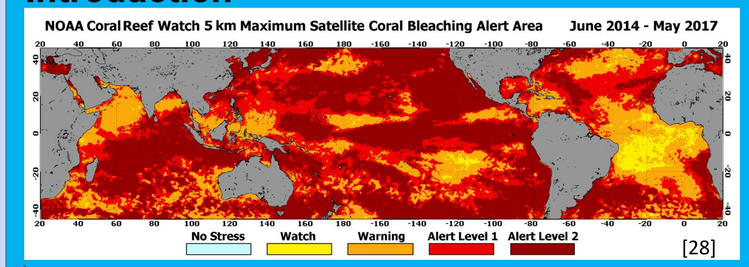
bleached white coral[14]

Saving The Corals

Introduction



[28]

- Corals occupy <0.1% of the sea floor, yet support ~25% of earth's marine species. [1]
- They provide coastal protection, food (e.g. fish) and personal income by way of fishing and tourism.[1]
- However, coral 'bleaching' (the paling of corals due to the separation of corals and their algal endosymbionts following exposure to environmental stress like global warming, acidification, pollution[2]) degrade coral reef[1]

Solution 1: Propagation Of Corals

Direct transplantation: Transplanting coral colonies or fragments without intermediate nursery phase

It involves the direct transplantation of coral fragments,from donor to recipient reef.It is used to salvage corals from poor conditions that may destroy or disturb the colonies[3]

Coral gardening :Transplanting coral fragments after an intermediate nursery phase

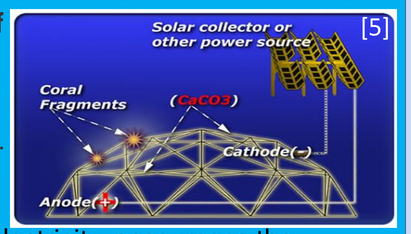
Coral fragments are raised in nurseries before outplanting on restoration sites. [3] Nursery protects corals from damaging conditions during their most vulnerable stages.[4]

coral fragments are cut → raised in nurseries → trasplanted to restoration sites

Solution 2:Substratum enhancement methods

Substratum addition—Artificial reef
Adding artificial structures for purposes of coral reef restoration

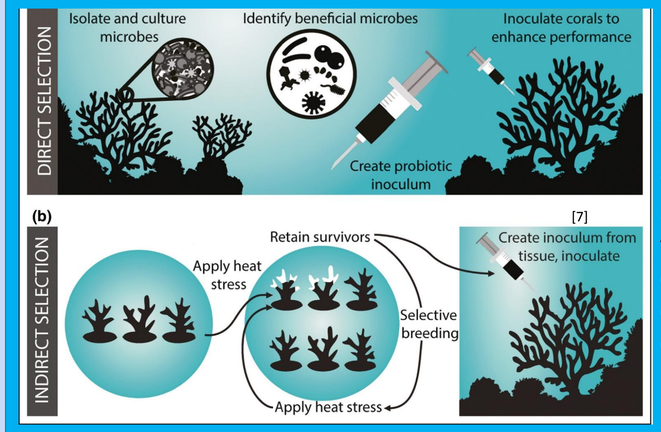
Substratum mimic characteristics of a natural reef. it increases potential habitat for reef fauna.[3]



[5]

Substratum enhancement with electricity encourages the precipitation of calcium and magnesium on artificial substrata[6],which increase the calcification of coral polyps, boosting colony growth and resilience to stressors.[3]

Solution 3:Microbiome engineering



Probiotics

Probiotics (Beneficial bacteria)are suggested as a rapid (day to weeks) natural strategy for corals to adapt to changing environmental conditions.[1]

beneficial bacteria	bacteria from the coral Acropora palmata[1]	oil-degrading consortium composed of 10 bacteria like Bacillus rigui [1]
Problem	Serratia marcescens forms a biofilm and disrupt the normal mucus layer on corals leading to the disease 'white pox"	oil spills
Use of the bacteria	Produce anti-bacterial chemicals against Serratia marcescens	accelerated the degradation of petroleum hydrocarbons

examples of usage of probiotics

Genetic Engineering

The use of CRISPR technology(DNA technology)to generate mutations in corals can reveal many aspects of coral biology and, guide conservation efforts. For example, there is a reduced thermal tolerance in a coral carrying CRISPR-induced mutations in the gene. This shows that HSF1 (Heat Shock Factor 1)gene function is required for the normal heat tolerance of coral larvae. It is achieved by microinjection of sgRNA/Cas9 complexes into fertilized coral egg[8]

Comparison

	Direct Transpl-antation	Coral Gardening	Artificial Reef (substrate additon)	Probiotics for corals	Genetic Engineering
Effectivene-ss/ %survival [3]	64%	66%	>75%	about 90.9% survival rates when inoculated with C. goreaui and exposed to heat[7]	>90% of the mutated gene copies are obtained when HSF1 is targeted[8]
cost[3][9]	cheapest	cheap	a bit expensive	expensive	expensive
Usage	most common	common	common	not common	not common

Discussions

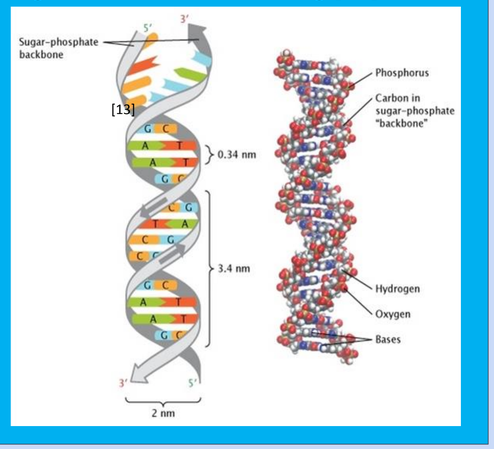
- these methods can be used together
- Microbiome engineering are the **newest** technology. It is still developing, uncommon, and the cost is **expensive.**
- However, they are much more **effective** than the traditional methods like direct transplantation.
- With **probiotics**, corals can adapt to changing environment, and there is no need to change the environment for them.
- For **genetic engineering**, it can increase our understanding about corals, thus help us to improve and think of more innovative new solutions.
- When the technology become more advanced, one day they will be **common** and **cheap** methods.

Future Developments and challenges

'Super Corals'

It is hoped that **genetically engineered corals** that are resistant against undesirable environment can be developed, not only for the understanding of corals, but also grown with other corals as direct mitigation to coral bleaching.[11]

However, it is controversial as some people fear that these super corals may have a competitive advantage over the normal ones and **dominate the reef ecosystem**. [12]



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