Larvi '09 –Fish and Shellfish Larviculture Symposium
(Ghent, Belgium)

A review of the broodstock management and larviculture of the Pacific northern bluefin tuna in Japan

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Location of tuna farming and breeding sites in Japan
JAPAN
: Tuna Farm
: Spawning site
Tokyo Sea Life Park (aquarium)
Wakayama Pref.
Kinki University
Nansei Archipelago
Amami Island
Fisheries Research Agency
Okinawa Island
Image NASA
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History on broodstock management and spawning of PBT in captivity in Japan

1970 ~ Research on broodstock management and farming of bluefin tuna in Japan has been at the forefront of the world since 1970 thanks to the federal and prefectural governments and universities in a national project intended to optimize productivity of the sea around Japan. Broodstock management of PBT has become possible by using large sea-pens for growing (Kumai and Miyashita, 2003).

1979 ~ Kinki Univ. had succeeded in the first spontaneous spawning of the world by broodstock of 5 year-old PBT in captivity and larviculture has started since then. After spawning in Kinki University in 1980 and 1982, no spawning occurred until 1994.

1986~ Maruha Nichiro Holdings, Inc. (MNH) (1987~) and Nippon Formula Feed Manufacturing Company, Ltd. (NFFMC) (1986 ~) became involved in broodstock management and succeeded in the spawning of 4 year-old broodstock in 1992.

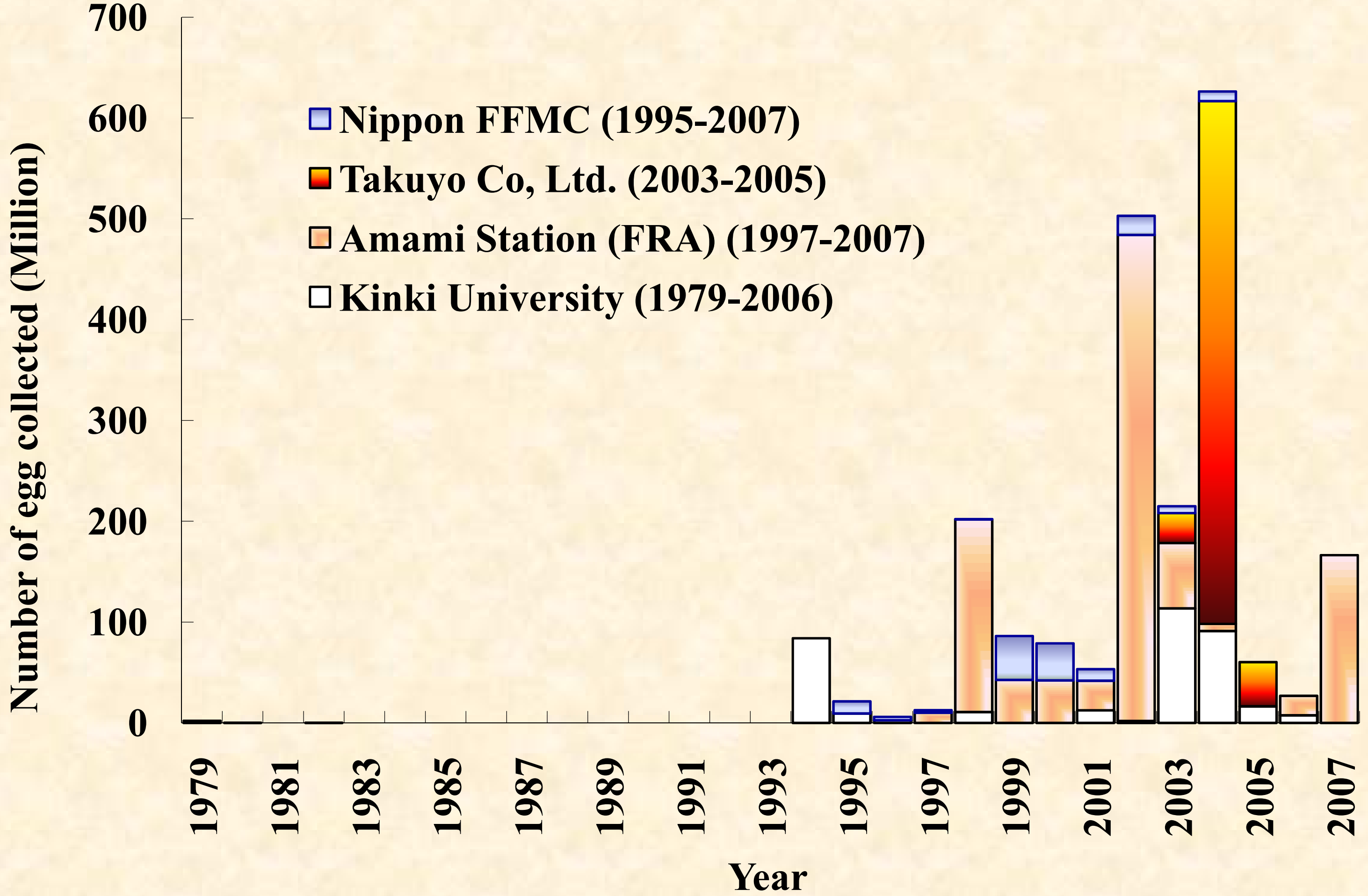
1997 ~ FRA, Amami station (formerly JASFA) has succeeded in the spawning ever since.

