COMPETITION AS A DOMINANT CONCEPT IN ECOLOGY: ON THE UNITY OF SCIENCE AND IDEOLOGY

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ABSTRACT. According to Kuhn's model, Ecology is a case of "normal science" which accepts the central postulates of the Malthusian Darwinian paradigm concerning the imbalance between populations, and resources, and the competition established among organisms to obtain the largest amount of resources for their survival. Ecology's discourse confer to competition a preponderant role, attempting to objectify its discourse through the construction of mathematical models. Concepts like "niche" and "competitive exclusion" reinforce this naturalization of competition, which has been compared to that existing among businessmen or sportsmen. Thus, by observing human society in a particular way that is extended to all species, Ecology may collaborate to make science an expression of ideology.

KEY WORDS. Competition, Ecology, ideology, paradigm, conceptual transference, niche, competitive exclusion, mathematical model.

INTRODUCTION

Born at the end of the nineteenth century, Ecology adopted the basic assumptions of the Malthusian-Darwinist model. One century later, Ecology itself can helps us to understand this model and how it is specialized, internalized, completed and made perfect. It also assists us to understand the ideological implications involved; among other things, because they can lead to particularly important consequences when contemporary human ecological and demographic problems are analyzed. Such is the case of the present ecological crisis, where its hegemonic interpretations possess a clear Malthusian-Darwinist character and in which some of its main experts have started their research in the field of basic Ecology [1].

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Using Thomas S. Kuhn's terminology (Kuhn, 1962), it can be affirmed that while Malthus and Darwin imposed upon themselves the task of building a paradigm, the scientists who started researching at the end of the nineteenth century in the attempt to consolidate Ecology as a discipline, set for themselves the task of completing and consolidating that paradigm in a period of what may be seen as "normal science". This distinction is fundamental because when the discourse and terminology utilized in Ecology are analyzed (particularly that of Population Ecology), it can be noted that the reality of the phenomena which did not seem so obvious in the writings of Malthus, Darwin and their contemporaries, have now become accepted without much discussion. In their time, both Darwin and Malthus made a great effort in discovering, delimiting, and explaining all those phenomena to the public. Ecology, on the other hand, could be characterized as an example of "normal science" which, according to Kuhn, consists in widening the knowledge of the facts that are shown as relevant for a particular paradigm, but do build new types of phenomena or discover new theories as a goal (*Ibid*, pp. 24, 35).

At the end of the nineteenth century, ecologists accepted as central the following Malthusian-Darwinist thesis, which constitutes the fundamental elements of their paradigm:

1. Species possess a natural tendency to reproduce indefinitely and geometrically if that tendency goes unchecked.
2. The resources that allow the survival of species, in contrast, grow at arithmetical rates.
3. This obligates all species to enter a permanent competition in order to have access to these resources; this contest is expressed in terms of the "struggle for existence".
4. One of the central mechanisms that explain both the evolution of species and human society is this struggle for existence, in which only the fittest individuals survive.

Once Ecology is founded as a discipline and its Malthusian-Darwinist assumptions internalized, it will work with models more progressively specific, to population structure and dynamics. The typical generality found in the populational thesis of Malthus and Darwin vanishes as Ecology develops, and so, any links with the ideological features of the paradigm become more and more invisible and mediated.

I. ECOLOGY IN THE BEGINNINGS AND THE CONCEPT OF COMPETITION

As previously stated, it will not be until the nineteenth century when discussions on the role of competition in the living world reach a peak.

First, Lyell and Auguste de Candolle—who affirmed in 1829 that all species of a region are found in a permanent state of struggle—paid attention to the role of the competitive process that takes place in nature. The way Darwin was influenced at the middle of such century by these ideas and concepts which originated in Political Economy, has been widely discussed (Bowler, 1976; Gale, 1972; Gordon, 1989; Herbert, 1971; Schwartz, 1974; Schweber, 1977; 1980, Vorzimer, 1969, Young, 1969, 1971a, 1971b, 1973, 1985). Around this time, the conceptions about the "balance of nature" will be strongly criticized by Darwin as well as by A. R. Wallace, who claimed that instead of balance a state of struggle, in which some individuals frequently exterminate others, prevails in nature. A static vision of nature is thus transformed into a dynamic one (Egerton, 1973), in which the Malthusian assumptions start to play a relevant role. Towards the end of the nineteenth century and the beginnings of the twentieth, concepts like 'niche' and 'competitive exclusion' are being used as a consequence of the relevance of those Malthusian principles already adopted by Darwin (*Ibid*). However, up to this moment, the role of competition is merely pointed out, leaving as a task for future ecologists to determine the precise nature and the details of this process. As Clements (1909) stated: "Competition has, however, been almost completely neglected until the ecologist has begun the investigation of it in the last few years, and there are few subjects in which botanical opinion is so completely unformed."

