



Risk of translocation of pathogens through trading of frozen or live shrimp: knowns and unknowns



Dr Grant D. Stentiford

Director, European Union Reference Laboratory for Crustacean Diseases

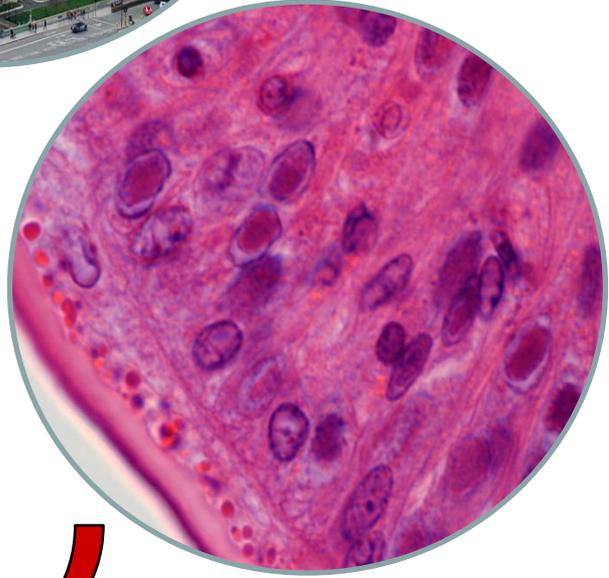
Team Leader for Pathology and Molecular Systematics Team, Cefas Weymouth Laboratory, UK

Cefas

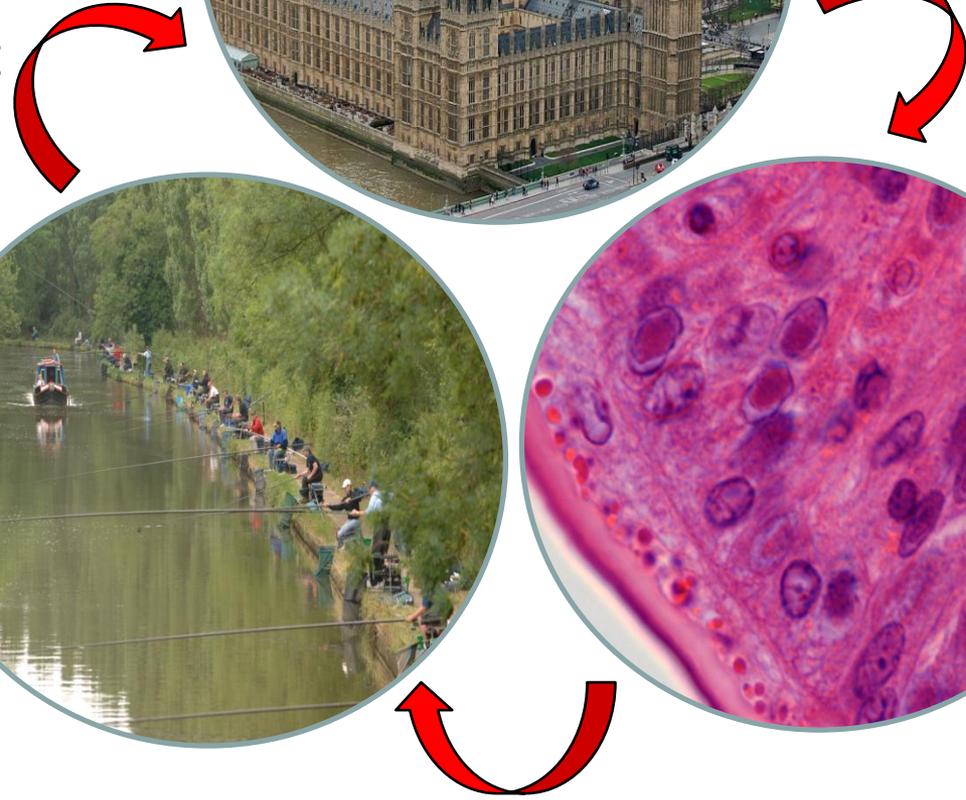
**STATUTORY ROLE,
ADVICE AND
SURVEILLANCE**



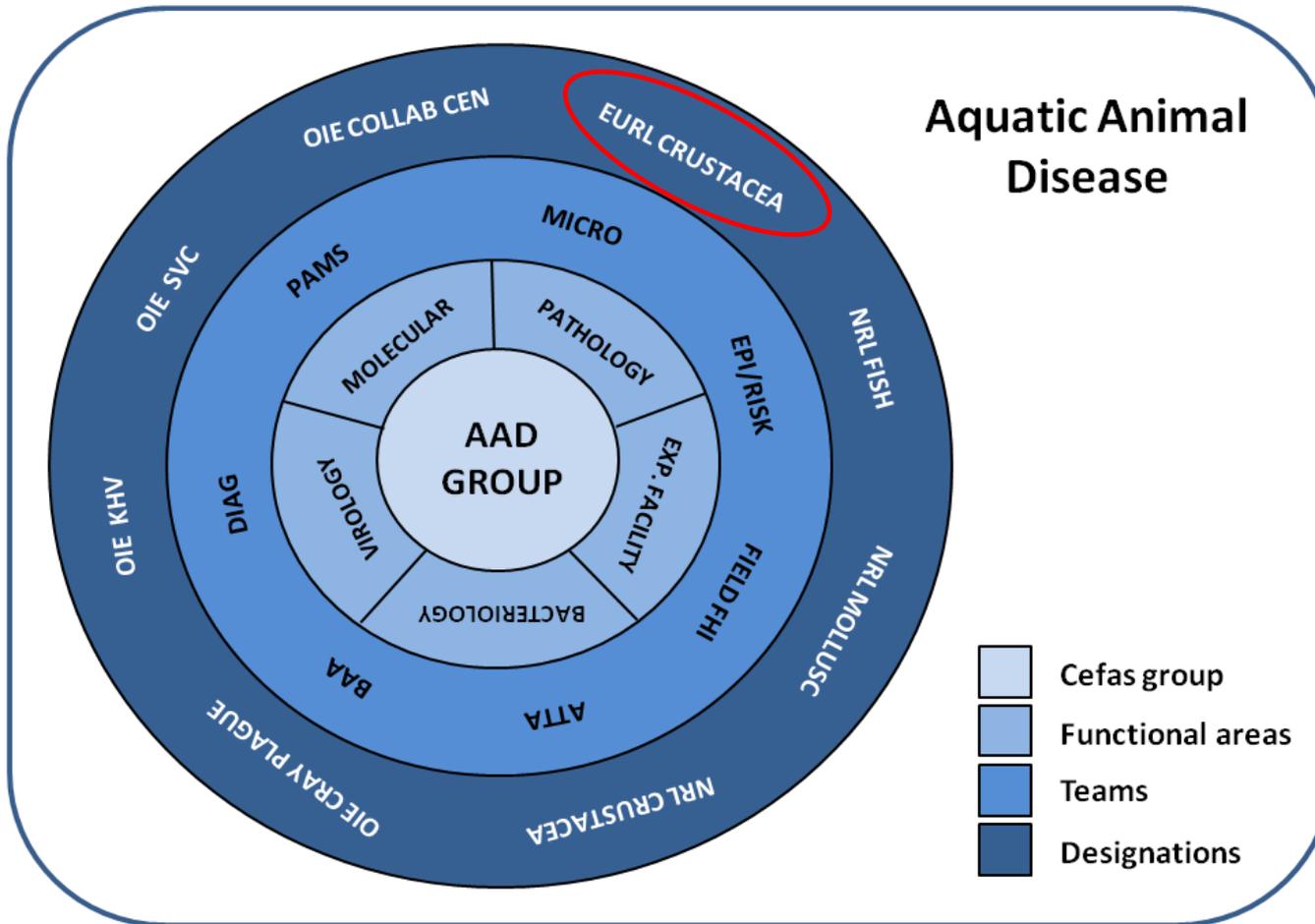
**DIAGNOSTICS
AND RESEARCH**



STAKEHOLDER ENGAGEMENT



Aquatic animal diseases and Cefas



‘Given the apparent high propensity for viral infections to occur in penaeid shrimp, and the documented survival of such viruses within raw frozen commodity products, the specific risks associated with the trading of raw product is being afforded increased attention’

