

NSW Eel (*Anguilla reinhardtii*) Project

New market and product development progress report

Jayne Gallagher, Andre Gorrissen, Dr Joanne Freeman

April 2022



Honey & Fox

Disclaimer

Created by Honey & Fox for the Fisheries Research and Development Corporation as part of the project 2018-087 Maximising the value of the NSW Long Fin Eel catch through a whole of supply chain approach.

The information in this publication is intended for general use to assist public knowledge and discussion and to help improve the development of the NSW Eel industry. You must not rely on any information contained within this publication without taking specialist advice relevant to your particular circumstances.

While all reasonable care has been taken in preparing this publication to ensure that information is true and correct, Honey & Fox gives no assurances to the accuracy of any information in this publication.

Table of Contents

Purpose	4
Background	4
Product development trials	4
Smoke Trap Eels	4
Bellingen Smokehouse	5
Noosa Seafood Market	5
2020 trials	5
2021 trials	6
Recovery rate and commercial viability	9
Market Development Opportunities	10
Conclusion	10
Recommendations & Next Steps	11

Purpose

This document outlines the progress of the project to identify potential new eel markets and products. This includes the results of trials with four eel processors as part of the project. All four are niche businesses. Noosa Seafood Markets, The Wild Man Food, Smoke Trap Eels, Bellingen Smokehouse

Background

The impetus for this project is the underutilisation of the NSW eel fishery. New markets and product development opportunities are being explored to re-establish the commercial viability of the NSW eel fishery. The major focus is on export markets as consumer and chef demand for eels is extremely low. While the global shortage of eels presents an opportunity for market development, this will require investment in new processing and/or holding facilities which in turn is dependent on economics.

Key fisheries characteristics that impact the options for the development of commercially viable value-added products are summarised below.

- An interim total commercial access level (ITCAL) of 139.9 t was introduced in 2017 and will remain in place until transitioning to an adjustable TAC in 2024.
- Current harvests are about 1% of that amount as there is no market. If a market was established at the correct price, this would increase % of the ITCAL caught.
- Fishers will normally catch eels while they are fishing for something more valuable. They would go and target if the price was right. It all comes down to price and demand.
- Commercial catches rapidly increased in the early 1990s to supply a newly

- established live export market to China and peaked at 167 t in 2000/01.
- After a sharp decline in the early 2000s, catches remained at around 80t until the last four years when the export market failed and processing facilities closed.
- Catches decreased from 82.6 t in 2014/15 to 8.2 t in 2018/19. The New South Wales commercial fishery targets the fully pigmented sub-adults or 'yellow eels' that return to estuaries on their migration back into freshwater systems. It does not permit any fishing above tidal waters.
- Most of the commercial catch is taken by eel trapping in the Estuary General Fishery (EGF), with seven main estuaries on average accounting for 73% of the catch.
- The legal minimum size is 58cm, so we can supply anywhere upwards of that size. They range significantly depending on the time of year, catch area and weather (freshwater flushes, etc).

In August 2019, discussions were held with eel fishers regarding their expectations for this project. It was clear from the fishers that their preference was for a solution for a total "run of catch". This approach would enable them to harvest eels based on size (above the minimum size) and then supply them to the market ungraded and unprocessed. Their price expectation was \$12/kg nett back to the fisher.

Product development trials

Smoke Trap Eels

Nik Hill from Smoke Trap Eels has developed a small range of smoked eel products principally sold through his restaurant in Sydney. He has a limited distribution to other venues within the Sydney region.



This slows down the processing due to staff needing to be extremely careful with the product.

Bellingen Smokehouse

Bellingen Smokehouse trialled smoking the product (see Fig 1). They assessed that the end product was “ok”. The company is not particularly interested in continuing to develop this product commercially currently. This may change in 2022.

Fig 1: Smoked eel product from Bellingen Smokehouse



Noosa Seafood Market 2020 trials

Initial trials were conducted in 2020, focusing on the ideal scenario for maximum returns to the fisherman with little to no input from the fisher aside from capture and packaging for transport. Coupled with no specifications of the region of capture and conditions of the environment, no standard was applied to the catch procedure or the after-catch handling method. This was left entirely at the discretion of the fisherman. The results of this trial are detailed in the previous project progress report. In summary:

1. Most of the eels were un-palatable due to taste and texture.
2. The batch size variance resulting from the “run of catch” specifications makes processing difficult, and it was concluded that such an approach

According to Nik there is little capacity to expand the line due to limitations in:

- Processing space/capacity - he operates out the back of a butcher shop limiting his capacity to 80kg per fortnight for the product line
- Market – chefs love the product but have two concerns – the unfamiliarity of consumers to it AND the cost

He could expand the line if he can establish both regular and dependable markets to sell products to and establish a steady profit.

