

Ecology of *Aulonocara* REGAN, 1922 in Lake Malawi

STUART M. GRANT, HORST W. DIECKHOFF, HANS J. MAYLAND & MANFRED K. MEYER

Introduction

The genus *Aulonocara* REGAN, 1922 lives endemically in Lake Malawi and includes according to MEYER et al. (this issue) 16 taxa described up till now.

The members of the genus have been found in water depths from 4 to 75 metres along the rock/sand interface on the east and west coast as well in the north and south of the lake and its islands.

The species of *Aulonocara* feed from the sand/rock substrate. Only a few members of the genus are specialised insectivores. The majority of the taxa feed additionally on molluscs and ostracods.

Material and methods

Approximately 50 specimens of *Aulonocara baenschi* MEYER & RIEHL, 1985 from Chipoka, *Aulonocara hueseri* MEYER, RIEHL & ZETZSCHE (this issue), Likoma Island, *Aulonocara nyassae* REGAN, 1922, from unknown locality and *Aulonocara maylandi* TREWAVAS, 1984, Kande Island, have been examined with respect to their stomach contents and rest of food at the lower pharyngeal bone.

The specimens were fixed in 10% formalin solution; some were fixed shortly after being caught; other fishes were fixed upon arrival in the holding centre at Salima.

The guts were cut in pieces of 1 cm, opened and mashed. The whole material was examined under a magnification of 20 to 40 times by the use of a stereomicroscope.

Observations of *Aulonocara* species in its natural habitats done by Mr. SAULOS MWALE and collaborators, Mrs. E. KORTHAUS, Mr. H.J. MAYLAND, and Mr. H.W. DIECKHOFF, are the basis of this work.

A considerable amount of underwater film and photomaterial taken by H.W. DIECKHOFF was used as reference material during the study.

The specimens were caught by using a curtain net made of nylon (10 X 1.5 m); size of mesh 8 mm, knot to knot.

Abbreviations on maps:

CH = Chipoka; CM = Chisumulu Island; CI = Chitendi Island; CU = Chilumba; EC = Eccles Reef; KA = Kande Island; LI = Likoma Island; MB = Mbenji Island; MI = Maleri Island; MA = Masinje; NK = Nkhomo; US = Usisya.