Stentiford G.D., Neil D.M., Peeler E., Shields J.D., Small H.J., Flegel T.W., Vlaskovic J., Jones B., Morado F., Moss, S., Lotz, J., Bartholomay, L., Behringer, D.C., Hauton, C., Lightner, D.V. (2012). Disease will limit future food supply from global crustacean fishery and aquaculture sectors. *Journal of Invertebrate Pathology* 110, 141-147.





Crustacean diseases and the OIE

The OIE and disease listing

OIE 'Office International des Epizooties' = World Organization for Animal Health

Established 1924. **178 Member Countries** by 2011

Considered as **reference body for animal health** by the World Trade Organisation (WTO)

Global mandate to set conditions to **facilitate trade while minimizing risk** of disease transfer

Publishes Aquatic Animal Health **Code** and **Manual** of Diagnostic Tests (6/3 year intervals)

Code gives guidance on trade of animals/products regarding transboundary disease movement

Manual contains specific chapters with required/recommended tests for the listed diseases

What gets on to the list?

Case definition

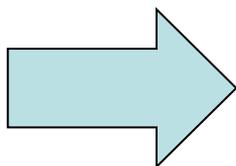


Table 1

Abbreviated summary of criteria for listing an aquatic animal disease.

-
- A. Consequences
 1. Significant production losses
 2. Negative effect on wild populations
 3. Zootonic potential
 - B. Spread
 4. Infectious etiology known
 5. Infectious etiology suspected
 6. Potential for international spread
 7. Disease-free regions exist
 - C. Diagnosis
 8. Robust diagnostic/detection method available.
-

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Minireview

Global transboundary disease politics: The OIE perspective

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Criteria for listing and de-listing (OIE)

Member State **proposal** to OIE/Aquatic Animal Health Standards Commission (AAHSC)

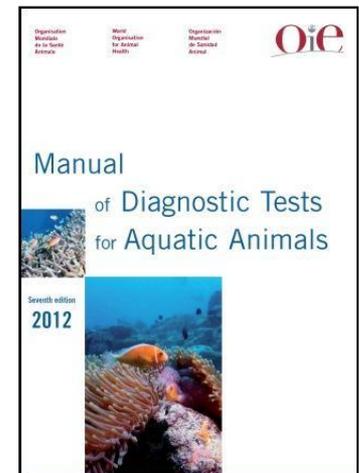
Proposal **distributed** to OIE Member States for comment

Support/Objections included in next meeting of AAHSC. Report to OIE HQ.

OIE HQ include proposal in next **World Assembly** of Delegates

Proposal **approved/rejected**. Returned to AAHSC/proposer

Listing/de-listing process can take 2-3 years



The current OIE list (2012)

EMS/AHPNS?

Section 2.2 – Diseases of Crustaceans*

Crayfish plague (*Aphanomyces astaci*)

IHHN (Infectious hypodermal and haematopoietic necrosis)

IMN (Infectious myonecrosis)

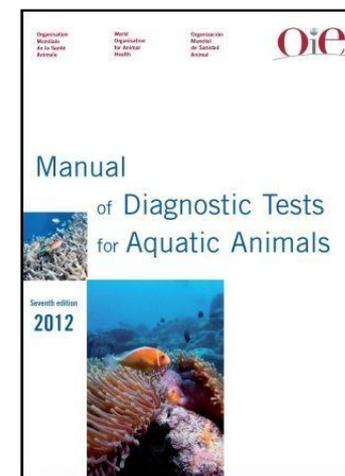
NHP (Necrotizing hepatopancreatitis)

TS (Taura syndrome)

WSD (White spot disease)

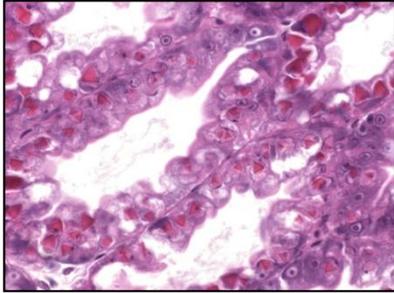
YHD (Yellowhead disease)

WTD (White tail disease)

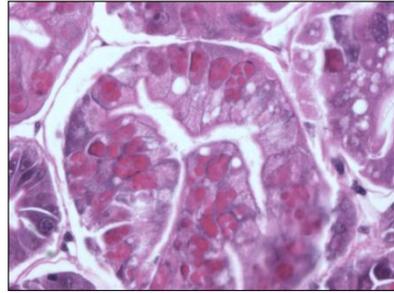


*similar lists exist for cattle, sheep/goat, equine, swine, avian, lagomorph, bee, amphibian, fish, mollusc and mixed host diseases

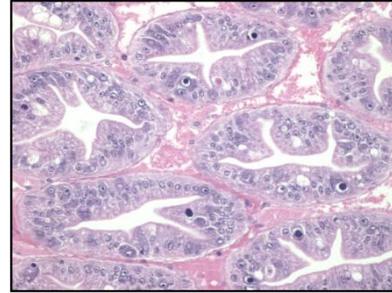
De-listed and current* OIE listed diseases



