

## AMPHIBIANS: THREATS AND CONSERVATION MEASURES

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### Summary

Many topics concerning the most common impact factors that can act on populations of amphibians in various parts of the planet have been dealt with. We describe the most common causes of alteration, fragmentation, and loss of habitat. Moreover, we discuss phenomena that act on a global level, such as the possible impact of the increase in solar UV-B radiation, acid rain, or global warming. As far as factors of pollution are concerned, we have principally considered the effects caused by the use of chemicals in agriculture, just because they are so widely used all over the world. Although we deal generally with the Class Amphibians, this paper particularly refers to the anurans and urodeles of the temperate zones of Europe and North America, because these are the species that have been most studied from the point of view of ecology and conservation. Guidelines for specific conservation measures that can be taken to help the populations at risk are described. Moreover, some case studies where conservation measures have been applied with success are reported.

### 1. Introduction

In recent centuries, a general crisis of biodiversity involved the planet and caused the decline and disappearance of many faunal species. Today, in many parts of the world, populations and/or species of amphibians are considered endangered or in decline. Since the survival of most species of amphibians is based on the possibility of keeping both wetlands and the surrounding terrestrial habitats in a good state of conservation, the transformations of landscape due to human activity can compromise some environmental features that amphibians need for their survival.

Without any doubt, the loss, fragmentation, and alteration of habitats are the widespread factors that have caused this decline. Moreover, for many cases of decline of amphibians described in different parts of the planet, there are not clear reasons or simple hypotheses that explain the phenomenon. Thus, since 1989 the hypothesis of a possible Global Amphibian Decline (GAD) has become a dominant theme in debates on the conservation of this faunal class. This work aims to describe the principal impact factors known as threats to the conservation of amphibians. For some amphibians, conservation measures to minimize the impact are suggested.

## **2. Wide-Scale Reclamation of Wetlands**

The wide-scale reclamation of wetlands carried out over the course of history to the damage of vast marsh areas has radically transformed the landscape. The hydraulic work of reclaiming wetlands was repeated for centuries until the first half of the twentieth century, when, due to new technologies, many areas were permanently dried up.

Besides being of limited size, the remaining wetlands are often fragmented, isolated, and more or less significantly altered, especially regarding the water cycle. Moreover, in many regions, wetlands are still completely subject to management methods which do not take into account conservation criteria. Those most responsible for this inappropriate management are hunters (periodically drying out areas for several months during spring and summer, burning marsh vegetation, plowing and/or milling the bottoms, etc.) and reclamation authorities (periodically drastic works are carried out on marsh vegetation surrounding the main ditches and canals).

Another major cause of the disappearance of wetlands is the gradual alteration of natural river environments by human intervention. In almost all densely populated zones these environments have disappeared as a consequence of works of canalization, especially in the last century.

In the last half of the twentieth century, particularly in Northern Europe, alternative engineering techniques more respectful of the environment have been used to save large sections of rivers from destruction and to restore areas that had been already damaged. Besides the continuous decrease in the size of wetlands, it should also be noted that the majority of wet habitats having environmental characteristics most favorable for amphibians (i.e., marginal ones such as bogs, wet meadows, temporarily flooded zones, etc.) became extremely rare. As a consequence of reclamation, wetlands are today constrained within artificial limits, generally embankments and boundary canals. The

result of all this is a marked change in the natural dynamics of these water bodies and the loss of large ecotonal areas subject to periodic flooding.

### **3. Intensive Farming and the Change in the Use of Farmland**

One of the worst problems for amphibians as well as for other faunal species following the introduction of new farming techniques is the marked change in or the disappearance of a large part of the structural elements (hedges, bordering woods, bush and shrublands, ponds, small bogs, etc.) which constitute the main habitats or microhabitats where they could find shelter and opportunities for feeding and breeding. The network formed by these structural elements guarantees the possibility of the species living inside the agricultural landscape (residence habitat) and being able to move and disperse across it easily (corridors).

Besides the problem of the direct loss of many of these elements, the use of modern techniques to work the land, in particular the speed of these works, presents a serious threat to many species of fauna, especially for those with limited capacity to escape. Among these are amphibians, whose only defense strategy lies in finding shelter in one small area.

As we know, the survival of most species of amphibians depends on having both terrestrial and aquatic habitats to complete their life cycle. Although the deterioration and progressive disappearance of many elements of the terrestrial habitat can have a strong negative effect on the conservation of populations, the growing alteration or disappearance of aquatic habitats suitable for reproduction is nowadays considered the most important factor of risk for the conservation of amphibians in many regions.

There are several types of small water bodies used by amphibians to breed. They can be natural or artificial, and generally they have water with little or no current. Many of these still waters are characterized by their isolation or lack of contact with other important water bodies. To indicate all these types of habitats, we often use the generic term, “pond.”

The causes of the disappearance of ponds in farmlands are various and include not only the intensification of cultivation techniques, but also the abandonment of zones which in the past were cultivated or used for grazing. In many cases the abandonment meant the loss of the ponds from natural causes, as they gradually fill up with sediments and vegetation. In fact, for hundreds of years, populations of amphibians had adapted themselves to breeding in bodies of water used by man, and it was the traditional periodic maintenance of these habitats that assured the ecological features suitable for the reproduction of species. In other cases the diminished social and economic importance of these water bodies has led to a marked loss of interest in them. Thus, they are no longer protected and have either become recipients of every sort of waste products or have been deliberately filled in.

