



Endangered species for mass consumption  
Illegal eel in the frozen food aisle

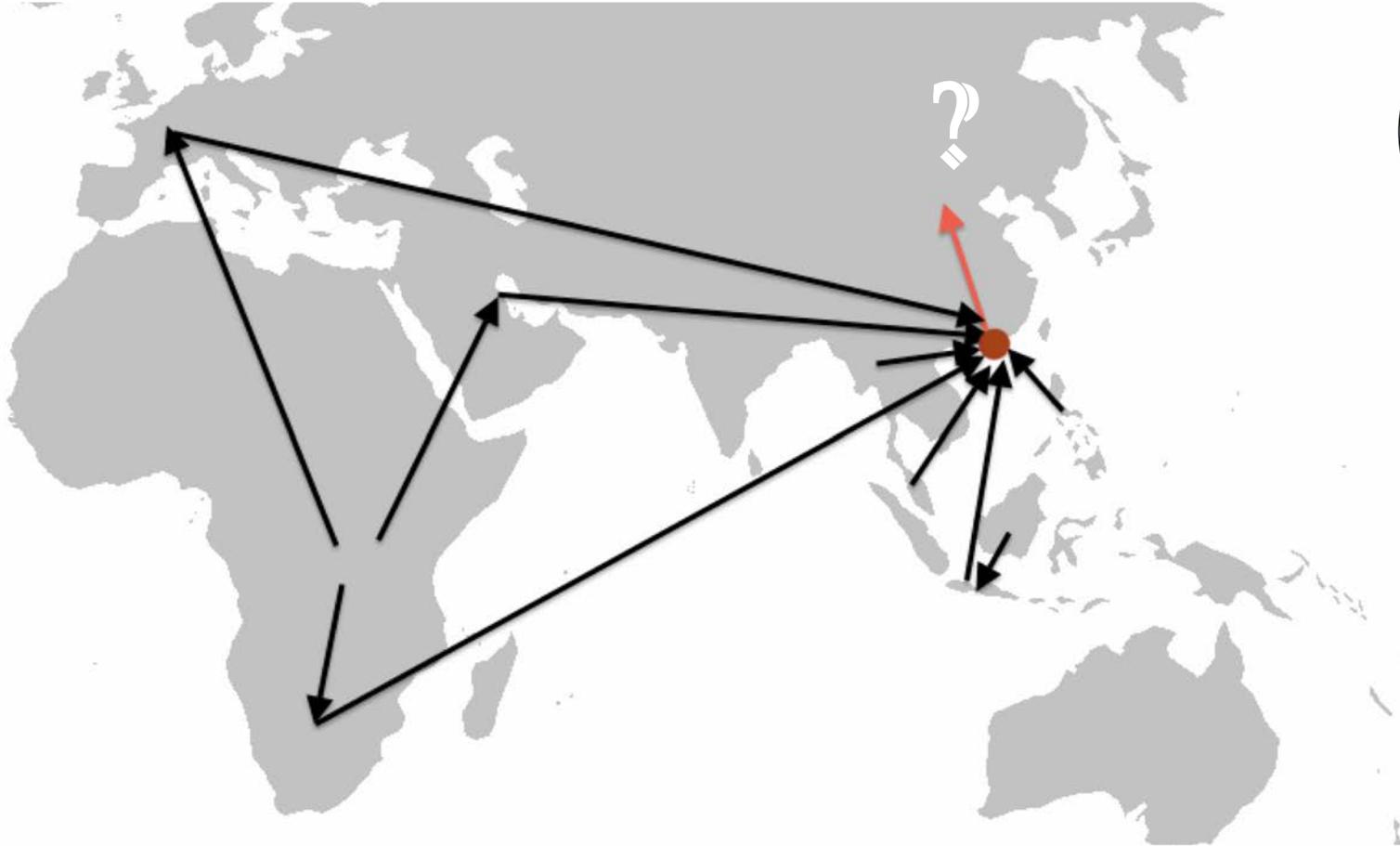
# Hong Kong: a wildlife trafficking hub



Shark fin



Rhino horn



Glass eels

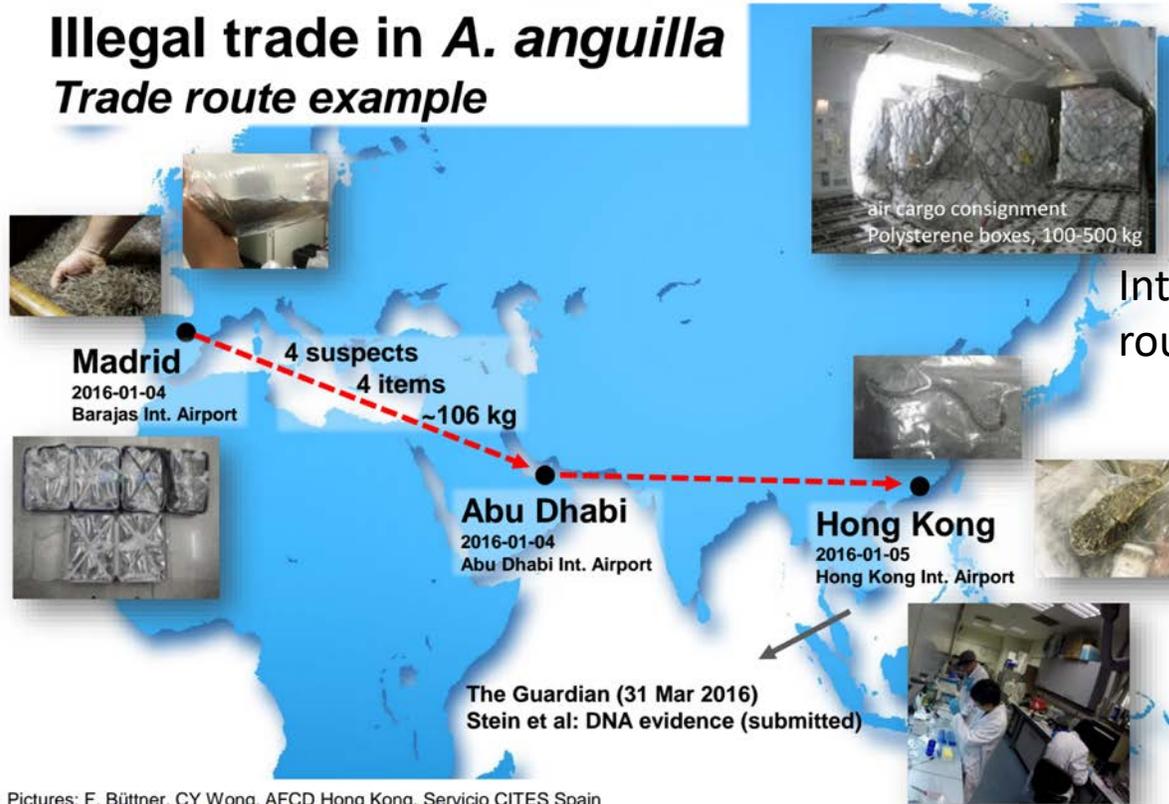


Ivory



# Hong Kong: a wildlife trafficking hub

## Illegal trade