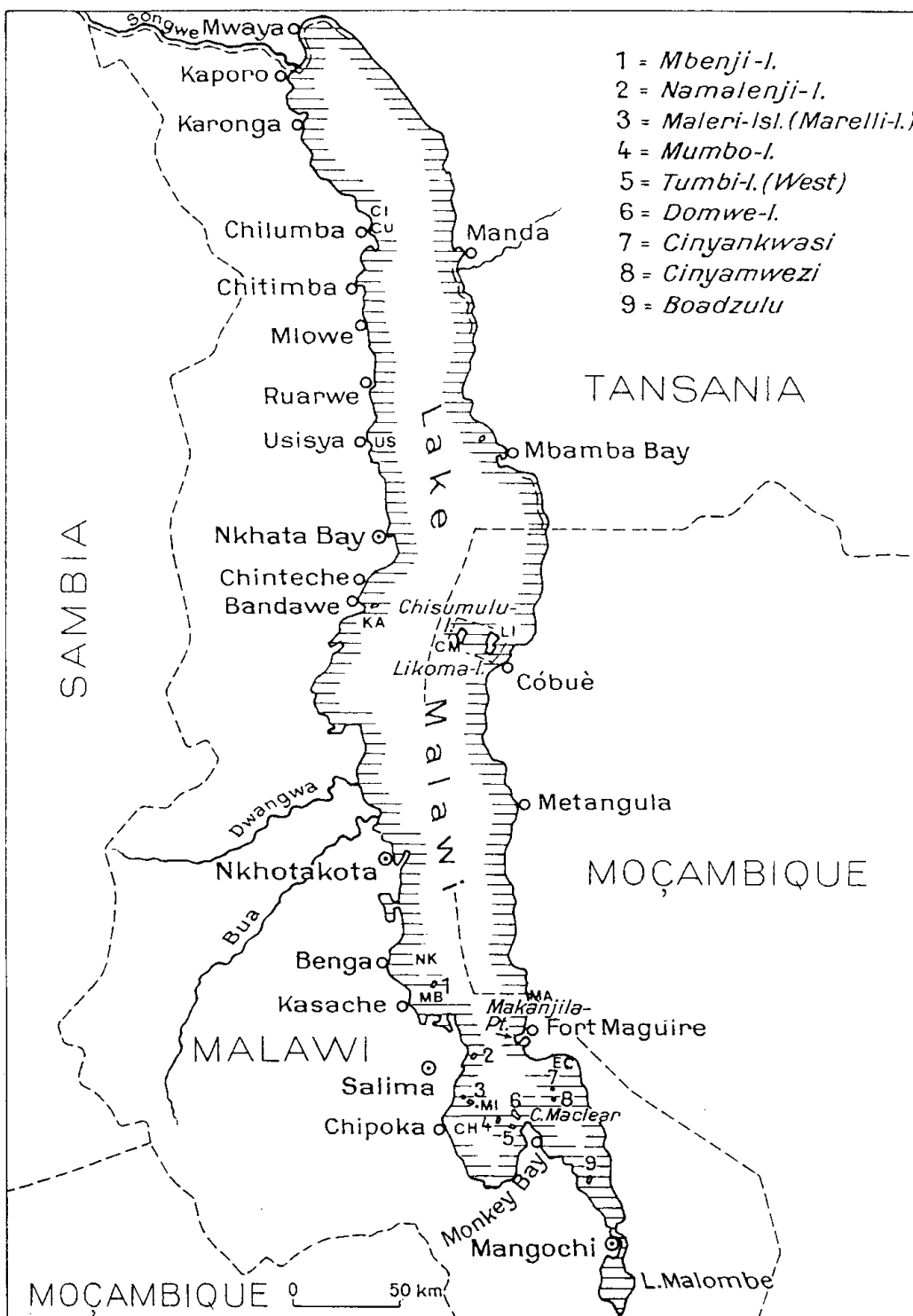


Fig. 1. Map of Lake Malawi.

Distribution

Two of the sixteen described taxa of the genus *Aulonocara*, *A. auditor* TREWAVAS, 1935 and *A. ethelwynnae* MEYER et al. (this issue) are known from the north of Lake Malawi, *A. auditor* could only be found near Vua and *A. ethelwynnae* at Chitendi Island. *Aulonocara steveni* MEYER et al. (this issue) is only known at Kande Island and *A. korneliae* MEYER et al. (this issue) at Chisumulu Island.

A. steveni has been found sympatrically with a form of the widely dispersed *A. maylandi* TREWAVAS, 1985.

From the southern and northern portions of the lake *Aulonocara stuartgranti* MEYER & RIEHL, 1985 is found at the Mbenji Island complex and Chilumba respectively. According to collection data the species *A. rostratum* TREWAVAS, 1935 is known from near Karonga, Vua and Monkey Bay; *A. microstoma* (TREWAVAS, 1935) and *A. nyassae* REGAN, 1922 are reported from the north and south end of the lake (data on localities is unavailable). For *A. microstoma* at Monkey Bay from the south, *A. nyassae* at Shire bar in the south and from the north Vua and Karonga are referred.

A. baenschi MEYER & RIEHL, 1985, a complex of *A. korneliae* and *A. hueseri* MEYER et al. (this issue) and *A. maylandi* are spread out in three or more localities. *A. baenschi* is distributed near Chipoka, Maleri Island complex, Nkhomo and Usisya.

A. hueseri is known from Likoma Island and a related population from Domwe Island; according to RIBBINK et al. (1983) this species is also known from Monkey Bay, Thumbi West Island, Nankumba and Nkhata Bay, but is not worked out.

Aulonocara maylandi is known from Eccles Reef and Kande Island; probably identical forms of *A. maylandi* are proved by RIBBINK et al. (1983) from Monkey Bay, Nankumba, Domwe Island, Thumbi West.

From the southern portion of the lake and excluding *A. baenschi*, *A. maylandi* and *A. stuartgranti* covered above the following taxa are known: *brevirostre* (TREWAVAS, 1935), *hansbaenschi* MEYER et al. (this issue), *jacobfreibergi* JOHNSTON, 1974, *saulosi* MEYER et al. (this issue), *macrocleithrum* (STAUFFER & McKAYE, 1985).

Several forms of *A. jacobfreibergi* are known at Domwe, Nkudzi, Monkey Bay, Nankumba and Otter Point (RIBBINK et al., 1983).