Nik asked whether there was a poison issue for processing – a rumour from one fisher of poisoning if the blood (or slime) of eel mixes with human blood.

would not be commercially viable without significant investment in grading and processing facilities.

3. There is a diminishing rate of return associated with increasing size. The larger the eel, the lower the recovery rate, in part due to the thickness of the skin and the increase in sinew towards the tail.
4. Having too large a range of sizes in a batch makes it difficult to determine appropriate cooking methods.

Each batch was kept separate on arrival. The fisher's name is recorded along with an assessment of size range, total weight, temperature, catch location, any processing/holding, and location of catch. When the eels were cooked, a further assessment was undertaken, recording information about taste, fattiness, texture, and colour.

From the first trial, eels originally sourced from the Hawkesbury River were considered to have the highest potential (see earlier report). However, a second load from the same fisher and the same location did not rate so well.

The second batch had been stored post-harvest for approximately 28 days without food. The eels, while not muddy tasting, scored poorly for fattiness, texture, skin thickness and recovery rate. See Figure 2 below

Figure 2: Eel (after 28 days purged post-capture)



Based on these initial trials, additional parameters have been established to allow a more targeted approach in determining suitability for different uses. One of those is habitat. Initial trials showed a strong correlation between where eels had been harvested from and how long they were held post-harvest without food. The best tasting eels were from waterways that have a sandy bottom. These conditions and areas seemed to produce eels with greater fat content, a distinctive yellow colouring to the flesh and significantly thinner skin.

2021 trials

Two further processing and cooking trials were conducted in 2021 using eels sourced from the regions that had previously produced the eels with the highest fat content. Unfortunately, the eels were not delivered using the required specifications or post-catch standards.

One batch was within spec (up to 1.5kg) and gutted and gilled; the other was provided as a run of catch and supplied gut and gill in. Obviously, this affects the potential flavour and recovery rate comparisons, requiring extra work by the processor that needs to be factored into costing and potential pricing strategies.

Both batches were assessed by the team and deemed to be generally in similar condition in terms of freshness, general health, skin colour, flesh colour, and fat content; the size variance of batch 2 was a significant issue, not only as compared to batch 1 but within the

batch. This variance in batch quality will need to be addressed if this project progresses to commercial arrangements.

A previous project progress report identified a potential ten new product ideas with five then selected as the most likely to succeed. It was decided, given the muddy flavour problem, to concentrate on smoking or highly flavoured products. Smoking was also deemed to be most suitable for several other reasons:

1. It is a traditional process used in many countries where the consumption of eels is part of their national cuisine. (The run-of-catch size of the Australian eels is significantly larger than those found in most European countries).
2. The need to alter the flavour. The process of smoking requires bringing prior to smoking; this provides an opportunity to address the remnant flavour of the eels and produce an enzymic reaction, breaking down some of the proteins that impact the mouthfeel and texture of the flesh.
3. Brining helps to address the problems associated with the larger size eels (firmer fleshed and have more sinew),
4. Brining also helps to address flavour. Note the off muddy flavour could be addressed through purging.
5. The addition of wood smoke, while acting as pasteurisation, allows for stronger flavours to be imparted on the protein that would otherwise not be possible using other cooking techniques.
6. The ability to regulate temperature during the smoking process allows for a lower temperature and, therefore, slower cooking time.

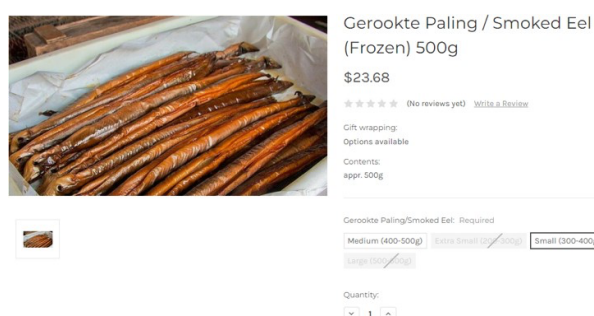
Smoked eels are traditionally sold whole per Fig 3. and Fig 4. The sale of whole eel is obviously the most cost-effective as the only waste (other than moisture loss during cooking) is that of gizzards. The eel in Fig 3

weighed 420g, while the weight range in Fig 4 is to a maximum of 500g.

