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Occurrence of the Giant African Snail in the Ogasawara (Bonin) Islands, Japan

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Abstract—The giant African snail, *Achatina fulica* Bowdich, was introduced from Taiwan into Ogasawara in the 1930's. The population gradually increased during the 1940's and reach high densities in the 1950's. During this period, snails spread over the entire islands and caused serious damage to agricultural crops in spite of hand picking and baiting with metaldehyde. The predatory land snail, *Euglandina rosea* Ferussac, was introduced from Hawaii to Ogasawara in 1965. However, its population density was very low and it was restricted to a few areas in Chichijima Island. In 1985, we started ecological studies on the life history of *A. fulica* and the factors responsible for fluctuation of its population density. In 1986, the population density of *A. fulica* started to decline sharply at all the infested areas. The reasons for this sudden decline of population after a 30-year build up have yet to be identified.

Introduction

The giant African snail, *Achatina fulica* Bowdich, has spread to the Indo-Pacific region from its original home of East Africa. In Japan, it is distributed in Ogasawara, Okinawa and Amami Islands (Koyano et al. 1989). In Ogasawara, *A. fulica* was first introduced to Chichijima Island in the 1930's (Mead 1961) and, in the 1950's, the population of *A. fulica* reached a high level in Chichijima Island (Mead 1961). Currently, *A. fulica* is distributed in Chichijima, Hahajima, Iwojima and Marcus Islands. In the former two, *A. fulica* has caused serious damage to agricultural crops. *A. fulica* is designated as a key plant quarantine pest in Japan. Ecological studies of *A. fulica* have continued since 1985 with the aim of controlling it in Ogasawara.

Life History

The life cycle of *A. fulica* in Ogasawara is shown in Fig. 1. In Ogasawara, the average temperature ranges from about 18°C in January and February to

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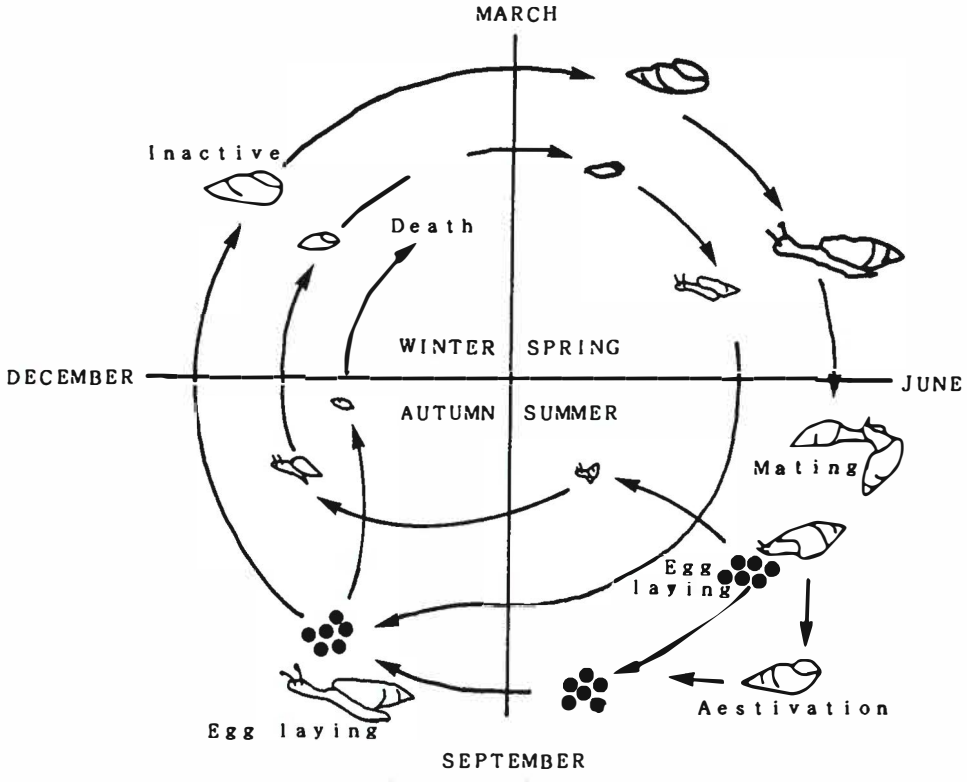

Figure 1. Life cycle of *A. fulica* on Chichijima and Hahajima Islands (modified from Yasuda & Suzuki).