in *A. anguilla* Trade route example



International trade routes of EE documented



Glass eels

[Conservation Genetics Resources](#)

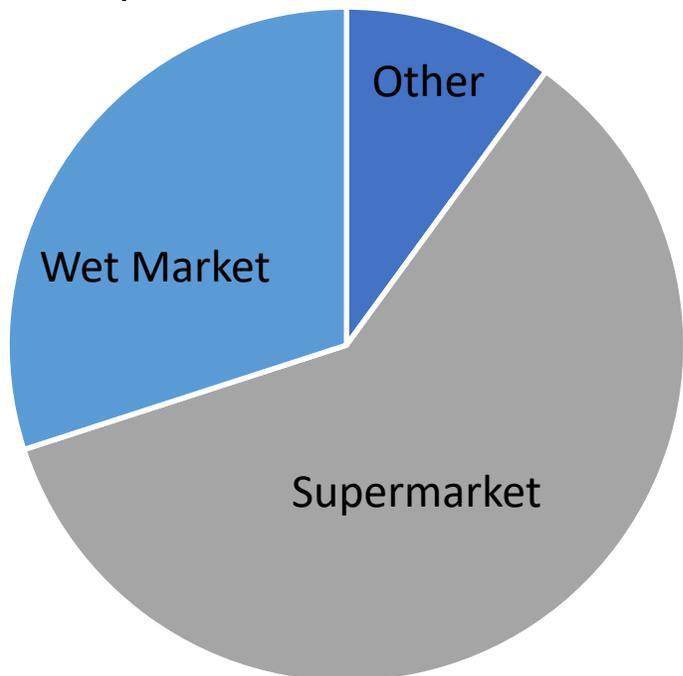
pp 1-5

Pictures: F. Büttner, CY Wong, AFCD Hong Kong, Servicio CITES Spain  
Map: <http://www.psdgraphics.com/file/blank-world-map.jpg>

