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REPORT

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Eel market dynamics:

An analysis of *Anguilla* production, trade and consumption in East Asia

Hiromi Shiraishi and Vicki Crook





TRAFFIC REPORT

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Eel farm in Kagoshima, Japan



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EXECUTIVE SUMMARY

There are 16 species of freshwater eels in the genus *Anguilla*, distributed throughout temperate and tropical waters. Various life stages of *Anguilla* species, ranging from juveniles to adults, are harvested, farmed, traded and consumed on a global scale, with East Asian countries/territories playing a major role in the eel industry.

Eel farming, which is responsible for over 90% of all *Anguilla* production worldwide, is reliant on growing out wild-caught juvenile eels (“glass eels” or “eel fry”). Historically, farming and trade in East Asia involved the Japanese Eel *Anguilla japonica*, native to the region; from the 1990s large quantities of European Eel *A. anguilla* glass eels were also imported, due to reduced availability of *A. japonica*. Concerns over the impact international trade was having on *A. anguilla* to and led to it being listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 2007 and in December 2010, the European Union banned all trade in *A. anguilla* from the EU. As a consequence the Americas and South-East Asia have become increasingly important sources of juvenile eels of other *Anguilla* spp. for farms in East Asia.

Changing farming, trade and demand dynamics are a conservation concern for this group of species, with populations of *A. anguilla*, *A. japonica* and American Eel *A. rostrata* having declined over the past four decades due to various threats, including exploitation. Global demand for eel has historically been driven by consumption in East Asia, in particular Japan. More recent data suggest that these consumption dynamics are changing; however, many knowledge gaps still exist with regards to supply and demand, including levels of illegal trade and consumption pressures. These changes/unknowns could have considerable implications for regionally and internationally co-ordinated and collaborative approaches to conservation and management being considered for this group of species.

This report presents analysis and research findings from various eel production, trade and consumption data and information sources, in an attempt to depict more accurately the evolving levels of demand for eels in East Asia, in particular over the last decade. Data sources used include Food and Agricultural Organization (FAO) global production and trade, the 2014 “Joint Statement” (live eel fry input into farms and production provided by mainland China, Japan, South Korea and Taiwan), Unagi net, UN Comtrade, East Asian Customs and the CITES trade database, in addition to literature and internet research, stakeholder interviews and targeted online and physical market surveys.

The data analysed for this report show that East Asian *Anguilla* production, trade and consumption are constantly evolving and that globally, eel production and consequently consumption may be on the decline. Reasons behind these changes include species/eel fry availability (affected by annual variations/declines in recruitment and legislation/trade controls); national investment and farming techniques (still under development for lesser known tropical species); and consumer behaviour (affected by various issues including prices, health and food safety).

Traditionally, Japan has been considered the dominant market for eels, with farms in mainland China and Taiwan, in particular, supplying Japan, in addition to Japan’s domestic production. However, the various data sources analysed for this report all suggest that Japan’s annual eel consumption has declined considerably over the past decade; from over 150,000 tonnes in 2000–2002 to ~35,000 tonnes in 2013. Repeated media coverage of the presence of prohibited chemicals in eel products from mainland China and large price increases due to changes in glass eel supplies are believed to have played important roles in changing Japanese consumer behaviour.

The change to Japan’s proportional role on the global eel market and the quantity of eel consumed in other countries/territories, however, is less clear, mainly due to large discrepancies in eel production and trade figures for mainland China. Analysis of production data reported to FAO, combined with

trade data, suggests that mainland China may have filled the gap in the consumption market, with a significant increase in domestic consumption over the past decade (reaching an estimated 150,000 tonnes of eels in 2012 and 2013). Using these data, in 2004, Japan's eel consumption accounted for 55% of global eel production and mainland China only 16%. In 2013, these proportions had changed to 13% and 62%, respectively. However, when using Joint Statement data, Japan's consumption is estimated still to account for 30–45% of global eel production in 2012–2013.

Experts also have differing views concerning eel production and consumption in mainland China; most of these falling somewhere between that reported to FAO and presented in the Joint Statement. Likewise, results from the brief online and physical market surveys carried out for this report indicate there may not have been such a dramatic change in consumption in mainland China, as FAO data would suggest; however further research in this area is required to clarify the current situation. In mainland China, *Anguilla* eel has been traditionally consumed in the southern provinces, where most eel farms are located, and the domestic market has reportedly been driven by the restaurant industry.

Globally, Taiwan and South Korea play lesser roles with regards to eel production and trade than mainland China or Japan, however data analysis suggests that the domestic market/consumption of eels in South Korea increased in the past decade, reportedly in response to a decline in meat consumption due to health/food safety reasons. Customs trade data suggest that there may be also other important emerging markets for eels produced in mainland China, such as Russia.

The report identified many data discrepancies; however the grounds for many of these are unclear. Possible reasons for differences in production data sources include the number of intermediaries through which production data are passed prior to official reporting and under/over-reporting of glass eel input and/or production due to illegal sourcing of glass eels. Differences in exporter and importer data can be a result of incomparability, lack of clarity over taxon-designation or misuse of Customs codes (trade reported as *Anguilla* in fact being of another eel species) or illegal trade.

Illegal trade in *Anguilla* eels is a prevalent concern, not only affecting the lucrative glass eel commodity, but also eel products for the end consumer. Many records of live eel fry imports into East Asia over the past decade have no corresponding records in exporter data and a number of eel seizures have been reported by European and Asian authorities supporting the fact that illegal trade in *Anguilla* spp. is ongoing and illegally-sourced glass eels are being used in East Asian farms. Doubts over the legality of *A. anguilla* eels grown out in mainland China farms exist, as they continue to be re-exported many years after glass eels could be legally sourced from the EU.

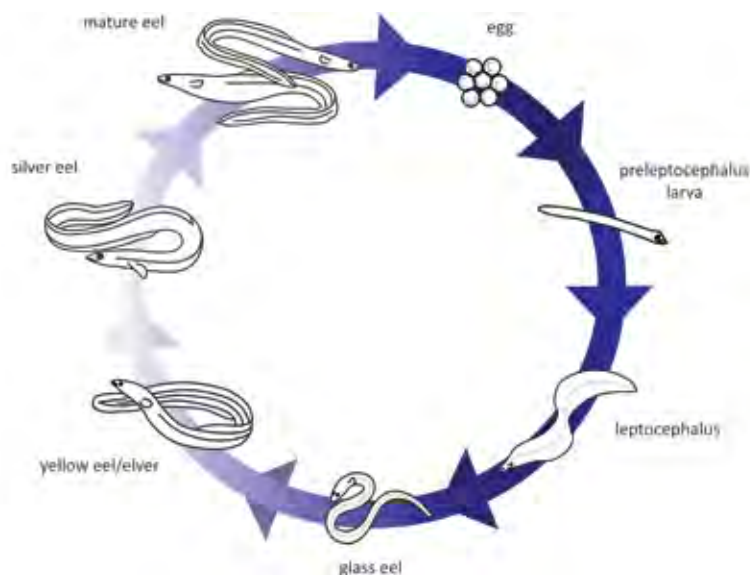
Taking into consideration these concerns and uncertainties, and the need for all East Asian countries/territories to consider their respective and evolving roles in the exploitation of this common resource, the report concludes with regionally collaborative recommendations for enhancing the traceability of sourcing, farming and trade of eels and the development of appropriate management and conservation decisions, covering: data collection, monitoring, reporting and analysis mechanisms; enforcement of legislation; additional research; and increased consultation with all eel stakeholders in East Asia.

INTRODUCTION

The family Anguillidae is composed of 16 *Anguilla* species¹ distributed throughout tropical and temperate waters, except for the eastern Pacific and south Atlantic (Silfvergrip, 2009). Commonly called freshwater eels, *Anguilla* spp. are facultative catadromous fish which spend most of their lifetime in marine, brackish and fresh water, after which they return to the ocean to spawn. Generation length is dependent on many factors including species and geographical location – it has been estimated that, on average, *A. japonica* spawns after seven to 10 years and *A. anguilla* after 15 years (Jacoby and Gollock, 2014; Jacoby *et al.*, 2014).

Various life stages (Figure 1), ranging from glass to silver eel, of all *Anguilla* species are harvested and traded on a global scale for consumption — directly or after culture — and for stocking purposes. According to Food and Agricultural Organization (FAO) data, eel farming, which is still dependent on wild-caught juvenile eels (also referred to as glass eels, live eel fry and/or elvers), is responsible for over 90% of all *Anguilla* production worldwide.

Figure 1
The life cycle of Anguillid eels.



Adapted from Jacoby *et al.* *in prep.*, and Henkel *et al.* (2012).

Eel farming and consumption in East Asia has traditionally involved the species native to the region—*Anguilla japonica*. However, fluctuations in the annual recruitment of *A. japonica* glass eels led to farms in Japan looking to import alternative species from the late 1960s (Tsunogai, 1997). An overall decline in glass eel recruitment in the region in the 1990s (leading to a dramatic increase in the price of *A. japonica* glass eels) resulted in many Asian farms, especially those in mainland China, importing large quantities of the relatively abundant European Eel *A. anguilla* glass eels as seed for farming (Han, 1999).

Concerns over the impact international trade was having on the European Eel led to it being listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora

¹ *A. anguilla*, *A. australis*, *A. bengalensis*, *A. bicolor*, *A. borneensis*, *A. celebesensis*, *A. dieffenbachii*, *A. interioris*, *A. japonica*, *A. luzonensis*, *A. marmorata*, *A. megastoma*, *A. mossambica*, *A. obscura*, *A. reinhardtii* and *A. rostrata* (Teng *et al.*, 2009). Three species (*A. bengalensis*, *A. bicolor*, *A. australis*) are sometimes further divided into two subspecies (Jacoby and Gollock, 2014; Watanabe *et al.*, 2006).

(CITES). This listing came into force on 13th March 2009. In December 2010, the European Union (EU) banned all imports and exports of *A. anguilla* to and from the EU, as authorities felt they were unable to determine that trade would not be detrimental to the conservation of the species. As a consequence, the Americas and South-East Asia have become increasingly important sources of juvenile eels for farming and larger live eels for direct consumption. Due to its similar texture and taste, if *A. japonica* is not available to the consumer, *A. bicolor* is considered to be the preferred second option and therefore in particular demand (Anon, 2013, 2014a; Arai, 2014).

These changing trade and demand dynamics are a conservation concern for this group of species. Populations of the temperate *A. anguilla*, *A. japonica* and *A. rostrata* are reported to have declined over the past four decades due to various threats including changes in oceanic currents, pollution, barriers in waterways, the loss of river habitat, diseases and exploitation. *A. anguilla* is currently listed as Critically Endangered on the IUCN Red List for Threatened Species and *A. japonica* and *A. rostrata* are rated as Endangered (Jacoby and Gollock, 2014; Jacoby *et al.*, 2014). Although there are fewer data available for tropical *Anguilla* spp., conservation concerns also exist for many of these species including *A. bicolor* (rated as Near Threatened).

Due to the widespread and panmictic² nature of *Anguilla* spp., the need for regionally and internationally co-ordinated and collaborative approaches to conservation and management is being increasingly recognized in recent years. In addition to the CITES Appendix II listing agreed in 2007, the European Commission (EC) adopted Council Regulation (EC) No. 1100/2007 establishing measures for the recovery of the stock of the European Eel (18th September 2007), which includes the requirement for Member States to establish national Eel Management Plans³. In 2014, the relevant fisheries agencies of mainland China, Japan, the Republic of Korea (hereafter South Korea) and Taiwan published a joint statement on “International Cooperation for Conservation and Management of Japanese Eel Stock and Other Relevant Eel Species”⁴. In this statement, authorities agreed to restrict “initial input” into farms of glass eels/eel fry of *A. japonica* and other species taken from the wild.

There are concerns, however, that several recent management measures being discussed and/or introduced are based on ease of application and arbitrary or out of date figures/data, and are not taking into consideration true conservation impacts and the real scale of demand. For example, illegal trade in glass eels (which is a very lucrative commodity) is an ongoing concern for many of the species being grown out in farms in East Asia. Customs and seizures data and other sources show that large quantities of eel fry have been exported illegally from Europe, the Philippines, Indonesia and also within East Asia over recent years (Anon, 2014b, 2015c; Crook, 2014; Han, 2014; Nijman, 2015). This unreported and illegal sourcing of glass eels further complicates traceability within the industry and the development of appropriate management measures.

Demand for eels over the last decades has been driven by East Asia, in particular Japan. According to various production and trade data analyses, publications and the media, Japan has reportedly been responsible for 60-70% of global eel consumption over recent decades, (Bai and Sano, 2006; Han, 2014; Kuroki *et al.*, 2014; TRAFFIC East Asia-Japan, 2003). However, FAO global datasets on production and trade suggest that although global *Anguilla* production has remained relatively stable over the past decade, with mainland China responsible for 85% of all eel production globally, Japan's eel production and imports have declined. This suggests that Japan's importance as a consumer may have diminished and that there may have been shifts in consumer demand to other existing and/or newly emerging markets (Crook and Nakamura, 2013).

2 All individuals of one species believed to come from one spawning stock.

3 <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32007R1100>. Accessed on 29 May 2015.

4 <http://www.jfa.maff.go.jp/j/saibai/pdf/140917jointstatement.pdf>. Accessed on 29 May 2015.

A good understanding of the ever-evolving production, trade and consumer dynamics for *Anguilla* will enable decision-makers to prioritize collaborative actions and management measures, taking into consideration the relative importance of each East Asian country/territory with regards to demand and impact on eel populations. This report provides an overview of production, trade and consumption of eels, with a focus on East Asia and recent trends over the past decade. It includes analyses of various data and information sources in an attempt to depict more accurately the evolving levels of demand for eels (both glass eels for farming and larger eels for consumption) in East Asia. The report findings are used to develop recommendations for further research, monitoring, regulation and management of *Anguilla* species, with the ultimate aim of ensuring the long-term sustainable use of this commercially important group of species.

METHODS

1. Production and trade data

The sources of *Anguilla* production and trade data used in this report and their associated complexities are described below. In addition to providing an overview of production and trade dynamics in East Asia, these various data sources were combined to estimate changes in consumption patterns in Japan, mainland China and South Korea (by adding imports to eel production and deducting exports) in recent years. Production is used in this report to describe overall eel production, based on both catch (capture) and farming (aquaculture), unless otherwise specified.

All life stages of various *Anguilla* species are captured and traded, but associated data do not necessarily differentiate life stages and species. Globally, there is a six-digit Harmonised Systems (HS) Customs code designated for live *Anguilla* eels (HS 030192). East Asian countries/territories have more detailed Customs codes which separate this code further, to enable differentiation between live eel fry (used for farming) and other (larger) live eels (for consumption), enabling more detailed analysis.

In most countries/territories (mainland China and Taiwan are the exceptions), Customs data for *Anguilla* are only reported to the genus level and catch and farming production data have traditionally been reported as being the species of local provenance (for example *A. japonica* for eels farmed in Japan). As many eel species are farmed, prepared and traded across the globe, this can lead to difficulties in determining the actual species involved. However, geographic provenance can still be used to infer the likely *Anguilla* spp. being farmed/consumed in certain cases.

Finally, there is potential for double counting when analysing eel trade data due to *Anguilla* spp. being traded internationally before and after being converted to different types of commodities. All these issues must be considered when interpreting the data and information presented in this report. See Crook (2010), Crook and Nakamura (2013) and Crook (2014) for further information on eel data complexities.

Food and Agricultural Organization (FAO) of the United Nations (UN)

Global and country/territory specific *Anguilla* “capture” and “aquaculture” data for 1950–2013 were downloaded from the “Global Statistical Collections” <http://www.fao.org/fishery/statistics/en> in March 2015. All *Anguilla* aquaculture production is reported to FAO by East Asian countries/territories as *Anguilla japonica* (X. Zhou, FAO, *in litt.* to TRAFFIC, October 2014). However, other *Anguilla* species are known to be farmed also, and total aquaculture production reported to FAO is assumed to contain production from all *Anguilla* species (even if described as *A. japonica*). FAO capture and aquaculture production data for mainland China from 1997 to 2006 are estimated, based on a downwards adjustment of 13% made by FAO in response to the result of China’s Second National Agriculture Census (S. Vannuccini, FAO, *in litt.* to TRAFFIC, September 2014). All other estimated quantities (marked with “F” in the FAO data) were also included in the analysis.

