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More Bad Consequences of Biofuels
http://co2science.org/articles/V11/N29/EDIT.php

In his misguided attempt to enlist Christianity to help promote the Intergovernmental Panel on Climate Change's anti-CO2 campaign, which is described in the September 2007 issue of *Physics Today*, England's Sir John Houghton claims we need "very large growth in renewable energy sources," among which he lists *biomass* in second place after *solar*. Already, however, it has been made abundantly clear that this "moral imperative" of his is not only not helpful, *it is hurtful*, as food prices around the world have soared in response to crops such as corn and sugar cane being sold for *fuel* -- as in *ethanol* -- instead of *food*.

But that is not the half of it, as we have indicated in a number of subsequent editorials that may be readily accessed by employing our website's search engine to seek out archived items containing the words "Sir John." And we here extend the list of bad consequences of this perverted policy even further, reviewing the findings of two groups of researchers published earlier this year in *Science*.

In an article entitled "Land Clearing and the Biofuel Carbon Debt," Fargione *et al.* (2008) explore what happens when non-agricultural lands are cleared for the growing of biofuel crops. In addition to the destruction of precious habitat needed to support what we could call "wild nature," this process releases huge amounts of CO2 to the atmosphere due to the burning and microbial decomposition of organic carbon stored in plant biomass and soils. And this initial "carbon debt" *must be repaid* before there is any net reduction in CO2 emissions from the use of the biofuel crops grown on the newly-cleared land.

So just how big can initial carbon debts be?

Fargione *et al.* make detailed calculations for six different scenarios of "native habitat conversion," which from the viewpoint of wild nature may be more properly described as *native habitat destruction*. These are: "Brazilian Amazon to soybean biodiesel, Brazilian Cerrado to soybean biodiesel, Brazilian Cerrado to sugarcane ethanol, Indonesian or Malaysian lowland tropical rainforest to palm biodiesel, Indonesian or Malaysian peat land tropical rainforest to palm biodiesel, and U.S. central grassland to corn ethanol." *These conversions, in their words, would release "17 to 420 times more CO2 than the annual greenhouse gas reductions that these biofuels would provide by displacing fossil fuels." And they note that the huge carbon debts they produce "would not be repaid by the annual carbon repayments from biofuel production for decades or centuries."*

Much the same conclusions are reached by Searchinger *et al.* (2008), who write that earlier studies of the benefits of substituting biofuels for gasoline "failed to count the carbon emissions that occur as farmers worldwide respond to higher prices and convert forest and grassland to new cropland to replace the grain (or cropland) diverted to biofuels." And by using a worldwide agricultural model to estimate emissions from such land-use changes, they find that *"corn-based ethanol, instead of producing a 20% savings, nearly doubles greenhouse emissions over 30 years and increases greenhouse gases for 167 years*," while "biofuels from switchgrass, if grown on U.S. corn lands, increase emissions by 50%."

In light of these several findings, it is clear, as concluded by Searchinger *et al.*, that "when farmers use today's good cropland to produce food," which is what reason has always dictated they should do, "they help to avert [the release of] greenhouse gases from land-use change." To suggest anything *different*, as John Houghton and his climate-alarmist colleagues do when they promote the production of biofuels -- and to invoke *religion* as the basis for such actions -- is a perversion of both sound science *and* morality. Each domain needs the other to enable proper policy decisions to be made. In this particular case, sound science is required to determine what is moral, and morality is what we all hope would constitute the basis for our actions.

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Searchinger, T., Heimlich, R., Houghton, R.A., Dong, F., Elobeid, A., Fabiosa, J., Tokgoz, S., Hayes, D. and Yu, T.-H. 2008. Use of U.S. croplands for biofuels increases greenhouse gases through emissions from land-use change. *Science* **319**: 1238-1240.

