AQUACULTURE update

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Short-term holding of wild adult sablefish in a SEA System II ã floating bag

Several research and practical initiatives are underway at present in British Columbia with the objective of commercial culture of the sablefish *Anoplopoma fimbria*. The culture requirements of this species are not well known, although earlier work by Fisheries & Oceans Canada (Kennedy 1974) established their general adaptability to tanks and small sea cages. The floating bag impoundment and pump system (SEA System II™) developed by Future SEA Technologies Inc. (FST) provides the opportunity to control temperature, salinity, water flow, dissolved oxygen and ambient light levels, as well as reducing exposure to predators and enabling the capture of all major effluents. Several recent tests have confirmed the system's suitability for culture of salmonids (Aquaculture Updates #79, 81 and 84). A joint trial was recently conducted by Fisheries & Oceans Canada and FST with the participation of Legacy Fish Products Ltd. as an initial test of the SEA System II™ bag for short-term holding of wild-caught adult sablefish. Reasons for the trial included interest in whether the wild fish would school naturally, suffer eye damage and other injuries from contact with container walls, and to evaluate other changes which might result from their transfer to the SEA System II™ technology. This Update outlines some of the observations collected during the trial.

Capture: Wild sablefish were caught off the west coast of Vancouver Island, B.C. between May 7 and June 11, 2000 at depths up to 350-400 fathoms on commercial long line gear. The catching vessel was equipped for live transport, with 2 holds supplied with pumped sea water. Four groups of sablefish were transported to the FST demonstration site at the Pacific Biological Station, Nanaimo, B.C. (Table 1). Experience and insights gathered from each trip were used to improve the health of the fish in following trips by careful removal of fish from fishing gear, progressive reduction in loading densities, and elimination of crowding and exposure of fish to air during unloading via use of a wet brailer with small lots of no more than 10 fish. Time in transit was about 48 hr from first fish caught to last fish unloaded. Fifty fish from each load were tagged at arrival with numbered external tags.

Table 1. Details of sablefish deliveries.

	May 7	May 21	June 5	June 11
# fish	1021	793	680	499
Mean length, mm	625.4	657.3	651.6	650.6
Mean weight, g	2349	2755	2701	2632
Condition factor[1]	0.95	0.94	0.96	0.94
Transport density, kg/m^3	109.0	99.3	83.5	59.7
Mucus rank "Good", %	N/A	21.4	31.3	64.2
5-day mortality, % (tags only)	18.0	12.0	10.0	12.0
5-day mortality, % (all fish)	9.2	5.9	*	*

[1]Condition factor = 100 X Wt (g) / Len^3 (cm)

* *untagged mortalities in later deliveries could not be reliably separated from earlier deliveries*

Feeding and behavior: The sablefish were fed once daily by hand, initially with chopped squid only, but over a period of about 2 weeks gradually introduced to a large-pellet commercial diet. Both feed types appeared to

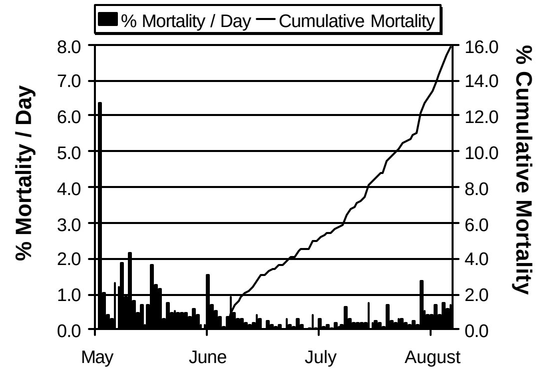
be readily consumed by many fish. Later deliveries of wild fish were thus given the pellets and squid combination immediately. Fish began to swim well directly upon transfer from the transport boat and were not seen to collide with the bag wall. The bag measured 15 m x 10 m deep with a volume of 1450 m^3. The fish swam against the current created by the pump (measured mean velocity of 0.14 m/sec) much as salmonids would, cruising, turning well and using the full depth and breadth of the bag except for the very centre and the top 1-4 m. No observations were made of their nocturnal behaviour.

Survival: Mortalities following each delivery declined over a period of a few days and also declined with each trip as handling improvements were made (Table 1). Temperature in the bag during the period of fish deliveries was 9.7-10.1°C, but rose in June and July to means of 11.6 and 12.3°C respectively. A top shade cloth was used to reduce internal light levels to 30 percent of ambient. Other environmental conditions are given in Table 2.

Table 2. Environmental conditions during the trial.

	Bag mean (range)	**External** mean at 4 m (range)
Temperature, °C	11.6 (8.8-16.2)	14.7 (9.7-19.1)
Dissolved oxygen, ppm	7.7 (5.4-10.6)	9.2 (8.2-11.6)
Salinity, ppt	30.7 (28.0-35.0)	27.1 (21.0-31.0)
Secchi (m)	7.2 (2.5-11.0)	6.0 (2.0-11.5)
ATU (deg.-days)	1103.9	1406.4
Intake depth, m	13 - 17	4

Mortality did not fully abate after fish deliveries were completed, and the subsequent appearance



of an atypical form of furunculosis disease in the fish during July prompted harvest on August 10, 2000 after a total of 95 days elapsed (Figure 1).

