



REFERENCE

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## PRESENT DISTRIBUTION OF THE THREATENED KILLIFISH *APHANIUS FASCIATUS* (ACTINOPTERYGII, CYPRINODONTIDAE) IN THE MALTESE ISLANDS.

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### ABSTRACT

A survey of the nine localities from which the threatened Killifish *Aphanius fasciatus* has been recorded in the Maltese Islands showed that large and thriving populations exist at Salina, at the Simar and Ghadira bird sanctuaries and in reservoirs at Marsa and Ghadira. The Simar and Ghadira populations are introduced and originate from a mixture of animals collected from Salina and Marsa. The provenance of the Marsa population is unknown but it is possibly autochthonous to the Marsa area. The Salina and possibly the Marsa populations seem to be the only remaining natural populations of this species in the Maltese Islands.

### INTRODUCTION

The killifish *Aphanius fasciatus* Nardo 1827 is a small euryhaline fish distributed round most of the Mediterranean coastline except for the Iberian, Algerian and Moroccan coasts, where it is replaced by *Aphanius iberus*, and for the extreme southeastern coasts of the Levantine Sea where it is replaced by *Aphanius dispar* (Tortonese, 1986), which may or may not be a Lessepsian immigrant (Kornfield & Nevo, 1976) (Fig.1). *Aphanius fasciatus* is considered to be threatened throughout its range and is listed in Appendices II (Strictly protected fauna species) and III (Protected fauna species) of the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats), and in Annex II (Animal and plant species of community interest whose conservation requires the designation of special areas of conservation) of the Habitats Directive (Council Directive 92/43/EEC (1) of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora as amended by Council Directive 97/62/EC of 27 October 1997) of the European Union. In spite of its protected status, some populations have declined, for example those of eastern Sicily (Ferrito & Tigano, 1995; 1996).

*Aphanius fasciatus* is native to the Maltese Islands where it has been reported by Gulia (1858-59) from running water and from the sea close to sources of freshwater, and by Despott (1919) and Lanfranco (1958) from brackish and hypersaline waters. More recently it has been recorded by Closs & Zammit (1973), Zammit (1975), Zammit & Van Es (1980) and Cilia (1986), and it is included in recent checklists of Maltese fishes (Lanfranco, 1993; Farrugia

Randon & Sammut, 1999; Sammut, 2001 and Farrugia Randon, 2001). It has been suggested (Darmanin, 1979) that local populations of this species present phenotypic differences from mainland populations while different localities in the Maltese Islands have different ecotypes (Zammit & Van Es, 1980). This species is listed as 'vulnerable' in the Red Data Book for the Maltese Islands (Schembri & Sultana, 1989) and local populations have been legally protected under the Flora and Fauna Protection Regulations since 1993 (Legal Notice 49 of 1993 as amended by Legal Notice 161 of 1999).

Reviewing all the published records of *Aphanius fasciatus* from the Maltese Islands, it results that this fish is known from the following localities: Kalafra, St. Georges Bay (Birzebbuga), Marsaxlokk, Marsascala, Marsa, Salina, Simar, and Ghadira, all on the island of Malta, and from Il-Qawra on the island of Gozo. However, it is not known if the species still occurs in these localities and what the condition of the various populations is. Obviously, given its status as a threatened and protected animal both locally and internationally, such information is of key importance for conservation and management of the species. For this reason we undertook a systematic survey of the localities where *Aphanius fasciatus* has been reported with the aim of confirming that these fish still occur and to assess the status of the populations.

### METHODS

Surveys were made in March-August 2002 as during the summer months the fish come to the surface to reproduce and are therefore more easily spotted. The localities listed

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above were visited and bodies of water likely to support fish were investigated. If fish were spotted, an attempt to estimate relative population size was made by standardised sampling using hand nets with 1mm mesh. For this, two workers approached the fish from opposite ends of the water body shepherding the fish before them into shallow water and collecting them by making a known number of sweeps of the net. At each locality, the general observations on the population and its situation were also made.