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Biofuels – Summary
http://co2science.org/subject/b/summaries/biofuels.php

In a world where food is fast becoming scarce in many places, it seems strange indeed to use the planet's land and water resources for growing anything else, as we note in our critique of Sir John Houghton's *Creation Care Crusade*, which is described by Feder (2007). In this regard, for example, Johansson and Azar (2007) analyzed what they call the "food-fuel competition for bio-productive land" by developing "a long-term economic optimization model of the U.S. agricultural and energy system," wherein they find that *the competition for land to grow crops for both food and fuel production leads to a situation where "prices for all crops as well as animal products increase substantially*." In fact, in the May/June 2007 issue of *Foreign Affairs*, Runge and Senauer (2007) report that corn-based ethanol in the United States *already* "takes so much supply to keep ethanol production going that the price of corn -- and those of other food staples -- is shooting up around the world." And *to put the situation in a perspective all can readily appreciate, they write that "filling the 25-gallon tank of an SUV with pure ethanol requires over 450 pounds of corn -- which contains enough calories to feed one person for a year."*

What makes this situation even more disturbing is that not only do people (and especially *poor* people) suffer the adverse consequences of this perverse policy, so too does what we could call "wild nature" suffer, as it loses ever more habitat and freshwater resources to the great anthropogenic land-and-water grab needed to sustain the biofuels craze. In fact, even *without* the biofuels problem, Raven (2002) has indicated that "species-area relationships, taken worldwide in relation to habitat destruction, lead to projections of the loss of fully two-thirds of all species on earth by the end of this century."

Also concerned about the world of nature were Tilman *et al.* (2001), who noted that at the end of the 20th century mankind was already appropriating "more than a third of the production of terrestrial ecosystems and about half of usable freshwaters." Consequently, in order to meet the *doubled* global food demand they predict for the year 2050, mankind could well be appropriating more than *two thirds* of terrestrial ecosystem production, as well as *all of earth's remaining usable freshwater*, as has also been discussed by Wallace (2000). What is more, Tilman *et al.* conclude that "even the best available technologies, fully deployed, cannot prevent many of the forecasted problems," and the world's climate alarmists would make the problem *even worse* with their misguided biofuels program.

Additional light on this aspect of the subject has been provided by Righelato and Spracklen (2007), who also find that the use of biofuels for transport, particularly ethanol from the fermentation of carbohydrate crops as a substitute for petrol, and vegetable oils in place of diesel fuel, "would require very large areas of land in order to make a significant contribution to mitigation of fossil fuel emissions and would, directly or indirectly, put further pressure on natural forests and grasslands." As an example of this phenomenon, the *two UK researchers calculate that a 10% substitution of petrol and diesel fuel would require "43% and 38% of current cropland area in the United States and Europe, respectively," and that "even this low substitution level cannot be met from existing arable land," so that "forests and grasslands would need to be cleared to enable production of the energy crops."*

Adding insult to injury, Righelato and Spracklen hasten to add that the required land clearance would result in "the rapid oxidation of carbon stores in the vegetation and soil, creating a large up-front emissions cost that would, *in all cases examined* [our italics], *out-weigh the avoided emissions*." Furthermore, even *without* the large up-front carbon emissions, they report that individual life-cycle analyses of the conversion of sugar cane, of sugar beet, and of wheat and corn to ethanol, as well as the conversion of rapeseed and woody biomass to diesel, indicate that "forestation of an equivalent area of land would sequester *two to nine times* ***more*** *carbon* [our italics and boldface] over a 30-year period than the emissions avoided by the use of the biofuel." As a result, they rightly conclude that "*the emissions cost of liquid biofuels exceeds that of fossil fuels*."

Coming to much the same conclusion in a News & Views article in *Nature* was Laurance (2007), who discussed the ability of forests to reduce catastrophic flooding. In addition to this important virtue, he writes that "tropical forests, in particular, are crucial for combating global warming, because of their high capacity to store carbon and their ability to promote sunlight-reflecting clouds via large-scale evapotranspiration," noting that "such features are key reasons why preserving and restoring tropical forests could be a better strategy for mitigating the effects of carbon dioxide than dramatically expanding global biofuel production."

Another analysis of this aspect of the subject was provided by Bradshaw *et al.* (2007), who studied the effects of the presence and absence of forests on the propensity for flooding, using data collected from 56 developing countries for the period 1990-2000. Employing generalized linear and mixed-effects models, they demonstrated that "flood frequency is negatively correlated with the amount of remaining natural forest and positively correlated with natural forest area loss." Based on an arbitrary decrease in natural forest area of 10%, for example, they report that "the model-averaged prediction of flood frequency increased between 4% and 28% among the countries modeled," additionally noting that the "unabated loss of forests may increase or exacerbate the number of flood-related disasters, negatively impact millions of poor people, and inflict trillions of dollars in damage in disadvantaged economies over the coming decades."

