United Soybean Board
Final Report Form – Technical Bulletin

Project # and Title	Project # 2463 Asian seabass: Validation of commercial grow-out feeds containing optimal levels of SBM and SPC
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Introduction: Statement on the rationale and background for the studies

GENERAL INTRODUCTION

NSW Department of Primary Industries (NSW DPI) is conducting research for The New Uses Committee of the United Soybean Board (USB) on utilization of soybean meal (SBM) and soy protein concentrate (SPC) in aquafeeds for Asian seabass *Lates calcarifer* (also known as barramundi). Thus far this collaboration has determined the digestibility of SBM, SPC and other major feed ingredients for Asian seabass, growth responses to increasing inclusion of SBM and SPC and affects of soy-based diets on carcass composition. Preliminary trials have also investigated the impacts of SBM and SPC on gut histology and the use of feed attractants to overcome palatability issues in soy-based feeds. The over-arching objective of this research to formulate and test commercially manufactured soy-based feeds for Asian seabass in a farm situation. To date much of the laboratory work has been conducted in Australia, but it is the intention of the USB and the American Soybean Association International Marketing (ASA-IM) group to conduct the farm verification trial in South East Asia (SEA), the region with the greatest production of Asian seabass and therefore the greatest potential for uptake of SBM and SPC in aquafeeds for this particular species.

Research undertaken in 2010 (Project 0463) showed that Asian seabass will tolerate high dietary levels of SBM (≈ 35%) in feeds that contain relatively high amounts of fishmeal (≈ 40%). However, the palatability of feeds in which fishmeal content was reduced to 10% and SPC content increased to 40% declined. Research completed in 2011 (Project 1463) determined the digestibility of additional key feed ingredients that could be used to compliment the use of SBM and SPC in diets for Asian seabass. This work was undertaken to provide a better

understanding of the nutritional quality of complimentary feed ingredients so that further reductions in fishmeal content or elevation in soy content could be investigated.

In 2012 (Project 2463) the USB funded NSW Department of Primary Industries (NSW DPI) to conduct 4 new research activities;

1) *Conduct a laboratory growth study with Asian seabass aimed at reducing or eliminating fishmeal in grow-out diets for this species by using elevated levels of soybean meal, soy protein concentrate and other feed ingredients*

2) *Conduct a verification trial of promising formulation/s for Asian seabass at a commercial saltwater facility in SEA.*

3) *Conduct an economic feasibility analysis of alternative soy based diets used in a verification trial (least-cost analysis).*

4) *Visit SEA, both at the inception and conclusion of 2012 to allow NSW DPI to observe the challenges facing the SEA finfish industry and to disseminate past and current USB research on Asian seabass to specifically targeted audiences.*

Activities 1 and 4 were successfully completed in the 2012 calendar year, with the exception that Dr Booth did not complete a return trip to SEA. Activities 2 and 3 were not completed in 2012 due to delays in identifying suitable research partners in SEA willing to be involved in verification trials with Asian seabass. However, as a result of ongoing negotiations with potential research collaborators in Vietnam, a proposal for conducting a verification trial in Nha Trang (Vietnam) commencing in 2013 was submitted to the USB for approval. This proposal was based on outcomes of the SEA visit conducted by Dr Booth, views of key ASA-IM Managers (Lukas Manomaitis) and lengthy consultation with Marine Farms Vietnam and Ocialis Feed Company.

This report presents completed research for Activities 1 and a brief description of Dr Booth's visit to South East Asia (Activity 4). The work detailed in this latest report to the USB builds on earlier research completed by NSW DPI over the previous 3 years. The combined research outcomes will ultimately be used to formulate soy-based aqua-feeds for verification trials on Asian seabass in the SEA environment.

Studies completed - brief summary of the number and type of studies conducted, including general study design and approach on how and where the studies were conducted, but without details of the materials and methods

ACTIVITY 1 – REDUCTION OF FISHMEAL IN DIETS FOR ASIAN SEABASS

INTRODUCTION

The primary aim of this study was to formulate, on a digestible nutrient basis, a series of experimental diets for Asian seabass that maximized the use of soybean meal (SBM) and soy protein concentrate (SPC), but at the same time systematically reduced fishmeal content to zero. Based on outcomes of our previous research we recommended that diets containing a blend of SBM and SPC could serve as a basis for formulating a commercial feed for Asian seabass as long as the total amount of soy product did not exceed 38%. This level was therefore maintained in the current study. A secondary aim was to revisit the use of feed

attractants. We suggested that feed attractants might also be necessary to maintain feed intake in soy based diets where fishmeal levels or other animal proteins were greatly reduced. In earlier work we had trialed top-coating 2% w/w liquid attractants onto feed pellets without success. In this study we evaluated the efficacy of a powdered tuna-based hydrolysate (HP4; SPF Diana Australia) which was incorporated into certain treatments (5% of the feed-mash) prior to pelleting. Attractant was added to diets formulated with zero levels of fishmeal as well as to a diet containing an SPC product being used by aquafeed manufacturers in Australia (Selecta Brazil).

STUDY DESIGN

The study was originally designed for 1 experiment lasting approximately 8 weeks. The original design was based on 10 test diets, each replicated in 4 experiment tanks (n=4). Two replicate tanks from each dietary treatment were assigned to similar tank based recirc systems (i.e. RAS-1 and RAS-2), respectively. Two of the diets had been evaluated in previous work (USB Project 0463) and served as benchmarks for this study as well as the basis for new formulations. They were a control diet containing 55% fishmeal and no soy products (FM55) and a diet containing 38% fishmeal and 35% solvent extracted SBM (SBM35). A current commercial Asian seabass (barramundi) feed was also included for comparison.

The first 6 diets formed the major part of the experiment and included FM55 (i.e. FM55, FM28, FM18, FM08, & FMZero). These diets were designed to determine if fishmeal could be gradually reduced from 55% to zero while keeping the total amount of soy products (i.e. SBM and SPC) close to 38%. The sixth diet was based on the FMZero formula but included 5% of the feed attractant HP4 (FMZero+HP4). In these diets original batches of Argentinean SBM and ADM Soycomil-K were used as per previous trials, however all other ingredients were newly received.

The 2 remaining treatments were based on low levels of fishmeal (10%) and use of an alternative soy protein concentrate (Selecta SPC). Due to ingredient cost this SPC product was forced into the formulation (see below) at 30% of the diet. The original batch of Argentinean SBM was used to maintain total soy product at 38% of the diet. The base formulation was known as Selecta30 and a similar diet was formulated with 5% of the feed attractant HP4 (i.e. Selecta30+HP4).

Formulation constraints

As for previous USB experiments we selected a DP:DE ratio ≥ 24g DP MJ DE-1 and set DE of all formulations to 16-17 MJ kg-1 based on updated digestible protein and energy requirements of Asian seabass (Glencross, 2012). The DP:DE ratio was selected in order to bracket the expected stocking and harvest weight of Asian seabass used in the feeding trials. All diets were formulated to have a minimum of 9-10% wheat for binding purposes. Fish oil content was restricted to 10% and the vitamin / mineral premix content was fixed at 0.3% of diet as per the manufacturer's instructions. Methionine and lysine content was set to 2.24% and 5% of crude protein, respectively according to recommendations made by Boonyaratpalin & Williams (2002). In all formulations with the exception of FM55 we ensured that total soy product was driven to 38% of the diet. All selected constraints, ingredients and their concomitant cost in American dollars were entered on an 'as fed basis' into the feed formulation software package known as WinFeed 2.8 Release 3 (Nutrition Laboratory, Cambridge University, UK;

www.winfeed.com). Please note formulations presented in earlier research have been adjusted to reflect the chemical analysis of new feed ingredients.

The measured proximate and amino acid composition of ingredients used to formulate test diets is presented in Table 1 and Table 2, respectively. The formula and estimated digestible nutrient composition and cost of experimental feeds, excluding the commercial diet is given in Table 3. The measured proximate and amino acid composition of each dietary treatment is presented in Tables 4 and 5, respectively.

Fish health issues – Trial 1 and Trial 2

Two weeks after stocking the fish in RAS-1 displayed signs of a parasitic-like infection. The infection was only mild but it appeared to have some influence on feed intake and some fish were afflicted with exophthalmos (popeyed); the eyes of these fish were generally opaque. Some fish were noticed rubbing on the walls of the tanks. It is unclear what the infection was, but a course of freshwater bathing and treatment with formaldehyde (30-200 mg L-1) as the trial progressed improved fish health significantly. This infection was not seen in the parallel system, but fish in this system were also treated as a precaution. After conducting the first monthly weight assessment it became apparent that the growth rate of fish in RAS-1 had been compromised. Although the trends in weight gain were similar to that observed in RAS-2, the growth rate was halved. Based on this evidence we decided to terminate this part of the experiment, remove the remaining fish from the experiment tanks and transfer them to a separate holding tank to be treated and recover. RAS-1 was thoroughly cleaned and disinfected with liquid chlorine (50mg L^{-1}) after which the recovered fish were restocked into the experiment tanks (approximately 2 weeks). The restocked design (Trial 2) incorporated only 6 of the most important dietary treatments from the original experiment (Trial 1), however each of these dietary treatments was now replicated in 3 experiment tanks (n=3) and each tank was stocked with 9 fish. Trial 1 continued with the original 10 diets in duplicate tanks (n=2; 10 fish per tank). Both Trial 1 and Trial 2 were run for 8 weeks. Trials were conducted in saltwater at 28-29°C.

Trial 1.

The effect of diet on harvest weight, feed intake, FCR, relative feed intake or relative weight gain in Trial 1 was determined using ANOVA. ANCOVA, using whole carcass weight of sampled fish as the covariate {Shearer, 1994 #504}, was used to determine the effect of dietary treatment on whole body moisture, organic matter, protein, fat, ash or gross energy content of fish. Two-factor ANOVA was used to investigate the combined effects of diet type (i.e. FMZero, Selecta30) and feed attractant (presence or absence of 5% HP4) on harvest weight, feed intake, FCR, relative feed intake and relative weight gain of Asian seabass in Trial 1.

Trial 2.

The effect of diet on harvest weight, feed intake, FCR, relative weight gain and relative feed intake of fish in Trial 2 was determined using one-way ANCOVA. In this case stocking weight was used as the covariate to control for minor variations between the average weights of fish in different replicate tanks.