1999 Aquarium of Tokyo sea life park has succeeded in the spawning, and no spawning occurred until 2007.

2003 ~ 3 year-old broodstock in tuna farming pens spawned at Takuyo Co., Ltd. in Amami.

2006 ~ Successful spawning of bluefin tuna aged over 3 year-old of broodstock and farming tuna has been reported from several sites.

Number of PBT eggs collected in captivity in Japan



These data were kindly provided from Nippon FFMC, Takuyo Co., Ltd., and Fisheries Laboratory of Kinki University

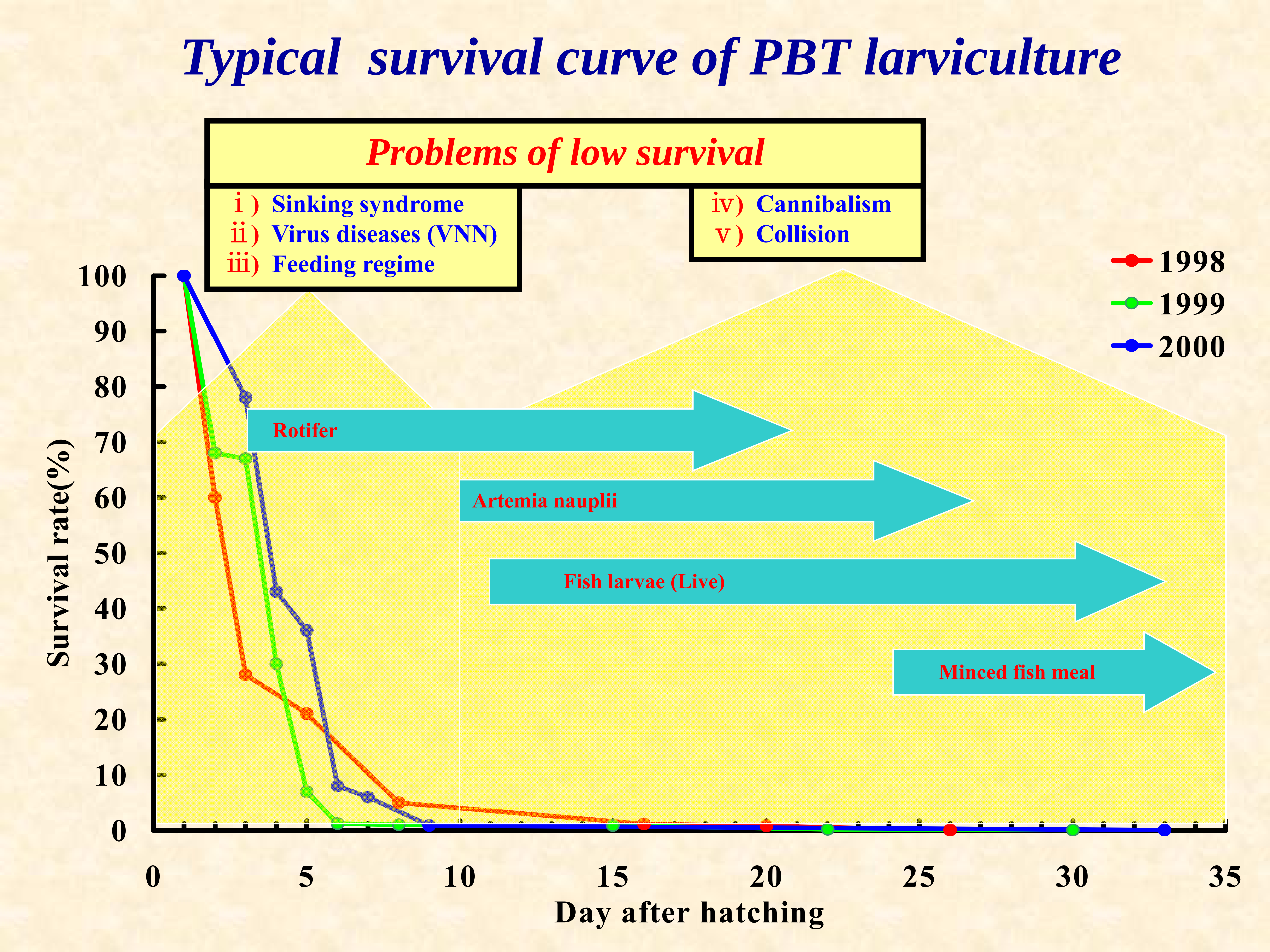
View on Broodstock Management for Spawning of PBT in captivity

