Preliminary Data on the Biology and Reproduction of *Ambrosina bassii* L. (Araceae) in Corsica

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ABSTRACT

This study explores the floral biology and reproduction mode of *Ambrosina bassii* L. that belongs to a monospecific genus of the subfamily Aroideae (Araceae).The species has a limited distribution and the number of mature plants within natural populations is low. Reproductive success of this species is limited due to low fructification and seed rates, however there is a positive relationship between the plant vigour and its investment to the reproduction. In stable habitats, there are more flowering plants than in newly colonized habitats, where the frequency of juvenile non-mature plants is higher. The knowledge of these biological and reproductive characters constitutes the first data useful for the preservation and the management of this rare, endangered and protected species on Corsica.

KEY WORDS

Ambrosina bassii, endangered species, reproductive biology, floral characters

INTRODUCTION

Species with a limited distribution range are often considered to be rare. This is the case of *Ambrosina bassii* L., which belongs to a monospecific genus of the tribe Ambrosineae in the subfamily Aroideae (Mayo *et al.,* 1997). This stenomediterranean species is present in Algeria but its populations there have almost disappeared. It persists in Italy (South Italy, Sardinia, Sicily) and in the south of Corsica, the northern limit of its distribution range.

While the floral morphology of the species has been studied recently (Barabé *et al.,* 2004), almost nothing is known about its biology. According to our knowledge, only two papers deal with the biology and ecology of *Ambrosina bassii* (Killian, 1929, 1933). These 70-yr old works dealt with the development and distribution of the species in Algeria according to the soil composition, with very few data on the reproductive biology. According to these papers, the flowering period begins in the fall with the first rains and lasts until spring. This species can multiply vegetatively by the production of bulbils after 3 yrs, but it takes 4 yrs before an *Ambrosina* individual reaches its mature stage and flowers (Figs. 1A, 1B, 1C).

The fructification rate is apparently very low as infructescences are rare (Fig. 1G). Killian (1929, 1933) mentioned that inflorescences could be visited by springtails, Embiideae (Orthoptera), earwigs (Dermaptera) and millipedes; but considers these animals to be accidental visitors looking for a safe place. In fact, more abundant were mites from the genera *Penthaleus* or *Bdella*. These insects would complete all their developmental cycle within the inflorescence and could be the pollinators. The seeds have an elaiosome and are dispersed by ants.

Ambrosina bassii L. is a small herb with a rhizomatous tuber of 4–8 cm (Fig. 1A).

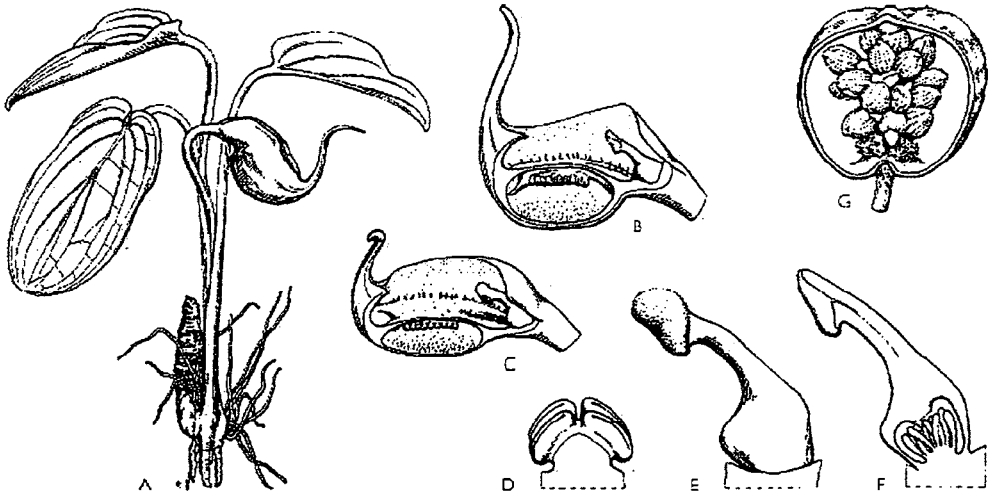

Fig. 1. Floral and vegetative morphology of *Ambrosina bassii* L. A: habit, B & C: inflorescence, D: male flower, E & F: female flower, G: infructescence (drawings from Mayo *et al.*, 1997).

The leaves (2–4) are obtuse and glabrous, and appressed to the soil (Fig. 1A). The spathe, which also lies on the ground, is pale green, more or less red-purple tainted, with a curved beak apex (Figs. 1B & 1C). The spadix is fused to the internal wall of the spathe which forms two longitudinal chambers separating the male flowers in the lower chamber from the single female flower in the open upper chamber (Mayo *et al.*, 1997, Fig. 2).