## RESULTS AND DISCUSSION

Fish were found at only four of the localities investigated; no fish were found at Kalafrana, St. Georges Bay, Marsaxlokk, Marsascalea and Il-Qawra (Gozo).

There are presently no brackish water bodies in the Kalafrana/St.Georges Bay area and no fish were spotted in the shallow water close to shore. The only likely habitat for *Aphanius fasciatus* in the area is the mouth of Wied Zembaq where there was previously a saline marshland; however, the area is now developed and only vestiges of the marsh remain, in the form of sparse halophytic vegetation. The only suitable habitats for *Aphanius fasciatus* at Marsaxlokk are the brackish water pools at Il-Ballut. Originally this was a saline marshland that was partially converted into ponds for keeping live fish caught at sea by fishers; these ponds were abandoned for many decades and the marsh all but disappeared, however, in the late 1980s the saline marshland habitat was reconstructed by the Government in partnership with a local non-governmental organization (Bonello, 1992). Although pools with brackish to hypersaline water are now present at Il-Ballut, there are no fish there, either surviving naturally or introduced. At Marsascalea, *Aphanius fasciatus* used to occur in the fish-ponds at Il-Maghluq and at the very head of the bay where the Il-Maghluq ponds connected with the sea (PJS, personal observations). During the present surveys, no fish were found in the ponds themselves or in the shallow water close to the shore at the head of the bay.

According to information provided to Cilia (1986), the population at Il-Qawra, Gozo was introduced by aquarists

but no specific sites are given. The likely habitats for this species in the Il-Qawra area are the permanent freshwater pool at Il-Qattara, and the so-called 'Inland Sea', which is connected to the open sea via a tunnel-cave and where the salinity is fully marine. The Il-Qattara pool is deep and turbid and difficult to investigate, however, there was no trace of killifish in the pool during any of four separate visits made in March, April and August. Neither were there any Killifish in the 'Inland Sea'.

*Aphanius fasciatus* was found at Marsa, Salina, Simar, and Ghadira. At Marsa, fish used to occur in the canal which connects the low-lying land at Ta' Ceppuna, where the Marsa Sports Grounds are situated, to the sea at Marsa Creek (Closs & Zammit, 1973; Zammit & Van Es, 1980; A.E. Baldacchino, personal communication) and also in the inner harbour itself (Zammit & Van Es, 1980). No killifish at all were found in the Marsa canal during the present survey. Indeed, when the canal was visited (in August), water was present only at the seawards end of the canal, and from the main thoroughfare inland as far as the Marsa Sports Ground, the canal was dry. The inundated region of the canal supported a very large population of grey mullet (*Mugil cephalus*), numbering in the thousands and including fish up to 20cm long, but no killifish were present. No fish appeared to be present in the inner harbour, although no sampling to ascertain this was made.

A small population of *Aphanius fasciatus* was however located in a freshwater reservoir used for irrigation purposes in the Marsa Sports Grounds. It is not known if this population derives from the one that originally inhabited the Marsa canal. This reservoir has an estimated volume of ca 100m<sup>3</sup> and has had killifish living in it at least for the past 50 years (Joseph Debono, personal communication). When this reservoir was visited in August, 'domestic' goldfish were also present in the reservoir. It is not known if the *Aphanius fasciatus* population in this reservoir derives from the one that originally inhabited the Marsa canal but there are indications that the reservoir overflows into the Marsa canal and therefore it is possible that this reservoir acts as a refuge for killifish during the dry season, when the canal is dry, and that the fish recolonise the canal during the wet

**Table 1 Population estimates for *Aphanius fasciatus* from different localities in the Maltese Islands.**

Locality	Population estimate by hand net collecting		Visual estimate
	No. collected/ No. of hand-net strokes	Catch per unit effort	
Marsa reservoir	-	-	Low hundreds
Salina	32/15	2.13	Many hundreds
Simar	9/35	0.26	Unable to determine due to dense reed beds
Ghadira Bird Sanctuary	37/25	1.48	Many thousands
Ghadira reservoir	-	-	Low hundreds

