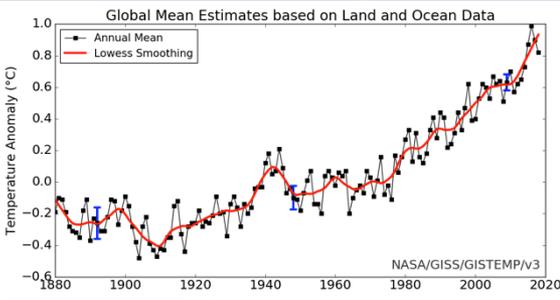
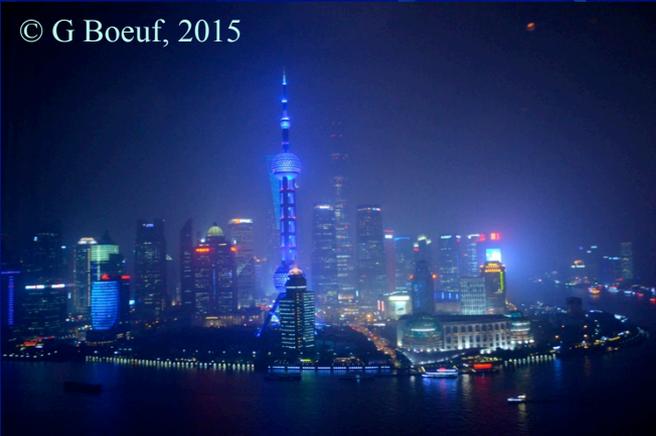
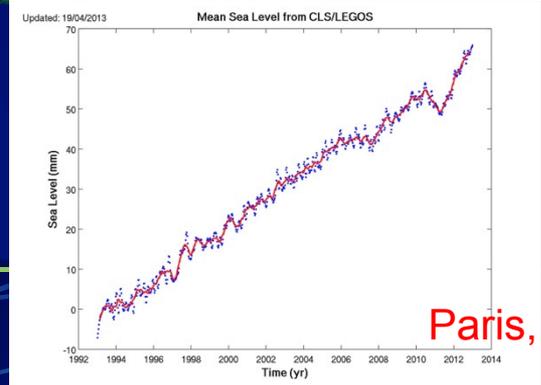


Océan, biodiversité et humanité : une résilience possible ?



Les raisons de notre intranquillité...



Les causes de l'intranquillité...

- Manger ou être mangé ?
- Questions de biodiversité et de l'humain avec...
- Du feu à la révolution nanotechnologique, robotique...
- Démographie, ressources.

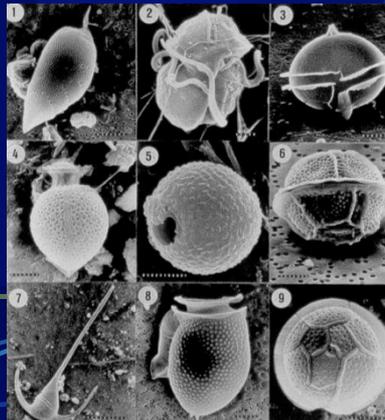
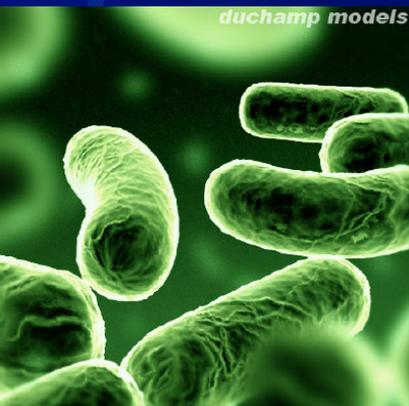


© Science Junior.fr

énergie, eau,
interactions de
passant par les
ue, numérique,

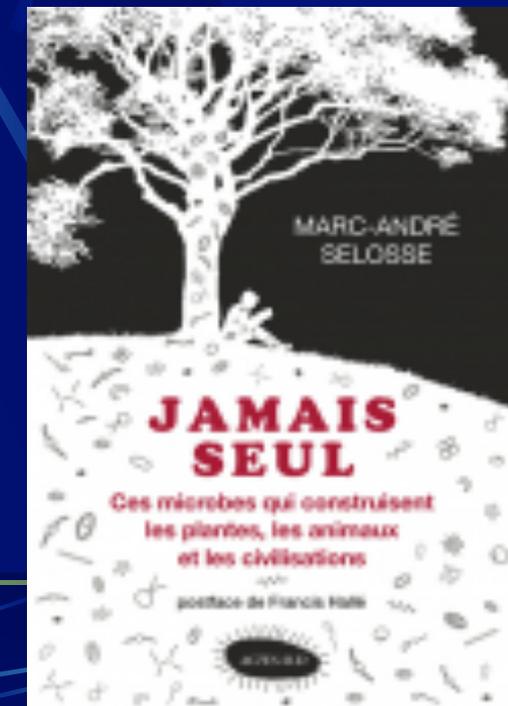
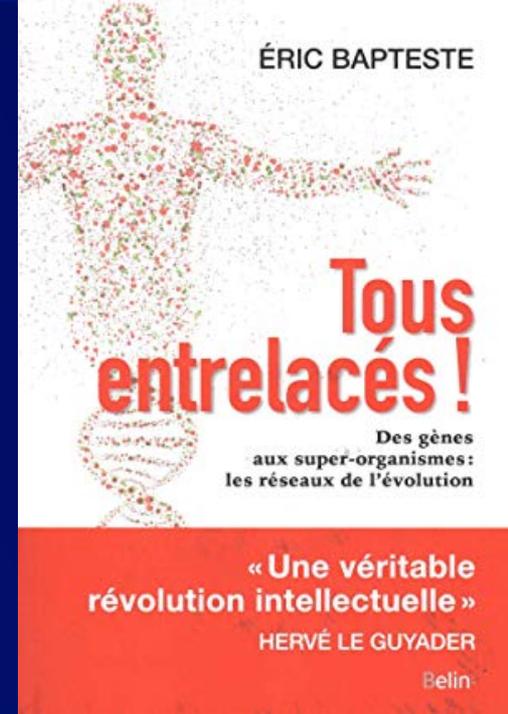
*Can a collapse of global civilization be avoided?
Paul R. Ehrlich and Anne H. Ehrlich*