The floral morphology of *Ambrosina bassii* has been studied in a recent paper (Barabé *et al.*, 2004). The female and male zones are situated on opposite side of the spadix (Fig. 2; Mayo *et al.*, 1997). The female zone is made up of one gynoecium

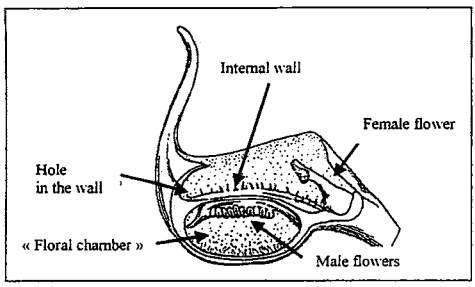

Fig. 2. Detail of *Ambrosina bassii* inflorescence (after Mayo *et al.*, 1997).

located on the superior face of the inflorescence (Fig. 2). The long style is curved towards the axis of the spadix, which is represented by the median wall of the inflorescence. The ovary has one locule which contains many ovules (Mayo *et al.*, 1997). The male zone, localized on the inferior face of the inflorescence, constituted of 16 to 24 thecae arranged more or less in two longitudinal rows of 8–11 thecae each (Barabé *et al.*, 2004). The thecae are grouped by two, occasionally by three; they are orientated transversely and opened by longitudinal slits (Fig. 2; Mayo *et al.*, 1997; Barabé *et al.*, 2004). Globular masses looking like glandular structures are present at the base of the thecae, but their role is unknown (Barabé *et al.*, 2004). The spadix surface is also covered by glandular hair-like structures. At anthesis when the pollen is shed, the discoid stigma is closely appressed to the surface of the spadix (Barabé *et al.*, 2004).

Ambrosina bassii is a stenomediterranean species present in Algeria (but known to have been disappearing in the 1930s), in Italy (South Italy, Sardinia, Sicily), but also present on Corsica (France) which represents the northern limit of its distribution range (Fig. 3).

Fig. 3. Distribution map of *Ambrosina bassii* L. (From Mayo *et al.*, 1997). Genera of Araceae (1997) does not indicate the species for Corsica.

This species was first discovered on Corsica in 1975 at "la Rondinara" by Bosc, Conrad & Pascal and later on a few other sites (Dutartre & Deschâtres, 1986; Deschâtres, 1988; Paradis, 1994). It is restricted to the Southern Corsica: Bonifacio (Bocca d'Arbia, Sant'Amanza, between Pomposa and Musella), at "la Trinité", Ventilègne (shooting range of Frasselli, Testa di u Gattu), Oriental Coast (between "Cap blanc" and the pond of Balistra), and at Suartone-Rondinara.

This study is a preliminary work on the population dynamics, the floral biology and the reproductive mode of *Ambrosina bassii* which is an endangered and protected species on Corsica (Torre, 2003). It will give the first data useful to develop a potential management program for the preservation of this rare species on Corsica.

MATERIALS AND METHODS

Species Status

Ambrosina bassii is considered vulnerable according to the UICN criteria and is cited in the first volume of the Red List of threatened species. In France, this species is protected (annex I of the law text of January 20th 1982) but its populations are not submitted to any management and conservation program even if they are located on a precarious habitat (e.g. littoral).

Studied Sites

Two populations were studied in the Bonifacio area: one population on the back of a beach at "la Rondinara", and one population near Suartone on scrubby burned hills on the road to Rondinara beach. Inflorescences of *Ambrosina bassii* were collected on December 2003, and the infructescences in March 2004 (Torre, 2003).

On each specimen from the two populations (N = 35 at "la Rondinara" and N = 48 at Suartone), several vegetative characters were measured (diameter, number of leaves, length and width of the limb). In addition, the surface of the limb was estimated by considering it as an ellipse with the following formula: surface = $\pi/4$ x L x l.

Characters associated with the reproductive system were also measured (numbers of inflorescences, of stamens and of ovules) on plants of both populations (N = 25 at "la Rondinara" and N = 18 at Suartone). Experiments of hand-pollinations were performed on 20 individuals from each of the two populations. Self-pollination is considered to be impossible, due first to the protogyny of the inflorescence and second to the unique inflorescence architecture with a wall separating male and female flowers in two different chambers. Infructescences (N = 13 at "la Rondinara" and N = 19 at Suartone) were also collected in order to estimate seed rates. Collected inflorescences and infructescences were conserved in 70% alcohol. Inflorescences were dissected under stereomicroscope in order to count first the stamens, and second the ovules within each ovary. Developed infructescences were opened in order to count the number of mature seeds.