» **Environmental factors related to successful spawning of PBT in Japan would be a change and range of ambient temperature over time. From results so far, appropriate sites for spawning of PBT could be around the Amami island waters due to the occurrence of favorable change and range of WT over time for maturation and stimulating a start of spawning. If water temp. does not rise on time, spawning will be late or perhaps not at all (Masuma, 2006).**

» **Age at first spawning for PBT is over 3 years-old at the earliest with good condition for spawning. Older PBT in captivity would become easier to spawn than younger fish. This view suggests the necessity for extending the rearing period of broodstock in order to produce eggs on a stable schedule every year in captivity.**

» **Therefore, important factors for successful spawning of PBT would be a location where proper management in the favorable environments for spawning is possible such as the accommodation and food.**

» **However, the present status of the egg collection from PBT in Japan is still unstable because PBT spawning is easily affected by WT and the broodstock maturity rate in captivity is low (Seoka et al., 2008) .**



Typical survival curve of PBT larviculture
Problems of low survival
i) Sinking syndrome
ii) Virus diseases (VNN)
iii) Feeding regime
iv) Cannibalism
v) Collision
1998
1999
2000
Rotifer
Artemia nauplii
Fish larvae (Live)
Minced fish meal
Survival rate(%)
100
90
80
70
60
50
40
30
20
10
0
0
5
10
15
20
25
30
35
Day after hatching

i) *Sinking syndrome*

» **We observed in 2000 that larvae sank to the bottom of a small tank at night (Masuma, 2008). Additionally, we experienced that the larvae often died during the night.**

» **The diel body density change of larvae was examined (Takashi et al., 2006).**