So that is what the world will ultimately experience if the biofuels craze continues. But if biofuels are *not* promoted, and if the air's CO_2 content is allowed to *continue* to rise, we should see just the *opposite* trend; for not only would we *not* experience the increase in floods caused by forest area loss to biofuel production, we *would* experience the *decrease* in floods caused by forest area *increase* due to rising atmospheric CO_2 concentrations, as described in our many reviews of pertinent scientific papers that we have archived under the headings of Long-Term Studies (Woody Plants) and Range Expansion (Woody Plants) in our Subject Index.

In an important paper published on 1 August 2007 in *Atmospheric Chemistry and Physics Discussions*, Crutzen *et al.* (2007) examine the subject of biofuels from an entirely different perspective, calculating the amount of nitrous oxide (N_2O) that would be released to the atmosphere as a result of using nitrogen fertilizer to produce the crops used for biofuels, which analysis, in their words, "only considers the conversion of biomass to biofuel" and "does not take into account the use of fossil fuel on ... farms and for fertilizer and pesticide production." As they describe it, this work revealed that "all past studies have severely underestimated the release rates of N_2O to the atmosphere, with great potential impact on climate warming." And why would greater N_2O emission rates have a tendency to cause the climate to warm? Because, as they describe it, N_2O "is a 'greenhouse gas' with a 100-year average global warming potential 296 times larger than an equal mass of CO_2."

The ultimate consequence of this phenomenon, as best the four researchers could evaluate it, is that "when the extra N_2O emission from biofuel production is calculated in 'CO_2-equivalent' global warming terms, and compared with the quasi-cooling effect of 'saving' emissions of fossil fuel derived CO_2, the outcome is that the production of commonly used biofuels, such as biodiesel from rapeseed and bioethanol from corn (maize), can contribute as much or more to global warming by N_2O emissions than cooling by fossil fuel savings."

As a result of these observations, Crutzen *et al.* conclude that "on a globally averaged basis the use of agricultural crops for energy production can readily be detrimental for climate due to the accompanying N_2O emissions." In addition, they note that "increased emissions of N_2O will also lead to enhanced NO_X concentrations and ozone loss in the stratosphere." Taken together, they thus conclude that the relatively large emission of N_2O associated with biofuel production "*exacerbates* [our italics] the already huge challenge of getting global warming under control."

As if all of these problems associated with the biofuels craze were not enough, Lal (2007) describes yet another one. Singing the praises of *soil organic carbon*, he notes that it "improves soil structure and tilth, reduces soil erosion, increases plant available water capacity, stores plant nutrients, provides energy for soil fauna, purifies water, denatures pollutants, increases soil biodiversity, improves crop/biomass yields, and moderates climate," as well as being "essential to ending global hunger and malnutrition." On a *negative* note, however, he reports that most agricultural soils have lost 25-75% of their antecedent pools of soil organic carbon, and that we can't afford to lose any more. Unfortunately, this is precisely the juncture where the lust for biofuels rears its ugly head.

Because of all the problems associated with biofuel production that we have discussed above, some people are suggesting that we produce biofuels from crop residues, since this approach would not involve the use of additional land and it would focus on an agricultural "waste product." However, as Lal points out, crop residues are not exactly unwanted by-products of farming, as they perform many vital functions. He reports, for example, that "there are severe adverse impacts of residue removal on soil and environmental degradation, and negative carbon sequestration as is documented by the dwindling soil organic carbon reserves." And he further notes that "the severe and widespread problem of soil degradation, and the attendant agrarian stagnation/deceleration, are caused by indiscriminate removal of crop residues."

Clearly, as Lal continues, "short-term economic gains from using crop residues for biofuel must be objectively assessed in relation to adverse changes in soil quality, negative nutrients and carbon budget, accelerated erosion, increase in non-point source pollution, reduction in agronomic production, and decline in biodiversity." And when all of the many benefits of soil organic carbon are tallied, he concludes that "the depleted soil organic carbon pool must be restored, come what may."

We totally agree. We cannot afford to destroy the productive potential of the soil that sustains all of humanity *and nature as well* (by enabling us to grow most of our own food and thereby not taking what the rest of the biosphere needs in terms of land and water to sustain itself). Truly, Scharlemann and Laurance (2008) have appropriately labeled multibillion-dollar U.S. subsidies for certain biofuel enterprises a "perverse incentive" that will only add to mankind's and nature's many overwhelming problems.

In a lengthy discourse entitled "Energy, Food, and Land -- The Ecological Traps of Humankind," Haber (2007) enlarges on these concepts by noting that energy, food and land are the principal resources required by contemporary human societies, but that "the absolutely decisive resource in question is land, whose increasing scarcity is totally underrated."