First genetic evidence of illegal trade in endangered European eel (*Anguilla anguilla*) from Europe to Asia

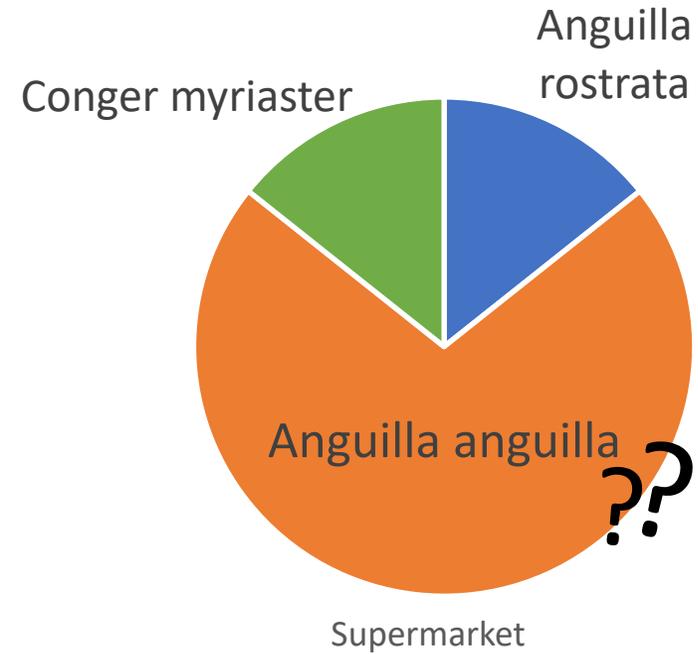
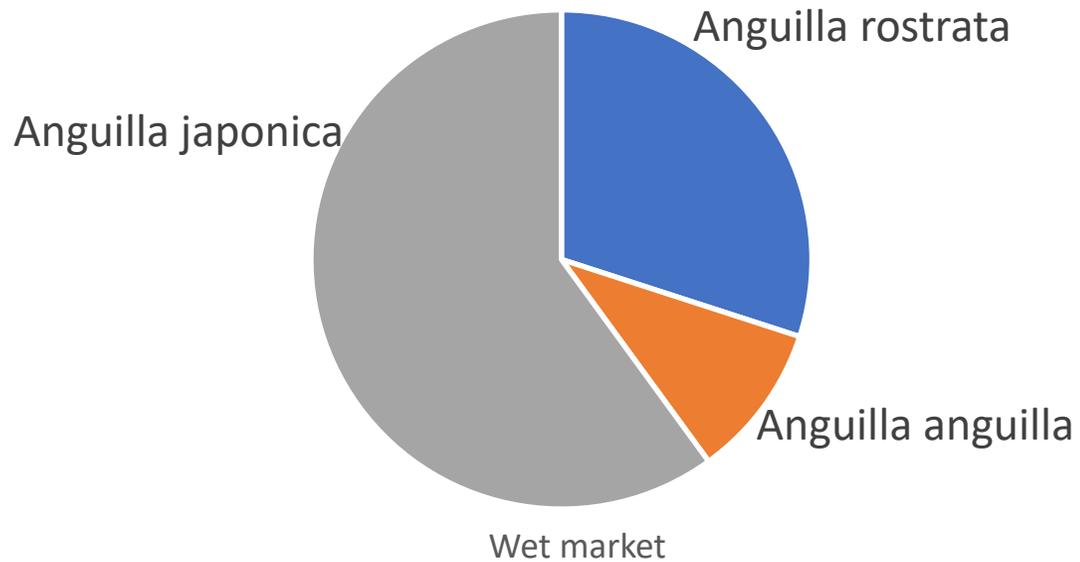