While fully accepting the postulates of the Malthusian-Darwinist paradigm, the first ecologists utilized a very direct language; they declare clearly that their thesis were supported by the central postulates of such paradigm. An example can be found in the work of S. A. Forbes, an American ecologist who pointed out in 1880:

> For the purposes of this inquiry I shall assume as established laws of life, the reality of the struggle for existence [...] I shall also postulate, as an accepted law of Nature, the generalization that the species is maintained at the cost of the individual.

In that same article he also emphasizes:

> Reproduction being more active than is necessary, the individual force and activity will be less than it might be, the species will be at a disadvantage in the search for food and in all its other activities, as compared with other species more exactly adjusted, or, as compared with members of its own species which tend to a better adjustment. As soon as a better competitor appears, the other must begin to suffer, and in the long course of evolution will almost certainly disappear.

Here is one of the traits that are repeated throughout the history of population dynamics analysis: the transposition of concepts and analo-

gies from the living world to human society and viceversa. This way several pre-Malthusian authors and Malthus himself found one of the basis for the analysis of animal and vegetable population growth (Henry, 1907, cited in James, 1979, Smith, [1776] 1966[2]). Darwin, on the other hand, stood on the Malthusian principles of human demography in order to explain animal and vegetable population dynamics. By doing so, he left the field prepared for his followers to continue with this way of reasoning. However, the metaphoric origin of the language became more and more obscure and was invested with an objective status that was missing in its origins.

One author that most clearly instruments this transport of terms from the field of society to the rest of the living world is C. Elton (1933, p. 31), who said:

> Just as man has been compelled to adopt methods of artificial limitation of numbers in his population, now that wars and famines and infant and adult mortality from disease organisms no longer provide a natural check, so animals which have no natural enemies, or which are comparatively immune from them, tend to adopt systems of limitation of numbers.
>
> In fact, just as the human social and economic system has certain properties (depending upon the monetary system and the reactions and biological relationships of human beings organized in a certain complex but definite matter) that lead to the development of trade circles or epidemics, so animal communities, with their peculiar mode of organization, so different from plants, but somewhat analogous to human communities, are subject to internal oscillations of population that result from and are set up from these inter-relations and the great powers of increase of animals (*Ibid*, p, 67).

In his *Animal Ecology*, a classic text on such matter, Elton (1927, p. 114) deals with this subject in the following way:

> If we follow up further with the analogy with human density of population, it becomes clear that every animal tends to have a certain suitable optimum, which is determined mainly by the habits and other characteristics of the species in question.

Further on, he illustrates the Malthusian nature of the concept of population dynamics:

> It is plain enough that the amount of food available sets an ultimate limit to the increase of any animal; but in practice, starvation seldom acts as a direct check upon numbers... (*Ibid*, p. 118).

Yet, for Frederic Clements competition is perhaps the fundamental process in the relationship among living beings and their surroundings. In the phenomena of succession, competition is the leading process and plants will be permanently competing for light, water, nutrients, oxygen and

carbon dioxide. The final result of this competition is the appearance of hierarchies that display among plants subordination relations to a community in which the dominant species are able to control the habitat.

In 1929, Clements, with John Weaver and Herbert Hanson, published their book *Plant Competition*, in which they openly admitted the connection between the ecological concept of competition and social phenomena.

According to Clements *et al.*, as the competition decreases and the role of dominant species increases, the community approaches its climax. Again, this conception of dominance and relations of subordination also originates in an analogy with human relationships.

These researchers support their conceptions based on the coincident expressions of earlier ecologists or pioneers of Ecology such as Macmillan or Eugenius Warming. Macmillan stated in 1892 (cited in Clements, *et. al.*, 1929, p. 3):

> Like other primary concepts en ecology, the idea of competition has gradually emerged from the general experience of mankind.
>
> It thus happens that the flora of any region—that is to say, the plant society of the regions—is in the same condition of mutual interdependence and mutual competition that we discover in human society. Complex interrelations of individual with individual, species with species, formation with formation arise, and the plant population of any area so far from being stable in its composition, is in a continual state of battle for soil, light, moisture, heat and useful alliances, both in the physical and biological senses of the word [3] (*Ibid*, pp. 8-9).
>
> Each species competes with those around it and in this competition the individuals may be said to stand shoulder to shoulder against the common foe, as may be seen in the united efforts of a human tribe or nation against some warring body (*Ibid*, p. 9).

By this time, such way of describing phenomena had widely spread throughout the world. The Danish geographer Eugenius Warming (1895, cited in Clements, *et. al.*, *op. cit.*, p. 314) affirmed in his *Plantesanfund* (published in 1909 in English with the title of *Oecology of Plants*):

> There are certain points of resemblance between communities of plants and those of human beings or animals; one of these is the competition for food which takes place between similar individuals and causes the weaker to be more or less suppressed.

The conclusion reached by Clements *et al.* (*op. cit.*, p. 327) is clear:

> [...] it seems that the competition plays the basic role in the community that food-making does in the plant. No community escapes its effects; indeed, it can be said it exist as such until the individuals come into this relation with each other. It is the controlling function in succession development [...] the

> complex functions of the community are chiefly or entirely dependent upon it.

