Coral Reefs -- Rainforests of the Sea?

A Coral-List Server Discussion Thread

This message was posted to the Coral List Server by John Ware, starting an interesting discussion. All of the messages posted thus far concerning this discussion are posted below. This page will be updated as more messages are posted. Some of the writers included a previous posting in their message. For simplicity, the included messages have been replaced by a link to the previous message that was quoted. If you follow that link, moving back in your browser should bring you back to your original position. This should continue to work even if you download the document to your machine. If you have any difficulties navigating this document, send a message to the CHAMP WebMaster.

From: John Ware [jware@erols.com]
Sent: Thursday, May 25, 2000 2:21 PM
To: coral-list@coral.aoml.noaa.gov
Subject: Rain forests of the sea??

Dear Coral List,

One of Jim Hendee's recent messages reminded me that one of the legitimate items for the coral list is "controversial topics in coral reef ecology".

I am not sure that this is a 'controversial topic', but the coral list has been pretty quiet lately. Are coral reefs really analogous to rain forests or is the coral reef community just taking advantage of a catchy 'sound bite' to gain status in the eyes of the ecologically minded public?

There are certainly some similarities, but I have often thought that the differences are large also. Anybody care to share their thoughts on this topic with the list??

John

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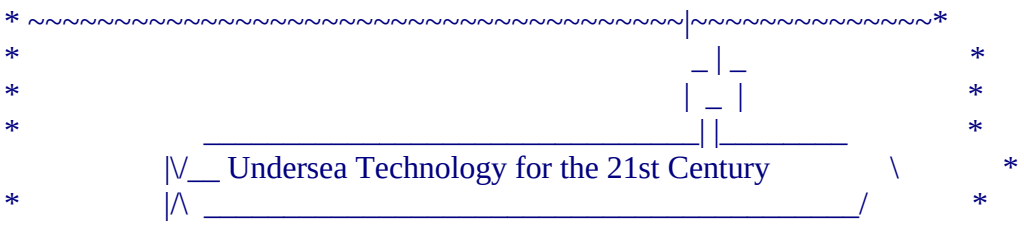

From: Don McAllister[mcall@superaje.com]
Sent: Thursday, May 25, 2000 4:02 PM
To: John Ware
Cc: coral-list@coral.aoml.noaa.gov; Callum Roberts
Subject: Re: Rain forests of the sea??

John Ware wrote:

>
> I am not sure that this is a 'controversial topic', but the
> coral list has been pretty quiet lately. Are coral reefs really
> analogous to rain forests or is the coral reef community just taking
> advantage of a catchy 'sound bite' to gain status in the eyes of the
> ecologically minded public?

I think the conservation community, including myself (!) has taken advantage of this analogy, although really coral reefs stand on their own tentacles. However, work of the IUCN SSC Coral Reef Fish Specialist Group suggests that about 25% of marine fish species are found on coral reefs. That's a pretty high level, given that coral reefs occupy less than 1% of the World Ocean, some 230,000 km2 according to a recent estimate. Hopefully Callum Roberts and Julie Hawkins will publish this year their fabulous species density maps for coral reef fishes of the world that will show the global hotspots for these fishes.

Marjorie L. Reaka-Kudla in Biodiversity II, however comes up with a better broad answer. She estimates that over 900,000 species (plants, animals, microbiota) inhabit coral reefs.

Another answer can be provided by a scuba/snorkel transect across a reef and into adjacent sandy areas. Lots of species in the first, few in the second.

But it isn't just a tropical affair (:-->), Norwegian studies show 300 species in deepwater coral 'reef' areas off their coasts. We haven't studied such areas thoroughly enough elsewhere to be sure of countes. But mapping deepwater corals off the West Coast of Canada, shows they are much more frequent there than had been hithertoo suspected and the available clues suggest a rich variety of biota. This would suggest that it is the

three-dimensional structural diversity in the tropics and boreal zones which provides shelter and food, that intensifies biodiversity.

don
Don McAllister

From: Bob Steneck[Steneck@maine.maine.edu]
Sent: Thursday, May 25, 2000 6:38 PM
To: John Ware; coral-list@coral.aoml.noaa.gov
Subject: Re: Rain forests of the sea??