Statistical Analysis

In order to find characters which could be indicators of the plant's vigour and of its reproductive potential, linear regressions were performed among the measured characters considering individuals from all the populations.

Analysis of variance and frequency distribution tests (χ^2) were performed using SYSTAT software (1998) in order to detect

Table 1. Description of the vegetative characters (mean ± standard deviation) of *Ambrosina bassii* L. in two Corsican populations.

Population	Diameter (mm)	Leaf number	Leaf length (mm)	Leaf width (mm)	Leaf surface (mm^2)
Rondinara	71.5 ± 20	2.6 ± 0.85	34.1 ± 8.2	22.7 ± 6.3	812 ± 392
Suartone	52.9 ± 17.7	2.2 ± 0.7	27.8 ± 6.3	17.5 ± 3.5	505 ± 195

significant differences between populations, individuals with different size classes (in term of the leaf number) and finally between juvenile (without an inflorescence) and mature individuals (with at least one inflorescence).

RESULTS

1—Individual Description

a—Vegetative characters—Plants from the two populations "la Rondinara" and Suartone are not significantly different for all the measured characters (Table 1).

b—Reproductive characters—Analysis of variance showed no differences between the two studied populations (Table 2) for the number of stamens ($F_{1,44}$ = 0.822, p = 0.37) and of ovules ($F_{1,44}$ = 0.09, p = 0.77). In contrast, plants from "la Rondinara" population produced an inflorescence more frequently (i.e. mature individuals are more frequent) than those from Suartone ($F_{1,44}$ = 8.9, $p < 10^{-3}$; Table 2).

2—Population Structure

a—In classes of size—Plants with two leaves are the most frequent in both studied population and they represent about half of all the individuals (Fig. 4). About a quarter of the individuals have three leaves (Fig. 4). In contrast, the two populations statistically differ in their frequencies of very young plants (i.e. with one leaf) and of oldest ones (i.e. with four leaves). Thus, the population of Suartone contains more young individuals (i.e. with one leaf) and fewer plants with four leaves than the population of "la Rondinara" (χ^2_3 = 38.1, $p < 10^{-3}$).

b—In number of mature individuals—The probability of flowering increases with the age of the plant (estimated as the number of leaves). Hence, young plants with one leaf have a very low probability to flower (6%), plants with two or three leaves have about 50% to flower, whereas plants with 4 or more leaves flower in more than 70% of the cases (χ^2_3 = 40.36, $p < 10^{-3}$, Fig. 5).

3—Manual Pollinations

The fructification rate in natural conditions does not vary among the two studied populations (χ^2_1 = 0.54, p = 0.46), in average 17.4% of the inflorescence are pollinated and produce a mature infructescence (Table 3). The fructification rate after hand-pollination is higher (26%) than

Table 2. Reproductive characters (mean ± standard deviation) of *Ambrosina bassii* in two Corsican populations.

Population	Inflorescence number	Number of stamens per inflorescence	Number of ovules per inflorescence
Rondinara	0.83 ± 0.4	16.5 ± 2.6	48.4 ± 9.1
Suartone	0.38 ± 0.49	15.8 ± 1.8	49.4 ± 13.7

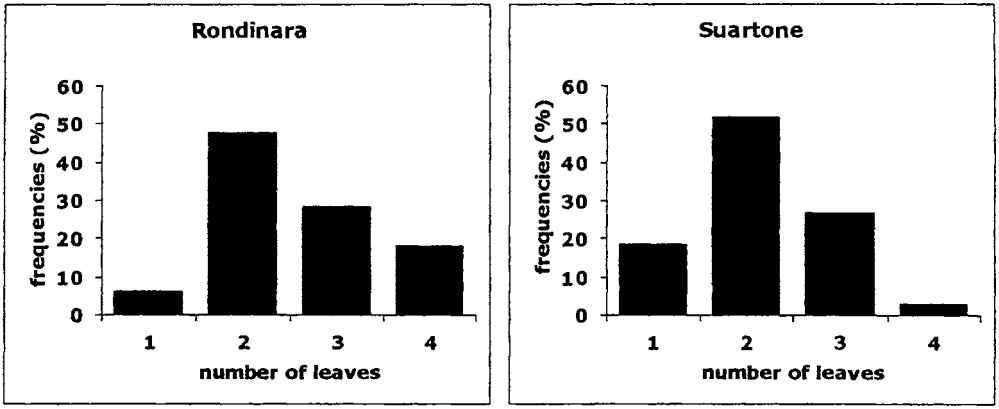

Fig. 4. Distribution in size classes (i.e. number of leaves) of *Ambrosina bassii* L. in the two studied populations "la Rondinara" (N = 344) and Suartone (N = 172).

in natural conditions but these two fructification rates are not statistically different (χ^2_1 = 1, p = 0.32).

