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On r- And K- Selection Theory: Life History Strategy of Emilia Coccinea (Sims) G. Don and Emilia Sonchifolia (Linn.) Dc

Aderopo Akinsoji
Department of Botany, University of Lagos.
Email-<aderopoakinsoji@yahoo.com

Abstract
Roots , stems, leaves and flowers of *Emilia coccinea (Sims)G. Don* and *Emilia sonchifolia* were harvested, separated and oven-dried at 110^0 C for 48 hours and then weighed to determine what proportion of their total biomass was allocated to each of the tissues. *E. coccinea* allocated 42.65% and *E. sonchifolia* allocated 36% of their total biomasses to stems respectively. These represent the greatest allocation of their total biomasses allocation. However, *E. sonchifolia* allocated a relatively greater proportion of its biomass to reproductive structures than *E. coccinea*. *E. coccinea* allocated 93.4% of its biomass to vegetative tissues while *E. sonchifolia* allocated 70.1% to vegetative tissues. The two species allocated about the same percentage of biomass to roots. On the basis of their allocations to vegetative and reproductive tissues *E. coccinea* can be said to be K- selected with respect to *E. sonchifolia* which is r- selected. The result of this study supports the r- and K- selection theory.
Keywords: life-history strategy, *Emilia coccinea, Emilia sonchifolia*. r-and K. selection

1. Introduction.

Natural selection dictates the life-history strategies of organisms. Dobzhansky (1950) observed two types selection based on environmental factors but did not clearly conceptualize his observation. The two terms r- and K- selection were coined by MacArthur and Wilson (1967) from the logistic equation. r- refers to the Malthusian parameter r_{max}, which is the maximal intrinsic rate of natural increase and K- refers to the carrying capacity. r-selected organisms are known to inhabit unpredictable environments which are subject to disturbance any time hence they reproduce early and produce large numbers of offspring to ensure continuity of the species. Consequently they are smaller in size, have early and rapid production and relatively short life spans. It is not coincidental that they devote a substantial amount of their resources to reproductive structures. K- strategists inhabit a relatively predictable and stable environment where competition is keen and consequently devote a greater proportion of their resources to body growth and maintenance for a better competitive ability. They have relatively large bodies, delayed reproduction and fewer offspring. Their population size is at or near the carrying capacity of the environment. The characteristics of these two types of organisms are well documented in Pianka (1970).

r- and K – selection are relative relationships, hence they are not absolute. However they provide a basis for comparison of organisms' life-history strategies. An organism is r- selected with respect to another and in a particular set of environmental of environmental conditions. As conditions change, it may progressively become more K-selected. Herbs have been indicated to be the most suitable materials for selection studies (Gadgil ans Solbrig, 1972). In this study, *Emilia coccinea* and *Emilia sonchifolia*, two herbaceous plants growing in contrasting environments on Mambilla Plateau , Taraba State, Nigeria were selected for this study (Fig 1). The study attempts to find out which of the two is r-selected with respect to the other based on allocation of biomass to reproductive and non-reproductive tissues and hence test the r- and K- selection theory.

2. Materials And Methods.

Forty randomly selected *Emilia coccinea* plants were carefully uprooted first by digging a hand trowel through the soil at the base of the plants to ensure that as much as possible all the roots were completely removed. The samples were brought to the Nigerian Conservation Foundation office in Yelwa. Each plant was cut into roots, stem, leaf and flower portions. The portions were wrapped in aluminium foil and sundried for a week after which they were taken to the Botany Laboratory at the University of Lagos. Further drying was done by placing the portions in an oven at 100^{0}C for 48 hours. The weights of the portions were then measured using a Mettler balance and recorded. The mean biomasses of roots, stems, leaves and flowers were calculated. From these, the mean total biomass was obtained as the sum of all the biomasses. The percentages of each portion were also calculated. Reproductive effort of the two plants were calculated as the proportion of the reproductive tissue in then total aerial tissue (Gadgil and Solbrig, 1972). The same procedures were used for *E. sonchifolia*.