Figure 1. Mortality of sablefish during holding trial. Cumulative plot begins upon completion of fish deliveries.

Health: At the time of the first delivery, nearly all sablefish showed some obvious distress. However, the severity diminished with successive loads. Hook wounds to the jaw and gill area and skin abrasions on the head appeared to originate with the long line gear. Histological examination of eyes of fish sampled at arrival showed corneal ulceration that led to entry of fluid causing cloudy eyes. In similar transports of largemouth bass, this injury was attributed to physical contact due to crowding (Ubels and Edelhauser 1987). Skin mucus was obviously reduced on many sablefish, but improved with each load (Table 1). Recovery from all evident traumas was well advanced by the time of harvest (Table 3).

Table 3. External condition indicators at capture and at harvest. Eye score ranges from 0 (clear), to 3 (badly clouded).

	Class	At capture	At harvest
Eye score, L/R	0	8.2/7.6	90.2/89.3
(% in each class)	1	36.1/33.3	2.8/2.8
	2	52.2/55.3	2.8/3.3
	3	3.1/3.8	4.2/4.7
Peduncle mucus	Good	42.8	83.2
(% in each class)	Medium	33.3	16.4
	Poor	23.9	4.7

Sablefish did not appear to suffer any damage associated with decompression at time of capture. The hook wounds healed the slowest, and were considered a possible point of entry for the furunculosis pathogen. On the final harvest day, 75.2 percent of the fish showed no visible hook wounds, with the remainder generally well advanced toward recovery (214 fish sampled). There were no predator attacks during the trial, and the light-proof fabric of the bag enclosure likely minimized stress from harbour seals that frequented the site. During a bloom of the hazardous plankton (*Chaetoceros convolutus)* normal feeding and behaviour continued at the highest concentration noted in the bag (1400 cells/liter). External parasites were seen on small numbers of sablefish at delivery and at harvest. Nearly all sablefish contained large numbers of anisakid nematodes (a common parasite in wild fish) throughout the trial.

Growth: It was apparent that not all sablefish adapted equally well to feeding protocols. While an overall weight gain was recorded (Table 4), monitoring of individually tagged fish over periods ranging between 2 and 3 months revealed three distinct groups: *growing* (55% of fish increased in weight), *maintaining* (17% had negligible weight change) and *starving* (28% lost weight).

Table 4. Culture performance summary (based on status after last delivery of new fish).

Total days elapsed	95
Days elapsed post deliveries	60
Start weight, g	2584
End weight, g	2892
Start length, mm	644.0
End length, mm	645.9
Start Condition Factor[1]	0.95
End Condition Factor	1.06
Growth rate, %/day	0.188
Growth coefficient *("Thermal", Iwama and Tautz '81)*	0.68
Cumulative mortality, %	15.90
Daily mortality, %	0.27
Harvest biomass, kg	6316
Harvest density, kg/m3	4.36

[1]Condition factor = 100 X Wt (g) / Len^3 (cm)

The foregoing observations may have been influenced by the compromised health of some of the fish.

Use of the SEA System II™ bag resulted in noticeably different growing conditions for the sablefish relative to what they would have experienced in an adjacent sea cage (Table 2). Regular monitoring of ambient water column temperatures was used to select the depth of the pump intake so as to maintain lower temperatures more favourable to sablefish. Thus, degree-day totals (ATUs) within the bag were considerably lower than just outside it; water temperature in the bag peaked at 16.2°C versus 19.1°C outside (4-m depth). Salinity was also maintained at levels closer to what sablefish experience in their offshore habitat (minimum in bag 28.0 ppt, minimum outside 21.0 ppt). Dissolved oxygen levels, which were slightly lower at the deeper intake levels, were supplemented so as to maintain a minimum of 5 ppm in the bag.

Conclusions: Sablefish appeared to respond well to the culture environment provided by the SEA System II™ bag. The fish did not appear to experience adaptation difficulties or harm while adjusting to their new environment. Harvested fish were marketed successfully and compared well to commercial sablefish in the processing plant. Future transfers of wild sablefish to holding environments would likely benefit from any steps taken to minimize wound trauma, including an early prophylactic disinfectant bath. Research is required to determine treatments for a variety of potential diseases of sablefish.

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References

Iwama, G.K. and A.F. Tautz. 1981. A simple growth model for salmonids in hatcheries. Can. J. Fish. Aquat. Sci. 38: 649-656

Kennedy, W.A. 1974. Sablefish culture: Final report. Can. Tech. Rep. Fish. Aquat. Sci. 452. 15 pp.

Ubels, J.F. and H.F. Edelhauser. 1987. Effects of corneal epithelial abrasion on corneal transparency, aqueous humor composition and lens of fish. Prog. Fish Cult. 49: 219-224.