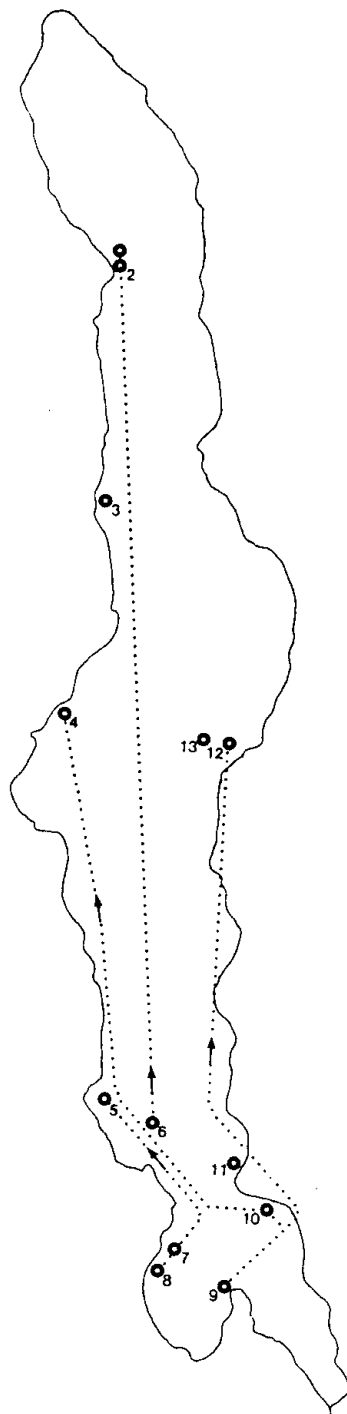


Fig. 2. Distribution of infraspecific *Aulonocara* forms. Station 2 and 6: *stuartgranti* from Chilumba (2) and Mbenji Island (6). Station 8, 7, 5, and 3: *baenschi* from Chipoka (8), Maleri Island (7), Nkhomo (5) and Usisya (3). Station 9, 10 and 4: *maylandi* from Domwe (9), Eccles Reef (10) and Kande Island (4). Station 9, 12 and 13: *korneliae-hueseri* complex from Domwe (9), Likoma and Chisumulu Island (12 and 13).

A. saulosi has only be located in very small numbers on the east coast of the lake in a small habitat some 8 kilometres south of Masinje. Here it occurs allopatrically with *A. hansbaenschi*.

A. macrocleithrum is known from Cap Maclear and Monkey Bay (STAUFFER & McKAYE, 1985).

A. brevirostre is only known from the southern end of Lake Malawi (TREWAVAS, 1935). This taxon is only known from two young specimens.

Ecology of *Aulonocara* of Lake Malawi

All known members of the genus inhabit the rock/sand interface from 4 to 75 metres depth. *Aulonocara* populations which live in depths from 40 to 75 metres are deeprooted. *A. macrocleithrum*, *A. microstoma* and *A. rostratum* are known to be deep water dwellers and the same is assumed for *A. nyassae*. All other described members occur most numerous in depths of 6 to 20 metres and are seldomly found in depths of more than 30 metres. Data for *A. auditor* and *A. brevirostre* are not available but it is assumed that those species can be found in depths of less than 30 metres.

Aulonocara feeds from the rock and sand substrate. The stomachs of most of the fishes investigated contained ostracods as well as molluscan components; only a few had insect larvae.

Aulonocara auditor

Habitat: No data available.

Aulonocara baenschi (Chipoka)

Habitat: The taxon is found on submerged rocks comprising the Chindunga Rocks reef in 10 metres depth. It feeds from the rock and sand substrate. Females gather in groups.

Aulonocara baenschi (Maleri Islands)

Habitat: This form occurs at the rock/sand interface and feeds on the rock and sand substrate. Numbers are small and these populations are comparatively scarce in comparison with its related populations at

Chipoka and Nkhomo. This species is found on the Maleri Island complex mainly between 8 to 20 metres it has been reported as occurring at 25 metres depth. The fishes feed from the rock and sand substrate.

Remarks: The fishes are present on all three islands in the Maleri Island complex and the density is limited in comparison to the *A. baenschi* populations of Chipoka and Nkhomo.

Aulonocara baenschi (Nkhomo)

Habitat: The Nkhomo population was located on a totally submerged pattern of rocks. The fishes are most numerous in 16 metres of water and are to be found at the junction of rocks and sand where they feed.