## European eel for sale



60% of the population relies on supermarkets for their day-to-day shopping compared to an estimated 30% for traditional wet markets

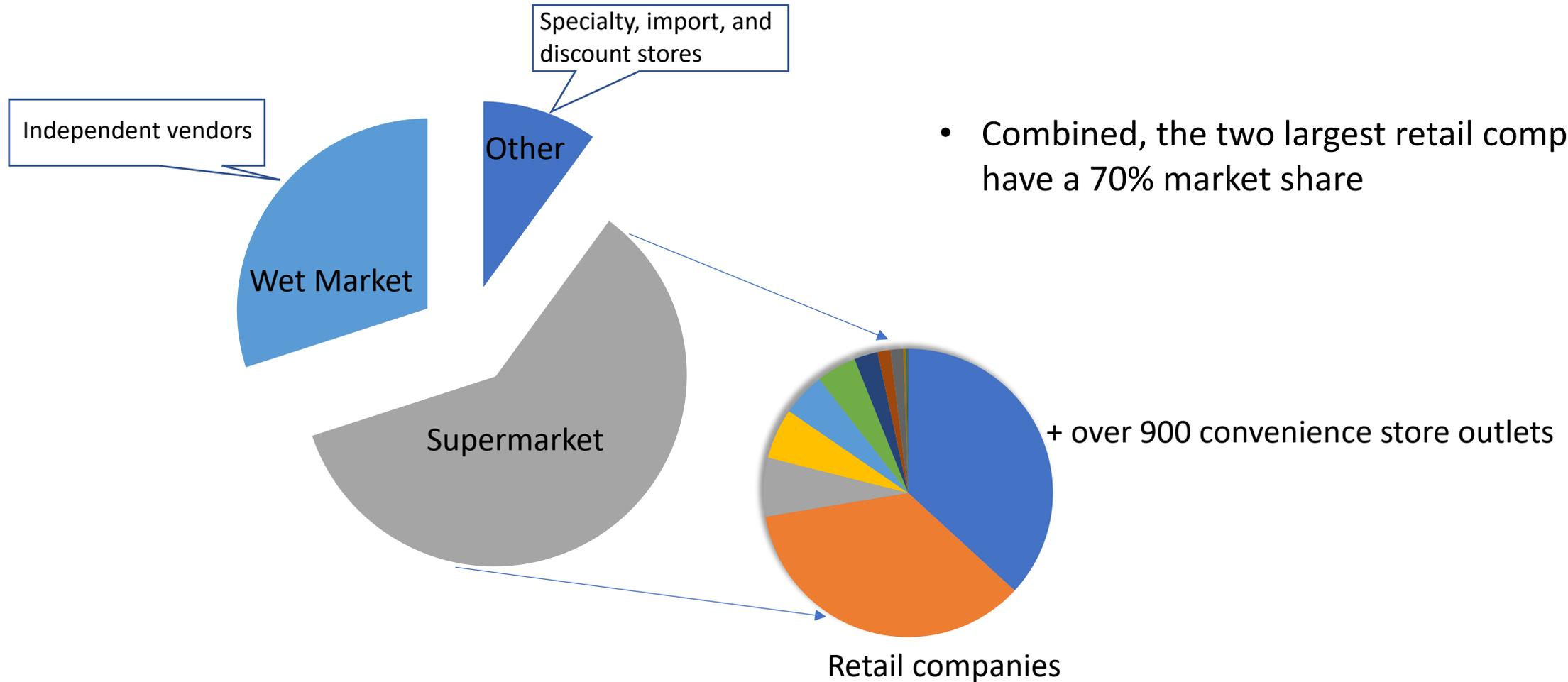
# European eel for sale



- Wet market fish are sold live or fresh
- Supermarket eel products were primarily ready-to-eat



