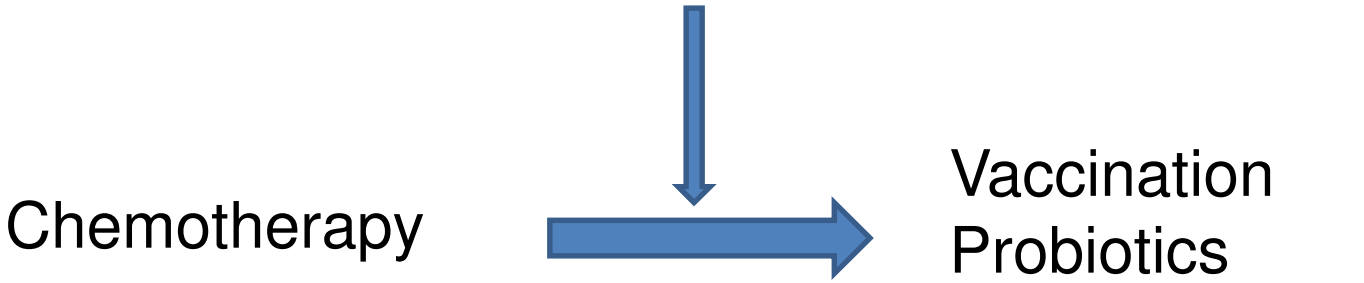
Possibility of disease control by ambient dissolved oxygen level

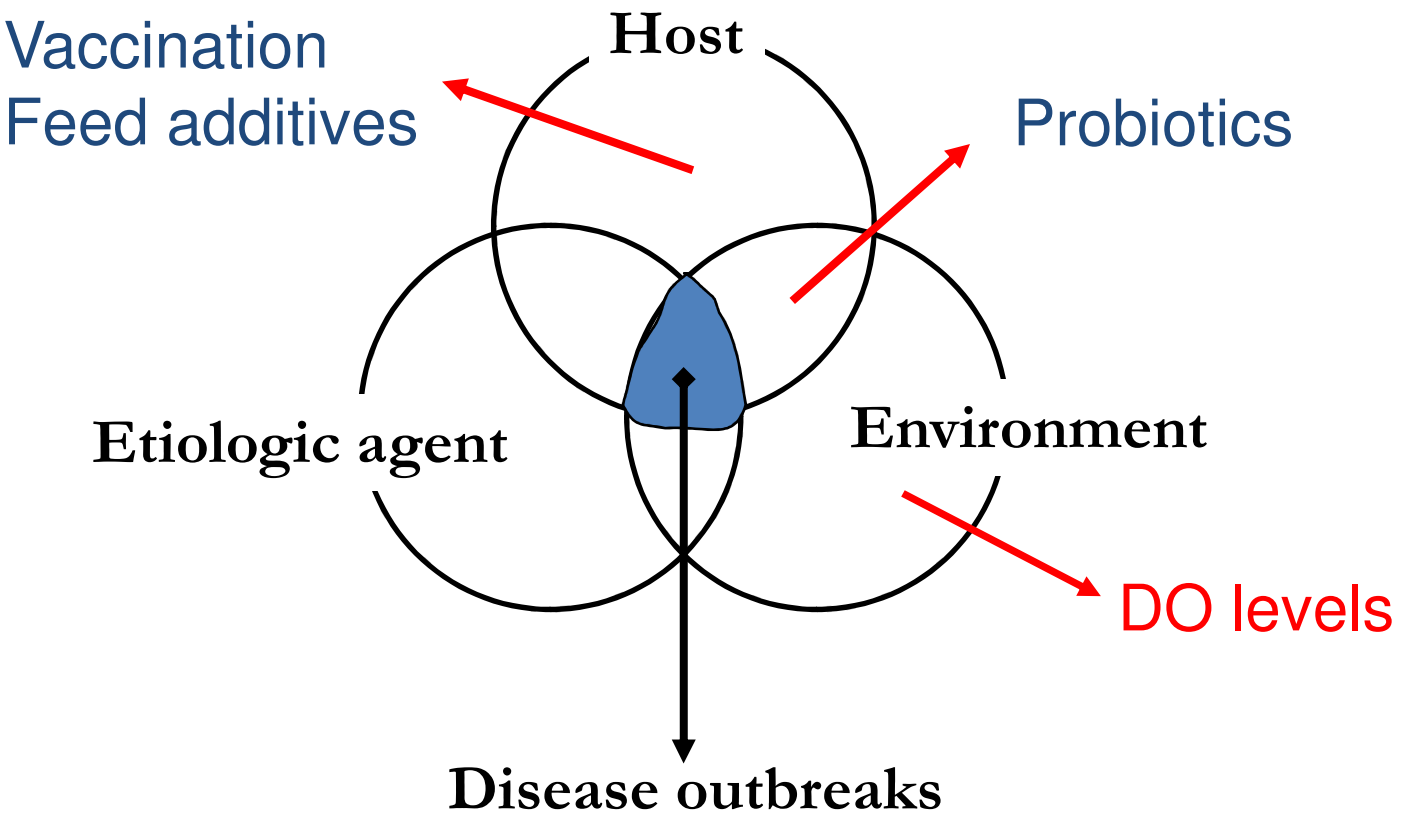
Masashi Maita
Tokyo University of Marine Science and Technology
Japan

