Aquaculture and Disease Threats in Australia and an update on EHNV

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What's up down under ?

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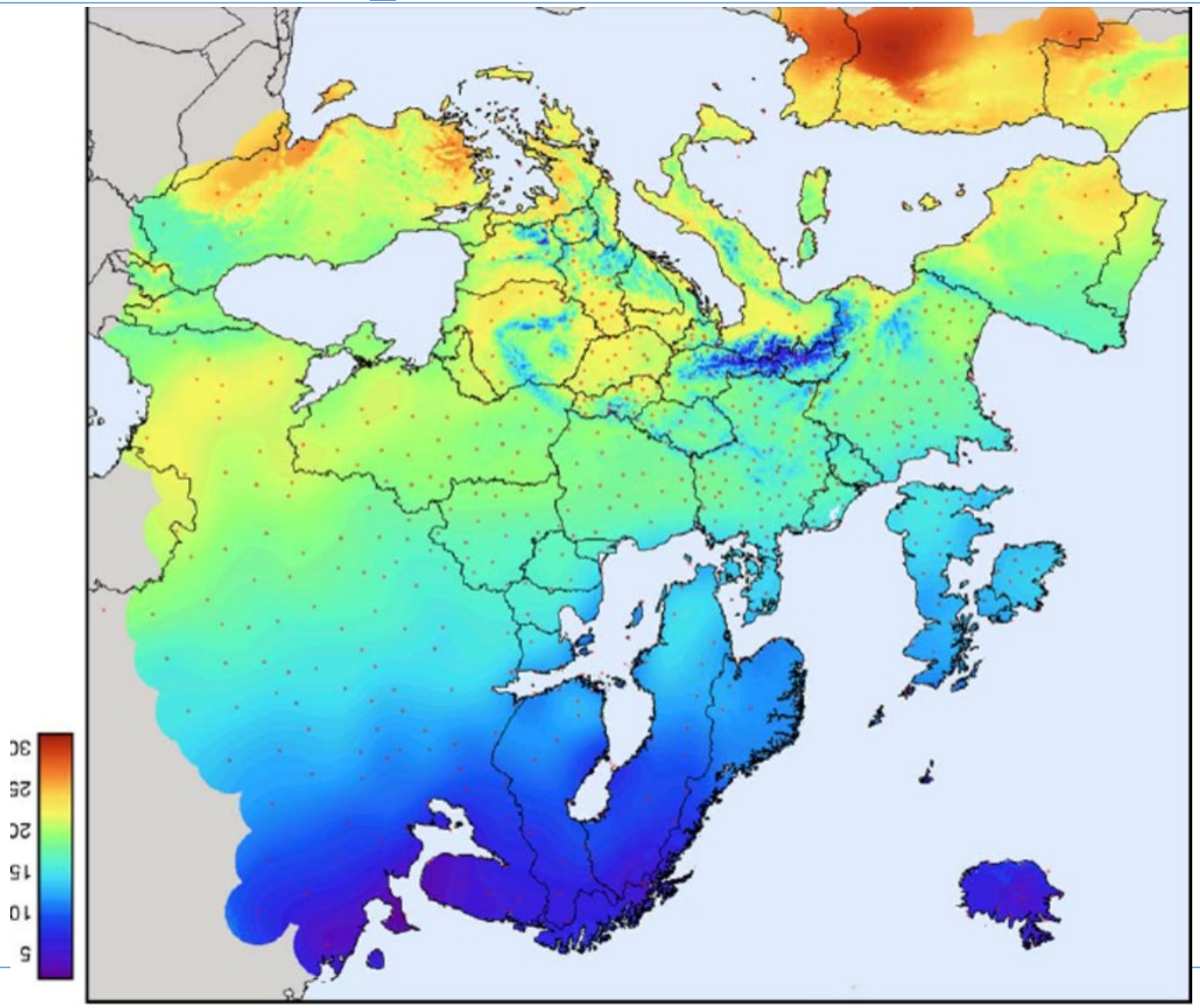
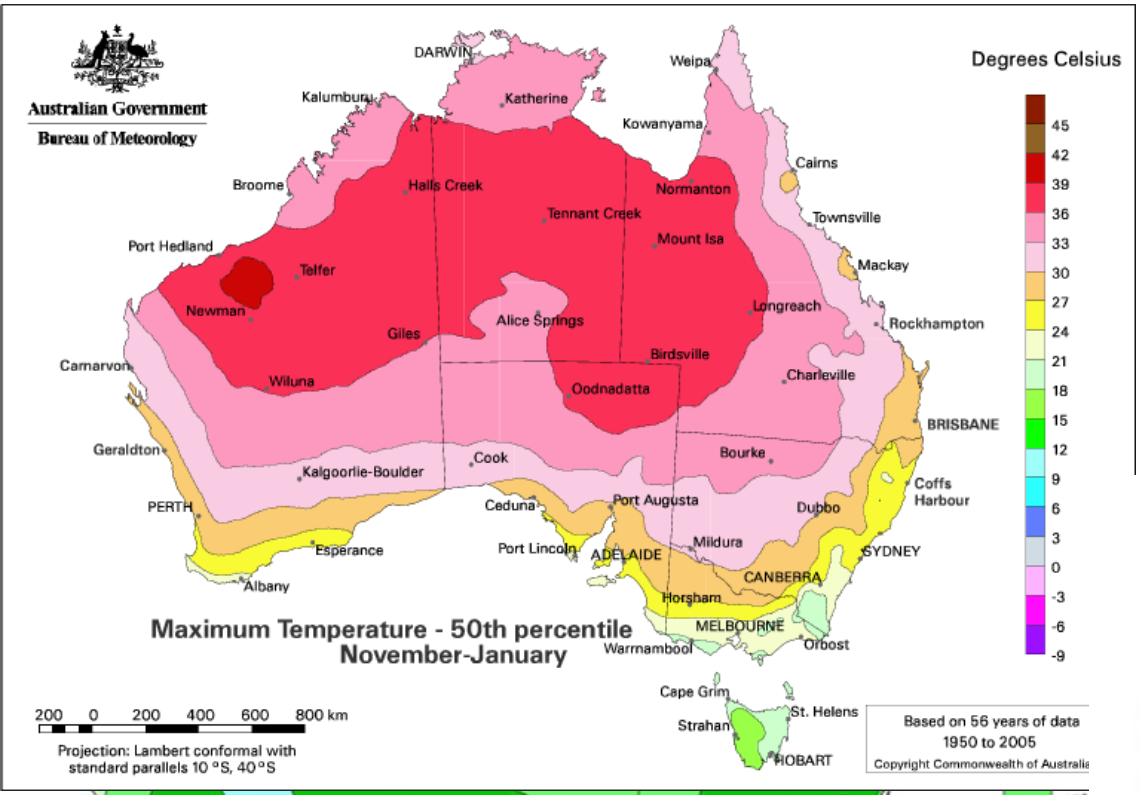
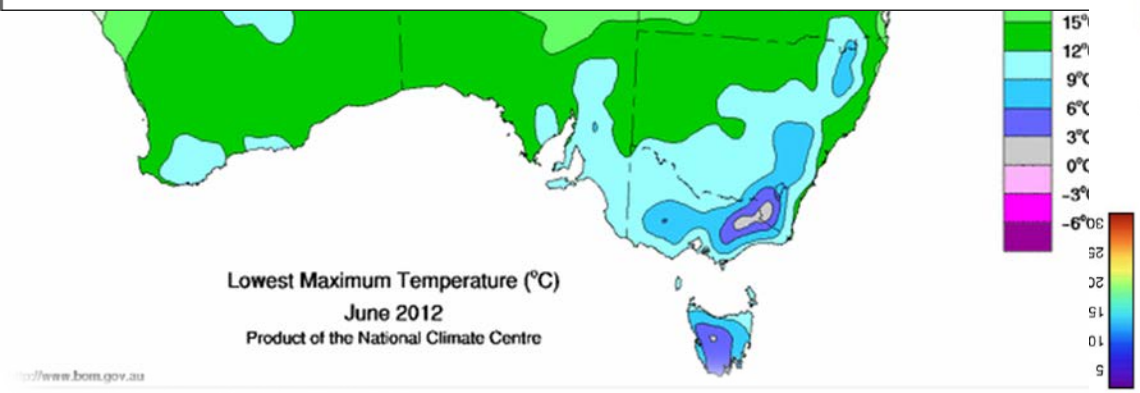
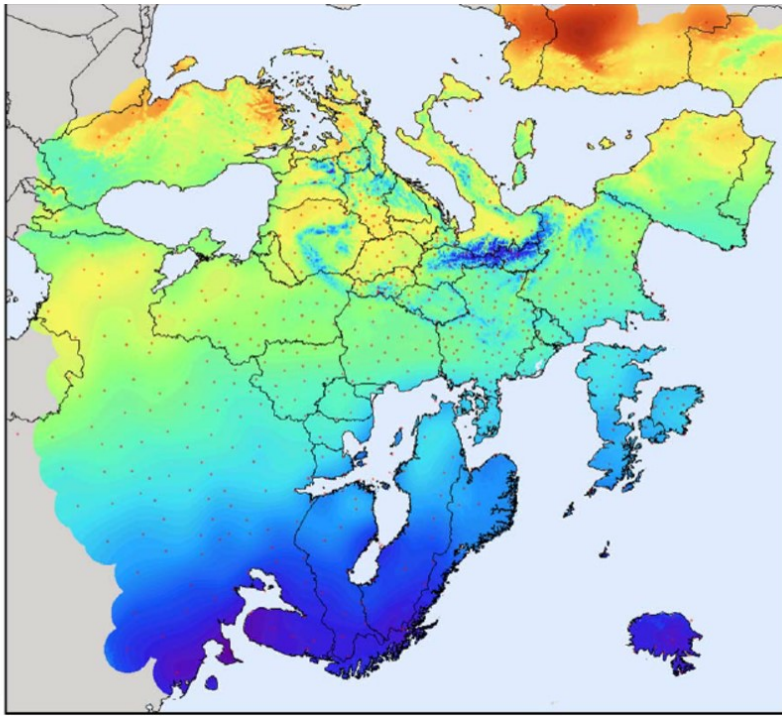