Results - sequential summary of results, ending with recommendations on soy diet formulations, feeding protocols, economics and other related recommendations

RESULTS

Trial 1. Effect of diets on performance

There was no significant effect of diet type on harvest weight, absolute feed intake or relative weight gain of Asian seabass in Trial 1 (all *P*>0.05; Table 6). However, there was a significant effect of diet type on relative feed intake (*P*=0.0292) and FCR (*P*=0.0002). The relative fed intake of fish fed the commercial Asian seabass diet was significantly lower than those fed Selecta30+HP4 or SBM35 (Table 6). Even though diet type affected FCR, the range in FCR values was narrow, rising from 0.97 (best) in FM28 to 1.23 (worst) in Selecta30+HP4. Though not significant, the relative weight gain of fish fed the Selecta diets (D7 & D8) and the Commercial diet (D12) were somewhat lower than the other diets. Lack of significance among diets with respect to harvest weight and feed intake is likely due to the magnitude of several treatment standard deviations (Table 6).

Trial 1. Effect of diets on carcass composition

One-way ANCOVA indicated there was no significant effect of diet type on adjusted values of whole carcass moisture, organic matter, crude protein, ash, gross energy or fat content (all *P*>0.05; Table 7).

Trial 1. Presence or absence of attractant HP4

There was no significant effect of diet type, HP4 or interaction between these terms in tests on harvest weight, absolute feed intake, relative weight gain or relative feed intake (all *P*>0.05). FCR was affected by diet type and HP4, but not by the interaction of these terms. In this case the FCR of fish fed diets containing no fishmeal (i.e. FMZero & FMZero+HP4) was significantly better (FCR=1.04; n=4) than fish fed diets containing 30% Selecta SPC (FCR=1.19; n=4) and the FCR of fish fed diets containing no HP4 was slightly better (FCR=1.08; n=4) than fish fed diets that did not contain this product (FCR=1.15; n=4).

Trial 2. Effect of diets on performance

ANCOVA indicated there was a significant effect of diet type on covariate adjusted values of harvest weight (*P*=0.0274), absolute feed intake (*P*=0.0019) and relative weight gain (*P*=0.0214). There was no effect of diet type on adjusted values of FCR or relative feed intake (all *P*>0.05). The harvest weight of fish fed FM55 was significantly higher than fish fed FM08 and FMZero. Similarly, relative weight gain of fish was higher in those fed FM55 than FM08, FMZero and FMZero+HP4. FCR for all diets was less than or equal to 0.98 (Table 8).

Further to the above, the outcomes of one-way ANCOVA also indicated there was no benefit of adding 5% powdered HP4 to the FMZero formulation. This agreed with the results of Trial 1 (Table 6 & 8).

DISCUSSION

Fishmeal reduction

Data from Trial 1 was more variable than data from Trial 2, but overall the results suggested that diets for Asian seabass that contain 38% of soy protein (mostly as SBM) can probably be formulated with quite low levels of fishmeal before growth performance and FCR are affected. We consider the results from Trial 2 to be more robust due to the slightly higher growth rate of Asian seabass in the second experiment and the additional replication of experimental tanks.

In Trial 2 the relative feed intake and FCR of each diet was statistically similar and the range in values for each index was quite narrow (Table 8). Despite these outcomes, we still found significant differences in indices of harvest weight, absolute feed intake and relative weight gain. This suggested that differences in absolute feed intake were driving differences in weight gain rather than the nutritional content of the diets. Similar findings with Asian seabass fed soy based feeds were discussed in an earlier USB report (Booth, 2010).

On face value it would appear that feed intake declined as fishmeal level was gradually reduced (see Figure 1). Recall that FM28 contained 33% SBM and 4.4% SPC, but FM18, FM08, FMZero and FMZero+HP4 all contained about 25% SBM and 13% SPC (See Table 3). For these diets, reductions in fishmeal level were mainly achieved by gradually increasing the level of poultry meal. Thus decreases in fishmeal or increases in poultry meal might have been indirectly affecting palatability of feeds. It seems unlikely the concomitant increases in poultry meal to a maximum of 33% reduced palatability and therefore feed intake of diets. In support of this claim Williams et al. (2003) showed that rendered meat meal (%50 of diet) could be used to successfully replace 100% of the fishmeal in diets for Asian seabass reared under farm and laboratory conditions without affecting feed intake or productivity.

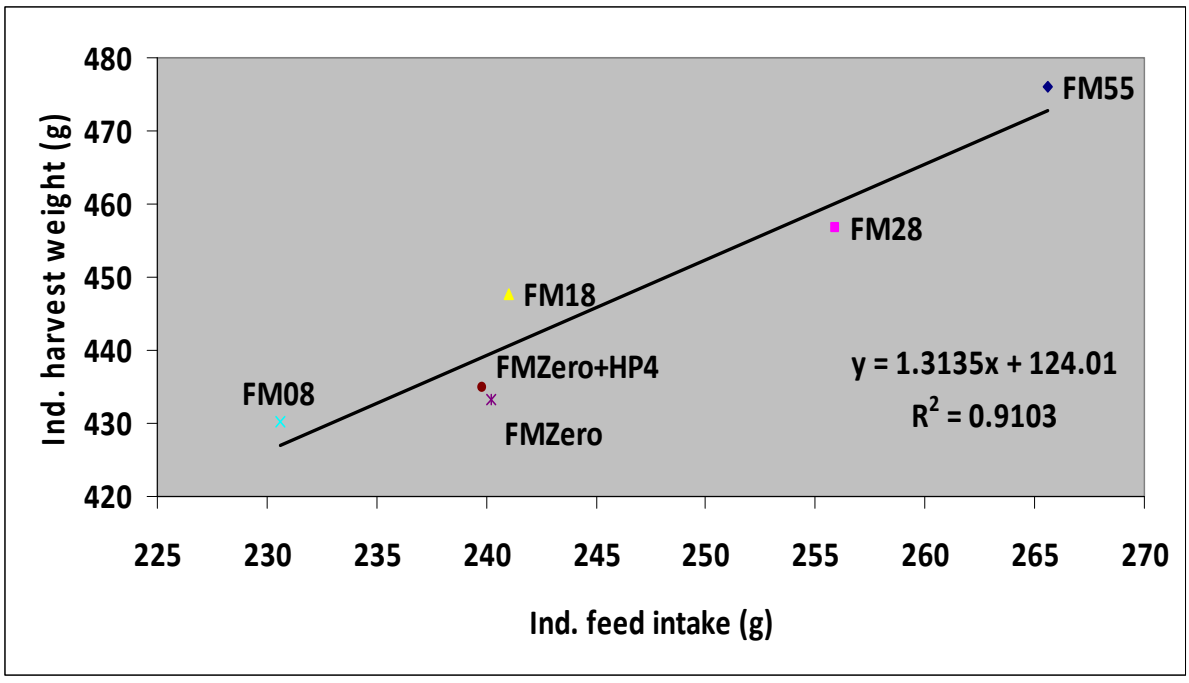

Figure 1. Relationship between harvest weight, feed intake and fishmeal content in Trial 2

However, their study did not evaluate graded reductions in fishmeal content with concomitant increases in meat meal content. Glencross et al. (2011) explored the use of poultry meal in diets for juvenile (140g) Asian seabass formulated to equivalent DP and DE levels. Their test feeds contained 30% and 41% of poultry meal, respectively and fish fed these diets performed better than fish fed a control diet containing nearly 60% fishmeal. In the same study these authors' also reported a relationship between dietary fishmeal level and impacts on feed intake (Glencross et al., 2011). They found a decrease in absolute feed intake when dietary fishmeal content was diluted to zero using lupin protein concentrate (LPC) to replace most of the digestible protein (see Figure 2). Based on their results they hypothesized that there may be a "threshold" level of around 15% fishmeal which is necessary to maintain feed intake in diets that contain high levels of plant proteins such as LPC. However this hypothesis was based on test diets that also contained increasing levels of wheat gluten meal and no other animal meals.

This phenomenon may apply to our study in so much as the masking effect of fishmeal on soy products may be greater than that of poultry meal when both fishmeal and poultry meal are included in the same diet (i.e. decreases in fishmeal content coupled with increases in poultry meal content resulted in reduced feed intake in diets that contained similar amounts of SBM and SPC). As can be seen in Figure 1 there is a linear relationship between absolute fed intake and harvest weight. This relationship seems to be governed to some degree by fishmeal content, at least for diets containing more than 8% fishmeal. Inexplicably, when fishmeal is excluded from diets containing SBM and SPC (i.e. FMZero & FMZero+HP4), feed intake increased slightly. However, we note that the difference was not statistically significant (Table 8).

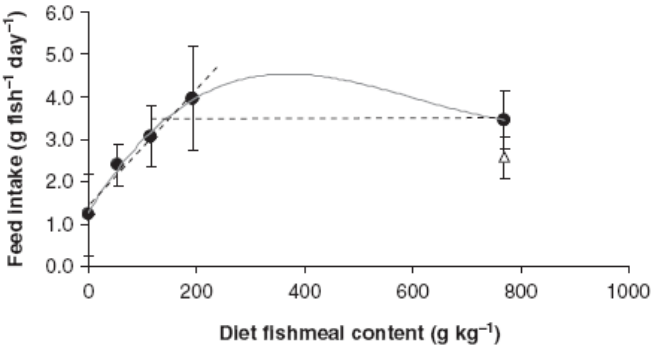

Figure 1 Feed intake (g fish^{-1} day^{-1}) of juvenile barramundi fed diets with varying fishmeal content (●), when the diets are prepared on an equivalent digestible protein and energy basis blended with lupin protein concentrate. Indicated also is the diet with 10 g kg^{-1} of sodium sulfamerazine (△) as a feed intake deterrent.

Figure 2. Relationship between feed intake and fishmeal content according to Glencross et al., 2011

The reasons why feed intake in the two zero fishmeal formulations was slightly higher than in one containing only 8% fishmeal are unclear. It could be argued that the addition of 5% HP4 or the increase in poultry meal content from 24 to 33% improved palatability of these diets to

some extent, but ingredient interactions can be very complex. Spearman-Rank correlations on ingredients which entered the formulations of all six diets in a systematic way (e.g. fishmeal, poultry meal and corn gluten meal) indicated there was a moderate positive correlation between fishmeal content and absolute feed intake (0.6457; *P*=0.0038) and not surprisingly a similar but negative correlation between poultry meal content and absolute feed intake (-0.6239; *P*=0.0057). Of more interest was a stronger negative correlation between corn gluten meal content and absolute feed intake (-0.7869; *P*=0.0001). Further research will be required to better understand the meaning of these results.

