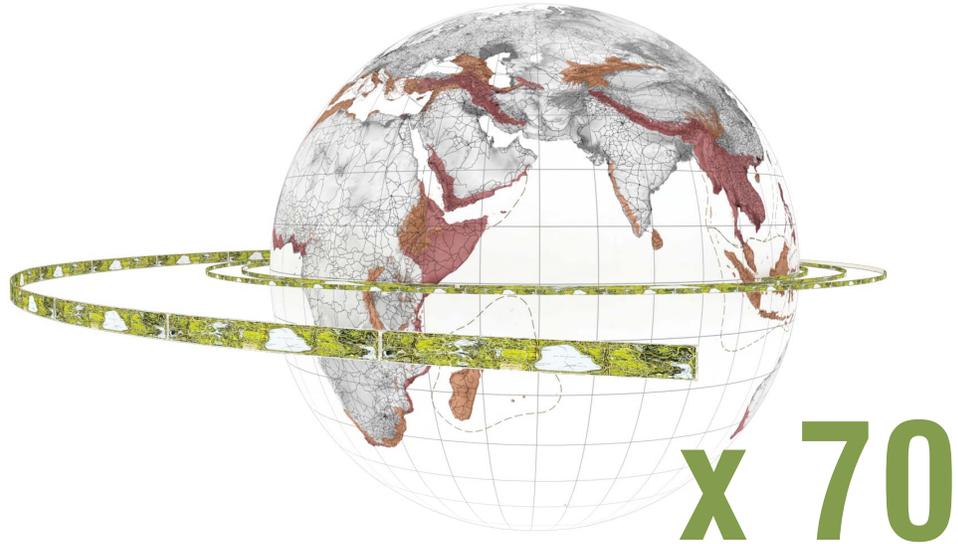


Fig 3: The world's biodiversity hotspots. The green areas have met United Nation's targets of protecting 17% of their total area the orange areas have not.

When my research assistants and I began this mapping project in 2013, the world's terrestrial protected area total was hovering at 13.5 %. Recent figures (2015 data) suggest a total of 15.4%. That's 20.6 million square kilometers of land distributed across more than 209,000 sites in 235 different countries.⁵ So, with 15.4% already secured, only an additional 1.6% protected area is needed to satisfy the Convention's 2020 target. This amount might seem paltry, but 1.6% of the earth's terrestrial surface is 2.3 million km², the equivalent of nearly 700,000 Central Parks. That's a Central Park stretching 70 times around the world! The research question we asked was where exactly should this additional protected land be?

⁵ D. Juffe-Bignoli, et al., "Protected Planet Report 2014," *International Union for Conservation of Nature* (June 1, 2016), <https://www.iucn.org/content/protected-planet-report-2014>.



695,825 Central Parks can wrap around the globe 70 times.

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Fig 4. To meet UN protected area targets over 700,000 Central Parks need to be added to the world's protected area estate.

According to the Convention, we can't just fence off 1.6% of Siberia, or some other place, and then say we're done! The crucial words in the small print of the Convention are that the global protected estate must be "representative" and "connected". In theory, this means 17% of each of the world's 867 ecoregions should be protected *and* connected.

The Atlantic Forests hotspot serves as an example. Currently it has only 8% of its territory under protection. Furthermore, when we break the hotspot down into its 15 constituent ecoregions, we find that 9 fall short of reaching 17% representation.

