At the heart of the coral triangle in West Papua: an Indonesian-French scientific exploration of a white area with closed-circuit rebreathers (eCCR): [poster]  
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The Bird's Island is connected to the Bird's head Peninsula with the rest of New Guinea is one of the last pristine areas remaining in Southeast Asia. Dominantly covered by limestone karsts, this vast region of West Papua (Indonesia) is still a terra incognita.

At the heart of the coral triangle in West Papua, the Lengguru area. "Lengguru 2014 expedition" was headed by IRD and P2O-LIP, RCB-LIP and POLTEK. Exploration and sampling effort were concentrated on several reef slopes from 20 m to the surface using closed-circuit rebreathers (eCCR) and open circuits. "Lengguru 2014 expedition" was the first French Oceanographic campaign organized by a national and academic research organization to use the rebreather.

The scientific diving operations were made under the responsibility of the French research institute IRD. Nevertheless, the French regulation presently only allows the use of rebreather for recreational uses. The main author participates as an expert in the Ministry of Labor to reform the law with specific applications to scientific purposes. This scientific expedition was therefore permitted in phase advance.

The Lengguru 2014 expedition was organized in complete autonomy for 6 weeks. It required extensive preparation and logistics, as well as some strengthened safety procedures for scientific dives. Forty vertical transects have been performed from -100 meters depth to the surface, silently with great autonomy and optimized decompression. The exploration of flooded karsts by cave diving has been possible with rebreather. It does not bubble and offers such autonomy. The use of eCCR offers together scientific benefits and enhanced diving safety.

The "Lengguru 2014 Expedition provided a science-based assessment of functional, genetic and morphological diversity for several marine biotas (schizomorphs, hard corals, gorgonians, mollusks) with major importance for biodiversity conservation."

**ADVANTAGES : ENHANCED DIVING SAFETY ...**

Significant improvement of the autonomy / Gas economy / Increased autonomy Constant oxygen partial pressure => Optimization of decompression

- Limitation of thermal losses (breathing of hot, humid air) => Increased decompression accident, no risk of freezing/icing in cold water diving

- No bubbles / silence => Greater attention to teammates and undersea environment

**... AND SCIENTIFIC BENEFITS**

- **Autonomy** - significant increase of the intervention time long interventions / reduction of the number of dives required especially in the 40-50 m zone when more observations, manipulations or use of instruments require time / realization of vertical profiles from the bottom to the surface

- **Silence** / no bubbles => better fauna approach / less scare wildlife (behavioral studies, captures, photos and videos...)

- Non-destructive approach, respect of Bioposture

- Exploration of the area up to 100 meters possible due to decompression and no risk of freezing/icing in cold water diving

- No bubbles / silence => Greater attention to teammates and undersea environment

- \[ \text{PRINCIPLE OF THE CLOSED CIRCUIT REBREATHER (CCR)} \]

A breathing loop to re-breath the same gas

- Breathing in water at eique pressure

- Elimination of CO₂ produced

- Use of air or gas mixtures

**Different kinds**: pur oxygen rebreather, closed-circuit rebreather (CCR), semi-closed-circuit rebreather (SCR), mechanical systems manufactures and many 12 certified models. Consensus for multi-gas electronic closed-circuit rebreather (eCCR).

**CAVE DIVING**

Increased autonomy => Stress reduction in cave

Absence of bubbles => cave diving less repressurization / decompression risk of collapse of the vault

In Lengguru, the vault is submerged to about 120 m depth. We explored a flooded network upstream of the village of Urisa. Network of labyrinth type, very developed mainly in the horizontal, in tractional veins, with a convex roof, which connected to the bottom of the Andamco eastern. Near the place of discovery of a third vault by the Lengguru people in 2003.

Dive log: performance only exploration and study of the network in the limit of 260 m from the entrance (safety covers needed)

All the dives for observations, transect measurements, sampling of organisms are systematically preceded by rebreather dive (safety tests).

**RESULTS & OUTPUS**

The use of rebreather in sciences exploration constitutes a new technological paradigm.

- Exploration and sampling effort on several reef slopes (with 40 stations) including the twilight zone (vertical transects between 100 meters depth)

- More than 650 specimens collected (hard corals, gorgonian, schizomorphs, mollusks, algae, seagrasses...)

- DNA barcoding and traditional taxonomy systematically for all samples. Additional and specific molecular analyses for several marine biotas (echinoderms, hard corals, mollusks...)

- Observation and photo identification (several hundreds reef fishes, turtles, corals...)

A data management strategy, with a share scientific database, a photos database of several thousands images.

Besides inventing oceanic communities based on DNA barcoding and traditional taxonomy, biologists infer the phylogenetic relationships of sampled taxa along with those originating from peripheral regions for a better understanding of the underlying diversification processes and for helping their conservation.

Such joint scientific ventures organized at the heart of the coral triangle and in a global context of biodiversity loss, represents an important contribution to the knowledge of historical and evolutionary processes explaining the unique biodiversity encountered in this still poorly studied region located at the junction of Asia and Australia and at the interface of the Indian and Pacific Oceans. It was also the opportunity to communicate, to increase scientific capacity building, and to raise public awareness through multimedia and photographic exhibitions, seminars and various web supports including a pedagogical program.

**REFERENCES**