Counter measures against infectious diseases in Aquaculture

Food safety issues by drug residues



Concept of disease outbreaks in farmed fish

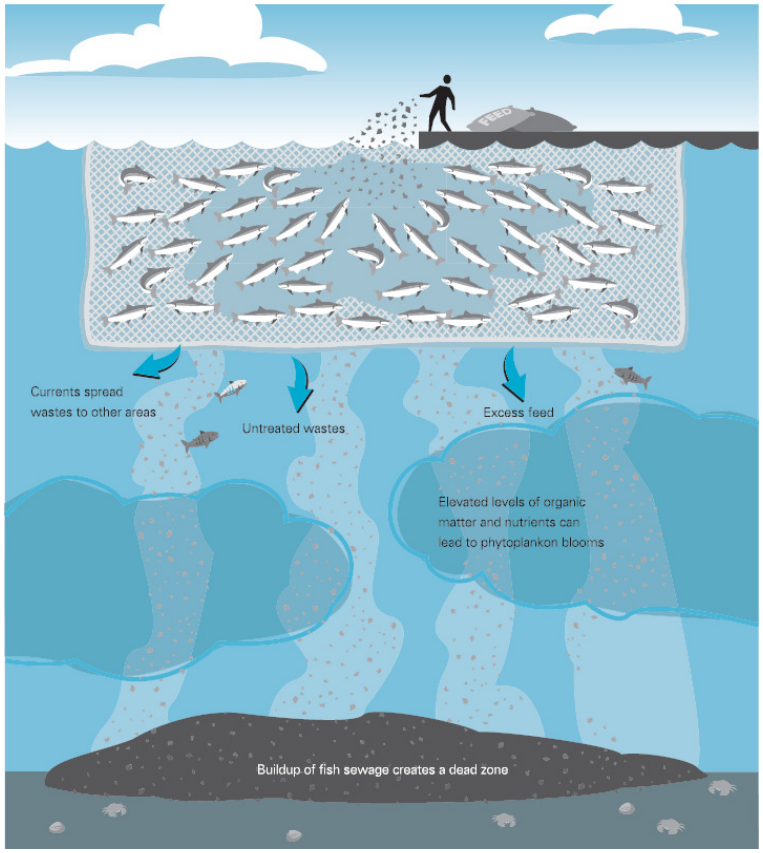


(Snieszko, 1974)

Hypoxia and infectious diseases

- Hypoxia (including Low Oxygen uptake by gill damage) are extremely common in aquaculture systems.
- Low dissolved oxygen in water has brought high mortality due to infectious diseases.

  (Fukuda *et al*. 1997; Walter & Plumb 1980; Mqolomba & Plumb 1992; Caldwell & Hinshaw 1995).



Author and year	Finding
Fukuda, Maita *et al*. 1997	Influence of **dissolved oxygen** concentration on **mortality** of **yellowtail** experimentally infected with *Enterococcus seriolicida*
Scapigliati *et al*.,1999	**Hyperoxygenation** of sea water resulted in **a two-fold increase of immunoglobulins** of **sea bass** compared to running seawater.
Barton, 2000	**Hypoxia** is strong enough to **alter homeostatsis** of fish, more **energy** in fish body might be **allocated** for **maintain integrity** and **less will be remain for immunity**
Boleza et al.,2001	**Hypercapnic hypoxia compromises bactericidal activity** of fish anterior **kidney cells** against opportunistic environmental pathogens
Cecchini and Saroglia, 2002	**Specific antibody response** of sea bass against **human-γ-globulin** was **reduced after hypoxia exposure** than fish in hyperoxia or normoxia
Welker *et al*., 2007	**Sub lethal hypoxia compromises immune response** of channel cat fish and **increase susceptibility** to Enteric septicemia
Choi *et al*., 2007	**Acute hypoxia compromises immunity** of fish