Anguilla spp. trade data for 1976–2011 were also downloaded in March 2015. The availability of data depends on each country/territory (i.e. Japan and South Korea from 1976, Taiwan from 1981 and mainland China from 1987). For some countries/territories, FAO data contain more commodity specific information compared to UN Comtrade data (i.e. more detail than the global HS codes, such as for prepared/preserved eels). It does not, however, separate data on life stages (for live eels), and for some countries the FAO data only appear to cover “other” live eels (i.e. not including live eel fry). Data from Customs authorities in individual countries/territories in East Asia were therefore used as the main source of trade data in this report, and FAO trade data were used to supplement these for earlier years/gaps and for comparison purposes. Also see UN Comtrade, below, for other differences in these data sources.

2014 “Joint Statement”

Live eel fry input into farms and production for 2004–2013 were provided by mainland China, Japan, South Korea and Taiwan as part of the “Joint Statement on International Cooperation for Conservation and Management of *A. japonica* and other relevant *Anguilla* spp”, released in September 2014 <http://www.jfa.maff.go.jp/j/saibai/pdf/140917jointstatement.pdf>. These data were published on the Fisheries Agency of Japan website: http://www.jfa.maff.go.jp/j/saibai/pdf/140917unagi_data.pdf and are presented in Tables 7 and 8 in the Annex. Farming production data from the Joint Statement (plus amendments) were compared with FAO production and trade data to estimate consumption in the region. East Asia is used throughout this report to describe these four countries/territories, unless otherwise specified (such as when Hong Kong Special Administrative Region, hereafter Hong Kong, is included).

There are a number of gaps in the Joint Statement production data for mainland China (totals not including *A. anguilla* production for 2004–2011) and for South Korea (production only reported for 2008–2014). TRAFFIC contacted those persons in charge of submitting data for the Joint Statement, but was not able to obtain *A. anguilla* production data for 2004–2011 from mainland China (W. Jin, National Fisheries Technical Extension Centre (NFTEC), *in litt.* to TRAFFIC, January 2015), nor further details on figures or calculations for South Korea. Additional calculations were therefore made in an attempt to fill these gaps.

For mainland China, total *Anguilla* production for 2004–2011 was estimated by converting *A. anguilla* glass eel farm input data provided on Unagi net <http://www.unagi.jp/> using various conversion factors (see below for more details), and adding these numbers to the Joint Statement production figures (which reportedly include *A. japonica* and other *Anguilla* species, but not *A. anguilla* for 2004–2011). For South Korea, Joint Statement *A. japonica* production for 2008–2013 appears to have been calculated based on Joint Statement live eel fry input data (multiplied by 1000 for 2008–2010 and by 1500 for 2011–2013). Taking into consideration South Korea’s increase in growth rate calculations between 2008 and 2013, and Lee’s (2014) conclusions that aquaculture production is calculated by multiplying glass eel amount by 800, TRAFFIC estimated 2005–2007 production based on 2004–2007 glass eel input data, multiplied by 800.

Unagi net

Information on the quantities of glass eels of *Anguilla anguilla* inputted into farms in mainland China is published on Unagi net <http://www.unagi.jp/member/data/data.htm> (data only available with registration). These data are reportedly derived from information provided at Japan-China eel trade meetings (S. Takashima, Nihon Yoshoku Shimbun, *in litt.* to TRAFFIC, April 2015) and were used in this report to estimate *A. anguilla* production in mainland China for 2004–2011 (which was missing from the Joint Statement data, see above). There are a number of factors influencing farming outputs (see section on production below for more details) and many unknowns surrounding changes in practices/success of farming *A. anguilla* in mainland China over the last decade. These calculations therefore involved a number of assumptions based on information collected from literature. Furthermore, annual figures may not be directly comparable between sources due to the different year types being described (in Unagi net figures are presented for the “eel year”, from September, and those in the Joint Statement are for years starting in November). It is therefore important to note that the results presented are only estimates, and were calculated in an attempt to fill a known gap in the Joint Statement production data described above.

The following methods/assumptions were used to calculate *A. anguilla* production in mainland China from *A. anguilla* glass eel farm input data:

- 1) There are ~3000 *A. anguilla* glass eels per kilogramme (Tabeta *et al.*, 1977), weighing 0.3 g each and these are reportedly grown out for 1.5–2 years or more, *A. anguilla* taking longer to grown out than *A. japonica* (Han, 1999; W. Jin, NFTEC, pers. comm., January 2015).

- 2) A conversion factor of x800–1000 is commonly used for calculating *A. japonica* production from glass eel input (Lee, 2014; Tsutsui, 2014). This conversion factor (x1000) was used as a basis for estimating *A. anguilla* production also (assuming *A. anguilla* eels were grown out to an average size of 300 g per eel), from glass eel input from two years previous (e.g. 2001–2002 glass eel input is converted to 2003 production).
- 3) As the survival rate of *A. anguilla* is lower than that of *A. japonica*, the x1000 conversion factor was amended to incorporate this. Bureau of Fisheries of China (2007) reported the survival rate of farmed *A. anguilla* in mainland China as 65%, but recent information suggests it may have increased to 90% (W. Jin, NFTEC, pers. comm., January 2015). A sliding scale for survival (assuming an approximate increase of 3% per year) was therefore used to adjust the calculations.

UN Comtrade

Global *Anguilla* export and import data of live, fresh, frozen and prepared/preserved eel for 1988–2014 were downloaded in March 2015 from the UN Comtrade Database: <http://comtrade.un.org/>. Japan and South Korea's eel trade data are available from 1988 onwards when HS Customs codes were designated to live, fresh and frozen eel; for mainland China and Taiwan data are available from 1992 and 1997 respectively. UN Comtrade includes records for 2013 and 2014⁵ (therefore is more up to date than FAO data), and also reports trade between individual trading partners. However, prior to 2012⁶, there was no HS code for prepared/preserved eel, and therefore global data for this commodity were not available in UN Comtrade (compared to FAO, see above). FAO data were therefore used as the main source of total global data until 2012, and UN Comtrade data were used to supplement this for more recent years and when individual trading partners needed to be identified. Taiwan data are reported under "Other Asia nes"⁷ in UN Comtrade.

It is important to note, however, that the new HS Customs code for prepared/preserved eel (160417) introduced in 2012 does not actually specify the genus "Anguilla", and trade in other species commonly called "eels" (see other sources, below) may be recorded under this. This is also a possibility for the other eel commodities, as Customs codes for *Anguilla* are believed to have been used incorrectly to report trade in other eel species such as Swamp/Rice eel in the past (Crook, 2014; X. Zhou, FAO, *in litt.* to TRAFFIC, October 2014).

East Asia Customs data

Customs import and export data for live, fresh, frozen and prepared/preserved *Anguilla* for East Asian countries/territories for 1998–2014 were obtained through China Customs Information Centre (data requested via China Cuslink Co. Ltd.), Hong Kong Trade Development Council http://bso.hktdc.com/bso/jsp/bso_home.jsp; Ministry of Finance, Trade Statistics of Japan <http://www.customs.go.jp/toukei/info/> (going back to 1973); Korea Customs Service <http://english.customs.go.kr/kcshome/trade/TradeCommodityList.do> and Korea International Trade Association <http://www.kita.org/>; and Taiwan Bureau of Foreign Trade <http://cus93.trade.gov.tw/ENGLISH/FSCE/>.

All East Asian countries/territories have adopted more detailed eel Customs codes in comparison to the global HS codes, however these vary between countries/territories and have changed over time. Table 1 summaries the Customs codes and commodities currently in use (valid in March 2015) in mainland China, Hong Kong, Japan, South Korea and Taiwan. Mainland China's Customs Import Tariff includes 10-digit species-specific eel codes (as shown in Table 1), however only 8-digit Customs code data are made available to the public (China Customs Information Center and China Cuslink Company, Ltd., *in litt.* to TRAFFIC, April 2015) and were therefore available for analysis.

5 At the time of writing, data for 2014 were incomplete. Global 2014 estimates were therefore not possible, but individual country/territory data were used, where available.

6 http://www.wcoomd.org/en/topics/nomenclature/instrument-and-tools/hs_nomenclature_2012.aspx. Accessed on 29 May 2015.

7 <http://unstats.un.org/unsd/tradekb/Knowledgebase/Taiwan-Province-of-China-Trade-data?Keywords=taiwan>. Accessed on 29 May 2015.

Although these countries/territories differentiate between “live eel fry” for farming and “other live eel” for consumption purposes (except for Japan’s live eel export Customs code), the definition of “live eel fry” varies between them. For example, “live eel fry” refers to glass eel and elvers less than 13 g per specimen in Japan⁸, but it includes young eels up to 50 g per specimen in South Korea (Table 1). South Korea differentiates between two different sizes of eel fry (by weight) and Taiwan differentiates between three sizes (by pieces per kg). For this report, unless otherwise specified “live eel fry” refers to juvenile/young eels (whatever size, including glass eels and elvers) used for farming, and “other live eel” refers to larger sized eels used for consumption (including large elvers, yellow and silver eels).

Table 1
Customs codes and descriptions of *Anguilla* spp. commodities for Hong Kong, mainland China, Japan, South Korea and Taiwan (valid in March 2015).

| | Customs Code | Commodity |
|----------------|---------------|--|
| Hong Kong | 0301.92.10 | Live eel fry " <i>Anguilla</i> spp." |
| | 0301.92.90 | Live eels, other than fry (<i>Anguilla</i> spp.) |
| | 0302.74.00 | Eels (<i>Anguilla</i> spp.), excluding fillets, livers and roes, fresh or chilled |
| | 0303.26.00 | Eel (<i>Anguilla</i> spp.), excluding fillets, livers and roes, frozen |
| | 1604.17.00 | Eels, whole or in pieces, but not minced, prepared or preserved |
| Mainland China | 0301.92.10.10 | Live eel fry of marbled eel (<i>Anguilla marmorata</i>) |
| | 0301.92.10.20 | Live eel fry of European eel (<i>Anguilla anguilla</i>) |
| | 0301.92.10.90 | Live eel fry, other <i>Anguilla</i> spp. |
| | 0301.92.90.10 | Live eels, other than fry (<i>Anguilla marmorata</i>) |
| | 0301.92.90.20 | Live eels, other than fry (<i>Anguilla anguilla</i>) |
| | 0301.92.90.90 | Live eels, other than fry (other <i>Anguilla</i> spp.) |
| | 0302.74.00.10 | Marbled eel (<i>Anguilla marmorata</i>), excl. livers and roes, fresh/chilled |
| | 0302.74.00.20 | European eel (<i>Anguilla anguilla</i>), excl. livers and roes, fresh/chilled |
| | 0302.74.00.90 | Other <i>Anguilla</i> spp. excl. livers and roes, fresh/chilled |
| | 0303.26.00.10 | Marbled eel (<i>Anguilla marmorata</i>), excl. livers and roes, frozen |
| | 0303.26.00.20 | European eel (<i>Anguilla anguilla</i>), excl. livers and roes, frozen |
| | 0303.26.00.90 | Other <i>Anguilla</i> spp. excl. livers and roes, frozen |
| | 0304.39.00.10 | Marbled eel (<i>Anguilla marmorata</i>) fillets, fresh/chilled* |
| | 0304.39.00.20 | European eel (<i>Anguilla anguilla</i>) fillets, fresh/chilled* |
| | 0304.51.00.10 | Marbled eel (<i>Anguilla marmorata</i>), minced or not, fresh/chilled* |
| | 0304.51.00.20 | European eel (<i>Anguilla anguilla</i>), minced or not, fresh/chilled * |
| | 0304.69.00.10 | Marbled eel (<i>Anguilla marmorata</i>) fillets, frozen* |
| | 0304.69.00.20 | European eel (<i>Anguilla anguilla</i>) fillets, frozen* |
| | 0304.93.00.10 | Frozen meat of Marbled eel (<i>Anguilla marmorata</i>), minced or not* |
| | 0304.93.00.20 | Frozen meat of European eel (<i>Anguilla anguilla</i>), minced or not* |
| | 0305.44.00.10 | Smoked <i>Anguilla marmorata</i> fillets, excl. edible offals* |
| | 0305.44.00.20 | Smoked <i>Anguilla anguilla</i> fillets, excl. edible offals* |
| | 0305.64.00.10 | <i>Anguilla marmorata</i> , dried/salted/in brine, not smoked, excl. offal* |
| | 0305.64.00.20 | <i>Anguilla anguilla</i> , dried/salted/in brine, not smoked, excl. offals* |
| | 1604.17.00.10 | <i>Anguilla marmorata</i> , whole/in pieces, not minced, prepared/preserved |
| | 1604.17.00.20 | <i>Anguilla anguilla</i> , whole/in pieces, not minced, prepared/preserved |
| | 1604.17.00.90 | Other eels, whole/in pieces, not minced, prepared/preserved |

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<http://www.customs.go.jp/tariff/kaisetu/data2/03rd.pdf>. Accessed on 29 May 2015.

| | Customs Code | Commodity |
|-------------|-----------------|--|
| Japan | 0301.92.10.0 | Live eel fry " <i>Anguilla</i> spp." (only used for imports) |
| | 0301.92.20.0 | Live eels, other than fry (<i>Anguilla</i> spp.) (only used for imports) |
| | 0301.92.00.0 | Live eel (<i>Anguilla</i> spp.) (only used for exports) |
| | 0302.74.00.0 | Eels (<i>Anguilla</i> spp.), excluding fillets, fresh or chilled |
| | 0303.26.00.0 | Eel (<i>Anguilla</i> spp.), excluding fillets, frozen |
| | 1604.17.00.0 | Eels, prepared or preserved fish |
| South Korea | 0301.92.10.00 | Glass eel (≤ 0.3 g per unit, for aquaculture) |
| | 0301.92.20.00 | Young eel (> 0.3 g and ≤ 50 g per unit, for aquaculture) |
| | 0301.92.90.90 | Live eels, other than fry (<i>Anguilla</i> spp.) |
| | 0302.74.00.00 | Eels (<i>Anguilla</i> spp.), excluding fillets, livers and roes, fresh or chilled |
| | 0303.26.00.00 | Eel (<i>Anguilla</i> spp.), excluding fillets, livers and roes, frozen |
| | 1604.17.10.00 | Eels, prepared or preserved fish - in airtight containers |
| | 1604.17.90.00 | Eels, prepared or preserved fish - other |
| Taiwan | 0301.92.10.10-1 | Eels, <i>Anguilla japonica</i> , live |
| | 0301.92.10.20-9 | Eels, <i>Anguilla marmorata</i> , live |
| | 0301.92.10.90-4 | Other eels (<i>Anguilla</i> spp.), live |
| | 0301.92.20.10-9 | Glass eel (> 5000 pcs per kg) |
| | 0301.92.20.20-7 | Eel fry (> 500 and < 5000 pcs per kg) |
| | 0301.92.20.30-5 | Young eel (elver) (> 10 and < 500 pcs per kg) |
| | 0302.74.00.00-6 | Eels, fresh or chilled |
| | 0302.89.94.10-4 | Offals of eel, fresh or chilled |
| | 0303.26.00.00-4 | Eels, frozen |
| | 0303.89.94.10-3 | Offals of eel, frozen |
| | 0304.39.00.10-6 | Eel fillets, fresh or chilled |
| | 0304.69.00.10-9 | Eel fillets, frozen |
| | 0304.93.10.10-7 | Frozen eel, minced (surimi) |
| | 1604.17.00.11-6 | Eels, whole/in pieces, not minced, prepared/preserved, frozen |
| | 1604.17.00.12-5 | Roasted eels, whole/in pieces, not minced, prepared/preserved, frozen |
| | 1604.17.00.20-5 | Eels, whole or in pieces, but not minced, prepared or preserved, canned |
| | 1604.17.00.90-0 | Other eels, whole or in pieces, but not minced, prepared or preserved |
| | 1604.20.90.21-0 | Other offal of eel prepared or preserved, frozen |
| | 1604.20.90.29-2 | Other offal of eel prepared or preserved |

*Other *Anguilla* spp. are grouped together in codes containing many fish species (not described here).

Source: Editorial Department of the Customs Import and Export Tariff of mainland China (2015); Hong Kong Census and Statistics Department; Ministry of Finance, Trade Statistics of Japan; Korea International Trade Association; Taiwan Bureau of Foreign Trade. Note: Mainland China uses 10-digit codes for Tariff purposes, but only 8-digit data (non-species-specific) are available for analysis.