Besides, diversion of water bodies and the introduction of nonindigenous fish or of other alien species (see section 8, “Introduction of Fish Species”) has often caused serious alteration of water bodies so that they cannot be used by amphibians to breed.

### **3.1. Case Study: Examples of Loss of Ponds in Tuscany**

To show the trend of pond loss in Tuscany in the last half of the twentieth century, three areas have been studied: the hills of Chianti, the plain near Florence (Piana Fiorentina), and the coastal plain near the lagoon of Orbetello. Historically, these three areas have been very different; however, ponds and other small water bodies were always an integral part of the life and activities of humans in these areas, allowing the conservation of the flora and the fauna that are dependent on their presence. From about 1940 to 2000, however, this equilibrium has been destroyed. In the new situation, ponds have undergone a marked decline. It is interesting to note that the loss of these habitats has occurred in similar ways in the three areas, even though they have been destined to different uses.

In Chianti, the economic changes that took place after World War II saw a progressive depopulation of the countryside which continued until the 1970s. A second phase has seen the re-occupation of many dwellings as second homes, involving significant renovation. These two processes have led to the widespread disappearance of the majority of ponds. The study attested that in this area roughly 35% of pre-existing ponds have been lost. Moreover, as far as the remaining habitats are concerned, we observed that roughly 40% were by now in highly critical condition as a consequence of their complete abandonment, and were in need of intervention to guarantee their conservation.

The area of the Piana Fiorentina has witnessed the development of an increasingly intensive agriculture over this time period. The territory is now (around 2002) in large part occupied by urbanized areas. In this new situation, ponds and other water bodies where amphibians can breed are increasingly rare (see section 4.1 Case Study: the Impacts of a Heavily Urbanized Area near Florence and Examples of Amphibian Conservation Projects for a description of the conservation initiatives taking place).

Finally, although agriculture is still prevalent, the area bordering on the Lagoon of Orbetello shows a progressive diminution of the number of ponds. Indeed, following the change in farming and grazing methods, many water holes have been lost, either by deliberate destruction or by abandonment. The study showed that, compared to the situation registered in the past, 12.5% of ponds had been lost; 50% showed clear signs of being filled in by the gradual accumulation of sediments and the spontaneous growth of vegetation caused by long-term abandonment; and only 37% were still judged to be in sufficiently good condition to be suitable for amphibian reproduction.

### **3.2. Guidelines for Amphibian Conservation in Farmland**

In order to preserve populations present in farmlands, the actions should be to:

- impede the process of further impoverishment of the ecological features;

- minimize the risk caused by modern intensive farming methods;
- return gradually to more traditional farming methods that are compatible with the conservation of typical landscape features and their historically linked faunal communities; and
- use appropriate measures to restore ecological conditions that are more suitable for amphibians.

As follows, guidelines are presented that should be followed for the planning of actions aimed at the conservation of amphibians in farming landscapes.

### **3.2.1. Habitat Conservation**

**Conservation of breeding sites:** The conservation of breeding sites has to include not only the water body in itself, but also the shores and the surrounding ecotonal habitat. Although the exact dimensions depend on the species' use of the habitat, a strip no narrower than 20 m from the shore is prudentially needed to conserve the quality and effective functioning of a reproductive habitat. In these buffer zones, no crops should be cultivated; only management operations aiming at the conservation of the habitat should be performed. Particular care is needed to avoid pollution of the area during chemical treatments of neighboring crops.

**Conservation of hibernation and aestivation areas:** Small woods, uncultivated escarpments, old heaps of stones, edges, the banks of rivers and canals, and drystone walls are all used by amphibians as hibernation and aestivation sites. Effective protection of the species must also protect buffer zones (at least 4 to 5 m wide) around these habitats or microhabitats.

**Conservation of corridors:** The protection of the network formed by the buffer zones described above allows the possibility by the species to move around the landscape with less risk. For amphibian species that undertake periodic mass migrations through specific areas, it is advisable to find these zones and protect them from possible factors of risk (including certain farming methods), at least during the period when annual migrations occur.

### **3.2.2. Reconstruction of Missing Structural Elements in order to Restore a Territorial Microhabitat Network**

For the conservation of amphibian populations on a large scale, the protection of remaining habitats and the reconstruction of others are needed, as well as the protection and/or restoration of all the structural elements that, taken together, form the network of microhabitats permitting the presence and movement of individuals in the landscape.

### **3.2.3. The Planning of Farming**

On the basis of our knowledge of the habitat features and how these are used by the species that dwell in them, it seems possible to plan human activities so that they have a less severe impact on existing populations. In particular, for proper choice of crops and proper timing of farming activities, it is useful to know in which periods it is most likely

that a large number of amphibians can be found around crops (migration of adults to and from breeding sites, migration of juveniles which are newly emerged from the pond, and migration of adults between summer and winter residence areas).

It is also advisable to make sure that the types of crops cultivated near breeding sites do not require direct drawing off of water from the water basins used by the amphibians (or also from the underlying water table) during the months when breeding occurs.

Many countries in Europe and in other parts of the world have adopted regulations and found the finances to maintain a diversified environmental structure in the agricultural landscape. Therefore, we must stress that it is often the lack of knowledge of these possibilities, together with unmotivated forms of prejudice, that lead to seriously impoverished situations in farmland landscapes, when these situations can and should be remedied.

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### **Biographical Sketch**

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