27°C from July to September. The annual precipitation over the last 20 years has less than 1300 mm. Almost all the snails become inactive in late November and bury themselves in the soil. Activity resumes in April. Mating behavior has been observed in every season. The snails lay eggs from April to December, although most are laid between May and July with only a few between October and December. Aestivation is observed in the dry climate of mid summer. Autumn-born juveniles do not possess the tolerance for low temperature and are assumed to die. Thus, *A. fulica* seems to reproduce once a year in Ogasawara. Moreover, results of the outdoor research indicate that *A. fulica* needs one and a half to two years to grow from egg to adult. The life cycle of *A. fulica* in the Okinawa island is similar to Ogasawara (Suzuki and Yasuda 1983). Compared with other countries the life cycle in Japan is somewhat lengthy (Chang 1984).

Distribution and Fluctuation of Population

Ogasawara Islands are located 27°N and 142°E in the Pacific, about 1,000 km south of Tokyo under subtropical conditions. Chichjima is the main island of Ogasawara and is about 25 km^2 with 1,500 residents. The central part of this

island is about 300 m above sea level and the residential area is limited to the northern part of the island. *A. fulica* habitats are confined almost exclusively to areas around human residence with hardly any noted in the natural forests (Aoki 1978). We investigated the distribution of *A. fulica* in this island in 1985 and 1989 (Fig. 2). In 1985, live snails were found in 39 sites out of 52. The population size was about 75% of that estimated by Numazawa et al. (1988). However, 4 years later, in 1989, the population had dwindled to 36%. The distribution of *A. fulica* is restricted to few areas. Similar reductions in population and distribution were observed in Hahajima Island. Snails were smaller in size in the residential areas compared with those in abandoned agricultural areas and around the natural forests. In the former the rate of reduction of the population density from 1985 to 1989 was higher than in the latter.

The fluctuation of *A. fulica* population at one of the research sites in the residential area is shown in Fig. 3. More than 100 adult snails with shell lengths greater than 40 mm in 10 m² areas were found in 1985, compared with 30 in 1986, 10 in 1987, and only a few in 1988. Similarly, more than 60 juvenile snails per 10 m² with shell lengths of 20 to 40 mm were found in 1985 and have become rare since 1986. Fig. 4 shows the fluctuation of the percentage of snails with eggs and the density of egg clutches, juvenile and adult snails in the site with white popinac, *Leucaena glauca* Benth. The percentage of snails with eggs and the clutch density were very low from 1985 to 1986 resulting in a lack of juvenile snails in 1986.

Natural Enemies

There are some natural enemies of *A. fulica* in Ogasawara (Table 1). The most important one is the carnivorous snail, *Euglandina rosea* Ferussac which

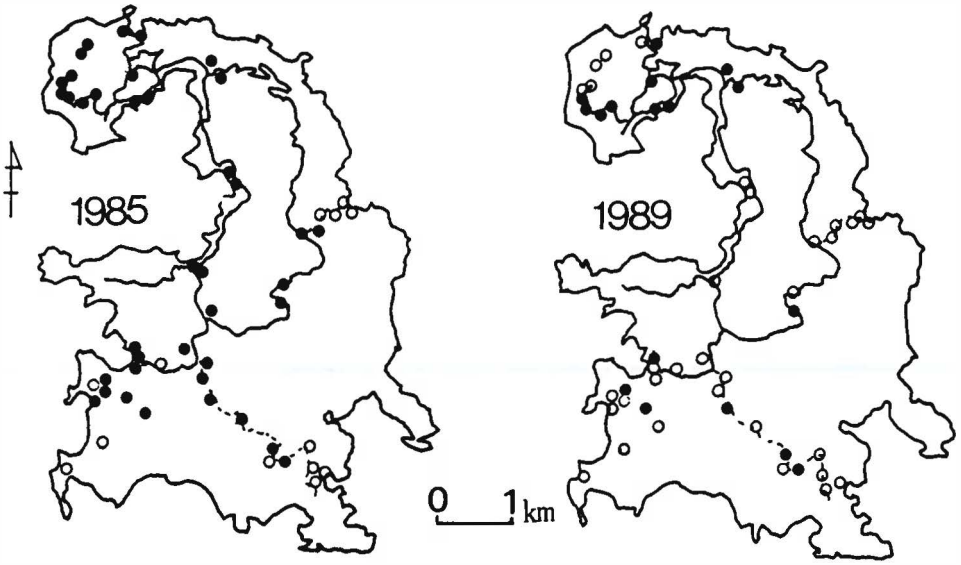

Figure 2. Distribution of *A. fulica* on Chichijima Island in 1986 and 1989. Solid circle (●) present: Open circle (○), no snail.