3. Results

The biomass data are presented in Table 1. *E coccinea* flowers had the least mean biomass (0.89g) and a percentage of 6.9% while the stem has the largest mean biomass of 5.37g with a percentage of 42.65%. The leaves have the next largest biomass of 4-5g and a percentage of 35.7% while the root has a mean biomass 1.89g which constitutes 15% of the total biomass. For *E. sonchifolia*, the root biomass of 0.9g amounts to 4.15% 0f the total biomass while flowers have a mean biomass 1.9g or 29.89% of total biomass which is relatively large when compared with 6.5% of *E. coccinea.* The stem has a mean biomass of 2.29g and a percentage of 36% which is the largest allocation to biomass in *E. sochifolia.* The leaves have a mean biomass allocation of 1.27g or 19.96%. Incorporated in Table 1 is the reproductive efforts and percentage reproductive efforts of the two plants.

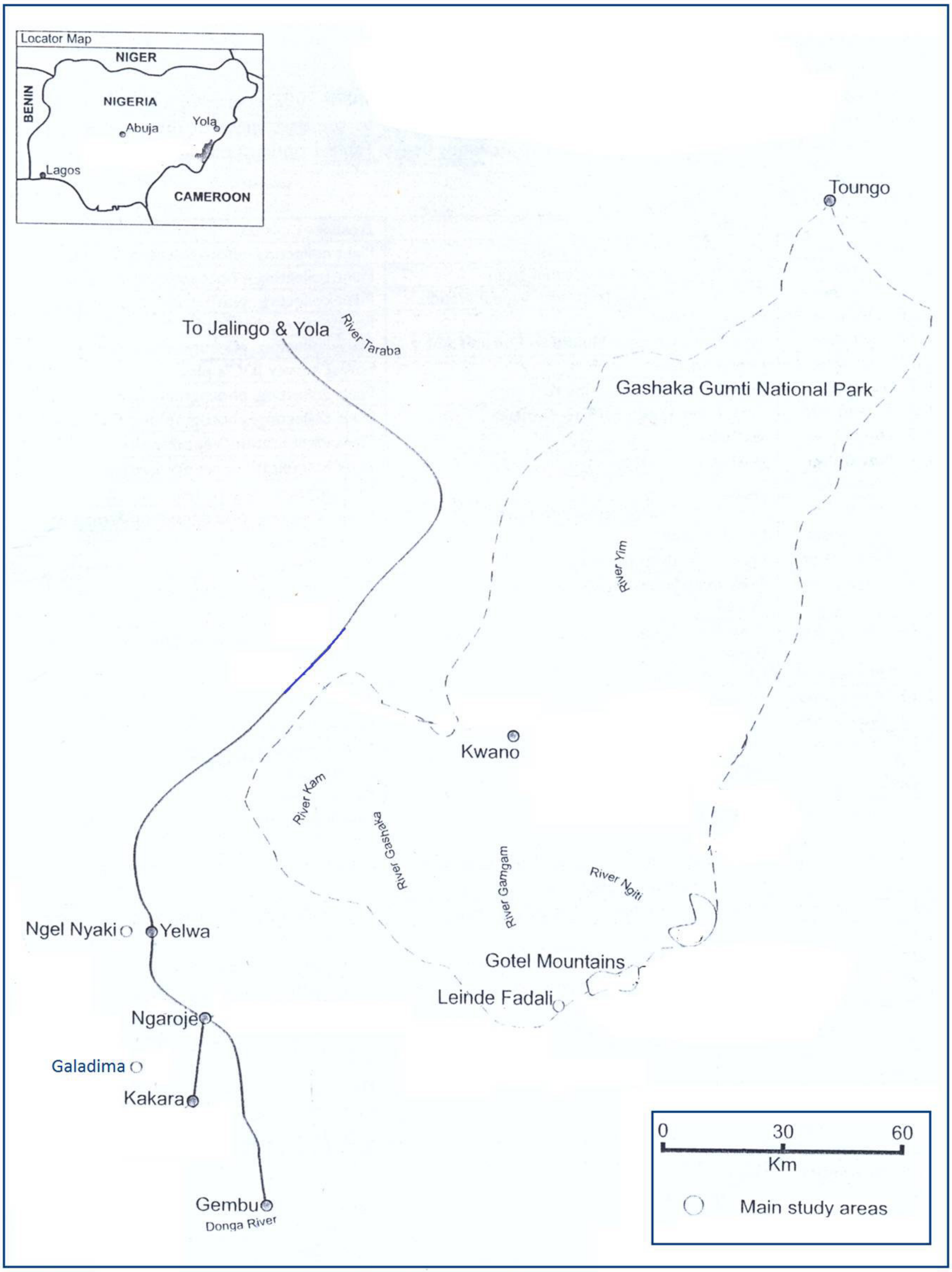

Figure 1: Map Of Mambilla Plateau Showing Study Sites. (Adapted From Chapman *et.al.,* 2003)

TABLE 1: Biomass allocation to plant parts in *Emilia coccinea* and *Emilia sonchifolia*

N=40	Root (mean biomass/g)	Stem (mean biomass/g)	Leaf (mean biomass/g)	Flower (mean biomass/g)	Reproductive effort (g)	Total biomass(g)
Emilia coccinea	1.89 (13%)	5.37 (42.65%)	4.5 (35.7%)	0.83 (6.59%)	0.078 (7.75%)	12.59
Emilia sonchifolia	0.9 (14.15%)	2.29 (36%)	1.27 (19.96%)	1.9 (29.87%)	0.346 (34.6%)	6.36

The percentage reproductive effort of *E sonchifloia (34%)* was significantly higher than that for *E. coccinea* (7.7%) ($p < 0.01$). Fig. 2 shows percentage allocation of biomasses to different parts by these plants while Fig. 3 shows that both allocated more biomass to vegetative tissues but *E sonchifolia* allocated a higher percentage of its biomass to reproductive tissues.

4. Discussion.