This is not different from the opinion of the British A. G. Tansley (1920, cited in MacIntosh, 1970):

> But the law of competition is here the dominant law of relationship. A highly integrated plant community, such as a mesophilous forest, depends for this integration on a balance of competitions between individuals of the same species and of different species, which allow the available space to be occupied only by a certain selection of life-forms in certain more or less definite proportions.

All these authors reinforce their statements with evidence coming from field and laboratory research. From the moment an individual settles down in a certain place and starts to reproduce, its reproduction will not go beyond the limit imposed by the disposable resources. When one or more of them become scarce, competition will start (Clements, *et. al.*, *op. cit*. p. 317; Milne, 1961, cited in MacIntosh, *op. cit*.). This is the basic thesis that has dominated the study of Ecology from its beginnings. In 1883, S. A. Forbes, while studying the dynamics of growth in white fish, expressed that it would be impossible for them to reproduce indefinitely without depleting the disposable resources in favor of their own survival. That is to say, once again it reinforce the Malthusian idea of the struggle for existence.

The way in which this concept of competition has dominated the study of Population Ecology is of great significance and has become an axis of Ecology as a science. The term *competition* appeared in a ratio of 4:4:1 with respect to *predation* and *mutualism* in ecological specialized journals until 1986; the number of pages of these journals in which the term was mentioned was found in a ratio of 5:6:1 with respect to the other two concepts (May and Seger, 1986, cited in Peters, 1991, p. 257). In 1989, the relations among competition, predation and mutualism in the registers of the index was of 8:5:1 (Keddy, cited in Peters, *op. cit.*, p. 257). The frequency in the appearance of mutualism could be due—among other things—to the studies on cooperation and group selection, whose importance for ecological studies has been highlighted by Mitman (1992).

As for the mechanism of cooperation, and the advantages that it brings to the organisms and their aggregations, it has also been the object of studies for a long time (Alee, 1927). Clements himself was not indifferent to the role of cooperation; he characterizes it as the final consequence of the process of aggregation. He also points out some of its advantages with respect to conservation of energy and food (Clements, 1952, p. 150) while attempting to combine and to complement it with the process of competition and natural selection (*Ibid*, p. 151). Notwithstanding, competition

has been particularly attractive to ecologists, as shown by the ratios listed above. The existence of the competition is assumed at the very start.

II. ECOLOGY AND MATHEMATICS

Besides qualitative analysis of population dynamics, it is necessary to consider another type of study: the mathematical models, which appeared at the beginning of the present century, and its application to Ecology suppose a stage characterized by greater objectivity and precision.

The application of mathematical models to Ecology is an event distinguished by the transference of concepts and methods of human populations analysis to those of other organisms. The presence of human demography in the development of Ecology dates from older times (Park, 1946, Allee, *et. al.*, 1949). Pierre François Verhulst, at the early nineteenth century, declared that in the first phases of growth, a population increases exponentially until the initial resources have been depleted. This idea was taken up again by Adolphe Quetelet, in 1835, and later by Raymond Pearl and Lowell Read, in 1920 (cited in Kingsland, 1982).

Through their contribution, Pearl and Read intended to postulate a universal law of population, one valid every time and one that can make possible projections of future growth. At this point, the objectives of Malthus began to be completed. Pearl took on the task to find evidence for his thesis by studing stadistics of population growth in various countries and cities. He found that diverse population growth dynamics always showed a logistic curve nature, in accordance with the model predicted by him (Kingsland, *op. cit.*). His model was criticized for its rigidness and its failure to take into consideration the fact that certain socio-economic and ethical factors can alter the dynamics of the population and, consequently, the behavior of the curve (Knibbs, 1925, 1926-27, cited in Kingsland, *op. cit.*). Pearl then slightly modified his thesis, attempting to adapt the sigmoid dynamics of growth to the environmental factors that could affect it, though without substantially altering its character. He thus postulated that in human populations certain phenomena, able to produce deep social modifications, would eventually allow population to experience periods of expansion and enlargement in the density of a certain area, being the industrial revolution an example of this idea. He concluded that in the presence of this type of revolutions, population behavior would show a logistic curve nature (Kingsland, *op. cit.*), Pearl looked for support in the studies of other populations as well, especially in *Drosophila sp*. He found that their reproductive ability decreased with their corresponding increases in population (Pearl, 1932). He was once again criticized for this idea on the basis that when population density increases, the flies intensify their competition for food. In any case, this

competition would be the cause of the decrease in their reproductive capacity, because when those insects were kept with enough food, their fecundity decreased less (Robertson and Sang, 1944, cited in Kingsland, *op. cit.*).