Economics of mixed SBM – SPC diets

The growth rates of Asians seabass reared in Trial 2 were on equal to or better than growth rates predicted for this species reared at a constant temperature of 29°C (Glencross, 2012). The Glencross & Bermudes 2012 model predicts that Asian seabass stocked at 185 g and reared at 29°C should take approximately 140 days to reach 1kg in body weight. Basic assessment of the economic value of the six major diets when based on formulation cost, price per kilogram of fish, harvest weight and FCR are presented in the following table. The price of formulations decreased as the content of fishmeal was reduced. The cost of FMZero+HP4 increased by $0.12 above the cost of FMZero as a direct result of incorporating the HP4 (ingredient cost commercial in-confidence). Based on the outcomes of the 8 week trial the net value of whole fish was higher in fish fed the fishmeal control (FM55) followed by FM28 and FM18. The net value of fish fed FM08 or the zero fishmeal formulations was similar.

Basic economic analysis of major test diets used in Trial 2

	Test diets					
Base Information	**FM55**	**FM28**	**FM18**	**FM08**	**FMZero**	**FMZero+Hp4**
Feed price - $/kg [ingredient cost only]	1.280	1.012	0.973	0.899	0.854	0.978
HOG Price - $/kg [farm gate]	10.00	10.00	10.00	10.00	10.00	10.00
FCR	0.93	0.96	0.94	0.98	0.98	0.98
Harvest weight hog (kg)	0.476	0.457	0.448	0.430	0.433	0.435
Feed cost ($/kg fish) [FCR x feed price]	1.19	0.97	0.91	0.88	0.84	0.96
Total feed cost ($/whole fish) [feed cost x harvest weight]	0.57	0.44	0.41	0.38	0.36	0.42
Whole fish value ($)	4.76	4.57	4.48	4.30	4.33	4.35
Net Value of whole fish ($) [whole fish value – total feed cost]	4.19	4.12	4.07	3.92	3.97	3.93

Determination of the stocking, interim (4 weeks) and harvest weights of fish in Trial 2 allowed the daily growth rates to be determined using linear regression. These regressions were used to estimate the number of production days at 29°C required to grow from approximately 185

g to a body weight of 1 kg when fed on the diets used in Trial 2 (see below).

Estimate of production days required to reach 1kg body weight

Diet	Regression equation	Production days	Additional days vs FM55
FM55	Weight gain (g) = 5.2087 x days + 176.87	158.03	na
FM28	Weight gain (g) = 4.8729 x days + 178.51	168.58	10.55
FM18	Weight gain (g) = 4.7055 x days + 180.70	174.12	16.09
FM08	Weight gain (g) = 4.2912 x days + 187.44	189.35	31.33
FMZero	Weight gain (g) = 4.4348 x days + 180.43	184.80	26.77
FMZero+HP4	Weight gain (g) = 4.4773•days + 180.51;	183.03	25.00

Based on the above analysis, Asian seabass fed diets containing 25% SBM and 13% SPC and no more than18% fishmeal will reach similar production weights (i.e. 1kg) to fish fed fishmeal quality diets approximately two weeks later. Reduction of fishmeal content to less than 18% in similarly formulated diets would see production time increase by about 1 month. These data are based on predictions outside the range of our data, however given the growth rates of Asian seabass in Trial 2 were very close to predictions made by other authors using much broader data sets {Glencross, 2012 #9024}, we feel they will serve as a useful comparison when similar high soy formulations are evaluated in farm verification trials.

Alternative SPC test feeds

The alternative SPC product tested in Trial 1 (Selecta Nutrition) was incorporated into feeds with and without HP4. Addition of HP4 did not improve weight gain or feed intake in these particular diets. Unlike the other test feeds, the Selecta SPC based diets were formulated with higher quantities of SPC (30%) and lower amounts of SBM (8%). Although formulated to the same DP and DE as other feeds, the relative weight gain of fish fed the Selecta30 diets was somewhat lower than that of other diets. The FCR of fish fed the SPC based diets was also significantly higher (worse) than most other treatments indicating these formulations were utilized less efficiently. This did not appear to be related to the gross proximate or amino acid composition of these two diets (Table 2 & 4).

When formulating these diets the digestible protein and energy content of this SPC product was assumed to be similar to that determined for the ADM Soycomil-K product. If the Selecta SPC was in fact less digestible than the ADM product then the digestible protein content of the Selecata30 diets would be lower than estimated. This may have affected feed utilization. Alternatively, both these diets contained higher levels of corn gluten and blood meal than other formulations. Blood meal is easily damaged during processing which can reduce the availability of amino acids, especially lysine {Knapp, 2011 #9086}. However, there is no evidence that this was the case in our experiments.

Both diets also contained about 56% in total of plant products, which was about 3% higher than other diets. Future evaluation of SPC products should be done with diets that incorporate about 18-20% fishmeal to ensure threshold levels of fishmeal are maintained.

SBM35 and commercial feed

Two reference diets were incorporated in Trial 1. The SBM35 formulation was assessed in previous USB experiments while the commercial "barramundi" diet was a proprietary product obtained for this study. Excluding the commercial feed, the average harvest weight, feed intake, relative weight gain and relative feed intake of fish fed SBM35 was not significantly different to the other test feeds. However FCR was higher (worse). This diet was expected to promote performance somewhere between FM55 and FM28 given that the fishmeal (38.3%) and SBM content (35.5%) of this diet was high. However, the variation in performance of the duplicate tanks fed this treatment in Trial 1 was large (Table 6), with one tank reaching an average body weight of 290.5g and the other an average of 274.7g. The higher data point is clearly within the range of values recorded for fish fed FM55 to FMZero (Diets 1-5) in Trial 1 and is indicative of the successful growth recorded with this diet in earlier studies. However, from a commercial formulation viewpoint the SBM35 contains only two major protein sources which makes it use imprudent in terms of spreading ingredient and nutrient risk across a range of protein sources.

The formulation of the commercial feed is unknown (commercial in confidence) and therefore it is difficult to interpret the performance of fish fed on this diet compared to fish fed the alternative feeds. Gross fat levels of this diet were lower than other feeds and the total starch and NFE content was considerably higher. The FCR of the commercial diet was however in line with industry expectations for fish of this size grown at 29°C.

REFERENCES

Boonyaratpalin M, Williams K (2002) Asian Sea Bass, *Lates calcarifer*. In: *Nutrient Requirements and Feeding of Finfish for Aquaculture* (ed. by Webster CD, Lim CE). CABI Publishing, New York, pp. 40-50.

Booth MA, Allan GL, Russell I (2010) Development of aqua-feeds containing optimal inclusion levels of SBM and SPC for Asian seabass *Lates calcarifer*. In: *Final Report Submitted to the United Soybean Board (USB) New Uses Committee USB Project FY2010 SB0463*. Industry & Investment NSW Port Stephens Fisheries Institute (PSFI), Taylors Beach, NSW, Australia, pp. 59.

Glencross B, Rutherford N, Jones B (2011) Evaluating options for fishmeal replacement in diets for juvenile barramundi (*Lates calcarifer*). *Aquacult. Nutr.,* **17**, e722-e732.

Glencross BD, Bermudes M (2012) Adapting bioenergetic factorial modelling to understand the implications of heat stress on barramundi (*Lates calcarifer*) growth, feed utilisation and optimal protein and energy requirements – potential strategies for dealing with climate change? *Aquacult. Nutr.,* **18**, 411-422.

Knapp J, St-Pierre N (2011) Blood meal variability affects dairy performance. *Feedstuffs,* **83**.

Shearer KD (1994) Factors affecting the proximate composition of cultured fishes with emphasis on salmonids. *Aquaculture,* **119**, 63-88.

Williams KC, Barlow CG, Rodgers LJ, Ruscoe I (2003) Potential of meat meal to replace fish meal in extruded dry diets for barramundi, *Lates calcarifer* (Bloch). 1. Growth performance. *Aquacult. Res.,* **34**, 23-32.

Conclusions - summarize overall value of research results and application opportunities by industry

CONCLUSIONS

Based on outcomes of Trial 2 it is clear that Asians seabass can be fed diets containing low levels of fishmeal and a mixture of 25% SBM and 13% SPC without dramatically affecting weight gain and FCR. However, despite the fact that soy based feeds were formulated to be similar in DP and DE, feed intake appeared to decline in response to decreasing fishmeal content. Similar trends were observed in Trial 1 albeit that data was far more variable. Therefore, to ensure feeds remain palatable to Asian seabass we recommend that diets formulated with 25% SBM and 13% SPC (i.e. 38% soy product) contain no less than 18% fishmeal. In addition, high quality rendered animal proteins such as poultry meal or meat meal should be included to complete the formulations.

The cost-benefit of rearing Asian seabass on a formulation similar to FM18 should be examined in a field-based study. Based on our basic assumptions Asian seabass could reach a marketable size of 1kg only two to three weeks later than fish reared on fishmeal based formulations. This production strategy is applicable to fish reared at a constant water temperature of 29°C. Fluctuations in the ambient water temperature experienced at different farm sites, feeding regimes and ingredient or diet quality will contribute to different outcomes. However, there is an approximately $0.28 difference between the feed cost of producing 1kg of fish on FM55 ($1.19) compared to FM18 ($0.91). This equates to a 23% reduction in cost. Although this represents a significant cost saving, the net return is still higher on FM55. Slight improvements in weight gain of fish fed FM18 would improve the net return of this formulation.

There appeared to be no advantage of adding 5% powdered HP4 (tuna hydrolysate) to diets containing zero fishmeal and elevated levels of poultry meal or diets based on Selecta SPC that contained blends of fishmeal, poultry meal and blood meal. Based on this and previous USB research on feed attractants it is likely that diets formulated with soy products and high levels of animal meal will not require fortification with feed attractants. Proprietary feed attractants are generally expensive thus significant savings can be made if they are not included in feed formulations. Amino acid analysis of the HP4 hydrolysate indicated it was particularly rich in taurine. As a concentrated source of taurine, HP4 or similar hydrolysates may prove useful in diets for marine carnivorous species such as yellowtail kingfish or cobia, especially where animal meals are also being excluded from the diet.