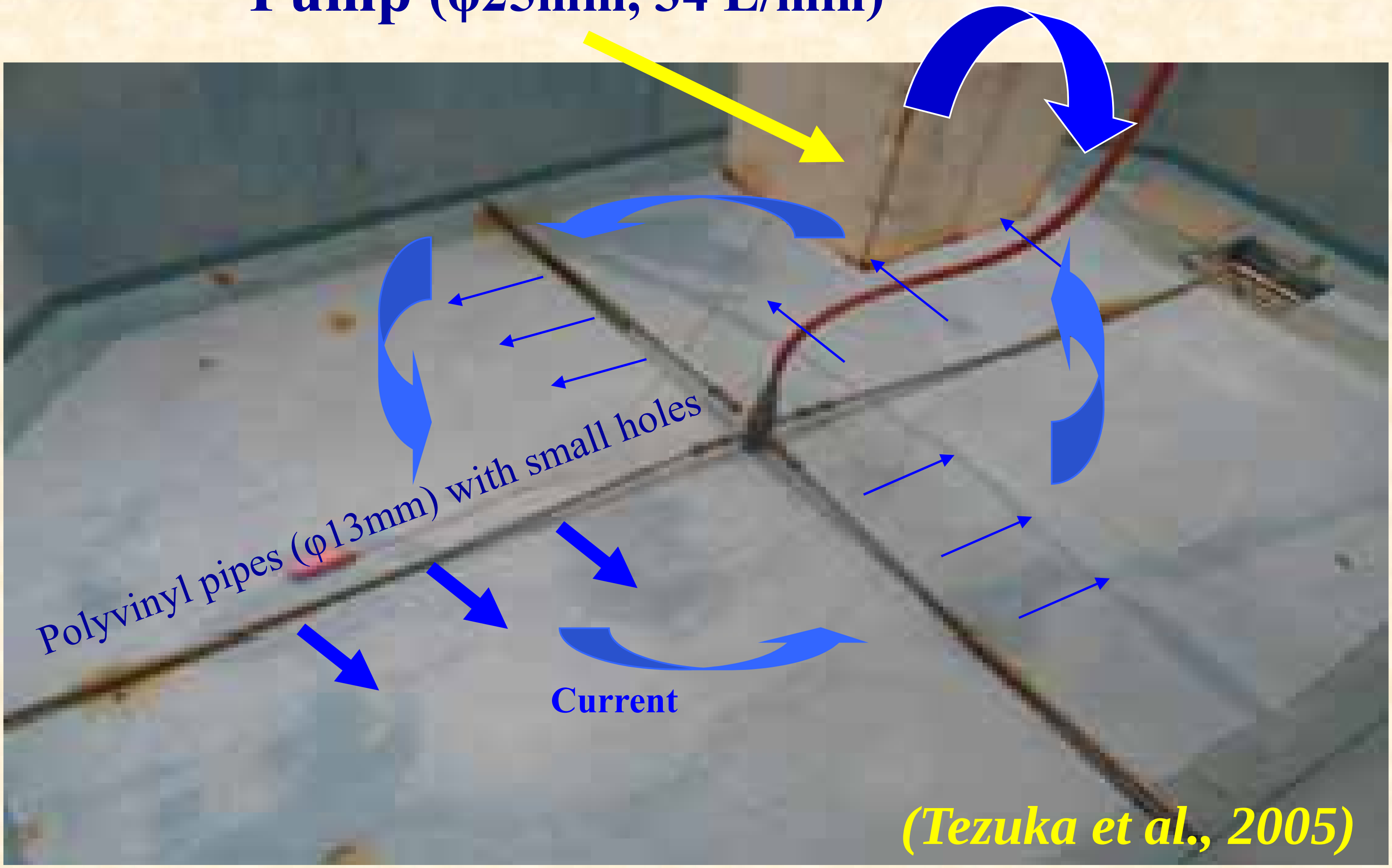
» **In addition, the state of sinking larvae in large tanks was confirmed (Tanaka et al., 2009).**