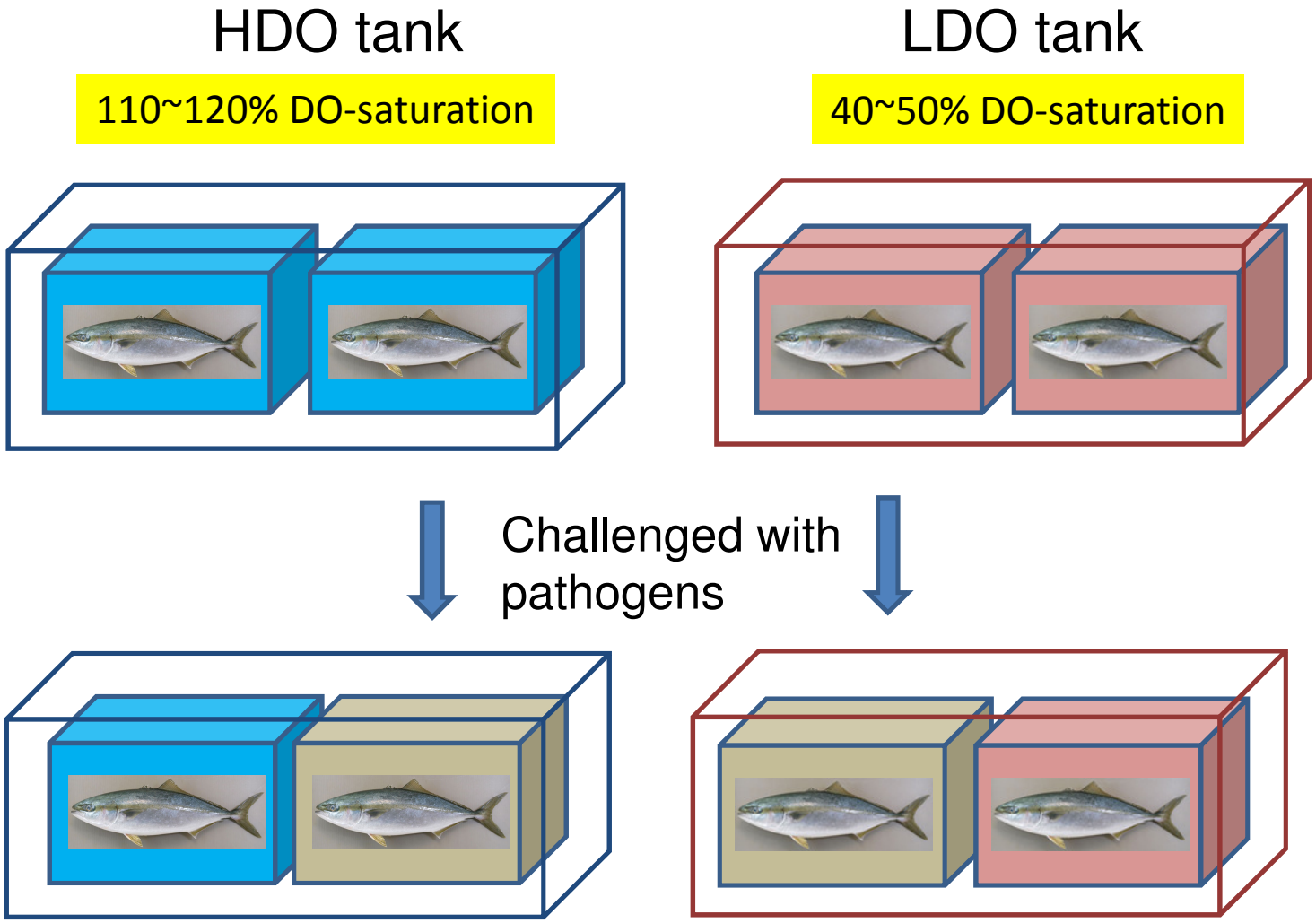
In human, it is well known that the oxygen-dependent bactericidal activity plays an important role to protect from bacterial infection (Johnston *et al*. 1975) and decreased environmental oxygen inhibits the NBT reduction activity, production of reactive oxygen species and the respiratory burst of leukocytes (Jarstrand *et al*. 1989; Gabig *et al*. 1979).