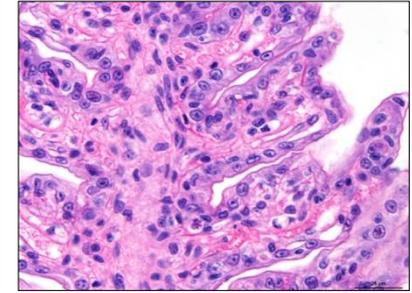
BP



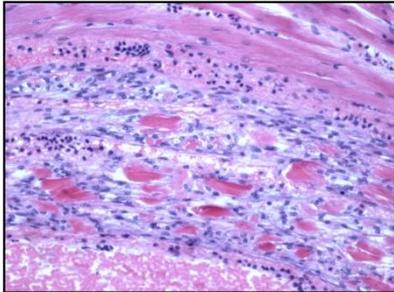
MBV



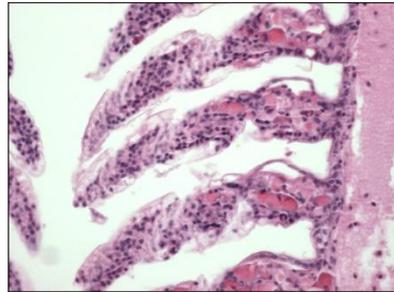
HPV



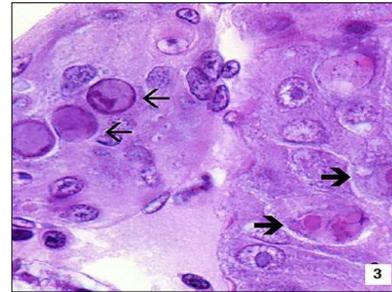
IHNV*



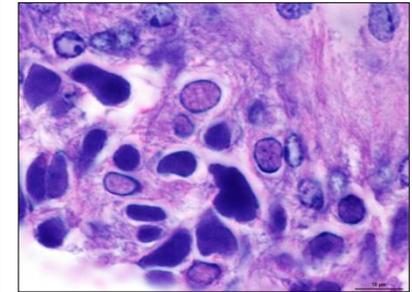
IMNV*



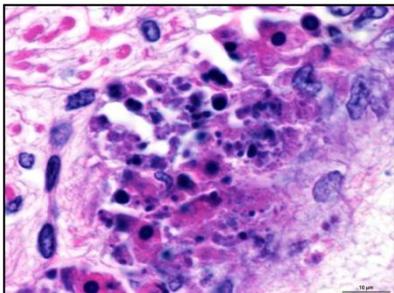
REO



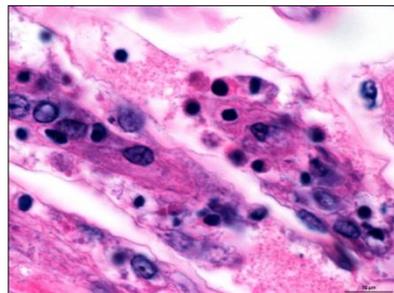
BMNV



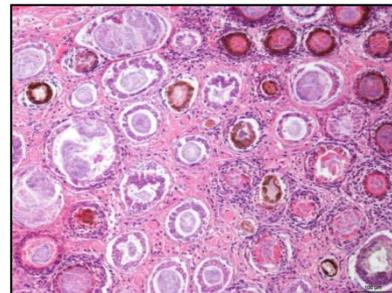
WSSV*



TSV*



YHV*



NHP*



Crayfish plague*

Disease reporting by Member Countries



Veterinary Authority of Member Country **notifies** OIE of outbreak

First occurrence, re-occurrence, new host species, new pathogen strain,
new zoonotic potential or not listed but significant emergence

OIE notify **all Member Countries** via website and weekly Disease Reports

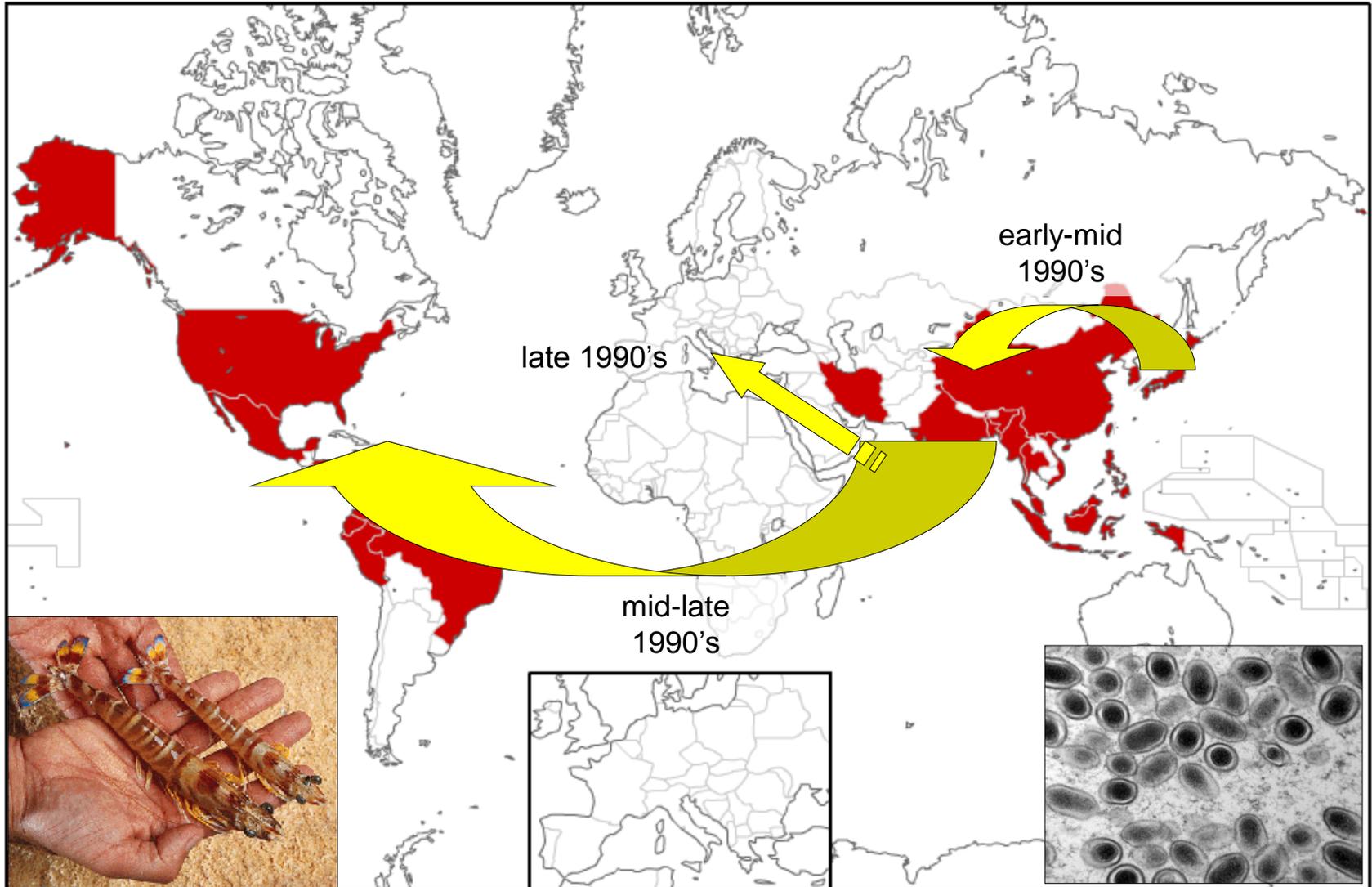
Member Country provides **weekly reports** until eradication/stability (for 6 months)

All Member Countries provide **6-monthly reports** to the OIE

International Database on Aquatic Animal Diseases (IDAAD) www.cefas.defra.gov.uk/idaad/



White spot disease (2009)