Proc. R. Soc. B 2013 280, 20122845, published 9 Jan 2013





© B Chevassus-au-Louis, 2005





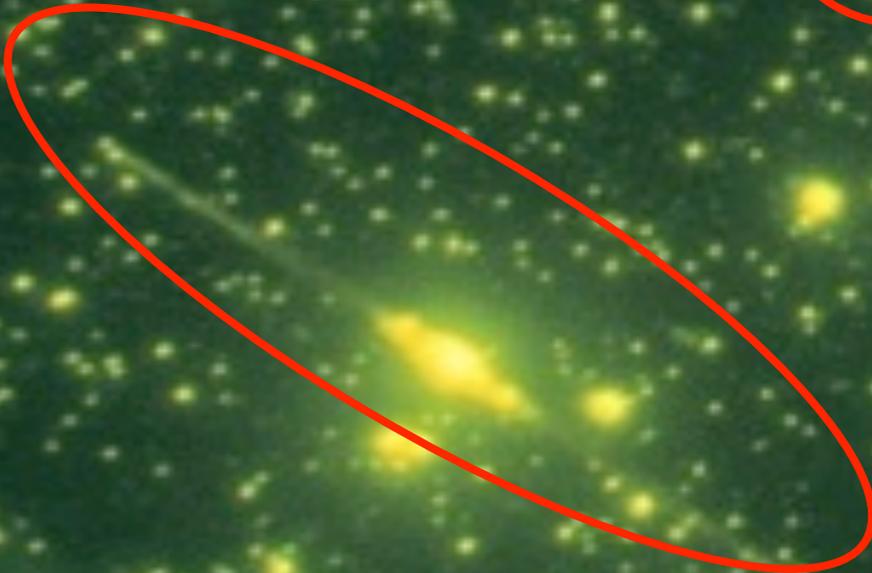
Bacteria



Virus

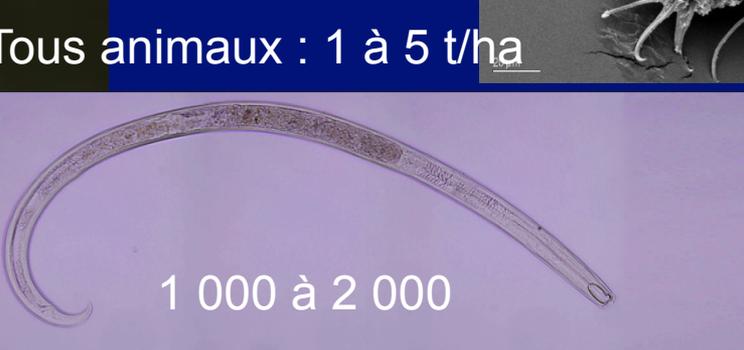
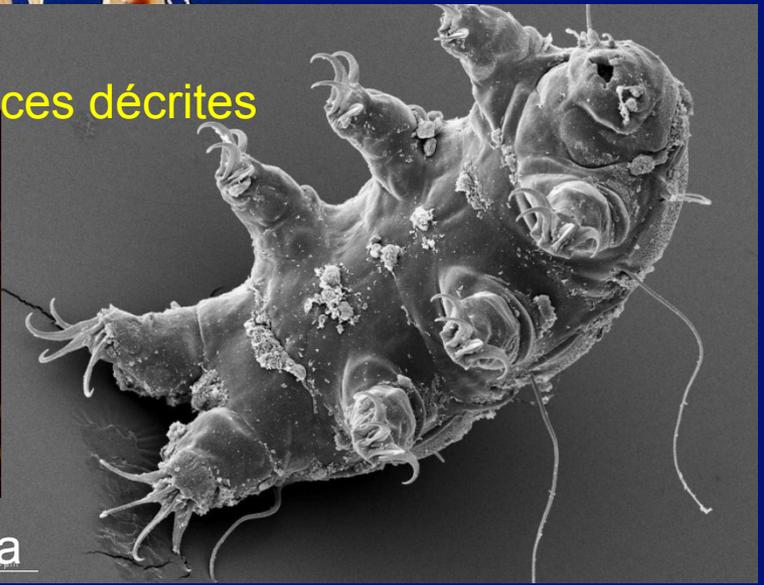
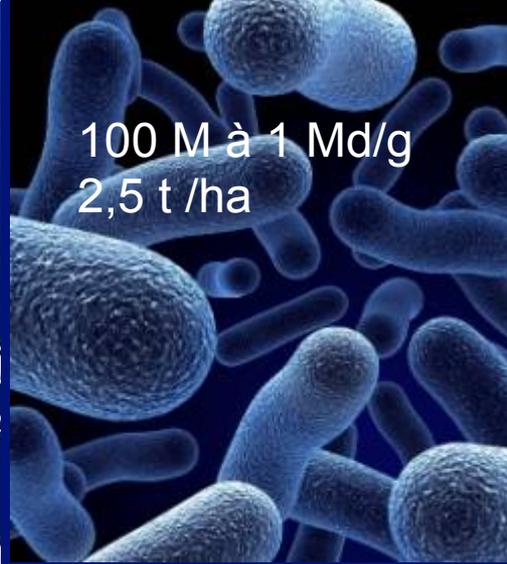
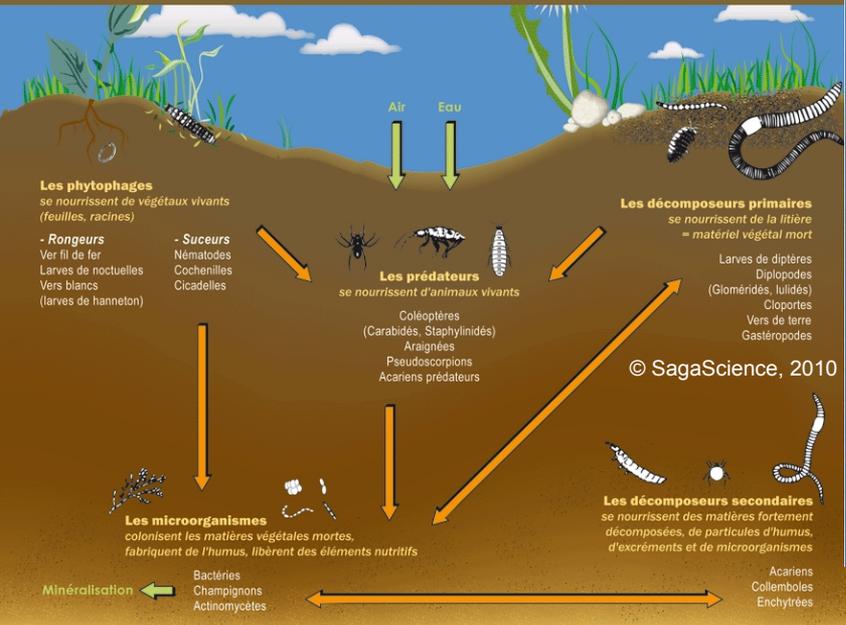


PROTIST

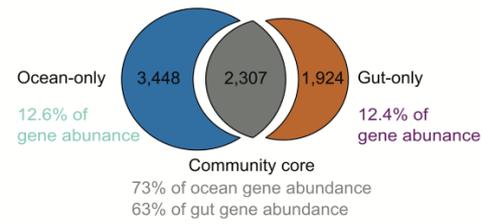


98% of the oceanic biomass is unicellular!

Les fonctions de la faune du sol



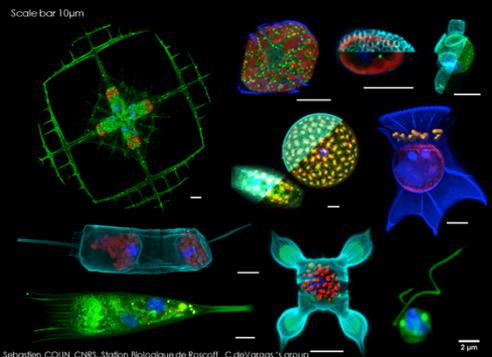
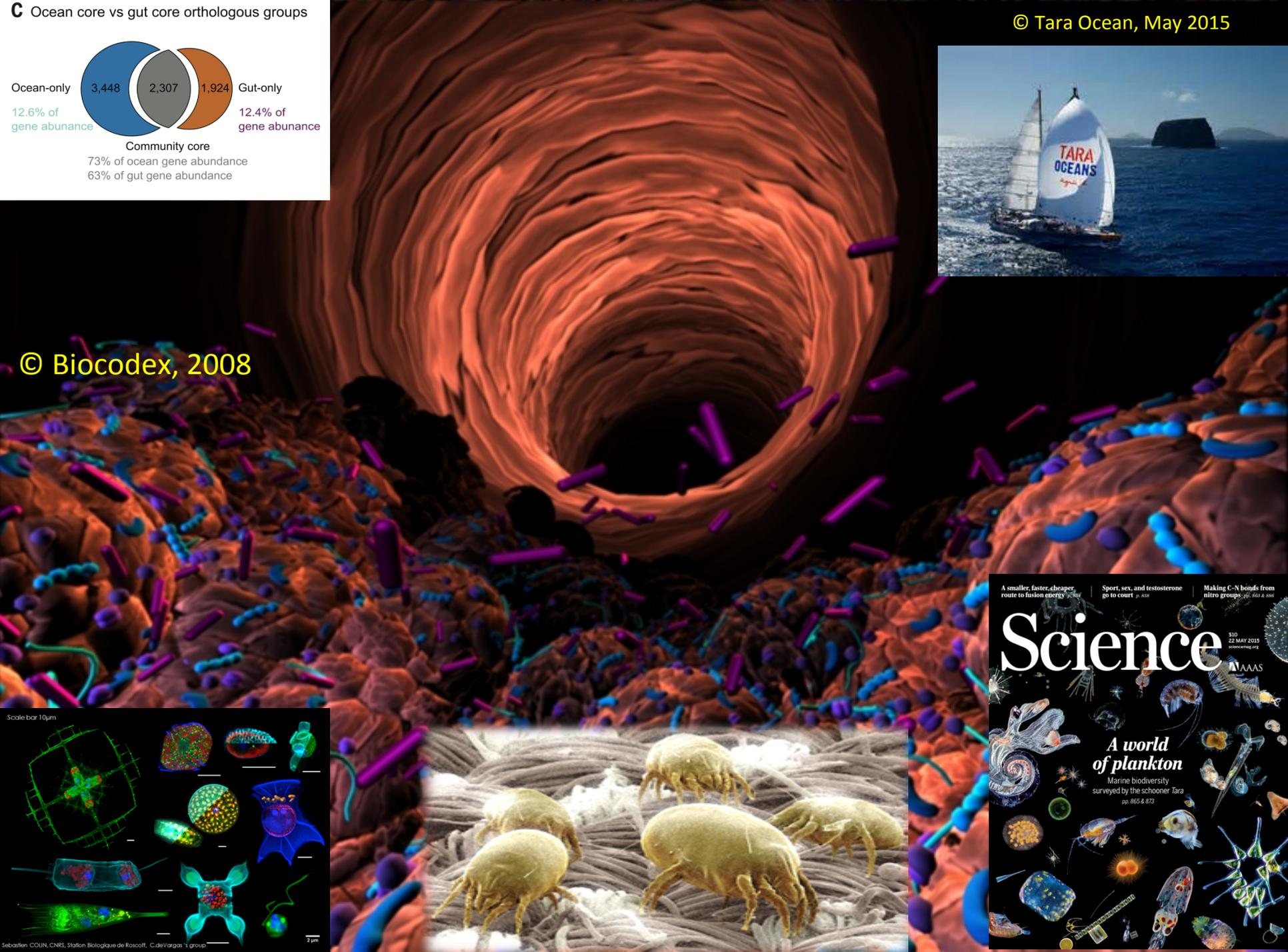
C Ocean core vs gut core orthologous groups



© Tara Ocean, May 2015

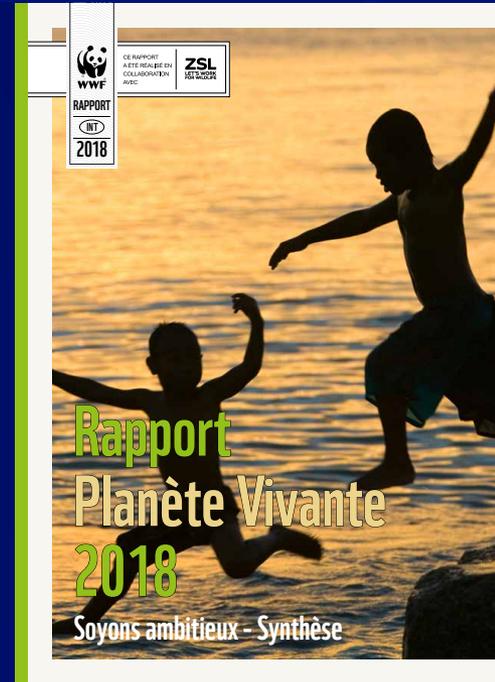


© Biocodex, 2008



Les sept plaies de la crise écologique

- La crise du productivisme agricole,
- La pénurie d'eau potable,
- Les ressources halieutiques s'épuisent,
- La déforestation progresse toujours,
- La biodiversité s'effondre,
- Des produits toxiques de plus en plus disséminés,
- Le changement climatique s'accélère.



