Economic potential of sablefish aquaculture in British Columbia

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ABSTRACT

We present in this paper results of an analysis of the potential economic contribution of sablefish farming in British Columbia (BC). This is necessary because a BC sablefish hatchery has recently begun production of juvenile sablefish for grow-out in marine net pens. The production from this single hatchery is anticipated to effectively support sablefish production that will match the entire current BC sablefish capture fishery. Two key questions we address are, how will net benefits (added value) to BC from the sablefish sector be affected if (i) BC and the rest of the world engage in sablefish farming, and (ii) BC bans sablefish farming while the rest of the world does not. We find that at low BC aquaculture production levels, small economic gains are possible. However, gains quickly disappear as production increases towards anticipated levels. A sablefish farming ban in BC could be beneficial to the province and Canada if BC wild sablefish landings command a price premium of at least 20 to 25%. This analysis may provide a template for assessing the numerous economically important species currently being adopted by commercial aquaculture systems.

INTRODUCTION

In 2003, 2,065 tonnes of sablefish or blackcod (*Anoplopoma fimbria*) with a net inflation adjusted value of about C$12 million were harvested from BC waters. Nearly all was harvested live in traps via an individual vessel quota system with about 90% of the total harvest exported to Japan. The rapid development of sablefish farming in BC in the absence of a cost-benefit analysis is representative of an increasingly common global gold-rush mentality to embrace intensive culture of high trophic level species. Not surprisingly such activities generate heated debate regarding what potential ecological and economic consequences these new initiatives hold for stakeholders already in the fishery. Here, we assess the economics of the incipient sablefish aquaculture industry in BC, Canada. We suggest our analyses may provide a template for assessing the numerous economically important species being adopted by commercial aquaculture systems.

Sablefish farming can affect current net benefits to BC through (i) ecological externalities on the wild sablefish sector, and (ii) market externality on both wild and farmed sablefish fisheries. Ecological externality refers to the impact on wild sablefish that emanates from the spread of disease and parasites originating from farms, and the potential effects of farm escapees and genetic interactions of farmed and wild stocks. Market externalities are realized through price effects that result from increased supply of sablefish to the market.

The ecological effects of sablefish farming on wild sablefish are currently not known with any certainty; therefore, we make assumptions on the possible impact of ecological

externality on the landings of wild sablefish. The likely effects of sablefish farming on the price commanded in the market for sablefish has been studied previously (Huppert and Best, 2004). Therefore, this effect is well understood and captured in our analysis.

We carry out our analysis under each of three ecological externality assumptions, for two scenarios:(i) where BC and the rest of the world engage in sablefish farming, and (ii) where BC bans sablefish farming while the rest of the world allows sablefish farming.

METHODS

Ecological externality

The likely ecological effects of sablefish farming in BC are uncertain, therefore, we make three assumptions on the degree of ecological externality that wild sablefish farmers will face due to sablefish farming. *Assumption 1*: No ecological externality, i.e., sablefish farming is ecologically benign and therefore does not affect current BC wild sablefish landings. *Assumption 2*: Medium (or 50%) ecological externality, i.e., sablefish farming in BC waters cause ecological externalities, with impacts on wild sablefish landings at only about 50% of the rate of decline observed in BC wild salmon landings post introduction of salmon farming (see Sumaila *et al.*, 2005). *Assumption 3*: High (or 100%) ecological externality – sablefish farming in BC waters comes with externalities, with impacts on wild sablefish landings at the same rate of decline observed in the case of BC wild salmon landings (Sumaila *et al.*, 2005).

Market externality: Price effects

Supply and demand economics dictate increasing sablefish supply without a corresponding increase in demand will drive sablefish prices down, as has occurred in salmon. Quantitative demand models developed by Huppert and Best (2004) predict that an additional production of 20,000 to 50,000 tonnes of farmed sablefish will drop ex-vessel prices by 19% to 62% depending on market conditions. GSGislason & Associates (2001) demonstrated that even though there should potentially be a strong market demand for farmed sablefish because (1) sablefish aquaculture can fill shortfall of sablefish and Patagonian toothfish in the Japanese market, (2) demand for sablefish in North America and other parts of the world beside Japan would be increasing in the long run, and (3) sablefish aquaculture can target under-exploited niche markets, they conclude that increasing supply of sablefish by 8,000 tonnes (about 30% increase over 2003 production) from aquaculture will drive sablefish price down by 40%, and that the declining price will result in correspondingly low returns for commercial sablefish fishers.