Hong Kong plays an important role as an eel trade hub, in particular for live eel fry. Hong Kong is sometimes described as the source (or "origin") of live eel fry in East Asian Customs data, which obscures the actual source of live eel fry as there are no glass eel fisheries or eel farms in Hong Kong and these are simply re-exports. Live eel fry data describing Hong Kong as the source has been excluded from analysis in this report (such as that presented in Figure 3), in order to minimise double-counting. Totals for "live eel" presented in the trade section exclude trade in live eel fry (which are grown out to "other eel" in farms and then traded again), also to avoid double-counting.

CITES data, other sources and conversions

CITES trade data for *A. anguilla* (2009–2013) were downloaded in April 2015 from <http://trade.cites.org/>. These data, in particular with regards to "meat" trade, were compared to Customs trade data in order to estimate the importance of European Eels in the Japanese market.

Scientific publications, government reports, press releases, online news articles and company websites in English, Japanese and Chinese were searched for information on eel fishing, farming, trade and consumption issues in Asia.

For this report, production, consumption and trade totals are calculated as original live weight. The conversion rates used are shown in Table 2. Conversion rates can vary greatly, for prepared eel in particular, depending on live eel size and how the products have been prepared (e.g. skin on/off; head on/off). Data for filleted, minced eel and offal for Taiwan were not included in the analysis as conversion rates for these are even more problematic, and double counting is also more likely for trade in these commodities.

Table 2
Percentage live weight for the main eel products associated with commodity groupings used in Customs codes and associated average conversion factors.

| Customs commodity | Main products | % live weight | Conversion factor |
|--------------------|--|--------------------|-------------------|
| Live | | 100 | 1 |
| Fresh/chilled | Meat with skin | 64-98 (average 81) | 1.23 |
| Frozen | Meat with skin | 64-84 (average 74) | 1.35 |
| Prepared/preserved | Kabayaki (broiled in sauce) with head | 64 | 1.67 |
| | Kabayaki (broiled in sauce) without head | 60 | |
| | Shirayaki (broiled) | 58 | |

Source: A. Koelewijn, Stichting DUPAN, in litt. to TRAFFIC, January 2015; M. Suzuki, Marine Stewardship Council, in litt. to TRAFFIC, January 2015.

Where price information is provided, average annual exchange rates for Japanese Yen (JPY) and Chinese Yuan (RMB) to US Dollars (USD) were taken from OANDA: <http://www.oanda.com/currency/historical-rates/>. Apart from *Anguilla* spp. (freshwater eels), other fish species are also called and consumed as “eel” in Asia, such as Conger Eel (*Conger* spp.), Conger Pike Eel (*Muraenesox* spp.), Swamp or Rice Eel (*Monopterus albus*) and Hagfish (*Eptatretus burgeri*). For this report, eel(s) refers to *Anguilla* spp. unless otherwise specified.

2. Market surveys

Online market surveys

Online market surveys were conducted in Mandarin and Korean in order to examine the availability of eel and eel products for consumption in mainland China and South Korea, as these had previously been identified as possible important and/or emerging markets for eel products. Both surveys were conducted by researchers fluent in Mandarin and Korean respectively.

Two major online shopping websites were surveyed for mainland China: JD.com (<http://www.jd.com/>) and TMALL.COM (<http://www.tmall.com/>) (in March 2015) and two for South Korea: G-market (<http://www.gmarket.co.kr/>) and Auction (<http://www.auction.co.kr/>) (in December 2014). The term “eel” was used in both languages to find the relevant advertisements and the total number of advertisements by product type was recorded. A representative selection of advertisements of each product type were then used to collect information on specific product names, prices, species and country of origin.

The term “eel” in Japanese was also searched for on two major Japanese online shopping sites: Rakuten ichiba (<http://www.rakuten.co.jp/>) and Yahoo! Japan (http://shopping.yahoo.co.jp/?sc_e=yt) in March 2015, in order to provide a comparison.

Beijing market surveys

Brief market surveys were conducted at fish markets and supermarkets in Beijing, mainland China in January 2015 in order to get an insight into the current status of commercial trade in eel and eel products in the capital. Traditionally, the southern provinces of mainland China have been important for eel consumption, with there being little tradition for this in northern cities such as Beijing (Bay and Sano, 2006). However, as past market survey data/information were not available for comparison purposes, and a comprehensive market survey across various provinces in mainland China was not possible for the purposes of this report, Beijing was selected for the survey, assuming that previous eel consumption there was minimal and any changes to this might be identified more easily by traders/market findings.

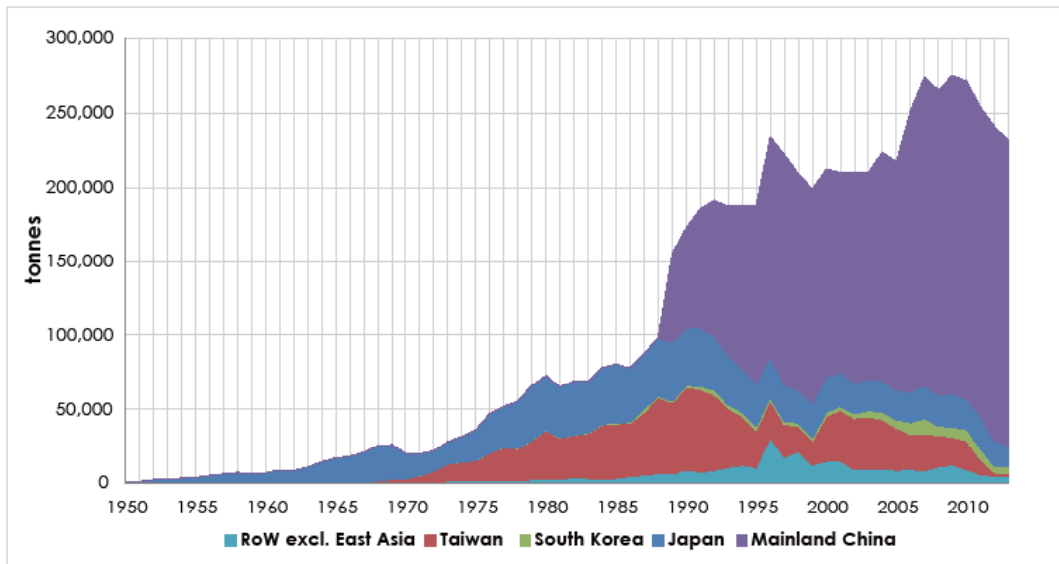
Four major fish markets and two large supermarkets were selected for this purpose. During the surveys, all eel products observed were recorded, together with qualitative data on product types and prices, species sold, origin of the products, main buyers and other information obtained through informal interviews with traders. All the interviews were conducted by native Mandarin-speakers.

EEL PRODUCTION, TRADE AND CONSUMPTION DYNAMICS IN EAST ASIA

1. Eel production

Global eel production has steadily increased over the last 30 years. This is mainly due to the expansion of farming (or aquaculture), which accounted for 95% of total production in 2013 according to FAO data. Figure 2 shows eel aquaculture production reported to FAO since 1950, demonstrating the importance of East Asia. Mainland China has played an increasingly important role in eel farming from the 1990s onwards, which continued to increase steadily over the past two decades, production reaching over 200,000 tonnes in 2007 (FAO, 2015a). According to FAO data, mainland China was responsible for nearly 85% of global eel production in 2013.

Figure 2
Global *Anguilla* aquaculture production, highlighting production in East Asian countries/ territories, 1950–2013, tonnes.



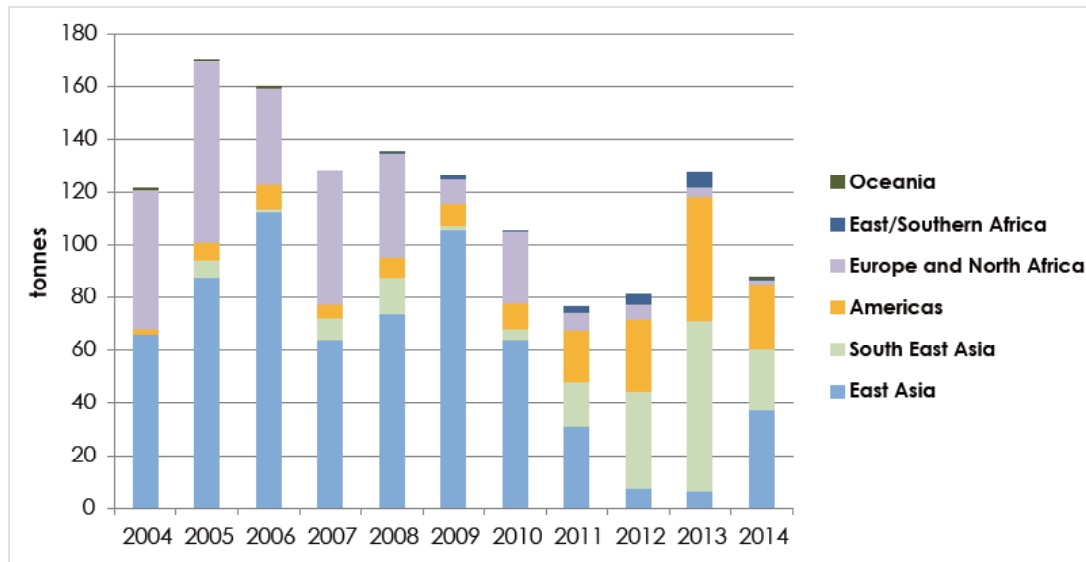
Source: FAO Fisheries Production. Estimated quantities (F) included. Rest of the World (RoW).

Eel farming is reliant on wild-caught juvenile eels (mainly live eel fry or glass eels), as breeding in captivity is not yet commercially viable. Eel farms therefore need to obtain juvenile eels as “seed”. The main species used for aquaculture in East Asia are Japanese Eel *A. japonica*, which is native to the region, European Eel *A. anguilla*, and to a less extent American Eel *A. rostrata*. Declines in populations of these temperate species, combined with international and national measures controlling their catch and trade, however, has led to an increase in use of other *Anguilla* spp. for farming in both range and non-range States.

Figure 3 shows changes in “source” regions of live eel fry imported into East Asia over the past decade. Imports from the Americas including Canada, the USA and the Dominican Republic (likely to be *A. rostrata*) and South-East Asia including the Philippines, Indonesia, Viet Nam and Malaysia (likely to be *A. bicolor* and other tropical *Anguilla* species) increased in 2012 and 2013 when *A. japonica* recruitment in the region was low. Korean Customs data for 2013 suggest that South Korea is one of the most important East Asian destinations for live eel fry of tropical *Anguilla* species (Crook, 2014). Farming techniques for these species, however, are still being tested/under development and production success is not yet comparable to that for *A. japonica* and *A. anguilla* (T. Moriyama, Japan Eel Importers Association, pers. comm., May 2015).

More recently, in keeping with changes in eel fry supply in the region, several South-East Asian countries, have also begun eel farming. In Indonesia, farming of tropical species, in particular *A. bicolor* is underway in large and small-sized eel farms, targeting the international and domestic markets, respectively. There are already concerns with respect to over-fishing of tropical eel species in Indonesia, however, there are no national regulations in place concerning glass eel catch and farming (Nomura, 2015). Additionally, although Indonesia has an export ban in place for juvenile eels not exceeding 150 g (i.e. ≤ 150 g), live eel fry are still imported from Indonesia into East Asia for farming. The demand for tropical eels varies each year, however, depending on the quantities of *A. japonica* glass eels available for input into farms in East Asia. The situation is similar in the Philippines, with illegal trade occurring despite the export ban in place since May 2012 for juvenile eels not exceeding 15 cm (i.e. ≤ 15 cm) (Crook, 2014).

Figure 3
Imports of live eel fry for farming (all sizes) into mainland China, Hong Kong, Japan, South Korea and Taiwan by source, 2004–2014, tonnes.



Source: mainland China, Japan, Taiwan, South Korea and Hong Kong Customs. Europe and North Africa (likely to be *A. anguilla*): France, Spain, the United Kingdom, Denmark, Germany, Belgium, Ireland, Romania, Netherlands, Greece, Morocco, Tunisia, Egypt; Americas (likely to be *A. rostrata*): Canada, the USA, Haiti, Dominican Republic and Cuba; East Asia (likely to be *A. japonica*): mainland China, Japan, Taiwan, South Korea, Democratic People's Republic of Korea; South-east Asia (likely to be *A. bicolor* and other tropical *Anguilla* species): Indonesia, Philippines, Malaysia, Viet Nam, Thailand, Bangladesh, Timor Leste and Singapore; East/Southern Africa (likely to be *A. mossambica* and other tropical species): Madagascar, Mauritius and South Africa; Oceania (likely to be *A. australis*): Australia.

The history and development of eel farming in each East Asian country/territory is described in more detail below.

Japan

In Japan, eel farming on a commercial scale began around 1890–1900, although there are records of eels being caught from the wild for consumption as early as 800 A.D. (Matsui, 1997). Both *A. japonica* elvers (eel “seeds” larger than glass eel) and glass eels were used in farms up to the 1970s, until techniques maximising the use of glass eels were developed (Kishida and Kanto, 2013).

Japan began importing *A. japonica* live eel fry from Taiwan, South Korea and mainland China in 1964, and *A. anguilla* live eel fry from France in 1969 (Tsunogai, 1997). Japanese Customs data suggest that farmers imported and tried to grow out several different eel species in the 1970s and early 1980s, with reported imports from 12 countries/territories during this time including Cuba, the

Dominican Republic and Thailand. However, efforts to apply the same techniques developed for *A. japonica* to other *Anguilla* spp. were not successful at the commercial level, and *A. japonica* has been predominantly farmed in Japan ever since (Ringuet *et al.*, 2002). In February 2015, in Japan there were reportedly 475 eel farmers using *A. japonica* and 61 using other *Anguilla* species (Fisheries Agency of Japan, 2015b).

There are two main farming methods used in Japan: “single year farming”, when live eel fry are placed in eel ponds in December–January and farmed for six to nine months⁹, ready for the eel day(s) “doyo no ushi”¹⁰ that same year; and “year round farming”, when live eel fry are placed in eel ponds in February–April and grown out with the aim of harvesting after that year’s eel days, usually between September and July of the following year (Anon, 2012). Eels are grown to 150–250 g—the “ideal” size for consumption in Japan. Eel farming production in Japan peaked at 39,704 tonnes in 1989 (FAO, 2015a), but has declined since, mainly due to strong competition from cheaper imported products and the rising price of glass eels (Masui, 2013).

Data on glass eel input into eel ponds in Japan are available, however, the actual quantity of glass eels caught in Japan (for input into farms) is less well known. In Japan, prefectural governments issue a licence for glass eel catch for specific fishing periods, usually between December and March. However, illegal and unreported fishing of glass eels has been occurring since the 1960s, and reportedly more than 50% of all glass eels are derived from non-licensed fishermen and/or traded through the black market (Jacoby and Gollock, 2014; Tsutsui, 2014). While glass eel catch reported by prefectural governments was two tonnes for the 2012–2013 fishing season and eight tonnes for 2013–2014, corresponding glass eel catch figures released by the Fisheries Agency were 5.2 and 17.3 tonnes, respectively (Anon, 2014c; Fisheries Agency of Japan, 2015b). The latter figures are estimated from total glass eel input into farming ponds, combined with Customs data.

In addition to national supplies, Japanese farming is dependent on imports of *A. japonica* live eel fry from other source countries and territories. More than 70% of Japan’s imports of live eel fry since 2007 have been from Hong Kong (where there are no glass eel fisheries¹¹), the majority of these live eel fry having originated in Taiwan (Han, 2014). Other countries/territories’ Customs data suggest Japan also exports live eel fry, however the majority are larger size individuals going to Taiwan (for farming there and re-import to Japan for consumption; see below). Export of live eel fry (≤ 13 g) from Japan has been regulated by the Export Trade Control Order since 1976 (Anon, 2015a) and currently, exports of live eel fry between December and March are banned, and exports between April and November need to be approved by authorities.

Taiwan

Taiwan began exporting live eel fry to Japan in 1968, to fulfil the increased demand for farming in Japan. Consequently, Taiwan began to develop its own eel farming industry and in January 1989 new legislation was introduced, banning exports of all sizes of eel fry, at all times of the year (J. Wu, TRAFFIC, *in litt.* to TRAFFIC, April 2015). This ban was lifted in March 2001, and was replaced with a new regulation in October 2007. This export ban covers all sizes of eel fry between November and March, with trade permitted between April and October only¹². The Fisheries Agency controls harvesting periods for glass eels (used for farming)—this was reduced from seven months in 2013–2014 (01/10/2013–30/04/2014) to four in 2014–2015 (01/11/2014–28/02/2015) in an attempt to limit total *A. japonica* glass eel exploitation in Taiwanese waters (Fisheries Agency of Taiwan, 2014). Despite these regulations, exports of glass eels from Taiwan to Japan have continued illegally due to high demand (Han, 2014).