We hypothesized

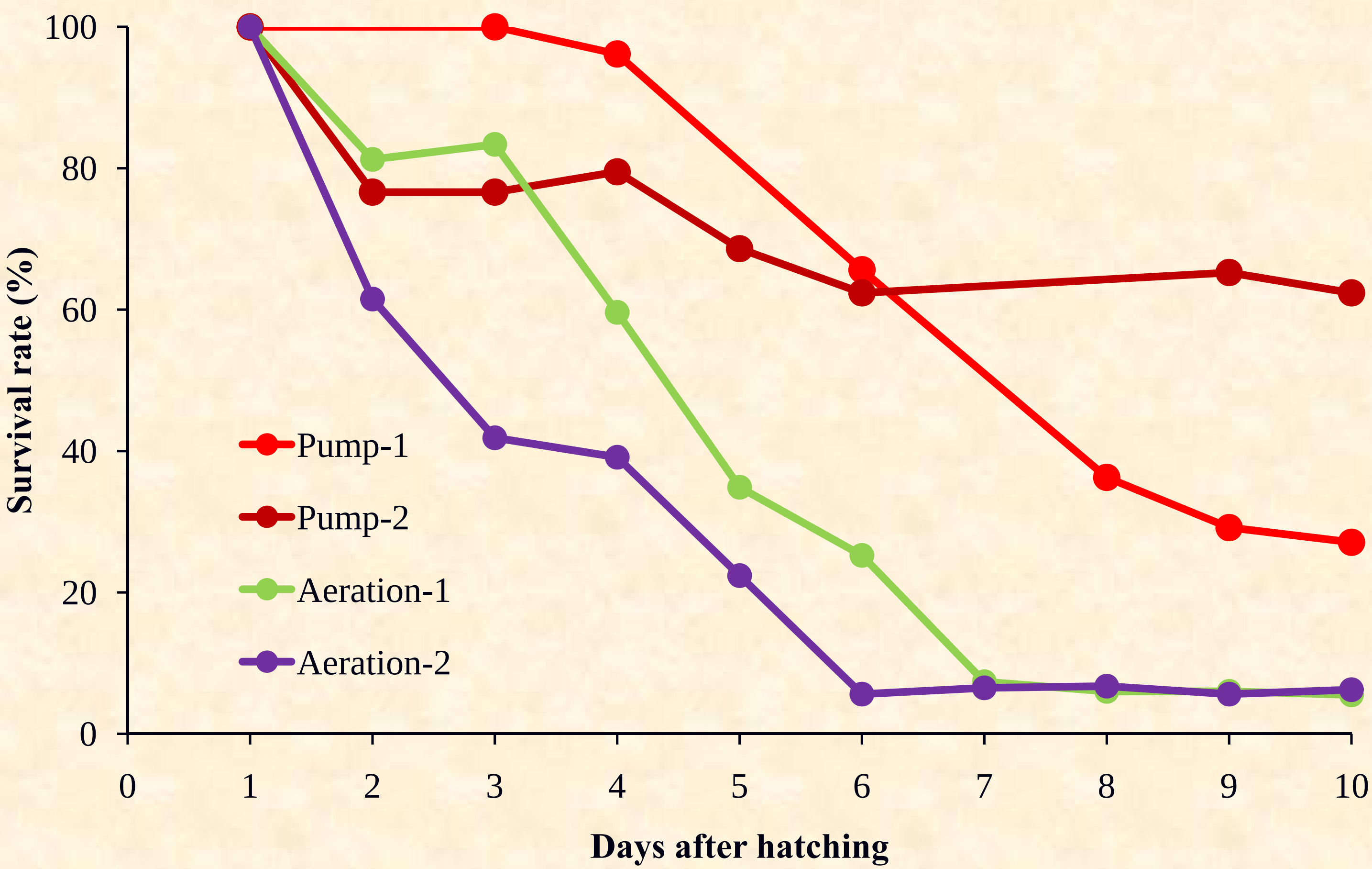
» ***If the larvae died on the bottom during night by some causes, it can be improved by making larvae drift.***

New methods generating water current in tank

Pump **(φ25mm, 34 L/min)**



i) *Effect of water pump method on sinking syndrome*



We improved survival of bluefin tuna larvae by generating a current in tank.

Water pump method could prevent sinking syndrome.

ⅱ) *Viral diseases (VNN)*

» Treatment of fertilized eggs with ozonated seawater and disinfection of rearing water by ozone is effective for VNN prevention （Tezuka et al., 2003）.

ⅲ) *Feeding regime*

» Fish larvae is important as food following rotifer/Artemia and before feeding the minced fish meat (Miyashita, 2002). Nutrient in Artemia obstructs the growth of larvae (Seoka et al., 2007). Use of Chilean fish meal is a candidate for the development of microdiets (Takii et al., 2007).