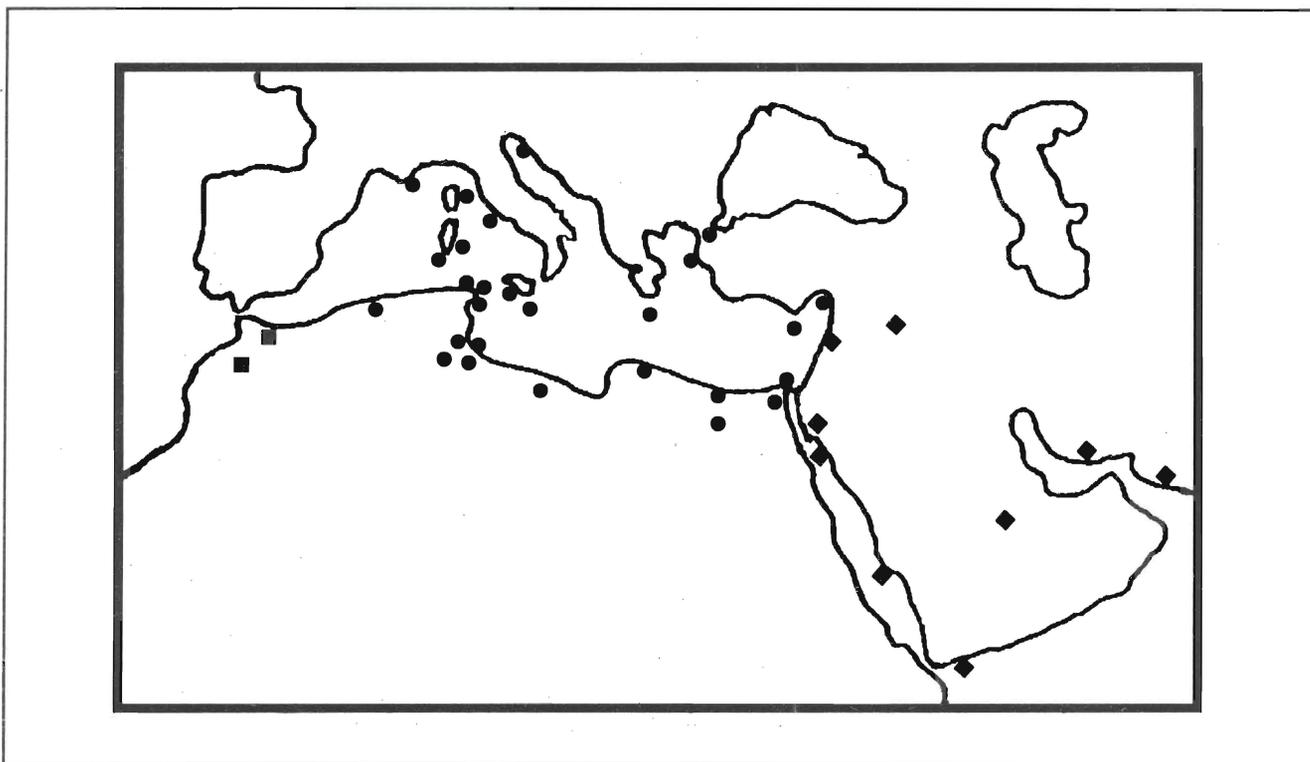


Fig. 1 *A. fasciatus* (●), *A. dispar* (◆) and *A. iberus* (■) distribution in the Mediterranean Area. (after Villwock, 1985)

season when the reservoir overflows into it. This may explain the intermittent occurrence of killifish in the Marsa canal over the years.