Ceballos, G, P A Ehrlich and R Dirzo, 2017. Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines.

PNAS, nline at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1704949114/-/DCSupplemental, June 2017.

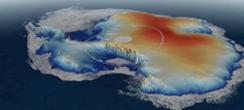


Greenland

Les calottes polaires

- Groenland →
7 m de hauteur de mer
- Antarctique de l'ouest →
3-5 m de hauteur de mer

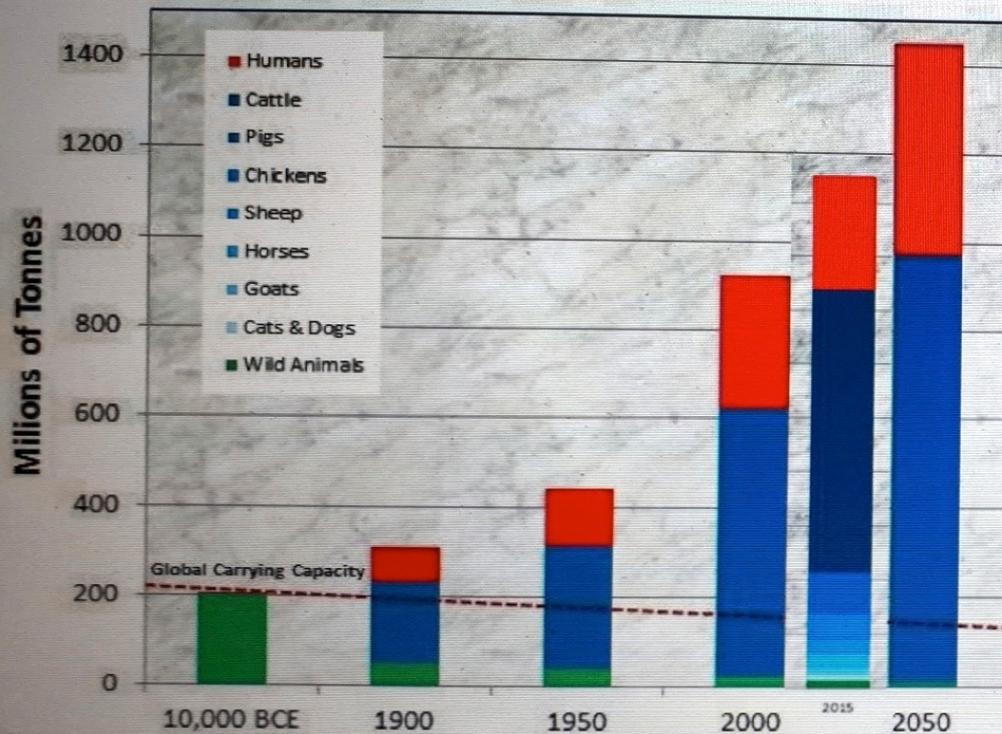
Antarctique



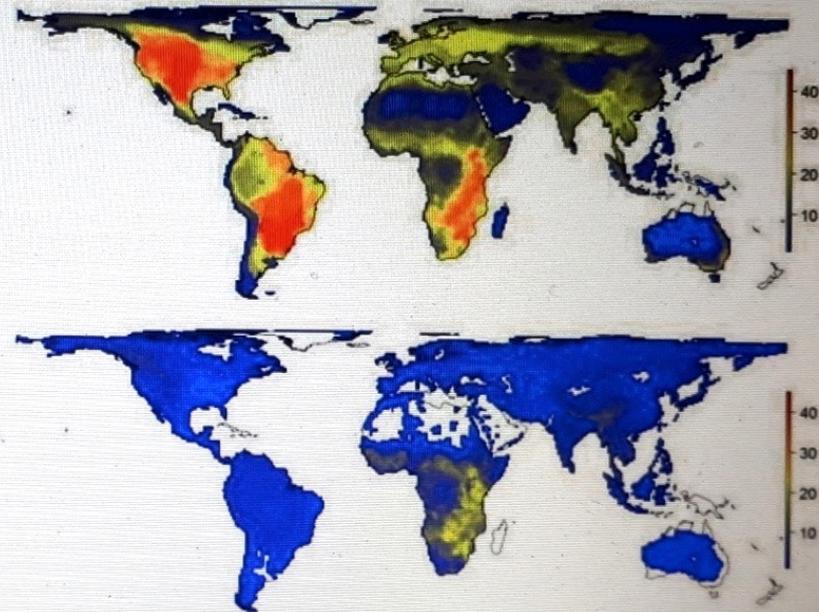
L'anthropocène: la grande accélération

Images de l'anthropocène: la grande accélération de l'extinction

Terrestrial Vertebrate Biomass



Data:
1900, 2000: Vaclav Smil
10,000 BCE, 1950, 2050: Paul Chefurka

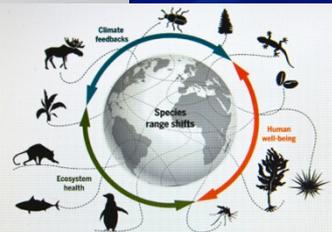


Top map shows the natural diversity of large mammals while second map shows current diversity of large mammals.

(Image: Soren Finstad)

La grande accélération ... de la consommation des ressources naturelles

En 15 ans, 30 % des oiseaux des champs ont disparu



As the global climate changes, human well-being, ecosystem function, and even climate itself are increasingly affected by the shifting geography of life. Climate-driven changes in species distributions, or range shifts, affect human well-being both directly (for example, through emerging diseases and changes in food supply) and indirectly (by degrading ecosystem health). Some range shifts even create feedback (positive or negative) on the climate system, altering the pace of climate change.



SCIENCE

Insect and bird populations declining dramatically in Germany

Two separate studies highlight a dramatic trend in Germany: the number of flying insects has declined by 76 percent over the past 27 years. There are 15 percent fewer birds than just twelve years ago.



A study by the German Nature and Biodiversity Conservation Union (NABU) concludes that the

Le déclin catastrophique observé en France par les chercheurs est largement dû aux pratiques agricoles

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

More than 75 percent decline over 27 years in total flying insect biomass in protected areas

Caspar A. Hallmann, Martin Sorg, Eelke Jongejans, Henk Siepel, Nick Hofland, Heinz Schwan, Werner Stenmans, Andreas Müller, Hubert Sumser, Thomas Hören, Dave Goulson, Hans de Kroon

Published: October 18, 2017 • <https://doi.org/10.1371/journal.pone.0185809>

Article	Authors	Metrics	Comments	Related Content
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Abstract

Global declines in insects have sparked wide interest among scientists, politicians, and the general public. Loss of insect diversity and abundance is expected to provoke cascading effects on food webs and to jeopardize ecosystem services. Our understanding of the extent and underlying causes of this decline is based on the abundance of single species or taxonomic groups only, rather than changes in insect biomass which is more relevant for ecological functioning. Here, we used a standardized protocol to measure total insect biomass using Malaise traps, deployed over 27 years in 63 nature protection areas in Germany (96 unique location-year combinations) to infer on the status and trend of local entomofauna. Our analysis estimates a seasonal decline of 76%, and mid-summer decline of 82% in flying insect biomass over the 27 years of study. We show that this decline is apparent regardless of habitat type, while changes in weather, land use, and habitat characteristics cannot explain this overall decline. This yet unrecognized loss of insect biomass must be taken into account in evaluating declines in abundance of species depending on insects as a food source, and ecosystem

PLOS | BIOLOGY

PERSPECTIVE
The paradoxical extinction of the most charismatic animals

Frank Courchamp^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Jean-Jacques Albert^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Yves Meinard^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, William J. Ripple^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}, Guillaume Chapron^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100}

Abstract
A widespread opinion is that conservation efforts disproportionately benefit charismatic species. However, this doesn't mean that they are not threatened, and which species are "charismatic"



Dramatic collapse of bird and flying insects populations in 12-30 years!

Biological Conservation, Feb 2019

Review Worldwide decline of the entomofauna: A review of its drivers

Francisco Sánchez-Bayo^{*,†}, Kris A.G. Wyckhuys^{b,c,d}

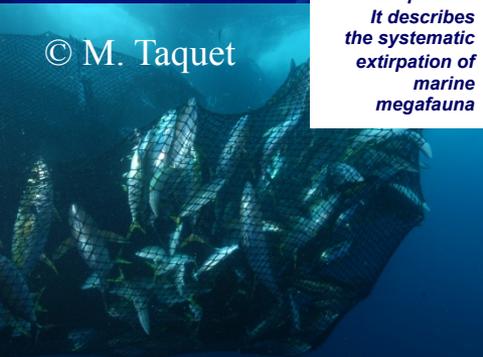
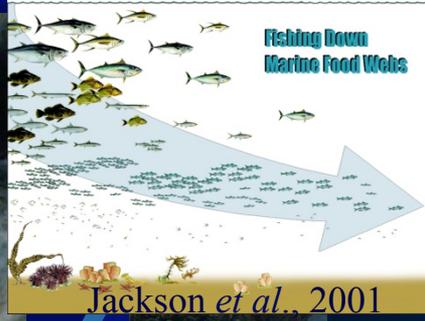
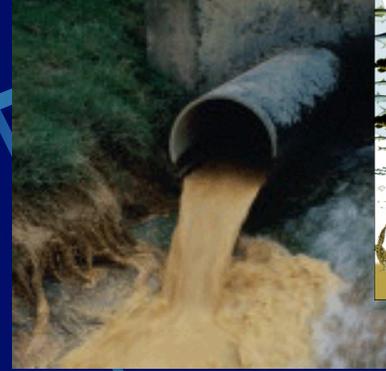


© UP Magazine, Fév 2019

Biodiversité en danger ?