The whole carcass proximate composition of Asian seabass was little affected by the diets examined in Trial 1. Future long term verification trials with Asian seabass fed soy based feeds incorporating animal meals such as poultry meal should also examine potential changes in the fatty acid composition of fish to ensure significant changes to n-3 composition are not occurring to the detriment of consumers.

Future evaluation of SPC in diets for Asian seabass should evaluate these types of products in much the same way as SBM was evaluated in the present study. This way decreasing

fishmeal levels can be assessed in combination with increasing levels of SPC at similar digestible protein and digestible energy ratios.

Table 1. Measured composition of ingredients used in NB712 Asian seabass trials (% as is basis).

	Dry matter	Ash	Organic matter	Fat	WSC‡	Gross energy	Nitrogen	Crude protein	Starch**	NFE
Fish oil*	99.0	na	98.50	98.00	na	38.00	na	na	na	na
Blood meal*	95.1	1.62	93.48	<0.50	<0.50	21.97	14.58	91.12	<2	na
Fish meal*	93.9	14.18	79.72	9.39	<0.50	19.34	10.47	65.44	<2	na
Poultry meal*	96.8	16.65	80.15	17.13	<0.50	20.81	10.19	63.71	<2	na
Meat meal*	93.3	30.04	63.26	11.01	<0.50	15.39	7.48	46.77	<2	na
Corn gluten*	91.4	1.83	89.57	2.38	<0.50	20.02	9.62	60.15	18.28	27.04
Wheat gluten*	93.4	0.75	92.65	<0.50	1.96	20.73	11.94	74.60	11.21	17.58
Cooked wheat*	95.3	2.00	93.30	1.81	2.57	16.87	2.49	15.55	74.33	75.94
Soybean meal (Arg.)†	88.8	6.84	81.96	2.13	6.93	15.98	6.92	43.23	<2	36.60
Soycomil-K SPC (ADM)†	88.9	5.96	82.94	0.71	<0.50	16.62	9.49	59.29	1.78	22.95
Selecta SPC‡	95.0	6.65	88.35	0.48	1.52	18.43	9.52	59.49	6.65	28.38
Aquativ HP4 (SPF Diana)*	96.6	8.21	88.39	7.92	4.35	20.48	9.39	58.68	3.86	21.78
Methionine*	100.0	<0.4	99.80	<0.50	<0.50	23.60	9.23	57.69	<2	41.41
DSM premix*	97.0	40.84	56.16	9.99	2.91	11.35	1.27	7.94	5.82	38.23

*Ingredients sourced from Ridley Aquafeed Pty Ltd (Narangba QLD, Australia). ‡ SPC provided by Selecta Brazil.
† Argentine soybean meal and Soycomil-K as used in previous USB trials.
‡ Water soluble carbohydrate; expressed as amount of sucrose (%) extracted
**Total starch = Non structural carbohydrate (NSC) - water soluble carbohydrate (WSC); Total starch expressed as amount of invert sugar (glucose units).
Nitrogen free extract (NFE) = 100 – (moisture + ash + fat + crude protein).

Table 2. Measured amino acid composition of ingredients used in NB712 Asian seabass trials (mg g^{-1} as is basis).

	Ingredient											
Amino acid	Blood meal	Fish meal	Poultry meal	Meat meal	Corn gluten	Wheat gluten	SBM Argent.	Cooked wheat	SPC (ADM)	SPC Selecta	HP4 (SPF)	Premix (DSM)
Hydroxyproline	<0.35	4.5	21.2	35.9	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	4.0	<0.35
Histidine	56.9	19.2	13.6	9.0	13.3	15.9	12.2	3.7	16.7	15.8	15.2	0.61
Taurine	<0.35	4.6	2.7	0.7	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	16.2	<0.35
Serine	49.7	27.0	30.1	19.9	33.8	36.9	23.7	7.4	33.0	31.5	25.2	1.34
Arginine	38.2	40.8	43.8	38.1	20.9	26.7	33.3	6.7	47.1	44.3	29.6	1.47
Glycine	38.5	38.7	60.0	81.9	18.4	26.3	19.7	6.8	27.0	26.0	32.4	1.73
Aspartic acid	94.4	60.4	47.7	36.8	38.2	24.9	52.1	8.8	71.6	68.5	49.5	1.75
Glutamic acid	81.1	83.7	78.4	59.7	133.5	276.2	83.3	42.9	114.6	108.9	69.9	6.57
Threonine	46.9	29.5	25.2	15.8	22.0	20.0	18.5	4.9	25.7	24.2	26.5	0.8
Alanine	73.2	40.8	38.3	39.4	53.2	19.5	19.5	5.9	27.0	25.5	33.9	1.19
Proline	35.0	26.8	42.6	48.3	57.9	97.3	23.6	14.3	32.5	31.0	25.2	1.89
Lysine	89.5	53.5	38.2	26.1	11.6	11.9	29.4	5.6	41.3	36.9	38.3	0.96
Tyrosine	26.5	20.9	17.4	9.1	27.2	23.7	12.9	2.0	19.3	17.6	15.7	0.52
Methionine	14.9	20.2	12.3	6.9	14.5	11.5	3.4	2.0	7.1	5.6	13.9	0.24
Valine	82.8	36.8	31.4	21.6	30.1	32.2	23.4	7.2	32.9	31.4	34.2	1.17
Isoleucine	7.3	30.2	24.6	13.1	26.0	29.0	21.6	5.5	30.3	29.0	26.2	0.79
Leucine	119.0	50.9	43.6	29.3	103.9	53.9	35.5	10.6	49.9	47.4	41.9	1.53
Phenylalanine	68.7	28.3	24.2	16.6	40.1	38.9	23.4	7.0	32.6	31.8	23.2	1.17
Cysteine**	12.4	7.4	8.4	2.8	12.0	12.0	6.8	2.7	8.6	6.0	8.4	-
Tryptophan**	12.0	8.3	6.2	3.4	5.0	5.0	6.0	1.7	8.2	8.0	6.2	-

Note: dry matter of ingredients as given in Table 1; Cysteine and tryptophan taken from previous USB data or product specification sheets.

Table 3. Formula of experimental diets used in NB712 Asian seabass trials.

Ingredient	D1. FM55	D2. FM28	D3. FM18	D4. FM08	D5. FMZero	D6. FMZero + HP4	D7. Selecta30	D8. Selecta30 +HP4	D11. SBM35 (2010)
Fish oil	10.0	10.0	10.0	9.0	9.0	9.0	10.0	10.0	10.0
Fish meal	55.0	28.0	18.0	8.0	-	-	10.48	10.0	38.31
SBM	-	33.0	25.11	25.27	25.0	25.2	8.0	8.0	35.54
SPC (ADM)	-	4.38	12.26	12.73	13.0	12.8	-	-	-
Cooked wheat	14.7	10.0	10.0	10.0	10.0	10.0	10.0	10.64	10.0
Meat meal	10.0	-	-	-	-	-	2.59		-
Poultry meal	10.0	13.95	18.84	24.07	32.55	28.59	12.27	10.0	5.93
L-methionine	-	0.12	0.18	0.26	0.31	0.3	0.37	0.36	-
DSM premix	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Blood meal	-	-	-	3.62	5.32	3.8	8.0	8.0	-
Corn gluten	-	0.25	5.31	6.75	4.52	5.0	8.0	7.7	-
Selecta SPC	-	-	-	-	-	-	30.0	30.0	-
HP4 (SPF Diana)	-	-	-	-	-	5.0	-	5.0	-
Digestible protein	44.4	41.5	41.9	41.4	40.8	41.0	43.1	43.6	41.9
Digestible energy	17.9	16.8	16.9	16.5	16.7	16.8	16.8	17.0	16.7
DP:DE ratio	24.8	24.7	24.8	25.1	24.4	24.4	25.7	25.6	25.1
Total soy product	0.0	37.4	37.4	38.0	38.0	38.0	38.0	38.0	35.54
Ingred. cost USD	***$1280***	***$1012***	***$973***	***$899***	***$854***	***$978***	***$962***	***$1089***	***$1064***

Diets were formulated on an “as is basis” ingredient composition.

Table 4. Measured composition of experimental diets used in NB712 Asian seabass trials (% as is basis).

Label	Dry matter	Ash	Organic matter	Fat	WSC	Gross energy	Nitrogen	Crude protein	Starch*	NFE**
D1. FM55	94.86	13.09	81.77	16.60	<0.50	21.06	8.25	51.58	10.43	13.6
D2. FM28	93.06	9.03	84.04	15.26	2.98	20.47	7.49	46.82	7.45	22.0
D3. FM18	93.09	8.38	84.71	14.89	2.23	21.04	7.68	48.00	8.38	21.8
D4. FM08	93.17	7.83	85.35	13.79	2.52	20.87	7.95	49.67	7.45	21.9
D5. FMZero	93.50	8.04	85.46	13.93	2.43	20.66	7.84	49.03	4.67	22.5
D6. FMZero+HP4	93.49	7.85	85.63	14.02	2.15	20.66	7.68	47.97	7.48	23.6
D7. Selecta30	94.74	7.29	87.45	13.17	0.66	21.51	8.34	52.11	13.26‡	22.2
D8. Selecta30+HP4	94.84	6.45	88.39	13.75	1.71	21.43	8.24	51.51	7.59	23.1
D11. SBM35 (2010)	92.92	9.39	83.54	14.22	3.07	20.44	7.64	47.74	5.58	21.6
D12. Commercial	96.6	7.73	88.87	11.79	1.45	21.16	7.95	49.69	13.52	27.4

*Total starch = Non structural carbohydrate (NSC) - water soluble carbohydrate (WSC); Total starch expressed as amount of invert sugar (glucose units).

**Nitrogen free extract (NFE) = 100 – (moisture + ash + fat + crude protein).

‡ Unusually high value.

Table 5. Measured amino acid composition of experimental diets used in NB712 Asian seabass trials (mg g^{-1} as is basis).