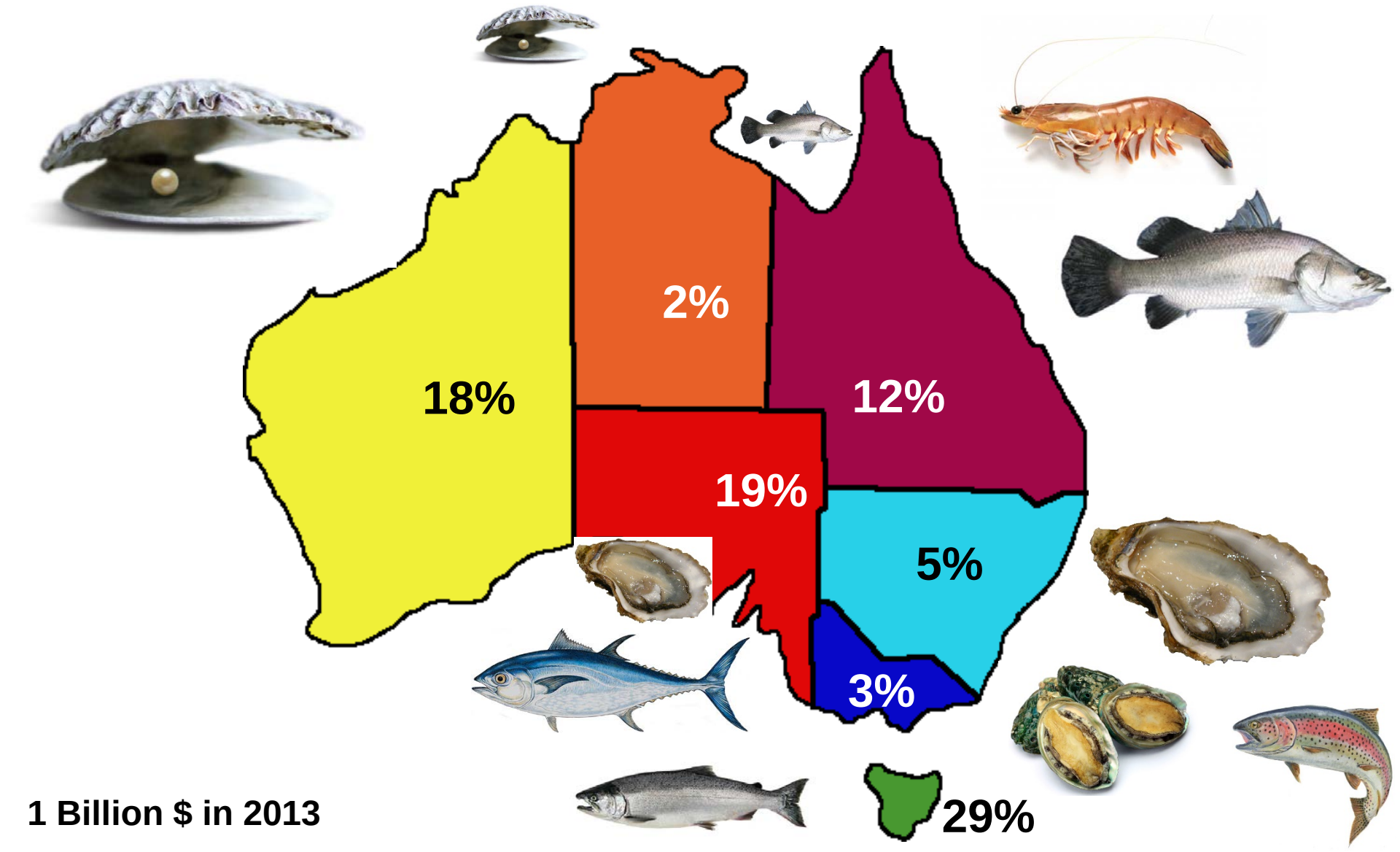
What's up down under





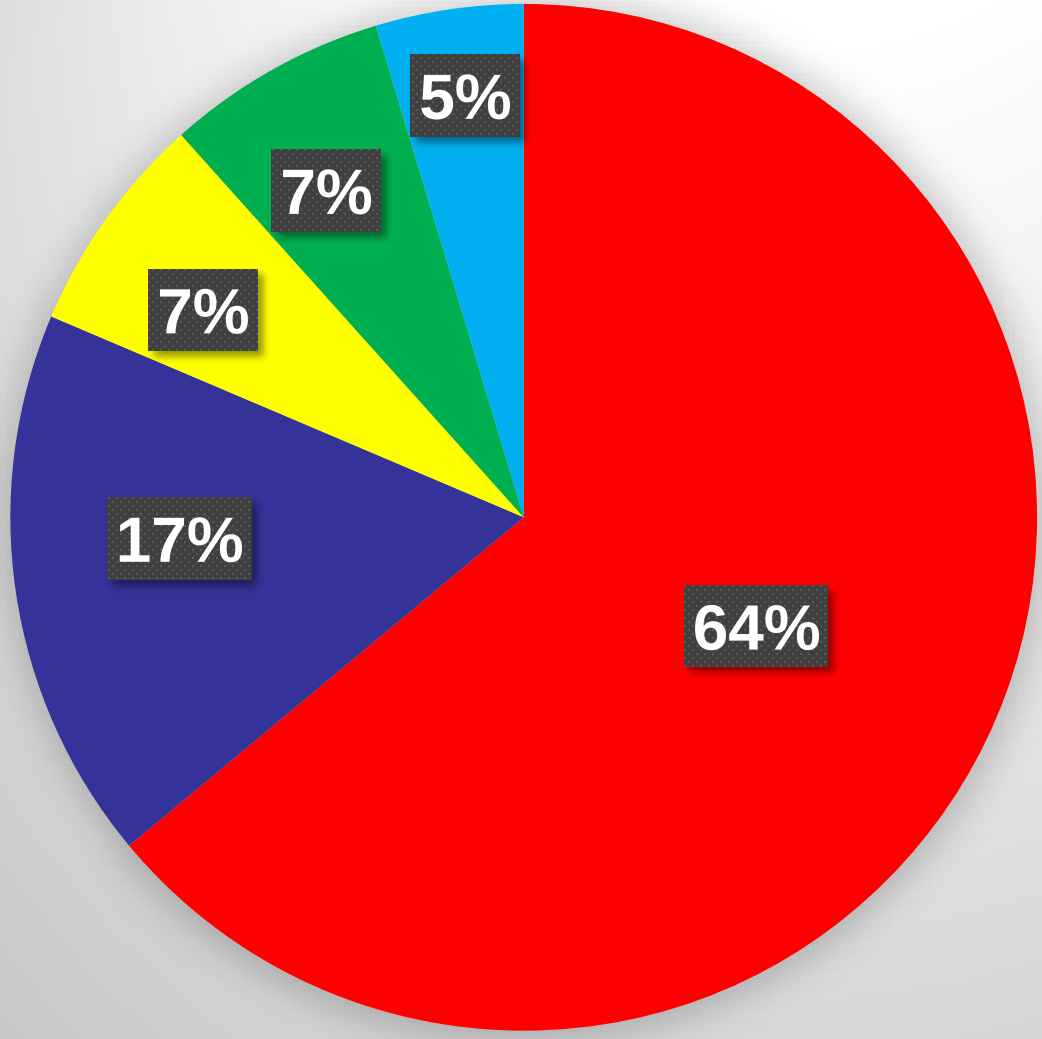


Aquaculture in Australia



1 Billion $ in 2013