9 An “eel year” begins in September (S. Takashima, Nihon Yoshoku Shimbun, *in litt.* to TRAFFIC, April 2015).

10 The main “eel days” correspond to one or two “Days of the Ox” in the summer (during late July and early August) based on a combination of two ancient calendar systems, and are when Japanese people traditionally consume eel.

11 Japan Customs data supposedly report imports by origin of the commodity not by export countries. http://www.customs.go.jp/toukei/sankou/howto/gaiyou_e.html. Accessed 29 May 2015.

12 <http://ekm92.trade.gov.tw/Pages/Detail.aspx?nodeID=39&pid=78994>. Accessed on 29 May 2015.

According to FAO data, eel aquaculture production in Taiwan exceeded Japan in 1987 and peaked at 55,816 tonnes in 1990, when there were at least 1,000 eel farmers registered in Taiwan (Anon, 2013). Since then farming has decreased dramatically, and Taiwan's production in 2013 was reportedly less than 2,000 tonnes. Most of the eels are grown out to 250 g and exported to Japan (Han, 2014).

Despite there being five native *Anguilla* spp. in Taiwan¹³, when *A. japonica* eel fry were available, farming in Taiwan focused on this species only (Tzeng *et al.*, 1995). However, in the 1990s (and then again in 2012–2013), when *A. japonica* glass eels were scarce, *A. rostrata* glass eels were also imported for farming (Han *et al.*, 2002; Han 2014). Small quantities of *A. marmorata* have also recently been imported/farmed in Taiwan (Han, 2014). Rearing of *A. anguilla* was never considered a viable option in Taiwan's outdoor ponds due to climate and competition with mainland China (Anon, 2013).

Mainland China

Eel farming in mainland China dates back to the Ming Dynasty (1364–1644), however it was during the mid-1970s when intensive eel farming began (Dou, 2014). In 1986, the State Council of the People's Republic of China issued a "notification of the development of eel production and regulation of eel fry export"¹⁴, introducing stricter measures for controlling eel fry export and encouraging domestic eel aquaculture (State Council General Office, 1986). Eel production in mainland China increased significantly after this. Exports of live eel fry from mainland China need to be approved by authorities and are taxed (W. Jin, NFTEC, pers. comm. to TRAFFIC, January 2015).

The increasing price of *A. japonica* live eel fry posed a threat to eel farming in the early 1990s, however (Han, 1999), and in 1992 mainland China began using *A. anguilla* live eel fry, which was cheaper than *A. japonica* and relatively abundant. High-yield farming techniques developed over the coming years successfully reduced production costs and in 2000 exports of eel and eel products made up 20% of mainland China's total foreign exchange earnings from aquatic products (Anon, 2007). The eel industry, including farming facilities, feed and processing companies, rapidly developed, in particular in Fujian and Guangdong provinces (Ren and Zeng, 2013, Figure 4). The survival rate of farmed *A. anguilla* in mainland China was 65% in 2007 (Bureau of Fisheries of China, 2007), but recent information suggests that survival may have increased to 90% (W. Jin, NFTEC, pers. comm. to TRAFFIC, January 2015).

Figure 4

The principal (dark grey) and other (light grey) eel farming provinces in mainland China.



Source: TRAFFIC, based on Bureau of Fisheries, Ministry of Agriculture of China (2014).

¹³ *A. japonica*, *A. marmorata*, *A. bicolor pacifica*, *A. celebesensis* and *A. luzonensis* (Tzeng, 2014)

¹⁴ http://www.gov.cn/zhengce/content/2013-08/26/content_3499.html. Accessed on 29 May 2015.

According to the Bureau of Fisheries of China (2007), 50% of the total *Anguilla* farming production in the late 1990s in mainland China was *A. anguilla*. This proportion later declined to 35% due to an increase in *A. japonica* glass eel catches in mainland China waters (Bureau of Fisheries of China, 2007).

Han (1999) observed that, on average, it takes 18 months for *A. anguilla* to reach commercial size, however more recently growing periods of two to three years have been quoted, partly due to restrictions over the use of chemicals since the 2000s (T. Moriyama, Japan Eel Importers Association, pers. comm., May 2015) and the use of mixed quality live eel fry (including slow-growers) after the *A. anguilla* CITES listing and related EU regulations came into force (W. Jin, NFTEC, pers. comm., January 2015). After *A. anguilla* was listed in CITES Appendix II, the Bureau of Fisheries of China (2007) encouraged the growing of larger-sized eels in order to utilize fully valuable resources, also noting that the European and Russian markets prefer larger sized eels.

Currently, the grow-out size and consequently farming period of *Anguilla* eels varies depending on the destination market—ranging from 250 g per live eel destined for Japan to 700–800 g per live eel destined for the domestic market (T. Moriyama, Japan Eel Importers Association, pers. comm., May 2015). Prices and sizes of *A. japonica* and *A. anguilla* farmed in mainland China have changed over the last decade. According to a newspaper report in March 2001, smaller eels (200 g) were the most popular on the wholesale market in mainland China, with *A. japonica* fetching higher prices than *A. anguilla*, for the same size (Anon, 2001). In March 2015, larger *A. anguilla* eels (500 g–1 kg per eel) fetched a higher price than the smaller individuals of that species, however small-sized *A. japonica* were still preferred (Anon, 2015b). *Anguilla anguilla* farmed in mainland China has reportedly mainly been used for producing prepared products and to supply the domestic market (T. Moriyama, Japan Eel Importers Association, pers. comm., May 2015).

Farming of other species including *A. marmorata*, *A. bicolor* and *A. rostrata* has been attempted, especially in Fujian province (Ren and Zeng, 2013). However, the demand for *A. anguilla* glass eel is still high and this species continues to be sourced from Europe and North Africa, in many cases illegally (TRAFFIC, 2012; Anon, 2014b, 2015c, 2015d).

South Korea

Eel farming began in the 1970s in South Korea (Lee, 2014) and was initially limited to growing *A. japonica* glass eels into larger-sized elvers for export (for farming to full-size elsewhere). Full-scale farming of adult eels ready for consumption only developed in the 1980s (National Fisheries Research and Development Institute of South Korea, 2009). In South Korea, eels are farmed for six months to one year, but when glass eel supplies are low, the farming period is extended and eels are grown to larger sizes, namely 300 g–500 g per eel (T.W. Lee, Chungnam National University, *in litt.* to TRAFFIC, January 2015).

In 2011, there were over 500 eel farms in South Korea, however eel farming is reportedly declining due to poor glass eel catches/supplies and price increases (Nohara, 2013). The glass eel catch in South Korea has fluctuated since the late 1980s and on average, half the glass eels used in farms come from imports (Lee, 2014). In 2013, according to South Korean Customs data, South Korea imported ~55 tonnes of live eel fry for farming (glass and “young” eels); nearly half of all live eel fry imports into East Asia for that year. Over 25 tonnes were imported from South-East Asia (the Philippines, Viet Nam and Indonesia), over 20 tonnes from the Americas (the US, Canada and the Dominican Republic) and nearly 4 tonnes from Madagascar (see Figure 3 for likely species compositions of these imports).

East Asian eel production data

There are various sources of eel production data for East Asia, including production reported to FAO, production figures provided by governments in the “Joint Statement” in September 2014, and production estimated from glass eel input (see Methods section). These data are provided in Tables 7 and 8 in the Annex and analysed in further detail below.

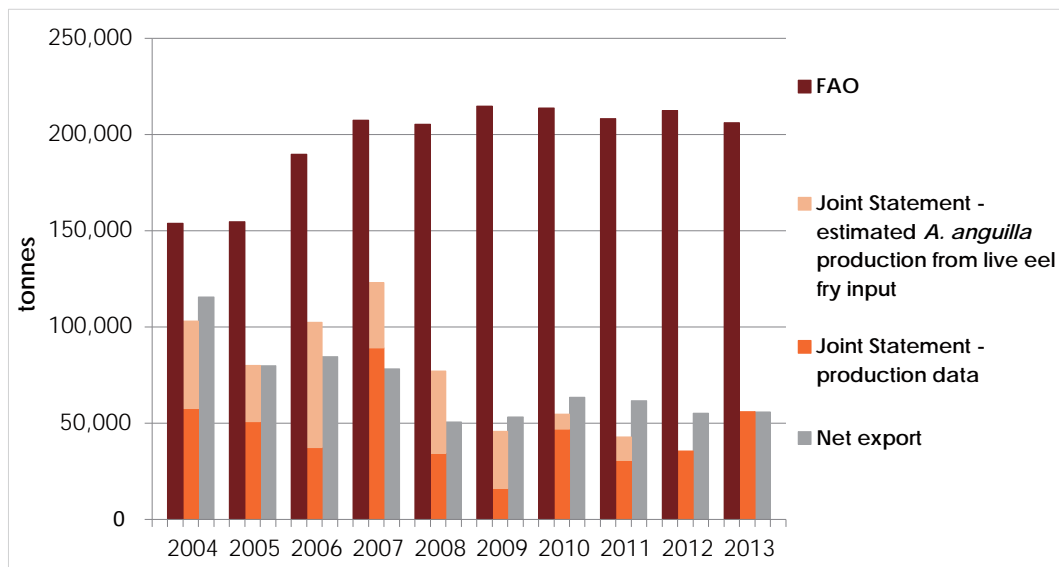
Aquaculture production data reported to FAO and in the “Joint Statement” are almost the same for Japan and Taiwan, but show significant differences for mainland China and South Korea. Figure 5 illustrates the difference between FAO aquaculture production, Joint Statement farming production data combined with additional production estimated from live eel fry input, and estimated net eel exports (exports minus imports converted to live eel weight) for mainland China in 2004–2013. For all years, annual production according to FAO (ranging from 150,000 to 215,000 tonnes), is considerably higher than production provided/estimated from other sources/methods (ranging from 15,000 to 125,000 tonnes).

FAO data for mainland China *Anguilla* production for 1997–2006 were adjusted downwards by 13% by FAO in response to the result of China’s Second National Agriculture Census. Results from the census were regarded as more reliable since they were based on more thorough surveying, compared to previous figures based on sampling plus estimates provided by local officials (S. Vannuccini, FAO, *in litt.* to TRAFFIC, September 2014). However, as China did not provide species/group breakdowns of these results, this estimated reduction was applied to all species in aquaculture, and this percentage may have been too high for the better monitored industries, such as eel farming (X. Zhou, FAO, *in litt.* to TRAFFIC, October 2014). Eel aquaculture production according to FAO data, with this reduction incorporated, was between 150,000 and 190,000 tonnes in 2004–2006; without the reduction it would have been between 175,000 and 205,000 tonnes. Therefore, if this reduction had not been applied, the differences between FAO and Joint Statement data for 2004–2006 would have been even greater.

FAO eel production data are derived from reports to the China federal government through several intermediaries (i.e. local governments); Joint Statement production data, on the other hand, were collected through local eel farming associations and these data are therefore considered more reliable (W. Jin, NFTEC, *in litt.* to TRAFFIC, January 2015). The Joint Statement data did not contain *A. anguilla* production for 2004–2011, however, and with *A. anguilla* being important for farming (making up between 30–50% of production over the last decades; Bureau of Fisheries of China, 2007), the Joint Statement production 2004–2011 data are likely to be an underestimate as it excludes this species.

Eel production according to the Joint Statement was less than net eel exports reported by China Customs for all years apart from 2007. As frozen prepared/preserved eel in airtight containers can be stored for one or two years after production, annual net exports could theoretically exceed annual production for individual years. However, the repeated trend as shown in Figure 5, combined with the fact that eels are also consumed in the domestic market, again suggests that production as reported in the Joint Statement is an underestimate.

Figure 5
***Anguilla* farming production reported and estimated from various data sources for mainland China, 2004–2013, tonnes.**



Sources: FAO aquaculture production, Joint Statement, Unagi net, China Customs. Trade data converted to live eel weight.

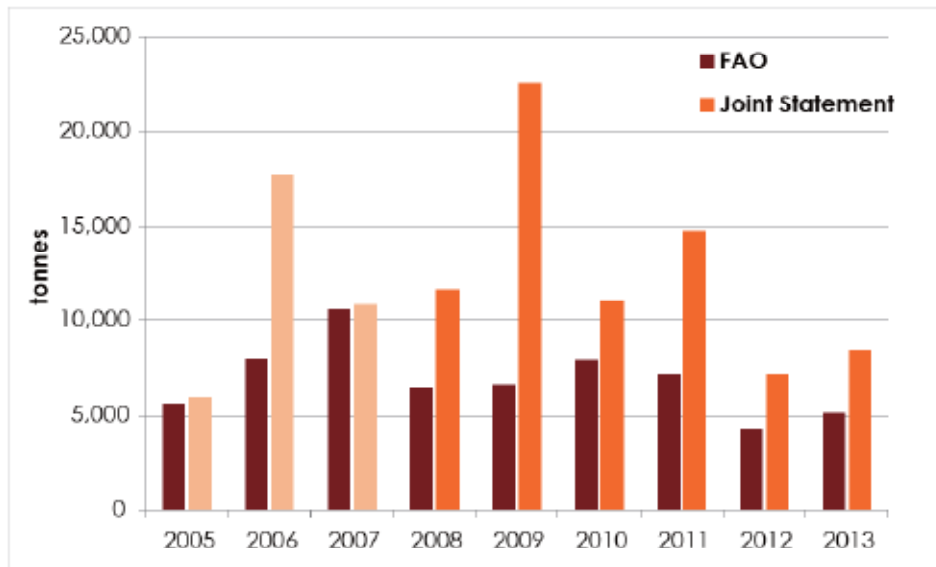
Once *A. anguilla* production estimates (paler orange bars in Figure 5) were added to the Joint Statement production data, production was larger than net exports for more years, suggesting this is a more reasonable estimate of total production over the years. Tsutsui (2014) reported inconsistencies between actual eel farming production and estimated production based on the quantity of live eel fry used for farming due to various reasons. For example, massive eel deaths as a result of diseases can lead to reduced farming production (Joh *et al.*, 2013). Furthermore, production estimates can be used to obscure the actual quantities of glass eels being traded on the black market (and consequently put into farms), by reporting lower survival rates (Anon, 2015e). It is important to note that the estimates presented in Figure 5 were based on many assumptions (see methods) and may not provide accurate figures for individual years, but as a minimum help to fill assumed gaps to gain a better understanding of overall production over the last decade. The fact that Customs data may include (mis-)reported trade in other non-*Anguilla* species (see methods) must also be considered, and therefore reported “eel” exports could be greater than actual *Anguilla* exports, further complicating the situation.

In 2012 and 2013, when *A. anguilla* production was reportedly included in the Joint Statement production data (see Table 8), and the totals were not amended as for 2004–2011, the differences between FAO and the Joint Statement production are still significant. Annual production in 2012–2013 according to FAO was 205,000–210,000 tonnes, and only 35,000–55,000 tonnes according to the Joint Statement data. For 2012, net exports were larger than Joint Statement production, but in 2013 the quantities were similar (see Consumption section for further discussion on this).

Dou (2014) estimated average annual aquaculture production in mainland China in the 1990s as 92,000 tonnes and in the 2000s as 107,000 tonnes, based on media and literature resources (S.-z. Dou, Chinese Academy of Science, *in litt.* to TRAFFIC, January 2015). The Bureau of Fisheries of China (2007) reported annual eel production of 120,000 tonnes. Figures provided by these two sources appear to fall somewhere between the FAO and Joint Statement data. With mainland China being such an important eel producer globally, these large differences in data lead to difficulties when estimating both domestic and global consumption of eels – see Section 3 on Consumption.

Whilst mainland China's eel farming production was considerably higher according to FAO data, South Korea data suggested the opposite—as Figure 6 shows, production according to the Joint Statement was larger than that reported to FAO. The Joint Statement did not include farming production data for 2004–2007—Figure 6 shows an estimate of this production based on the live eel fry input quantities (see Methods section).

Figure 6
Anguilla farming production reported and estimated for South Korea, 2005–2013, tonnes.



Source: FAO aquaculture production, "Joint Statement". 2005–2007 data (paler orange) was estimated using live eel fry input.