Expanding on this theme, Haber writes that the *energy trap* is "formed by a quasi-return to renewable energy suppliers for which we need very vast, hardly available tracts of land," that the *food trap* is "formed by increased use and demand of arable and pasture land with suitable soils," and that the *land trap* is "formed by the need of land for urban-industrial uses, transport, material extraction, refuse deposition, but also for leisure, recreation, and nature conservation." *All* of these needs, as he continues, "compete for land," and *good soils*, as he adds, are becoming "scarcer than ever ... scarcer than coal, oil and uranium."

Haber also notes that "we are preoccupied with fighting climate change and loss of biodiversity," and he says that "these are minor problems we could adapt to, albeit painfully." In fact, he states that "their solution will *fail* [our italics] if we are caught in the interrelated traps of energy, food, and land scarcity," which are looming menacingly before us just a few short decades down the road.

"Land and soil," as Haber continues, "have to be conserved, maintained, cared for, [and] properly used, based on reliable ecological information and monitoring, planning and design." We agree; and we have reported, in this regard, that a *switch to biofuels* to help meet our energy needs will result in our taking unconscionable amounts of land and freshwater resources from nature to produce them, and that the simple task of *growing enough crops to meet the food needs of the world's population in the year 2050* will require our using so much more land than we do now, that the resulting loss of habitat will drive unnumbered species of plants and animals to *extinction*.

So what's the solution? As we have noted in many of our other writings on this question, it is to let the air's CO_2 content continue to climb as the world's scientists and engineers devise ways of meeting mankind's growing energy needs without usurping the remaining habitat of "wild nature." We say this because of two things. First, some of the world's most prominent ecologists have concluded that even with all agricultural advancements they can anticipate over the next few decades, we may still not be able to grow sufficient food to sustain the planet's human population without appropriating for this purpose vast amounts of land and water that are currently needed to support the other species with which we share the earth. Second, we have calculated (Idso and Idso, 2000) that the crop yield enhancements and water-use efficiency increases that should be caused by the expected increase in the atmosphere's CO_2 concentration between now and the year 2050 should be sufficient, but only barely, to enable us to grow the crops we will need at that time *on the lands* and *with the water* that we *currently* use for this purpose. If we are to prevent the extinctions of innumerable species of plants and animals that many see occurring only *half a human lifespan from now*, we must pursue a course of action that is congruent with the one we outline here.

In bringing this Summary to a close, we feel it important to recount some of the thoughts of Norman Borlaug, which were eloquently expressed in a recent *Science* editorial (Borlaug, 2007), wherein he begins his mini-treatise on "feeding a hungry world" by noting that "some 800 million people still experience chronic and transitory hunger each year," and that "over the next 50 years, we face the daunting job of feeding 3.5 billion additional people, most of whom will begin life in poverty."

Discussing a bit of history, the father of the Green Revolution recounts how "over a 40-year period, the proportion of hungry people in the world declined from about 60% in 1960 to 17% in 2000," primarily because of the effectiveness of the movement he was instrumental in initiating. Had that movement *failed*, he says that environmentally fragile land would have been needed to be brought into agricultural production, and the resulting "soil erosion, loss of forests and grasslands, reduction in biodiversity, and extinction of wildlife species would have been disastrous." And that same result is what awaits the world of tomorrow if the biofuels scheme of the world's climate alarmists is ever implemented to a significant degree.

Borlaug notes, for example, that "for the foreseeable future, plants -- especially the cereals -- will continue to supply much of our increased food demand, both for direct human consumption and as livestock feed to satisfy the rapidly growing demand for meat in the newly industrializing countries." In fact, he states that "the demand for cereals will probably grow by *50% over the next 20 years* [our italics], and even larger harvests will be needed if more grain is diverted to produce biofuels."

Noting that most food increases of the future "will have to come from lands *already in production* [our italics]," and that "70% of global water withdrawals are for irrigating agricultural lands," Borlaug's facts suggest that crop *water use efficiency* (biomass produced per unit of water used) will have to be increased dramatically if we are to meet humanity's food needs of the future without creating the disastrous consequences he outlines above; and it should be evident to all but those most blinded to the truth that this requirement can only be met if biofuels are *not* a part of the picture, while the aerial fertilization and anti-transpiration effects of atmospheric CO_2 enrichment *are*.