Remarks: On maps the nearest point that can be identified is Benga or Nkhomo south of Chia Lagoon, Malawi, Lake Malawi.

Aulonocara baenschi (Usisya)

Habitat: Occurs over sand and rocks from 4 to 6 metres deep. The population is comparatively numerous with breeding males over rocks, holes and small caves with females moving over the sand in groups. It seems that this population mainly feeds from the sand.

Aulonocara brevirostre

Habitat: No data available.

Aulonocara ethelwynnae (Chitendi Island)

Habitat: This species occurs over sand and rocks. Females and immature males can be found in 3 metres depth forming schools. Breeding males are found from 6 to 7 metres deep and are not numerous. Females gather in small groups. It feeds from rock and sand substrate, plate 1, fig. 10; plate 4, fig. 27 (MEYER et al., this issue).

Aulonocara hansbaenschi (Masinje)

Habitat: It occurs over rocks from 4 to 6 metres deep. Prefers holes and crevices formed by the rocks. The top of the rocks may be only 3 metres below the surface. In the context of preferring holes and caves formed by the jumble of rocks, these fishes are more akin to what is known about *A. jacobfreibergi* territories.

A great advantage of *hansbaenschi* living in this shallow water is the fact that there is no need of decompression after having been collected. Where large caves or holes are formed, groups of males could be seen close to each other, just a few inches apart, with up to ten females in the cave area.

Aulonocara hueseri (Likoma Island)

Habitat: The Likoma population are most numerous in waters of 12 to 15 metres depth. It has been reported that this fish can extent to water 40 metres in depth.

Aulonocara spec. (Domwe Island)

Habitat: No exact data available.

Remarks: It is thought that similar conditions will apply as for the Likoma type.

Aulonocara korneliae (Chisumulu Island)

Habitat: This species occupies the water between 9 to 12 metres depth over rocks and sand. (Plate 1, figs. 7 to 9).

Aulonocara macrocleithrum (Cape Maclear)

Habitat: This species is found at Cape Maclear in 75 metres depth and at Monkey Bay in 73 metres depth. The feeding is not known but it is suggested (STAUFFER & McKAYE, 1985) that *Aulonocara macrocleithrum* feeds on small benthic macroinvertebrates and perhaps small fishes.

Aulonocara maylandi (Eccles Reef)

Habitat: This species is found along the rock/sand interface. It occurs in reasonable numbers from 7 to 25 metres. Most are caught between 12 to 25 metres. It extends to 40 metres. The fishes feed from the sand. Females form schools.

Aulonocara maylandi (Kande Island)

Habitat: A population which is numerous at 10 metres deep. Breeding males select small territories in the rocks up from the rock/sand interface while the females in groups move over the sand.

Remarks: The stomach contents of four individuals, all comprised molluscan components, and in 2 mixed with sand.

Aulonocara microstoma

Habitat: No data available.

Aulonocara nyassae

Habitat: No data available.

Aulonocara rostratum

Habitat: This species was found in waters of 64 metres depth at Monkey Bay. No data available.

Aulonocara saulosi (Masinje)

Habitat: This species lives above sand and rock over a range from 6 to 15 metres. Although located in deeper water they are to be found in the area where *Aulonocara hansbaenschi* lives. They prefer sandy inserts in the sloping jumble of rocks but at the final junction of rock and sand, i.e. where the rocks peter out completely onto the true sandy bottom, they are not to be found. Males are widely spread out at distances of five metres or more between their respective territories. Females have not been seen in groups. They occur singly, or, on occasion, with a male, in their mutual rocky niche. *Aulonocara saulosi* are not so small cave oriented as *Aulonocara hansbaenschi* but prefer a small bed of sand surrounded by rocks. It is thought that *Aulonocara saulosi* feeds from the sand.

Remarks: No molluscan components could be found in their stomachs.

Aulonocara spec. (Likoma Island)

Habitat: This species is a more solitary fish not occurring in groups. It can be found in waters of 12 to 15 metres at the rock/sand interface but prefers small individual pockets of sand surrounded by the last few rocks. Males have their small territory and females occur singly.

Aulonocara steveni (Kande Island)

Habitat: This *Aulonocara* occurs at 10 metres depth and the same locations where a population of *Aulonocara maylandi* dwell, but is a much scarcer fish. Sometimes females also scarce have inadvertently been caught with the females of *A. maylandi*. Feeding data for *Aulonocara steveni* not available.

