By Dr.Howard Dryden . www.GoesFoundation.com

Carbon dioxide is removed from the atmosphere by photosynthesis, and oxygen is produced in accordance the following equation;

Photosynthesis

$$6\,CO_2 + 12H_2O + Light\ Energy \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

$$carbon\ dioxide + water + chlorophyll \rightarrow glucose + oxygen + water$$

When organic matter is consumed by animals, biologically decomposed or ignited, the carbon is returned to the atmosphere as carbon dioxide, and oxygen is consumed in direct proportion to the carbon dioxide released, in accordance to the following equation;

Respiration

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$$

$$glucose + oxygen \rightarrow oxygen + water + Energy$$

Note that respiration equation is essentially the reverse of the carbon dioxide fixation equation for photosynthesis. In terms of CO2 fixation, the only part of the terrestrial ecosystem that sequesters CO2, are wetlands and peat bogs, because the vegetable matter does not decompose to release the CO2 back into the atmosphere. To put this into perspective, the peat bogs and marsh lands of Scotland and Ireland combined, sequester more CO2 than the Amazon rain-forest. In fact tropical rain forest can be a carbon source [1], pumping huge amounts of carbon dioxide back into the atmosphere as a consequence of deforestation, burning and decomposition of the trees and vegetation.

Peat bogs, marsh land and wet lands are therefore incredibly important as part of the carbon cycle and they must be protected. In effect, this also means you could cut down all the trees and terrestrial plants everywhere, and it will make no difference to CO2 fixation, because over a timescale, the system is in equilibrium. I do not for a second suggest cutting down all the trees and plants, I just wish to illustrate the point.

CO2 is also sequestered by silicates from mineral erosion and by primary productivity in the oceans. The ratio is approximately;

- 10% peat bogs and marsh lands
- 30% marine ecosystems
- 60% silicates and mineral erosion

Oxygen production

Oxygen is only produced where carbon dioxide is sequestered to result in a net production of oxygen. This means that in addition to there being no net fixation of carbon dioxide by terrestrial plants, there is no net oxygen production. It therefore follows that all of our oxygen is derived from peat bogs and wetlands as well as primary productivity from the oceans in the

same ratio as carbon dioxide fixation. It follows that 75% of our oxygen must come from the oceans and 25% from terrestrial ecology. Anaerobic fermentation of organic matter will convert organic matter into carbon dioxide and other organic matter, such as alcohol which should also be factored into the equation, but there is no consumption of oxygen by the process.

The above is a simplistic representation, but it means that 3 out of every 4 breaths we take, come from the Oceans. The disturbing issue is that oxygen levels are declining at a faster rate than can be explained by the increase in carbon dioxide. Atmospheric analysis in Europe from 2000 to 2005, confirmed CO_2 increased by 1.7±0.2 ppm/year while oxygen decreased at -4.2±0.3 ppm/year(+/- 1,2) [2] [3]. The decline in oxygen is three times faster than the increase of carbon dioxide, and as such it cannot be explained as a consequence of the burning of fossil fuels. There must therefore be other factors involved which actually have more of an impact on the atmosphere that than the burning of fossil fuels.

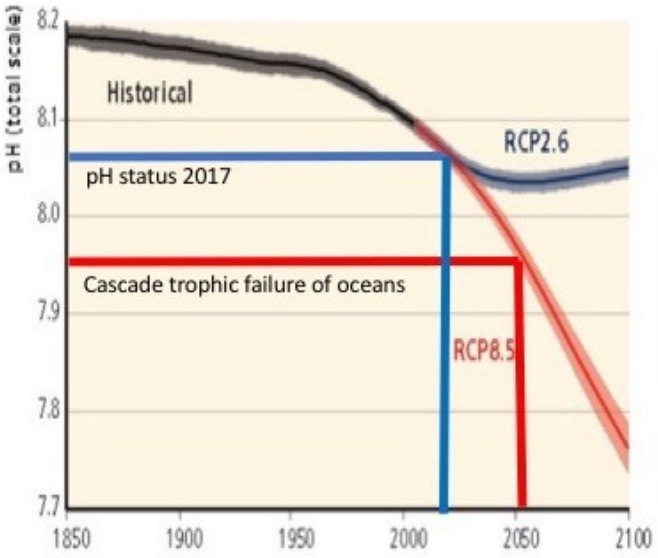
Where is all the oxygen going?

It is not a question of where the oxygen is going but it can be explained by a reduction of oxygen production. As oxygen production drops, carbon dioxide will increase by the same amount, so there is a deficit or a carbon sink where the carbon dioxide is accumulating, and again this happens to be the oceans and atmosphere.