Pearl postulated his idea for the first time in the decade of the twenties. Soon after, other opinions and mathematical models that favored it appeared. Such were the cases of Alfred J. Lotka, Vito Volterra, and Georgii F. Gause. Lotka, in 1925, reached the conclusion that the reason that an individual growth pattern to be the same as that of the populations, was that at its core both were expressions of cellular growth. He agreed that it dealt with a general law of population growth, but he went further by accepting that, in certain cases, this development might exhibit different behaviors, due to the irruption of unknown factors in the system. Then, for each case, the shape of the growth curve needed to be revised (Kingsland, *op. cit.*). For his part, Vito Volterra had been interested in the application of mathematical models to Ecology since 1925, and had based his work on the observation of fish populations. Through mathematical analysis he concluded that the relative abundance of the species, in the case of parasitism and predation, corresponds to periodical oscillations whose widening depends upon the initial size of prey to predator and parasite to host populations ratios (Scudo, 1971)

In general, the models of Lotka and Volterra postulated that the increase in the abundance of a prey would be a function of predator abundance. When the latter diminishes, the prey population expands geometrically until it constitutes a source of food that allows for a geometrical expansion of the predator, which, when arriving at its crest, causes a decrease of the prey with a corresponding decrease in its own abundance. Having reached its lowest point, the prey population grows once more restarting the cycle (Pianka, 1974). The Malthusian character of this model rests on the assumption that population tend to possess an unlimited exponential growth that will last until obstacles that check it appear, and these will originate when the resources for surviving become scarce due to that same population growth.

Finally, having worked on the subject of distribution and abundance of animals in relation to their habitat, since the late twenties, the soviet scientist G. F. Gause concluded in 1931 that the relation between the abundance of a species and the ecological factors would follow his law (Gause, 1931).

Under the direct influence of Volterra and Vladimir W. Alpatov, one of Pearl's collaborators, Gause published in 1934 a book with an evident Malthusian character: *The Struggle for Existence* (Gause, 1934, cited in McIntosh, 1970, *op. cit.*). In 1936, he said that in the relations between organisms, the process of the struggle for existence is fundamental and its

immediate consequence is the growth or decrease of populations (Gause, 1936). His purpose was to quantify this concept. One of his most important contributions was to utilize the study of these questions for the experimental analysis of competition (Kingsland, *op. cit*.).

What is the importance of these mathematical studies in the analysis of Malthusian theory? As was pointed out at the beginning, the paradigm in which these authors are working is already built. The Malthusian assumptions are integrated within the fundamental viewpoint and it is no longer essential to make great modifications nor to produce an entirely new knowledge. The important task for all of them was to complete and to develop the unconcluded or the few missing details of the paradigm in order to reinforce it. Neither Malthus nor Darwin went deeper into the field of mathematics in order to justify their points of view. The labor of Pearl, Lotka, Volterra or Gause conferred more precision to Malthus's and Darwin's approaches by augmenting the degree of "objectivity" in their statements and by making them heuristically applicable through models which had measurable parameters. In a word, their work had the function of completing the population analysis which had started at the end of the nineteenth century.

However, in the case of Population Ecology, the result is the creation of models characterized by their reductionism. Lotka's explanation about geometrical growth at cell, individual and population levels, in the sense that it deals, at least, with cellular populations, miscomprehends the qualitative changes that take place in living matter when passing from one level of complexity to another. Moreover, Pearl not only looked for comparisons with human populations, but built his model from a physico-chemical analogy of individual growth, where comparisons between the effects of density within kinetic gases were done. Lotka, basing his work on the second law of thermodynamics, analyzed populations as opened systems, with their corresponding changes in matter and energy. Volterra also utilized these types of analogies (McIntosh, 1985, pp. 175-176). Critics have called to atention the reductionism displayed in these models (Levins and Lewontin, 1985, pp. 132-160); it has been mentioned that even though mathematical models are essential tools for the work of ecologists, they do not possess a satisfactory predictive role, given the great complexity of their objects of study: the ecosystems (Soberón-Mainero, 1990). Organisms and populations do not behave as if they were molecules; in all of them interactions prevail that cannot be explained exclusively by means of the models and conceptual frameworks of Physics and Chemistry. The reductionism continues developing and reinforces itself, acquiring an anthropocentric character when the analogy between human population growth is equated with that of animal and plant population.

The presence of this reductionism should not sound strange, for it deals with a model that accepts the foundations of Malthus's paradigm which states that in society there is one, and only one, universally valid law of population, and that extends to the entire living world, according to Darwin.