Fig 3. Smoked eel. Produced in New Zealand and purchased in Harris Farm Brisbane.



Fig 4. Smoked Eel. Produced in Holland. Available frozen online purchase in Australia.



After several trials, an initial preparation process was found to provide a reasonable product result that could be tested in the market. Essentially, this process consists of the following:

1. gutting and gilling (if not done by the fisher)
2. carefully cleaning eels, removing all traces of slime and internal organs.
3. first brine soak for 48 hours designed to break down the toughness of the tissue, it also removes any remaining muddy taint to the flesh. This brine also minimises weight loss
4. rinse in ice water before being dried.
5. a second brine soak for 48 hours adds flavour and further assists in sinew and protein break down
6. remove from the brine and hang in a cool room for a further 24hrs to dry.
7. separated into sizes and then smoked.

Experiments were conducted with different temperatures, types of wood, amount of smoke and time of smoking to produce a commercially acceptable product. Although

more refinement is required, the samples created are suitable for initial feedback from potential clients.

The run of catch for the batches of eels used in the trials ranged up to almost 5kg. It is not possible to sell these large eels whole (except perhaps for a live product) so they were portioned (see fig 5 below).

A significant weight loss results which impacts the consumer price. Although the consumer benefits from this by not paying for in-edible parts of the eel, direct price comparison with competitor products and retailer price points can be impacted, requiring a customer education program.

Fig 5 Smoked eel skin pack (for larger eels)



Fig 6: Portioned larger eels



Recovery rate and commercial viability

This size variability impacts on both the recovery rate and commercial viability for eels under 1kg ie those that can be sold whole versus portioned eels over 1 kg is shown in Table 1. The impact of portioned eels on commercial viability is reflected in Table 2 below.

Table 1. Australian Wild Caught Eel processing data (February 2022)