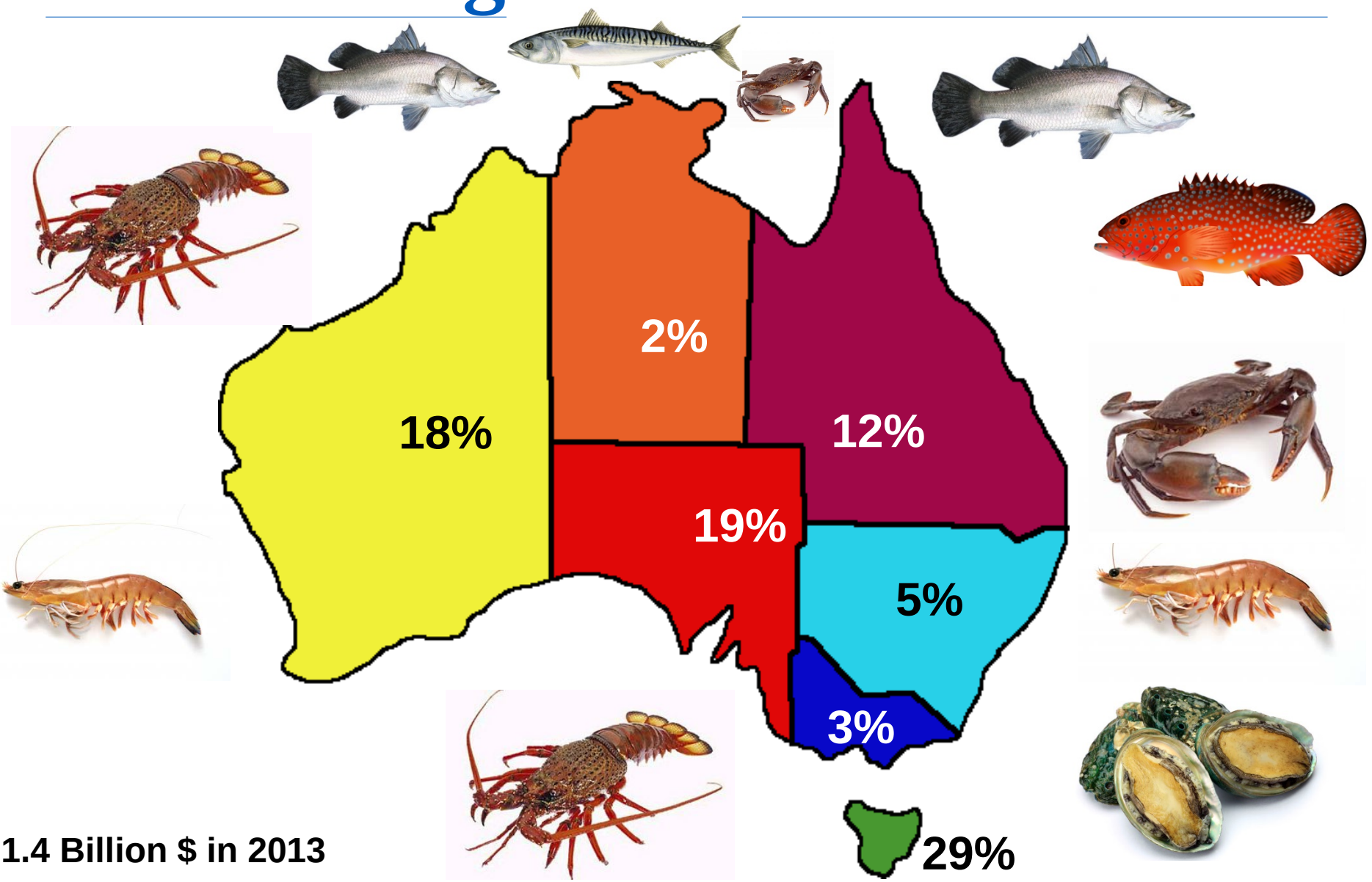
Top five species in Aquaculture



- Salmonids
- Tuna
- Pearl Oysters
- Edible Oysters
- Prawns

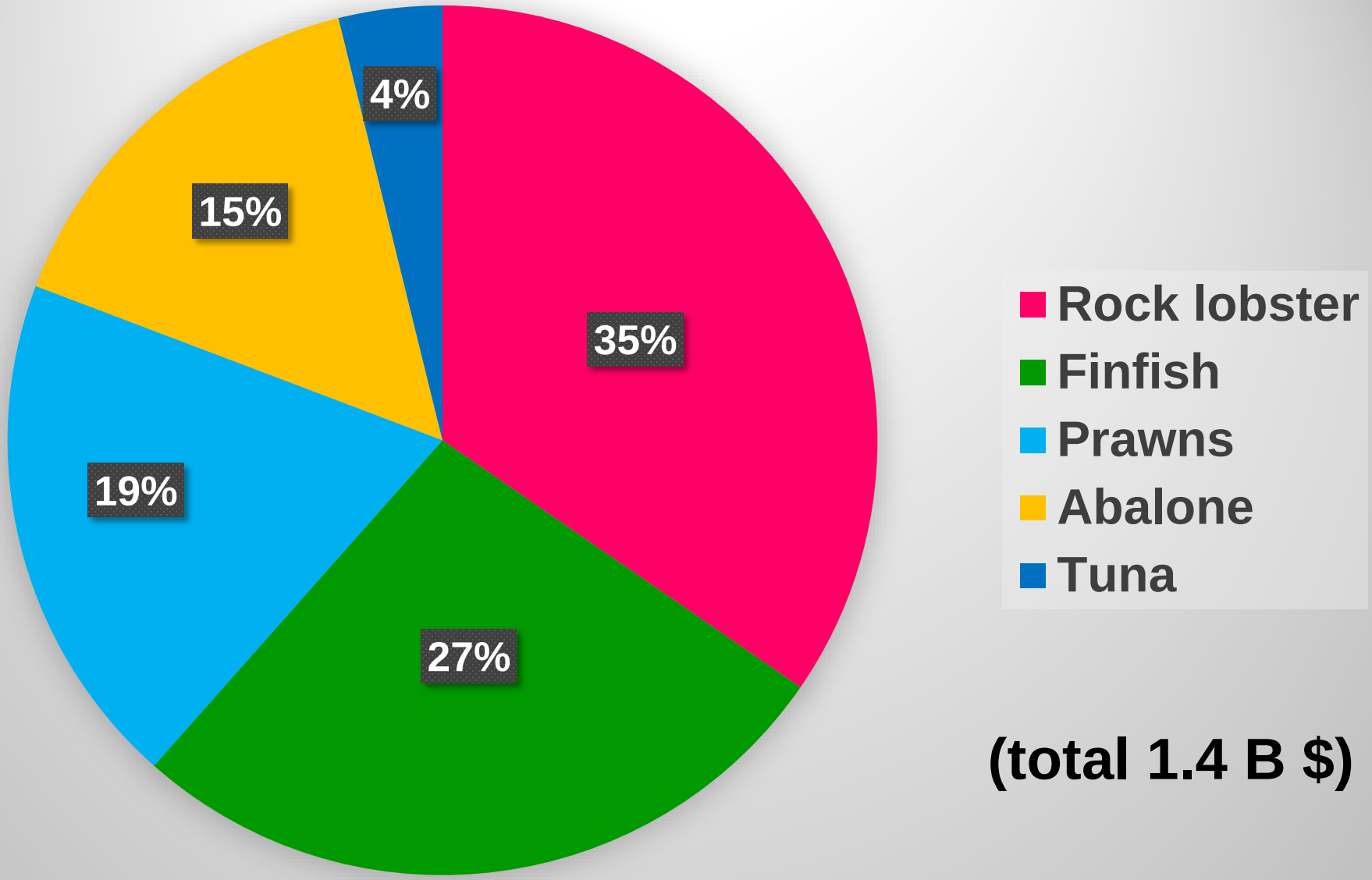
(total 1 B $)