FAO data were used to describe total global eel production at the beginning of this report (Figure 2) and are the most widely available data source for global production. However, if FAO data were replaced with the data provided in the Joint Statement for mainland China and South Korea, global production and the corresponding roles of the main eel producers would change dramatically. For example, for 2012 and 2013, global eel production would be only ~82,000 and ~97,000 tonnes respectively, compared to ~255,000 tonnes per year as reported by FAO. Accordingly, the global roles of mainland China and South Korea in relation to eel production would also change, with mainland China's importance as an eel producer decreasing to ~60% of global production (from 85%) and South Korea's importance increasing to ~10% (from ~2%). It is vital that these differences be researched further as any conclusions made regarding production, from analysis of available data, play a vital role in determining the scope, scale and effectiveness of any future eel management and conservation decisions at national/territory and regional levels.

2. Eel trade

Live, fresh and prepared *Anguilla* eels are traded globally. In this section, trade of live ("other live eel", excluding live eel fry traded for farming purposes), fresh, frozen and prepared eels (converted to live eel weight) is analysed in order to examine further eel trade and consumption dynamics in East Asia. Taiwan's role in eel trade is not presented in a separate section, but is discussed under the corresponding sections of its trade partners.

According to FAO, the volume of global live, fresh, frozen and prepared/preserved eel exports peaked at approximately 190,000 tonnes in 2001, before declining gradually to below 110,000 tonnes in 2011.

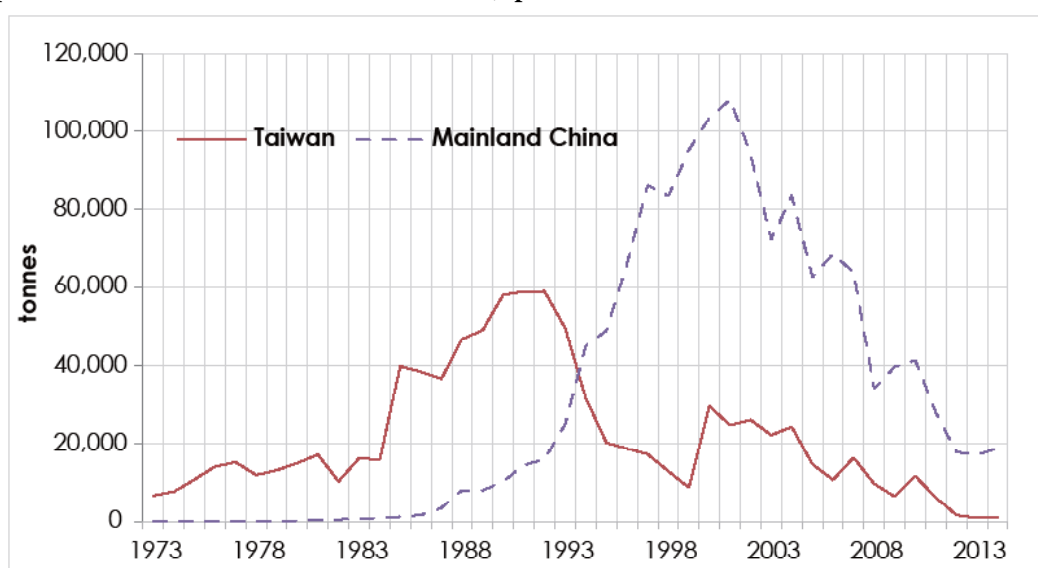
Of the four commodities, prepared/preserved eel has accounted for more than half of total exports over the past 10 years, followed by live, frozen and fresh eels. The main eel exporter over the last decade has been mainland China, which accounted for 64% of all eel exports, and Japan was the main importer, responsible for 70% of global eel imports. However, Japan's role as an importer appears to have been decreasing in importance in recent years.

Japan

Over the past 20 years Japan has been the world's largest eel importer (FAO, 2015b), importing on average 86,000 tonnes per year. However, in 2013 Japan imported only 18,000 tonnes, less than 40% of the total traded globally. Eel exports from Japan are minimal. *Anguilla* spp. are imported into Japan almost exclusively as two commodities—live and prepared/preserved eel, mainly *kabayaki* (filleted eels dipped in a sweet soybean sauce before and after broiled on a grill). Japan Customs data for 1973–2014¹⁵ show that Japan has imported live and prepared/preserved eels from a number of countries/territories, but mainly from Taiwan and mainland China. As Figure 7 shows, until 1993, Japan imported most of its eel products from Taiwan, after which imports from mainland China surpassed imports from Taiwan.

Information on trade in eel products is generally not available to the species level. This makes it difficult to identify to what extent *A. anguilla* or other eel species have been imported and are available on the Japanese market. However, it is known that *A. anguilla* farmed in mainland China was imported into Japan, especially from 1990s onwards—the Fisheries Agency of Japan (2015a) attributes changes in eel consumption patterns in Japan between 1985 and 2014 to variations in *A. anguilla* farming/production in mainland China. DNA analysis reported by Taki *et al.* (1999) showed that *A. japonica* accounted for only 34% of prepared eel sold in supermarkets, with the remainder being made up of various other species such as *A. anguilla* and *A. rostrata*. More recently, according to CITES trade data, over 40% of all prepared/preserved eel imported into Japan from mainland China between 2009 and 2013 was *A. anguilla* (Table 3).

Figure 7
Eel imports from Taiwan and mainland China into Japan, 1973–2014, tonnes.



Source: Ministry of Finance, Trade Statistics of Japan. Total of “other” live, fresh, frozen and prepared/preserved eel, converted to original live weight. Prior to 1985, the only commodity reported was “other” live eel.

15

A specific Customs code for live eel was in place from 1973 in Japan; for prepared/preserved eel from 1985.

Table 3

***A. anguilla* meat imports and prepared/preserved eel imports into Japan from mainland China, 2009–2013, tonnes.**

| | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|--------|--------|--------|-------|-------|
| Imports of <i>A. anguilla</i> (meat), CITES data | 7,403 | 7,792 | 5,874 | 4,371 | 5,319 |
| Imports of prepared/preserved eel, Japan Customs data | 19,784 | 21,198 | 13,869 | 8,818 | 8,021 |
| Estimated percentage of <i>A. anguilla</i> | 37% | 37% | 42% | 50% | 66% |

Source: CITES database (importer data) and Ministry of Finance, Trade Statistics of Japan.

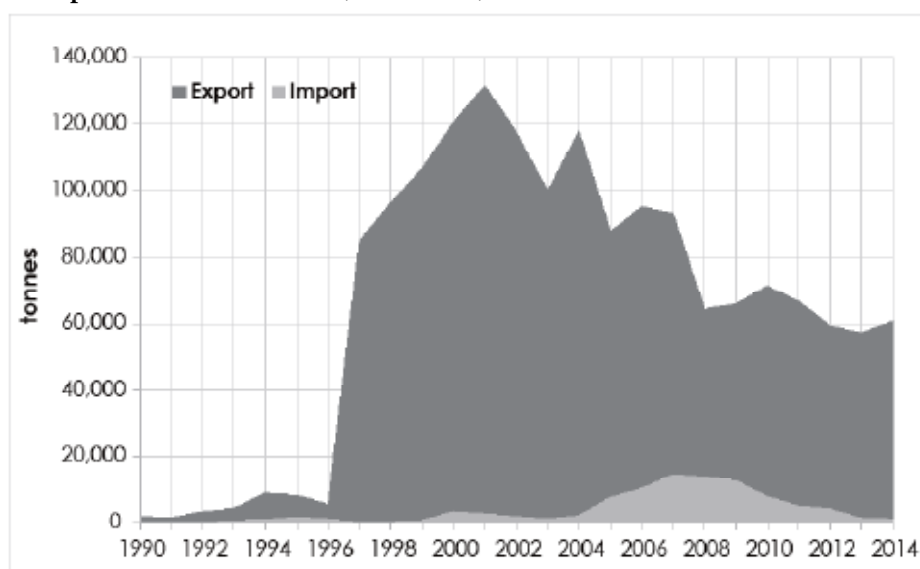
Note: *A. anguilla* CITES import data for 2009 do not include imports prior to 13 March 2009. There are no fresh/frozen eel imports from mainland China reported to Japan Customs during these years, “meat” as described in the CITES database was therefore regarded to be prepared and preserved eel as described by Customs.

Mainland China

Over the past 15 years, mainland China has been the world’s largest eel exporter (FAO, 2015b), exporting on average 95,000 tonnes per year. Figure 8 illustrates reported annual exports and imports of eel and eel products from/into mainland China from 1990 to 2014. Exports increased from just over 5,000 tonnes in 1996 to approximately 85,000 tonnes in 1997, when data on trade in prepared/preserved eel became available. Eel exports from mainland China peaked in 2001 with 130,000 tonnes, after which it has been gradually declining. In 2014, exports were approximately 60,000 tonnes, 80% of which was prepared/preserved eel.

Figure 8

Eel exports and imports of mainland China, 1990–2014, tonnes.



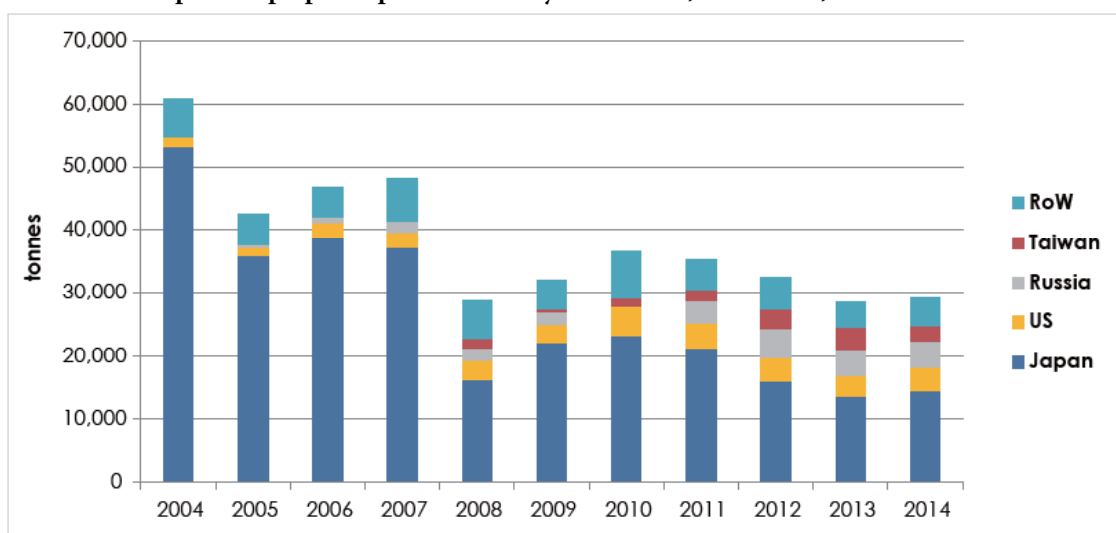
Source: FAO Fishery commodities trade for 1990–2003, China Customs for 2003–2014. Total of “other” live, fresh, frozen and prepared/preserved eel, converted to original live weight.

Although Japan is still the most sizeable importer of prepared/preserved eel from mainland China, according to China Customs data, its importance has decreased from 87% in 2004 to only 50% in 2014. During this period the number of trading partners increased from 18 to 41 countries/territories, with Russia, Taiwan and the United States (USA) becoming increasingly important destinations for eel

exports from mainland China (Figure 9). Other new destinations include Chile, Turkey and Colombia. According to CITES trade data (available for the past five years only) mainland China was the largest exporter of *A. anguilla* (live and meat) between 2009 and 2013. 86% of *A. anguilla* meat exported from mainland China was destined for Japan, followed by Poland (3%) and the USA (2%).

However, there appear to be discrepancies between mainland China Customs eel export data and destination import data, and between CITES *A. anguilla* importer and exporter data, making it difficult to make conclusions over the importance of any new/emerging markets. For example, Customs imports of prepared/preserved eels reported by the USA and Taiwan in 2014 (1,590 and 0.2 tonnes respectively) were less than exports reported by mainland China (3,633 to the USA and 2,370 tonnes to Taiwan, see below). This, together with the fact that the USA reports annual exports of eels (~600 tonnes of prepared/preserved between 2012 and 2014, in addition to live eels), suggests the US eel market may not have increased as much as Figure 9 suggests. According to UN Comtrade, annual Russian imports, on the other hand, are similar to those reported by China (~5,000 tonnes, although CITES data reported by Russia and China for *A. anguilla* differ), and with only eight and 27 tonnes of reported eel exports from Russia in 2012 and 2013, the importance of Russia as a consumer market for eels farmed in China does appear to have increased significantly over the past decade.

Figure 9
Mainland China exports of prepared/preserved eel by destination, 2004–2014, tonnes.



Source: China Customs. Destinations for exports of less than 1000 tonnes per year on average, plus exports to Hong Kong, are included in the Rest of the World (RoW).

Reported trade of various eel commodities between mainland China and Taiwan differs significantly over the last decade. Taiwan prohibits the import of certain eel commodities from mainland China including live *A. marmorata* and other *Anguilla* spp. eels and fresh, frozen and prepared/preserved eel (only Customs code of 1604.17.00.11-6)¹⁶ to prevent commodities from mainland China and Taiwan being mixed and re-exported as all having originated in Taiwan (J. Wu, TRAFFIC, *in litt.* to TRAFFIC, May 2015). Additionally, import of some other eel commodities, such as live *A. japonica*, frozen fillets and roasted eels needs to be authorized beforehand by the Fisheries Agency of Taiwan. Permission for trade in live *A. japonica* has reportedly not been given since the 1990s (J. Wu, TRAFFIC, *in litt.* to TRAFFIC, May 2015).

Mainland China Customs, however, reports exports in these eel commodities from mainland China to

16 <https://fbfh.trade.gov.tw/rich/text/indexfh.asp>. Accessed on 29 May 2015.

Taiwan (with no corresponding reports by Taiwan Customs)—for example, mainland China reported exports of 22 tonnes and 30 tonnes of “other live eel” into Taiwan in 2012 and 2013 respectively. This commodity includes all *Anguilla* live eels not reported as live eel fry, which corresponds to the three separate live eel commodities recorded by Taiwan Customs (live *A. japonica*, *A. marmorata* and other *Anguilla* spp.), for which no trade has reportedly been authorized. This raises concerns over possible mis-reporting (of non-*Anguilla* eels in trade, see methods) and illegal trade.

Finally, it is important to note that despite the increasing number of destinations for eel exports from mainland China, each of these markets appears to still be relatively small when compared to Japan (H. Cui, China Aquatic Products Processing and Marketing Alliance (CAPPMA), pers. comm., January 2015). The global expansion of Japanese cuisine and the consequent increase in the number of Japanese restaurants offering eel dishes overseas may have an important role to play in these changing trade dynamics (H. Cui, CAPPMA, pers. comm., January 2015). For example, Nijman (2015) observed that 17 out of 20 Japanese restaurants in Indonesia offered eel dishes on their menus, where eels are not traditionally consumed.

South Korea

Globally, South Korea plays a lesser role with regards to eel production and trade than mainland China or Japan, however, according to the various sources of data available, South Korean production and trade dynamics have changed considerably over the past two decades. Figure 10 shows that in the late 1970s and early 1980s, South Korea was an exporter of eel commodities (~7,000 tonnes per year), but that between 1988 and 1998 trade appeared to cease or be minimal. Then from 1999 onwards South Korea began to report annual imports of ~3,000 tonnes of eel commodities, together with an increase in eel production. These data suggest that the domestic market/consumption of eels in South Korea has increased in the past decade (as supported by Lee (2014), see section on eel consumption for further details).

Figure 10
South Korea eel exports, imports and production, 1976–2014, tonnes.



Source: FAO Fisheries Production, FAO Fishery commodities trade for 1976–1999, South Korea Customs for 2000–2014. Total of “other” live, fresh, frozen and prepared/preserved eel, converted to original live weight.