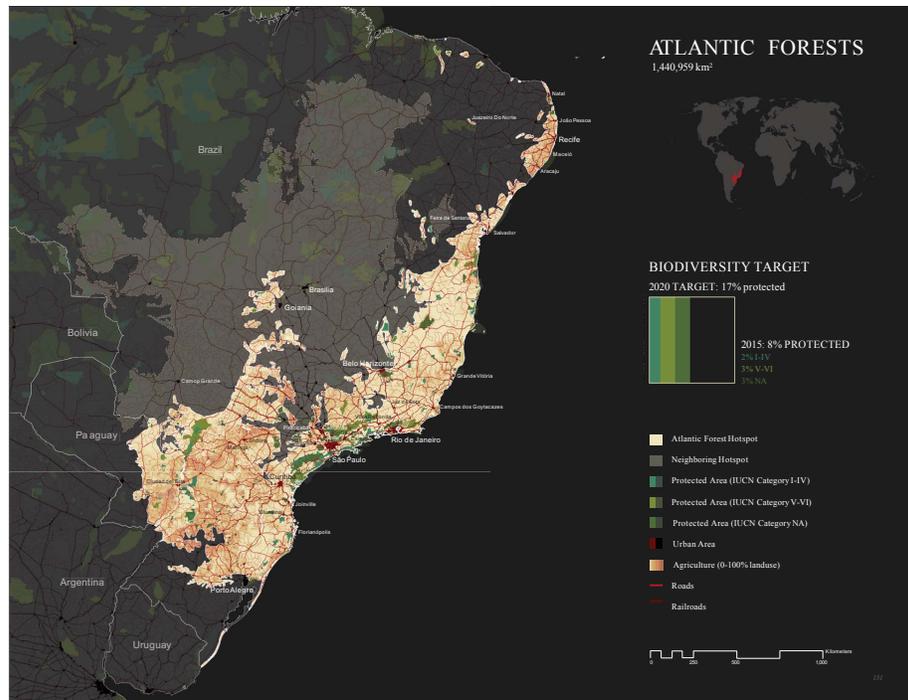


Fig 5: An example of one of 35 of the world's hotspots: The Atlantic Forests

In total 21 of 35 hotspots currently fall short of reaching the 17% protected area target. More specifically, 201 of their 391 ecoregions fall short. With the new *Atlas*, any nation can know how much land needs to be protected and where if it wants to meet its obligations under the Convention. This is not to say that blanket targets are always appropriate on the ground, but, it's a start.

In addition to identifying these protected area shortfalls, the critical nexus this research addresses is the global tension between food production, urbanization and biodiversity. On the world map (below) are three squares. The first and smallest is the world's current crop land. The second, in the middle, is current crop land plus current grazing land, plus what is thought to be the world's further potential supply of arable land a total of 50% of the earth's ice-free surface area. These leave 50% of the planet's land for other uses, exactly what EO Wilson has called for in his book, 'Half Earth'. 50% seems like a lot, but remember that 33% of this land is desert land which by definition is not suited to either

biodiversity or agriculture. Subtracting the world’s deserts leaves 17% for biodiversity – precisely the amount demanded by the Convention.