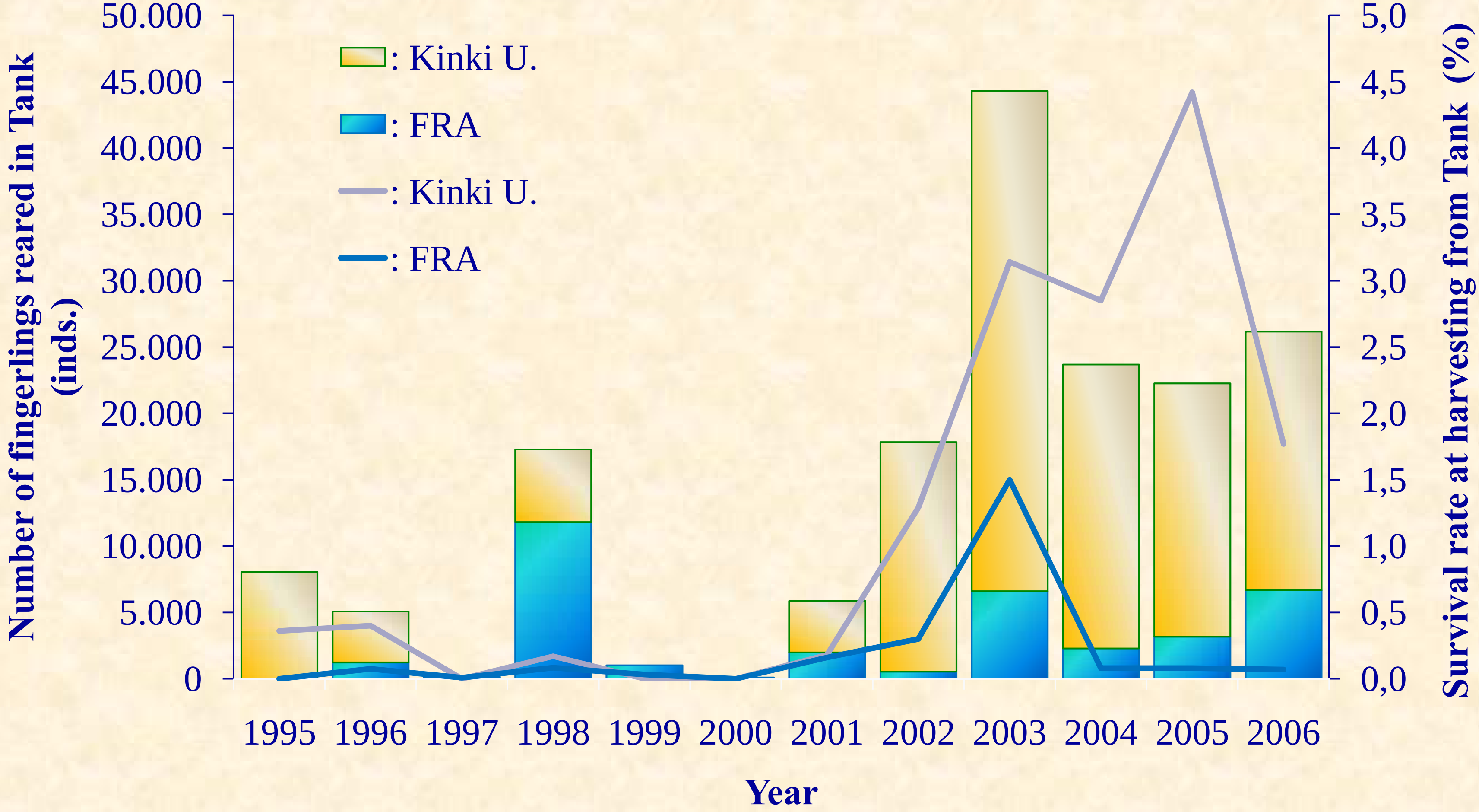
ⅳ) *Cannibalism*

» Cannibalistic behavior is observed only under starvation, and cannibalism can be reduced if we can feed sufficient amounts of appropriate diets (Sabate et al., 2009).

ⅵ) *Collision*

» Juveniles are extremely sensitive to the sudden light stimulation in the night, and it leads to collision (Miyashita et al., 2000). And collision death can be controlled by artificial illumination in the nighttime (Ishibashi et al., 2009).

Number and survival rate of PBT juveniles raised in tank in Japan



These data were kindly provided from Fisheries Laboratory of Kinki University.

Future perspectives on PBT Larviculture

» The early phase of PBT larviculture has been progressing significantly and production of tens of thousands of hatchery-raised juveniles is being achieved in the several institutes and fish farms at present.

» However, further studies to assure the high early survival are necessary for the stable mass seed production of PBT.

» The bottleneck is that the post-flexion larvae and early juveniles of PBT still require huge quantities of live fish larvae as the diet, which is unstable, costly, laborious, and risky for VNN infection and for cannibalism caused by starvation.

» Development of microdiets and alternative live feeds for PBT is urgent for stable production of PBT.

Thank you for your attention !

Acknowledgements

- ***Fisheries Laboratory of Kinki University***
- ***Nippon Formula Feed Manufacturing Co., Ltd***
- ***Takuyo Co., Ltd***
- ***Taiyo A&F Co., Ltd. (TAFCCO)***
- ***Dr. Daniel Margulies, Senior Scientist, IATTC reviewed my article***