# Hong Kong Retail Landscape

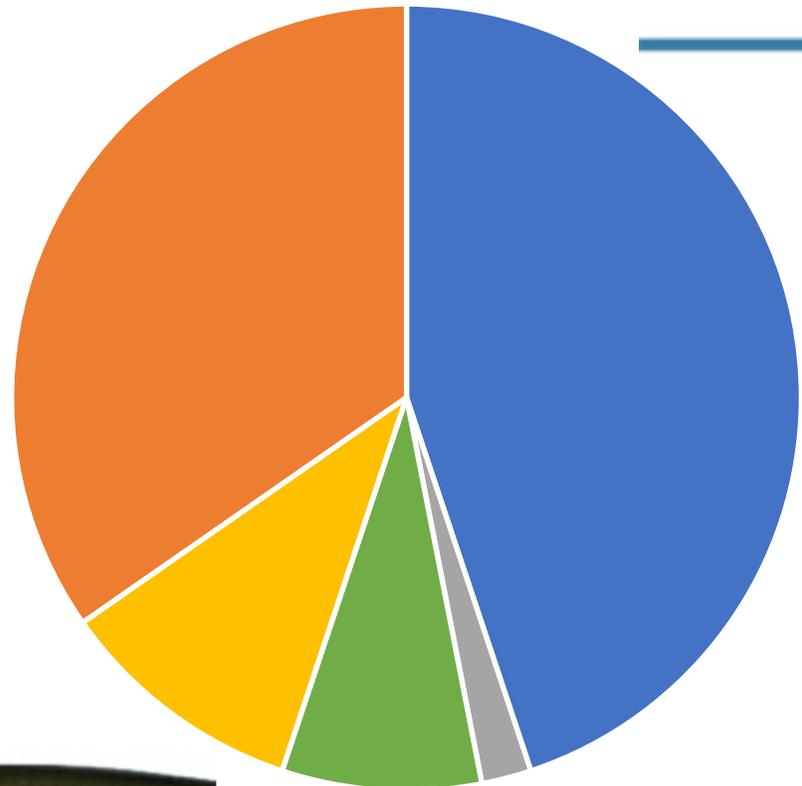




- Sampled across major districts and price points
- Sampled all eel products on sale
- Identified species using CO1 barcoding
- Combination of BOLD + phylogenetic tree-based analysis



*Anguilla anguilla*



*Anguilla rostrata*



*Anguilla japonica*

■ *Anguilla bicolor* ■ *Conger myriaster*

No declared imports of European eel meat into Hong Kong in 2017/2018



Tool development

Trade monitoring

How can we improve surveying and  
detection methods?





# Trade monitoring



Aberdeen Wholesale Fish Market

How can we improve surveying and detection methods?



Airport customs seizures



# Tool development



Suspected illegal shipment

Rapid identification

Shipment detained

Thorough identification  
(CO1 barcoding)

Sequencing → Species ID  
Finally!



Extraction



:30

PCR



1:30

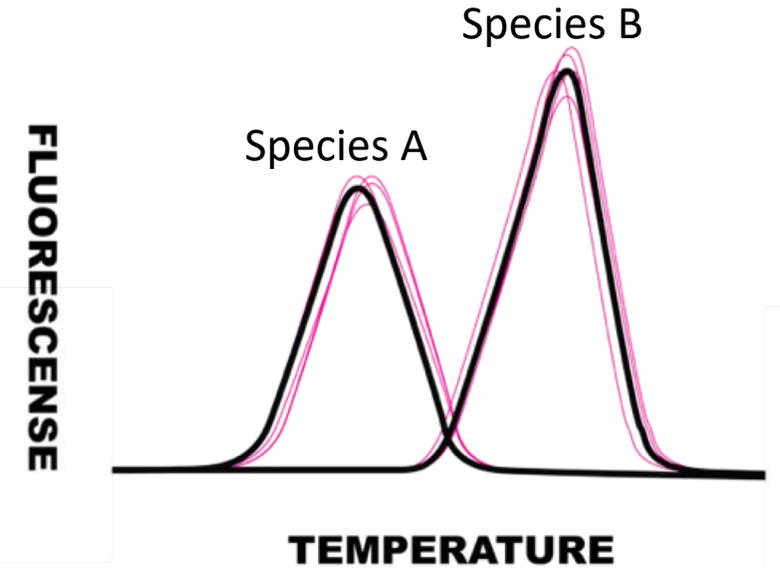


9:00



# Tool development

- Quantitative PCR (qPCR or RT-PCR)
- DNA amplification we can “watch” using a fluorescent dye
- Fluorescence is measured and plotted on a graph, resulting in a “melt curve”
- Small differences in cytochrome *b* gene sequence result in different melt curve profiles



