Species Pollution

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Of the major areas of concern in the study of pollution today, that which has been of concern for the greatest length of time is species pollution. Species pollution may be defined as the accidental or deliberate introduction of non-native forms of life into the environment. Most areas of pollution have been of concern only since man became industrialized. Species pollution, however, has been a problem to man even prior to the industrial revolution, whereby as a result of his travels he has managed to disturb the natural environment in one way or another.

How Species Are Introduced

Accidental introduction of a new species is usually accomplished by the organism traveling with man, by attaching itself either to his person or to his mode of transportation; for example, the Chinese crab, *Eriocheir sinensis,* was introduced into Europe by a ship from the Far East carrying water as ballast, and the clothes moth, *Tinea pellionella,* was introduced into the United States by the Pilgrims. However, some escape from captivity; for example, the water hyacinth, *Eichhornia crassipes,* was introduced into this country as a pool ornament.

No one questions how a deliberately introduced species arrived. However, one might well question why. In some cases the fear of the unknown and the need for survival were the reasons as well as the need for familiar things to provide comfort, security, and memories of home. The early settlers to this country brought with them seed, livestock, and pets to aid them in their conquest of the new land. Therefore, the economic factor has always been of utmost importance, but along with this is the aesthetic appreciation that man has for various plants and animals.

In order that we may fully understand the ecologic principle involved in species pollution, I have created the following analog:

Every organism occupies its own ecologic niche; competition arises only if a new organism is introduced into the environment in such a way that their functions overlap.

To illustrate this point let us use the example of the postoffice. The postoffice itself serves as the environment, while the mailboxes represent the various ecologic niches. Each family or organization, which represents a different species, has its own mailbox (that is, ecologic niche). Everything operates smoothly until a new family (new species) with identical names (similar functions) to that of a present member of the community moves into the community (hereby represented by the P.O.—the environment), acquires a mailbox (ecologic niche) and begins to compete for mail (that is, its existence). In the final analysis, we will probably discover that one of the families (species) will give up the struggle and make other arrangements for mail (extermination). The term ecologic niche as used in this paper denotes the location of an organism within its environment resulting from its adjustment to that environment.

Will an Exotic Survive?

Organisms so introduced are sometimes collectively known as exotics. The success or failure of such an introduction depends upon several factors, name-

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Examples of species pollution.

Species	Located from	Located to	Accidental or deliberate	Successful	Harmful or Beneficial
Chinese crab, *Eriocheir sinensis*	E. Asia	Europe	Accidental	Yes	Harmful
Clothes moth, *Tinea pellionella*	Europe	U.S.	Accidental	Yes	Harmful
Water hyacinth, *Eichhornia crassipes*	S. America	U.S.	Deliberate	Yes	Harmful
Reeves' pheasant, *Syrmaticus reevesii*	E. Asia	U.S.	Deliberate	No	?
Raccoon-dog, *Nyctereutes procyonoides*	E. Asia	Russia, Siberia	Deliberate	Yes	Harmful
Grey squirrel, *Sciurus carolinensis*	U.S.	England	Deliberate	Yes	Harmful
Nutria, *Myocastor coypu*	S. America	U.S., Europe, Asia	Deliberate	Yes	Generally harmful
Starling, *Sturnus vulgaris*	Europe	U.S.	Deliberate	Yes	Harmful
E. African giant snail, *Achatina fulica*	Africa	Asia, Pacific O. islands	Deliberate	Yes	Harmful
Siberian roe-deer, *Capreolus pygargus*	U.S.S.R.	Europe	Deliberate	Yes	Harmful
Mallard, *Anas platyrhynchos*	N. America	New Zealand	Deliberate	Yes	Harmful
Cheatgrass, *Bromus tectorum*	Europe	U.S.	Accidental	Yes	Harmful

ly: (i) does an available ecologic niche exist that the organism can fill? (ii) can the organism successfully compete with a native organism for an ecologic niche? (iii) will the organism prey on its competitor? (iv) will it breed with a native population? and (v) how adaptable is the organism to its new environment? Thus the introduction of an organism into a new environment, by any one or a combination of the above factors, may well result in the establishment of an artificial biologic community, which usually results in disastrous consequences. Generally speaking, these consequences result because little or no effort is expended in order to determine what effects the organism would exert on its new environment. This of course is true only if the organism is deliberately introduced or because we fail to police the possible entry of such an organism, rather than the accidental entrance of an organism. In order to more fully understand the magnitude of the problem, let's illustrate the above factors with some concrete examples.

Does an available ecologic niche exist that the organism can fill? While frequently a niche does exist, there are exceptions; for example, Reeves' pheasant, *Syrmaticus reevesi,* has been introduced repeatedly into the United States but with scant success. The reasons for this lack of success may range from the simple to the complex; for example, the niche may already be filled by a prior tenant, or we may discover that something in the environment is lacking—a something that is necessary for survival. It therefore becomes obvious that an ecologic niche may exist, but because the organism cannot adapt to the necessary extent it may not survive. If the organism does succeed, then we can easily say that the ecologic niche existed. New Zealand is an example of a country that has many vacant ecologic niches: originally the only mammals were two species of bats, but the mammal population now exceeds 30 different species.