Objective of this study

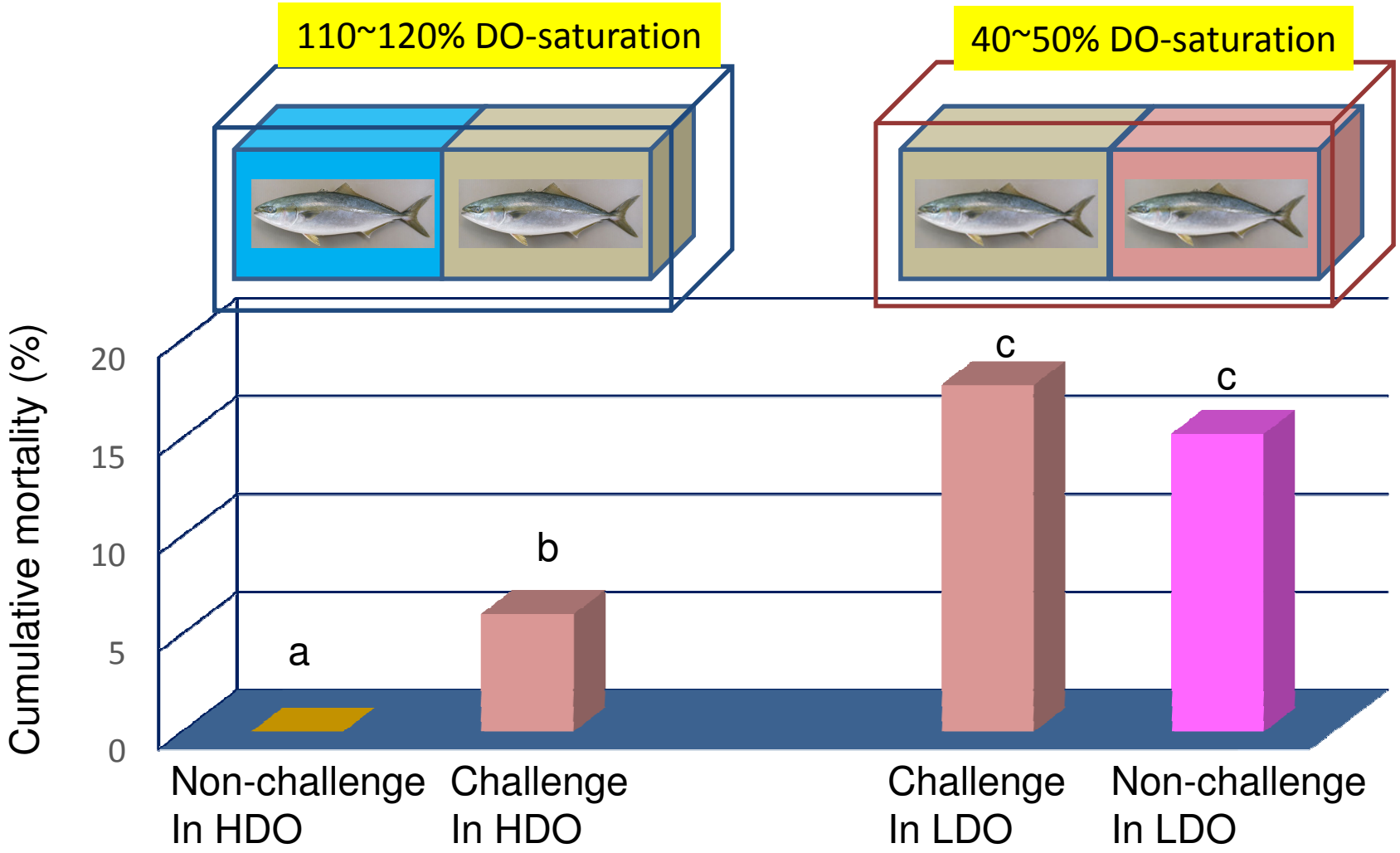
To investigate the effects of **Hypoxia , Hypoxia –reperfusion** **on mortality and immune response** in fish and find the possibility of disease control by ambient oxygen management.

Notify:

