

Introduction

Movement of fish beyond their natural distribution range has been associated with human migration since ancient times (Pillay, 1977). However, more organized and purposeful movement of fish began with the colonization of nations. A classic example is the introduction of salmonids, primarily for recreational purposes, across the British Empire (Fernando and Indrasena, 1969). The spread of cyprinid species (e.g. common carp, crussian carp and goldfish) with the movement of ethnic Chinese people across most of Asia in the seventeenth century is another example (Termvidchakorn *et al.*, 2003). After the Second World War, many purposeful moves took place aimed at increasing food fish production, weed control, pest control, and recreation (Pillay, 1977; Welcomme, 1988).

Tilapias are a group of fish that have been moved around the world over the last 50 to 60 years. They have been introduced into many countries worldwide (Pullin *et al.*, 1997), with a global distribution second only to common carp (De Silva, (ed.), 1989). The primary purpose of introduction of tilapias into Asia was to increase food fish supplies for the rural poor. Although there had been many fish introductions across watersheds, nations and continents, the introduction of tilapias into Asia stands out in two respects. This group of fish not only has contributed significantly to increasing fish food supplies, but also has become a major contributor to inland capture fisheries production in Asia, thus contributing to rural livelihoods with major socio-economic impacts.

Tilapia is the common name used for a large species assemblage in three genera; *Oreochromis*, *Sarotherodon* and *Tilapia* that belongs to the tribe Tilapiini, Family Cichlidae (Order Perciformes). The only two cichlid species indigenous to Asia are the estuarine species *Etroplus suratensis* (Bloch) and *E. maculatus* (Bloch), the only known members of the Sub-Family Etroplinae, which occur along the southeast Indian coast line and in Sri Lanka. In this document, the word tilapia (or tilapias) is used in a generic sense and refers to members of the genera *Oreochromis*, *Sarotherodon* and *Tilapia*. Within Asia, it is believed that the first movement of a tilapia species was in 1930, where *Oreochromis mossambicus* (Peters) was introduced to Indonesia from South Eastern Africa. This presumably constituted the founder stock of the species that was distributed throughout the region (Mair, 2002). The introduction of cichlid fishes to Asia have been reported in detail by Welcomme (1984, 1988), De Silva (1989) and Welcomme and Vidthayanon (1999).

Tilapias are cultured globally, with production currently exceeding 1.5 million tonnes valued around US\$ 1.8 billion in 2002. According to the Food and Agriculture Organization of the United Nations (FAO) aquaculture statistics, in 2002 tilapias had the third largest production among groups of fish (after carps and salmon and trout) in the world. The global aquaculture production of tilapias has been increasing steadily over the past years, with an average percent rate of growth (APR) of 13.2 for the period 1970–2002 (Figure 1). For total aquaculture production for the same period, the corresponding rate is 8.9 percent. It should be noted that, in reporting aquaculture production data to FAO, many countries do not report all production to the species- or genus-level. Thus, the data contain a large (almost 20 percent of the total) category of

miscellaneous freshwater fish, which is not included in the analysis of tilapia production. It is reasonable to assume that some of these miscellaneous fish are, in fact, also tilapias so that the reported totals are underestimated.

While tilapias contribute to increased food fish production for sale, they are also a major source of animal protein for poorer sectors of many Asian communities (Lin, 1977). Tilapias are also gaining increasing acceptance among consumers in developing and developed countries as well as in sophisticated markets (Ferdouse, 2001; Vannuccini, 2001). In addition, they contribute significantly to inland capture fisheries production in many tropical Asian countries, particularly in the lacustrine waters of Indonesia (Sarinita, 1999), Lao People's Democratic Republic (Bernacsek, 1997; Mattson *et al.*, 2001), Philippines (Guerrero, 1999), Sri Lanka (Fernando and Indrasena, 1969; De Silva, 1988), Thailand (Moreau and De Silva, 1991; Bernacsek, 1997) and Viet Nam (Phan and De Silva, 2000). Total production, capture and culture, of tilapias in the Association of South-East Asian Nations (ASEAN) countries and China was 1 166 737 in 2002 (Bartley *et al.* in press). However, there is a concern, which is being increasingly expressed, that the introduction of tilapias, accidental or deliberate, into Asia has had detrimental effects on the indigenous fauna and flora. Indeed, it has been suggested that the introduction of tilapias was responsible for the collapse of some traditional fisheries, even to the extent of endangering local species (Gindelberger, 1981; Aypa, 1993).

Available information about tilapias in Asia primarily comes from: (a) aquaculture and inland capture production; (b) biology in natural and quasi-natural waters; and (c) culture of selected species. Despite much speculation, the environmental and socio-economic impacts of tilapia introductions have rarely been examined or evaluated. In this document, the authors examine the production trends of tilapias in Asia, for both aquaculture and capture fisheries, and to evaluate the socio-economic impacts of the introductions. In addition, the document evaluates the perceived negative influences of tilapias on biodiversity and the environment in Asia.