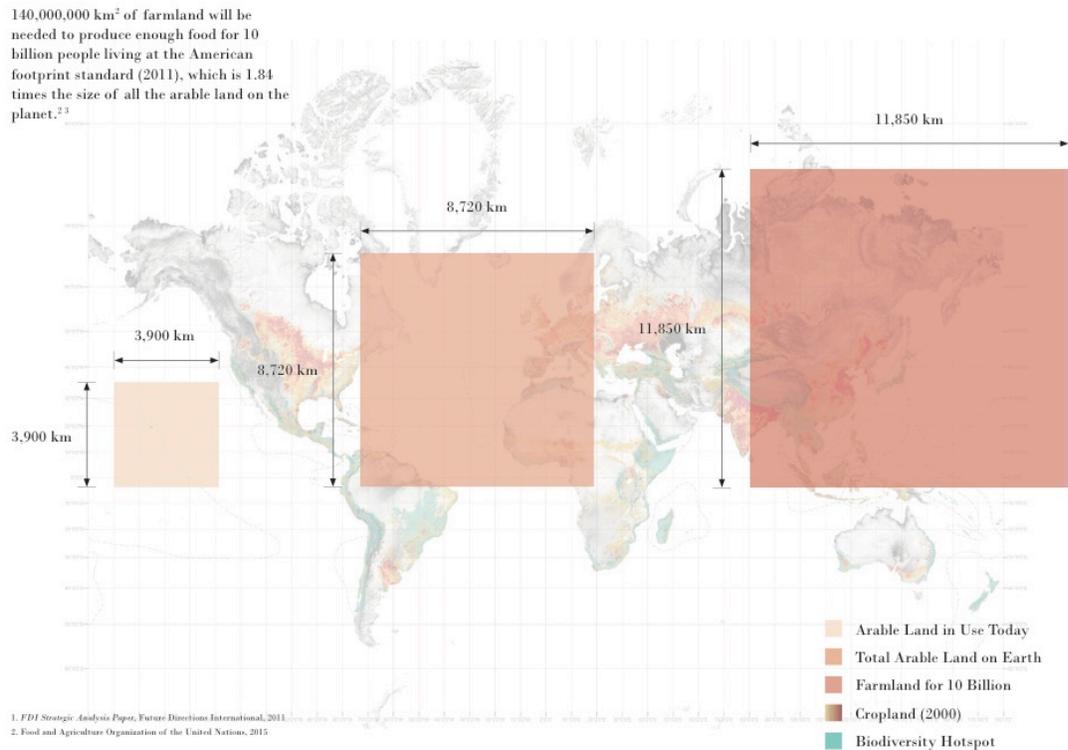


Fig 6: The world existing and possible future foodbowl for 10 billion people

The bigger cause for concern is however the large square on the right: the land area necessary to feed 10 billion people. The UN is now forecasting anywhere between 9.5 and 13.3 billion by 2100, so 10 is a conservative estimate.⁶ But these projected 10 billion consumers are not “average” global citizens; let us suppose they are people like us; who shop in supermarkets and eat more or less whatever they want, whenever they

⁶ United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision, Key Findings and Advance Tables* (2015). Available at <https://esa.un.org/unpd/wpp/Publications/>.

want. They are average Americans; people with a food footprint of 1.4 hectares each. 10 billion people consuming at this level would require a whopping 93% of the earth's ice-free terrestrial surface. In this scenario, not only would all the world's arable land be used for agriculture, but so too would the world's deserts, plus some. After we've finished our burgers, a mere 7% of the earth's terrestrial surface would be left for biodiversity – for all practical purposes a mountainous zoo in the midst of a global monoculture of corn and cattle, hooked up to desalination plants.

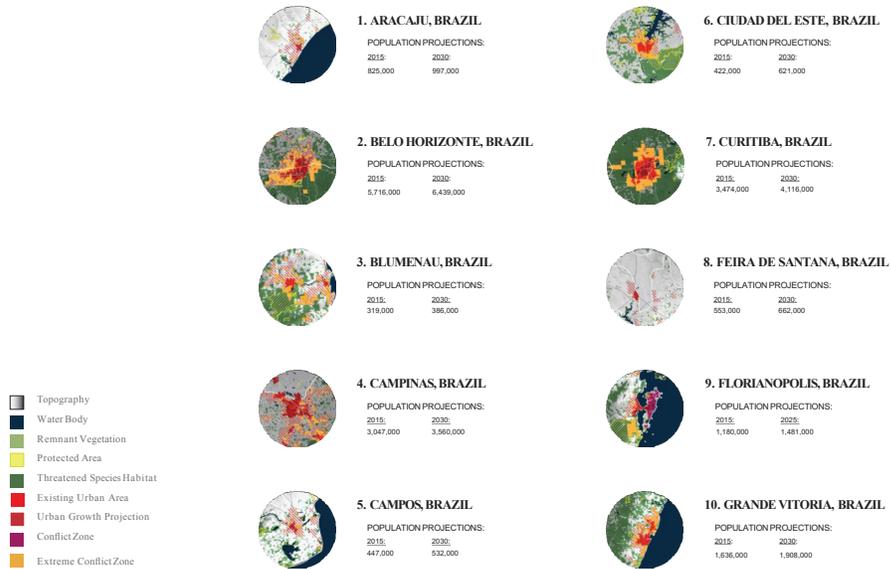
These proportions of land-use will likely change when global population drops, as it probably will in the 22nd century due to socio-economic influences associated with urbanization. The other mitigating factor would be if the bulk of food production shifted to the oceans, and/or if meat could be produced independently of ruminants entirely. Then, ecological restoration could take place on a scale commensurate with that which is needed to partially correct the earth system's current imbalances.⁷ The challenge will be to get through this century's incredibly tight ecological bottlenecks and come out the other end with some ecosystems, preferably the hotspots, partially intact.

The second major area of this research concerns 422 cities in the world's hotspots. We zoomed into each city of 300,000 people or more and superimposed their 2030 growth trajectory (as per Karen Seto's work at Yale⁸). We then plotted remnant habitat and threatened (mammal) species from the International Union for the Conservation of Nature's Red List.⁹ What emerges are the flashpoints between future urban growth and biodiversity.