For statistical analysis purposes only infructescences which produced seeds were retained. In fact, five inflorescences in natural conditions and two in the hand-pollination treatment didn't produce any seeds. Inflorescences pollinated naturally produced on average 15.5 (±8.9) seeds whereas hand-pollinated individuals matured a mean of 23.2 (±3) seeds. The difference between these two numbers of seed productions is weakly significant ($F_{1,52}$ = 3.56, p = 0.06). Thus it can be seen that the reproductive success of *Ambrosina bassii* is quite weak since only about 32% of the ovules mature as seeds.

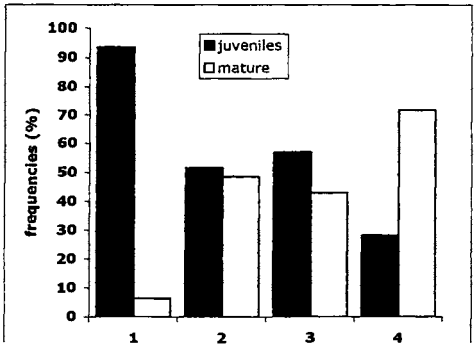

Fig. 5. Distribution of flowered and non-flowered *Ambrosina bassii* L. according to their number of leaves (N = 293).

4—Flower Variation

There is a positive linear regression between the plant vigour (estimated as the leaf length) and the number of ovules contained in the female flower ovary ($F_{1,44}$ = 7.6, p = 0.008, Fig. 6). By contrast, no such relationship exists for the number of stamens per inflorescence which remains constant whatever is the size of the leaf ($F_{1,44}$ = 1.09, p = 0.3, Fig. 6).

Table 3. Number of marked inflorescences in both studied populations and numbers of maturing infructescences. Manual pollinations are hand-pollinated inflorescences with the corresponding number of maturing infructescences.

Population	Number of inflorescences	Number of infructescences
Rondinara	46	8
Suartone	35	9
Manual pollinations	20	7

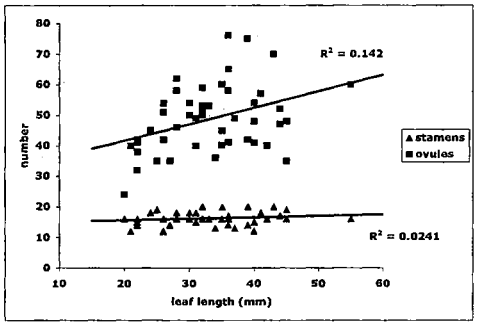

Fig. 6. Variations of the number of stamens (triangles) and of ovules (squares) in *Ambrosina bassii* L. according to the length of the leaf.

DISCUSSION

This preliminary study made on Corsica is the first contribution to understanding the vegetative and reproductive characteristics of *Ambrosina bassii* L. First of all, our results show that the number of mature plants is relatively low in the natural populations. Moreover, the reproductive success of this species in natural conditions is also low, only 17% of the inflorescences mature into infructescences of which only 32% of the ovules set seeds. We did not observe any insects in the opened inflorescences studied. The reproductive success is apparently limited by the rarity of the pollinators. Any difference for hand-pollinated inflorescences to produce more seeds than those in natural conditions may have been obscured by the unequal sample size between the two treatments: only 5 plants were analysed for the hand-pollination treatment against 49 for natural conditions. Such an experiment should be repeated to confirm or deny this tendency.

There is a relationship between the plant vigour and its investment in reproduction. First, larger plants with three or four leaves do flower more frequently than smaller ones. Second, mature plants with bigger leaves produce more ovules, and thus potentially seeds, than plants with smaller leaves. Moreover, this reproductive investment affects only the reproductive female function since the reproductive male function, in terms of the number of stamens, does not vary according to the plant vigour. We consider here that the number of pollen grains per stamen does not vary with the plant vigour, but this hypothesis must also be confirmed in future works.

The two studied populations appear to be in different demographic situations. At Suartone, the population is apparently colonizing a new habitat after a fire and contains a higher frequency of young / small individuals. In contrast, the population at "la Rondinara" may be more at an equilibrium occupying a restricting habitat, rocks at the back of the beach.

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