Wild caught Australia



1.4 Billion $ in 2013

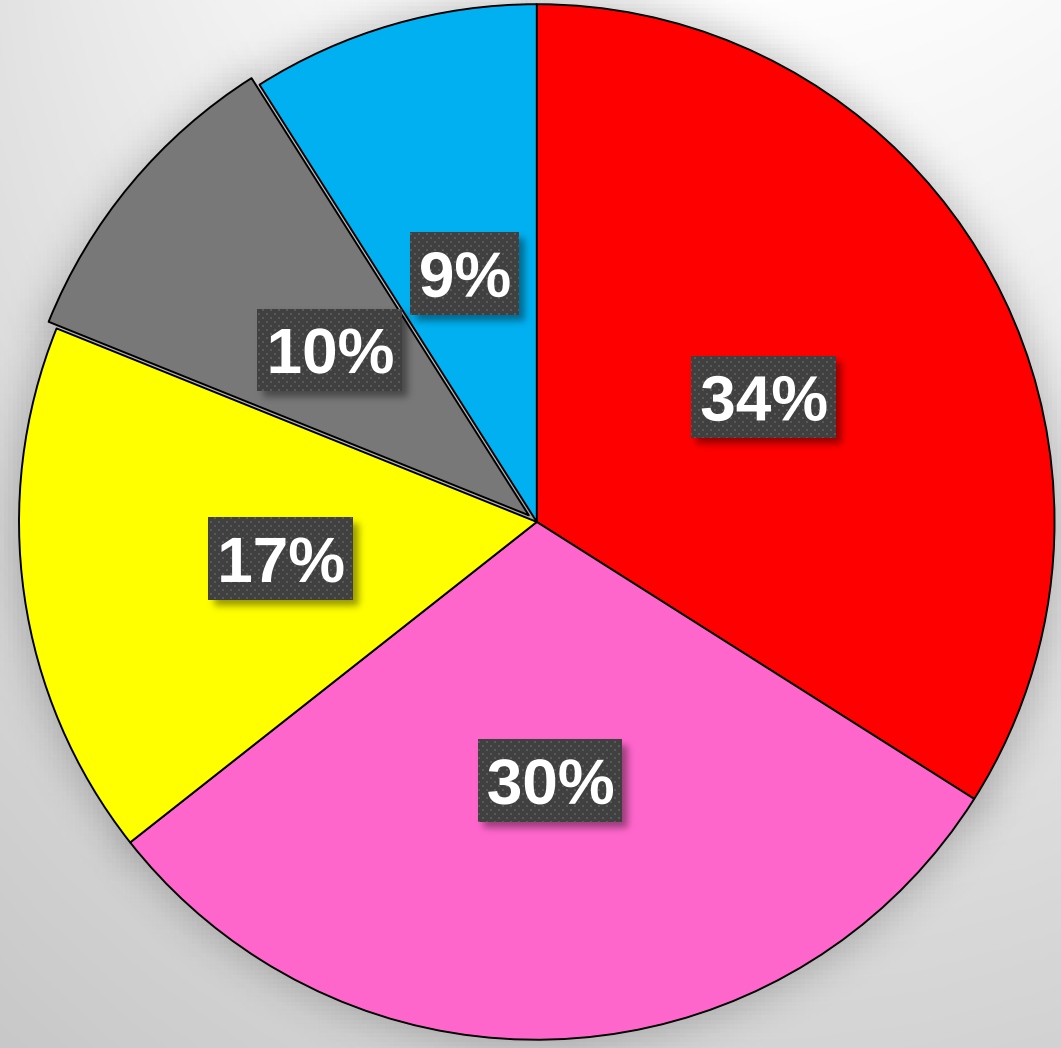
Top five species wild caught



(total 1.4 B $)

Top five species by weight

(total 126.466 tonnes)



- Salmonids
- Rock Lobster
- Prawns
- Abalone
- Tuna

Aquaculture in Australia

Salmonids: Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*)

Salmon culture is a mature industry. It is focused on the colder waters of Tasmania.

Rainbow trout culture is small and centred in the SE parts of the country

Aquaculture in Australia

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Southern bluefin tuna: (*Thunnus maccoyii*)

The industry is based on wild-capture of small tuna and "fattening" on bait fish in sea cages.

Aquaculture in Australia

Edible oysters: (Pacific- *Crassostrea gigas* & Sydney rock – *Saccostrea glomerata*)

Oyster farming is one of the oldest industries in Australia and is focused on the introduced Pacific Oyster outside of NSW. The industry needs to move to a new phase to overcome disease and environmental problems.

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Pearl oysters: (*Pinctada maxima*)

Cultured on the tropical coast line of northern Australia

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Prawns: (*Penaeus monodon, Marsupenaeus japonicus*)

Prawn farming uses land-based ponds in tropical and warm-temperate Australia. The industry has faced competition from imported product and focuses on high-value niche markets.

Aquaculture in Australia

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Barramundi: (*Lates calcarifer*)

Barramundi aquaculture is a growing industry as it is a hardy fish suitable for cage, pond and tank culture in fresh and salt water. Industries supplying domestic and international markets are developing as the technology for the culture of this species improves.

Aquaculture in Australia

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Redclaw crayfish: (*Cherax quadricarinatus*)

Freshwater crayfish farming is a nascent industry. It has recently overcome technological challenges in the hatchery phase and is moving from extensive farming into more intensive systems.