When carbon dioxide is dissolved in water, it forms carbonic acid which drops the pH, this is why we have Ocean acidification. Oceanic pH was around pH 8.26 about 50 years ago, pH is has now dropped and is pH 8.06. In accordance to the IPCC at RCP8.5 the oceanic pH will drop to pH 7.9-7.95 over the next 25 to 40 years. Marine organisms are critically dependent upon a stable pH, there will be some adaptation to the low pH conditions, but there will still be a catastrophic cascade failure of the marine ecosystem and we will lose many of the invertebrates such as copepods, as well as whales, seals, birds and fish as a consequence of acidification. The oceans can survive without the terrestrial ecosystem, but we cannot survive without the oceans. By way of example, the moon generates tidal forces to move huge amounts of oceanic water and energy, wind induced mixing with wave action also moves a massive amount of water, but copepods, one of the smallest animals in the oceans, collectively may move as much water during their nightly migration to the surface, as the moon or the wind [4]. From the IPCC chapter 6 Ocean Systems [5], Ocean acidification poses many other potential risks, but these cannot yet be quantitatively assessed because of the small number of studies available. Oceans have the most important role helping to buffer climate, yet basic water quality parameters such as pH cannot be assessed because of a lack of information. Copepods and diurnal plankton migration to the surface are not factored into the climate change model.

pH and Ocean acidification

The historical data, and predicted pH change, assuming we progress without a reduction in carbon dioxide emissions, will result in RCP 8.5 (Representative Concentration Pathway). China is not going to decrease CO_2 emissions until at least 2030, India and Brazil are increasing rapidly, and the USA will follow, RCP8.5 is therefore likely over the next 40 years, in which case we end up with the prediction in the graph below by the IPCC.



As marine biologists designing public aquarium life support system and closed system aquaculture for the last 35 years, we know for sure that you cannot sustain marine life in the systems at pH7.9. Many organisms will survive a low pH, but their behaviour will change, they become prone to predation or

susceptible to disease. The tipping point is set to start at pH7.95 and the clock is now ticking for a trophic cascade failure of the entire marine ecosystem over the next 25 to 40 years.

Why are oxygen levels dropping?

The decline in atmospheric oxygen demonstrates there is a reduction of photosynthetic activity (primary productivity) on a massive scale, NASA's imagery have reported that there is a 1% drop year on year of primary oceanic productivity, [6], and a paper published in Nature by Dalhousie University reports a 40% drop in primary productivity over the last 50 years, [7]. On the basis of 75% of all our oxygen is produced in the oceans, and the fact that it is declining 3 times faster than carbon dioxide is increasing, coupled with the supporting evidence from C. Greggs, and Boyce, we are now experiencing a crash in oceanic primary productivity. The ocean ecosystem is declining and over the next few decades it will catastrophically fail, and once the process reaches the tipping point it will be really quick, over a time frame of two or three years, the ocean ecosystem will be destroyed, and we lose all the whales, birds seals, most fish and the food supply for nearly 2 billion people.

Dr.Howard Dryden delivering marine biodiversity presentation in Shenzhen, China 2018

Most scientists blame climate change for the reduction in productivity and biodiversity, but all the evidence indicates that it is not climate change and that the crash in oceanic primary productivity may be the primary reason for climate change, not the other way around. One possible explanation for the impending crash in primary productivity is man-made pollution by those most toxic of persistent industrial and domestic products called Priority Chemicals which include fire retardants (PBDE) methyl mercury, organic tin, and PCBs. Nano and micro plastics are also implicated as carriers of the priority chemicals. Nature has not been able to adapt to these man-made chemicals and plastic, and as a consequence it is suffering and dying. It impacts on the smallest of animals such as copepods and single celled plants. Yet it goes un-noticed because they are hidden below the water and you need a micro-scope to see them clearly. Yet algae in the oceans give us 75% of our oxygen and copepods collectively represent the greatest mass of animals on the planet.