Besides, it is worth mentioning how, with this type of analogy, a circular reasoning is built: in order to comprehend the dynamics of human population growth, Malthus supported his argument with, among other things, what was happening to plants and animals (Malthus, [1826] 1971, p. 2). Darwin, from his side, first attempted to understand, and later to make clear, the character of animal and plant population dynamics by basing his argument on, among other things, the dynamics in human population growth postulated by Malthus. Modern Ecology follows accordingly. The demographic theories for human beings and for other organisms have not been built through observing the particular characteristics of one or the other, rather, the tendency for the researcher is to make an analogy at the point where he/she can find parallelisms between them. In this a way, the phenomenon distinguished is "naturalized" and treated as being ideology-independent and neutral. If any demographic phenomenon is observed in society, its equivalent is searched for in plants or animals, or both, in order to reinforce the explanatory tactic. Once the phenomenon that is thought to be the equivalent has been found, then social phenomena are positioned to be explained by thinking of them as if they were the equivalent of what has been found in plants or animals. This is to say, it deals with a two-century history of projecting what happens in a sphere of one world towards what happens in another, apparently very similar, but actually a very different one, forced to make it appear as similar.

I consider valid to make analogies and transposition of terms. Evenmore, this has been a constant in the history of science, but in the case analyzed here, the differences between human beings and other species, along with their respective demographic dynamics, have been hidden or relegated to an inconsequential place. It has not been shown sufficiently enough whether the qualitative differences are more than the similarities, where the latter has been given priority and its analysis overestimated. This being the case, there is a risk of making a rather superficial analysis of the problem by thinking that these equivalencies, while apparently clear and obvious, are the very essence of the problem. More importantly, the metaphoric character of models and terms utilized in modern Ecology is lost and, therefore, competition is presented as something that actually occurs in nature. What for Darwin was metaphor (Darwin [4], [1859] 1968, p. 116), for Ecology, since the end of the nineteenth century, has ceased to be such. The abuse of this language and of this transference of terms, along

with the progressive increase of specialized research, has led to a narrow cultural horizon for the researcher, one that causes a withdrawal from the original supposed metaphorical character of the model.

III. THE CONCEPTS OF 'NICHE' AND 'COMPETITIVE EXCLUSION'

Intimately linked, 'niche' and 'competitive exclusion' are two of the concepts that play an important role in our discussion. These concepts are so important in Ecology that this science might be refereed as "the study of niches" (Pianka, *op. cit*., p. 185). The concept of niche has its origin in the first decades of the twentieth century. The first to use it was R. H. Johnson who said in 1910:

> One expects the different species in a region to occupy different niches in the environment. This at least is a corollary of the current belief that every species is as common as it can be, its members being limited only by its food supply, a belief which is the result of the strong Malthusian learnings of Darwin (Johnson, 1910, cited in Hutchinson, *op. cit*., p 154).

Joseph Grinnel considered that the niche was the last behavioral and distributional unit of living beings. One that defines "its place in the biotic environment, its relations and enemies," according to Elton (1927, cited in Pianka, *op. cit*., p 185). Later, Hutchinson defined niche as the total set of conditions under which an individual lives and reproduces itself. For this author, each characteristic of an organism could be represented in a dimension in a multi-coordinate axis, in such a way that a niche could be represented as a "hypervolume" (Pianka, *op. cit*., pp. 186, 190-192). In 1959, Odum conceived it as resulting from what a typical organism does-makes, expressing that while the habitat of an organism is its "address", the niche would be its "profession". Lastly, Pianka defines it "as the sum total of the adaptations of an organismic unit" (*Ibid*, p. 190).

The concept of 'niche' becomes important for this analysis when it is linked to the concept of 'competitive exclusion', which establishes that two different species with identical niches cannot coexist for a long time in the same habitat (*Ibid*, p. 141). In other words, two or more niches could be found superimposed at a certain moment, but if the organisms that occupy them are utilizing the same resources and competing for them in order to survive, a separation of the former occupied niches will result. Diverse organisms would then inhabit a place that shows an "ecological vacuum" at a certain moment. Their population will start growing in an exponential way until density is high enough for the resources to get scarce. From that moment, one of the species will continue its growth, inhibiting the other, whose rate, of populational growth might reach zero or even exhibit negative rates until almost disappearing from such place

(De Bach, 1966). A process of exclusion of one species by another through means of competition has taken place. In the process of succession, to comprehend this mechanism is essential in order to explain the total or partial displacing of a group of species by others. In evolutionary terms, the diversification of niches within prolonged lapses is the most important effect of this process (Pianka, *op. cit*., pp. 144, 147-151). The competition is more intense when the struggling individuals are very similar, when they belong to very proximate species, or when a great quantity of individuals of one or several species are present in a given place (*Ibid*, pp. 147-153, 192-195). It is said that in a community, where remotely related species are found, those species are more abundant in absence of competitors (Diamond, 1978). In this particular statement, the Malthusian discourse is clearly expressed. Above all, competitive exclusion takes place in saturated environments. Before saturation, it does not exist or it is carried out with much less intensity.

This is the core of the idea. From it, diverse studies about competition have been conducted, in occasions attempting to extrapolate and interpret the expressions of this process into human beings affairs in order to better understand the effects of unrestricted population growth. Such is the case, to cite an example, of laboratory experiments in which correlations of mice populations growth with variance in aggression, mortality and fertility have been shown (Southwick, 1955).