Emilia sonchifolia allocated a greater portion of its biomass to reproductive tissue than E. coccinea thus its r-selected compared to *E. coccinea*. This can be explained by the habitat differences. *E. sonchifoloia* was collected from a habitat that is relatively disturbed by farming activities while *E. coccinea* was collected from a relatively undisturbed habitat. This allocation of biomass supports the r- and K-selection theory. Gadgil and Solbrig (1972), Adamson and Gadgil (1973) obtained similar results with goldenrods (*Solidago* spp) while Solbrig and Simpson (1974) obtained similar results with *Taraxacum officinale*. The percentage reproductive effort of E. *sonchifolia* was four times greater than that of *E coccinea*. Harper *et a*l, 1970) established that organisms which allocate a smaller fraction of their resources to reproduction are K-selected thus *E. coccinea* is K- selected compared with *E. sonchifloia*. However both species allocated greater percentages of their biomasses to vegetative tissues (Fig. 3). Gaines *et al* (1974) obtained similar results with Helianthus spp. This is not surprising since a greater proportion of biomass must be allocated for growth and maintenance to successfully compete in a relatively undisturbed and mature habitat such as in Yelwa. For *E. sonchifolia*, the plants have to primarily maintain themselves to be able to support , nourish and sustain the reproductive structures. It was observed at the onset of the experiment that *E. coccinea* plants were bigger thus supporting the assertion of Smith (1954) that larger organisms are known to be more K- selected than smaller organisms. The low proportion allocation to roots by both species can be explained by their perennial habitat as elaborate and extensive root systems are not developed. However, the biomass allocation to roots could have been underestimated since it was not possible to have removed all the rootlets from the soil while sampling.