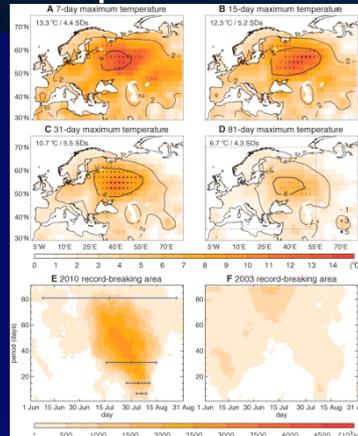
The 'fishing down' effect is ubiquitous. It describes the systematic extirpation of marine megafauna

© M. Taquet

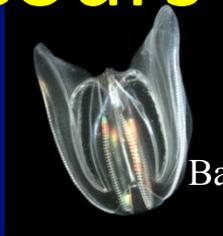


2 Surexploitation

1 Destruction et pollution



La 6^{ème} crise d'extinction massive est-elle en cours ?



Barnosky *et al.*, Nature, 2011

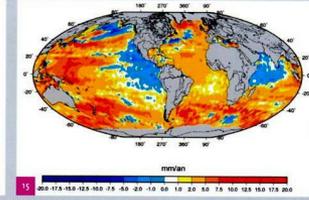
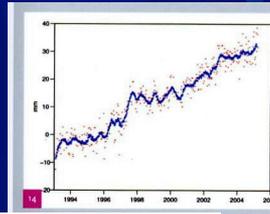
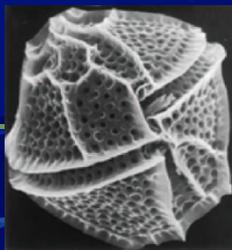


Figure 15 Distribution géographique de la vitesse d'évolution du niveau de l'océan, moyennée entre janvier 1993 et octobre 2005, issue du satellite TOPEX/POSEIDON, © CNRS, LEGOS

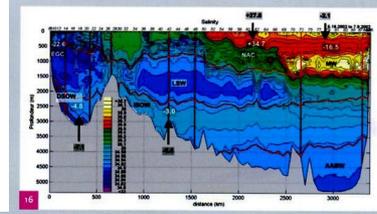
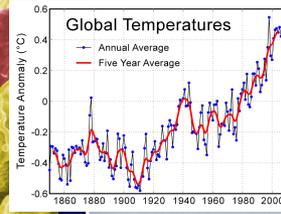


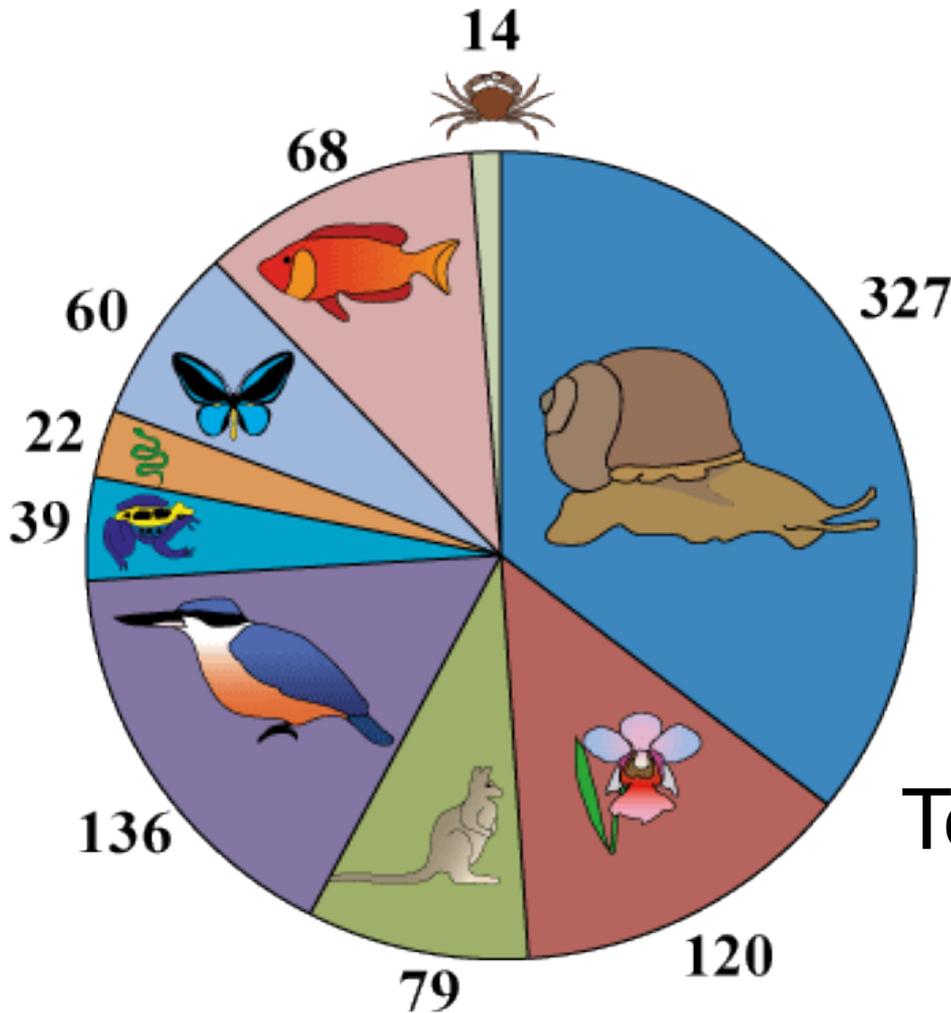
Figure 16 Coupe hydrographique obtenue dans le secteur Atlantique Nord entre le Groenland et le Portugal pendant la campagne OVIDE en 2002 et représentant la salinité, marqueur des différents masses d'eau ; sont aussi indiquées les valeurs des flux de masses d'eau significativement différentes entre 1997 (en noir) et 2002 (en blanc), © IFREMER, INSU, LPO

3 Espèces invasives

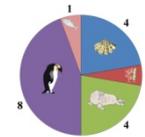
4 changement climatique

Liste Rouge UICN 2018

Espèces éteintes



Dont espèces marines



Total 18

Total 865

Le cri d'alarme de 15 000 scientifiques pour sauver la planète

IL SERA BIENTÔT TROP TARD...

- L'ampleur de l'initiative inédite : 15 000 scientifiques issus de 184 pays signent une alerte solennelle sur l'état de la planète. « Le Monde » publie l'intégralité de leur appel
- « Pour éviter une mise générale et une perte catastrophique de biodiversité », les scientifiques appellent l'humanité à changer radicalement de mode de vie
- Réchauffement climatique, biodiversité, déforestation... Tous les indicateurs montrent une dégradation continue de l'environnement sous la pression de l'homme
- Après trois années de stagnation, les émissions mondiales de CO₂ sont repartiées à la hausse en 2017, portées notamment par la Chine

PAGES 6-9

14 novembre 2017

UN MILLION D'ESPÈCES MENACÉES DE DISPARITION

IL N'EST PAS TROP TARD POUR AGIR...

- Le rythme d'extinction des espèces s'accélère dangereusement, menaçant désormais un million d'entre elles, avertissent les scientifiques
- Parmi elles, 500 000 espèces terrestres sont d'ores et déjà considérées comme des « morts ambulants », car leurs territoires s'amenuisent
- L'homme est le principal responsable de cette extinction de masse, en raison de la destruction et de la surexploitation des milieux naturels
- Les experts mettent en cause un modèle de consommation insoutenable et appellent un « changement en profondeur »

ÉDITORIAL
L'HUMANITÉ FACE À SES RESPONSABILITÉS
PAGE 31
PAGES 6 A B, IDEES - PAGES 28-29

7 mai 2019

SCIENCE'S COMPASS • REVIEW

REVIEW: EVOLUTION

Humans as the World's Greatest Evolutionary Force

Stephen R. Palumbi

In addition to altering global ecology, technology and human population growth also affect evolutionary trajectories, dramatically accelerating evolutionary change in other species, especially in commercially important, pest, and disease organisms. Such changes are apparent in antibiotic and human immunodeficiency virus (HIV) resistance to drugs, plant and insect resistance to pesticides, rapid changes in invasive species, life-history change in commercial fisheries, and pest adaptation to biological engineering products. This accelerated evolution costs at least \$33 billion to \$50 billion a year in the United States. Slowing and controlling arms races in disease and pest management have been successful in diverse ecological and economic systems, illustrating how applied evolutionary principles can help reduce the impact of human-kind on evolution.

The Pace of Human-Induced Evolution

Paul Müller's 1939 discovery that DDT killed insects won him the 1948 Nobel Prize, but before the Nobel ceremony occurred, evolution of resistance had already been reported in house flies (3, 4). By the 1960s, mosquitoes resistant to DDT effectively prevented the worldwide

agents like *Staphylococcus aureus* are penicillin-resistant, and up to 50% are resistant to stronger drugs like methicillin (11). Treatments that used to require small antibiotic doses now require huge concentrations or demand powerful new drugs (10). But such solutions are short-lived. For example, vancomycin, one of the only treatments for methicillin-resistant infections, has been overcome by some of the most frequent infectious agents in hospitals (2, 12). Antibiotics also generate evolution outside hospitals. Resistant strains are common on farms that use antibiotics in livestock production (13) and have been found in soils and groundwater affected by farm effluents (14).

Retroviruses with RNA genomes evolve even more quickly than bacteria (15). Every year, vaccinations against influenza must be reformulated, making prediction of next year's viral fashion one of preventative medicine.

Le « Groupe international de travail sur l'Anthropocène » (*Anthropocene Working Group*) a été créé en 2008,

Earth Planet Summit, 11-12 décembre 2017





Ecosystèmes très sensibles...