⁷ An Ecomodernist Manifesto, "Manifesto," <http://www.ecomodernism.org/manifesto-english/> (accessed June 1, 2016).

⁸ Karen C. Seto, Burak Güneralp, & Lucy R. Hutyra, "Global Forecasts of Urban Expansion to 2030 and Direct Impacts on Biodiversity and Carbon Pools," *Proceedings of the National Academy of Science of the United States* 109, no. 40 (2012): 16083-16088.

⁹ The IUCN Red List of Threatened Species, <http://www.iucnredlist.org> (accessed June 1, 2016).



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Fig 7: Examples of some cities of more than 300,000 in the Atlantic Forest Hotspot (bright yellow and purple indicates imminent conflict with biodiversity).

In the circular images of the cities in the Atlantic Forests hotspot, orange indicates zones of imminent conflict between urban growth and biodiversity. Alarmingly, 383 of the 422 cities in the world’s hotspots are on a collision course with unique and irreplaceable biodiversity.

And we are not just talking about a little bit of sprawl. If an extra 3 billion people move into cities by 2100, as is entirely likely, it means we need to build 357 New York Cities in the next 84 years, i.e., 4.25 New

Yorks per year. Much of that growth will occur as both formal and informal sprawl in Africa, India and South and Central America, much of it up against biodiversity and much of it unregulated.

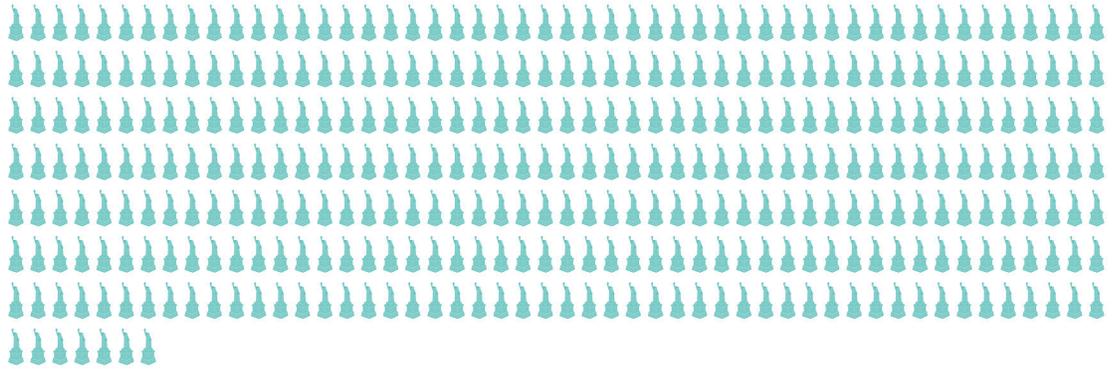
URBAN GROWTH

Even if these 3 billion Americans all live in cities like New York, 464 New York Cities would be required. In terms of construction, this means building 4.25 New York Cities every year starting now until the year of 2100.



NYC X357

4.25 NEW YORK CITY'S TO BE
BUILT PER YEAR



1. United Nations (2015) World Population Prospects, 2015

Fig 9: An extra 3 billion people moving into cities this century means we need to build 357 New York Cities.

As documented in the *Atlas* our analysis suggests that most of these 383 cities that are encroaching on valuable habitat don't have any semblance of as whole-of-city urban planning. This lack of planning at the city scale is also evident at the national scale: almost all the nations in whose jurisdiction the world's hotspots lie don't in so far as we can tell have national land-use plans incorporating biodiversity.

Under the Convention on Biological Diversity, each nation must develop a *National Biodiversity Strategy and Action Plan*. In practice, these tend to be platitudinous reports and most don't take into account the 17% target for protected area. Most of the nations who are signatories to the Convention on Biological Diversity are also signatories to the Paris Agreement on Climate Change, which demands that they prepare national climate change plans.

The Atlas for the End of the World lays the ground work for the 142 nations who preside over the world's biodiversity hotspots to now view climate change, biodiversity *and* urbanization as interrelated phenomena and plan for the future. To do so would be a new beginning.

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