Coral folk,

It's all relative but both rainforests and coral reefs are unique and probably worthy of the sound-bite analogy. Both concentrate diversity, have complex habitat architecture and are highly productive (high gross productivity). Species richness and canopy heights are greater in rainforests, gross productivity is greater on reefs. Taxonomic composition differs significantly. In rain forests most species are insects, angiosperms and birds. Reefs have no marine insects, hardly any angiosperms and certainly no birds. However, reefs have much greater higher-order diversity (e.g., number of phyla). While there is a wider phyletic range of primary producers (endosymbionts, plankton and multiple phyla of benthic algae) the within group diversity for each is relatively low. For example, species richness in algae is much lower than that for angiosperms, reef fish are less diverse than rainforest birds. There are low diversity reefs (e.g., Clipperton in the eastern Pacific, Abrolhos off Brazil and Hawaii) that have many of the same zones, groups and ecosystem function of high diversity reefs. I don't know of low diversity rainforests - this may reveal my ignorance.

Coral reefs may be most unique because of their role in producing calcium carbonate bioherms (reef rock). In a relatively short period of time, say 500 or 1000 years, they can significantly change their physical environment as they grow to and reach sea level.

Finally, both ecosystems are globally threatened. Would it be useful to consider the rates of change in these two ecosystems? Reefs in the Caribbean have lost much of their largest framework building corals (the acroporids). Are there rainforest analogs? Are the two systems equally resilient to perturbations?

Just some food for thought.

Cheers,

Bob Steneck

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From: Rick Grigg[rgrigg@iniki.soest.hawaii.edu]
Sent: Thursday, May 25, 2000 8:41 PM
To: Bob Steneck; John Ware; coral-list@coral.aoml.noaa.gov
Subject: Re: Rain forests of the sea??

Dear John,

Perhaps a perspective might be gained by turning the analogy around. Rain forests are the "coral reefs of the land".

Not even, as they say in Hawaiian these days.

Rick Grigg
University of Hawaii

From: Osha Gray Davidson[osha@pobox.com]
Sent: Thursday, May 25, 2000 9:56 PM
To: Rick Grigg; Bob Steneck; John Ware; coral-list@coral.aoml.noaa.gov
Subject: Re: Rain forests of the sea??

Hey, Rick, if you're going to quote from my book, the least you could do is give the proper citation (The Enchanted Braid, p. 6.) ;->
Osha

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Note: *Davidson had Grigg's whole message in his original message. Rick Grigg's message is already displayed above.*

From: Gould, Rob[Rob.Gould@itn.co.uk]
Sent: Friday, May 26, 2000 4:30 AM
To: 'coral-list@coral.aoml.noaa.gov'
Subject: Re: rainforests of the sea/raising awareness

Coral people,

I was interested by the recent comparison between reefs and rainforests. I'm producing a documentary for Discovery Channel on the marine research in the Mascarene area of the Indian Ocean. Coral reefs clearly play an important part in the ecology here and these reefs suffered particularly badly in the 1998 bleaching event. The idea that coral reefs are analogous to rainforests is one I've heard and was planning to use as one of the themes in the programme.

One reason for linking the two ecosystems, from my point of view, is the hope that it will raise public awareness of the importance of coral reefs in the way that the destruction of the rainforests became popular cause in the final decades of the last century.

I am structuring the programme at the moment so any thoughts from you, the experts, would be greatly appreciated. Any information about possible implications of reef destruction and, of course, the positive contributions coral reefs make to the wider environment are particularly welcome.

Your knowledge on this subject is obviously far greater than mine so I would very much appreciate any help or ideas.

Many thanks,

Rob Gould

rob.gould@itn.co.uk

From: Don McAllister[mcall@superaje.com]

Sent: Friday, May 26, 2000 10:06 AM
To: coral-list@coral.aoml.noaa.gov
Subject: Re: Rain forests of the sea??