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Saltwater crocodile: (*crocodylus porosis*)

Small industry based mainly on turism and leather trade. Eggs are often collected from wild nests.

Diseases in Australian Aquaculture

Australia is relatively isolated and has benefited from freedom from serious diseases due to strict biosecurity measures. A few diseases listed by the OIE are present though.

Crustacean diseases listed by the OIE

White Spot Disease
Gill Associated Virus
Infectious Hypodermal and Haematopoietic Necrosis Virus
White Tail Disease

Diseases in Australian Aquaculture

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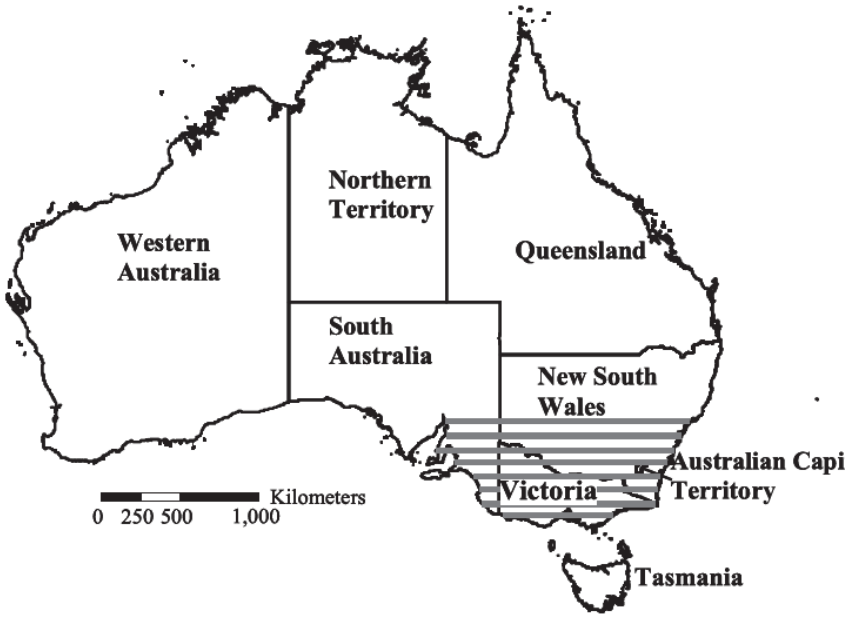
Molluscs

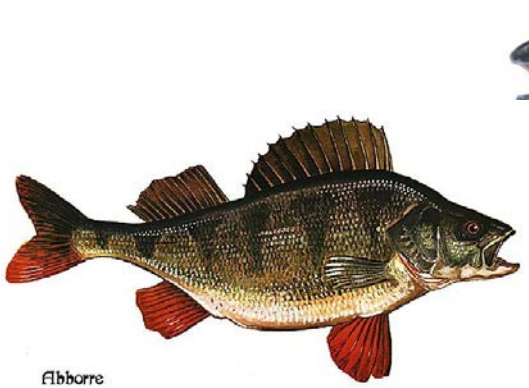
Bonamia Sp
Marteilia sydneyi
Perkinsus olsoni
Abalone viral ganglioneuritis
Pacific Oyster Mortality Syndrome

Fish

Viral Encephalopathy and Retinopathy
Epizootic Ulcerative Syndrome
Epizootic Haematopoietic Necrosis Virus
Edwardsiella ictaluri
Aeromonas salmonicida

Epizootic Haematopoietic Necrosis Virus





- **Restricted to freshwater fish in south-eastern Australia**
- **Sporadic outbreaks since 1984. None in the last 2 years.**
- **Acute, high mortality in wild redfin perch (*Perca fluviatilis*);**
- **Less severe in farmed rainbow trout (*Oncorhynchus mykiss*)**
- **Both natural hosts are introduced species in Australia**

Epizootic Haematopoietic Necrosis Virus

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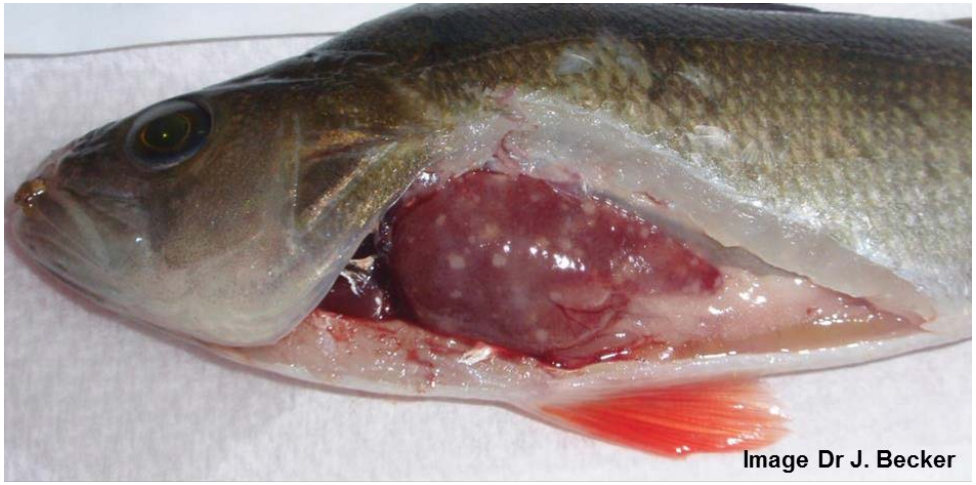
Pathology

Widespread systemic necrosis, most severe in hematopoietic tissues

Grossly: enlarged kidneys and spleen, focal discoloration of liver



Adult redfin perch, experimentally infected with EHNV. Multifocal hepatic necrosis evidenced by areas of pale discoloration in the liver.

