

## History, Conservation and Research Program of Indonesian Coelacanth

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**ABSTRACT:** Coelacanth or living fossil was firstly discovered in Indonesia seas in 1997, however its holotype specimen (Indonesian Coelacanth, *Latimeria menadoensis*) was found in 1998. Till nowadays, 8 specimen of coelacanth from Indonesia were listed with the CCC no 174, 175, 215, 225, 254, 287, 299 and 305. Observation on this fish has been conducted since 2005, and its results show its distribution and habitat in Indonesian waters. Several detailed information on specimen collections are described, and some remarkable findings during the last 21 years field observations are also reported. Research collaboration program for Indonesian coelacanth for the period 2017-2019 includes several topics such as Meristic and morphology study of Indonesian Coelacanth; Evolutional analysis of the lateral line scale and associated neuromast in Osteoichytes; Quantitative study of antropogenic chemicals accumulated in Coelacanth; Comprehensive survey of gut microbiota and food preference of coelacanth, based on metagenomics; Coelacanth Indonesia distribution survey uses eDNA technique.

Keywords: History, Conservation, Research collaboration, Indonesian Coelacanth.

### BACKGROUND

This species of fish is known as the "living fossil fish" or "sea king fish", because it is estimated that all groups of fish from the order Coelacanthiformes have been extinct for 70 million years ago. However, this conjecture vanished, after the fish was found on the coast off South Africa in 1938. This specimen was identified and given the scientific name *Latimeria chalumnae* (Smith, 1939). Then, for 60 years, the east coast of Africa became the world's only concern for research of sea king fish, and until now it has been known that this type of fish is spread on countries such as Kenya, Tanzania, Comoros, Mozambique, Madagascar and South Africa.

Since 1998, the phenomenon of the east coast of Africa as the only distribution area for 'Raja Laut' fish has changed, because it was found in the waters of Manado Tua (North Sulawesi) by Mr. Lameh Sonathan (ERDMANN et al. 1999). The captured specimen were later made as the holotype of coelacanth from Indonesia, with the scientific name *Latimeria menadoensis* (POUYAUD et al., 1999). Since then, the coelacanth research has begun in Indonesia, especially in the waters of north Sulawesi. This paper informs the progress that has been achieved from observing the coelacanth (*L. menadoensis*) in the period 1998-2018, and planning for developing the future research on the biology and ecology of the coelacanth.



Fig 1. Distribution of sea king fish in the world and the first year found (Source; IWATA et al., 2009).

## UNEXPECTED DISCOVERY

The first report on the existence of sea king fish in Indonesia in 1997 was taken by Dr. Mark V Erdmann (University of California at Berkeley, USA) and his wife, Arnaz Mehta. This finding was basically unexpected and happened by accident, when they saw a fish with a unique shape was on a cart in the Manado Bersehati market. At that time, Mark and his wife only had a chance to take a photograph of the fish. However, Mark had suspected that this unique fish was a "coelacanth". To confirm their finding, the photos of the fish were later shown to several ichthyologists. Then, it confirmed that it is king sea fish or known as living fossil fish (ERDMANN, 1999). Based on the results of the photograph, the Coelacanth Conservation Council (CCC) provided a sequence number for these specimens with CCC no. 174. Other additional information from this species, such as the total length was approximately 130 cm and the total weight was 30 kg (ERDMANN, 1999). A year later, on July 30, 1998, Lamah Sonatham, a fisherman from Manado Tua Island accidentally caught a sea king fish, and then this specimen was used as the holotype of *Latimeria menadoensis* (POUYAUD et al., 1999). The scientific name for this fish was proved by Comptes Rendus de L'Academie des Sciences in March 1999. This second specimen was numbered CCC 175, with a total length of 124 cm, weighs 29.2 kg and is female with 3 eggs that have developed in the abdomen (ERDMANN et al., 1999). The specimen was then transferred to Bogor and then preserved and stored in the Bogor Zoological Museum located in Cibinong Science Center – LIPI (Holotype MZB 10003)



Fig 2. Raja Laut fish collection at Bogor Zoological Museum as holotype (CCC no. 175) (Doc : Zoological Museum of Bogor).