© G Boeuf, 2009



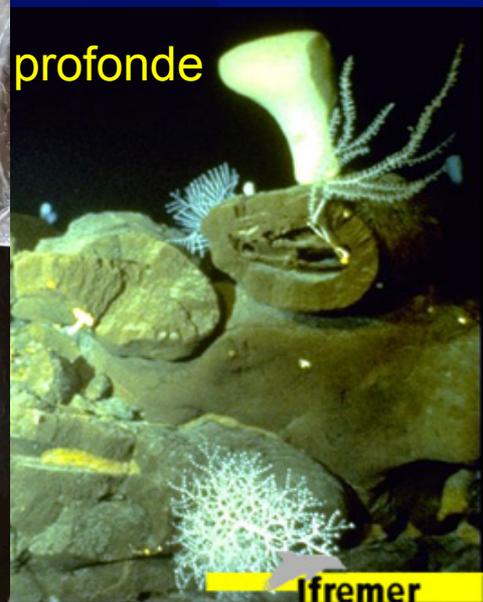
Herbiers



Mangroves

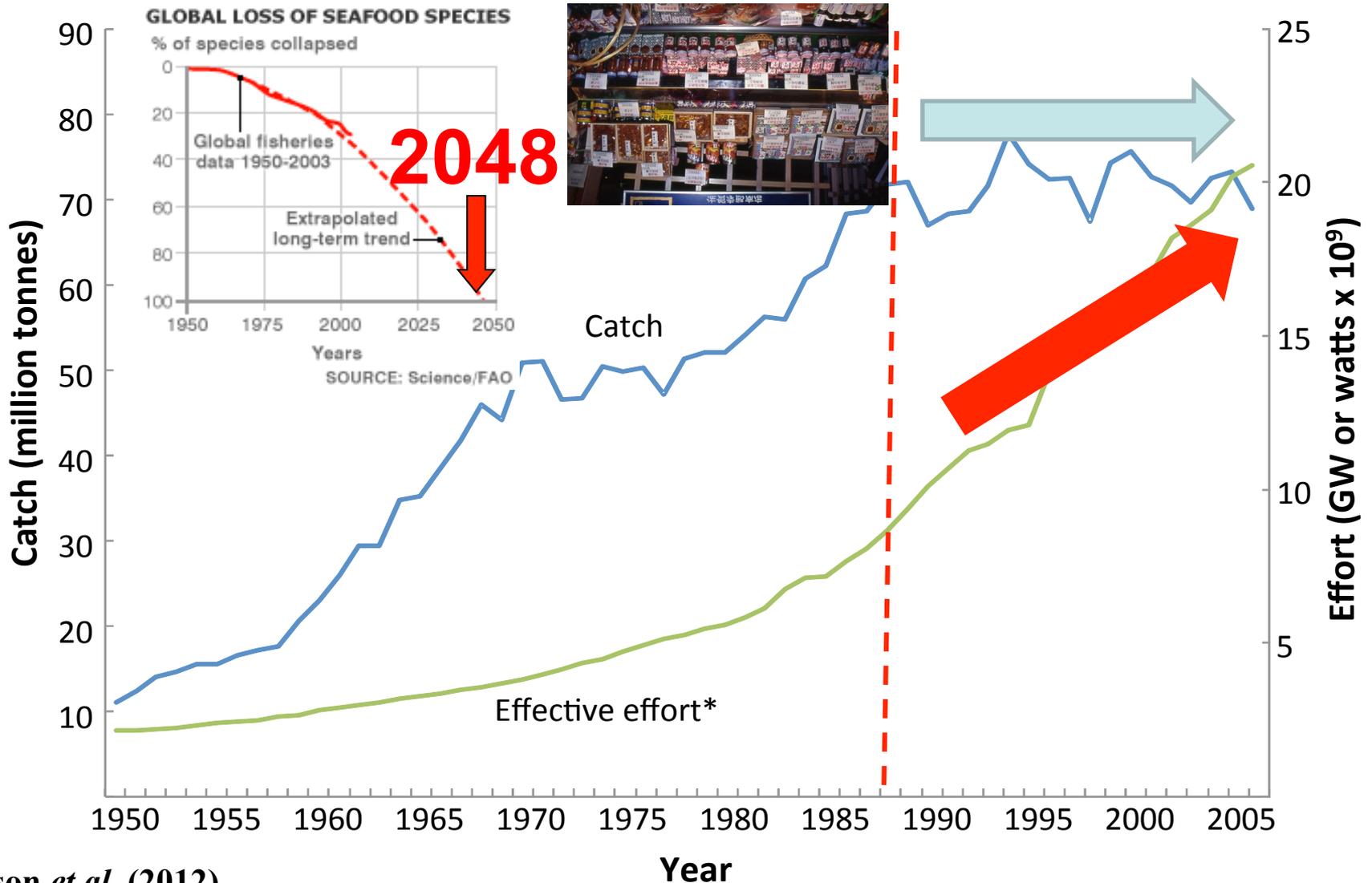


profonde



Ifremer

Capture stable mais un effort de pêche qui s'accroît considérablement



Watson *et al.* (2012)

*Effective effort indexed on 2000 based on average 2.42% increase annually

« Shifting baseline »

© P. Bouchet, 2012

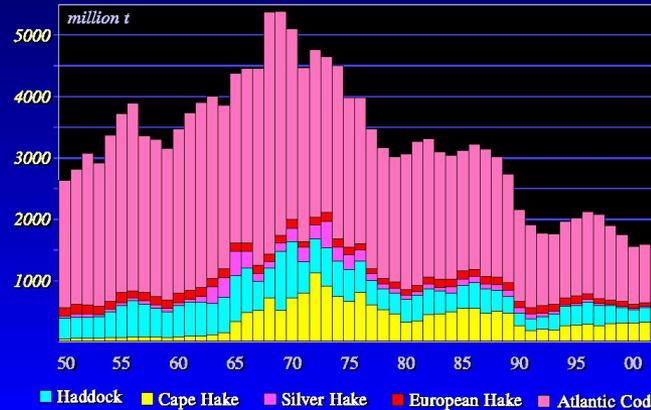
1926 – Thon rouge en mer du Nord



1957 - Trophées de Key West (USA)



Catch of major demersal fish

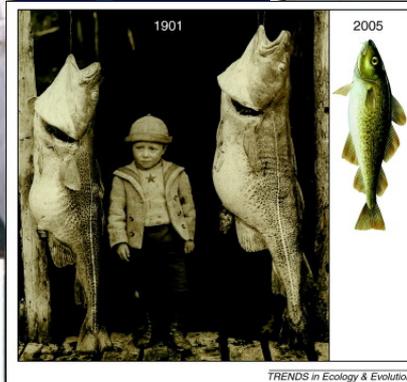


(EIO, 2004)

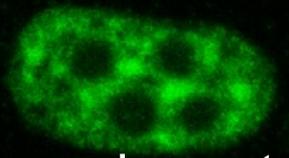
Début des années 80 – Key West



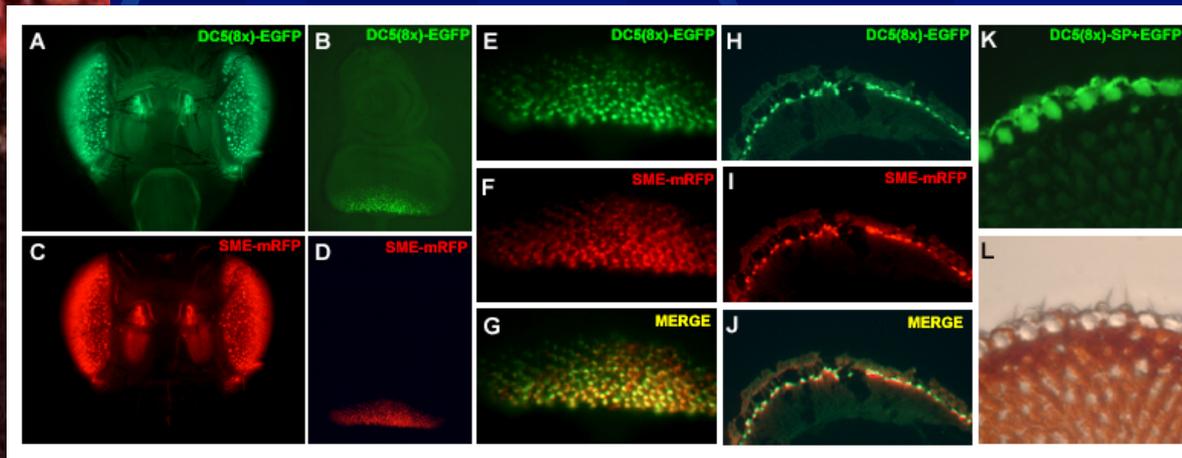
2007 – Key West



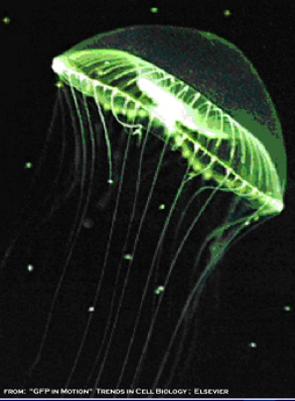
Molécules d'intérêt pharmacologique



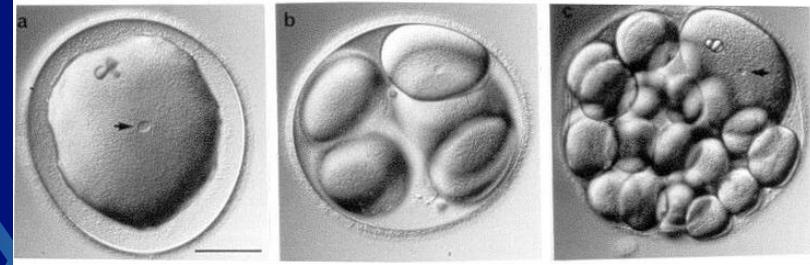
- Environ 50 % des molécules actives aujourd'hui utilisées en pharmacie sont extraites ou synthétisées à partir de **produits naturels**
- Plus de 26 000 produits ont été isolés d'organismes marins et certains sont passés en utilisation courante : **anticancer** Ara-C (leucémie myélocytique aigüe et lymphome non-Hodgkin), **anti-viral** Ara-A (herpès), nucléosides isolés d'éponges, **bryostatine** (de bryozoaire), **antiviraux bactériens** (anti-HIV)... Sondes moléculaires, 30 % des substances ont été trouvées chez les **spongiaires**,
- **Anti-cancereux**, antibiotiques, antiviraux, anti-fungi, immunostimulants, immunosuppresseurs, facteurs, de croissance, régénérateurs osseux,.... outils moléculaires (polymérases, protéines de fluorescence... *etc...*) .