Epizootic Haematopoietic Necrosis Virus

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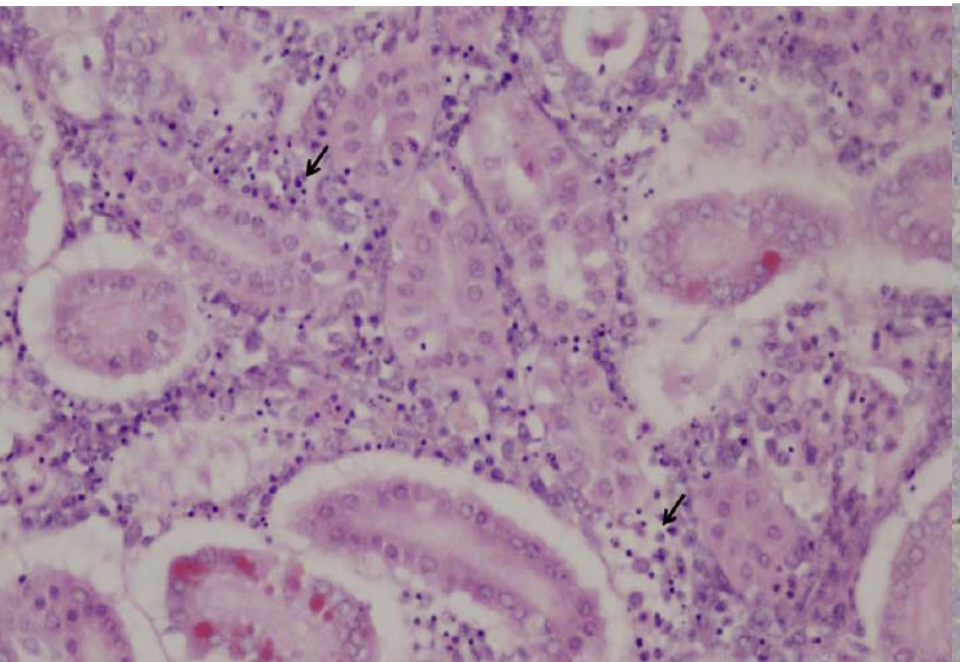
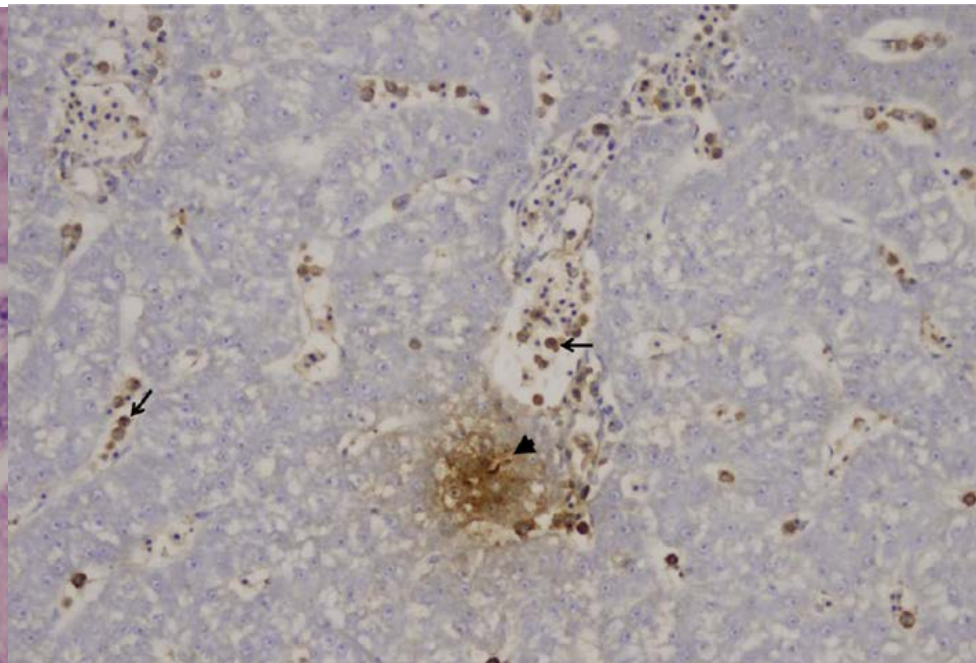
Histopathology

Kidney (H&E). Interstitial necrosis with karyorrhexis and karyolysis, creating a “starry sky” appearance.



Liver (IHC). Dissemination of virus in cells in liver sinusoids



Epizootic Haematopoietic Necrosis Virus

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Isolation in cell culture

EHNV in BF2 cells. Cytopathic effect: focal lysis of the cell monolayer, rounding of cells on the margins of the lytic areas.