Eel	Whole	Gutted	Recovery	Soaked	Change	Cooked	Recovery	recovery	Packaged	Recovery	Tail Meat	Head & Tail Waste
U 1.2kg	0.78	0.767	98.21%	0.799	0.032	0.657	84.12%	2 pce @ .457g	0.457	58.51%	0.045	0.144
U 1.2kg	0.76	0.666	87.52%	0.766	0.1	0.561	73.72%	2 pce @ .393g	0.393	51.64%	0.051	0.115
	2.60	2.42	93.08%	2.7	0.28	1.814	69.77%	portion bagged pce @ 1.178kg	1.178	45.31%	0.185	0.416
U 1.2kg	0.70	0.663	94.99%	0.693	0.03	0.566	81.09%	2 pce @ .418g	0.418	59.89%	0.041	0.99
U 1.2kg	1.01	0.997	98.91%	1.034	0.037	0.83	82.34%	3 @ .570g	0.57	56.55%	0.063	0.191
	4.60	4.32	93.91%	4.6	0.28	3.56	77.39%	portion bagged pce @ 2.57kg	2.57	55.87%	0.265	0.653
	4.00	3.72	93.00%	4	0.28	3.06	76.50%	9pce @ 2.415kg	2.415	60.38%	0.143	0.483
U 1.2kg	1.11	1.013	91.59%	1.117	0.104	0.794	71.79%	2 @ .545g	0.545	49.28%	0.072	0.17
U 1.2kg	0.82	0.765	92.84%	0.828	0.063	0.598	72.57%	2 @ .439g	0.439	53.28%	0.053	0.1
	2.73	2.58	94.64%	2.736	0.156	1.987	72.89%	@ 1.452kg	1.452	53.26%	0.117	0.371
	1.47	1.365	92.61%	1.491	0.126	1.038	70.42%	3 @ .724g	0.724	49.12%	0.085	0.222
Average Batch 1	20.58		93.75%		0		75.69%			53.92%		
U 1.2kg	0.87	0.809	92.56%	0.887	0.078	0.664	75.97%	3pce @ .468g	0.468	53.55%	0.038	0.158
	1.33	1.263	94.96%	1.338	0.075	1.072	80.60%	3pce @ .681g	0.681	51.20%	0.093	0.293
	1.43	1.323	92.84%	1.428	0.105	1.109	77.82%	3pce @ .718g	0.718	50.39%	0.1	0.289
	2.27	2.178	95.78%	2.298	0.12	1.832	80.56%	5pce @ 1.168kg	1.168	51.36%	0.473	0.158
	1.51	1.396	92.70%	1.521	0.125	1.126	74.77%	3pce @ .655g	0.655	43.49%	0.141	0.323
	1.31	1.268	96.79%	1.328	0.06	1.034	78.93%	3pce @ .700g	0.7	53.44%	0.103	0.215
U 1.2kg	1.01	0.944	93.19%	1.024	0.08	0.838	82.72%	3pce @ .605g	0.605	59.72%	0.053	0.183
U 1.2kg	1.00	0.965	96.50%	1.017	0.052	0.846	84.60%	3pce @ .581g	0.581	58.10%	0.07	0.193
	2.75	2.377	86.50%	2.764	0.387	1.892	68.85%	5pce @ 1.330kg	1.33	48.40%	0.123	0.442
U 1.2kg	0.75	0.732	97.47%	0.758	0.026	0.586	78.03%	2pce @ .416g	0.416	55.39%	0.039	0.131
U 1.2kg	1.13	1.099	97.26%	1.152	0.053	0.959	84.87%	3pce @ .651g	0.651	57.61%	0.057	0.239
U 1.2kg	1.15	1.128	98.09%	1.182	0.054	0.95	82.61%	3pce @ .628g	0.628	54.61%	0.078	0.247
U 1.2kg	1.05	1.018	96.68%	1.073	0.055	0.862	81.86%	3pce @ .580g	0.58	55.08%	0.053	0.228
	1.91	1.789	93.57%	1.928	0.139	1.496	78.24%	4pce @ 1.060kg	1.06	55.44%	0.113	0.315
Average batch 2	19.48		94.63%				79.32%			53.41%		
Average both			94.19%							53.66%		

Table 2. Impact of buy price on end user pricing for whole and portioned eel

Sell Whole	Purchase price	Whole			sell 25%			Based on 30% G.P. Manu	
		Ave recovery	cost price	Prdn cost	25% GP	30%GP	43%gp	Dist Margin	Retail Margin
Eel under 1kg	8	82	\$9.76	\$5.00	\$19.63	\$21.10	\$25.82	\$28.06	\$49.11
	9	82	\$10.98	\$5.00	\$21.25	\$22.85	\$27.96	\$30.38	\$53.17
	10	82	\$12.20	\$5.00	\$22.87	\$24.59	\$30.09	\$32.70	\$57.23
	11	82	\$13.41	\$5.00	\$24.49	\$26.33	\$32.23	\$35.02	\$61.29
	12	82	\$14.63	\$5.00	\$26.11	\$28.08	\$34.36	\$37.34	\$65.35
	13	82	\$15.85	\$5.00	\$27.74	\$29.82	\$36.49	\$39.66	\$69.41
	14	82	\$17.07	\$5.00	\$29.36	\$31.56	\$38.63	\$41.98	\$73.47
	15	82	\$18.29	\$5.00	\$30.98	\$33.31	\$40.76	\$44.30	\$77.53
	16	82	\$19.51	\$5.00	\$32.60	\$35.05	\$42.90	\$46.62	\$81.58
	17	82	\$20.73	\$5.00	\$34.22	\$36.80	\$45.03	\$48.94	\$85.64
	18	82	\$21.95	\$5.00	\$35.85	\$38.54	\$47.16	\$51.26	\$89.70
	19	82	\$23.17	\$5.00	\$37.47	\$40.28	\$49.30	\$53.58	\$93.76
	20	82	\$24.39	\$5.00	\$39.09	\$42.03	\$51.43	\$55.90	\$97.82
Sell Portioned	Purchase price	Ave Recovery	cost price	Prdn cost	25% GP	30%GP	43%gp	25%	40%
Up to 2kg	8	53	\$15.09	\$5.00	\$26.79	\$28.73	\$35.17	\$38.30	\$67.03
	9	53	\$16.98	\$5.00	\$29.30	\$31.43	\$38.47	\$41.90	\$73.33
	10	53	\$18.87	\$5.00	\$31.82	\$34.13	\$41.77	\$45.50	\$79.62
	11	53	\$20.75	\$5.00	\$34.33	\$36.83	\$45.07	\$49.09	\$85.91
	12	53	\$22.64	\$5.00	\$36.85	\$39.53	\$48.37	\$52.69	\$92.21
	13	53	\$24.53	\$5.00	\$39.36	\$42.23	\$51.67	\$56.29	\$98.50
	14	53	\$26.42	\$5.00	\$41.88	\$44.92	\$54.98	\$59.88	\$104.80
	15	53	\$28.30	\$5.00	\$44.39	\$47.62	\$58.28	\$63.48	\$111.09
	16	53	\$30.19	\$5.00	\$46.91	\$50.32	\$61.58	\$67.08	\$117.38
	17	53	\$32.08	\$5.00	\$49.42	\$53.02	\$64.88	\$70.67	\$123.68
	18	53	\$33.96	\$5.00	\$51.94	\$55.72	\$68.18	\$74.27	\$129.97
	19	53	\$35.85	\$5.00	\$54.45	\$58.41	\$71.49	\$77.87	\$136.27
	20	53	\$37.74	\$5.00	\$56.97	\$61.11	\$74.79	\$81.46	\$142.56