The Sulawesi coelacanth was firstly published in Nature on September 24, 1998, as a cover story. At the same year, in Manado, Indonesian also involved in commemoration of the International Year of the Ocean 1998 (IYO 98) launched by the UN / IOC-UNESCO. The activity was inaugurated by President Habibie, where he signed the charter

"The Ocean Charter" and "Bunaken Declaration" stated the importance of the development of the archipelago's marine future. News, posters and information about the findings of the big sea king fish were immediately exhibited and soon became the world's big news which was covered extensively in various media including CNN, ABC News, National Geographic. Discover magazine even placed this finding as the top science stories of 1998.

The specimens of the three sea king fish from Indonesia were only discovered 10 years later. On Saturday May 19, 2007, a king sea fish was caught by a fishing rod from local fisherman Justinus Lahama and his son, Delvi Lahama, on the Malalayang beach (Manado city). The total length of this fish is 129 cm and weighs 51 kg, while the sex is female. In the stomach of this fish is found 25 eggs. This specimen is given CCC registration number 215 (Figure 3). It means that in the last 10 years there have been 40 sea king fish caught throughout the world. The third specimen was exposed at Aquamarine Fukushima, Japan (November 2007 - March 2008), and around 50,000 people were visited while the fish had been in Japan. In May 2009, this specimen became a mascot in the World Ocean Conference and Coral Triangle Initiative (CTI) Summit in Manado.



Fig 3. Head part of king sea fish (CCC 215) caught May 19, 2007 on Malalayang beach, Manado. A hook still remains in its mouth (Doc: Augy Syahailatua).

On November 22, 2008, a report from the Talise area (55 nautical miles from Manado) that a sea king fish measuring 110 cm in length and weighing 20 kg, was caught. This specimen becomes the 4th and registered with the code CCC no. 225 (Figure 4). Currently this specimen is collected by Sea World in the Taman Impian Jaya Ancol Complex (Jakarta). Furthermore, on September 16, 2009, at this location one king sea fish specimen was caught, with a total length of 116 cm and weighing 27 kg. The registration number for this specimen is CCC no. 254 and is the 5th specimen from Indonesia (Figure 5). Currently these specimens are stored in the Faculty of Fisheries and Marine Sciences - Sam Ratulangi University, Manado.



Fig 4. Specimen of sea king fish CCC No. 225 caught on November 22, 2008 in the waters of northern Talise Island (Doc: Augy Syahailatua).



Fig 5. Sea King Fish CCC 254 caught on September 16, 2009 in the northern waters of Talise P. (Doc: M. Iwata).

On July 20, 2011 at around 05.00 a coelacanth was caught again by a fisherman named Rafles Tampi in the Popontolen waters. The caught fish measures 112 cm and weighs 13.1 kg. This specimen is given CCC registration number 287. Then the seventh fish was caught on November 5, 2014 around P. Gangga, North Sulawesi with a body length of about 130 cm and weighing around 37.8 kg. The fish is registered coded CCC 299. On July

1, 2018 again an angler named Dave Lenny Santoso managed to catch a coelacanth using a fishing rod at 8:30 a.m. Because they did not know this fish is coelacanth, the angler immediately cut the fish, so that the fish had not yet been measured and weighed. However, body parts are still available for DNA analysis. The results of DNA analysis confirmed that the fish is a coelacanth. The registration number for this specimen is CCC no. 305.

Table 1. Coelacanth fish caught in Indonesian waters since 1997-2018

No.	CCC	Date	Location	Sex	Total Length	Body Weight
1.	174	Sep 18, 1997	Manado	Unknown	130 *	30 *
2.	175	Jul 30, 1988	Manado	F	124 cm	29,2 kg
3	215	May 19,2007	Manado	F	129 cm	51kg
4	225	Nov 25, 2008	Talise	M	110 cm	20 kg
5	254	Sep 16, 2009	Talise	M	116 cm	27 kg
6	287	Jul 21, 2011	Amurang	M	105 cm	13,1 kg
7.	299	Nov 5, 2014	Gangga Is.	F	130 cm	22 kg
8.	305	July 1, 2018	Raja Ampat	Unknown	Unknown	Unknown