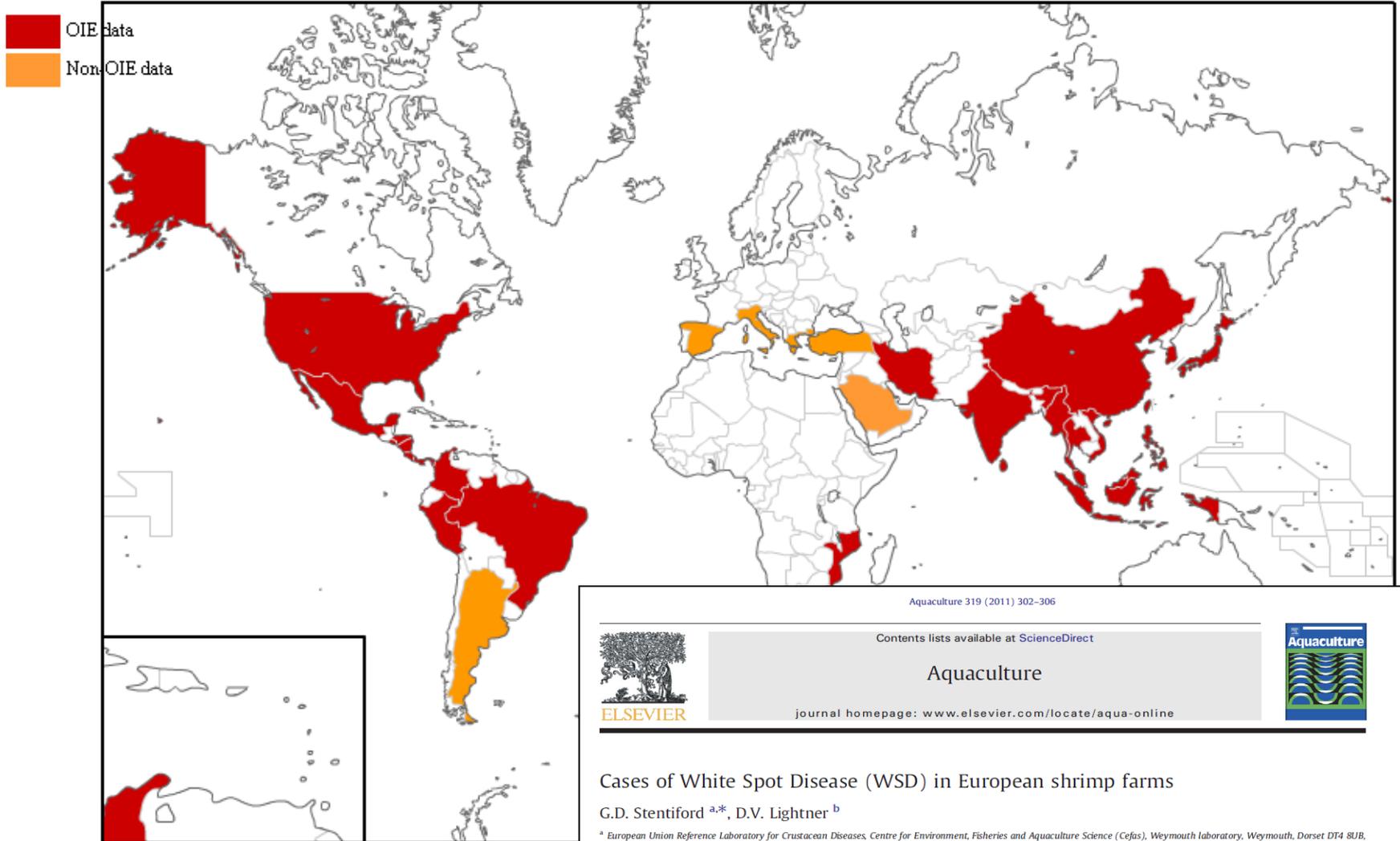


Type host: *Penaeus japonicus*

WSSV virions



WSD global status 2011



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Cases of White Spot Disease (WSD) in European shrimp farms

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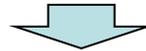
^b Aquaculture Pathology Laboratory, Department of Veterinary Science and Microbiology, University of Arizona, Tucson, AZ 85721, USA

White Spot Disease – global impact

New Outbreaks continue to occur (e.g. Saudi Arabia 2010, Mozambique 2011)

Viable virus in post-larvae, broodstock, carrier animals and commodity

Major impact on food security from
shrimp sector (**\$1.5bn/annum**)





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Minireview

Disease will limit future food supply from the global crustacean fishery and aquaculture sectors

G.D. Stentiford^{a,*}, D.M. Neil^b, E.J. Peeler^a, J.D. Shields^c, H.J. Small^c, T.W. Flegel^d, J.M. Vlak^e, B. Jones^f, F. Morado^g, S. Moss^h, J. Lotzⁱ, L. Bartholomay^j, D.C. Behringer^k, C. Hauton^l, D.V. Lightner^m

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Listed crustacean diseases and EC Directive 2006/88



COUNCIL DIRECTIVE 2006/88/EC
of 24 October 2006

on animal health requirements for aquaculture animals and products thereof, and on the prevention and control of certain diseases in aquatic animals

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 37 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament,

Having regard to the opinion of the European Economic and Social Committee (1),

Whereas:

- (1) Aquaculture animals and products fall under the scope of Annex I to the Treaty as live animals, fish, molluscs and crustaceans. The breeding, rearing and the placing on the market of aquaculture animals and products thereof constitutes an important source of income for persons working in this sector.
- (2) In the context of the internal market, specific animal health rules were laid down for the placing on the market and introduction from third countries of the products concerned by Council Directive 91/67/EEC of 28 January 1991 concerning the animal health conditions governing the placing on the market of aquaculture animals and products (2).
- (3) Outbreaks of diseases in aquaculture animals could cause severe losses to the industry concerned. Minimum measures to be applied in case of outbreaks of the most important diseases in fish and molluscs were established by Council Directive 93/53/EEC of 24 June 1993 introducing minimum Community measures for the control of certain fish diseases (3) and Council Directive 95/70/EC of 22 December 1995 introducing minimum Community measures for the control of certain diseases affecting bivalve molluscs (4).
- (4) Existing Community legislation was drafted mainly to take into account the farming of salmon, trout and oysters. Since that legislation was adopted, the Community aquaculture industry has developed significantly. A number of

additional fish species, particularly marine species, are now used in aquaculture. New types of farming practices involving other fish species have also become increasingly common, particularly following the recent enlargement of the Community. Furthermore, farming of crustaceans, mussels, clams and abalones is becoming increasingly important.

- (5) All disease control measures have an economic impact on aquaculture. Inadequate controls may lead to a spread of pathogens, which may cause major losses and compromise the animal health status of fish, molluscs and crustaceans used in Community aquaculture. On the other hand, over-regulation could place unnecessary restrictions on free trade.
- (6) The Communication from the Commission to the Council and the European Parliament dated 19 September 2002 sets out a strategy for the sustainable development of European aquaculture. That Communication outlined a series of measures designed to create long-term employment in the aquaculture sector, including promoting high animal health and welfare standards, and environmental actions to ensure a sound industry. Those measures should be taken into account.
- (7) Since the adoption of Directive 91/67/EEC, the Community has ratified the World Trade Organisation (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). The SPS Agreement refers to the standards of the World Organisation for Animal Health (OIE). The animal health requirements for placing live aquaculture animals and products thereof on the market within the Community set out in Directive 91/67/EEC are more stringent than those standards. Therefore, this Directive should take into account the Aquatic Animal Health Code and the Manual of Diagnostic Tests for Aquatic Animals of the OIE.
- (8) In order to ensure the rational development of the aquaculture sector and to increase productivity, aquatic animal health rules should be laid down at Community level. These rules are necessary, *inter alia*, in order to contribute to the completion of the internal market and to avoid the spread of infectious diseases. Legislation should be flexible to take into account the continuing developments in and diversity of the aquaculture sector, as well as the health status of aquatic animals within the Community.

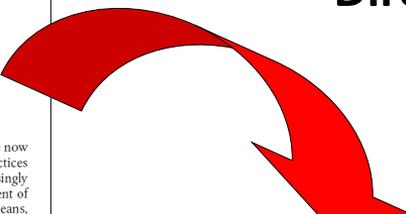
(1) OJ C 88, 11.4.2006, p. 13.

(2) OJ L 46, 19.2.1991, p. 1. Directive as last amended by Regulation (EC) No 806/2003 (OJ L 122, 16.5.2003, p. 1).