Market Development Opportunities

Desktop research has been conducted on several potential markets. For each market, a trends and opportunities dashboard has been produced.

Key observations include:

- Australian eel exports have experienced a steady decline at the same time as our imports of eel have increased.
- The two largest markets for Australian eel exports are Korea and China. Japan has been a steady export market for many years.
- With a worldwide shortage of eels, there is unmet demand in many of these markets.
- While live eels are still the preferred product format in Japan and China there is an emerging trend for frozen prepared products.
- Globally eels have a good reputation as a tasty fish providing many health benefits
- There are opportunities to use waste products that need to be explored further.

Conclusion

The project has highlighted opportunities for commercialising Australian wild-caught eels in a value-added format. It has provided detailed insight into the variances present within the fishery, such as size, texture, and flavour, and how these impacted on the development of value-added products.

The complexity of producing a value-added solution suitable for the entire “run of catch” was identified, requiring any solution to be able to deal with product quality and suitability variances attributed to habitat conditions and size of the eel. More work is needed to identify potential markets for these large-size eels. Work should also focus on a “whole of eel” utilisation strategy. We know from our research, for example, that roasted eel bones are a delicacy in Korea; the skins can be made into leather, etc. The economic viability of these options needs to be further considered.

A potentially marketable smoked eel product has been successfully produced. Some limitations regarding maximum size acceptability have been highlighted. Initial trial feedback has been largely positive; however, the sample size was small. More market acceptance trials are underway to provide more conclusive results.

Regarding market fit, a realistic price point is yet to be established. However, initial comparisons have been made with similar products on the market to give an idea of the competitor range. The impact on price for portioned and whole have also been provided. These numbers show that to provide a competitive market price, the price back to the fisherman would need to be around the \$8/kg mark. The tables in this report provide complete transparency for that price point.

No allowance has been made for the price impact of the provenance and global rarity of wild-caught eel. It could reasonably be assumed that these will increase the market’s acceptance of higher pricing.

Recommendations & Next Steps for Eel Market and Product Development

1. The smoked eel product should be market tested in Hong Kong, Singapore, and the EU. Following feedback, the project steering committee will discuss the findings with the fishers, including agreement on minimum quality specifications and the potential for different price points depending on quality and size.
2. A market visit to Japan and Korea that was delayed due to COVID-19 should be undertaken to better understand importer requirements, market trends and new product opportunities.
3. Work should continue breaking down the eel into components that could have other uses. This will include calculations of recovery weights and price points for these.
4. Work should continue with other niche processors to enable the development of a diversified market strategy to be developed and presented to the fishers.
5. Focus on identifying product development for the larger eels (plus 1kg), as part of a run of catch
6. Send sample products to international markets for detailed feedback.
7. Eel consumption is not common in Australia. Creating an Australian market would need investment in information and communications resources, including consumer and chef education programs.