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Interview with Yossi Loya (Aug. 2018)

Which coral reef of the world is your favorite one and why?

Clearly the coral reefs of Eilat, where I have carried out most of my research for the last 50 years. I have been privileged to dive in many exciting reefs around the world, but in terms of spectacular beauty and color, the coral reefs of the Sinai and the southern Red Sea are definitely my favorites. As an example, I note one specific reef, along the arid shorelines of the Sinai, south of Sharm El Sheikh, Egypt. While on a field trip with my students we encountered a huge sand dune that is partially covered by the sea. Out of sheer curiosity, we decided to dive there. Typical of the Red Sea, the water was crystal clear, enabling us to see to a depth of at least 50 m. The yellow sand of the dune shining against the background of the blue water covered the reef down to ca. 20 m depth and from there on there was a straight 90 degrees drop to a wall covered with a high diversity of stony corals, colorful gorgonians and sponges and, darting among them, literally millions of colorful reef fishes. It was a stunningly breathtaking site, the most amazing reef I have ever encountered.

What has been your most exciting underwater experience?

By far my most exciting underwater experience was back in 1973, when I was sharing an underwater habitat for two weeks with four other scientists I had not met before, at Mayaguez, Puerto Rico, at 20 m depth, ca. four miles from the shore. This was a unique social and scientific experience. We felt as though we were in space, isolated from the rest of the world, eating, sleeping and working under an air pressure of three atmospheres. While in the habitat we were continuously observed through a closed-circuit video system. A diving physician visited us daily, checking our health. The extreme social interactions that took place during our mission are in themselves a subject for a whole book. It was an unbelievable experience. However, more important was the opportunity to work in deep parts of the reef at 30 to 60 m depth, unrestricted by time, as decompression took place automatically when we entered the habitat. We worked underwater on our different research projects for an average of 10 hours a day. I myself studied the effect of sedimentation on corals. In calculating the time needed to do the same work at these depths by means of conventional diving, it would have taken us almost a year of daily dives.

Which coral reef is the one you wish you would have studied more? Why?

Over the past two decades, I have been visiting on and off during the summer, the coral reefs of Okinawa, working on two major projects: The coral community structure in shallow water and the surprising phenomenon of sex change in fungiid corals that my Japanese colleague K. Sakai and I discovered for the first time in corals. In fact, I consider this discovery among my most important contributions to our knowledge of the biology and ecology of corals. My studies with my friend and colleague Rob van Woesik and several Japanese colleagues on the coral community structure of Okinawan reefs pre and post the devastating 1998 bleaching event,

yielded one of our most cited papers: "Coral bleaching : the winners and the losers" (Ecology Letters, 2001). We published a subsequent paper: "Revisiting the winners and the losers a decade after coral bleaching" and I very much wish we could also have done so two decades after the original study.

What are the most important threats coral reefs around the globe are confronted with?

The most devastating bleaching events experienced recently is in the Great Barrier Reef of Australia, as well as past catastrophic bleaching events in the wide Pacific Ocean and the Caribbean Sea, causing mass mortality of corals, seeing increases in sea-water temperatures resulting from global climate change. This is the most important threat to the long-term well-being of coral reefs around the world. Increasing number of studies done in different geographical areas point out the bleak future of coral reefs, estimating that 30% of the reefs on a global scale are already seriously damaged and 60% could disappear by 2030 if remedial measures are not taken, due to the negative impacts caused by human activities. Moreover, recent studies warn that at current rates, the combined effects of rising temperatures and ocean acidification could increase the frequency of bleaching events and reduce coral calcification by 80% of modern values when atmospheric CO2 concentrations reach 560 ppm around 2055. That is, acidification-induced reductions in calcification are projected to shift coral reefs from a state of net accretion to one of net dissolution this century. Nevertheless, we cannot ignore a suite of other anthropogenic, harmful effects that are escalating the degradation of coral-reef ecosystems, including: overfishing, destructive fishing practices, coastal urban development and deforestation, eutrophication from agriculture and sewage, pollution (oil, herbicides and pesticides), mining, and diseases (which are currently poorly understood and assessed). The multiple nature of stressors on reefs associated with climate change is unprecedented in human history and studies of its synergisms are still in their infancy. It is however, probable that the consequences of synergistic multiple impacts will be far more severe than that indicated from studies of individual stressors.

What would be the most effective and pragmatic means for protecting coral reefs?