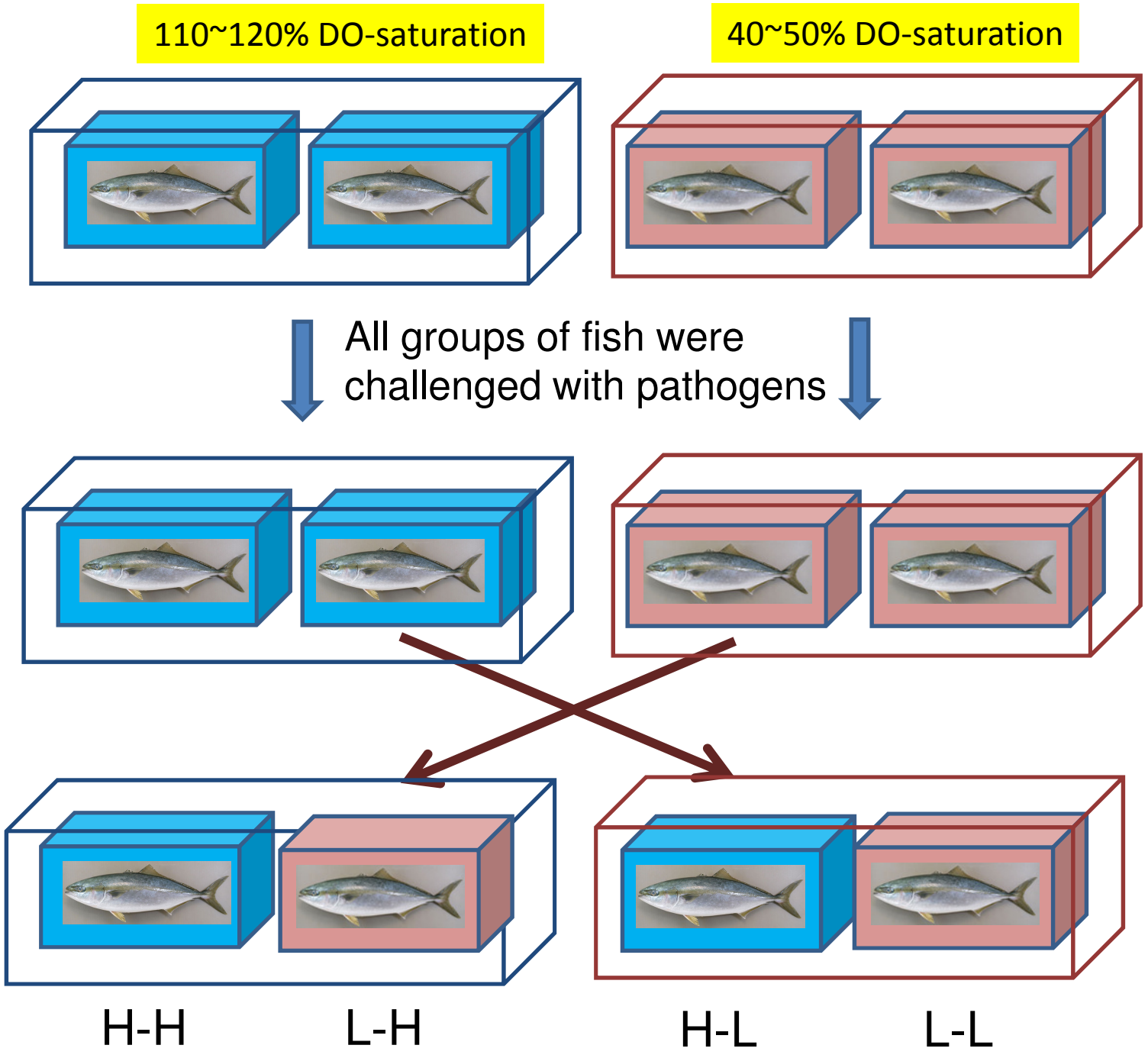
In this study Hypoxia is defined as “low oxygen level (50% DO saturation) where no physiological or behavioral changes could observe”