Bob Steneck wrote:
However, reefs have much greater higher-order diversity (e.g., number of phyla).

You could say that rainforest diversity is based mosly on beetles!

:=>

don
Don McAllister

From: Dricot-Fellenius[karlf@sfu.ca]
Sent: Friday, May 26, 2000 4:23 PM
To: Gould, Rob
Cc: 'coral-list@coral.aoml.noaa.gov'
Subject: Re: rainforests of the sea/raising awareness

Rob,

I am on this listserver to gain knowledge about coral reefs that can be used in the management of coastal and marine tourism. As such, I can appreciate the analogy between rain forests and coral reef environments from a tourism perspective. While tourism is more prevalent in reef environments, ecotourism tends to have more success in rain forests. In accordance with ecotourism principles, the conservation ethic by tourism operators and the extent of local benefit from the operation are two themes that could be elaborated upon in your programme.

There are a number of sites that can be referenced for this kind of info:

http://www2.planeta.com/mader/planeta/0295/0295shores.html
The Challenge of Ecotourism

http://ecotourism.homepage.com/definitions.htm
Dealing with Definitions - John Shores

http://www.gorp.com/gorp/features/misc/ecotour.htm
Principles of Ecotourism - GORP

http://www.green-travel.com/gtdef.htm
Toward Definition

http://www2.planeta.com/mader/ecotravel/tour/definitions.html
Definitions - Ron Mader/Planeta.com

http://www2.planeta.com/mader/ecotravel/tour/latam.html
Latin American Ecotourism - What is it?

http://www2.planeta.com/mader/planeta/1196/1196agents.html
Evaluating Ecotourism Operators and Agents

regards,

karl

"Gould, Rob" wrote:

> I am structuring the programme at the moment so any thoughts from you, the
> experts, would be greatly appreciated. Any information about possible
> implications of reef destruction and, of course, the positive contributions
> coral reefs make to the wider environment are particularly welcome.
>
> Your knowledge on this subject is obviously far greater than mine so I would
> very much appreciate any help or ideas.

--
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karlf@sfu.ca

From: Gregor Hodgson[gregorh@pacific.net.hk]
Sent: Saturday, May 27, 2000 5:19 AM
To: Gould, Rob
Cc: coral-list@coral.aoml.noaa.gov
Subject: Why is it useful to compare rainforests and reefs?

Extending poetic license to ecology, we have used the phrase "coral reefs are the rainforests of the sea" in Reef Check's published and website PR and media materials since 1996, so have probably helped to spread this useful ecological falsehood far and wide. I don't know where the phrase was first used (and I would be interested to find out), but we found it very valuable to convey in a nutshell many of the conservation related ideas already noted by others.

The fundamental message that this phrase carries to the general public is that coral reefs, like rainforests:
1) have a high biodiversity

2) are suffering heavy human impacts
3) deserve protection/conservation.

The public and media have already been through a long learning curve regarding the "save the rainforests" campaign and it is a useful analogy primarily in this sense. However, I have seen some fellow ecologists wince when they hear it.

To add to Bob's ecological comments, I would also note that a major difference between the two ecosystems is that many rainforest organisms such as insects, birds, and mammals are herbivores and EAT the major structural component of a rainforest --- trees (leaves, flowers, fruit etc), whereas, there are few coral reef organisms which directly consume corals. Fish are not insects and corals are not trees.

GH
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From: Brylske@aol.com
Sent: Saturday, May 27, 2000 10:20 AM
To: coral-list@coral.aoml.noaa.gov
Subject: reefs and rainforests

I've been watching this threat with a great deal of interest, given the nature of my own research as a marine educator. For the past two years I've been studying the role of analogies in human learning, and specially how analogy-based instructional strategies can be used in the acquisition of scientific concepts.

