Fred Kibenge

University of Prince Albert Island
Canada

Dr. Fred Kibenge is a professor of virology and chairman of the Department of Pathology and Microbiology at the Atlantic Veterinary College, University of Prince Edward.

Kibenge has studied infectious salmon anemia since its first occurrence in eastern Canada in 1997.

His laboratory confirmed the first occurrence of ISA in farmed Atlantic salmon in Chile in July 2007, and characterized the virus responsible for the 2007-2010 ISA epizootic in Chile.

Worldwide Update on Infectious Salmon Anaemia (ISA):

Efforts to Successfully Manage ISA

Fred S.B. Kibenge[1], Marcos G. Godoy[2] & Molly J.T. Kibenge[1]

Prologue

- **Aquaculture is a millennia-old industry practiced at many levels; it is a journey, not a destination.**
- Viruses are the principal pathogens that are negatively impacting aquaculture.
- The aquatic environment poses a number of unique challenges when it comes to dealing with viral diseases such as ISA:
- Lack of physical barriers to wild fish populations (which act as pathogen reservoir for farmed fish) ……means biosecurity can never be absolute.
- Pathogen eradication is unlikely to be successful.
    - Vaccination & breeding for resistance may be the only sustainable methods for controlling viral diseases in aquaculture.

ISA-At-A-Glance

- ISA emerged in Norway in 1980s.
- Prolonged ISA outbreaks in Norway, North America (Eastern Canada & Maine) and Chile.
- Successful ISA eradication in Scotland following two independent emergences (1998 & 2009).
- ISA eradicated in Faroes Islands following collapse of industry (2000-2005).

Global Economic Losses Due to ISA

- **ISA is arguably the most important viral disease of marine-farmed Atlantic salmon**
- Norway: 1 billion KR/yr.
- Canada:
    - New Brunswick: Can$80 million in 2006
    - PEI:……in 2009
    - Nova Scotia:….. in 2012
    - Newfoundland:….. in 2012 & 2013
        - Depopulated 1.8 million yearling fish are sent to rendering plant for animal feed
        - Loss of millions of $$$$
        - Loss of markets for the following year when fish would have reached market size
        - Cost of disinfection of pens (netpens have to be removed from the water & site fallowed for 3-6 months) .
        - Costs for enhanced diagnostic and surveillance efforts.

Global Economic Losses Due to ISA

- Scotland: £37-100 million in 1999; ??? in 2009.
- Faroe Islands (2001-2003): $60 million.
- United States 2001: US$8.3 million from USDA + $12 million from industry in 2001.

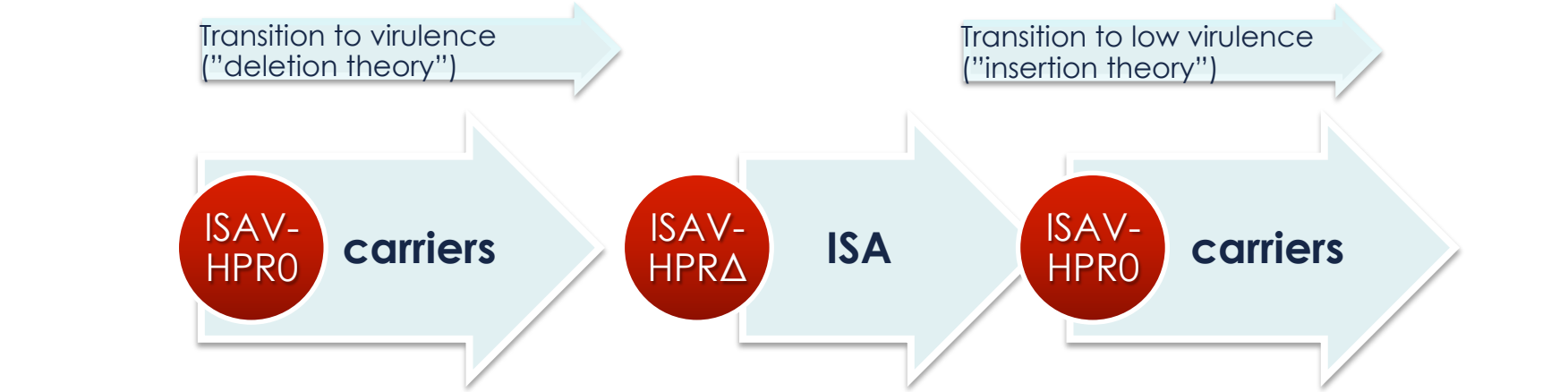
Global Economic Losses Due to ISA

- Chile, July 2007-September 2010 outbreak:
  - 2007: 9% reduction in US$2.24 billion industry (i.e., $20 million) & ~3.0% reduction in workforce;
  - 2009: ~60% drop in Atlantic salmon production (from peak of ~400,000 tons before ISA crisis)
  - Projected losses for 2007-2011 were ~$1 billion (i.e., 50% of the economic value of the industry);
  - Full recovery of industry not before 2013.
- Chile, 2013 outbreaks:

2013 Outbreaks:	April 2013 (ISA)	April 2013 (ISA)	May 2013 (ISAV)*
# Fish affected:	941,993	790,000	904,829
% mortality/week:	0.31	2.16	0.14
ISAV-HPR:	HPR3	HPR14	HPR3
Action taken:	Emergency harvest	Emergency harvest	Emergency harvest

***Not ISA outbreak although ISAV HPR3 was detected.**

Where is ISAV in the Salmon Industry?



Natural asymptomatic infection:
-Farmed Atlantic salmon
-Wild salmonids (Atlantic salmon, brown trout, sea trout)
-Other wild fish?
--Some wild aquatic animal?

Natural disease occurs in farmed Atlantic salmon
-Experimental disease produced in Rainbow trout

ISAV-HPRΔ introduced to Chile

HPR0 viruses are detected late during ISA outbreaks and persist long after disease is contained or eradicated:
-Recovered Atlantic salmon
-Wild salmonids
-Other wild fish?
-Some wild aquatic animal?

ISA – Control and Prevention

- Vaccination
  - Vaccination is used in North America (New Brunswick & Maine) since 1999, and in Faroe Islands since 2004 with questionable results
    - inactivated whole virus vaccines do not give sterile immunity, and vaccinated fish may become virus carriers.
      - level of protection is correlated to amount of ISAV antigen in vaccine (RPS of 86% has been achieved).
  - Vaccination was allowed in most parts of Norway in 2010
  - Vaccination is used in Chile since 2010
    - high demand for ISA vaccines has resulted in improved vaccine products (at least 6 different ISA vaccine products are currently marketed in Chile).
  - Efficacy of ISA vaccines in presence of the wide spread HPR0 infections is not known.

Conclusions

- The salmon farming industry in Chile rapidly responded and dealt with two ISAV outbreaks in April 2013, demonstrating that it has benefited from the lessons learned from the original outbreak.
- The biggest challenge to the Atlantic salmon industry worldwide is how to deal with the non-pathogenic variant ISAV HPR0 that exists in the wild fish reservoir in the same water column.
  - The ultimate solution is to come up with a robust vaccine that can protect against all ISAV strains including non-pathogenic strains.
- The genetic diversity of ISAV needs more study in order to understand how the virus evolves in the aquatic environment.
- Further reading: Kibenge *et al.,* 2012. Countermeasures against viral diseases of farmed fish. Antiviral Research 95:257-281.

  http://www.sciencedirect.com/science/article/pii/S0166354212001441