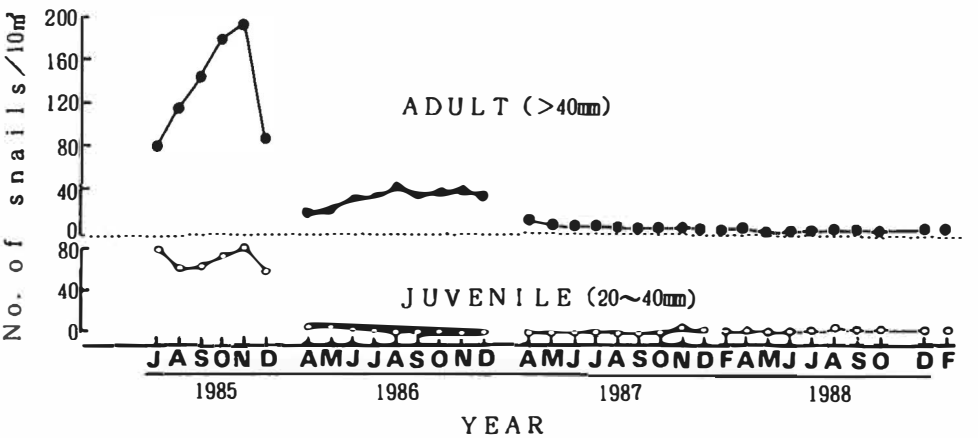

Figure 3. Population fluctuation of *A. fulica* at one of the research sites in the residential area on Chichijima Island.

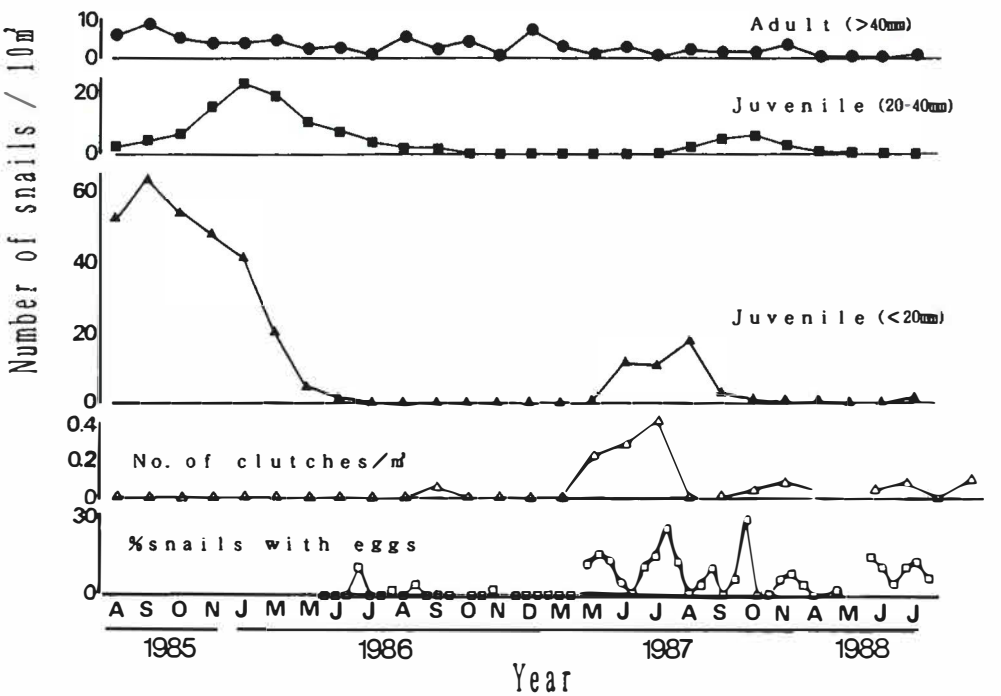

Figure 4. Fluctuation of the percentage of snails with eggs and the density of egg clutches, juvenile and adult snails in the site with White popinac, *Leucaena glauca* Benth on Chichijima Island.

was introduced from Hawaii in 1965. *E. rosea* was introduced to Hawaii from Florida in 1955 (Davis and Butler 1964). The *E. rosea* population increased suddenly 8 years after its introduction and reduced *A. fulica* population by about 20%. Since then *E. rosea* has been introduced to other Pacific regions. *A. fulica*

Table 1. Known species of natural enemies for *A. fulica* in Ogasawara.