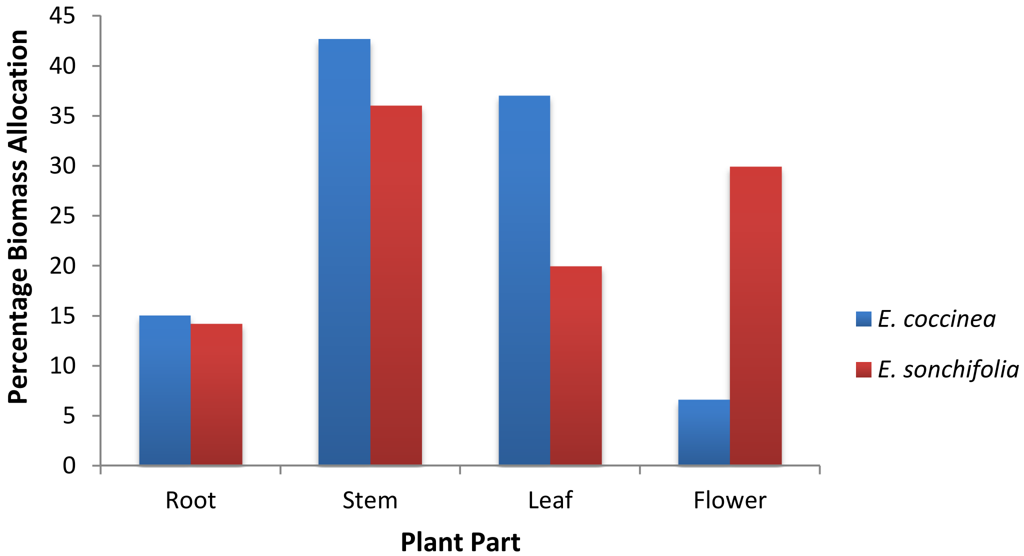

Figure 2: Comparative biomass allocation in *E. coccinea* and *E. sonchifolia*

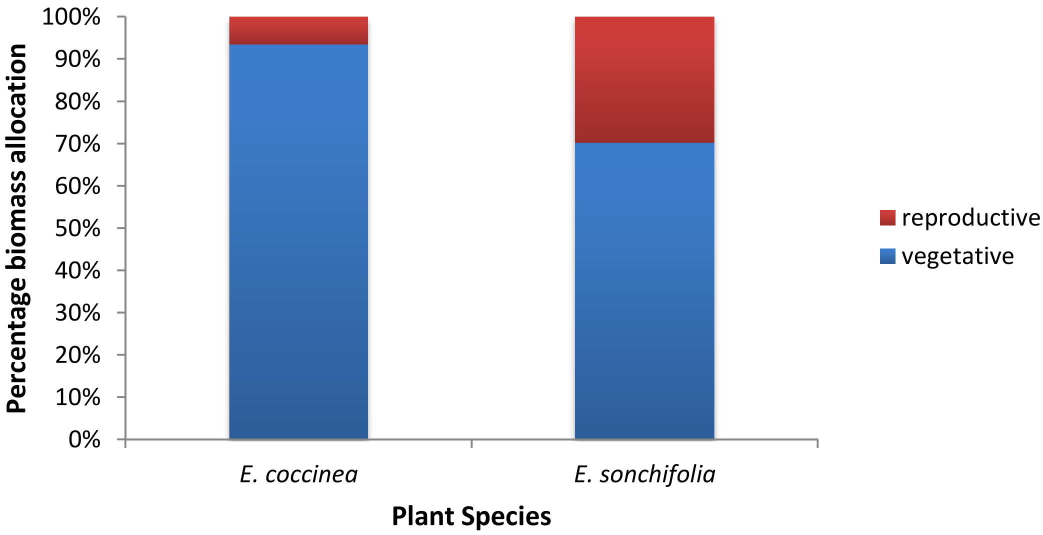

Figure 3: Percentage biomass allocation to Vegetative and Reproductive Parts

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