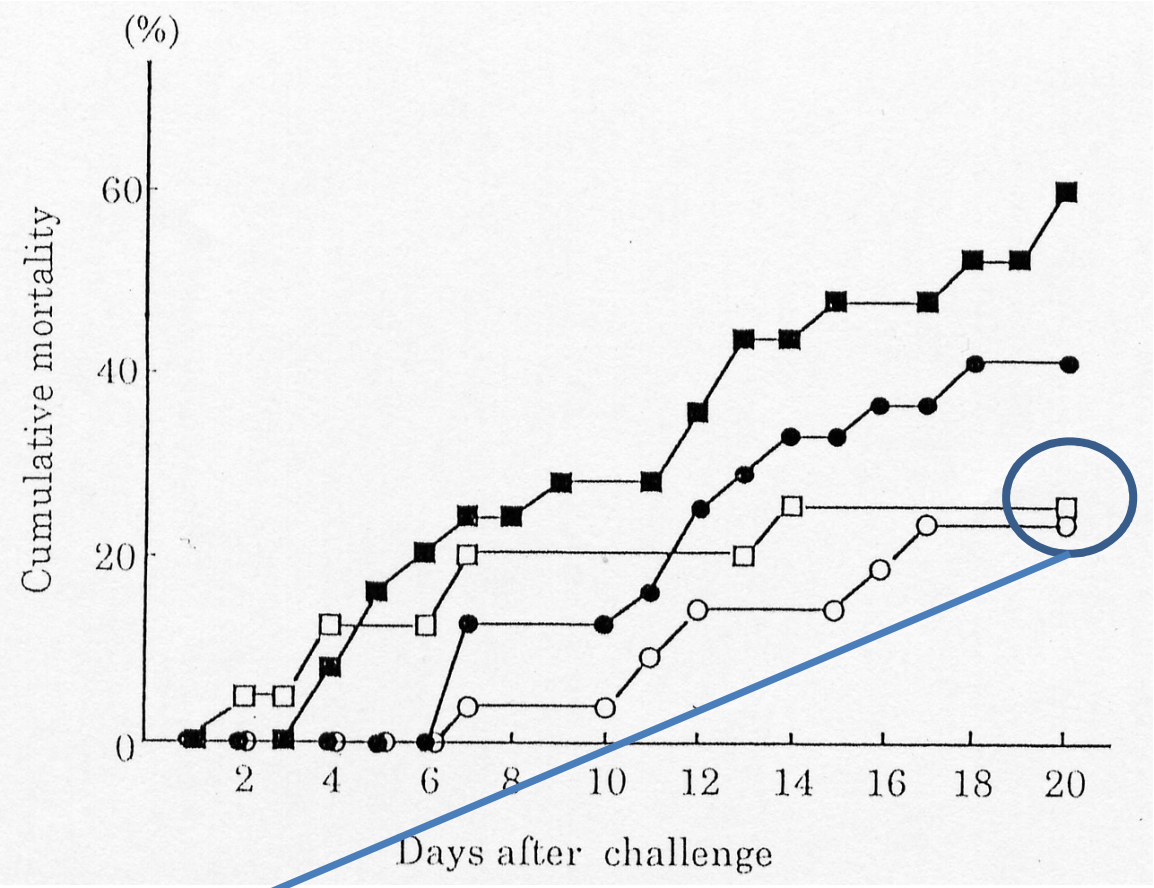


Challenged fish and non-challenged fish were cohabited in same tank.



- Mortality due to experimental challenge in LDO was significantly higher.
- **Horizontal transmission was easy to occur in moderate hypoxic condition.**


110~120% DO-saturation
40~50% DO-saturation
All groups of fish were challenged with pathogens
H-H
L-H
H-L
L-L



Mortality of infected fish that were transferred to the hyperoxic condition were significantly lowered.

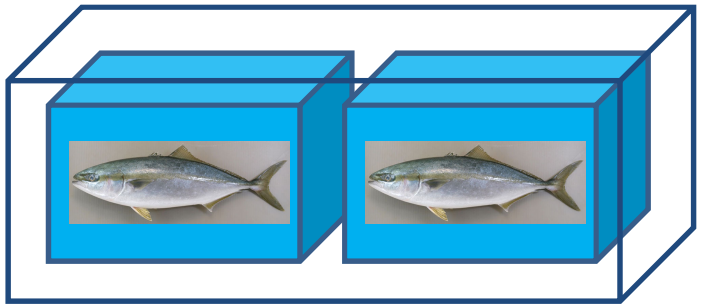
Infected fish reared in hypoxic condition would cause high mortality but the mortality could lowered by transfer to hyperoxic condition.