Currently, I'm finishing my dissertation entitled, "The Effects of Analogy-Based Instruction on Concept Learning and Retention in a Non-Formal Coral Reef Ecology Program." My research supports the idea that analogies are powerful instructional tools, particularly with low-ability learners or those with minimal background/experience in the subject area. While my project involved the often-used "coral reef as a city" analogy, there's no reason to believe that the rain forest concept wouldn't be just as effective. If, in fact, you'd like a wonderful example of the reef/rain forest analogy, take a look at Dave Gulko's outstanding book, Hawaiian Coral Reef Ecology (pp. 136-137).

My experience is that scientists often ignore or shy away from the vital role

of communicating their research to any audience except their peers; and I'm very pleased to see educational issues addressed in this forum. I welcome any comments of questions in this regard.

Alex Brylske

From: Brylske@aol.com
Sent: Saturday, May 27, 2000 10:30 AM
To: gregorh@pacific.net.hk; coral-list@coral.aoml.noaa.gov
Subject: Re: Why is it useful to compare rainforests and reefs?

In a message dated 5/27/00 5:41:16 AM, gregorh@pacific.net.hk writes:

<< to add to Bob's ecological comments, I would also note that a major difference
between the two ecosystems is that many rainforest organisms such as insects, birds, and mammals are herbivores and EAT the major structural component of a rainforest --- trees (leaves, flowers, fruit etc), whereas, there are few coral
reef organisms which directly consume corals. Fish are not insects and corals are not trees. >>

This is a very important issue. When not used appropriately, analogies are prone to cause misconceptions among learners. Those who have studied the phenomenon--and developed prescriptive procedures for analogy-based instruction--all emphasize that, as part of the strategy, the learner must be told where the analogy BREAKS DOWN as well as where it applies. My definition, an analogy is something similar, not exactly the same as something else.

Alex Brylske

From: Ursula Keuper-Bennett[howzit@turtles.org]
Sent: Saturday, May 27, 2000 1:45 PM
To: Brylske@aol.com; gregorh@pacific.net.hk; coral-list@coral.aoml.noaa.gov
Subject: Re: Why is it useful to compare rainforests and reefs?

Hi Alex (others)

re: "coral reef as a city" analogy vs "coral reef as a rain forest".

I've never heard the coral reef/city analogy before but I guess most people know more about a city than a rain forest so educators would go with what

most people know. I can certainly SEE similarities once I get past the huge hurdle that "city" is a human construct and rainforest/coralreef both natural treasures are threatened BY human constructs.

Let's see... similarities.... a city is run by movers-and-shakers and there sure are movers-and-shakers on any coral reef making everything else run. There's all kinds of interdependency and huge changes in activity between day and night. Scavengers and parasites make do as they can... Anyone being in the wrong place at the wrong time and they won't repeat that mistake.

Yes, I can see the analogy.

I still like the coral reef as rainforest analogy better. Never experienced a rain forest --only what I've seen on TV or read about. But a rainforest sure "feels" like a coral reef. Both are 3D worlds with a lot of up and down.

I've shot videotape of a reef system off the coast of West Maui from 1989 through 1999 and for various reasons, need to return to those tapes frequently. As I fast forward one thing strikes me.

It's possible to forget the footage is underwater especially when reviewing wide-angle/distant segments. And when that happens what I don't see a reef system but something that looks for all the world like a furrowed meadow with swarms of bees buzzing about.

I'm fortunate to spend two months on the same coral reef every year. I've frequently found myself forgetting I'm underwater. Very easy to do. And then the corals feel like trees, bushes and hedges, the fish like butterflies and bees and the turtles --our beautiful turtles, FLY like birds.

And here's where our reef is also like a rainforest. Sometimes we just see everything mobile DASH to the bottom hugging the corals. ZING --like that. And we look around knowing something big scared the lot of them. The "insects" fled to the safety of the "trees". I'm sure when BIG shows in a rainforest, small flees to the trees too.

The analogy DOES break down though no question. If a coral reef resident falls off a coral head (even a huge TALL one) gravity is much more forgiving than it is for rainforest trees (even a small short one).