One of the problems in the study of the process of competitive exclusion has been the difficulty to show the existence of competition. This has led some authors to postulate that this process is invalid (Ayala, 1969, 1970). In its defense, other voices have claimed that what has actually happened is that until the late fifties ecologists had not fully understood the concept of niche and therefore they did not know what to look for when they spoke of the exclusion (Diamond, *op. cit*.). It has been shown, however, that such ignorance did not exist and that the concepts of niche and competitive exclusion were clear enough for ecologists from the second decade of the century and that they had been utilized since then in diverse studies (Jackson, 1981).

The debate on the existence of this process is interesting. Ayala (1972) states that competing species can actually coexist, and finds that in diverse species of *Drosophila*, two species can actually compete if their populations are smaller when they coexist than when they are separated. He mentions that the principle of competitive exclusion is based on concepts that ignore the complexity of the living world and, in the end, natural selection might enable competing species to efficiently explore the resources that they could share with others, or that the species could develop variant individuals able to use previously non-utilized resources. Therefore, competitive exclusion cannot possess a universally valid character. It could be said

that two species coexisting in the same area should possess an ecological difference, but this is trivial and obvious (Ayala, 1969, *op. cit*.). Physical and biotic environments of the organisms are too heterogeneous both temporal and spatially, and species are not monolithic entities composed of verbatim copies of the same model (Ayala, 1971). To this last argument, G. F. Gause (1970), responds that actually the afore mentioned example corresponds, from the beginning, to species with different niches and that the data shown are not susceptible to mathematical treatment.

This objection, however, reflects the reductionist notions of its defender and is formulated in a way that does not allow for any argument against the existence of the exclusion principle. If an experiment finds that one species is able to displace another, arguments which favor the validity of the competitive exclusion principle will arise, but if such a process is not found, then it should be argued that the species in question actually do not occupy the same niche and that among them exists subtle differences that had not been noted at the beginning. This was used as part of Hardin's argument in his defense of the exclusion principle (Hardin, 1960).

This way of reasoning leads to a concept of niche too vague as well as too rigid. It is also always possible to argue that the niche a certain species occupies in a community has not been correctly designated. What Hutchinson maintains is that the niche an individual occupies is composed of a multitude of dimensions corresponding to each one of its characteristics. However, as variations in space and time are constant, the dimensions of an individual in the Huthsinsonian hipervolume should constantly be changing and, therefore, the niche would be modified. The phases of individual development, changes in weather, ecological perturbations, genetic plasticity, among many others, are all factors that constantly modify niches. Then, what should one understand when it is stated that two species share a niche or that they occupy two different ones? Here we find a conceptual problem, whose resolution must take into consideration the dynamics and the enormous complexity of living beings and their interactions within ecosystems. It has been stated that the evolutionary theory upon which these concepts are based reflects the intellectual revolution undergone by the capitalist class (Levins and Lewontin, 1985, *op. cit*., pp. 3-4). Not only is it a materialist and kinetic theory, it is also a Cartesian conception of the world: the organism and its environment assume a separate, alienated existence, where the environment changes by means of processes independent from those that produce changes in organisms. This leads to a vision in which though the organisms change, the medium in which they develop remains in a stable state. This may be likened to a bourgeois conception, in which, regardless of the modifications that occur in the particular composition of a society, the hierarchy of the prevailing relationships will remain constant (*Ibid*, p. 22). According

to this view, interactions between the parts and the whole, among the parts themselves and between the whole with its parts, along with the spatial and temporal modifications due to all these interactions, remain relegated to a secondary position. It is here that rigidness and insufficiency of the concepts of niche and of competitive exclusion appear. When the components of an ecosystem are separated, the whole is limited to play the role of the sum of its parts, while the possibility of a coexistence of two (or more) species is limited to the observation of a quantitative interaction between them. In this way, the modifications exerted on the environment by this interaction, within a much more complex system, are left aside.

IV. OBJECTIVITY AND THE METAPHOR OF COMPETITION

It is pertinent to ask now: Do the species compete? One cannot deny that an ecological model based on this concept is able to solve numerous problems in a satisfactory way. It has been mentioned above that in the history of Ecology many of the concepts and methods of analysis came across human demographic studies. The case of competition is no exception. What should be analyzed is why ecologist use it as one of the basic principles in their everyday work.

Peters (*op. cit.*) argues that the components of the theory of competition in ecology are nebulous and imprecise, both in the specific and qualitative sense, and that, frequently, the reader does not know the exact meaning of a given term. It also presupposes homogeneous environments, identical organisms, populations in equilibrium and other constants, not because they accurately represent nature but because they fit better into mathematical models. He also says that this could represent the presence of extra-scientific factors rooted in the cultural precepts of Western society, as well as a chauvinistic conception of life. He concludes, however, that competition does indeed exist and he expresses his hope that in the future, investigative research an its techniques and approaches will be renewed in order to generate a different theory of competition (Peters, *op. cit.*, pp. 256-272). This is, for Peters the problem consists in a momentary impossibility to show the existence of a phenomenon that nevertheless exists. It seems that this term does not possess a metaphorical meaning, in spite of his admission that a strong influence of extra-scientific factors support the theory of competition as such.