Copepod Valdiviella insignis by R. Hopcroft, University of Alaska

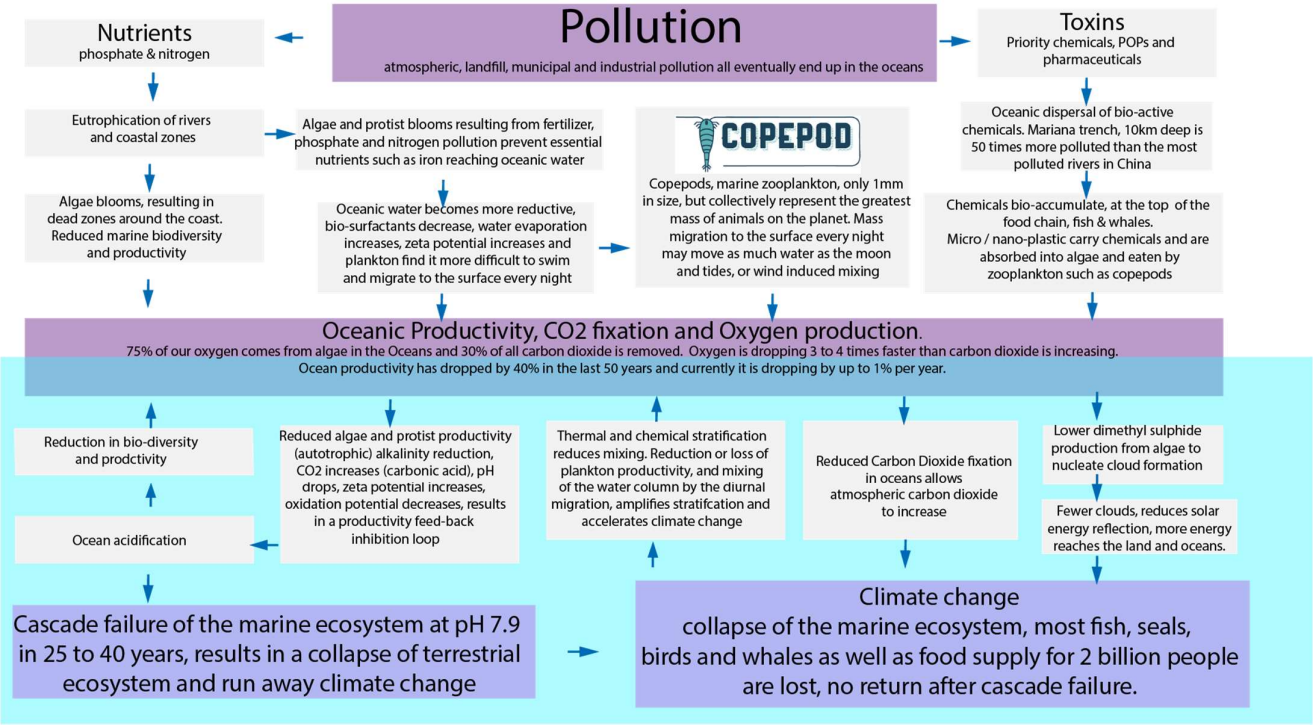
The reduction in primary productivity as a consequence of chemical pollution, reduces the production of oxygen and allows carbon dioxide to accumulate in the oceans, and this leads to ocean acidification and climate change.

Planet Earth's survival.

Climate change is often dismissed, sceptics do not believe the mass of data and scientific evidence. In some respects, they are correct to question, we need to question and debate all aspects of climate change and aquatic pollution, but in this case the mass of evidence has so much inertia that all of the scientist and politicians are looking in the same direction and are not willing to deviate, at the Goes Foundation we are convinced that it is in the wrong direction. Climate change is still caused by carbon dioxide and greenhouse gases, but the primary factor is anthropogenic chemical pollution, and unless we can raise the debate and change the focus, we are heading for the pH cliff, beyond which there is no return. By raising the question, it also provides the solution, currently we have an impossible task of reducing CO2 emissions, even if we stop burning fossil fuels now, it will be too late, but if the primary reason is toxic chemical pollution, then in reality we

have an easy fix, we must prevent the discharge of toxic man-made chemicals into the environment. We succeeded in stopping CFC production and almost fixed the hole in the ozone layer, until a few companies in China started to use CFCs again for fabrication of home insulation material. This demonstrates that a relative small amount of chemicals can have a major impact on a global scale. Eliminating priority chemicals and substances or preventing them from entering the environment will be much more difficult that solving the CFC issue, but we know that it can be accomplished if all countries work together.

The mission of the Goes Foundation is to disseminate information and engage with citizen science in order to collect plankton samples for priority chemical analysis. There is almost a complete lack of this data in the literature as reported by the IPCC, which makes it critically important that we succeed. If we can effect change over the next 10 years, we may be able to recover the oceanic ecosystem and its ability to produce our oxygen, remove carbon dioxide and protect all the wonderful plant and animal life from the smallest copepod to all the fish and whales.



What can you do to help?

Join the Copepod mission at www.GoesFoundation.com and critically inspect all chemical products that you purchase to make sure they are eco-friendly, by way of example 1 bottle of sun block containing oxybenzone could destroy a 100m of coral reef, one tooth brush full of toothpaste containing Triclosan would wipe out all life in a water mass the size of an Olympic swimming pool, do not under any circumstances flush old pharmaceuticals down the toilet. Avoid using plastic once and recycle all your waste. For ocean going yachts we can provide plankton nets and USB micro-scopes to allow plankton samples to be taken, the plankton samples are returned to Edinburgh for analysis by Goes Foundation. We need to start collecting data in order to provide specific evidence of the impact of priority chemicals on marine plankton.

More information will appear in the www.GoesFoundation.com website which will provide clear instruction about what you can do and how you can help. For the time-being it is important that we raise the debate and start the discussion, so please disseminate and circulate this report, and if you have any suggestions or recommendations, please be in contact.

References

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