Ursula Keuper-Bennett
TURTLE TRAX
http://www.turtles.org

Note: *Keuper-Bennett had* Brylske*'s message in his original message.* Brylske*'s message appears above.*

From: Robyn Cumming[Robyn.Cumming@usp.ac.fj]
Sent: Sunday, May 28, 2000 10:01 PM
To: coral-list@coral.aoml.noaa.gov
Subject: Re: Why is it useful to compare rainforests and reefs?

Hi Coral-listers

Since we are discussing similarities between rainforests and reefs I think it is worth pointing out a number of parallels in terms of predation on the main habitat builders – trees and reef-building corals.

A large number of species prey directly on reef-building corals, including echinoderms, gastropods, crustaceans, polychaetes and fish (see for example Robertson 1970, Pacific Science 24:43). In both systems, these predators are grazers which normally injure rather than kill their prey. This opens up possibilities for complex behavioural and defensive responses of the prey. For many of them, with the notable exception of some vertebrates, the prey also provides substrate and protection.

In at least one case, the amount of prey standing crop removed annually parallels that of insect herbivores (2-12% by the gastropods Drupella {my data – unpublished}). I will go further to suggest that the ecological role of Drupella in coral reefs parallels that of insects in terrestrial forests, in that they exert a continual drain on energetic resources of their hosts.

Also, some species undergo population outbreaks like those of insect herbivores: Acanthaster planci, Drupella cornus, Drupella fragum.

Robyn

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From: Mohan, Pete[Pete.Mohan@seaworld.com]
Sent: Monday, May 29, 2000 9:20 AM
To: 'Coral Health Server Posting List'
Subject: RE: rainforests of the sea/raising awareness

I used the "Rainforests of the Sea" theme for a short video I just completed that accompanies our living coral exhibits here at SeaWorld Cleveland. I felt that public perception of rainforests is often limited to the idea that they are complex tropical systems that are endangered. At this rather simplistic level the analogy works.

Pete Mohan
Curator/Fishes

From: Robert van Woesik [b984138@sci.u-ryukyu.ac.jp]
Sent: Monday, May 29, 2000 8:31 PM
To: coral-list@coral.aoml.noaa.gov
Subject: reefs and rain forests
RE: Coral reefs and Rain forests

A similarity in diversity maybe the only thing that coral reefs and rain forests have in common; let us not forget Steele's classic paper in 1985 (Steele, J.H. (1985) A comparison of terrestrial and marine systems. Nature 313, 355-358).

Plant communities appear limited by dispersal in both temperate (Tilman's many references) and tropical regions (Hubbell S.P., Foster, R.B., O'Brien, S.T., Harms, K.E., Condit, R., Wechsler, B., Wright, S.J. and Loo de Lao, S. (1999) Light-gap disturbances, recruitment limitation, and tree diversity in a neotropical forest. Science 283, 554-557), where seed shortages keep diversity high and gaps may be occupied at random. Hubbell et al. (1999, p. 557) state "...sites [in a tropical moist forest] are won by 'default' by species that are not the absolutely best competitor for the site". However, in the tropical marine environment 'seed' dispersal does not appear to be a problem, as broadcast spawning ensures widespread dispersal of coral larvae. Many coral communities show no sign of recruitment limitation (except maybe very isolated reefs). Steele (1985) suggested a combination of an immense annual larval production in the oceans with extensive larval dispersal might be a reflection of the dampened short-term environmental variability of that environment. On the other hand, organisms in the terrestrial system must cope with more short-term variability and hence display more restricted dispersal mechanisms than oceanic organisms. A means to the same end (i.e., high diversity) differs between tropical terrestrial and tropical marine systems, the former most likely being dispersal assembled and the latter by some other mechanism(s). Yet, it is hardly surprising that the mechanisms causing high diversity on the land may differ from those in the sea. The environmental variability, for example

temperature, in terrestrial systems is large in both the short and long-term, but the oceans have a smaller amplitude of variability in the short term (Steele 1985); variations to this variability will be more detrimetal to organisms in the marine environment than to terrestrial organisms (e.g., the 1998 high SST and consequent coral bleaching), because marine organisms are adapted to small physico-chemical variability. Caution is necessary if we continue to compare the two systems (i.e., coral reefs and rain forests) as similar systems when in fact the processes that shape the systems are completely different.