Amino acid	D1. FM55	D2. FM28	D3. FM18	D4. FM08	D5. FMZero	D6. FMZero + HP4	D7. Selecta30	D8. Selecta30 +HP4	D11. SBM35 (2010)	D12. COM.
Hydroxyproline	8.2	4.5	5.9	5.5	7.0	6.3	4.2	3.1	3.4	3.1
Histidine	14.1	12.8	12.4	14.0	13.8	12.8	15.9	16.1	14.9	15.8
Taurine	3.1	1.8	1.4	1.2	1.0	1.7	0.9	1.6	3.1	0.8
Serine	22.0	22.2	24.0	25.6	25.0	23.9	26.4	26.2	21.4	24.1
Arginine	32.4	31.6	32.3	32.8	32.4	30.7	32.5	31.6	31.5	29.5
Glycine	37.7	28.6	29.7	30.5	32.0	30.1	28.5	26.7	27.5	26.0
Aspartic acid	43.0	46.4	44.8	47.8	46.8	44.9	51.6	51.0	47.4	43.7
Glutamic acid	67.2	74.3	77.6	82	78.4	74.7	83.3	82.2	74.3	71.3
Threonine	22.3	20.0	20.2	21	20.3	19.5	21.8	22.0	20.2	20.4
Alanine	31.4	26.2	27.3	29.3	28.6	27.3	30.8	30.4	26.7	27.2
Proline	26.8	25.1	28.5	30.6	30.4	28.7	29.8	28.7	23.4	26.4
Lysine	36.3	33.7	31.0	32.3	31.5	29.6	34.2	34.1	34.3	32.9
Tyrosine	15.4	13.9	14.6	15.3	14.2	13.2	15.3	14.6	13.6	12.7
Methionine	14.2	9.9	10.2	10.3	9.8	10.5	12.2	11.4	9.9	8.4
Valine	27.9	25.5	25.4	28.0	27.6	25.3	29.7	30.0	25.7	29.0
Isoleucine	22.4	21.8	21.6	21.3	19.9	18.9	20.2	20.4	21.8	16.8
Leucine	38.8	36.7	40.1	44.5	42.6	39.9	48.6	48.4	36.9	42.1
Phenyl	21.9	21.9	23.1	25.3	24.6	22.9	27.7	27.6	21.9	24.1
Cysteine	5.6	6.1	6.6	6.9	7.0	7.0	6.4	6.6	6.0	-
Tryptophan	5.8	5.7	5.6	5.7	5.6	5.5	6.1	6.2	5.8	-
SUMAA	485.2	456.8	470.1	497.6	485.9	460.7	513.6	506.3	457.9	454.2

Note: dry matter of diets given in Table 4; Diet codes as per Table 4; Cysteine and tryptophan based on WinFeed formulation.

Table 6. Mean ± SD performance of Asian seabass reared in Trial 1: 56 days, 10 diets, n=2 replicates, 10 fish per tank

Diet	Harvest weight (g)	Feed intake (g)	FCR	Relative weight gain (g kgBW d^{-1})	Relative feed intake (g kgBW d^{-1})
D1. FM55	289.3 ± 17.4	170.4 ± 0.7	1.04 ± 0.07^{ab}	13.0 ± 1.8	14.2 ± 0.5^{ab}
D2. FM28	308.5 ± 0.4	173.8 ± 2.6	0.97 ± 0.01^{a}	14.7 ± 0.0	13.8 ± 0.2^{ab}
D3. FM18	287.6 ± 13.2	161.0 ± 9.8	1.01 ± 0.03^{a}	13.6 ± 0.8	13.5 ± 0.4^{ab}
D4. FM08	296.0 ± 8.3	163.7 ± 10.3	0.98 ± 0.01^{a}	14.0 ± 0.5	13.5 ± 0.6^{ab}
D5. FMZero	296.8 ± 27.9	169.6 ± 22.1	1.01 ± 0.04^{a}	14.0 ± 1.6	13.6 ± 0.9^{ab}
D6. FMZero+HP4	283.6 ± 2.5	165.8 ± 2.6	1.07 ± 0.02^{abc}	13.4 ± 0.1	13.6 ± 0.4^{ab}
D7. Selecta30	271.3 ± 1.3	165.0 ± 8.3	1.15 ± 0.03^{c}	12.8 ± 0.4	14.1 ± 0.7^{ab}
D8. Selecta30+HP4	265.6 ± 13.6	169.3 ± 15.3	1.23 ± 0.01^{d}	12.4 ± 0.5	15.0 ± 0.7^{a}
D11. SBM35 (2010)	282.6 ± 11.2	173.4 ± 5.5	1.12 ± 0.02^{bc}	13.4 ± 0.2	14.8 ± 0.1^{a}
D12. Commercial	258.5 ± 3.8	143.9 ± 2.2	1.08 ± 0.04^{abc}	11.4 ± 0.5	12.4 ± 0.5^{b}

Data analysed using ANOVA; effect of diet on harvest weight, feed intake and relative weight gain was not significant.
Significant differences between FCR or relative feed intake of different diets is indicated by different superscript letters.

Table 7. Mean ± SD composition of Asian seabass reared in Trial 1: 56 days, 10 diets, n=2 replicates

	Moisture %	Crude protein %	Ash %	Organic matter %	Fat %	Gross energy $MJkg^{-1}$
D1. FM55	70.2 ± 1.7	18.0 ± 0.5	2.9 ± 0.4	26.9 ± 1.3	9.1 ± 1.2	7.5 ± 0.1
D2. FM28	68.9 ± 0.2	18.6 ± 0.1	3.4 ± 0.4	27.8 ± 0.6	9.0 ± 0.2	7.8 ± 0.1
D3. FM18	69.3 ± 0.4	18.4 ± 0.2	2.7 ± 0.1	28.1 ± 0.2	9.0 ± 0.4	7.8 ± 0.1
D4. FM08	69.8 ± 0.2	17.8 ± 0.7	2.7 ± 0.2	27.6 ± 0.0	8.4 ± 0.1	7.5 ± 0.1
D5. FMZero	70.2 ± 0.5	18.1 ± 0.7	2.6 ± 0.2	27.3 ± 0.3	8.8 ± 0.1	7.7 ± 0.2
D6. FMZero+HP4	68.9 ± 0.2	18.4 ± 0.3	3.1 ± 0.1	28.1 ± 0.3	9.9 ± 0.4	7.8 ± 0.0
D7. Selecta30	70.7 ± 0.6	17.7 ± 0.6	2.4 ± 0.4	27.0 ± 0.2	8.2 ± 0.1	7.6 ± 0.2
D8. Selecta30+HP4	69.4 ± 0.1	18.3 ± 0.4	2.7 ± 0.4	28.0 ± 0.2	9.4 ± 0.7	7.8 ± 0.1
D11. SBM35 (2010)	68.8 ± 0.8	18.5 ± 0.4	3.0 ± 0.8	28.3 ± 0.1	8.8 ± 0.3	8.0 ± 0.1
D12. Commercial	69.6 ± 1.8	17.8 ± 0.5	3.3 ± 0.5	27.2 ± 0.3	9.3 ± 0.6	7.5 ± 0.3

Note: Compositional data based on homogenate of 3 whole fish from each replicate tank.
Data analysed using ANCOVA; using carcass weight as the covariate the effect of diet type on moisture, crude protein, ash, organic matter, gross energy or fat content was not significant. All data is presented as original mean ± SD.

Table 8. Mean ± SD performance of Asian seabass reared in Trial 2: 56 days, 6 diets, n=3 replicates, 9 fish per tank

Diet	Harvest Weight (g)	Feed intake (g)	FCR	Relative weight gain (g kgBW d^{-1})	Relative feed intake (g kgBW d^{-1})	Harvest* weight (g)
D1. FM55	476.0 ± 25.2^{a}	265.6 ± 4.5^{a}	0.93 ± 0.08	15.3 ± 0.9^{a}	14.2 ± 0.4	445.2
D2. FM28	456.7 ± 14.3^{ab}	255.9 ± 13.1^{ab}	0.96 ± 0.06	14.8 ± 0.5^{ab}	14.2 ± 0.4	440.7
D3. FM18	447.7 ± 14.4^{ab}	241.0 ± 3.5^{bc}	0.94 ± 0.04	14.5 ± 0.8^{ab}	13.5 ± 0.3	454.6
D4. FM08	430.3 ± 5.5^{b}	230.6 ± 1.3^{c}	0.98 ± 0.02	13.5 ± 0.3^{b}	13.2 ± 0.1	453.2
D5. FMZero	433.3 ± 15.3^{b}	240.2 ± 8.4^{bc}	0.98 ± 0.01	14.0 ± 0.1^{b}	13.8 ± 0.2	441.5
D6. FMZero+HP4	435.0 ± 26.1^{ab}	239.8 ± 12.1^{bc}	0.98 ± 0.02	14.1 ± 0.8^{b}	13.7 ± 0.7	443.8

Data analysed using ANCOVA; using stocking weight as the covariate the effect of diet type on FCR and relative feed intake was not significant.
All data is presented as original mean ± SD. Significant differences between absolute feed intakes or relative weight gains of different diets is indicated by different superscript letters. *Covariate adjusted (absolute feed intake) data on harvest weight of Asian seabass

Introduction: Statement on the rationale and background for the studies

ACTIVITY 4 – VISIT TO SOUTH EAST ASIA TO DISSEMINATE USB RESEARCH

Travel to SEA was undertaken from 21 May – 1 June 2012 and the itinerary was in large part arranged by Lukas Manomaitis (ASA-IM SEA Technical Director Aquaculture). At his request Dr Booth prepared 4 power point seminars to present to 3 stakeholder audiences in SEA (Bangkok, Ho Chi Minh City & Jakarata). These groups were mostly composed of feed ingredient suppliers, technical specialists, aquafeed nutritionists, aquafeed company managers and some government researchers. The length of individual seminars ranged from 45-75 minutes in duration and covered topics on 1) USB Research on Asian seabass; 2) Nutrient Requirements of Asian seabass; 3) Ingredient Assessment and 4) The Australian Asian seabass Industry. In addition to the seminars Dr Booth also provided ASA-IM SEA with a thorough list of peer reviewed literature on nutritional studies with Asian seabass. This "Asian Sea Bass Reference Collection" was placed on the ASA-IM SEA website and password protected to retain "fair use" of copyrighted material (http://tinyurl.com/7a8bbep).

Apart from the presentation of USB research on Asian seabass, Dr Booths travel to SEA also aimed to identify potential farmer collaborators and feed manufacturers willing to participate in verification trials testing soy based aquafeeds for Asian seabass. To this end field trips were undertaken to Asian seabass farms in Thailand, Vietnam and Indonesia and meetings were conducted with several feed company representatives. A suitable partner group was established in Vietnam (Nha Trang) following Dr Booths return to Australia and a research funding proposal for a verification trial with Asian seabass was submitted to the USB New Uses Committee in late 2012.

