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Aquatic Genetic Resources and Technologies for Food and Environmental Security

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Introduction

Aquatic genetic resources (AqGR) of farmed aquatic species and their wild relatives have been used and exchanged for millennia. In China evidence of fish farming is found over two thousand years ago; in ancient Rome marine species were held in special coastal enclosures for consumption and as an indication of wealth and status; European monks in the middle-ages farmed and transferred the common carp from its native range in Asia and the Danube River to many parts of Europe (Nash, 2011).

Today aquatic genetic resources continue to provide the world with food and recreation: the world's fisheries harvest over 2000 species including fish, crustaceans, molluscs, coelenterates, echinoderms and aquatic plants (FAO, 2014). The number of farmed aquatic species is smaller, but still extremely diverse (Table 1).

As capture fisheries reach the limit of their productive capacity, aquaculture will be called on to provide a greater share of the world's aquatic food. Aquaculture production is growing (Figure 1); it is the fastest growing food production sector globally and more aquatic species are being farmed today than ever before. However, for aquaculture to continue to provide food for a growing population, better use of and information on aquatic genetic resources will be needed.

The member countries (Members) of the Food and Agriculture Organization (FAO) realized these needs and tasked FAO, through the FAO Commission on Genetic Resources for Food and Agriculture (Commission) and the Fisheries and Aquaculture Department, with overseeing the production of the first *Report on the State of the World's Aquatic Genetic Resources for Food and Agriculture* (Report). This Report will complement the ongoing process of reporting on fisheries and aquaculture at the species level that is routinely done by Members and summarized in FAO's flagship publication, the *State of World Fisheries and Aquaculture* (see for example FAO, 2014). Members are currently preparing country reports[1] on *inter alia*, the status of their AqGR, and the drivers, policies, threats and opportunities related to them. A draft Report has been made publicly available[2] and this present document describes early results of the process as countries continue to submit their country reports to FAO. It is hoped that the process and the country reports will help countries use and conserve AqGR.

Table 1. Diversity of aquatic species (FAO FishStatJ, 2016)

Taxon	Wild species	Number of farmed species (number of families)
Finfish	31,000	359 (>90)
Molluscs	85,000	103 (27)
Crustaceans	47,000	61 (>13)
Other aquatic animals	**	15 (>8)
Aquatic plants	13,000	~37 (>22)
Total	180 000	575

**These include echinoderms, coelenterates and tunicates too numerous to list, many of which have no potential as food and are all marine species, as well as a few amphibian and reptiles.

Methodology

Information was collected from the FAO fishery statistics database (FishStatJ[3]) and from the country reports submitted by Members. A total of 47 country reports were analysed for this preliminary assessment.

1 Country reports are based on an on-line questionnaire available in multiple languages at http://www.fao.org/fishery/AquaticGeneticResources/en
2 http://www.fao.org/fi/static-media/MeetingDocuments/AqGenRes2016/Inf2e.pdf
3 http://www.fao.org/fishery/statistics/software/fishstatj/en

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Results and Discussion

Unlike terrestrial agriculture in which farmers have been using hundreds of useful breeds and varieties for thousands of years, the domestication of aquatic species in aquaculture became more widely practiced only during the last century (Nash, 2011). The common carp is a notable exception to this as it was domesticated centuries ago (Balon, 1995). None the less, aquaculture is the fastest growing food production sector and is expected to play a major role in providing seafood in the future as production from capture fisheries has plateaued (FAO 2014; Fig. 1). Currently about 50% of the seafood we eat comes from aquaculture.

The FAO database[4] contains over 500 species items from inland, marine and coastal waters (Table 2) derived from two kingdoms and over four phyla (chordata, mollusca, arthropoda and echinodermata).

However, information in the FAO database is largely at the species level. The FAO standard for reporting statistics, the Aquatic Sciences and Fisheries Information System (ASFIS), does not have the capacity to register information on stocks, strains, polyploids, or other genetically altered farmed types of aquatic species. ASFIS does contain certain hybrids however.

Analysis of the country reports revealed that more species and more farmed types, e.g. hybrids, are being farmed than have been previously reported to FAO. For example, the ASFIS currently includes 11 hybrid species items and additional hybrids reported in country reports included:

- *Pseudoplatystoma reticulatum*×*Pseudoplatystoma corruscans*,(and reciprocal crosses) and *Pseudoplatystoma reticulatum*×*Phractocephalus hemeliopterus* from Brazil;
- *Oreochromis mossambicus*×*O. niloticus* from the Philippines;
- *Epinephelus lanceolatus*×*E. coides, E. coides x E. fuscoguttatus, E. lanceolatus x E. fuscoguttatus* from Viet Nam and Malaysia;
- *Onchorryncus mykiss x O. masou* from Japan;
- *Barbonymus gonionotus*×*B. schwanefeld* and *Clarias batrachus x C. microcephalus* from Thailand;
- *Channa micropeltes*×*C. striata* from Lao PDR;
- *Patinopecten caurinus*×*P. yessoensis* from Canada.

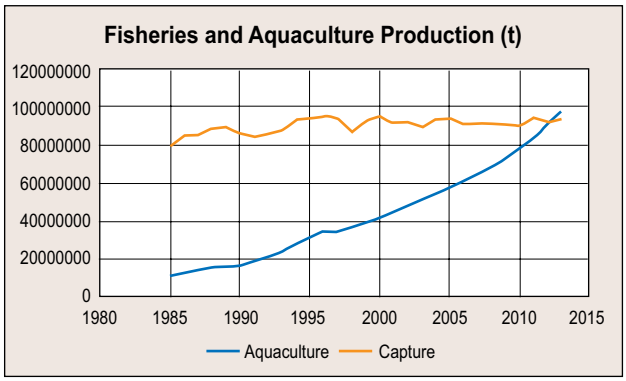

Fig. 1. Fisheries and aquaculture production as reported to FAO

Further analysis revealed that introduced species play a large role in aquatic food production from aquaculture. Aquaculture is the main reason for the deliberate introduction of aquatic species (Bartley and Casal, 1998). From the country reports about 200 species items were reported cultured in countries where they are non-native and there were over 300 reports of countries farming non-native species. In fact, the most commonly farmed species are farmed in more non-native areas than where they are native (Table 3).

Although the country reports listed several types of genetic improvement being applied to farmed aquatic species, the wild type was the most common farmed type reported. Additionally, the collection of seed, early

4 http://www.fao.org/fishery/collection/asfis/en

Table 2. Number of farmed aquatic species

Taxa/Region		Africa	Americas	Asia	Europe	Oceania
	Finfish	81	119	194	122	30
	Molluscs	16	41	31	35	21
	Crustaceans	14	19	39	20	17
	Other animals	3	4	11	7	1
	Plants	8	11	23	14	3
Total – all aquaculture taxa		122	194	298	198	72