Vertebrata		
	Bird:	*Turdus dauma* Latham[1]
	Mouse:	*Rattus rattus* Linnaeus
		R. norvegicus Berkenhout[1]
		Mus musculus boninensis[1]
	Frog:	*Bufo marianus* Linne
Arthropoda		
	Crab:	*Geograpsus grayi*[2] (H. Milne-Edwards)
		Sesarma dahaani[2] (H. Milne-Edwards)
		Metopograpsus messor[2] (Forskal)
		Ocypoda cordimana[2] (Desmarest)
	Hermit crab:	*Coenobita brevimanus* Dana
		C. purpreus Stimpson
		C. perlatus H. Milne-Edwards
Mollusca		
	Land snail:	*Euglandina rosea* Ferussac
Platyhelminthes		
	Flat worm:	*Bipalium* sp.
		Geoplanidae sp. or spp.

[1] Not confirmed by the present authors.
[2] From Iga 1982.

density in Chichijima was very high for more than 30 years and it was hardly affected by *E. rosea*. The distribution of *E. rosea* was very limited, and also the population was low.

Some of the terrestrial turbularian flatworms are said to be remarkable enemies of *A. fulica*. Muniappan (1986, 1987) reported that *Platydemus manokwari* de Beauchamp effectively reduced *A. fulica* in Guam and other islands. A different species of that worm occurs in Ogasawara. It does feed on *A. fulica*. It occurs in low density and its distribution is limited. Therefore, we consider it was not responsible for the reduction population of *A. fulica*.

Some land crabs were reported to on feed *A. fulica* (Iga 1982). Other natural enemies were also reported to feed on *A. fulica*, but no information is available on their effectiveness.

Control

A. fulica has been controlled using metaldehyde pellets in farming areas. The recent reduction in population of *A. fulica* has reduced it to below pest density in Chichijima and Hahajima.

A. fulica is distributed throughout Chichijima, while *E. rosea* occurs only in limited areas (Fig. 5). *E. rosea* also occurs near natural forests. More than 60 species of land snails endemic to Ogasawara occur in these natural forests (Kurozumi 1988). As these species are natural monuments, it is not advisable to