Aulonocara stuartgranti (Chilumba)

Habitat: The population is most numerous in water 8 metres deep over rock and sand. Females occur in small groups. The fishes feeds from rock and sand substrate.

Aulonocara stuartgranti (Mbenji Island)

Habitat: The species populates all islands of the Mbenji complex but prefers the leeward, i.e. western side of the islands where there is an element of shelter from the strong south easterly winds that can occur at all times during the year.

Generally *A. stuartgranti* is found from 8 to 15 metres deep, but a few have been sighted in water as shallow as 3 metres and others at up to 25 metres deep. It frequents the rock/sand interface and feeds from the rock and sand substrate.

Females occur in groups. Males frequently have their territories in holes or caves made of rocks scattered over the sand, and hide underneath. (Plate 1, figs. 4 to 6).

Summary

The largest occurrence of the members of the genus *Aulonocara* is concentrated in the southern part of Lake Malawi. Going more south from Mbenji Island in the west and Fort McGuire at the east coast there can be found eleven species of *Aulonocara*.

However, on the contrary in the north between Karonga to Usisya along the west coast four or five taxa have been found; the east coast in this area is unexplored.

Six or seven species are concentrated on the middle region of the lake, between Nkhata Bay to Benga in the west and in the east between the islands of Likoma and Chisumulu.

In the northern part of the lake there can be detected two species, in the middle region two species and in the south three to four species, each taxon only known from one locality. As far as known all members of the genus *Aulonocara* are living in the adjoining areas of rocks and sand. Two species are living mostly in caves. Twelve species are primarily concentrated in water depths between 10 and 20 metres. Four species have been reported from deepwater zones with *rostratum* being caught at 64 metres depth and *macrocleithrum* at 75 metres.

Aulonocara specimens feed from the rock and sand substrate on insect larvae, molluscs, ostracods and perhaps on small fishes.

Acknowledgements

The authors gratefully acknowledge the collaboration and assistance of the following persons: Mr. S. MWALE, Salima; Mrs. B. DIECKHOFF and Mrs. A. BOGDAN, Herten; Mr. Dr. M. SCHARTL, München; Mr. S. LONGWE, Salima; Mr. V. LA ROSA, Bad Vilbel; Mrs. E. KORTHAUS (†), Hagen.

References

- MEYER, M.K., R. RIEHL & H. ZETZSCHE (1987): A revision of the cichlid fishes of the genus *Aulonocara* REGAN, 1922 from Lake Malawi, with descriptions of six new species. - Cour. Forsch.-Inst. Senckenberg (this issue).
- MAYLAND, H.J. (1982): Der Malawi-See und seine Fische. Lanbuch-Verlag GmbH, Hannover, pp. 336.
- RIBBINK, A.J., B.A. MARSH, A.C. MARSH, A.C. RIBBINK & B.J. SHARP (1983): A preliminary survey of the fishes of rocky habitats in Lake Malawi. - South African Journ. Zool., 18: 147-308.
- STAUFFER, J.R. & K.R. McKAYE (1985): *Cyrtocara macrocleithrum*, A Deepwater Cichlid (Teleostei: Cichlidae) from Lake Malawi, Africa. - Copeia, 3: 591-596.
- STUART M. GRANT, Collector of African Tropical Fishes, P.O. Box 123, Salima, Malawi, Africa.
- HORST W. DIECKHOFF, Arenbergstraße 27, D-4352 Herten, West Germany.
- HANS J. MAYLAND, Starenweg 1, D-6370 Oberursel, West Germany.
- MANFRED K. MEYER, Schwalheimer Hauptstraße 22, D-6350 Bad Nauheim, West Germany.



Plate 1

Fig. 3. Commercial fish collection for the Malawian export. Fig. 4. Mbenji Island. Fig. 5. Mbenji Island complex, locus typicus of *Aulonocara stuartgranti*. Fig. 6. *Aulonocara stuartgranti* (Mbenji Island), male in natural habitat. Fig. 7. Chisumulu Island. Fig. 8. Chisumulu Island, locus typicus of *Aulonocara korneliae*. Fig. 9. *Aulonocara korneliae* (Chisumulu), male in natural habitat. Fig. 10. *Aulonocara ethelwynnae* (Chitendi Island), male and female in natural habitat, see also MEYER et al. (this issue) plate 1, fig. 27.