Régulation du cycle cellulaire et cancer



FROM: "GFP IN MOTION" TRENDS IN CELL BIOLOGY: ELSEVIER



Vée et al., *J. Cell Science*, 2001

Onze Prix Nobel obtenus à partir de modèles aquatiques

E Metchnikoff
1908



O von Warburg 1931



J W Szostak



EH Blackburn 2009



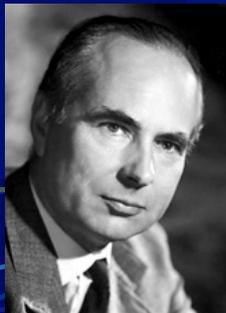
C W Greider

C Richet
1913

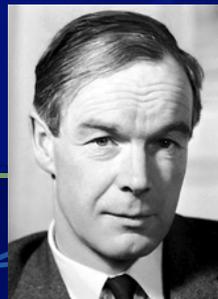


La phagocytose, les vagues calciques intra-cellulaires, le choc anaphylactique, les modalités de la transmission de l'influx nerveux, les bases moléculaires de la mémoire, les molécules-clé du cancer, le premier récepteur membranaire à un neurotransmetteur, la protéine de fluorescence verte de méduse, l'enzyme télomérase...

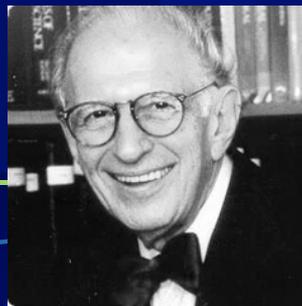
A Hodgkin 1963



A Huxley



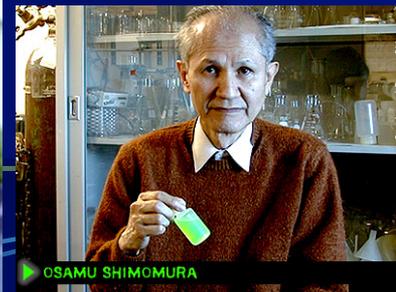
E Kandel 2000



T Hunt 2001



O Shimomura
2008



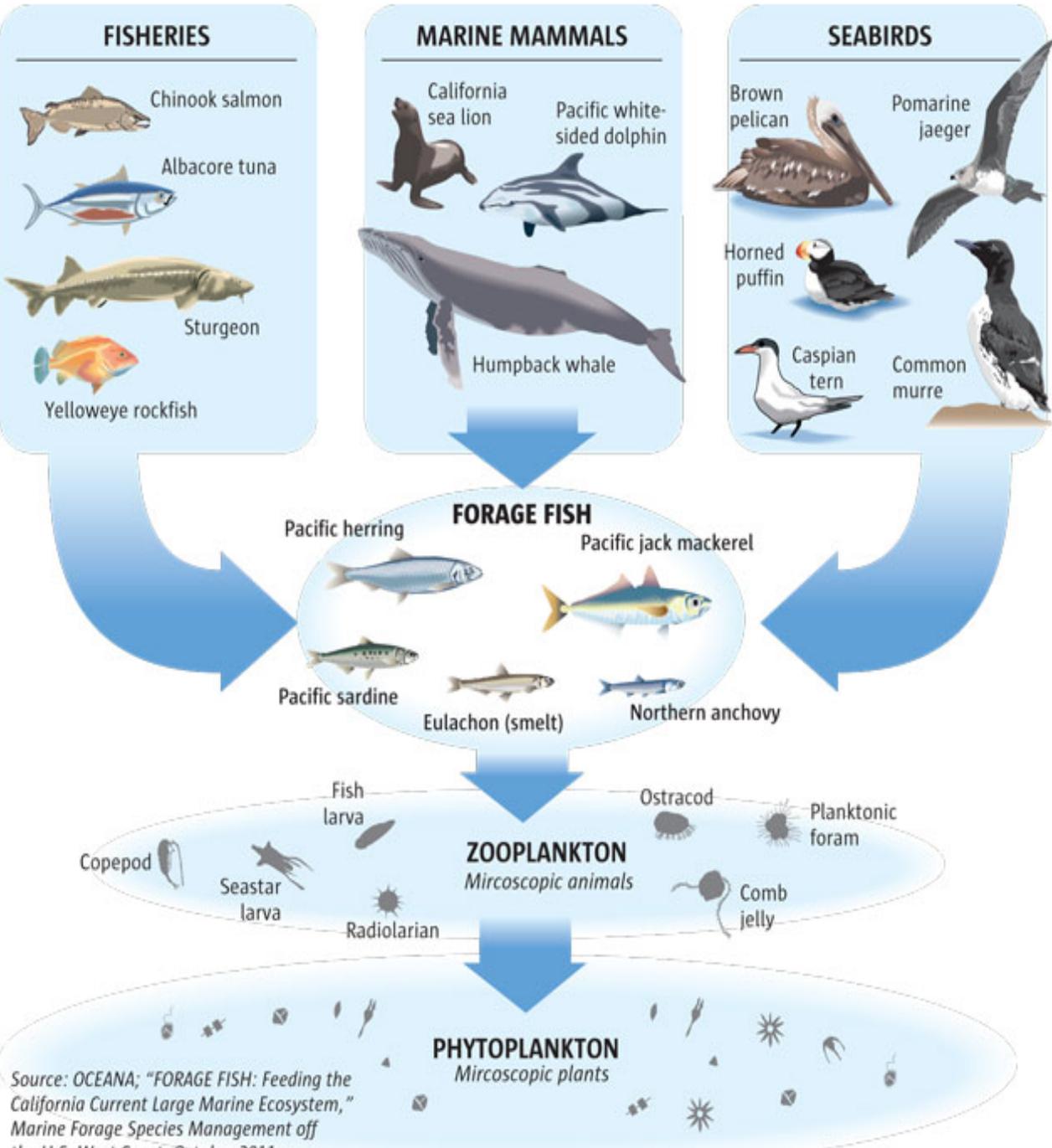
OSAMU SHIMOMURA

Courtesy of Osamu Shimomura

Inside the ocean...

- Nature Climate Change, E Poloczanska *et al.*, Aug 2013,
- *Here, we synthesized all available studies of the consistency of marine ecological observations with expectations under climate change. This yielded a metadatabase of 1,735 marine biological responses for which either regional or global climate change was considered as a driver. Of the species responding to climate change, rates of distribution shifts were, on average, consistent with those required to track ocean surface temperature changes. Rates of observed shifts in species distributions and phenology are comparable to, or greater, than those for terrestrial systems.*
- **208 studies, 857 marine sp, 42 years of watching, 72 km per 10 years (6 for land sp), phytoplankton, 470 km per 10 years, 272 for fishes,**
- **Biologiques cycles largely advanced, size and structure of populations...**





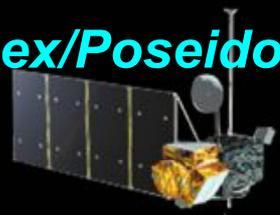
© Ron LeVal

Rôle clé des poissons fourrage dans les écosystèmes marins

(Cury et al., 2011)

Source: OCEANA; "FORAGE FISH: Feeding the California Current Large Marine Ecosystem," Marine Forage Species Management off the U.S. West Coast, October 2011

Topex/Poseidon (1992)



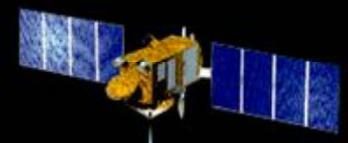
Jason-1 (2001)

Jason-2 (2008)

ERS-1/2 (1991/1995)

Envisat (2002)

Saral/AltiKa (2013)



© G Boeuf, Dec 2015

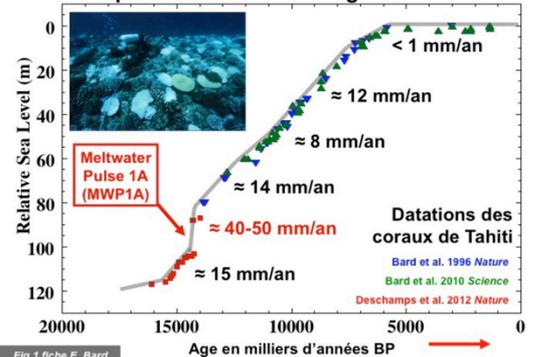


© G Boeuf, Apr 2015

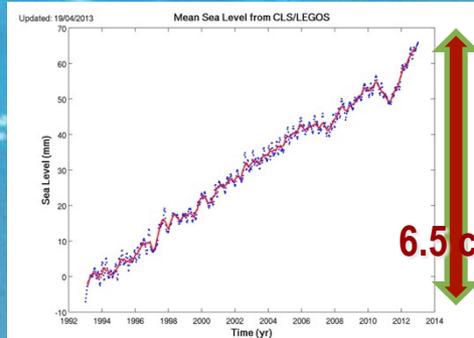


© G Boeuf, Dec 2015

Remontée du niveau marin (> 120m) pendant la dernière déglaciation



© G Boeuf, 2017



© A Cazenave, 2015

Since the beginning of the 90's
→ Spatial altimetry of high precision

Une planète, deux scénarios

WE
ARE
HERE

Nous laissons faire: +4°C

L'avenir est
entre nos
mains

Nous agissons résolument: +2°C

2020

2100

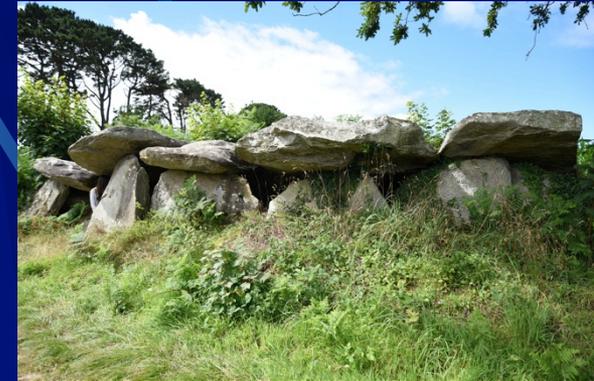


38°

1850

S'engager ?