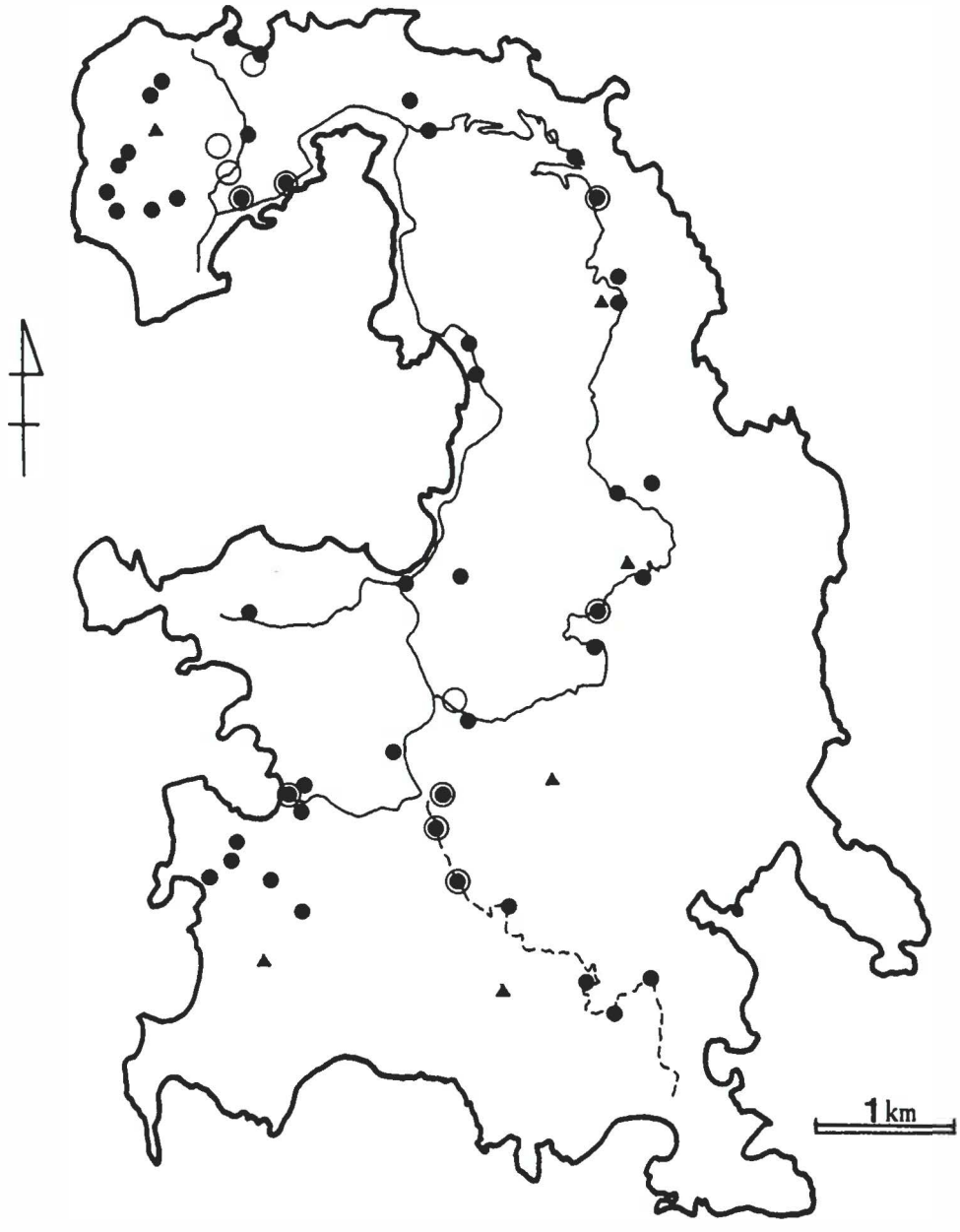

Figure 5. Distribution of two snails, *A. fulica* (●) and *E. rosea* (○), on Chichijima Island.

release *E. rosea* or *P. manokwari* in these areas. An understanding of the factors responsible for change in population density and life history are more important than biological control in Ogasawara.

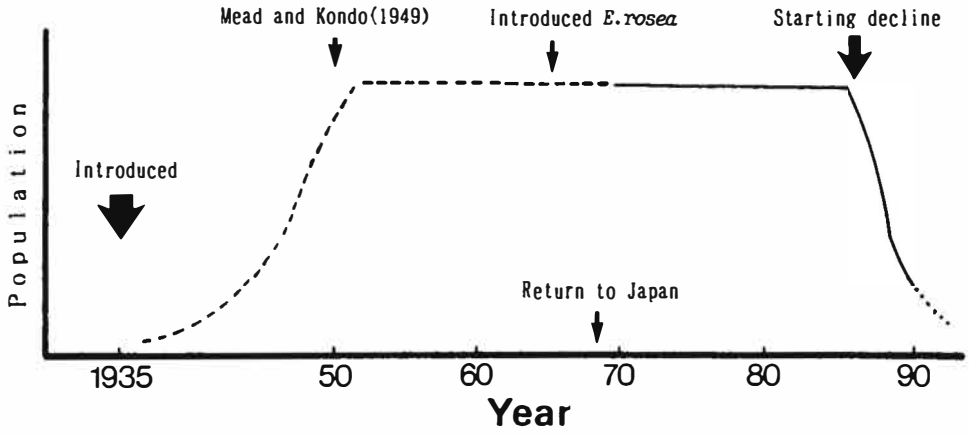

Figure 6. Supposed trend of *A. fulica* populations in Chichijima for last 55 years.

Conclusion

Since Ogasawara was returned to Japan, *A. fulica* remained at a high density for more than 30 years in spite of various control methods. *A. fulica* population has suddenly declined since 1986 in Chichijima and Hahajima islands (Fig. 6). The extremely low percent snails with eggs during 1985 and 1986 might have caused reduction in production of adults. Also our investigation to determine the possible climatic effects on the reduction *A. fulica* did not produce any positive results. Complex factors responsible for this phenomenon are currently being investigated.

Our future research of *A. fulica* will mainly be aimed at understanding the factors that change the population of *A. fulica*. In addition, we plan to compare the population dynamics of other *A. fulica* populations in the Pacific region.

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