At Salina, the fish occurred in the narrow canals between the salterns, which are used to fill the salt pans with seawater for the production of sea-salt. At both Ghadira and Is-Simar, the fish occurred in the water pools within the bird sanctuaries in these two localities. Zammit & Van Es, 1980) Both Ghadira and Simar are reconstructed and engineered wetlands. It is known that the population of *Aphanius fasciatus* at Ghadira was introduced by the non-governmental organization that runs the sanctuary. Fish from two distinct natural populations, that at Salina and that which used to occur at Marsa, were introduced into Ghadira (A.E. Baldacchino, personal communication), which is unfortunate in view of the possible occurrence of different ecotypes. The same non-governmental organization in turn introduced fish from Ghadira to Simar. In addition to the population in the brackish water pool at Ghadira, a small population of killifish was found in a water reservoir (estimated volume *ca* 45m<sup>3</sup>) on farmland close to the Ghadira bird sanctuary, where they co-occurred with 'domestic' goldfish. The most likely provenance of this population is the Ghadira bird sanctuary.

Because of difficulty of access, population size could only be assessed visually for the populations in the reservoirs at Marsa and Ghadira and was estimated to be in the low hundreds in both cases. For the other localities an attempt was made to estimate the population by standardised

collecting and the results are shown in Table 1. However, these results are at best only indicative as the success of collecting these fish depends greatly on the habitat. Thus, at Simar, the fish could easily hide amongst reeds, which impede sweeping with the net, so the population here is almost certainly underestimated. The individuals at both Ghadira and at Simar were generally small, (size range 2-3cm and 3-4cm respectively) relative to individuals from Salina (size range 5-7cm).

#### CONCLUSIONS

Of the seven localities where *Aphanius fasciatus* has been recorded, it is now only found in four, Salina, Simar and Ghadira, and the reservoir at Marsa; fish may also possibly occur in the inner reaches of Marsa Creek, although none were spotted here during the present survey. All four populations are large and thriving. The populations at Ghadira and Simar occur in artificially engineered pools and are derived from mixed parent populations, originating from Salina and Marsa. Therefore, the only truly natural populations of this species that still occur in the Maltese Islands appear to be those at Salina and Marsa. Although thriving, both these populations are rather vulnerable since they occur in extremely anthropised environments: the first in the canals supplying the salterns and the second in a reservoir used for the storage of irrigation water.

The life cycle of *Aphanius fasciatus* does not include dispersal phases and therefore gene flow between different populations is very limited; consequently, the species

presents a high degree of morphological and genetic differentiation among populations (Tigano & Ferrito, 1985; Parenti & Tigano, 1993; Tigano *et al.*, 1999; 2001; Maltagliati, 1998; 1999; Ferrito *et al.*, 2002). Given the high scientific interest of *Aphanius fasciatus* and its actual threatened status, urgent intervention is required for the conservation of this species in the Mediterranean, and in particular of the last remaining natural populations in the Maltese islands.

