

## CHAPTER 14

# THE INTRODUCTION OF NONNATIVE FISHES INTO FRESHWATER SYSTEMS OF PERU

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**Abstract:** Since the 1930s, alien fishes (fishes not native to Peru) have been introduced into the freshwater systems of Peru for different purposes such as fish farming, the ornamental fish trade, public health applications, and sport fishing. The fish were introduced either deliberately or casually into the three hydrographic systems of the country (Amazon, Pacific coastal rivers, and Lake Titicaca). To date, 20 alien species have been found in the continental water systems of Peru: *Aristichthys nobilis*, *Carassius auratus*, *Cichlasoma nigrofasciatum*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Gambusia cf. affinis*, *Hypophthalmichthys molitrix*, *Odontheistes bonariensis*, *Oncorhynchus mykiss*, *Oreochromis aureus*, *Oreochromis hornorum*, *Oreochromis mossambicus*, *Oreochromis niloticus*, *Oreochromis urolepis*, *Poecilia reticulata*, *Poecilia velifera*, *Tilapia rendalli*, *Trichogaster leerii*, *Xiphophorus helleri*, and *Xiphophorus maculatus*. Native-species transfers have also occurred; seven Peruvian species have been transferred from lowland forest waters to water systems of both the highland forest and the coast (reservoirs): *Arapaima gigas*, *Astronotus ocellatus*, *Brycon cephalus*, *Cichla monoculus*, *Colossoma macropomum*, *Piaractus brachypomus*, and *Prochilodus nigricans*. Herein, we present an overview of the current situation of these species introductions and transfers in Peru based on both fieldwork and a review of the pertinent literature. We then focus on the three alien species most frequently found in natural environments but not previously evaluated for their impacts. Our surveys in the aquatic basins of the Parque Nacional Río Abiseo (PNRA; high-altitude, Amazon River system) show that the alien *Oncorhynchus mykiss* (rainbow trout) is the dominant species and that the three native species usually common in Peruvian highland Andean river basins (*Astroblepus* spp.) are present only in low numbers. The other two alien species—*Oreochromis niloticus* (tilapia) and *Poecilia reticulata* (guppy)—are well established and widely distributed in both the Huallaga (highland forest, Amazon River system)

and Rio Grande (Pacific Ocean coastal system) river basins. We also discuss other introductions and transfers. For example, the introduction of *Odonthestes bonariensis* (pejerrey argentino) and *Oncorhynchus mykiss* into Lake Titicaca caused a negative impact on native *Orestias* species and the transfer of the giant Amazonian fish *Arapaima gigas* (paiche) initiated a chain of introductions and impacts in Sauce Lagoon. The introduction of species into nonnative waters is a complex problem without a unique solution. We give some suggestions for the control of both *O. mykiss* in the PNRA and *O. niloticus* in the Huallaga River basin and for the practice of environmentally sustainable aquaculture. Minimally, it is necessary to establish biological monitoring programs in the affected river basins and, for comparison to the affected basins, to obtain adequate data on the distributions and relative abundances of native species in analogous unaffected basins. We also recommend that environmental education programs be developed and promulgated to inform the public of the general problem.

**Key words:** alien species, aquaculture, ecosystem, environment, exotic species, fish, freshwater impact, Peru

## 1. INTRODUCTION

Due to its particularly high number of species and habitats and the genetic diversity of its species, Peru is acknowledged as one of the ten biologically megadiverse countries of the world (Gentry, 1992; Rodríguez et al., 1993; Carrillo and Icochea, 1995; Chang and Ortega, 1995; Pacheco et al., 1995; CONAM, 1999). Freshwater fish diversity in Peru is very high; 855 species of freshwater fishes have been reported (Chang and Ortega, 1995) from sea level to 4080 m altitude (Ortega, 1992; Ortega, personal observation). They are unevenly distributed in the three main drainage systems of the country: (1) Amazon River, (2) Pacific Ocean coastal river, and (3) Lake Titicaca (Figure 1).

However, despite such wealth in fish biodiversity, numerous alien fish species have been introduced into the cold and warm waters of the country, for various reasons. For example, fishes have been introduced into Peru for aquaculture and fisheries purposes since the 1930s. The first introductions were principally into aquatic basins of the Andean region (FAO, 1998), which had few native fish species. The alien cold-water species *Oncorhynchus mykiss* [= *Salmo gairdneri*] and *Odonthestes bonariensis* (Everet, 1973) were introduced to increase local fisheries production and for sport fishing. The alien *Poecilia reticulata* was introduced into the coastal region during the 1950s to control malaria insect vectors. Other species such as *Cyprinus carpio*, *Oreochromis aureus*, *Oreochromis hornorum*, *Oreochromis niloticus*, and *Tilapia rendalli* were introduced repeatedly into coastal and central Amazon forest river basins to increase food availability to local communities (Bartley, 1993). Within Peru, species have also been transferred from one river system to others. For example, during the 1970s, species from lowland tropical forests were transferred into both highland forest and coastal river basins, and species have been transferred to Lake Titicaca with amazingly negative results.