Studies completed - brief summary of the number and type of studies conducted, including general study design and approach on how and where the studies were conducted, but without details of the materials and methods

The following activities were undertaken as part of Activity 4:

1) Field trips to Asian seabass and or marine finfish farms in Thailand, Vietnam and Indonesia.
Detailed notes on field trips and meetings with famers and feed manufacturers are included below.

2) Preparation and presentation of USB research and nutritional information on Asian seabass in Bangkok, Ho Chi Minh City and Jakarta.
Copies of the four seminars can be viewed at the ASA-IM website(http://tinyurl.com/7a8bbep)

3) Preparation of a reference collection on relevant nutritional studies on Asian seabass for ASA-IM SEA website.
Please see reference collection at ASA-IM website (http://tinyurl.com/7a8bbep).

4) Liaison, preparation and submission of 2013 research proposal for verification trials with Asian seabass in Nha Trang, Vitenam.
As submitted to the New Uses Committee for consideration in October 2012.

Results - sequential summary of results, ending with recommendations on soy diet formulations, feeding protocols, economics and other related recommendations

DETAILED NOTES OF TRAVEL IN SOUTH EAST ASIA

THAILAND ITINERARY

Monday 21 May 2012
Travel from Newcastle to Sydney. Travel from Sydney to Bangkok. Arrive Bangkok airport and take taxi to from airport to Somerset Sukhumvit Thonglor serviced apartments. Check in and then meet Lukas Manomaitis for dinner. Retire.

Tuesday 22 May 2012
Picked up by Dr Siri Ekmaharaj (ASAIM Local Coordinator Aquaculture - Thailand Representative). Pick up Lukas Manomaitis and head out from Sukhumvit District on field trip to visit two Asian seabass farms on the Bangpakong River, The first was located in the Bangpakong District at the southern end of the Bangpakong River. The second farm was approximately 60 km up-river in the Bang Khla District. Both Districts a part of the Province of Chachoengsao. On route to the first meeting we picked up Pramote Sangsuksirikul (Pramote Farm) from a roadside service centre.

Meeting #1 Sutin Farm, Bangpakong, Chachoengsao, Thailand
Arrive for meeting with Asian seabass grower (Mr Sutin Wutisin) at Sutin Farm on the Bangpakong River. Exchange formalities and commence discussions on farm issues. Pramote acted as translator. Mr Sutin has been in business for 30 years. Salinity ranges from near freshwater (about 4 months) to seawater depending on the time of year. Using Lee Pattana Co. brand feed 5mm (cheapest) but also using Thai Union. Since 2008 have only been using pellets after moving away from feeding trash fish. Seems to think that Asian seabass fed Thai Union feeds are too fatty and feed from CP (Charoen Pokphand) is not stable. Survival generally averages about 30% but has been as low as 10%. Fish appear thin and emaciated; often die in ones and two's (chronic morbidity / mortality). Farmer has about 104 cages.

Feed conversion on pelleted feed in 2008 was about 2:1. In 2010 more like 2.2:1. At times FCR has been as high as 3.2:1. Uses only floating feeds with feeding frames installed within cages. Fish are fed twice daily to apparent satiation judged by cessation in feeding response; once at 0600h and again at 1700h. Owner claims to be feeding about 12kg feed per tonne of fish delivered over approximately 3 minutes. This equates to about 1.2% body weight per AM and PM feed. Close to 2.4% of total body weight per day (this seems high?; could induce poor FCR). Disease treatments are delivered by top-coating feed pellets with the drug (apparently oxytetracycline). Additional premix of vitamins and minerals is sometimes top-coated onto pellets during disease outbreaks.

Water quality is never measured? Sometimes fish are taken to the Fisheries authorities to help identify parasites or diseases they cannot diagnose themselves. The owner expressed concerns about environmental issues in the river and as a result of the recent flood events.

Market weight averages around 0.68kg. Fingerlings are stocked at about 80mm (4 inches) and harvested at between 0.7-0.9kg after about 8 months growth. Cages are 4x4x2m and are generally stocked with about 3000 fingerlings. Grading is undertaken once a month and continues during grow-out. About 800 fish per cage at harvest weight (50 fish m^{-2}). Receiving about $TBH 200 per kilogram for Asian seabass.

Mr Sutin wasn't quite sure what defines a high quality feed. He is interested in a "good formula" but it was apparent he did not really know what this meant. Primary concern is to produce fish with a good meat quality followed by fast growth then by good market price. Inspection of feed specification tags revealed Thai Union feeds had a crude protein of about 36-42% and a fat content of about 7-8%. Feed is stored for up to 3 months but apparently there are no mould problems.

Mr Sutin felt that catfish industry led to deterioration in the environment surrounding his farm. The loading of cages along the river is at about maximum now. The farm set-up deals with a 2.5m tidal fluctuation, being as low as 1m and 14m at the bank and open side of the lease at low tide, respectively.

Number and proximity of cages appears to be an issue. Water quality is likely to be very poor at this site (n.b. it is also close to several large commercial / industrial sites) and water exchange is likely to be very limited due to the overcrowding of cages and their proximity to one another. The cages are also flanked by other farms at either end which no doubt exacerbates issues with water flow. Feed is stored in pickle barrels in crudely built structures located close to the cages to make feeding easier. These are a good idea as they keep pellets dry and restrict losses due to vermin such as water rates and birds. However, sealed drums can cause feed to "sweat" if humidity and temperature is variable. The owner crowded some Asian seabass into one corner of a net in order for us to inspect the fish. They appeared a little on the lean side but there were no outward signs of disease or infection. This site would not be suitable for running trials.

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Meeting #2 Bangpakong Farm, Bangkhla District, Chachoengsao, Thailand
Arrive at farm for meeting with second Asian seabass grower, Mr Rungrot Thongsima (Farm Manager), a young very bright fellow. Farm is growing 3 species; Asian seabass, red tilapia and black tilapia. Farm has been in operation for about 9 years and is located on the Bangpakong River, but much further inland from the river / estuary mouth (60km by road). Thus water quality should be a little better? Water almost fresh but can reach 12ppt (max) at certain

times.

Farm had about 200 cages in the river. No Asian seabass are cultured in ponds (except for nursery stages where fish are grown for a short period in cages in ponds). Mr Rungrot explained that Asian seabass fingerlings are purchased at about 1cm length and placed into nursery tanks for weaning onto pelleted feeds. After this they are transferred to cages in the ponds and then later to the river cages. Approximately 1000 x 50mm fingerlings are stocked into 4x2m cages and fed "CP" brand. Weaning small fish is conducted by feeding a mix of Artemia and small micro-pelletized CP diet (possibly INVE 800um). Survival of fish between 1 and 3 inches is around 50% while survival of fish greater than 2 inches is about 70%. Fish are grown for about 7months and harvested at between 0.4 and 1.0 kg. FCR is typically 1.5:1 on CP feed. FCR tends to be controlled by feeding around 80-90% satiation. Feeds are offered twice daily at 0700h and 1800h. Asian seabass are cultured all year round and graded every couple of months. Asian seabass fetch about $TBH 200 per kg. Feed cost about $TBH 40 per kg.

Mr Rungrot indicated that there are some problems with diseases such as Aeromonas sp. as well as Strepp and some parasites. There are no issues with Nodavirus. Mr Rungrot stated that CP feeds produced a leaner fish, Lee Pattana produced a fattier fish and Thai Union feed was not stable in water.

The overall farm operation now appears to be more focused on rearing tilapia. Red tilapia is returning FCR of 1.2:1 and black tilapia are returning an FCR of 1.2:1. Some mention of polyculture of shrimp and tilapia. CP has a contract with the farm and provides the farm with tilapia as well as feeds for the tilapia. This arrangement applies only to the tilapia side of the business. The farm also acts as a delivery agent for CP feeds to other farmers. Tilapia farm is a "2 step" process. Farm grows 50g fingerling tilapia for sale as well as grow-out of fish to 0.5-0.7kg. The cost of electricity to run aerators in ponds (24h a day) is about $TBH 60,000 per month. Farm also runs and operates a guest house for tourists. This farm was more professional than Sutin Farm, but would not be suitable for Asian seabass trials due to the strong focus on Tilapia and the fact it is located in the freshwater reaches of the river.

Wednesday 23 May 2012

Seminar series #1, Swissotel Le Concorde, Bangkok, Thailand

Travel from Somerset Hotel via sky train and underground rail to Swissotel Le Concorde Hotel Bangkok with Lukas Manomaitis. Present three seminars (Ingredient Assessment, Nutrient Requirements & USB Research on Asian Seabass) to audience of approximately 35 persons in the Jamjuree Room between 0900 and 1300h. Following presentations attend luncheon at Swissotel Le Concorde Hotel with participants. After luncheon discuss possibility of conducting verification trials in Thailand with Dr Mali Boonyaratpalin and Tamtin Montakan (DOF Thailand). Return to Somerset Hotel.

VIETNAM ITINERARY

Thursday 24 May 2012

Meeting #3 Research Institute for Aquaculture Ho Chi Minh City, Vietnam

Depart Thailand and travel to Ho Chi Minh City, Vietnam. Check into Sheraton Hotel and contact Hsiang Pin Lan (ASA-IM Regional Marine Aquaculture Contractor). Arrange to travel to Ministry of Agriculture and Rural Development Research Institute for Aquaculture No. 2 (RIA

#2, Ho Chi Minh City) to meet Dr Nguyen Duy Hoa (Head Division of Research Management). Email hoaria2@yahoo.com. RIA#2 has water quality, micro, pathogen / disease and nutrition laboratories on-site. Also have mini extruder mill for pellet making.

Present at meeting were Dr Mark Booth, Hsiang Pin Lan and Dr Nguyen Duy Hoa. Conduct afternoon meeting and informal seminar on USB Asian seabass research. Dr Booth presented power point summary of USB Asian seabass research to Dr Hoa using a laptop. Discussions lasted approximately 3 hours. Dr Hoa did his PhD on domestication of black tiger shrimp *Penaeus monodon*. Dr Hoa has professional links to Dr Nigel Preston, Dr Brett Glencross & Brett Coleman (CSIRO, Australia) and Mike Rimmer (ACIAR, Australia).