Hardin, on the other hand, admits that the theory of competition (and the principle of competitive exclusion) has its roots in Ricardian Political Economy, and he equates it with the uses that this term possesses when used in Economics, Genetics or in Ecology. According to him, competition is something natural and innate; it is present in all spheres of life, within society as well as among plants and animals (Hardin, *op. cit.*). Competition

among human beings has always existed and not so much for the sake of the competitor, but for that of societies. Hardin states that: "In their actions, both as individuals and as groups, men show that they have an implicit understanding of the exclusion principle" (*Ibid*). I think that this is the basic idea which, whether consciously or not, has inspired ecologists to present competition as one of the central processes in the relationships between living beings. This idea, actually, has its origin in Political Economy since Darwin conceived the idea of natural selection (Darwin, [1887] 1958, p. 42). As the paradigm remains basically the same, so do the sources that feed it both from within and outside the scientific environment. The idea of competition in modern Ecology continues to be a projection of processes that have ruled human relationships for three centuries and are a transposition of terms and concepts which come from the economic theory that has been built in order to understand and justify those processes. Moreover, Keller (1988) has pointed out that Hardin does not pretend to subject the competitive exclusion principle to experimental verification, but present it as a matter of logic, legitimizing it by reference to its isomorphism to economics.

Ecology has attempted to "objectify" the processes of competition; it has attempted to present competition as a phenomenon that actually occurs. However, it is important to point out that objectivity, even when it deals with cases, which existence nobody can doubt, is something arising from the historical development of humanity. As Antonio Gramsci (1975 [1930-1932]) wrote:

> To me it seems a mistake to demand science as such the proof of objectivity of real: this is a conception of the world, a philosophy, not a scientific data [...] Scientific work has two aspects: one which tirelessly rectifies the method of knowledge, and rectifies or reinforces the organs of sensations and the other that applies this method and uses these organs always more perfectly to establish what must necessarily exist in the sensations and what is arbitrary and transitory. What is common to all men, what all men can see and feel in the same way it is so established, with the condition that they have respected the scientific conditions of research. From the moment this objectivity is established, the being itself is affirmed, the common being to all men, regardless of every particular point of view. But this too is a conception of the world, it is an ideology.
>
> [...] Without the activities of men, creator of every value, even scientific, what would the objectivity be? A chaos, that is to say, nothing, the void if even this might be said, because actually if it is imagined that man does not exist it is not possible to imagine either language or thought [5].

When Ecology attempts to objectify competition, rectify it, or present it as something that actually exists, regardless of opinions, it is forgotten that this term would be meaningless were it not a product of the historical development of humanity. It is false that competition as such has been a

dominant process present in society from its origin. Most of human history took place in a setting in which there was no surplus of goods and human groups lived scarcely and simply by collecting what nature provided. There existed no commodities or trade, therefore no competition prevailed. Later, humanity existed within a slavish economic system, in which competition played a role limited only to the spheres of trade. The same might be said about feudalism in Western societies, in which the prevailing economic trend was the delivery of goods in the form of tributes by vessels to their lords. Competition here was restricted to the process of circulation of commodities and the majority of production was, as in the cases of slavery and recollection systems, a production of use values.

In other regions of the world, the dominant form of production was either a variation of the feudal or the slavish form of Western civilization, in which use values outweighed change values and where competition was an activity restricted to merchants. It was not until less than three hundred years ago, with the rising of the capitalist mode of production, that production of change values outweighed that of use values, commodity relations pervaded and competition appeared as the predominant activity, ruling the destiny of humanity (Mandel, 1977). Evenmore, it is from this standpoint that political economists and many intellectuals conceive the laws of Political Economy as possessing universal and eternal validity (Smith, *op. cit*., vol. 1, pp. 16-20), and then it can be understood why scientists, particularly ecologists like Hardin, make this kind of defence of the principle of competitive exclusion.

I attempt to show the historical character of the development of the concepts in ecology (particularly the debates that emerged among those in favor of the principles of competition, and others, like W. C. Allee and A. E. Emerson, who defended the point of view of cooperation among living beings). Mitman (*op. cit*., pp. 136-137,142, 144) points out that after World War II, the relative gains that Allee's cooperative standpoint had achieved suffered a serious setback when the idea of prevalence of individual competition gained a wider consensus. This clearly was related to the political context of the Cold War since the Yalta agreements. In the same sense, Keller (*op. cit*.) observes that since the sixties, the concepts of competition among living beings gained ground, and by the end of the next decade the discourse of competition had dominated ecological theory. This left the point of view regarding cooperation and group selection in a second plane.