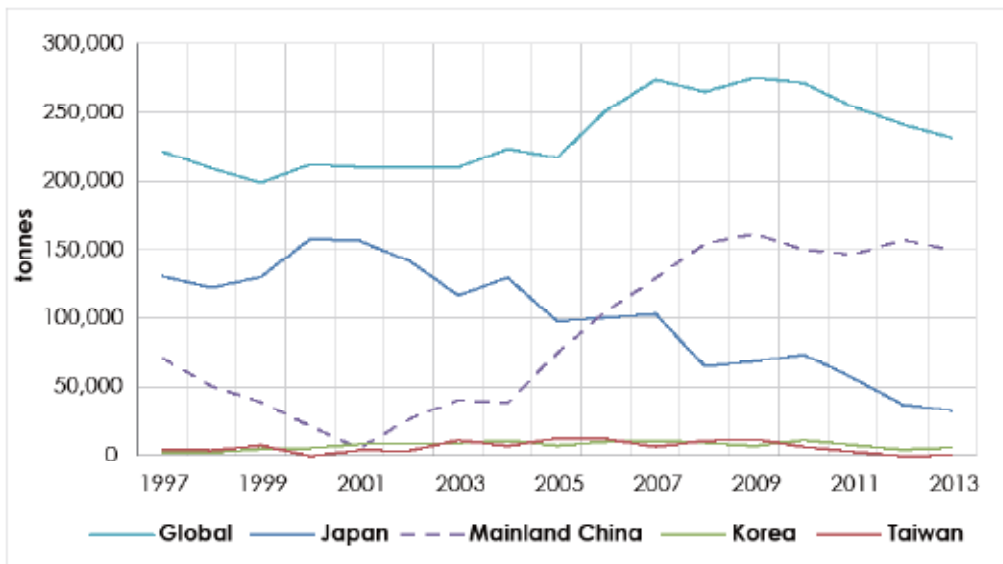
The principal eel commodity imported by South Korea is live eels. Over the past five years, South Korea has imported most of its other live eel (excluding eel fry) from mainland China (84%), with New Zealand, Taiwan and Canada supplying smaller quantities. According to CITES data, South Korea imported 11 and 13 tonnes of live *A. anguilla* from Tunisia in 2011 and 2012. South Korea also imports prepared/preserved eel (almost exclusively from Taiwan and mainland China), however these imports have declined in recent years. Between 2008 and 2011, annual prepared/preserved imports averaged ~150 tonnes; in 2012–2014 annual imports were only ~70 tonnes. This decrease coincides with changes to Customs codes for prepared eels in 2012, and changes in reporting should be considered when interpreting these data. Frozen eel imports are minimal, however have been increasing in the last five years (from one tonne in 2010 to 43 tonnes in 2013) – the majority of these are imported from Madagascar and the USA.

3. Eel consumption

Global demand for eel products for consumption has historically been driven by the East Asian market, especially Japan. According to FAO production and Customs trade data for eels, Japan's annual consumption¹⁷ was estimated at more than 150,000 tonnes (converted to live eel weight) between 2000 and 2002, which corresponded to 70% of global production at the time (Figure 11). However, from 2002 onwards, even though global production reported to FAO was stable or continued to increase, Japan's domestic production and imports both decreased (see Figures 2 and 7), leading to an apparent decline in consumption. According to Figure 11, consumption in mainland China started to increase at the same time (due to stable or increasing production and reduced exports), and FAO data suggest that from 2007 mainland China became the principal eel consumer in the world.

Figure 11

Global, Japan, mainland China and Korea eel consumption based on FAO production data, converted to live eel weight, 1997–2013, tonnes.



Source: FAO Fisheries Production and Commodities Trade, East Asian Customs. Consumption was estimated from 1997 onwards, as data for prepared eel for mainland China only became available in 1997.

However, as shown in Section 1 of this report, there are different production estimates available for analysis. Mainland China eel production reported to FAO is considerably higher than that provided in the “Joint Statement” combined with calculations from live eel fry input, and in some years, the

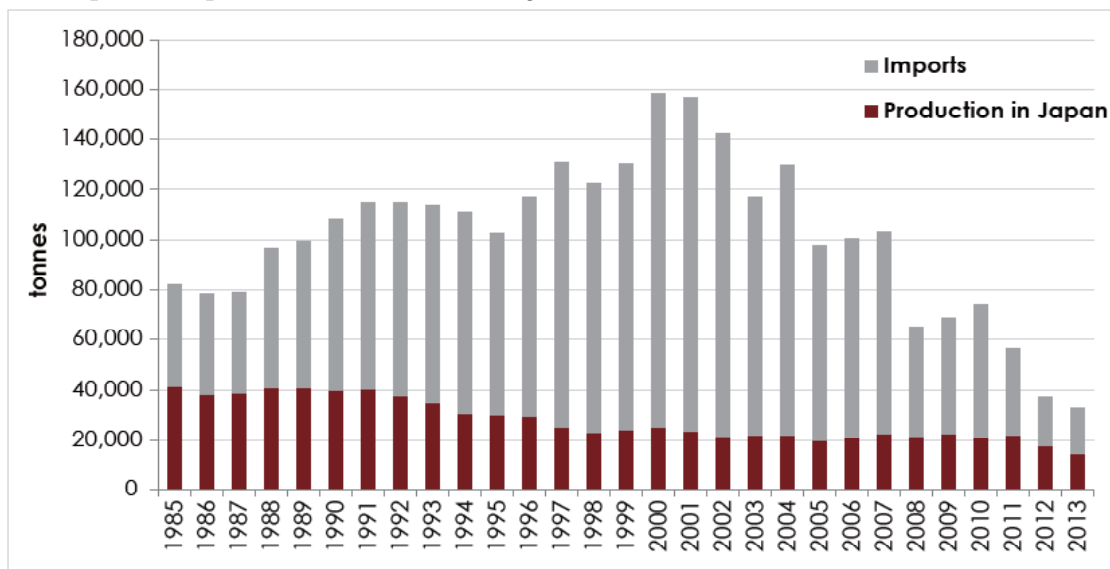
latter is actually less than mainland China's reported net exports, suggesting that there is no, or in fact a minimal, domestic market there. According to FAO data, South Korea and Taiwan's roles as eel consumers in the region are relatively small. On the other hand, Joint Statement data suggest that South Korea may in fact play a more important role. Both datasets are comparable for Taiwan, however — according to FAO data, Taiwan's annual eel consumption reached ~13,000 tonnes between 2003 and 2009, but has been below 5,000 tonnes since 2011. Bai and Sano (2006) estimated Taiwan's eel consumption at the time to be 5,000–10,000 tonnes per year. A more recent report suggests that, in Taiwan, ~3,000 tonnes of prepared products are sold on the retail market each year, in addition to 500–600 tonnes being consumed in eel restaurants (Anon, 2015f).

This section reviews the different data sources and provides supporting information on consumption behaviour/patterns in Japan, mainland China and South Korea from literature and market surveys, to help clarify some of these discrepancies and gain a better understanding of the current situation in the East Asian eel market. Taiwan's role as a consumer is not discussed in further detail below.

Japan

With eel being such a commercially and culturally important fish in Japan, *Anguilla* consumption estimates are commonly reported in the media and literature. These are based on readily available information on farming times, eel sizes for consumption and products being consumed (almost exclusively *kabayaki*). Figure 12 shows the estimated quantity of eel consumed in Japan for 1985–2013, based on national production and imports (exports being minimal). Eel consumption increased steadily in the 1980s and 1990s, reaching a maximum of ~160,000 tonnes in 2000. After this, Japan's domestic consumption declined steadily, with consumption in 2013 (33,000 tonnes) being 80% less than in 2000.

Figure 12
Eel consumption in Japan, converted to live eel weight, 1985—2013, tonnes.



Source: FAO Fisheries Production, Ministry of Finance, Japan Trade Statistics. Exports from Japan are less than 100 tonnes each year.

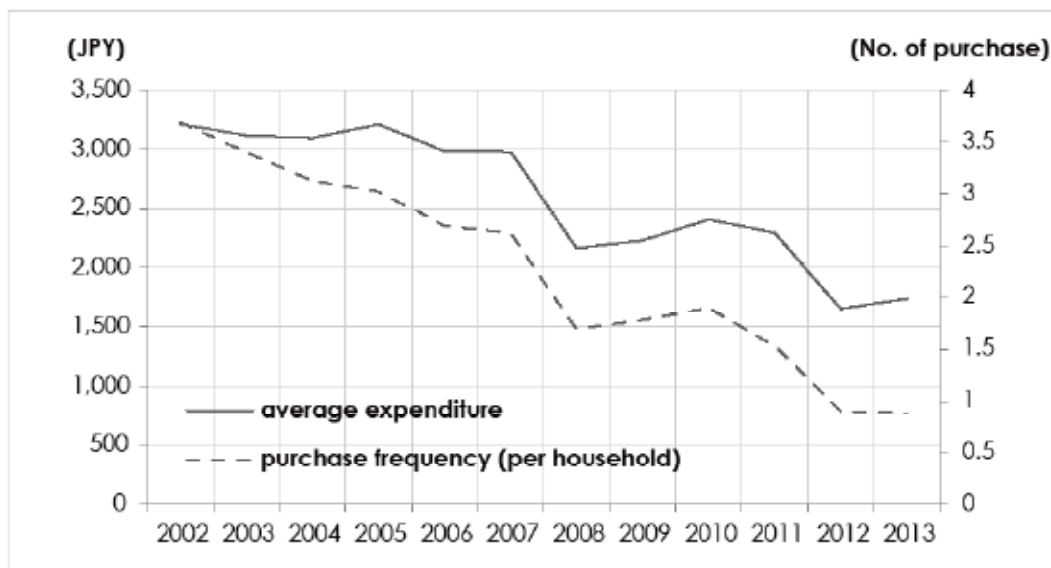
Domestic farming production in Japan declined from 1990 onwards after peaking at ~39,000 tonnes in 1989, and increasing demand in the 1990s was met by an increase in imports. Imports supplied ~85% of eels consumed in 2000. Imports have also been decreasing over the last decade (and in particular in the last two years), resulting in an overall decrease in consumption. In 2000 and 2001, Japan's

consumption accounted for approximately 70% of global *Anguilla* production according to FAO data—this dropped to less than 15% in 2013. When using production data from the Joint Statement, Japan's role as a global consumer does not appear to have declined as significantly, and Japan's consumption is estimated to account for 46% and 34% of global eel production in 2012 and 2013 respectively. This suggests that Japan is still a major consumer of eel, but that its influence on the global market has decreased over the past decade, whichever data source is used.

One of the major factors believed to have caused a decline in eel consumption after 2000 in Japan is repeated media coverage of false labelling of origin and the use of prohibited chemicals in farms in mainland China (S. Takashima, *Yoshoku Shimbun*, pers. comm., March 2015). Ose (2014) found that eel was repeatedly referred to as a food safety issue in major Japanese newspapers in 2000–2013. In addition to the presence of malachite green, furazolidone, dicofol and endosulfan in eel products from mainland China (Mori *et al.*, 2013), consumers were concerned that the origin of eels (reportedly produced in Japan) was being falsely declared. A large price increase for eel products (due to changes in glass eel supplies) also occurred in 2011–2012, further leading to a reduction in consumption. According to statistics of the Metropolitan Central Wholesale Market¹⁸, between 2006 and 2010 the average price of *kabayaki* was JPY2,140 per kg (USD18). This increased in 2011 (to JPY3,090 per kg, USD26), and in 2013 had reached JPY4,315 per kg (USD36).

This change in consumer behaviour is also supported by results of annual household “Income and Expenditure Surveys” conducted by the Ministry of Internal Affairs and Communications, which record how much and how often Japanese households pay for major commodities, including *kabayaki*. The average price per year a Japanese household reported spending on *kabayaki* fell from JPY3,216 (USD27) in 2002 to JPY1,736 JPY (USD14.5) in 2013. The frequency of purchases per household decreased each year, from 3.69 in 2002 to 0.88 in 2013, as shown in Figure 13 (Ministry of Internal Affairs and Communications of Japan, 2014).

Figure 13
Average expenditure and purchase frequency for *kabayaki*, per household in Japan, 2002–2013, JPY — Japanese Yen.



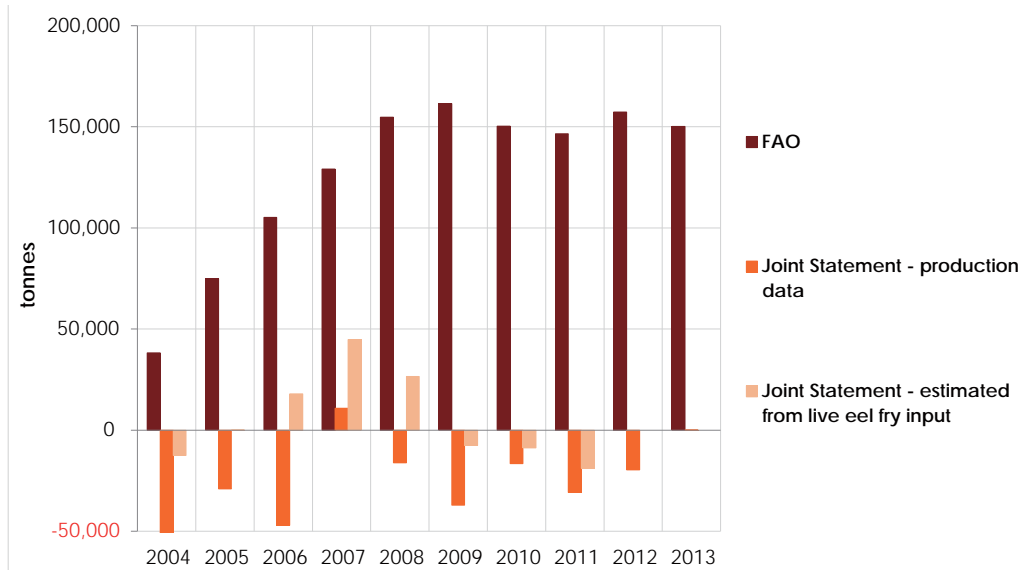
Source: Household Income and Expenditure Survey, Ministry of Internal Affairs and Communications (in Japanese) <http://www.stat.go.jp/data/kakei/npsf.htm>.

Mainland China

As different sources provide very different production estimates for mainland China and there are many uncertainties surrounding the accuracy of these data (see section 1), it is difficult to estimate the true quantity of eels consumed in mainland China. With annual exports from mainland China over the last decade being significantly less than annual production according to FAO data, mainland China could be considered an increasingly important eel consumer. Using these data, annual consumption is estimated at more than 150,000 tonnes of eels in 2012 and 2013 (see Figure 14).

Figure 14

Eel consumption in mainland China, converted to live eel weight, 2004–2013, tonnes.



Source: FAO Fisheries Production, Joint Statement; Unagi net, China Customs.

However, according to Joint Statement data, farming production in mainland China was exceeded by exports in eight of the past 10 years. When these data were amended to include estimates for *A. anguilla* production, exports still exceeded production in four years. Based on these figures, mainland China's annual consumption (excluding those years with negative values) ranged from 150 to 45,000 tonnes. As frozen prepared/preserved eels in air tight containers can be stored for one or two years after production, annual net eel export could theoretically exceed annual production for individual years and still allow for quantities for domestic consumption. However, a repeated trend as shown in Figure 14 (falsely showing a “negative” consumption for mainland China) suggests that production as reported in the Joint Statement is an underestimate. The differences in the data sources make it very difficult to make an accurate assessment of mainland China's role as an eel consumer and further research into these data discrepancies is essential to solve this.

In the same way that there are large differences in production and consequently consumption estimates between data sources, there are also differing views amongst experts concerning eel consumption in mainland China. The Bureau of Fisheries of China (2007) estimates annual eel consumption at 30,000 tonnes per year. Xia and Zhang (2014) believe there is great potential for an increase in demand for eel products on the Chinese market, but note that currently the domestic market is very small due to a lack of awareness of the nutritional value of eel. At the Japan-China eel trade meeting in 2015, Chinese eel traders noted that 40% of the total *A. japonica* currently being grown out in mainland China eel farms (14,000–15,000 tonnes), and 45% of the total estimated *A. anguilla* and *A. rostrata* production (18,000 tonnes) are destined for the domestic market (Anon, 2015g). The president of a major eel processing company in mainland China stated that domestic eel consumption has increased by 10–15% between 2013 and 2014 and that approximately 40% of eels produced in mainland China are destined for the domestic market (Anon, 2015h).

Anguilla eel was previously considered a luxury food item in mainland China (Kuroda, 1998), but it is more affordable now (Xia and Zhang, 2014). According to Bai and Sano (2006), most of the domestic market is driven by the restaurant industry and eels are mainly traded as live eels for this purpose. Dou (2014) reports that eels are eaten in many forms—fried, stewed, steamed and dried, in addition to Japanese style (*kabayaki* and *sushi*). Eels are consumed mostly in southern China (Bai and Sano, 2006; Dou, 2014).