Discussion then held on the state of the Vietnamese aquaculture industry. Discussed need for ASA-IM Manager in Vietnam. Dr Hoa indicated that a salary of about US $5000 would be required to secure that position. SPC available in Vietnam in 2 grades; American 64% CP and Brazil 60% CP. Other imported ingredients include poultry meal, blood meal (spray and ring dried) meat meal and feather meal. Discussions about melamine in fish meal.

Pangasius production is thought to be close to 1.1 million tonnes per annum. This industry is suffering from some mortality and recent drop in price. Some shrimp farmers are switching to Asian seabass due to disease issues in shrimp. However, diseases are also occurring in pond grown Asian seabass. Asian seabass production thought to be about 3,300 metric tonnes based on VASEP data (Seafood Export Association). Asian seabass stocked at 3, 10 and 15g fingerlings. There is a lot of size variation in ponds and market ready stock. No nutrition projects currently running on Asian seabass in Vietnam, however RIA#3 is looking at brood-stock issues and genetics in the hope of improving fingerling quality and survival (contact Dr Phuong). Dr Hoa phoned a colleague (Mr Liam?) while we were there to get some information on the South Vietnamese Asian seabass industry. This contact estimated that about 3 million x 10g fingerlings were stocked in 2011/12. A lot of farmers were very inexperienced but farms were expanding requiring somewhere between 10 to 15 million fingerlings in 2012/13. Local farmers need training on grow-out technology and disease management!

Friday 25 May 2012

Seminar series #2, GreenFeed Vietnam Corporation, Ben Luc District, Long An Province, Vietnam

Meet in foyer of Sheraton and travel by car to Green Feed Company Mill to present three seminars (Ingredient Assessment, Nutrient Requirements & USB Research on Asian seabass). Present were Hsiang Pin Lan, Dr Mark Booth, Tran Trong Chien (US Grains Council & ASA-IM), Dr Tri Nhu Nguyen (Nong Lam University HCMC; expert translator). Introduction and short seminar by Hsiang Pin Lan. The participants (≈45) were mostly feed company nutritionists. Start seminars at 0850h hours and finish at around 1400h. Luncheon with participants after meeting and then return to Sheraton. Green Feeds main products are Pangasius feed. Production of 2000 ton/month fingerling feeds and 10000 ton/month grow out feeds. Produce about 1000 tonne/month Tilapia feed. Marine fish feed produced to order. In peak season produce about 1500-tonne/month and as little as 200 tonne/month in low season. There are 4 Green Feed Mills in Vietnam and one in Cambodia. The Feed mill in Ben Luc District is the only one than can process fishmeal.

Saturday 26 May 2012

Travel from Ho Chi Minh City to Nha Trang with Hsiang Pin Lan and Tran Trong Chien. Arrive in Nha Trang and travel directly to office of Jorge Alarcon (Marine Farms Vietnam).

Meeting #4 Marine Farms Vietnam, Khanh Hoa Province Vietnam

Visit to Marine Farms Vietnam Office in Nha Trang City. Present at meeting (1400-1530 h) were Jorge Alarcon General Manager (Marine Farms Vietnam), Dr Mark Booth (NSW Department of Primary Industries), Tran Trong Chien (ASA-IM & US Grains Council) and Hsiang Pin Lan (ASA-IM Asia Marine Specialist). Meeting commenced with Hsiang giving background on reason for visit and roles of Dr Booth and Tran Trong Chien.

Jorge Alarcon was a student of Daniel Benetti in the Caribbean and previously worked at Marine Farms in Belize. He is university trained with a degree in marine biology and has an extensive background in marine aquaculture and marine hatchery. He was appointed as the General Manager of the Vietnam operation after it nearly failed due to poor FCR, poor survival and a raft of other operational issues. He has been with Marine Farms for nearly 9 years.

Marine farms commenced cobia farming in Vietnam in 2006/2007 aiming to develop markets in the United States (high value white table cloth). Original aim was to reach production of about 1000 metric tonnes per year in Vietnam. Sales into the USA were difficult and the demand / volume were generally low. Some marketing such as secret ingredient on "Iron Chef" aimed to promote cobia into the market. Sales into the USA peaked at 10 metric tonnes per week.

Problems with the early cobia operation in Vietnam soon appeared; high economic FCR and scale-up costs were high. There were also many supply issues with local hatcheries as the company was looking for approximately 250,000 cobia fingerlings. Local feed quality was variable and unpredictable. Morpol took over operation in 2010 as well as the seabream and seabass operations held by Marine Farm to consolidate the enterprise and focus on Atlantic salmon. Only the cobia operation in Vietnam was retained (note: a large hurricane in Belize destroyed most of the infrastructure related to cobia culture in the Caribbean). Marine Farms retains a cobia hatchery in Belize and hopes to build a state of the art facility in Vietnam if the production side of the business succeeds.

Jorge Alarcon stated that the Management decided to give the Vietnam cobia operation one more chance (i.e. the time Jorge Alarcon was appointed) to succeed with the primary goals of demonstrating the business could improve overall production and reduce mortality. Sales and marketing were secondary goals, but the business was required to make enough sales to break even. The 2011/2012 season is looking very promising. To diversify, the farm also commenced growing Pompano and also has plans to expand into Asian seabass (50,000 fingerlings already stocked). Target weights for cobia are about 3.5-4.0kg within 10 months. FCR gets progressively worse in fish larger than 4kg and seems impossible to control through feeding, especially on pellets. 1.5 million Pompano and 250,000 cobia fingerlings were stocked from a mix of local and other hatcheries.

Major issues with cobia include "winter syndrome" where water temperatures drop rapidly from 29°C to about 24°C due to cold fronts sweeping across the coast. The cold shock syndrome seems to be much worse for juveniles than adult cobia. There are some disease

issues (probably Nocardiosis) identified in larger stock as well as ulcerous stones “cobia pearls” (mostly in brood-stock). The Business is now using a new stocking regime to overcome winter syndrome in stocked fingerlings; i.e. stock no later than July.

Quality of pelleted feeds is a big issue. Mostly using Ocialis feeds at present but have tried nearly every other feed available (Skretting, Cargill, EWOS, Uni President). General Manager feels quality of feeds available in Vietnam very poor and ingredient quality also an issue. However he feels feed quality is slowly improving.

Using a new feeding strategy to control poor FCR in larger fish; i.e. Company feeds pellets until FCR starts to climb and then feeds a mix of pellets and trash fish (frozen minimum 3 weeks) and eventually only trash fish. The Company ran a small un-replicated trial where cobia were fed trash fish vs pellets and the fish fed on trash fish were double the weight of pellet fed fish by the end of the trial (4kg body weight vs 8kg body weight). Overall condition of trash fed fish was superior to pellet fed fish.

At present the Pompano part of the business has limited the cobia production at a time when demand for cobia is high. Cobia is sold to Japan, Korea, and fresh to Australia. The business has recently diversified into Asian seabass; Company thinks they have potential and market demand in Vietnam is high at present. Marine Farm is located near to Australis Barramundi farms but has little to do with them.

Discussion were held on possibility of running verification trials on Asian seabass at Marine Farms. Jorge Alarcon stated he would be interested in running replicated cage trials with Asian seabass on his farm to evaluate new USB / ASA-IM soy based diets for this species. He indicated they could probably provide replicated 5x5 cages for 5 to 6 diets with several hundred fish in each cage. He has the research and technical expertise to make this possible. However, we were not able to visit the farm site to inspect cages or the operation so follow up will be required.

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Meeting #5 Khatoco Khanh Hoa Feed Factory, Ninh Hoa District, Khanh Hoa Province, Vietnam

Depart Nha Trang and travel by car (more than 1 hour) to meet Director and Technological Manager of Khanh Hoa Feedmill. Tran Trong Chien acted as translator at this meeting. Present were Dr Mark Booth, Hsaing Pin Lan, Tran Trong Chien, Nguyen Thien Phong (MBA) (Director, Khanh Hoa Feed Factory), Tran Quang Hai (Technological Manager). When we arrived we were informed the mill was not operating today. Meeting conducted in Directors office. Commenced with everyone introducing themselves and why we were visiting the mill etc. After a brief discussion we were taken on a tour of the mill and shown the pellet mill and

ingredient storage areas. Feed mill has basic laboratory for analytical work and quality assurance (QA) of feeds and ingredients. After the tour we returned to the Directors office to complete the discussions. Hsiang Pin Lan presented slides on some ASA-IM formulations. Meeting continued till 1830h. Recommendations included need for training in aquafeed production and ingredient selection. This mill could probably make shrimp feed based on equipment they already have. ASA-IM will try and assist in pushing this along.

This mill does not produce aquafeeds yet, but are keen to learn how to produce aquafeeds as soon as possible. At present they are producing pelletized feeds for ostrich, duck, pig and chicken. Capable of producing about 10 tonnes feed per hour. The business is 40% State owned and growing at about 20% per annum according to the Director. They have about 130 staff. Director said there is a lot of competition for feeds and a huge demand for freshwater and marine aquaculture feeds. The Director stated that Asian seabass farming not very successful in the Nha Trang area. Most farmers are culturing fish in old shrimp ponds less than 1m deep where water quality is poor. Most have experienced high mortality, low yield and poor performance. Sea cages seem to have better outcomes. Asian seabass are mostly being fed on trash fish. There is a big demand for quality product.

Feed mill stores included US SBM (apparently), soy lecithin, phytase, several types of local and imported fishmeal 55 – 65% CP. Imported fishmeal (Pesquera branded) and kept in air conditioned store. There was a large quantity of amino acids and other supplements such as taurine also stored in cool rooms. Other basic ingredients stored in bags (20-40kg) and stacked meters high. Hard to see how turnover was maintained. Mr Phong indicated he could organize farmer co-operators running small sea-cage farms in the Nha Trang area for verification trials with Asian seabass. Return to Sheraton Nha Trang.