Extraction

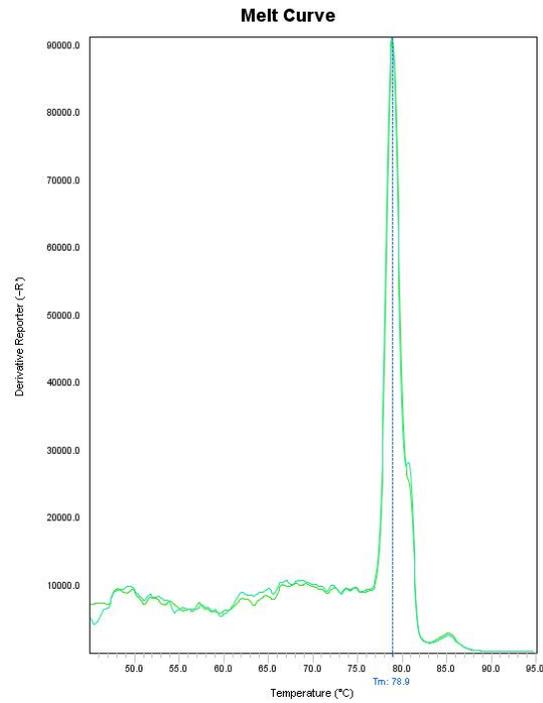


qPCR

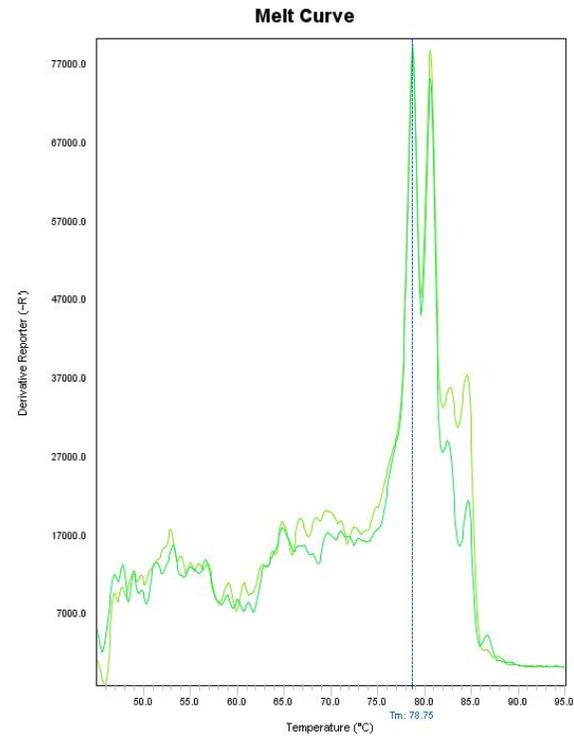




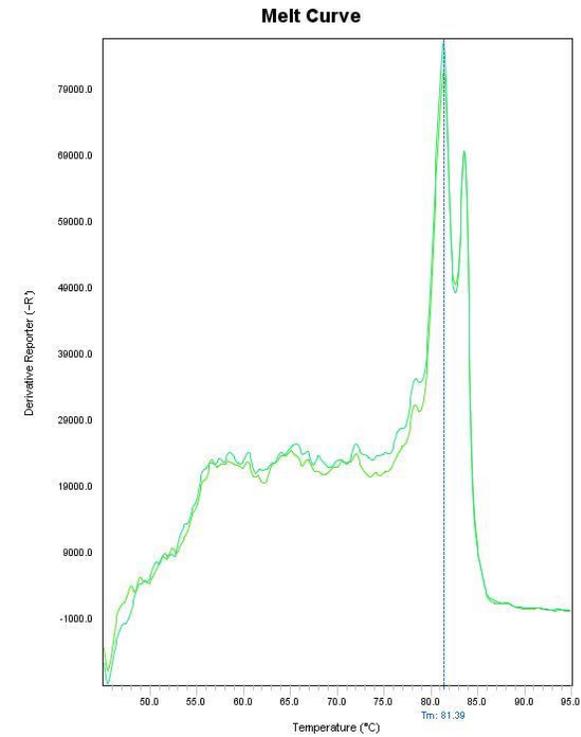
# Tool development



*Anguilla anguilla*



*Anguilla rostrata*

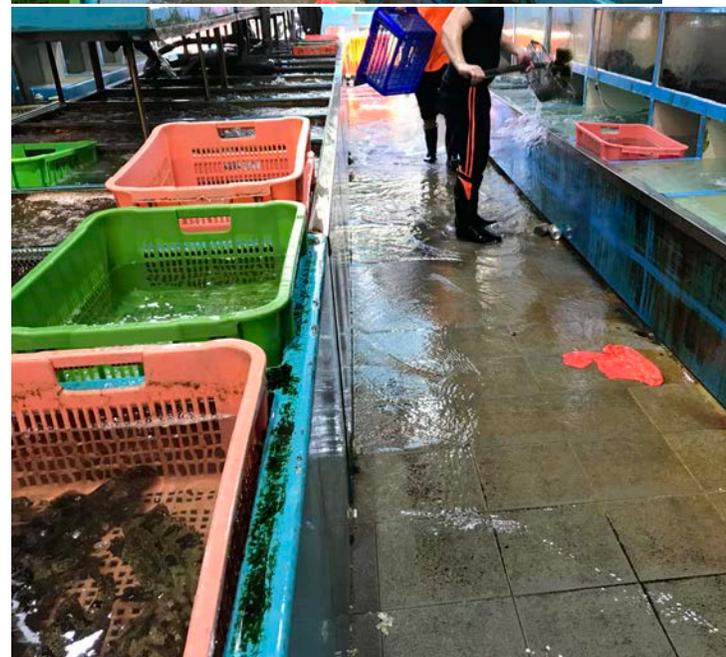


*Anguilla japonica*

# Trade monitoring



Aberdeen Wholesale Fish Market



- Largest wholesale seafood market in Hong Kong
- Both live and fresh fish
- Sells to market vendors, restaurants, fish wholesalers
- Seafood arrives directly from boats or is trucked in

# Trade monitoring



- Trace eDNA in tank runoff water
- DNA extracted from 15ml of water
- Metabarcoding with fish specific primers (Miya et al. 2016)