Although Borlaug notes that conventional plant breeding, improvements in crop management, tillage, fertilization, and weed and pest control, as well as genetic engineering, will help significantly in this regard, we will in all likelihood need the beneficial biological byproducts of concomitant increases in the atmosphere's CO_2 concentration *in addition*. Without them, to borrow a chilling phrase from Borlaug, "efforts to halt global poverty will grind to a halt," and, we might add, much of the world of nature will be no longer.

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New Evidence for a Planetary Temperature Regulator
http://co2science.org/articles/V11/N29/C1.php

Reference
Kleypas, J.A., Danabasoglu, G. and Lough, J.M. 2008. Potential role of the ocean thermostat in determining regional differences in coral reef bleaching events. *Geophysical Research Letters* **35**: 10.1029/2007GL032257.

What was done
The authors looked for evidence of an "ocean thermostat" by analyzing patterns of *sea surface temperature* (SST) increases in the tropics over the past five decades, focusing their attention on the *western Pacific warm pool* (WPWP), because, in their words, "this is a region where maximum SSTs are thought to be limited by negative feedbacks," as described in the writings of Reginald Newell (1979) -- who they cite -- and who in collaboration with Thomas Dopplick employed what he had learned of the subject to demonstrate -- *nearly three decades ago* -- that the degree of CO2-induced global warming predicted by the climate models of that day was far greater (and is greater still today) than what is allowed by the real world (Newell and Dopplick, 1979), as is further described in the historical narrative of Idso (1982).

What was learned
Kleypas *et al.* say their analysis indicates that "the warmest parts of the WPWP have warmed less than elsewhere in the tropical oceans," which fact "supports the existence of thermostat mechanisms that act to depress warming beyond certain temperature thresholds." In addition, they report that "coral reefs within or near the WPWP have had fewer reported bleaching events relative to reefs in other regions," which is also indicative of the existence of an upper-limiting temperature above which SSTs typically do not rise, presumably because of the "kicking-in" of the oceanic thermostat when they approach 30°C in the region the three researchers describe as "the center of coral reef biodiversity," which likely merits that description because of the effectiveness of the hypothesized thermostat.

What it means
These recent findings tend to support the thesis put forward years ago by both Newell and Dopplick (1979) and Idso (1980, 1982, 1989), i.e., that rather than the earth possessing some thermal "tipping point" above which global warming dramatically accelerates, the planet's climatic system is organized so as to do just the *opposite* and greatly *attenuate* warming above a certain level.

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Arctic and Antarctic Sea Ice Trends
http://co2science.org/articles/V11/N29/C2.php

Reference
Comiso, J.C. and Nishio, F. 2008. Trends in the sea ice cover using enhanced and compatible AMSR-E, SSM/I, and SMMR data. *Journal of Geophysical Research* **113**: 10.1029/2007JC004257.

What was done
Noting that earth's polar regions "are expected to provide early signals of a climate change primarily because of the 'ice-albedo feedback' which is associated with changes in absorption of solar energy due to changes in the area covered by the highly reflective sea ice," the authors set about to provide updated and improved estimates of trends in Arctic and Antarctic sea ice cover for the period extending from November 1978 to December 2006, based on data obtained from the Advanced Microwave Scanning Radiometer (AMSR-E), the Special Scanning Microwave Imager (SSM/I) and the Scanning Multichannel Microwave Radiometer (SMMR), where the data from the last two instruments were adjusted to be consistent with the AMSR-E data.

What was learned
Comiso and Nishio report that trends in sea ice extent and area in the Arctic over the period of their analysis were -3.4 ± 0.2 and -4.0 ± 0.2% per decade, respectively, while the corresponding trends in the Antarctic were +0.9 ± 0.2 and +1.7 ± 0.3% per decade.

What it means
If it indeed is true that earth's polar regions should "provide early signals of a climate change," it would appear that the Northern and Southern Hemispheres are scheduled to go their own separate ways in response to a continuation of whatever caused them to behave as they did over the past three decades, which climate alarmists claim were *increasing greenhouse gas concentrations*. But since we don't really know if *either* of these two assumptions is true, it is anyone's guess as to what *really* may lie in store for the planet, as the future gradually unfolds in the years and decades ahead.

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The Little Ice Age and Medieval Warm Period in the South Shetland Islands, Antarctica
http://co2science.org/articles/V11/N29/C3.php

Reference
Hall, B.L. 2007. Late-Holocene advance of the Collins Ice Cap, King George Island, South Shetland Islands. *The Holocene* **17**: 1253-1258.

