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Optimum Acclimation Rates from Salt- to Freshwater for Juvenile Sea Bass *Lates calcarifer* Bloch

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Abstract - The rapid acclimation of 19-30 day-old sea bass (*Lates calcarifer*) fingerlings from seawater (28 ppt salinity) to freshwater was investigated. Sea bass reared in seawater were gradually acclimatized to freshwater over 0, 3, 6 and 8 hours. There was no significant difference (P <0.005) in survival between fish in the seawater control and those acclimated over 6 or 8 hours but fish placed directly into freshwater all died within 2 hours.

In Australia, sea bass, locally known as barramundi (*Lates calcarifer* Bloch), has long been recognized as a prime sport and table fish with particular importance to the recreational fishery. Successful breeding and rearing of the species in Southeast Asia and high market prices in Australia have prompted a fledgling Queensland aquaculture industry to target sea bass. Some private hatcheries have shown considerable interest in rearing sea bass with particular emphasis on the supply of fingerlings for small-scale pond or cage growout operations. In most instances, fish obtained from hatcheries are grown to a marketable size in freshwater ponds.

Since 1984 the aquaculture potential of this species has been investigated by the Fisheries Research Branch of the Queensland Department of Primary Industries (QDPI) in a pilot-scale hatchery program located at the Northern Fisheries Research Centre (NFRC) in Cairns (Pearson 1987). Sea bass eggs are fertilized in seawater (28-33 ppt) and the rearing of the larvae continues in seawater usually until at least day 16 when they are transferred to freshwater (MacKinnon 1986). The practice of ongrowing sea bass in freshwater earthen ponds is preferred over intensive growout due to limited saltwater facilities.

Previously, sea bass 17-20 days old have been acclimatized to freshwater by lowering the salinity in stages over a 24-hour period to around 5 ppt and then transferring them directly into freshwater (Russell et al. 1987). Fish produced in seawater at Cairns were ongrown to stocking size (50 mm total length (TL)) in freshwater ponds at QDPI Walkamin Research Station prior to stocking into public storage impoundments. These procedures required acclimation of the juvenile sea bass from seawater before stocking into freshwater ponds.

The acclimation of sea bass from salt- to freshwater can be a crucial stage in a sea bass hatchery operation. The stress of handling and the dramatic physiological changes that the fish undergo can cause extensive mortalities, particularly in the presence of disease or infections (MacKinnon 1986). An acclimation time which is too short will result in deaths caused by inability to handle the osmotic stress (MacKinnon, pers. comm.); too long a period may result in deaths due to starvation; cannibalism or poor water quality in the absence of biological filtration. A rapid acclimation is essential to minimize the loss of fish and to increase hatchery efficiency by maximum turnover.

The objective of this investigation was to determine the minimum time for acclimation of *Lates calcarifer* fingerlings from sea- to freshwater.

Ten round, polyurethane tubs (60-cm diameter) each containing 100 l of seawater (28 ppt) were set up with 30 sea bass fingerlings (size 6-10 mm TL) in each tank. The tubs were aerated to ensure mixing of the fresh- and seawater. A continuous supply of freshwater was arranged to provide varying rates of flow to each set of replicates.

A tub with a seawater flow only was used as a control and a tub of freshwater was used in the 0 hours control. Flow rates were adjusted to allow for three specific periods of time (3, 6 and 8 hours) for complete acclimation to freshwater. Two replicates of each treatment were used. Flow rates were initially calculated using the formula of Wickins and Helm (1981) and then modified by trial and error. The water temperature range was 25-28°C. The ages of the fingerlings used for experiments 1, 2 and 3 were 19, 25 and 30 days, respectively. Salinity was measured with a temperature compensated refractometer. Sea bass in the tanks were observed at hourly intervals for the first 12 hours; dead fish were removed and the times of death noted. Fish were kept for 48 hours after acclimation in the experimental containers to allow for delayed mortalities. The effectiveness of the acclimation rate was gauged by the percentage survival of fish at the completion of the trial. The trial was repeated three times so that any experimental variation would be minimized. Fish were preserved in 10% formalin for histological analysis.

The number of sea bass remaining alive after 48 hours for each experiment is shown in Table 1. Fish placed directly into freshwater died within two hours. Deaths which occurred in the controls were attributed to handling stress. Analysis of variance showed a significant difference between survival in the different treatments (P <0.001).

Table 1. Number of sea bass *(Lates calcarifer)* fingerlings alive 48 hours after acclimation from 28 to 0 ppt.

Experiment	Control salinity	Acclimation time (hours) 0	3	6	8
1	26	0	9	25	26
	26	0	12	23	26
2	24	0	13	18	23
	21	0	16	14	18
3	30	0	20	26	30
	25	0	20	24	25

A Student-Newman-Keuls test indicated that there were significant differences in survival between the control group and both the 0- and 3-hour acclimation groups (P <0.05). There was no significant difference in survival between the control group and the 6 and 8 hour acclimation group.

Hyaline droplets were found in the liver and kidney of those fish converted in 3 and 0 hours but were not found in fish from the 6 and 8 hour acclimation groups. Fingerlings that died during the experiment had bulging eyes and swollen bodies.

The results suggest that mortalities sustained when acclimating 19-30 day-old sea bass from seawater (28 ppt) to freshwater can be influenced by acclimation time. The 6-hour period is the shortest acclimation time which will result in the minimum of deaths for fingerlings 8 mm or greater in length.

Rapid acclimation of euryhaline fish from sea- to freshwater results in a considerable drop in plasma osmolarity and in the concentration of Na^+, K^+ and Cl^- and often leads to death (Holmes and Donaldson 1969). Hyaline droplet formation can indicate a major ion imbalance in the liver and kidney cell (J. Norton, pers. comm.). The histological findings of hyaline droplets and the visual observation of bulging eyes and swollen bodies in those fish that died, would be consistent with an ionic imbalance being the primary cause of death.

Both Davis (1985) and Russell and Garrett (1983) reported the presence of juvenile sea bass in hypersaline conditions in supralittoral habitats. The effect of sudden salinity and temperature changes from freshwater runoff on the survival of these sea bass has not been fully investigated. However, Russell and Garrett (1983) suggest that juvenile sea bass in the natural nursery situation appear to be quite tolerant of fluctuations in temperature and salinity.

It should be noted that this acclimation period may not be relevant to fingerlings younger than those used in the experiment (i.e., 19 days) or fish that are affected by additional factors such as disease or extreme stress. Sea bass larvae smaller than 8 mm TL, are unlikely to withstand transfer to freshwater because salinity requirements of larvae are likely to be more critical than those of juveniles. In addition, the use of three different age groups in the present study may have caused some variation in the survival of fish in each experiment.

The aquaculture industry can benefit greatly from knowledge of the shortest period in which juvenile sea bass can be transferred to freshwater. A reduced acclimation time allows a greater turnover of fingerlings, reduced man-hours and associated handling costs and also a reduction in the stressful "crowding" of fish. In situations of crisis such as the threat of certain diseases or sudden food shortage, the rapid acclimation to freshwater growout ponds could be of great benefit to a hatchery by minimizing the level of mortalities and economic loss.

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