Rob van Woesik

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From: Fredrik Moberg [fredrikm@system.ecology.su.se]
Sent: Tuesday, May 30, 2000 5:49 AM
To: coral-list@coral.aoml.noaa.gov
Subject: Re: Rain forests of the sea??

In the latest issue of the journal of the Royal Swedish Academy of Sciences (Ambio) there is an article by Ariel Lugo, Caroline Rogers and Scott Nixon (see abstract below). It deals with the resistance, ruin and recovery of rainforests and coral reefs in the Caribbean.

It also includes a list of the similarities and contrasts between reefs and rainforests.

Hurricanes, coral reefs and rainforests: Resistance, ruin and recovery in the Caribbean

Lugo AE, Rogers C, Nixon S

AMBIO 29: (2) 106-114, MAR 2000

Abstract:

The coexistence of hurricanes, coral reefs, and rainforests in the Caribbean demonstrates that highly structured ecosystems with great diversity can flourish in spite of recurring exposure to intense destructive energy. Coral reefs develop in response to wave energy and resist hurricanes largely by virtue of their structural strength. Limited fetch also protects some reefs from fully developed hurricane waves. While storms may produce dramatic local reef damage, they appear to have little impact on the ability of coral reefs to provide food or habitat for fish and other animals. Rainforests experience an enormous increase in wind energy during hurricanes with dramatic structural changes in the vegetation. The resulting changes in forest microclimate are larger than those on reefs and the loss of fruit, leaves, cover, and microclimate has a great impact on animal populations. Recovery of many aspects of rainforest structure and function is rapid, though there may be long-term changes in species composition. While resistance and repair have maintained reefs and rainforests in the past, human impacts may threaten their ability to survive.

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e-mail: fredrikm@system.ecology.su.se

From: Les Kaufman[lesk@bio.bu.edu]
Sent: Tuesday, May 30, 2000 9:05 AM
To: Robert van Woesik
Cc: coral-list@coral.aoml.noaa.gov
Subject: Re: reefs and rain forests

The spatial dynamics of larval delivery make local supply a determining factor even when net larval numbers are astronomically high. This is one contributor to spatial heterogeneity and "storage effects" on reefs.

Les Kaufman
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Woesik

Note: *Kaufman's message is in response to Woesik's message displayed above.*

From: Brice Quenoville[quenovib@naos.si.edu]
Sent: Tuesday, May 30, 2000 10:02 AM
To: coral-list@coral.aoml.noaa.gov
Subject: coral reefs/plants

Hi,

Talking about comparing terrestrial and marine life, marine life is =
evolving in three dimensions: latitude, longitude and also vertically. =
Plancton is very common in the marine realm, as a way of life or as a way =
of dispersion and most organisms have at least part of their life as a =
planctonic entity. Now looking at terrestrial life only plants do really =
compare with marine organisms by using a planctonic way or at least an =
"aerial" way of dispersion. Such convergence of behaviour could have =
eventually created similarities in species diversity and occurence. I =
don't know enough about all this but coral reefs could then be compared =
to tropical vegetation because of similar latitude/longitude distribution =
and maybe such comparisons could also be done for marine life/plants at =
different latitude/longitude. Recent molecular studies tend to show a =
higher level of population structure and divergence in marine organisms =
than previously expected and plants can also be highly structured and =
diversed on relatively short distances or short heigth. Hybridization, =
polyploidy, variation in the number of chromosomes is very commonly =
recognized in plants and start to be more and more reported or suspected =
for marine life.=20

Anyway, it's lunch time and my food is not drifting in the air...

brice

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lasted updated 06/01/00
by Monika Gurnée
CHAMP Webmaster