What was done
The author presents "radiocarbon and geomorphologic data that constrain [the] late-Holocene extent of the Collins Ice Cap on Fildes Peninsula (King George Island, South Shetland Islands: 62°10'51"S, 58°54'13"W)," which, in her words, "yield information on times in the past when climate in the South Shetland Islands must have been as warm as or warmer than today," based on field mapping of moraines and glacial deposits adjacent to the ice cap, as well as radiocarbon dates of associated organic materials.

What was learned
Hall's data "indicate ice advance after ~650 cal. yr BP (AD ~1300)," which she notes is "broadly contemporaneous with the 'Little Ice Age', as defined in Europe." She also says that this was "the only advance that extended beyond the present ice margin in the last 3500 years, making the Little Ice Age in that part of the world likely the coldest period of the current interglacial. And the fact that "the present ice cap margin ... is still more extensive than it was prior to ~650 cal. yr BP" leads her to conclude that the climate prior to that time -- which would have comprised the Medieval Warm Period -- may have been "as warm as or warmer than present."

What it means
These several observations help to demonstrate the worldwide nature of the millennial-scale oscillation of climate that alternately brings the planet century-scale warm and cold periods *independently of any variations in atmospheric CO2 concentration*, which suggests there is no need to invoke the historical rise in the air's CO2 content as the cause of the Little Ice Age-to-Current Warm Period transition, as it is likely nothing more than the natural continuation of this age-old cycle of climate.

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Marine Ecosystem Response to "Ocean Acidification" Due to Atmospheric CO2 Enrichment
http://co2science.org/articles/V11/N29/B2.php

Reference
Vogt, M., Steinke, M., Turner, S., Paulino, A., Meyerhofer, M., Riebesell, U., LeQuere, C. and Liss, P. 2008. Dynamics of dimethylsulphoniopropionate and dimethylsulphide under different CO2 concentrations during a mesocosm experiment. *Biogeosciences* **5**: 407-419.

Background
The authors write that "ocean acidification is one of the effects of increased anthropogenic CO2," that "oceanic DMS [dimethylsulphide] production is a result of complex interactions within the marine food-web," and that "ocean acidification may affect DMS concentrations and fluxes by altering one or more of the various pathways or impacting some of the species involved," with the

reason for concern being the fact that the particulate atmospheric oxidation products of DMS can act as cloud condensation nuclei and lead to the creation of more numerous and more reflective clouds that can cool the planet by reflecting more incoming solar radiation back to space, which would tend to mute the greenhouse effect of rising atmospheric CO_2 concentrations and keep the planet from getting too warm.

What was done

Effects of atmospheric CO_2 enrichment on various marine microorganisms and DMS production were studied in nine marine mesocosms maintained within 2-meter-diameter polyethylene bags submerged to a depth of ten meters in a fjord adjacent to the Large-Scale Facilities of the Biological Station of the University of Bergen in Espegrend, Norway. Three of the mesocosms were maintained at ambient levels of CO_2 (~375 ppm), three were maintained at levels expected to prevail at the end of the current century (760 ppm or 2x CO_2), and three were maintained at levels predicted for the middle of the next century (1150 ppm or 3x CO_2), while measurements of numerous ecosystem parameters were made over a period of 24 days.

What was learned

Vogt *et al.* report that they detected no significant phytoplankton species shifts between treatments, and that "the ecosystem composition, bacterial and phytoplankton abundances and productivity, grazing rates and total grazer abundance and reproduction were not significantly affected by CO_2 induced effects," citing in support of this statement the work of Riebesell *et al.* (2007), Riebesell *et al.* (2008), Egge *et al.* (2007), Paulino *et al.* (2007), Larsen *et al.* (2007), Suffrian *et al.* (2008) and Carotenuto *et al.* (2007). In addition, they say that "while DMS stayed elevated in the treatments with elevated CO_2, we observed a steep decline in DMS concentration in the treatment with low CO_2," i.e., the *ambient* CO_2 treatment.

What it means

With respect to their many findings, the eight researchers say their observations suggest that "the system under study was surprisingly resilient to abrupt and large pH changes," which is just the *opposite* of what the world's climate alarmists characteristically predict about CO_2-induced "ocean acidification." And that may be why Vogt *et al.* described the marine ecosystem they studied as "surprisingly resilient" to such change: it may have been a little unexpected.

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