# Trade monitoring



Over 140 species detected



- |                               |                              |                           |                              |                               |
|-------------------------------|------------------------------|---------------------------|------------------------------|-------------------------------|
| Acanthopagrus latus           | Gymnothorax flavimarginatus  | Platycephalus indicus     | Ostorhinchus fleurieu        | Acanthopagrus latus           |
| Acanthopagrus sivicolus       | Gymnothorax javanicus        | Plectorhinchus cinctus    | Ostorhinchus pleuron         | Acanthopagrus sivicolus       |
| Aethaloperca rogaa            | Gymnothorax pseudothyroideus | Plectropomus areolatus    | Ostorhinchus sp              | Aethaloperca rogaa            |
| Alepes djedaba                | Gymnothorax reticularis      | Plectropomus laevis       | Ostracion immaculatus        | Alepes djedaba                |
| Alopias pelagicus             | Hapalogenys nigripinnis      | Plectropomus leopardus    | Oxyurichthys auchenolepis    | Alopias kleinii               |
| Alopias superciliosus         | Harpadon nehereus            | Plectropomus oligacanthus | Oxyurichthys sp              | Alopias pelagicus             |
| Aluterus scriptus             | Hypophthalmichthys molitrix  | Plotosus lineatus         | Pagrus major                 | Aluterus scriptus             |
| Anguilla rostrata             | Ilisha elongata              | Polydactylus sextarius    | Pampus chinensis             | Cephalopholis argus           |
| Arnegottius aspidios          | Isurus oxyrinchus            | Pomadasyd kaakan          | Pampus cinereus (argenteus)  | Cephalopholis boenak          |
| Branchiostegus argentatus     | Johnius belangerii           | Priacanthus tayenus       | Pampus sp                    | Cephalopholis boenak          |
| Cephalopholis argus           | Kyphosus bigibbus            | Protonibea diacanthus     | Parapristipoma trilineatum   | Cephalopholis sonnerati       |
| Cephalopholis boenak          | Kyphosus vaigiensis          | Pseudolabrus eoethinus    | Parupeneus cyclostomus       | Chaetodon modestus            |
| Cephalopholis sonnerati       | Lagocephalus wheeleri        | Pterygotrigla hemisticta  | Parupeneus spilurus          | Cirrhitichthys aurens         |
| Chaetodon modestus            | Larimichthys crocea          | Rachycentron canadum      | Pelates quadrilineatus       | Cirrhitichthys aureus         |
| Channa argus                  | Lateolabrax maculatus        | Rastrelliger kanagurta    | Pennahia argentata           | Collichthys lucidus           |
| Channa marulius               | Lates calcarifer             | Repomucenus curvicornis   | Platax teira                 | Cromileptes altivelis         |
| Cheilodactylus zonatus        | Lethrinus cf                 | Rhabdosargus sarba        | Siniperca obscura            | Decapterus maruadsi           |
| Choerodon anchorago           | Lethrinus haematopterus      | Salmo salar               | Sparus aurata                | Diagramma picta               |
| Cirrhitichthys aurens         | Lutjanus argentimaculatus    | Sardinella albella        | Sphyraena pinguis            | Drepane punctata              |
| Cirrhitichthys aureus         | Lutjanus johnii              | Sardinella hualiensis     | Stephanolepis cirrhifer      | Eleutheronema tetradactylum   |