Unfortunately, I am doubtful if there is an easy and realistically effective solution to this pressing problem. The ultimate proof of success in protecting coral reefs lies in its proven results. In a nutshell, our over-riding purposes should be to protect (our prime objective), conserve, and enhance awareness of the public and national decision-makers of the significance of coral reefs. Unfortunately, on a global scale, we are failing to do so. Nevertheless, we should not give up. We (scientists, reef managers, and the public) should continue our efforts to convince international leaders and national decision-makers of the significance of protecting these iconic ecosystems which form one of the most diverse ecosystems on Earth, providing important economic, social, aesthetic, and biological benefits. In addition, reef structures shield thousands of kilometers of coastline from the impact of storm waves, protecting essential lagoon and mangrove habitats for vulnerable life stages of a wide range of commercial and non-commercial species. Coral reefs are also a rich source of medically active compounds. The demise of the reefs would mean the loss of up to a quarter of the world’s marine biodiversity (something never experienced before in human history) and hundreds of millions of the world’s poorest people would lose their primary source of food and livelihood. Hence, local communities should play a role in decision-making about how to protect the reefs, since they are often the people whose livelihoods are most affected by damage to reef ecosystems and the most able to observe and report useful data to scientists and/or enforcement personnel. Nowadays, we stand at a tipping point that if not reversed, damage to reef communities will become extensive with consequent acute reduction of biodiversity and species extinction. We urgently need to reduce the suite of anthropogenic disturbances (which I mentioned in the previous question) to a minimum by means of strict legislation and controls. Currently, reefs no longer have the resilience they once had. Effective regulation that minimizes

localized threats to coral reefs could give these ecosystems greater resilience and a chance to survive the effects of the changing environment. Sharing and integrating the data obtained in many countries of various coral reef monitoring programs will allow us to gain a broader picture on the status of coral reefs at country, regional and global level for further management plans.

Which criteria have to be fulfilled to ensure a sustainable survival of the coral reefs of the world?

I am tempted to answer "I have a dream"…but, in avoiding being emotional and instead of listing strict criteria, I prefer to simply draw my "wishful thinking" for an ideal planet, enabling the well-being of coral reefs around the world. In general, a combination of local management actions to protect reefs from locally generated stresses and global action to mitigate the effect of climate change is urgently required to sustain the well-being of reefs. First and foremost is the urgent need for a global drastic decrease in CO2 emissions. Temperature-induced mass coral bleaching causing mortality on a wide geographic scale started when atmospheric CO2 levels exceeded 320 ppm (compared to pre-industrial levels of 280 ppm). In a healthy, flourishing coral reef, the rates of CaCO3 production by corals and other reef calcifiers should remain the same or be higher than the rates of erosion. That is, in an ideal planet, ocean chemistry should be restored closer to pre-industrial conditions to enable net coral-reef communities' calcification. At today's level of ca. 390 ppm, most reefs world-wide are committed to an irreversible decline. I can only echo the excellent climate action organization 300.org call that "we must return atmospheric CO2 concentration to about 300 ppm CO2", based on the documented position of over 100 scientists and science-informed climate activists. Currently, reefs are threatened by rapid and irreparable decline world-wide from multiple synergies arising from mass bleaching, ocean acidification, and a suite of other anthropogenic harmful impacts. In an ideal planet, international obligations to protect coral reefs must be implemented by national governments by adopting laws and regulations that address the unique challenges confronting reefs within their territories. Legislation should establish a clear hierarchy of objectives, with protection and conservation as core objectives. Finally, scientific research is fundamental to establishing a baseline understanding of the state of corals in an area and to making informed decisions about development in coastal areas and management of marine resources. Therefore, governments have an important role to play in conducting scientific research and in promoting research by nongovernmental entities; in short, increasing marine science research budgets should be a matter of high priority!

Which are the key channels the coral reefs community is using for exchanging information, knowledge, and expertise?

I think that the Springer's journal *Coral Reefs* is our key channel in exchanging scientific knowledge, expertise and innovative ideas on coral reefs. On a personal note (which discloses perhaps my bias), I had the privilege of being the first Biological Editor of the journal back in 1982, promoted and established by its first Editor in chief, the late David Stoddart. At that time coral reef science was still at its infancy and we had to encourage colleagues to submit their research manuscripts to the new journal. And the rest is History…. Other important channels include the NOAA's popular web site *coral-list*, the news journal, *Reef Encounter* of the International Society for Reef Studies (ISRS), a variety of other scientific journals, as well as workshops and conferences of national, regional and international societies of coral reefs.

Yossi Loya is one of the editors of the book Mesophotic Coral Ecosystems and was the first Biological Editor of the journal Coral Reefs