Online market survey findings

There are several names for *Anguilla* spp. in Chinese including “鳗鱼(mán yú)”, “白鳝(bái shàn)”, “鳗鲡(mán lí)” and “河鳗(hé mán)”. However, only “鳗鱼” was used for the online survey in March 2015 as no or few advertisements were found when the other three terms were searched. After advertisements for sea eel¹⁹ were removed from the results, 65 and 227 advertisements for freshwater eel were found on the two Chinese shopping websites JD.com (<http://www.jd.com/>) and TMALL.COM (<http://www.tmall.com/>).

On JD.com, frozen broiled eel was the most commonly available product with 43 advertisements, whereas eel snacks were the most advertised product on TMALL.com with 132 advertisements, followed by frozen broiled eel with 45 advertisements (Table 4). It is not known, however, if “eel snacks” are definitely made of freshwater eel, and there is a possibility that they could be made from non-*Anguilla* eel species. Mainland China was described as the origin in 85% of the advertisements.

In comparison, when the term “eel” in Japanese was searched for on two major Japanese shopping websites (Rakuten ichiba and Yahoo! Japan), also in March 2015, 6,788 and 4,263 adverts were identified respectively. Non-*Anguilla* species (i.e. conger eel, pike eel) are not included in these adverts as they have different names in Japanese.

When the Chinese name for *Anguilla* spp. “鳗鱼” was searched for on the largest restaurant search website in mainland China, 大众点评网(<http://www.dianping.com/>) in April 2015, 0.5% of the total restaurants in Beijing (566 of 112,373 restaurants) and in Guangzhou (362 of 72,038 restaurants) were offering eel on their menus. Japanese and Korean restaurants made up a slightly greater proportion of the total restaurants serving eel in Beijing (75% and 7% of the total) than in Guangzhou (67% and 2%), where eel consumption is believed to more traditional, and not as directly related to Japanese and South Korean culinary influences.

Table 4
Number of advertisements for eel products found on Chinese websites JD.com and TMALL.COM in March 2015.

| Eel product type | JD.com | TMALL.COM |
|--|-----------|------------|
| Frozen broiled eel | 43 | 45 |
| Canned eel (braised or in salted black bean) | 8 | 23 |
| Dried salted eel | 7 | 18 |
| Snacks | 4 | 132 |
| Eel fried rice | 2 | 4 |
| Frozen eel | 1 | 0 |
| Eel swim bladder | 0 | 3 |
| Eel meat flake | 0 | 2 |
| Total | 65 | 227 |

¹⁹ These included adverts for dried sea eel “鳗鱼鲞” (Anon, 2015i).

Physical market survey findings

In January 2015, four fish markets in Beijing were surveyed for live eels and eel products. Each fish market was composed of a number of small shops (between 50 and 500, some of which were empty) which were selling to both retailers and individuals. Only a small number (1%) of these were selling *Anguilla* eels (Table 5). Live eels were the most common eel product type in nine shops, followed by prepared eel in airtight containers in four shops. Fresh eels were available at two shops. Whereas “鳗鱼” (mán yú) was commonly used at online shops, “白鳝” (bái shàn) was more common in the fish markets.

The species of *Anguilla* being offered for sale at the markets were unknown in most cases, however some shop owners mentioned species names such as *A. japonica* and *A. anguilla* when questioned. Live eels were displayed in tanks, as shown in Figure 15. Most of them were much larger than the size more commonly used for *kabayaki* in Japan (200–250 g per eel) and were priced at ~100 RMB (16 USD) per kg. According to the shop owners, these eels are mainly sold to Japanese or Korean restaurants in Beijing.

Table 5
Number of shops offering eel products for sale in selected fish markets in Beijing in January 2015.

| | Total no. of shops | No. of shops offering live, fresh, frozen eel | No. of shops offering prepared eel |
|---|--------------------|---|------------------------------------|
| Dayangfang Road Aquatic Products Market 大洋路海鲜批发市场 | 193 | 2 | 0 |
| Jingshen Aquatic Products Market 京深海鲜市场 | 57 | 5 | 1 |
| Huilongguan Trade Market 城北回龙观商品交易市场 | 300 | 1 | 2 |
| Beijing Aquatic Crossing Four Trading Market 北京四道口水产批发市场 | 500 | 2 | 1 |

Note: Total number of shops is based on information provided on the website (Jingshen Aquatic Products Market <http://www.jshxsc.com.cn/Sales.aspx>) and by interviews (Y. Guo, TRAFFIC, in litt. to TRAFFIC, January 2015).

All prepared eel products for sale were similar to the Japanese style *kabayaki* (Figure 16), some of which had both product names and cooking instructions in Chinese and Japanese. Packages contained one eel fillet each and unit price was RMB15 (USD2.4) to RMB25 (USD4). These are reportedly mainly sold to Japanese restaurants, but also sometimes to individual consumers.

Finally, eel products were found in two major supermarkets surveyed. Although prepared eel in an airtight container (product name in Japanese) was found in one supermarket, the ingredients suggested that it was sea eel, and not freshwater eel. Frozen eel fillets were found at the other supermarket, but again, it was not possible to confirm whether they were *Anguilla* spp. or sea eel.

Figures 15 and 16

Live eel sold at Jingshen Aquatic Products Market and prepared eel sold at Beijing Aquatic Crossing Four Trading Market, Beijing, January 2015.



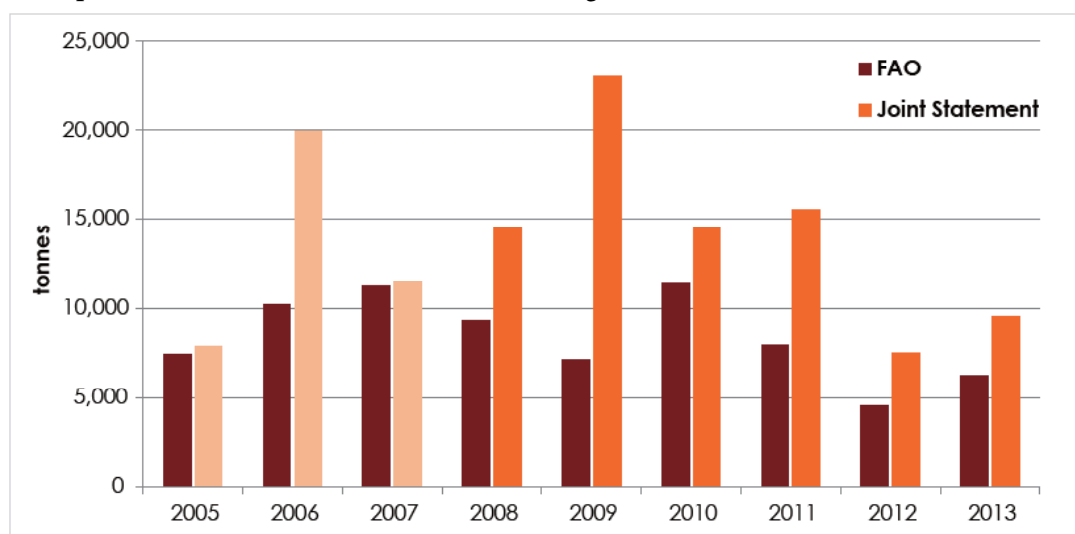
South Korea

Figure 17 shows the estimated eel consumption in South Korea based on different data sources—FAO eel production, the Joint Statement production data (2008–2013) and estimated production data from the quantity of live eel fry used for farming (2005–2007). According to these data, annual South Korean consumption from 2005 to 2013 ranged between 4,500 and 23,000 tonnes. As is the case for mainland China, consumption varies considerably depending on the data source, with the greatest difference apparent in 2009 (7,000 tonnes using FAO data versus 23,000 tonnes using the Joint Statement data). South Korea’s role as a producer (see Production section of this report) and an eel consumer correspondingly varies depending on the data used—its importance increases significantly when using the Joint Statement data, consuming an estimated 9–10% of all global eel production in 2012–2013, the quantity being equivalent to 30% of Japan’s consumption in 2013.

According to Lee (2014), South Korea does not have a long tradition of eating eel—eels became more popular in the 1970s when South Korean people started to become aware of their nutritional value. Lee (2014) reported that annual eel consumption in South Korea was less than 7,000 tonnes until the late 1990s, but this increased to more than 15,000 tonnes after 2000. This increase reportedly occurred as a result of the decline in meat consumption due to foot-and-mouth, mad-cow disease and bird flu (Lee, 2014). Kim and Matsumoto (2009) categorized both conger eel and freshwater eels as “sometimes used” in South Korea, and Nohara (2013) noted that eel consumption in South Korea is declining due to an increase in eel product prices. Eel are commonly served in restaurants in South Korea as “장어구이 (grilled eel)” with a variety of sauces (Lee, 2014).

Figure 17

Eel consumption in South Korea, converted to live eel weight, 2005–2013, tonnes.



Source: FAO Fisheries Production, “Joint Statement”; Export and import data: South Korea Customs. 2005–2007 data (paler orange) was estimated from live eel fry input.

Online market survey findings

Eel in Korean “장어 (Jangeo)” was searched for on two South Korean shopping websites G-market (<http://www.gmarket.co.kr/>) and Auction (<http://www.auction.co.kr/>) in December 2014. After adverts for conger eel were excluded, 49 and 42 adverts were identified respectively. Fresh eel (opened, gutted and deboned) was the most commonly advertised product with 28 and 20 adverts on each site, followed by broiled eel with soy sauce. Other eel products included “eel extract or mixture of eel and other extracts”, broiled eel with salt and deep fried eel bones (Table 6). South Korea was reported as the origin for 80% of adverts, with the remainder coming from mainland China (broiled eel with soy source) and Madagascar (eel extract).

Table 6

Number of advertisements for eel products found on two South Korean shopping websites G-market and Auction, in December 2014

| Eel product type | G-market | Auction |
|---|----------|---------|
| Fresh eel | 28 | 20 |
| Broiled eel with soy sauce | 9 | 11 |
| Eel extract/mixture of eel and other extracts | 10 | 9 |
| Broiled eel with salt | 2 | 1 |
| Deep fried eel bones | 0 | 1 |
| Total | 49 | 42 |

When eel in Korean “장어” was searched on the South Korean restaurant search website Menupan (<http://www.menupan.com/main.asp>) in March 2015, 110 restaurants were identified (out of a total of 70,000), of which 81 were Korean and 28 were Japanese restaurants. It should be noted, however, that “장어” is used to describe “long fish”, mainly-meaning freshwater eel (*Anguilla* spp.), but these characters are also used to describe other eels such as conger eel, pike eel and hagfish.

DISCUSSION

This report provides an update on the status of the East Asian *Anguilla* eel industry and demand for eel products, based on available production, farming, trade and demand data and information. 95% of global eel production, according to FAO data, is from farming (the growing out of glass eels/eel fry caught in the wild), historically driven by East Asia and since the 1990s by mainland China. The various data sources examined for this report, however, show that production dynamics in the region over the last decades have been changing, both in relation to species use and total quantities being produced, consequently impacting trade and consumption patterns.

Glass eel farm input and trade data show that when the availability of *A. japonica*, the species native to the region, declines, alternative sources are exploited. The use of other *Anguilla* species in East Asian farms has been reported from the 1970s onwards, however, the main changes occurred in the 1990s (with a large increase in imports of *A. anguilla* for farming in mainland China) and over the past five years, due to *A. anguilla* trade controls and years of very low *A. japonica* recruitment. According to East Asian Customs import data, live eel fry are being increasingly imported from the Americas (suggesting these are *A. rostrata*) and South-East Asia, including the Philippines, Indonesia and Viet Nam. These shipments could include a variety of tropical *Anguilla* species with overlapping ranges, however *A. bicolor* is reportedly the most desirable due to its similarities in taste and texture to *A. japonica*.

Available data suggest that, although farms across East Asia may be experimenting with these different species, mainland China is the principal user of non-*A. japonica* eel fry. Having developed advanced farming techniques to grow out *A. anguilla* in the 1990s, mainland Chinese farms are now increasingly using the other, more available, temperate species *A. rostrata* and various tropical species. However, mortality is still relatively high for tropical species, making these less desirable when compared to the temperate species. An increase in the farming of tropical species in their range States, such as in Indonesia and the Philippines, has also occurred over the past decade.

These changes in availability of glass eel/eel fry and related differences in survival rate have affected production, trade and consumption patterns in the region, in addition to total output. For example, there are already signs that farms are growing eels to larger sizes to make the most of the limited glass eel sources and alternative markets are being sought for these different sizes and species.

Traditionally, Japan has been considered the dominant market for eels, with farms in mainland China and Taiwan, in particular, supplying Japan, in addition to Japan's domestic production. However, the various data sources analysed for this report all suggest that Japan's demand for eel products has declined considerably over the past decade. According to national production and import data (combined to estimate consumption, with Japanese exports being minimal), Japan's annual consumption was estimated at over 150,000 tonnes (converted to live eel weight) between 2000 and 2002. However, from 2002 onwards eel consumption declines steadily, with consumption in 2013 being only 20% (~35,000 tonnes) of that one decade earlier. This decline is supported by various other information sources, such as a government household survey which reported a 70% decrease in household annual purchasing frequency of kabayaki between 2002 and 2013.

Repeated media coverage of false labelling of farming and/or processing origins of products and the presence of prohibited chemicals in eel products from mainland China, is believed to have played a major role in the decline of demand for eel in Japan from 2002 onwards. A large price increase for eel products, due to changes in glass eel supplies, also occurred in 2011–2012, leading to further decreases in consumption.

Although the reality of a decline in Japan's eel consumption over the past decade is relatively well documented and supported by various data sources, consequent changes to Japan's proportional role

on the global eel market and the quantity of eel consumed in other countries/territories is less clear. Considering this decline in demand from Japan, and with mainland China playing such an important role in eel production worldwide, eel production and trade data for mainland China could ideally be used to establish if and where eel products are being consumed in increasing quantities in other countries/territories. However, analysis of data sources combined with information from experts gathered for this report show large discrepancies in eel production and trade figures for mainland China in particular. For example, between 2004 and 2013, annual production in mainland China according to FAO (ranging from 150,000 to 215,000 tonnes) was considerably higher than production estimated from other sources/methods such as the data provided as part of the “Joint Statement” released by East Asian authorities in 2014 (ranging from 15,000 to 125,000 tonnes).

These large differences in reported production for mainland China consequently mean that it is very difficult to estimate actual global eel production and consumption. According to FAO data, between 2007 and 2013, annual eel production in mainland China showed no signs of decreasing, being constant at 205,000–215,000 tonnes. However, considering the fact that total amount of glass eel input into ponds in East Asia appears to have been declining over the last decade (except for 2013–2014) and farming techniques for “new” species are still in the development stage, farming production over the past five years is likely to have declined, and therefore it is possible that FAO data are over-estimated. If FAO farming production data were replaced with the data provided in the Joint Statement for mainland China and South Korea, global production and the corresponding roles of the main eel producers would change dramatically. For example, for 2012 and 2013, global eel production would be only ~82,000 and ~97,000 tonnes respectively, compared to ~255,000 tonnes per year as reported by FAO.

Analysis of production data reported to FAO, combined with trade data, suggests that mainland China may have filled the gap in the consumption market, with a significant increase in domestic consumption over the past decade (reaching an estimated 150,000 tonnes of eel in 2012 and 2013). Using these data, in 2004, Japan’s eel consumption accounted for 55% of global eel production and mainland China only 16%. In 2013, these proportions had changed to 13% and 62%, respectively.

However, when using another production data source (i.e. the Joint Statement), for several years between 2004 and 2014, farming production in mainland China was exceeded by, or was similar to, net exports. Based on these figures, mainland China’s annual consumption ranged from 150 to 45,000 tonnes (excluding negative values). Consequently, according to these data, Japan’s role as a global consumer does not appear to have declined as significantly, and Japan’s consumption is estimated to still account for 30–45% of global eel production in 2012–2013. In addition, Japan is still playing a crucial role as an importer of *A. anguilla*. According to CITES trade data, Japan imported more than 30,000 tonnes of *A. anguilla* “meat” from mainland China between 2009 and 2013, accounting for 98% of total *A. anguilla* meat imports reported to CITES as of April 2015.