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#### REFERENCES

- Bonello, A. (1992). *Vegetational and other changes at Il-Ballut saline marshland: a nature reserve in the making*. Unpublished B.Sc dissertation. Faculty of Science, University of Malta; ix + 124pp.
- Cilia, J.L. (1986) Il-Buzaqq (*Aphanius fasciatus*). *Potamon* [Malta] 15:131-136.
- Closs, A. & Zammit, C. (1973) Some notes on the genus *Aphanius fasciatus* (Val. 1811). *British Killifish Ass. Newsletter* 89: 4-6.
- Darmanin, L. (1979) The only killifish in Maltese waters. *The Sunday Times*, 11 March 1979, p.12.
- Despott, G. (1919) The ichthyology of Malta. Critien's Press, Valletta, Malta; 59pp.
- Farrugia Randon, S. (2001) *Il-Hut ta' Malta*. [Sensjela Kullana Kulturali 33] Pubblikazzjonijiet Indipendenza, Pieta, Malta; x + 126pp. [in Maltese].
- Farrugia Randon, S. & Sammut, R. (1999) *Fishes of Maltese waters*. [The authors], Malta; xiii + 248pp.
- Ferrito, V. & Tigano, C. (1995) The distribution of the ichthyofauna in the Simeto basin (Sicily). *Cybium* 19(2):187-198.
- Ferrito, V. & Tigano, C. (1996) Decline of *Aphanius fasciatus* (Cyprinodontidae) and *Salaria fluviatilis* (Blenniidae) populations in freshwaters of eastern Sicily. *Ichthyological Exploration of Freshwaters* 7(2): 181-184.
- Ferrito, V., Maltagliati, F., Mauceri, A., Adorno, A., & Tigano, C. (2002) Morphological and genetic variation in four Italian populations of *Lebias fasciata* (Teleostei, Cyprinodontidae). *Italian Journal of Zoology*, in press.
- Gulia, G. (1858-59) *Repertorio di storia naturale*. Anglo-Maltese, Valletta, Malta; 111 + 246pp.
- Kornfield, I.L. & Nevo, E. (1976) Likely pre-Suez occurrence of a Red Sea fish *Aphanius dispar* in the Mediterranean. *Nature* 264: 289-291.
- Lanfranco, G.G. (1958) *A complete guide to the fishes of Malta*. Dept of Information and Tourist Services, Valletta, Malta; 74pp. + 41 plates.
- Lanfranco, G.G. (1993) *The fish around Malta (Central Mediterranean)*. Progress Press, Valletta, Malta; xi + 132pp.
- Maltagliati, F. (1998) A preliminary investigation of allozyme genetic variation and population geographical structure in *Aphanius fasciatus* from Italian brackish-water habitats. *Journal of Fish Biology* 52: 1130-1140.
- Maltagliati, F. (1999) Genetic divergence in natural populations of the Mediterranean brackish-water killifish *Aphanius fasciatus*. *Marine Ecology Progress Series* 179: 155-162.
- Parenti, L. & Tigano, C. (1993) Polymorphic skeletal characters in *Aphanius fasciatus* (Teleostei: Cyprinodontiformes). *Copeia* 4: 1132-1137.
- Sammut, R. (2001) *Mediterranean fishes (central region)*. [The author], Malta; x + 203pp.
- Schembri, P.J. & Sultana, J. [eds.], (1989) *Red data book for the Maltese Islands*. Department of Information, Valletta, Malta; viii + 142pp.
- Tigano, C. & Ferrito, V. (1985) Studio osteologico comparato del cranio di popolazioni di *Aphanius fasciatus* Nardo (Pisces Cyprinodontidae) dell'Adriatico e dei fiumi di Sicilia. *Animalia* 12: 13-57.
- Tigano, C., Ferrito, V., Nicosia R. (1999) Morphological analysis of the pharyngeal jaws in two populations of *Lebias fasciata* Valenciennes, 1821 (Teleostei: Cyprinodontidae). *Journal of Morphology* 241:107-114.
- Tigano, C., Ferrito, V., Adorno, A., Mannino, M.C. & Mauceri, A. (2001) Pharyngeal and oral jaw differentiation in five populations of *Lebias fasciata* (Teleostei: Cyprinodontidae). *Italian Journal of Zoology* 68:201-206.
- Tortonese, E. (1986) Cyprinodontidae. Pp. 623-626. In: Whitehead, P.J.P.; Bauchot, M.L.; Hureau, J.C.; Nielson, J. & Tortonese, E. [eds] *Fishes of the North-east Atlantic and the Mediterranean* Vol.2. UNESCO, Paris, France.
- Villwock, V. (1985) Contribution on natural hybrids between two valid species of *Aphanius* (Pisces: Cyprinodontidae) from the Bardawil Lagoon, north Sinai, Egypt. *Rapport du Congrès de la Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée* 29(8): 57-63.
- Zammit, C. (1975) *Aphanius fasciatus* – a killi among non-killie keepers. *Ilma Car* [Malta] 13:16-18.
- Zammit, C. & Van Es, H. (1980) *Aphanius fasciatus* Valenciennes 1821. *Killi News: Journal of the British Killifish Association* 179: 141-144.