\* Approximate value from Erdmann (1999)

## RESEARCH OF INDONESIAN COELACANTH

The discovery of the sea king fish in the waters of North Sulawesi attracted the attention of national and international scientists. So, in 1999, the Max Planc Institute (Germany) and LIPI conducted a situ-observation using the research vessel Baruna Jaya VIII and Submersible "Jago". Firstly, they observed in the waters around Manado Tua Island, where the first two specimens of king sea fish found. But they could not find any coelacanths in their habitat. Then, they moved to the coastal area of Buol near Toli-Toli town, and finally they recorded the presence of two sea king fishes at 145 meters depth around Buol waters (border between Provinces of North Sulawesi and Central Sulawesi). Furthermore, biological and ecological survey of sea king fish a marine king fish biology was designed by researchers from LIPI Centre for Oceanography, Aquamarine Fukushima (Japan), and University of Sam Ratulangi to understand the distribution of this fish in Indonesia waters, particularly in Sulawesi waters. This survey began in 2006, and by using ROV (Remotely Operated Vehicle), we succeeded recording the presence of several sea king fishes lived at depths of 150-200 m in the Sulawesi Sea.

Recordings of sea king fish in the waters of Manado Bay on June 27, 2007 were considered impressively, because these findings could be attributed to the capture of CCC no. 215 in a relatively similar location. Thus verified that Manado Bay is one of the coelacanth habitat. Then, in November 2009, the coelacanth research team also succeeded in recording the presence of marine fish measuring 31 cm in total length, which is thought to be the sea king fish at the juvenile level. This finding also adds to the information that the possibility of spawning location of sea king fish is also around the Manado Bay.

Coelacanth is not only found in the waters of north Sulawesi. In November 2010, the team from Fukushima Aquamarine (lead by Dr. Masamitsu Iwata) in collaboration with Center for Oceanography, Indonesian Institute of Science (lead by Dr. Kasim Moosa) discovered these ancient fish in the waters southeast of Biak Island (Province of Papua).

## CONSERVATION STRATEGY

According to all information obtained from coelacanth study, it could be seen that the sea king fish are not only caught with hand-lining, but also

with trawls and gill nets (BURTON et al., 1992; HISSMANN et al., 1998; ERDMANN et al., 1998). Besides that in some remote locations, there are still possibilities, fishermen can catch fish with using explosives and chemicals technique. All of these fishing method could be danger to the life of the sea king fish. For this reason, research on the sea king fish must be carried out continuously in order to disclose the distribution and population conditions of this fish. These information are very necessary to implement for protecting the coelacanth at its habitat. Based on several discoveries of king sea fish and the increasing recognition of these fish as one of the ancient fish that live in Indonesian waters, protected strategy for this fish are needed. Legally, this fish has been protected through the Minister of Forestry Regulation No. 7/1999. So that efforts to catch the sea king fish for any reasons are not allowed. Furthermore, sea king fish is also protected by CITES (Convention on International Species of Wild Fauna and Flora). Coelacanth, *Latimeria chalumnae* has been registered on CITES Appendix II since July 1<sup>st</sup>, 1995.

## FUTURE COLLABORATIVE WORKS

Collaborative works between Indonesian and Japanese researchers has been continued after workshop on coelacanth survey held in Jakarta on November 24, 2015. One agreement from this workshop that coelacanth specimen with registration number CCC 295 is transported to Aquamarine Fukushima Laboratories for some detailed analyzing. The fish was cargo to Japan in August 2016 and then, mini symposium on coelacanth study was conducted at Aquamarine Fukushima in November 2016 to discuss on observation. After this symposium, the research team form both sides had measuring morphometric and dissecting abdomen of the coelacanth specimen, and also sampling some parts from this specimen. Finally, this specimen had fixed into formaldehyde for 6 months, then it would be preserved into alcohol for display at the Aquamarine and Marine Science Museum Fukushima.