| Collichthys lucidus           | Lutjanus malabaricus         | Sardinella lemuru         | Takifugu xanthopterus        | Epinephelus awoara            |
| Cromileptes altivelis         | Lutjanus rivulatus           | Saurida microlepis        | Telatrygon acutirostra       | Epinephelus bleekeri          |
| Decapterus maruadsi           | Lutjanus russellii           | Scarus ghobban            | Terapon theraps              | Epinephelus bruneus           |
| Diagramma picta               | Lutjanus sebae               | Scatophagus argus         | Thryssa hamiltonii           | Epinephelus corallicola       |
| Drepane punctata              | Lutjanus stellatus           | Sciaenops ocellatus       | Thryssa kammalensis          | Epinephelus fasciatomaculosus |
| Eleutheronema tetradactylum   | Monacanthus chinensis        | Scolopsis vosmeri         | Trachinotus blochii          | Epinephelus fasciatus         |
| Epinephelus awoara            | Mugil cephalus               | Scophthalmus maximus      | Trachinotus ovatus           | Epinephelus fuscoguttatus     |
| Epinephelus bleekeri          | Mus musculus                 | Scorpaenopsis cirrosa     | Trichiurus sp                | Epinephelus lanceolatus       |
| Epinephelus bruneus           | Nematalosa nasus             | Scorpaenopsis ramaraoi    | Trypauchen vagina            | Epinephelus malabaricus       |
| Epinephelus corallicola       | Nemipterus bathybius         | Sebastiscus marmoratus    | Uroconger lepturus           | Epinephelus merra             |
| Epinephelus fasciatomaculosus | Nemipterus japonicus         | Seriola dumerili          | Variola albimarginata        | Epinephelus moara             |
| Epinephelus fasciatus         | Nemipterus virgatus          | Siganus fuscescens        | Gymnothorax javanicus        | Epinephelus polyphekadion     |
| Epinephelus fuscoguttatus     | Odontamblyopus sp            | Siganus punctatus         | Gymnothorax pseudothyroideus | Epinephelus quoyanus          |
| Epinephelus lanceolatus       | Oreochromis sp               | Siganus spinus            | Gymnothorax reticularis      | Epinephelus quoyanus          |
| Epinephelus malabaricus       | Ostorhinchus doederleini     | Siganus vermiculatus      | Hapalogenys nigripinnis      | Epinephelus quoyanus          |
| Epinephelus merra             | Ostorhinchus fasciatus       | Siganus virgatus          | Harpadon nehereus            | Epinephelus quoyanus          |
| Epinephelus moara             |                              | Sillago asiatica          | Ilisha elongata              | Epinephelus quoyanus          |
| Epinephelus polyphekadion     |                              | Sillago sihama            |                              | Epinephelus quoyanus          |
| Epinephelus quoyanus          |                              |                           |                              | Epinephelus quoyanus          |
| Evynnis tumifrons             |                              |                           |                              | Epinephelus quoyanus          |
| Glaucostegus cemiculus        |                              |                           |                              | Epinephelus quoyanus          |





Sustainable  
*Eel Group*



**GOOD FISH**  
FOUNDATION



European Maritime  
& Fisheries Fund



**Agriculture, Fisheries and Conservation Department**  
The Government of the Hong Kong Special Administrative Region



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