(3) OJ L 175, 19.7.1993, p. 23. Directive as last amended by the 2003 Act of Accession.

(4) OJ L 332, 30.12.1995, p. 33. Directive as last amended by the 2003 Act of Accession.

Directive 2006/88/EC



(e) 'aquatic animal' means:

(i) fish belonging to the superclass *Agnatha* and to the classes *Chondrichthyes* and *Osteichthyes*;

(ii) mollusc belonging to the Phylum *Mollusca*;

(iii) crustacean belonging to the Subphylum *Crustacea*;



PART II

Listed diseases

EXOTIC DISEASES		
	DISEASE	SUSCEPTIBLE SPECIES
FISH	Epizootic haematopoietic necrosis	Rainbow trout (<i>Oncorhynchus mykiss</i>) and redfin perch (<i>Percia fluviatilis</i>)
	Epizootic ulcerative syndrome	Genera: <i>Catla</i> , <i>Channa</i> , <i>Labeo</i> , <i>Mastacembelus</i> , <i>Mugil</i> , <i>Puntius</i> and <i>Trichogaster</i> .
MOLLUSCS	Infection with <i>Bonamia exitiosa</i>	Australian mud oyster (<i>Ostrea angasi</i>) and Chilean flat oyster (<i>O. chilensis</i>)
	Infection with <i>Perkinsus marinus</i>	Pacific oyster (<i>Crassostrea gigas</i>) and Eastern oyster (<i>C. virginica</i>)
	Infection with <i>Microcytos mackini</i>	Pacific oyster (<i>Crassostrea gigas</i>), Eastern oyster (<i>C. virginica</i>), Olympia flat oyster (<i>Ostrea conchaphila</i>) and European flat oyster (<i>O. edulis</i>)
CRUSTACEANS	Taura syndrome	Gulf white shrimp (<i>Penaeus setiferus</i>), Pacific blue shrimp (<i>P. stylirostris</i>), and Pacific white shrimp (<i>P. vannamei</i>)
	Yellowhead disease	Gulf brown shrimp (<i>Penaeus aztecus</i>), Gulf pink shrimp (<i>P. duorarum</i>), Kuruma prawn (<i>P. japonicus</i>), black tiger shrimp (<i>P. monodon</i>), Gulf white shrimp (<i>P. setiferus</i>), Pacific blue shrimp (<i>P. stylirostris</i>), and Pacific white shrimp (<i>P. vannamei</i>)

NON-EXOTIC DISEASES		
	DISEASE	SUSCEPTIBLE SPECIES
FISH	Spring viraemia of carp (SVC)	Bighead carp (<i>Aristichthys nobilis</i>), goldfish (<i>Carassius auratus</i>), crucian carp (<i>C. canassius</i>), grass carp (<i>Ctenopharyngodon idellus</i>), common carp and koi carp (<i>Cyprinus carpio</i>), silver carp (<i>Hypophthalmichthys molitrix</i>), sheatfish (<i>Silurus glanis</i>) and tench (<i>Tina tina</i>)
	Viral haemorrhagic septicaemia (VHS)	Herring (<i>Clupea</i> spp.), whitefish (<i>Coregonus</i> spp.), pike (<i>Esox lucius</i>), haddock (<i>Gadusa aeglefinus</i>), Pacific cod (<i>G. macrocephalus</i>), Atlantic cod (<i>G. morhua</i>), Pacific salmon (<i>Oncorhynchus</i> spp.) rainbow trout (<i>O. mykiss</i>), rockling (<i>Onos mustelus</i>), brown trout (<i>Salmo trutta</i>), turbot (<i>Scophthalmus maximus</i>), sprat (<i>Sprattus sprattus</i>) and grayling (<i>Thymallus thymallus</i>)
	Infectious haematopoietic necrosis (IHN)	Chum salmon (<i>Oncorhynchus keta</i>), coho salmon (<i>O. kisutch</i>), Masou salmon (<i>O. masou</i>), rainbow or steelhead trout (<i>O. mykiss</i>), sockeye salmon (<i>O. nerka</i>), pink salmon (<i>O. rhodunus</i>) chinook salmon (<i>O. tshawytscha</i>), and Atlantic salmon (<i>Salmo salar</i>)
	Koi herpes virus (KHV) disease	Common carp and koi carp (<i>Cyprinus carpio</i>).
	Infectious salmon anaemia (ISA)	Rainbow trout (<i>Oncorhynchus mykiss</i>), Atlantic salmon (<i>Salmo salar</i>), and brown and sea trout (<i>S. trutta</i>).
MOLLUSCS	Infection with <i>Marteilia refringens</i>	Australian mud oyster (<i>Ostrea angasi</i>), Chilean flat oyster (<i>O. chilensis</i>), European flat oyster (<i>O. edulis</i>), Argentinian oyster (<i>O. puelchana</i>), blue mussel (<i>Mytilus edulis</i>) and Mediterranean mussel (<i>M. galloprovincialis</i>)
	Infection with <i>Bonamia ostreae</i>	Australian mud oyster (<i>Ostrea angasi</i>), Chilean flat oyster (<i>O. chilensis</i>), Olympia flat oyster (<i>O. conchaphila</i>), Asiatic oyster (<i>O. denselamellosa</i>), European flat oyster (<i>O. edulis</i>), and Argentinian oyster (<i>O. puelchana</i>).
CRUSTACEANS	White spot disease	All decapod crustaceans (order Decapoda).

Crustacean diseases listed in European aquatic animal health legislation for the first time



Survey

CHAPTER VI

CONTROL PROGRAMMES AND VACCINATION

SECTION 1

Surveillance and eradication programmes

Article 44

Drawing up and approval of surveillance and eradication programmes

1. Where a Member State not known to be infected but not declared free (category III as referred to in Part A of Annex III) of one or more of the non-exotic diseases listed in Part II of Annex IV draws up a surveillance programme for achieving disease-free status for one or more of those diseases, it shall submit that programme for approval in accordance with the procedure referred to in Article 62(2).

Such programmes may also be amended or terminated in accordance with that procedure.

The specific requirements for surveillance, sampling and diagnostic shall be those provided for in Article 49(3).

CHAPTER VII

DISEASE-FREE STATUS

Article 49

Disease-free Member State

1. A Member State shall be declared free of one or more of the non-exotic diseases listed in Part II of Annex IV in accordance with the procedure referred to in Article 62(2), if paragraph 2 of this Article is complied with and:

- (a) none of the species susceptible to the disease(s) in question is present in its territory;

or

- (b) the pathogen is known not to be able to survive in the Member State, and in its water source;

or

- (c) the Member State meets the conditions laid down in Part I of Annex V.

Designate

Disease notification

Article 26

National notification

1. Member States shall ensure that:

- (a) when there are any reasons to suspect the presence of a disease listed in Part II of Annex IV, or the presence of such disease is confirmed in aquatic animals, the suspicion and/or the confirmation is immediately notified to the competent authority;

and

- (b) when increased mortality occurs in aquaculture animals, the mortality is immediately notified to the competent authority or a private veterinarian for further investigations.