CONCLUSION: ECOLOGY AS AN IDEOLOGICAL EXPRESSION

Since Ecology is not an exceptional scientific discipline in regards to its ideological assumptions, these components have a very important weight

in the build up of the principles and assumptions being analyzed. Although important, it is not accurate the analysis that attributes Raymond Pearl's logistic curve success to the promotion he made about it, nor to the contacts he established with Lotka and Gause (Kingsland, 1982, *op. cit*.). These and other principles of Ecology have a deep ideological basis that explain its success and acceptance, and its favorable promotion. From Malthus's times to the present day, population models have provided their supporters with a powerful theoretical recourse for presenting animal, plant and human communities under the light of what they expected to see: a representation that coincides, and reinforces, with their most basic ideological perceptions linked to individualism, meritocracy and liberal ethics.

Another simplistic extreme consists in stating that these concepts of ecology and population ecology will automatically change with the transformation of the relations of production among human beings. This is J. D. Bernal's opinion when he states that the concept of 'struggle for existence' will be replaced by the concept of 'cooperation among different organisms' (Bernal, 1989). This idea is not so easy to accept. Bernals thesis, with its characteristically vulgar Marxist approach, contains the idea that a socialist mode of production would automatically substitute the concept of 'competition' for the concept of 'cooperation' and therefore natural phenomena would be observed in a totally distinct way. Regardless this might be true or not, in case any concept that could eventually substitute the one of 'struggle for existence', it would be as metaphoric as the former and, more important, it does not have to be something that will appear as suddenly or as simply with a change in social relations, specially if this socio-economic change is not supported or reinforced with a radical ideological change, with a different world view. Evidence of this was seen precisely in the Soviet Union, a country in which vulgar Marxism was the hegemonic ideology well into the twentieth century, yet where the approach to the struggle for existence was developed with great strength, thanks to Gauses ideas. And this happened at a time when that country imposed a strict control on scientific research, a strong repression toward scientist not following the official line and by the rejection of Malthusian and Darwinist principles.

The Malthusian-Darwinist concept of competition has helped to explain some phenomena that occur in the living world in a clear and coherent way. But against what positivist epistemology might state, the success that that concept has gained, as well as its derivative concepts, is due to the powerful influences of cultural factors (such as ideological, social and economic) that, according to the same positivistic approach, are deemed as "extra-scientific" or "non-scientific". Actually, this features should be considered inherent to science, they considerably alter the

vision of our world, therefore, scientific evidence should not be the result of a mere "neutral" evaluation of facts. In addition, the vision of the living world as one in which every organism develops by means of competition and war of all against all is neither the only possible nor the sole one that has been proposed recently. Gilbert White, Henry David Thoreau and Aldo Leopold conceived nature as an entity where what prevails is the perfect harmony of all components, where living beings play a very important role in which collaboration and cooperation predominate among them. This idea has been formulated from the field of philosophy and the present debate on the environmental crisis has revitalized the ideas of these and other people, and has put in question the typical "scientific" and "rational" ways of observing nature, in particular Ecology (Worster, 1977, Pepper, 1984). Though the analysis of these last ideas exceed the purposes of the present work, I consider necessary to mention them briefly because it would seem, from ecological studies, that the concept of competition for scarce resources and the notions resulting from it are the only ones from which a coherent model that explains the relationships between living beings can be built. This is not necessarily so. In order to comprehend population phenomena within the whole living world, critics should question whether the concept of competition is the only valid or the best one. It is necessary to maintain a prudent distance between the pragmatic use of a model and its unconditional acceptance as unquestioned truth. The prevalence of such terms and concepts is due to an abuse in their transposition, basically from the analysis of certain social and economic phenomena in a period of history, to biological processes. Behind such transferences is a well-masked ideology that remains particularly hidden when it is spoken in strictly biological terms, giving the impression that what prevails is exclusively the objective comprehension of the nature of the relationships between living beings. This is quite evident when human populations are analyzed as if they were ruled by those same principles.

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NOTES

1 I refer specifically to personalities such as Paul Ehrlich, Anne Ehrlich and Garret Hardin.

2 Among other examples, those of Benjamin Franklin and Adam Smith might be referred. See Henry, A. (ed, 1907): *The Writings of Benjamin Franklin, Vol II*. Cited in James, P. (1979): *Population Malthus*. London: Routledge and Kegan Paul; Smith, A. (1966): *An Inquiry into the Nature and Causes of the Wealth of Nations*. Facsimile of the First Edition, 1776. London: Augusts M. Kelly Publishers, p. 97.

3 Both in this cite and in the next, the source where it was taken from is not indicated, or there is a print error in the consulted edition.

4 Here Darwin expressed: "I should premise that I use the term Struggle for Existence in a large and metaphorical sense, including dependence of one being on another, and including (which is more important) not only the life of the individual but success in leaving progeny."

5 Gramsci. A. (1975): *Quaderni dei Carcere*. Notebook 4, pp. 75 bis-76. Gerratana, V, (ed). Vol I, pp: 466-467. Torino: Giulio Einaudi. (My own translation.)

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