Several research topics related to the coelacanth specimen that would be conducted by scientists from Indonesia and Japan 2017-2019, as follow;

1. Meristic and Morphology Study Indonesian Coelacanth (AORI - University of Tokyo, Aquamarine / Marine Science Museum Fukushima, Indonesian Institute of Sciences, Museum of Natural History and Human History Kitakyushu, Fukuoka)

2. Evolutional Analysis of the lateral line scale and associated neuromast in Osteichyetes (Jikei University and Indonesian Institute of Sciences)
3. Comprehensive survey of gut microbiota and food preference of coelacanth, based on metagenomics
4. Quantitative study of antropogenic chemicals accumulated in Indonesian Coelacanth (Ehime University, Indonesian Institute of Sciences, and Agency For the Assessment and Application of Technology)
5. Distribution survey of Indonesian Coelacanth using eDNA (Univ Riukyu, Indonesian Institute of Sciences, and University of Sam Ratulangi, Indonesia.

Based on these research programs, there are several scientific publication would be produced, such as:

1. A Prototype a seen from the comparative morphology of lateral line scale and the accompanying neuromast in the body of *Osteichthyes*;
2. Field Survey on the Indonesian Coelacanth, *Latimeria menadoensis* using remotely operated vehicles in from 2005 to 2015
3. Observation of the first juvenile Indonesian coelacanth, *Latimeria menadoensis* from Indonesian waters with a comparison to fetuses of *L. chalumnae*
4. A detailed morphological measurement of the seventh specimen of Indonesian Coelacanth, *Latimeria menadoensis*, with a compilation of current morphological data of the species;
5. Osteology of Indonesian coelacanth, *Latimeria menadoensis* with a comment on the origin of extant coelacanths
6. The first investigation of Polychlorobiphenyls (PCBs) in Multiple Tissues of Coelacanth from Indonesia;
7. First assessment of persistent organic pollution (POPs) in Organ of Coelacanth from Indonesia: Concentration and Patterns of PBDEs;
8. Organoclorine contamination concentration in Multiple Tissue of Coelacanth from Indonesia;
9. Biodiversity on gut microbiota on Coelacanth fish;
10. Mapping the distribution of Indonesian coelacanth fish using eDNA study

## REFERENCES

- BRUTON, M. N; A.J.P. CABRAL and H. FRICKE 1992. First capture of a coelacanth, *Latimeria chalumnae* (Pisces, Latimeriidae), off Mozambique. *African J. Sci.* 88: 225-227.
- ERDMANN, M; R. CALDWELL and M.K. MOOSA. 1998. Indonesian 'king of the sea' discovered. *Nature* 395: 335.
- ERDMANN, M.V. 1999. An account of the first living coelacanth known to scientists from Indonesian waters. *Environmental Biology of Fishes* 54: 439-443, 1999.
- ERDMANN, M.V.; R.L. CALDWELL; S.L. JEWETT and A. TJAKRAWIDJAJA. 1999. The second recorded living coelacanth from north Sulawesi. *Environmental Biology of Fishes* 54: 445-451.
- HISSMANN, K.; H. FRICKE and J. SCHAUER. 1998. Population monitoring of the Coelacanth (*Latimeria chalumnae*). *Conservation Biology*, 12 (4): 759-765.
- FRICKE, H.; HISSMANN, K.; J. SCHAUER.; J. ERDMANN.; M. K. MOOSA and R. PLANTE. 2000. Biogeography of coelacanths. *Nature* 403, 38.
- IWATA, M.; S. YAMAUCHI; K. FUJII; K. YOSHIMURA; A. KOMODA; M. K. MOOSA; A. SYAHAILATUA; D.H. KUNARSO; K. W. A. MASENGI; I.F. MANDAGI; P. A. ANGMALISANG; J. BUDIMAN; F. P. T. PANGALILA and Y. ABE. 2009. Biological Survey on Indonesian Coelacanth, *Latimeria menadoensis*. *Paper presented in the World Ocean Conference, Manado. May 2009* (unpublished paper).
- POUYAUD, L.; S. WIRJOATMODJO; I. RACHMATIKA; A. TJAKRAWIDJAJA; R. HADIATY and W. HADIE. 1999. A new species of coelacanth. *C. R. Acad. Sci. III* 322, 261- 267.