Notify

Three viral disease listed (WSD, TS, YHD)



All EU Member states to designate status for non-exotic pathogens (WSD)



Disease freedom claim from historic absence, lack of susceptibles or national survey



Health status dictates geography for live animal and product import/export



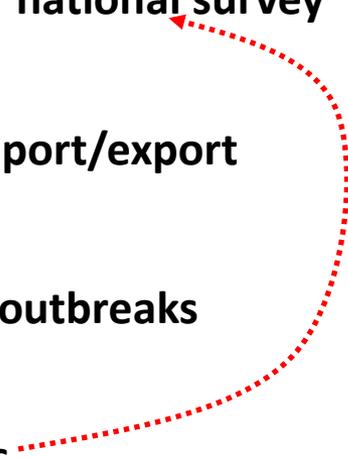
Member State National Reference Laboratory to investigate outbreaks



Outbreak of listed disease will dictate new health status



Outbreak of listed disease notifiable to Member State Competent Authorities



Implication of 2006/88/EC for imports/exports

- Directive covers pre-import requirements (between exporter and the EU)
- Member States to apply conditions set out in Directive when importing

For live animals:

aquaculture (farmed) animals or wild animals for introduction to aquaculture can only be imported from areas designated free from the listed pathogens (or from areas of equal disease status)

For commodity products

Health certification required unless products are destined for further processing, or in 'retail sale' packages, labelled in accordance with EC Regulation 853/2004*

*Therefore, products (live or frozen, directly for human consumption) **do not need to originate from areas designated free from listed pathogens**, even when imported to disease free Member States





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Review

Crustacean diseases in European legislation: Implications for importing and exporting nations

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Assessing post-import risk - is commodity 'safe'?

EU Member States wishing to protect 'disease free' status may elect to carry out **Import Risk Assessment** for commodity products

Reports of viable WSSV in **supermarket** commodity (e.g. Hasson *et al.* 2006)

Argued that Risk Assessments do not consider "**normal-use pathways**" (Flegel, 2009)

However, **Australian ban** on certain commodity products from disease endemic regions

The Australian approach

IRA implicates endemic countries for the OIE-listed diseases

Import options are:

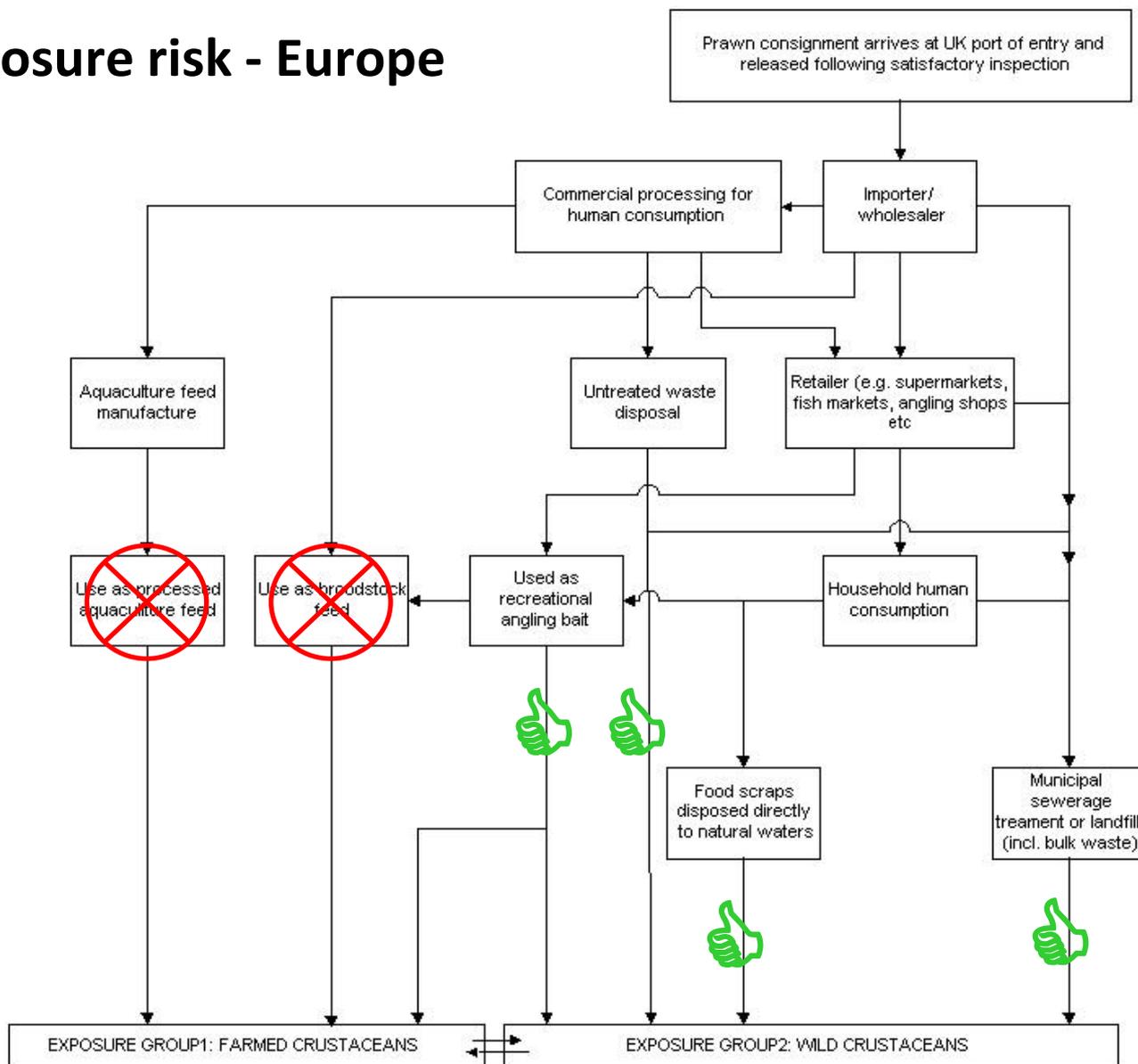
1. Sourcing uncooked product **disease free** country/ zone
2. Head and shell removed and batches held in quarantine , tested and found to be **free of pathogens via PCR** (95% confidence/ 5% prevalence)
3. **Highly processed** with head and shell removed , for human consumption (e.g. breaded)
4. **Cooked** in premises approved by/under control of appropriate Competent Authority in exporting country



Australian Government
**Department of Agriculture,
Fisheries and Forestry**



Assessing exposure risk - Europe



Assessing exposure risk - pathways



John Lampitt,
from

ASK
Ian Chapman

Prawns on the menu

Q Should you fish prawns cooked or raw and can you recommend any day ticket waters in Yorkshire where I can catch using them?

G. Strauss, Brighouse.

Chappy says...

Prawns are not a standard bait like corn and meat, and by using them you stand a good chance of catching when everyone else might be struggling. In my experience it's best to use them raw as they will stay on the hook better. If you think about it, they are like huge caddis fly larvae and fish love those. You can have a go with prawns at any venue. Somewhere like the Specimen Pool at **The Oaks**, Thirsk (01845 501321) would be a safe bet. Send in a picture when you catch your first carp on them!

Lilly Pond a respectable ca
have been suc
pellets and ma
There are of
Call 07815 03C
any way to hook a crayfish so
fish for chub with them and
better dead or alive?
n, Cheshire.

er says...

question turned up as believe
yfish are protected and in
part of a crayfish you are
law.
stand the law was introduced
native English crayfish which
ecline but unfortunately
rfish including non
pecies such as signal crayfish.
ng we would want is to see
secuted by the EA for out of
aking the law.
It is not lost as the tail of a
ooks very much like that of a

ry these on the fish counter
l supermarkets but they are

the few of use using them
rem particularly effective not
but also for big perch and

I have found them a better bait
an in winter. Sometimes in
ve had expensive tiger prawn
by other crayfish.