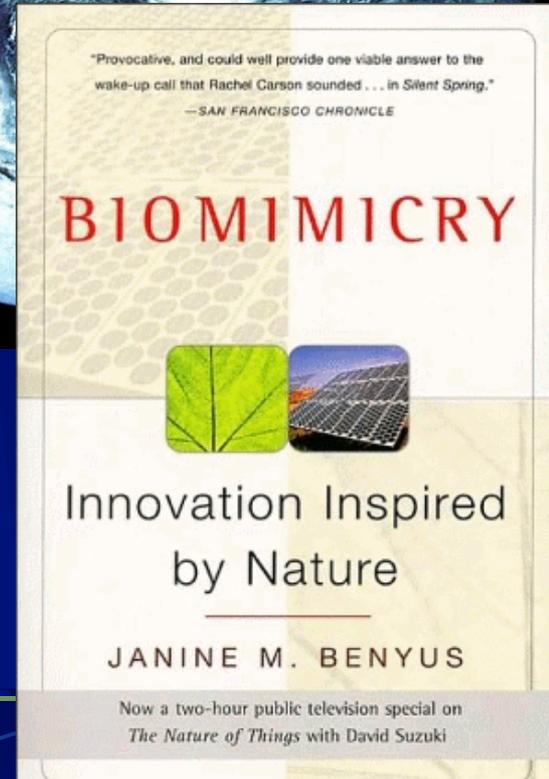
- Oui, pour changer, pour s'adapter !
- Le rôle de l'entreprise,
- Un développement en harmonie avec les milieux,
- Une économie non basée sur la destruction de la nature ou sa surexploitation !
- Une Région préservée dans sa capacité à évoluer dans le contexte international...



Prévoir à long terme ?

Transformation

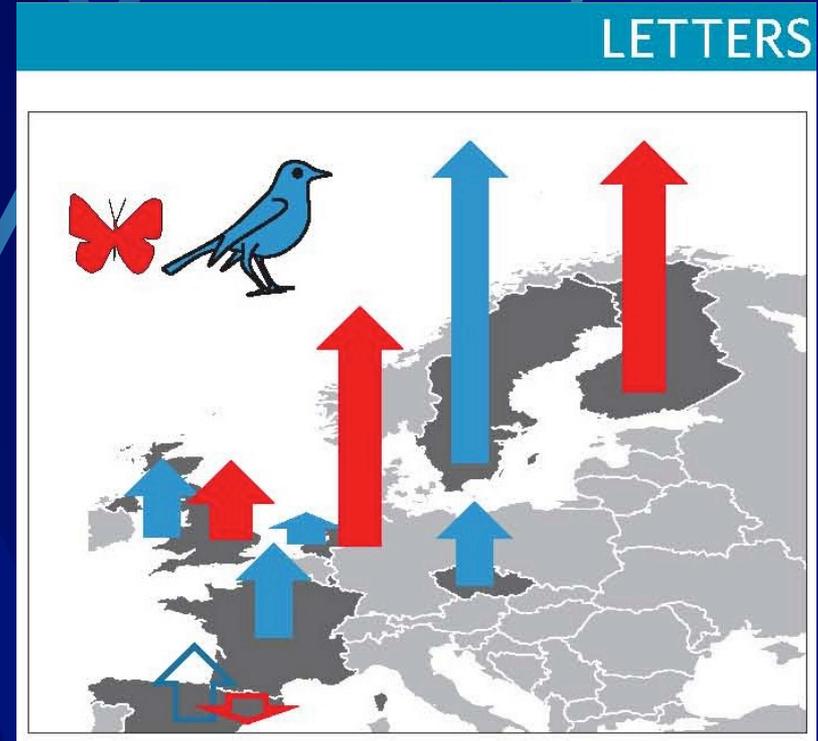
- Climat,
- Accès à l'eau,
- Gestion des déchets spatiaux,
- Gestion des déchets nucléaires,
- Stockage du CO₂,
- Evolution de la biodiversité,
- Quels modes de gouvernance ?



Differences in the climatic debts of birds and butterflies at a continental scale

Devictor *et al.*, *Nature Climate Change*, Jan 2012,

Figure 3 | European variations in the temporal trend of bird and butterfly CTI. The map shows the temporal trend of bird and butterfly CTI for each country. The height of a given arrow is proportional to the temporal trend and its direction corresponds to the sign of the slope (from south to north for positive slopes). The arrow is opaque if the trend is significant.



Birds and butterflies move less than temperature: to find new habitat!
33km for birds, 114 km for butterflies on 18 years. + 1°C and 249 km to North
in Europe, accumulation of the climatic debt.

S'inspirer ?

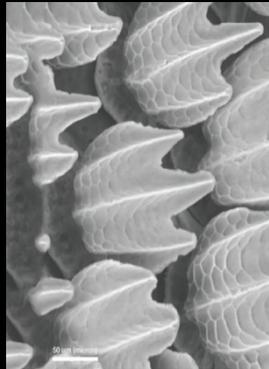
La vie, quelle entreprise* !



- S'inspirer des formes,
- S'inspirer des mécanismes, des matériaux,
- S'inspirer des relations durables établies,
- Très grande interdisciplinarité.



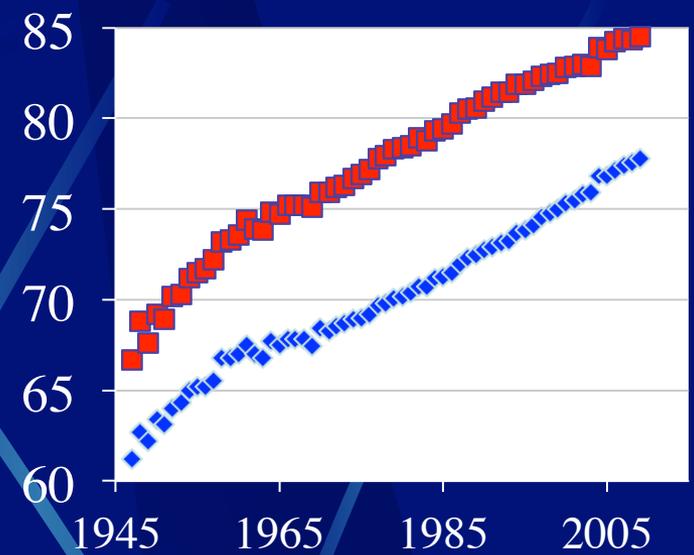
Inspiré de l'océan...



Les scientifiques réfléchissent à l'usage des toxines des cônes dont les analgésiques s'avèrent 1000 fois plus puissants que la morphine et non addictifs

Optimisation of potentials

Energetic supplies	+ 100%	(1500 kCal)
Performance	+ 33 %	
Size	+ 10 %	(15cm)
Weight	+ 100%	(30 kg)
Lifespan	+ 120%	(35 years)
Demography	+ 700%	(7Mds)
Agricultural yields	+ 1000%	(70 q/h)
Economy	+ 2000%	(?)
Knowledges	+ ??? %	