Assuming that an ecologic niche does exist, can the exotic successfully compete with a native organism (which already fills the niche) for possession of that niche? The answer of course is yes, it may; but the manner in which it does may be totally unexpected. The raccoon-dog, *Nyctereutes procyonoides,* was introduced into Russia and Siberia from eastern Asia, whereupon it changed its feeding habits: instead of eating aquatic life it preys on rodents and birds. The introduction of the grey squirrel, *Sciurus carolinensis,* from the United States into England has been at the expense of the European squirrel, *S. vulgaris,* which has now disappeared from many localities. The nutria, *Myocastor coypu,* when introduced into Louisiana caused the decline of the muskrat, *Omdatra zibethica.*

Predation

Will the organism prey on its competitor? The introduction of any carnivore into a new environment carries with it the risk of having introduced a fearful predator. But it should be noted that the organism may eliminate its competitor, not by killing him but by a variety of other means. For example, the starling, *Sturnus vulgaris,* has drastically upset the balance of native bird populations by occupying nesting sites as well as competing for available food. Of course we must realize that it is not always necessary that a bird compete with another bird (as in our above example) but that a mammal may compete with a reptile for the same ecologic niche; for example, the dog, which was imported into the Galápagos Islands to destroy goats, also destroyed young reptiles. Sometimes it is necessary to introduce a predator in order to control a predator; for example, the East African giant snail, *Achatina fulica,* which likes to climb trees to eat young buds and shoots, became widely distributed throughout the Pacific Ocean area during the 1800s and even appeared in California in 1947. In order to control this pest, it became necessary to introduce its natural enemies the carnivorous molluscs *Gonaxis kibweziensis, G. quadrilateralis,* and *Edentulina affinis.*

It should be noted that it is not always a simple matter to distinguish between the above two factors; namely, can the organism successfully compete with a native organism for an ecologic niche or will the organism prey on its competitor? It should be obvious the second always implies the first but the first does not always imply the second, but it is not always obvious which of the factors is more important. As a result, many will experience more peace of mind if they combine the two factors.

Interbreeding

Will the organism breed with a native population? Usually the answer to such a question is no, but there are exceptions. For example, in Czechoslovakia the Siberian roe-deer, *Capreolus pygargus,* interbred with the native roe-deer, *C. capreolus.* However, because of the smaller size of native females, many died giving birth because of the size of the young. In addition, the wild gray duck of New Zealand, *Anas superciliosa,* is disappearing because of interbreeding with the introduced mallard, *A. platyrhynchos.*

And finally, how adaptable is the organism to its new environment? The degree of adaptability will vary from zero (those that cannot survive) to perhaps as much as 100% in some cases. It is probably quite safe to say that the degree of survival depends directly upon the ability to adapt. The previously discussed factors are all important insofar as survival is concerned, and inherent in these factors are subfactors such as food supply, climate, soil organisms, and others too numerous to mention. To answer the ultimate question, however, will involve long-range studies of the organism and its reproductive rate. This latter is of special importance: one may assume that if a species numbers are increasing it is well on its way to becoming successful. There is actually no need to list here any examples since all of the above-mentioned indicate organisms have been able to adapt to a new environment (with the exception of Reeves' pheasant).

It will be noted that I have essentially ignored all mention of plants. I have done so not because plants have not been introduced successfully into new environments, but because plants, unlike animals, can survive only when they are protected in more or less modified environments. For example, in the western states, as a result of over-grazing, the weed cheatgrass, *Bromus tectorum,* is widespread, yet wherever you find the native grasses you will discover that they compete successfully with the cheatgrass. Furthermore, reintroduction of the native grasses will eventually result in the elimination of the weed. It is not impossible that if man and his exotics should disappear the native vegetation would reestablish itself and eliminate most if not all of the introduced species.

Disastrous Results

In an attempt to summarize species pollution, it is important to note that imported species will either die or multiply. In the latter case the results are usually disastrous. Any introduction of a new plant or animal into a different environment will result in disturbance and the creation of new food chains. This is especially likely to be true if the ecologic niche is vacant, as may be witnessed by the superiority of the rabbit over the marsupials in Australia. It may be noted that at times man has attempted to reestablish the ecologic balance by introducing new species. With the exception of insects, these attempts have usually failed. An example of such a failure was the introduction of the European fox, *Vulpes vulpes,* into Australia in an effort to control the above-mentioned rabbit: the result was that the fox multiplied rapidly and killed many of the native marsupials.

And finally, one final note. Nothing that I have included in this paper is by any means new, but I have felt that with the increased awareness of the environment a distinct need existed at this time to synthesize some of the existing material on species pollution into a digestive form that can be used by teachers who have neither the time nor available resources to work up units for themselves.

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