Angler's Mail

Assessing exposure risk - hosts



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Journal of Invertebrate Pathology

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Susceptibility to infection and pathogenicity of White Spot Disease (WSD) in non-model crustacean host taxa from temperate regions

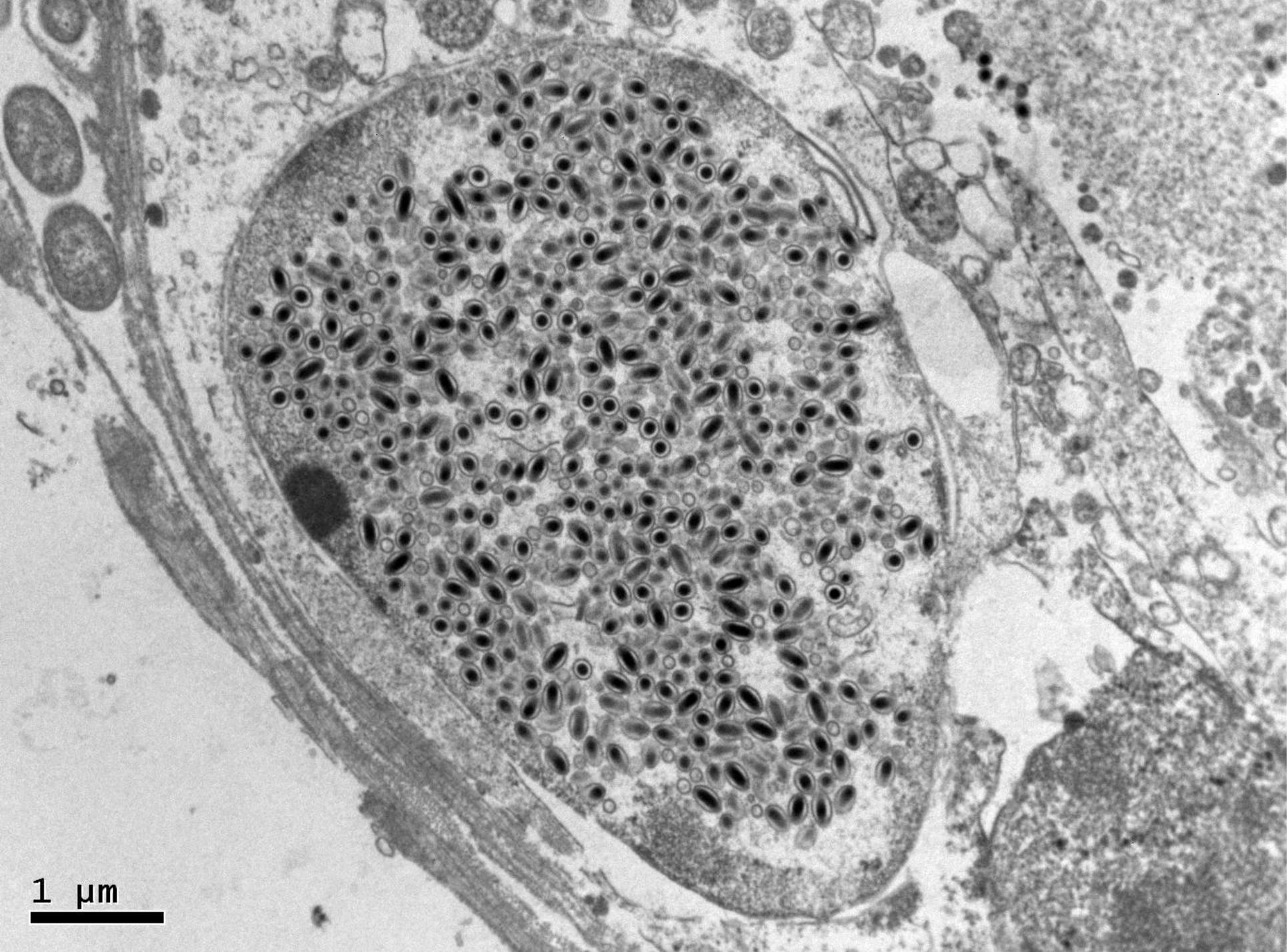
K.S. Bateman^{a,*}, I. Tew^a, C. French^a, R.J. Hicks^a, P. Martin^a, J. Munro^{b,c}, G.D. Stentiford^a

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1 μm

Different host susceptibility

	Mortality	Pathology	Example hosts
Type 1 - High	High mortality in both injected and fed exposures	Classic white spot pathology obvious in tissues from both fed and injected exposures	Penaeid shrimp White Clawed Crayfish Signal Crayfish Chinese Mitten Crab
Type 2 - Medium	High mortality in injected exposure, little or no mortality in fed exposure	Classic white spot pathology obvious in tissues from injected exposure. Little or no pathology evident in fed exposure	European Lobster Norway lobster Edible crab
Type 3 - Low	Low level mortality in both injected and fed exposures	Little or no pathology evident in either injected or fed exposures	Shore crab

Availability in supermarkets

Batch prevalence from 0-100%

>3×10⁵ copies/ng total DNA in +ve control (lab)

~5×10² copies/ng total DNA in supermarket shrimp

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DISEASES OF AQUATIC ORGANISMS
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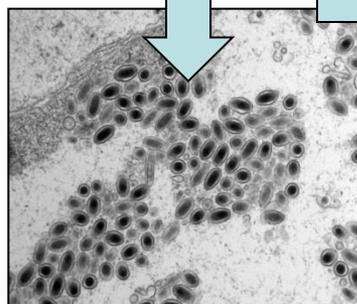
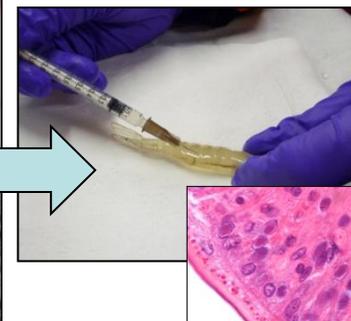
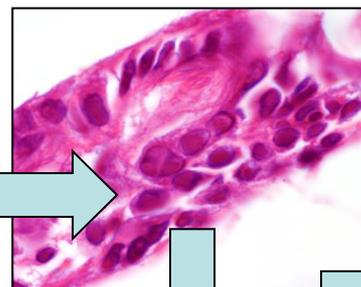
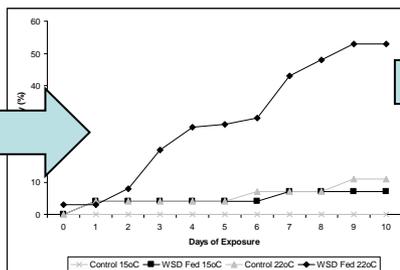
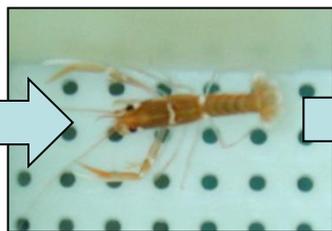
Contribution to the DAO Special 'Disease effects on lobster fisheries, ecology, and culture'

OPEN ACCESS

Susceptibility of juvenile European lobster *Homarus gammarus* to shrimp products infected with high and low doses of white spot syndrome virus