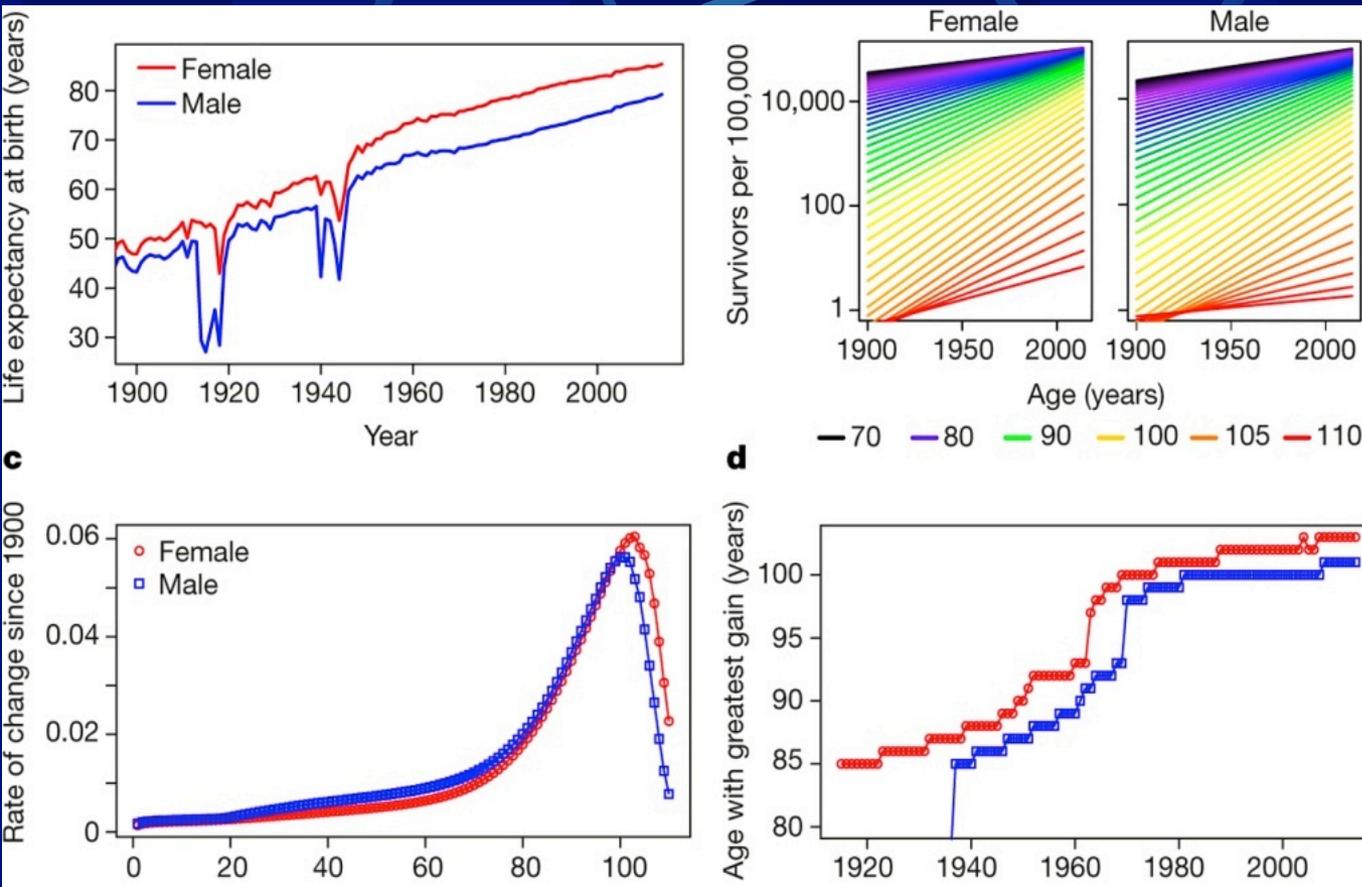


Very long term: will we have time?

19 – 20th Century

Evidence for a limit to human lifespan

Xiao Dong, Brandon Milholland & Jan Vijg, Nature, doi:10.1038/nature19793, 5 octobre 2016



Jeanne Calment, Fr 122
164 j

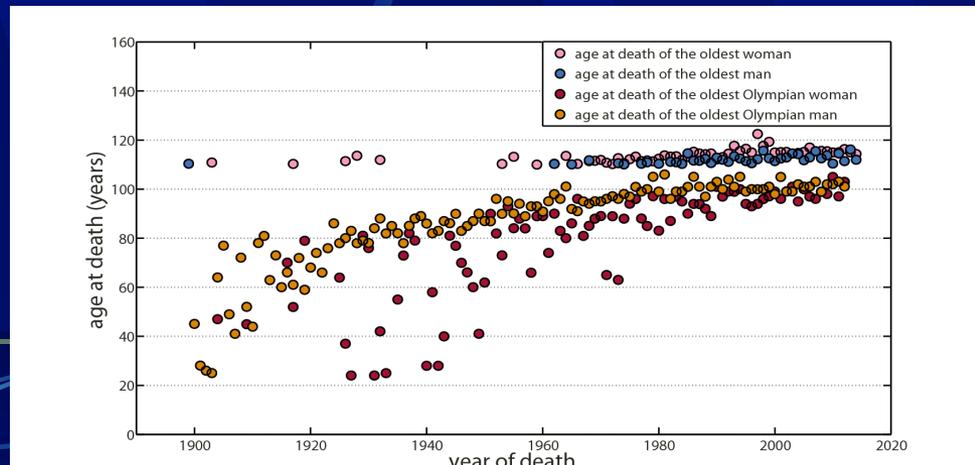
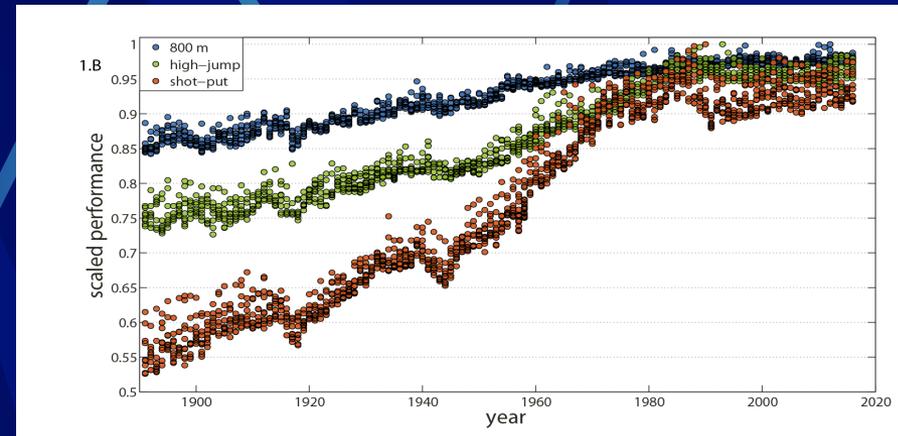
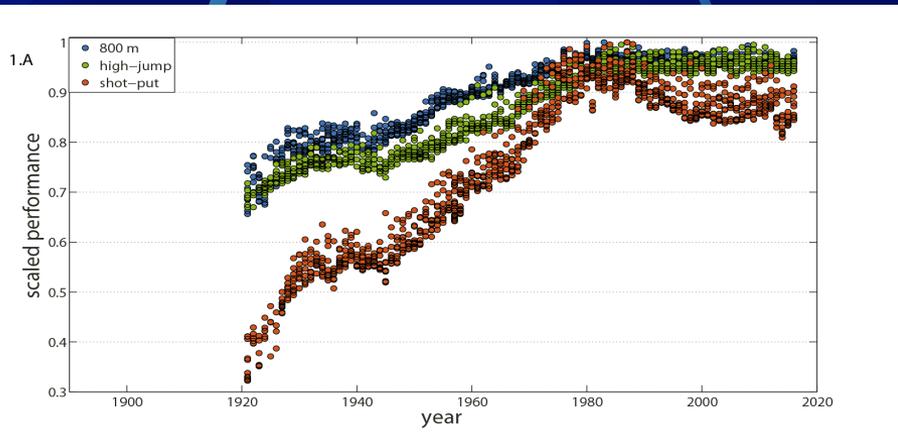


Kane Tanaka, Jap 116

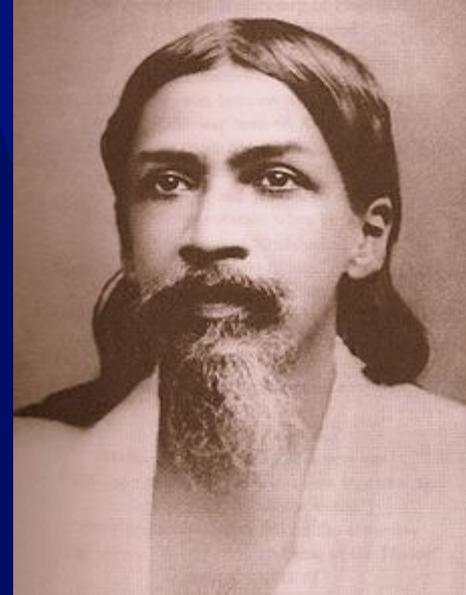
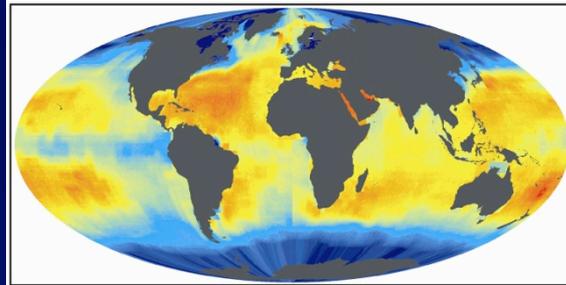
Trends in life expectancy and late-life survival

Are We Reaching the Limits of Homo sapiens?

Adrien Marck, Juliana Antero, Geoffroy Berthelot, Guillaume Saulière, Jean-Marc Jancovici, Valérie Masson-Delmotte, Gilles Boeuf, Michael Spedding, Éric Le Bourg and Jean-François Toussaint.



Changer ?



- *« L'Homme ne peut plus désormais supporter le développement gigantesque de la vie extérieure sans un changement intérieur »,*
- *« ...Si l'humanité veut survivre, une transformation radicale de la nature humaine est indispensable... ».*



Edgar Morin, 2010, Bayard, Paris

Comment vivre en temps de crise ?

- *Le vaisseau spatial Terre est emporté par un quadrimoteur, la science, la technique, l'économie et le profit. Et chacun de ces moteurs est profondément ambivalent.*
- *Le probable est catastrophique, il est que nous allons vers l'abîme.*
- *Pourtant, il y a toujours eu de l'improbable dans l'histoire humaine, le futur n'est jamais joué.*
- *Le propre de la métamorphose, comme de toute création, est de ne pas être prévisible... il nous manque la conscience d'humanité planétaire...*
- *Homo faber, H. demens, H. sapiens.*



Duo, Mak' it, Montpellier, 7 mars 2019

« A force de sacrifier l'essentiel à l'urgence, on finit par oublier l'urgence de l'essentiel. » Edgar Morin, 2019.

Les avantages du vivant

- Le vivant innove constamment et ceci, depuis la nuit des temps,
- L'innovation est utilisable par tous,
- Tout se fait avec grande parcimonie d'énergie,
- La nature ne produit jamais une substance qu'elle ne sait pas dégrader, elle trouve toujours un acheteur pour ses déchets !
- Le vivant ne maximise jamais, il « optimise » en permanence,

Conclusion : Stopper une économie stupide et suicidaire qui consiste à faire du profit en détruisant ou surexploitant la nature !!