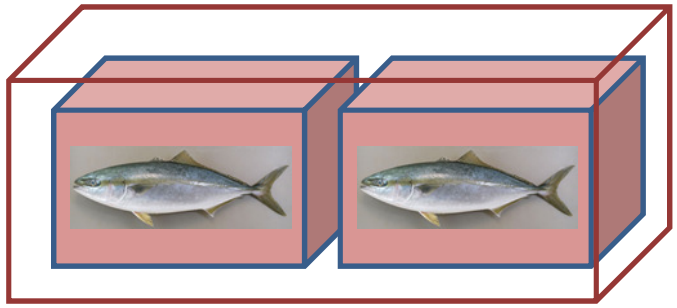
HDO tank

110~120% DO-saturation

LDO tank

40~50% DO-saturation

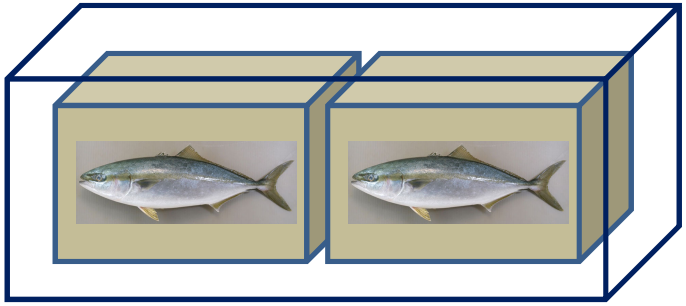


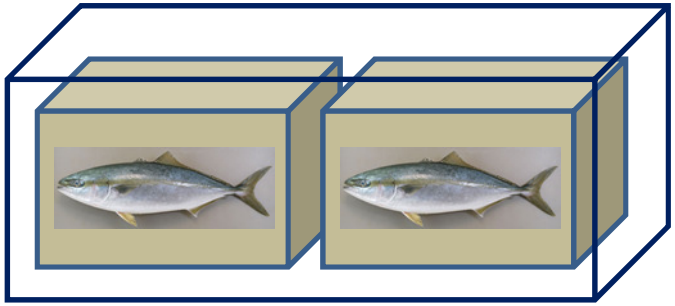


Decrease 40-50% saturation

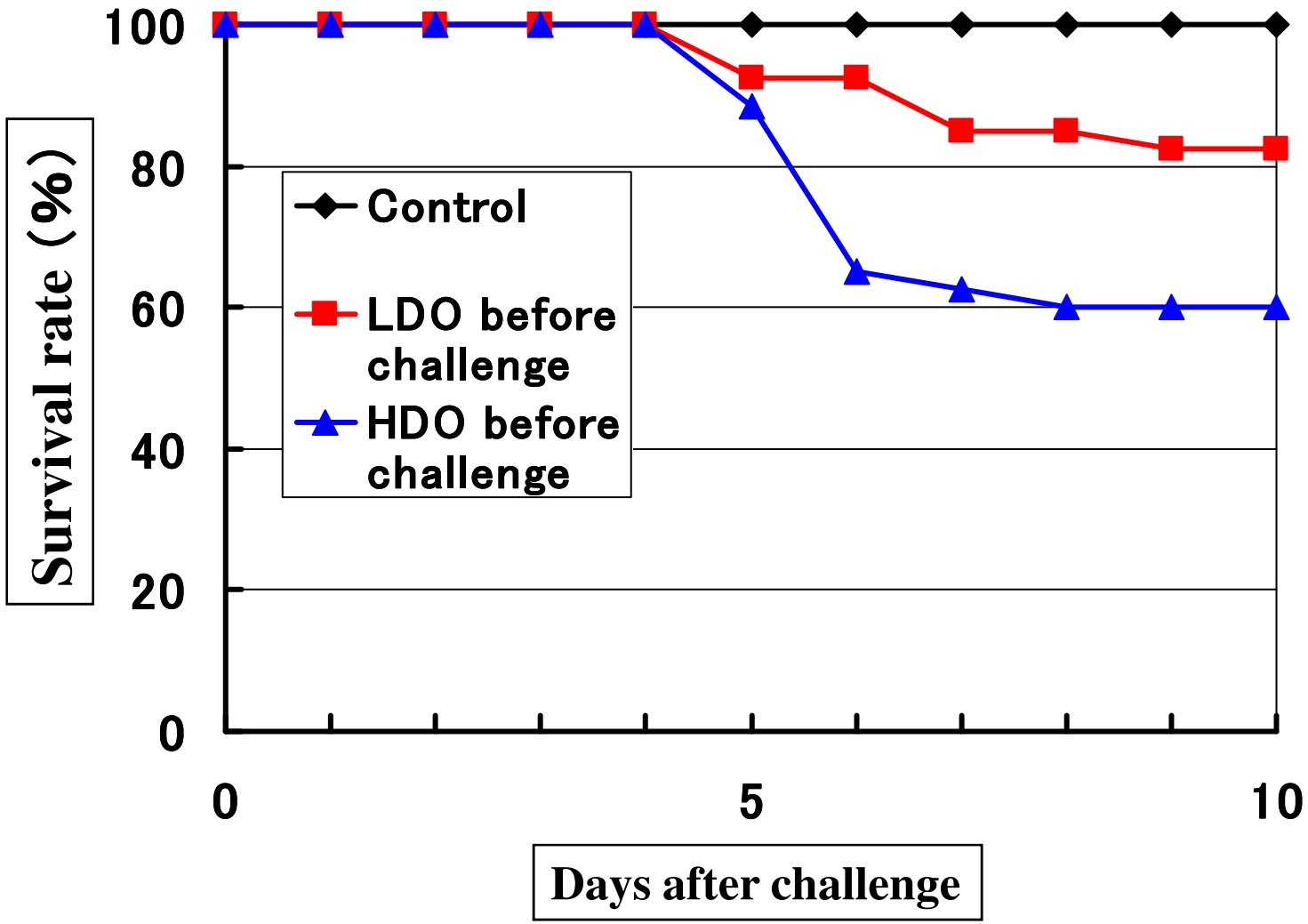
Challenged with pathogens

Increase 40-50% saturation



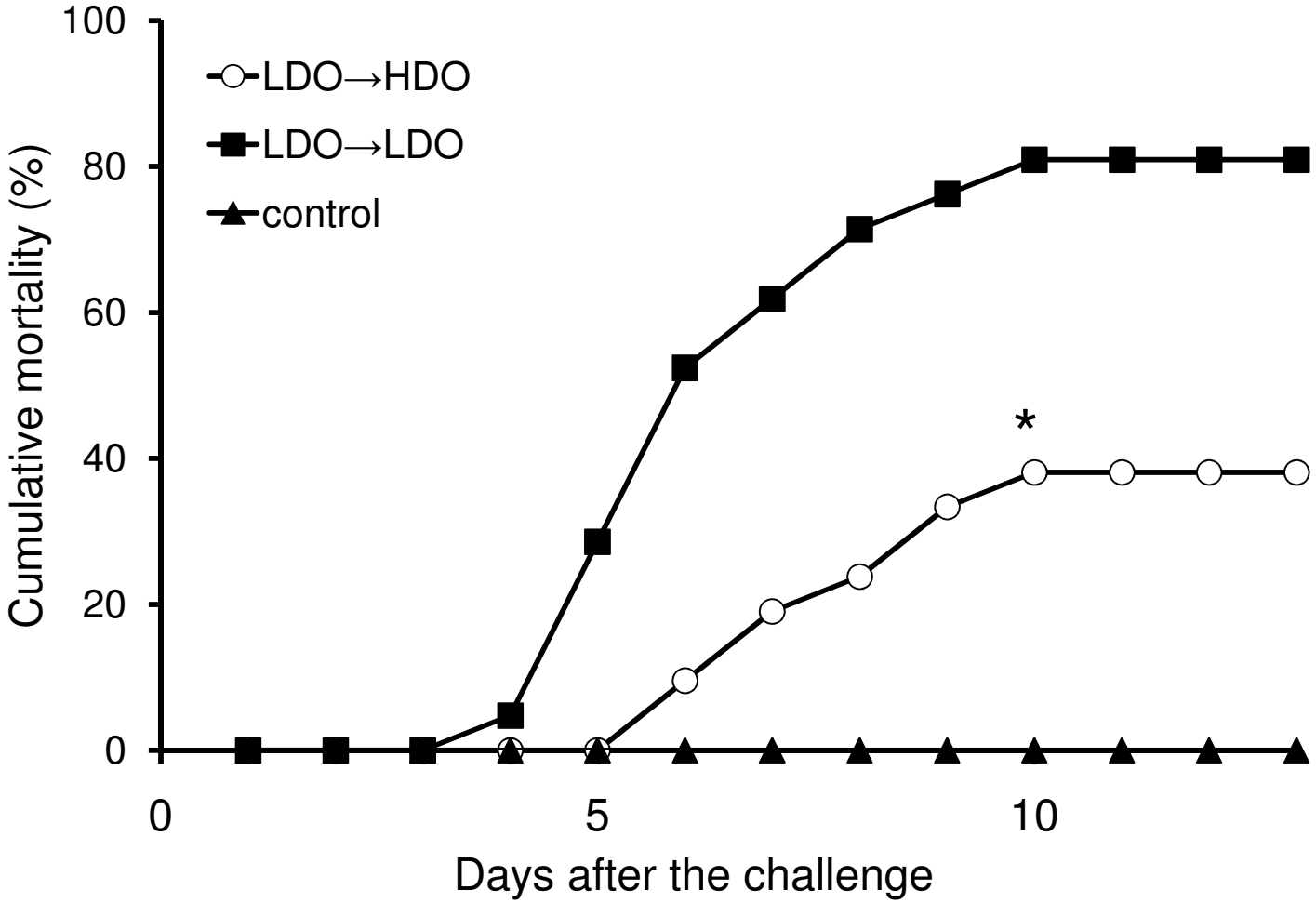


Both group of fish were reared at normoxic tank (80~90% saturation).



If the dissolved oxygen level after infection maintain higher than acclimated level, the mortality could be decreased.

Cumulative mortality of rainbow trout challenged with *Vibrio anguillarum*



Recommendation

- The dissolved oxygen levels in rearing water should monitor frequently to know the oxygen levels that fish are acclimated.
- If a few diseased fish are found, oxygen should be supply into the water.

Awaiting solution

- Optimum farm management procedure on dissolved oxygen should be established.
- Suitable equipment of oxygen supply should be developed.

Practical use of oxygen generator