K. S. Bateman^{1,*}, J. Munro^{2,3}, B. Uglow¹, H. J. Small⁴, G. D. Stentiford¹

¹European Union Reference Laboratory for Crustacean Diseases, Centre for Environment, Fisheries and Aquaculture Science, Weymouth Laboratory, Weymouth, Dorset DT4 8UB, UK
²School of Animal and Veterinary Sciences, University of Adelaide, Adelaide, South Australia 5005, Australia
³South Australian Research and Development Institute, 2 Hamra Avenue, West Beach, South Australia 5024, Australia
⁴Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, Virginia 23062, USA



Susceptibility in European lobsters **fed once** with WSSV contaminated shrimp purchased from UK supermarkets

Harvesting strategy affects risk

Transboundary and Emerging Diseases

Transboundary and Emerging Diseases

REVIEW

White Spot Syndrome Virus (WSSV) Concentrations in Crustacean Tissues – A Review of Data Relevant to Assess the Risk Associated with Commodity Trade

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² European Union Reference Laboratory for Crustacean Diseases, Centre for Environment, Fisheries and Aquaculture Science, Weymouth Laboratory, Weymouth, Dorset, UK

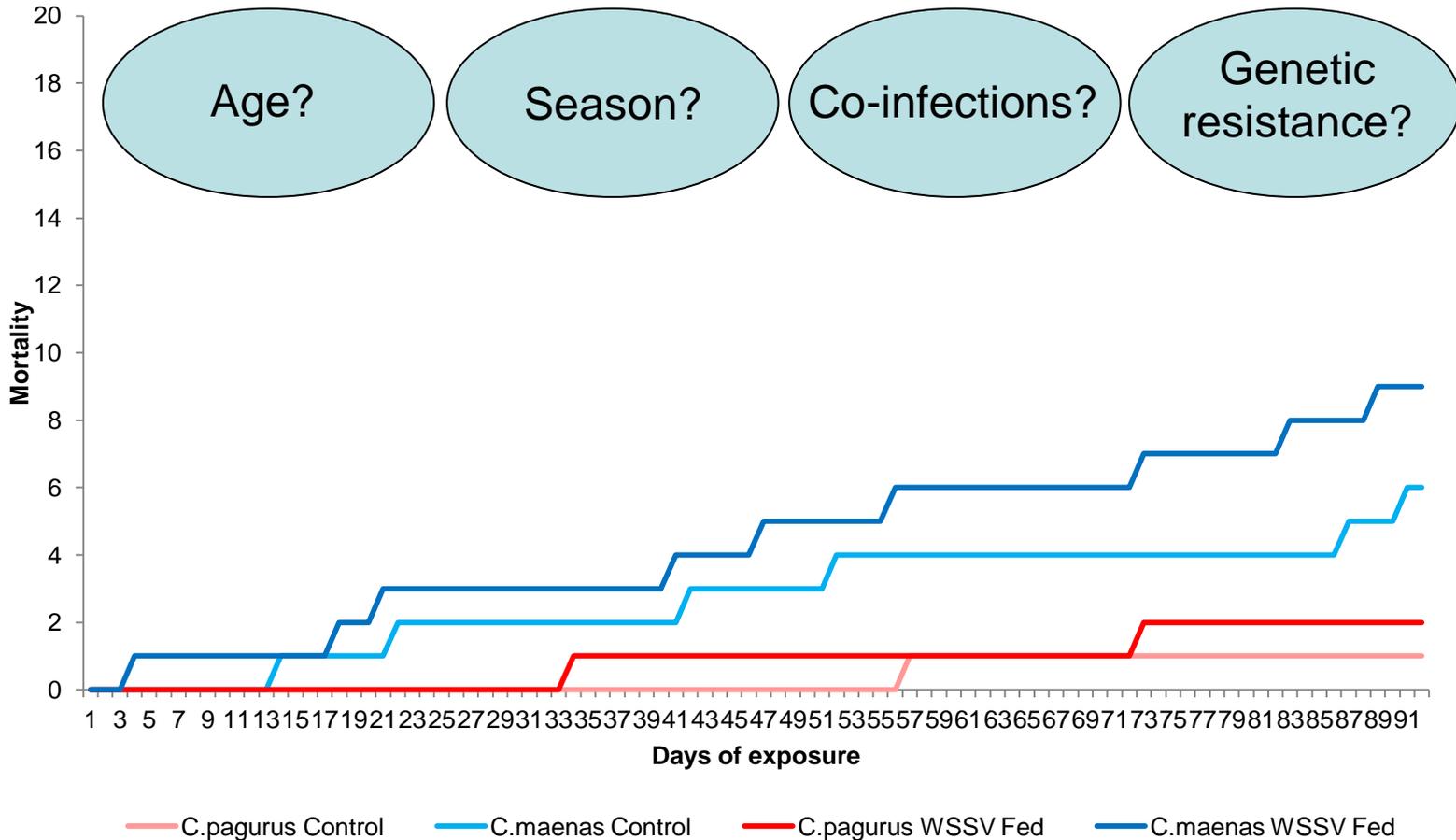
Dose required to infect shrimp *per os* is about **10 times higher** compared with intra muscular injection

In outbreak scenario/emergency harvest, copy numbers of **>10¹⁰** per gram shrimp tissue may occur

Commodity from emergency harvesting poses **significantly higher risk** than from normal harvest

Assessing consequence – the great unknown

Low mortality in single-feed, long term exposures of wild-sourced animals



The OIE and 'safe' commodity

OIE *ad hoc* committee established 2008 (Safety of Products Derived from Aquatic Animals)

Recognising increasing trade in aquatic animal commodity and knowledge gaps in risk associated with contaminating pathogens

More information in the OIE Aquatic Code and....

Transboundary and Emerging Diseases

ORIGINAL ARTICLE

Assessment of the Safety of Aquatic Animal Commodities for International Trade: The OIE Aquatic Animal Health Code

B. Oidtmann¹, C. Johnston², K. Klotins³, G. Mylrea⁴, P. T. Van⁵, S. Cabot⁶, P. R. Martin⁷, L. Ababouch⁸ and F. Berthe⁹

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⁸ FAO, Rome, Italy

⁹ European Food Safety Authority, Risk Assessment and Scientific Assistance Directorate, Parma, Italy



Summary

OIE list aquatic animal diseases in their 'Code' and 'Manual' series

Emerging risks (e.g. commodity) considered by *ad hoc* panels

Regional legislation (e.g. EC) also has trading implications

BUT:

Commodity risk currently being handled post-import (e.g. within EU)

Some information for release/exposure risk but little for consequence

Continual health improvements will benefit food security AND create a safer commodity



'The responsibility to protect naïve habitats and hosts against transboundary movements of disease agents should be a shared one – between those countries involved with the production of animals and their products and those countries consuming them'



**FENACAM Organizing Committee
Brazilian Shrimp Farmers Association (ABCC)**



DG SANCO, European Commission



UK Department for Environment, Food and Rural Affairs (Defra)



**Muito
obrigado!**

Point of Need (PON) Diagnostics in Shrimp Aquaculture

Rapid, sensitive and **de-centralised** diagnostic testing

For use in **near farm settings**, using low-skilled work force

Single or multiplex detection **of listed and non-listed** shrimp pathogens

Potential for relay of diagnostic data via user **smart phone** technology

Dynamic national and regional **management** of disease outbreaks

Driving a **cultural change** in disease reporting and response

For more information: grant.stentiford@cefasc.co.uk