In the same way that there are large differences in production estimates between data sources, there are also differing views amongst experts concerning eel consumption in mainland China. Information from experts suggest that production (and consequently consumption) is in fact somewhere between that reported to FAO and presented in the Joint Statement. Traditionally *Anguilla* eel has been consumed more in the southern provinces of China (where most eel farms are located) and the domestic market has been reportedly driven by the restaurant industry, with most internal trade being in live eels. Information collected from traders during the brief physical market survey carried out in Beijing in January 2015 supported these facts. Only 1% of all traders in four Beijing fish markets were selling eels (mostly live). No traders highlighted a noticeable change in consumption/demand in Beijing, and all reported their main customers as being Japanese and Korean restaurants in Beijing.

An online restaurant search of websites showed that 82% of all Beijing restaurants offering eel on their menu were Japanese or Korean, compared to 69% of restaurants in Guangzhou, where eel consumption

is believed to be more traditional, and not as directly related to Japanese cuisine. The number of online offers for sale of eel products on principal shopping websites was considerably lower on Chinese language websites than their equivalents in Japan—in March 2015, 300 versus over 10,000. Additional research into demand and consumption, in particular in the provinces in southern China, would be essential to establish whether any possible overall increase in demand in mainland China is due to consumption increases of traditional or Japanese-style eel products. The market survey results obtained for this report will also provide a baseline for future research and establishing whether there are changes in consumption patterns in Beijing, or country-wide, in the future.

Although, globally, Taiwan and South Korea play lesser roles with regards to eel production and trade than mainland China or Japan, production and trade dynamics have changed considerably in South Korea over the last two decades. According to the data analysed, in the early 1980s, South Korea was an exporter of eel commodities (~7,000 tonnes per year). Then between 1988 and 1998 trade all but ceased, and from 1999 onwards South Korea began to report annual imports of ~3,000 tonnes of eel commodities, together with an increase in eel production. This suggests that the domestic market/consumption of eel in South Korea increased in the past decade, which reportedly occurred as a result of a decline in meat consumption due to health/food safety reasons. Furthermore, as for mainland China, South Korea's role as a producer and an eel consumer varies depending on the data used, with annual consumption ranging between 4,500 and 23,000 tonnes in 2005–2013. South Korea's global importance increased significantly when using the Joint Statement data, consuming an estimated 10% of all global eel production in 2012 and 2013, the quantity being equivalent to 30% of Japan's consumption in 2013.

In addition to a possible increase in consumption in mainland China and South Korea over the past decade, Customs trade data suggest that there may be other important emerging markets for eel produced in mainland China. Between 2004 and 2014, the number of trading partners increased from 18 to 41 countries/territories, with Russia, Taiwan and the USA becoming increasingly important destinations for prepared/preserved eel exports from mainland China. However, there appear to be considerable discrepancies between mainland China Customs prepared/preserved eel export data and destination import data, and between CITES *A. anguilla* importer and exporter data, making concrete conclusions over the importance of any new/emerging markets difficult. All sources of data, however, suggest that the importance of Russia as a consumer market for eels farmed in China does appear to have increased significantly over the last decade.

Data discrepancies have been highlighted as a concern throughout this report, however the grounds for these discrepancies are unclear. Possible reasons for differences in production data sources include the number of intermediaries through which production data is passed prior to official reporting and under/over-reporting of glass eel input and/or production due to illegal sourcing of glass eels. Differences in exporter and importer data can be a result of incomparability, lack of clarity over taxon-designation or misuse of Customs codes (trade reported as *Anguilla* in fact being of another eel species) or illegal trade.

Although countries/territories in East Asia have more specific Customs codes for eel than many other countries, the systems are often incomparable. For example, there are three live eel fry Customs codes in Taiwan, split according to number of individuals per kg, and two in South Korea, split according to weight per individual (neither of these corresponding directly to one of Taiwan's codes). Non-*Anguilla* eel species (such as Conger, Pike and Rice Eel) are also consumed in Asia and there are reports of *Anguilla* Customs codes being used incorrectly to report trade in these species. Furthermore, as the newly designated HS code for prepared/preserved eel in 2012 does not specify that it is for the genus *Anguilla*, there is the possibility that this is being used to record trade in other non-*Anguilla* eel species. It has been reported that eel consumers in mainland China and South Korea are often not able to distinguish *Anguilla* from other eel species and there can be a lack of differentiation between the

various eel species in Chinese and Korean languages, due to the use of similar characters to describe the different eel species. One of the eel products found during the market survey was described as freshwater eel on the main label, but the ingredients described it as “sea eel”.

Illegal, unregulated and unreported (IUU) fishing and illegal trade in eels is a prevalent concern, not only affecting the lucrative glass eel commodity, but also eel products for the end consumer. In Japan, 50% of all live eel fry are reportedly caught by non-licensed fishermen and/or traded through the black market. Many records of live eel fry imports into East Asia over the past decade have no corresponding records in exporter data. These differences are most apparent where the exporting country/territory has an export ban in place either for conservation reasons or to encourage domestic farming production. Reported exports of several eel commodities from mainland China to Taiwan are not reported in Taiwan Customs import data, with there being corresponding import bans in place. A number of eel seizures have also been reported by European and Asian authorities, as well as by the Philippines, supporting the fact that illegal trade in *Anguilla* spp. is ongoing.

Anguilla anguilla products derived from mainland China farms and currently on the market are reportedly derived from *A. anguilla* glass eels exported from the EU prior to the trade ban coming into force in December 2010, in addition to some glass eels exported from non-EU range States, such as those in North Africa. Re-export permits from mainland China for *A. anguilla* grown out from glass eels imported prior to December 2010 are reported to expire in June 2015. However, illegal trade in *A. anguilla* is an ongoing concern, and considering the fact that *A. anguilla* farmed in mainland China has mainly been used to produce prepared products for re-export and supply the domestic market, importing countries/territories of prepared products and mainland China as a consumer play important enforcement roles with regards to the traceability and legality of these eel products.

In conclusion, the data analysed for this report show that East Asian *Anguilla* production, trade and consumption are constantly evolving and that globally, eel production and consequently consumption may be on the decline. Reasons behind these changes include species/eel fry availability (affected by annual variations/declines in recruitment and legislation/trade controls); national investment and farming techniques (still under development for tropical species); other trade controls (restricting trade in eel products for conservation and health reasons) and consumer behaviour (affected by various issues including prices and food safety).

The data presented suggest that Japan’s previous relative monopoly over the global eel market has changed over the last decade. Research indicates that a proportion of Japan’s previous eel market has been replaced by demand in mainland China, South Korea and many smaller markets outside East Asia, such as Russia. Japanese culinary influences are believed to play a role in these changes, with demand for eel often linked to Japanese-style products and restaurants.

However, many uncertainties surrounding actual global production and consumption quantities, and especially the role of mainland China, remain. These gaps in our knowledge could have serious implications on the effectiveness of any future eel management and conservation decisions, and determining their appropriate scope and scale. For example, East Asian countries/territories are increasingly considering the setting of quotas for “live eel fry input” into farms and/or production from farms as a management measure, as outlined in the Joint Statement of 2014. However, if quotas are set without taking illegal sourcing, misreporting and annual variations in recruitment into consideration, they could result in serious negative conservation impacts.

As is emphasised by the Joint Statement, a collaborative and coordinated approach to eel management and conservation is essential for ensuring sustainable use of *Anguilla* species into the future. This is even more paramount, given the constantly changing dynamics of the East Asian eel industry and many knowledge gaps identified in this report. Despite Japan’s historic influence over the market,

it is vital that all East Asian countries/territories consider their respective and evolving roles in the exploitation of this common resource whilst developing and adapting management and conservation measures in the region. The report concludes with specific recommendations for data collection, monitoring, reporting and analysis mechanisms; enforcement of legislation; additional research; and increased consultation with all eel stakeholders in East Asia to enhance the traceability of sourcing, farming and trade of eels and the development of appropriate management and conservation decisions.

RECOMMENDATIONS

Data collection, monitoring, reporting and analysis

Fisheries and Customs authorities across East Asia, in collaboration with local governments, fishermen, eel farmers and fisheries/farming/trade associations, are urged to:

- Investigate and address the reasons for the data discrepancies identified throughout this report, including the large difference between production data reported to FAO and released along with the “Joint Statement”, and differences between reported exports and imports of prepared eel from mainland China to Taiwan.
- Develop and share standardized methods for data collection (catch, farm input, farming production), and for estimating production (based on the most up to date information on survival and growth rates, grow-out sizes and periods) when actual production data cannot be obtained.
- Collect, record and make publically available data on glass eel catch, farming input and production to the species level, as a minimum differentiating between *A. japonica*, *A. anguilla*, *A. rostrata* and tropical species such as *A. bicolor* and *A. marmorata*.
- Provide FAO with the most accurate production data possible, preferably to the species level, to enable more accurate global analyses of eel production.
- Regularly monitor and inspect eel farms and examine any discrepancies between actual and reported/estimated eel fry farm input and production.
- Co-ordinate any future changes to Customs codes used for *Anguilla* spp. at national levels, to ensure these are comparable across the region, for example, if new species-specific codes are introduced in Japan or South Korea (such as those designated for tariffs in mainland China), and/or if mainland China or Japan introduce codes for different sizes of live eel fry (such as those already in existence in Taiwan and South Korea). Ideally, standardised eel codes would be introduced across East Asia.
- Make the most detailed Customs data publically available for analysis, such as the 10-digit species-specific codes for mainland China, and work with processing industries to collect information to establish appropriate conversion factors for all eel products to live weight.
- Allocate resources and carry out research into consumption, in particular in mainland China, and in improving the transparency of the eel trade chain including potential traceability schemes, and make the results publically available.

Legislation and enforcement

Fisheries, CITES, Customs, Police and other authorities across East Asia are encouraged to:

- Enhance national enforcement effort, carry out risk/intelligence analysis and establish enforcement priorities for eel fishing and trade in East Asia, in particular focusing on illegal fishing of *A. japonica*, illegal trade of *A. anguilla* eel fry from the European Union and of *A. japonica* eel fry within East Asia; in addition to increasing controls and checks of re-exports of *A. anguilla*, in particular from mainland China.
- Carry out capacity-building/training in national and local legislation, inspection procedures for farming operations and species identification and share information on illegal fishing and trade, including peak seasons, modus operandi, mis-labelling and main trade routes.
- Regularly analyse and investigate discrepancies in trade and CITES permit data for potential illegal trade.
- Co-operate and share intelligence and information with *Anguilla* source countries/territories, in particular in Europe, the Americas and South-East Asia; including keeping up to date with changes in national export regulations.
- Raise awareness and provide information to importers on the various international and national regulations in place, such as export bans for eel fry from the Philippines and Indonesia, and the total ban on export of *A. anguilla* from the European Union.

Additional research, collaboration and consultation with stakeholders

All eel stakeholders in East Asia, including fisheries, Customs and CITES authorities, fishermen, eel farmers, fisheries/farming/trade associations, traders, retailers and researchers, are urged to cooperate and:

- Together analyse all available data sources and collaboratively develop management decisions and traceability systems for the East Asian eel industry, with a particular focus on ensuring legality and sustainability of sourcing of glass eels and eliminating illegally sourced eel products from the supply chain.
- Exchange experiences and information with other *Anguilla* spp. range States to ensure conservation and management measures are complementary and adaptable to the changing circumstances across the globe.
- Carry out further research and initiate dialogue with potentially important emerging markets such as Russia.
- Encourage international organisations involved in setting up systems for reporting of fisheries data to specify, where possible, the genus/species to be reported under designated codes; for example request that FAO adds the genus “*Anguilla*” to categories such as “River Eels Nei” (FAO production) and World Customs Organization (WCO) adds “*Anguilla*” to the new HS code for prepared/preserved eels introduced in 2012.
- Raise food industry, retail and consumer awareness with regards to eel legality and sustainability issues and potentially suitable traceability schemes.

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ANNEX

Table 7
Live eel fry input into farms, 2004–2014 tonnes.

| Country /area | Species/ Year | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|----------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Japan | Total | 18.8 | 29.2 | 25.1 | 21.7 | 29.0 | 19.9 | 21.8 | 16.3 | 13.9 | 29.6 |
| | Japanese eel | 18.8 | 29.2 | 25.1 | 21.7 | 28.9 | 19.9 | 21.8 | 15.9 | 12.6 | 27.0 |
| | Other species | 0.02 | 0.03 | 0.0 | 0.0 | 0.14 | 0.03 | 0.01 | 0.43 | 1.3 | 2.6 |
| Mainland China | Total | 94.0 | 112.5 | 117.0 | 83.5 | 57.8 | 43.6 | 41.5 | 22.5 | 27.0 | 70.0 |
| | Japanese eel | 42.0 | 30.0 | 75.0 | 26.0 | 9.0 | 26.5 | 10.5 | 8.0 | 7.0 | 45.0 |
| | Other species | 52.0 | 82.5 | 42.0 | 57.5 | 48.8 | 17.1 | 31.0 | 14.5 | 20.0 | 25.0 |
| | European eel (Unagi net) | 100.0 | 50.0 | 60.0 | 40.0 | 10.0 | 15.0 | 15.0 | 11.0 | 11.0 | 20.0 |
| Taiwan | Total | 22.3 | 35.1 | 20.5 | 14.3 | 25.0 | 13.1 | 3.8 | 7.7 | 11.5 | 14.0 |
| | Japanese eel | 22.3 | 35.1 | 20.5 | 14.3 | 25.0 | 13.1 | 3.8 | 2.2 | 1.5 | 12.5 |
| | Other species | - | - | - | - | - | - | - | 5.5 | 10.0 | 1.5 |
| South Korea | Total | 7.5 | 22.1 | 13.5 | 11.0 | 23.5 | 12.1 | 11.1 | 9.5 | 16.2 | 16.8 |
| | Japanese eel | 7.5 | 22.1 | 13.5 | 11.0 | 22.0 | 10.6 | 9.5 | 3.6 | 3.0 | 13.9 |
| | Other species | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 1.5 | 1.6 | 6.0 | 13.1 | 2.9 |

Source: Joint Statement and Unagi net (grey shading, use for mainland China *A. anguilla* production estimates in Table 8)

Note 1: "20XX-XX+1" means season of input of glass eel for farming from 1 November 20XX to 31 October 20XX+1.

Note 2: The numbers for the 2013–2014 glass eel season are provisional.

Table 8
Eel farming production in East Asian countries/territories. 2004–2013, tonnes.

| | Species/ Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|-------------------|------------------|----------------|---------------|----------------|----------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Japan | Total | 21,776 | 19,744 | 20,773 | 22,241 | 20,952 | 22,406 | 20,543 | 22,006 | 17,377 | 14,200 |
| | Japanese eel | - | - | - | - | - | - | - | - | - | - |
| | Other species | - | - | - | - | - | - | - | - | - | - |
| Mainland China | Total | 103,050 | 79,960 | 102,390 | 123,050 | 77,070 | 45,680 | 54,650 | 42,810 | 35,480 | 56,000 |
| | Japanese eel | 57,550 | 50,450 | 35,660 | 87,860 | 31,850 | 11,720 | 38,750 | 15,810 | 11,050 | - |
| | Other species | 0 | 260 | 1,730 | 1,190 | 2,620 | 4,360 | 8,200 | 15,000 | 24,430 | - |
| | European eel | 45,500 | 29,250 | 65,000 | 34,000 | 42,600 | 29,600 | 7,700 | 12,000 | - | - |
| Taiwan | Total | 29,603 | 28,481 | 23,838 | 24,822 | 21,038 | 19,044 | 19,361 | 10,535 | 2,244 | 1,904 |
| | Japanese eel | 29,603 | 28,481 | 23,838 | 24,822 | 21,038 | 19,044 | 19,361 | 10,535 | 2,244 | 1,500 |
| | Other species | - | - | - | - | - | - | - | - | - | 404 |
| South Korea | Total | - | 6,000 | 17,680 | 10,800 | 11,630 | 22,540 | 11,020 | 14,730 | 7,170 | 8,460 |
| | Japanese eel | - | 6,000 | 17,680 | 10,800 | 11,000 | 22,000 | 10,600 | 14,250 | 5,400 | 4,500 |
| | Other species | - | - | - | - | 630 | 540 | 420 | 480 | 1,770 | 3,960 |

Source: "Joint Statement" (production data provided – no shading, estimates derived from live eel fry input for Korea – grey shading) and Unagi net (estimated production of *A. anguilla* for mainland China, based on live eel fry input – grey shading). Note: Mainland China's farming production according to the Joint Statement only includes *A. anguilla* for 2012 and 2013, and Korean production for 2004–2007 was not provided. See methods for more details on data sources, assumptions and methods used to fill these gaps.

TRAFFIC REPORT

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