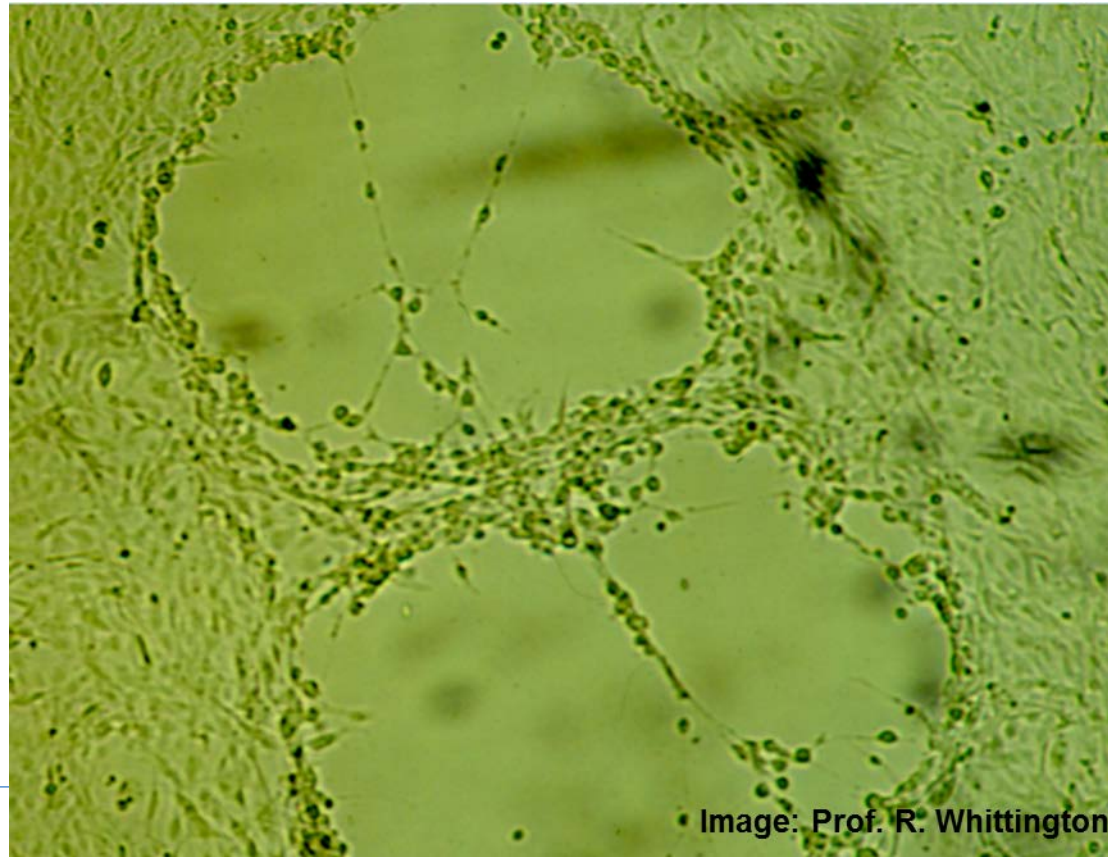

Image: Prof. R. Whittington

Epizootic Haematopoietic Necrosis Virus

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Current research

Whole genome sequence of EHNV isolates collected between 1986 and present showed limited genetic variation within the viral isolates, unlike the larger genetic variation presently being discovered across fish ranaviruses.

Epizootic Haematopoietic Necrosis Virus

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Current Research - Publications past 2 years

1. Ariel E, Steckler N, Subramaniam K, Olesen N and Waltzek T (2016) *Genomic sequencing of ranaviruses isolated from turbot (Scophthalmus maximus) and Atlantic cod (Gadus morhua).* Genome Announcements, 4 (6). pp. 1-2
2. Ariel E, Wirth W, Burgess G, Scott J and Owens L (2015) *Pathogenicity in six Australian reptile species following experimental inoculation with Bohle iridovirus.* Diseases of Aquatic Organisms, 115 (3). pp. 203-212
3. Becker JA, Tweedie A, Gilligan D, Asmus M and Whittington RJ (2016). Susceptibility of Australian redfin perch *Perca fluviatilis* experimentally infected with Epizootic haematopoietic necrosis virus (EHNV). Journal of Aquatic Animal Health 28: 122-130.
4. Duffus ALJ, Waltzek TB, Stöhr AC, Allender MC, Gotesman M, Whittington RJ, Hick P, Hines MK, Marschang RE (2015). Distribution and Host Range of Ranaviruses. In M. J. Gray & V. G. Chinchar (Eds.), Ranaviruses: Lethal Pathogens of Ectothermic Vertebrates (pp. 9-58) Springer Open. DOI 10.1007/978-3-319-13755-1.
5. Forzán M, Jones K, Vanderstichel R, Wood J, Kibenge F, Kuiken T, Wirth W, Ariel E and Daoust P (2015) *Clinical signs, pathology and dose-dependent survival of adult wood frogs, Rana sylvatica, inoculated orally with frog virus 3 Ranavirus sp., Iridoviridae.* Journal of General Virology, 96 (5). pp. 1138-1149
6. Gray , Matthew J., Brunner, Jesse L., Earl, Julia E., and Ariel, Ellen (2015) *Design and analysis of ranavirus studies: surveillance and assessing risk.* In: Gray, Matthew J., and Chinchar, V. Gregory, (eds.) Ranaviruses: lethal pathogens of ectothermic vertebrates. Springer, Heidelberg, Germany, pp. 209-240.
7. Hick P, Ariel E and Whittington R (in press) Epizootic Hematopoietic Necrosis and European Catfish Virus. In: Woo PTK (ed) Fish Viruses and Bacteria: Pathobiology and Protection, CABI
8. Hick PM, Subramaniam K, Thompson P, Whittington RJ, Waltzek TB. (2016) Complete genome sequence of Bohle iridovirus from ornate burrowing frog (*Limnodynastes ornatus*) in Australia. Genome Announcements, Issue 4.
9. Hick, P.M., Becker, J.A., Whittington, R.J., (2016). Chapter 8. Iridoviruses of Fish. In: Kibenge, F.S.B., Godoy, M. (Eds.), Aquaculture Virology. Elsevier Inc. http://dx.doi.org/10.1016/B978-0-12-801573-5.00008-5.
10. Holopainen, Riikka, Subramaniam, Kuttichantran, Steckler, Natalie K., Claytor, Sieara C., Ariel, Ellen, and Waltzek, Thomas B. (2016) *Genomic sequence of a ranavirus isolated from pike-perch Sander lucioperca.* Genome Announcements, 4 (6). pp. 1-2.
11. Kawato Y, Subramaniam K, Nakajima K, Waltzek T and Whittington R (2016) Chapter 12. Iridoviral Diseases (Red Sea Bream Iridovirus and White Sturgeon Iridovirus). In: Woo PTK and Cipriano RC (eds), Fish Viruses and Bacteria: Pathobiology and Protection. CABI, Oxfordshire, UK.
12. Miller, D.L., Pessier, A.P., Hick, P., Whittington, R.J., 2015. Comparative Pathology of Ranaviruses and Diagnostic Techniques. in: Gray, J.M., Chinchar, G.V. (Eds.), Ranaviruses: Lethal Pathogens of Ectothermic Vertebrates. Springer International Publishing, Cham, pp. (171-208).
13. Subramaniam, Kuttichantran, Toffan, Anna, Capellozza, Elisabetta, Steckler, Natalie K., Olesen, Niels J., Ariel, Ellen, and Waltzek, Thomas B. (2016) *Genomic sequence of a ranavirus isolated from short-finned eel (Anguilla australis).* Genome Announcements, 4 (4). pp. 1-2.

Epizootic Haematopoietic Necrosis Virus

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OIE listing

- EHNV risk for fish in other countries is sufficient to warrant listing by the World Organisation for Animal Health (OIE)
- However, European redfin perch and rainbow trout do not appear to be as susceptible to EHNV.
- Risk to aquaculture and conservation based on experimental evidence of susceptibility of some native Australian species
- OIE Reference Laboratory supplies reagents: control material for molecular tests, antibodies and antigen for ELISA, serology and IHC