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Sunday 27 May 2012

Meeting #6 Small scale marine cage farms, Vinh Luong Community Ward, Nha Trang City

Check-out of Sheraton Nha Trang and travel about 45 min to Long Phu Tourist Joint Stock Company to meet local provincial / government officials and prepare for farm visits. Tran Trong Chien acted as translator at this meeting. Farm visit and transport was arranged by

contacts of Mr Nguyen Thien Phong (MBA) (Director) from the Khanh Hoa Feed Factory. The tourist marine park is another enterprise of the Khatoco Company. Present were Dr Mark Booth, Hsiang Pin Lan, Tran Trong Chien, Le Dung Lam (Director Long Phu Tourist Park), Mr Toan (Party Chairman, cage village) Tran Quang Hai (Technical Manager Khanh Hoa Feed Factory. The park manager Mr Le Dung Lam provided one of his very fast boats to take us to the offshore farms. Two family operated farms were inspected. Various species were being grown including cobia and grouper. Trash fish was being used to feed most of the juvenile fish, but some small pellets are used when available. Trash fish caught around cages using bait fish traps etc. Farms all about same in terms of design (raft culture), incorporating 20-30 cages of 3x3x3m attached to home made frames of wood, bamboo and plastic pickle drums. Nets were generally heavily fouled. Not recommended to run verification trials at this location. There were only small quantities of Asian seabass being grown at this location. After visiting the farms we were taken to a nearby island resort for lunch. Afterwards we returned to the tourist park and were driven directly to Nha Trang Airport to return to Ho Chi Minh City, ready for departure to Jakarta (Indonesia) the following morning.

Contact information:
Mr Toan
Chairman / Village Leader
Manger of Collective Farms
Local Authority

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INDONESIAN ITINERARY

<u>Monday 28 May 2012</u>

Depart Ho Chi Minh City (Vietnam) and travel to Jakarta (Indonesia) via Singapore. Arrive at Jakarta Gran Melia Hotel approximately 1945h and make contact with Hsiang Pin Lan. Confirm arrangements for Tuesday & Wednesday.

Tuesday 29 May 2012
Meeting #7 Cargill Animal Nutrition, Jakarta Office, Indonesia
Travel from Gran Melia Hotel to Cargill Office in Jakarta CBD. Travel with Hsiang Pin Lan, A. Ali Basry (ASA-IM USB Indonesia Representative Office) and Dr Gede S. Sumiarsa (ASA-IM Local Coordinator Aquaculture). Meet with Cargill staff and three major finfish producers totaling about 15 persons. Hsiang Pin Lan introduced reason for visit and gave short presentation on ASA-IM goals and vision etc. Dr Booth presented seminar on Australian Asian seabass industry which was followed by a group discussion involving all participants. Discussion topics centered around Asian seabass included VNN and vaccinations (being trialed by Intervet in Indonesia), streptococcus, supply of fingerlings (Singapore / Indonesia), difficulty in registering vaccines in

Indonesia, in feed treatment of antibiotics, fatty pale colored livers in cultured Asian seabass (CHO issues?) and the need for a health examination workshop.

About 5000-6000 tonnes of Asian seabass are grown in Indonesia per year (2000 tonne from seacages). Production costs seem to be close to those in Australia. Questions on Australis in Vietnam; Dan Fegan (Cargill) doesn't think they are going very well. Farmers are not happy with their feeds. Disease is still the biggest challenge, survival rates an issue, both floating and sinking feeds used, adding vitamin C. Most marine feeds target all species and are not designed for specific fish. Value of pond feeds vs sea cage feeds also an issue. Generally not a good idea to feed pond feeds to marine fish! Indonesian farmers are also facing a lot of competition from Asian seabass imports from Malaysia and Thailand. Pond based exports tend to be poor quality. Discussion on appropriate fat levels for different size Asian seabass (Madam Esther Satyono, Indonesian Mariculture Industries)

Seminar series #3, Gran Melia Hotel Jakarta

Return to Gran Melia Hotel in preparation for afternoon seminars. There were about 20 participants, mostly feed company nutritionists from various companies including Cargill and JAPFA. The seminars and plan of the afternoon was introduced to the participants by Hsiang Pin Lan. Dr Booth presented three seminars (Nutrient Requirements, USB Research on Asian Seabass and Update on the Australian barramundi industry). Start seminars at about 1300h and finish around 1700h including question time.

Wednesday 30 May 2012

Meeting #8 Nuansa Pramuka Island (Gosong Pulau Pramuka, Kab.Adm Kep. Seribu), Indonesia

Field trip to seacage farms north-west of Jakarta. Present were Hsiang Pin Lan, Dr Mark Booth, Dr Gede S. Sumiarsa (ASA-IM Local Coodinator – Aquaculture), Handiman (ASA-IM), Martin Hadinoto (General Manager Nuansa, Nusa Resto). Depart Gran Melia Hotel and travel about 1 hour to Ancol Port. Board a very fast boat for the 50km trip to the outer reefs. The water in Jakarta Bay was very dirty. Improved markedly the further north we travelled.

Visited Pramuka Island (Gosong Pulau Pramuka, Kab.Adm Kep. Seribu). Met with the General Manager Martin Hadinoto to discuss his operation. He was schooled in Perth, Australia. His operation about 10 years old. Combined farm and restaurant/tourism business. Prawn hatchery for Vannamei (brood-stock from Kona Hawaii; 200 pairs producing 5 million nauplii a day). They are doing there own plankton production. Juvenile fish are nursed as fingerlings in tank and raceway systems before stocking into seacages (raft culture). Growing milkfish represents about 80% of the grow-out operation. The remaining 20% consists of Pompano, Asian seabass, grouper and genetically selected saltwater tilapia (new project). Mr Hadinoto has about 70 staff; many live on the small coral atoll.

They source their Asian seabass fingerlings from Bali. About 80% of feeding is done using dry pelleted feeds and the other 20% is trash fish or offal. Tiger grouper are also fed pellets when trash fish is not available. They can make their own pellets from restaurant kitchen waste (fish off-cuts, heads and offal etc) + 1%CMC. Sun dried on jetty. Asian seabass are fed a 50% crude protein diet. They will sometimes use Otahimi feed for juveniles costing about $70,000 IDR/kg. Usually use cheaper feeds with 40% crude protein from Grobest costing $13-14,000 IDR/kg. They buy feeds based on price not quality! Water temperature at this site is 27-29°C year

round. The specifications on bag of Asian seabass feed were 42% crude protein, 12% fat, 13% ash and 10% moisture. Mt Hadinoto stated he has done feed trials at this location before, but they failed due to feed supply issues. Logistics: boats generally leaving Jakarta 2-3 times daily. Best site seen for verification trials in terms of water quality and cage set-up. Mr Hadinoto was contacted by Dr Booth on his return to Australia to see if he was interested in running verification trials with Asian seabass at his farm, but he failed to return emails. Follow up required.

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Meeting #9 PT. Lucky Samudra Pratama Farm, Pompano sashimi, Indonesia

Depart and travel further north to Lucky Samudra Pratama Farm. Meet with Misai Tsai (President Director) for informal discussions and tour of his farm operation. Misai was also present at the Cargill meeting. Misai is a Taiwanese national. Present were Hsiang Pin Lan, Dr Mark Booth, Dr Gede S. Sumiarsa (ASA-IM Local Coodinator – Aquaculture), Handiman (ASA-IM) and Misai Tsai (President Lucky Samudra Pratama).

Species cultured at this location include Pompano, Asian seabass, red snapper (Lutjanidae) and Giant grouper. On face value appears a very good operation with a mix of different cage types; square pontoons and 20m polar circles. A great deal of staff was on hand. On arrival we had to sign in and then pass through a quarantine hand-wash station (no foot bath). On arrival saw catching and bleeding of Pompano (1.5kg) and immediate icing. Farm workers were washing biofouling from nets with pressure cleaners; however this was close to grow-out cages?

At present Misai Tsai is using Uni President Feed (45% crude protein and 3% fat; floating eel formula) to feed Pompano to ensure the meat quality of the sashimi meets their texture, flavor and taste requirements. Pompano production is about 500 tonnes per year but they have concessions allowing an increase to 1500 tonnes. They currently have Asian sebass fingerlings in quarantine and were bathing them in small outdoor tanks (possible strepp treatment?). The plan is to initially stock 40,000 Asian seabass fingerlings increasing to 500,000 in the future. They also plan to develop brood-stock from this initial batch of fingerlings when they reach maturity of 2-4kg. They aim to produce their own Asian seabass fingerlings on-site.

Misai indicated his farm has a fish in fish out (FIFO) ratio of 4:1 on pompano which he needs to reduce to retain his green credentials (GEDEP). He is trialing seaweed culture to offset his carbon footprint and demonstrate his company's willingness to green their operation and be sustainable. This site is a long way from Jakarta and geared very much towards commercial production of fish. Verification trials at this site would be difficult logistically and may interfere with the commercial enterprise.

Contact information:
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Thursday 31 May 2012
Breakfast with Hisang Pin Lan and debrief. Work on USB report (Gran Melia). Check out of Gran Melia and travel to Jakarta airport. Depart for Sydney 2345h.

Friday 1 June 2012
Arrive Sydney and return to Newcastle. End SEA travel.

Conclusions - summarize overall value of research results and application opportunities by industry

CONCLUSIONS

USB research on Asian seabass and seminars on the nutrient requirements of Asian seabass, ingredient assessment and the Australian seabass industry were successfully delivered by Dr Booth (NSW DPI) in Thailand, Vietnam and Indonesia at seminars and meetings organized by Lukas Manomaitis (ASA-IM SEA Technical Director Aquaculture). Feedback on the content, duration and delivery of material was positive. This approach to the dissemination of USB and ASA-IM research on the use of soy products in aquaculture feeds encouraged the participation of feed mill representatives, nutritionists and famers in collegiate and informal surroundings. This opportunity was well received by all participants and similar dissemination strategies to promote the use of soy products in aquafeeds should be adopted wherever possible.

Good husbandry, understanding of water quality, fish health, proper feeding techniques and feed storage is lacking in the management of many small-scale finfish farms. These areas could be improved considerably through training and workshops. Targeted workshops could be conducted by ASA-IM SEA representatives allowing opportunities to build technical relationships and the soy in aquaculture brand. There is also scope to assist the development of extruded feed technology in the Nha Trang area, which currently relies on traditional steam press to produce pelleted feeds.

A new research funding proposal for a verification trial with Asian seabass was submitted to the USB New Uses Committee in October 2012 as a direct result of Dr Booth's travel to South East Asia. This proposal has subsequently been approved and research will commence on use of high soy feeds in diets of Asian seabass in 2013 in Nha Trang, Vietnam. Major collaborators in this research include NSW DPI, Marine Farms Vietnam and Ocialis Feed Company.

It is envisaged that the high-soy, low-fishmeal diets selected for the verification trial in Nha Trang will be based on modifications of the formulations examined in Activity 1 (see above). New formulations will accommodate availability and choice of local feed ingredients and be designed to satisfy feed manufacturing constraints outlined by Ocialis Feed Company.