Applying the more conservative (the one which predicts less severe impacts) of the two price models developed in Huppert and Best (2004), we calculated the impact of different quantities of sablefish supply to the market from farming globally under the three ecological externality assumptions (Figure 1).

Figure 1 in here!

We see from Figure 1 that sablefish price drops most precipitously when there is no ecological externality reducing landings from wild sablefish. The price decreases depicted in Figure 1 will affect the net benefits to BC and the rest of the world as demonstrated below.

Cost of Fishing

Operating costs for BC sablefish farms include direct farm costs (e.g., stock, feed, additives, labor, insurance, maintenance, transportation, etc.) and processing and packaging costs. The total operating cost for sablefish aquaculture is estimated at $4.51 per kg (Huppert and Best, 2004). The operating cost for sablefish fishing is estimated at about $3.62 per kg (Wickham, pers. comm.) including fuel, labor, maintenance, etc.

Net Social Benefits

We determine the potential net benefits or net social benefit to BC using the ecological externality assumptions, cost and price information described above under the following two policy environments.

Policy environment 1: Sablefish farming everywhere including BC

Net benefits are calculated under the assumption that there will be sablefish farming globally with BC producing 10% of global farmed and wild sablefish production. The 10% figure is based on the current BC contribution to the global wild sablefish landings.

Table 1 in here!

Under the no ecological externalities assumption, total BC sablefish production increases by the quantity of sablefish produced from farming. In physical terms this is a positive outcome, as more sablefish is made available for consumption. Under the other two assumptions where externalities do occur, we see that as more sablefish is produced in farms, the landings of wild BC sablefish decreases.

Combining the predicted prices and costs, BC farmed sablefish production, BC wild sablefish landings, we plot the total predicted net benefits to BC (i.e., net benefits) from sablefish in Figure 2a,b,c.

Figure 2 in here!

Assuming no ecological externality, the sum of net benefits to BC increases marginally initially and stays relatively stable until BC production of farmed sablefish exceeds 1,000 t. triggering a sharp decline in values mainly as a result of a sharp drop in prices. (Figure 2a). Even the sablefish farmers do badly under this scenario. This is partly because of the higher cost of production they face relative to the wild sablefish fisheries. Under the medium ecological effect scenario, we see a similar trend in the aggregate, but with regards to the two sectors, there is a marked difference in net benefits as sablefish farming grows. We see the wild sablefish sector taking a major economic hit as BC sablefish production exceeds 1,000 t., while values to the farming sector increase. This is because the ecological impacts

imply less supply coming from the wild sector thereby militating against the kind of steep price decline experienced under the no externality scenario. It should also be noted that after the supply from farming has exceeded about 3,000 t. the total net benefit to BC starts to fall. Figure 2c, which depicts the outcome under the assumption of high ecological externality, demonstrates how the negative outcome under the medium ecological impact (externality) scenario is intensified under this scenario.

Policy environment 2: Sablefish farming everywhere, except BC

What if BC bans sablefish farming, while other countries allow it, supplying their production to the global market? With a ban, it is safe to assume that the scenarios with negative ecological externality will cease to be a problem in BC, and therefore the wild sablefish sector will not be negatively affected because of impacts from farming. What BC will not be able to escape is the impact of increased supply of farmed sablefish from other countries on the price the province receives for its wild sablefish. However, it may be possible for BC to market its supply of wild sablefish under an eco-label, and thereby enjoy a price premium for its supply to the world market. We calculate net benefits to BC under this assumption and report the results in Figure 3.

Figure 3 in here!

We see from Figure 3 that if BC is able to obtain a price premium of up to 25%, then a ban on sablefish farming will result in the highest net benefit for the province from the sablefish

sector. Even lower price premiums will still make a ban with price premium an economically reasonable decision until total global production becomes large. On the other hand, a BC ban without price premium scenario does worst in terms of net benefit, until being eclipsed by 'farmed with no externality' at the highest production levels.

How realistic are the above results? The closest to the situation analyzed in this paper is the case of salmon farming in BC. Data on the contribution of salmon aquaculture to BC's economy shows that currently the sum of the contribution to GDP from wild and farmed BC salmon is below or about the same as the contribution to GDP from wild salmon alone when there was no salmon farming in B.C., indicating that the introduction of farmed salmon has not, at least up to date, resulted in an overall increase to the GDP of BC (Canada) from the salmon sector (see Sumaila *et al.* 2005). Further, export earnings from wild and farmed BC salmon have not increased significantly with the introduction of salmon farming. This is due in large part to the overall price erosion of both products reflecting a global salmon glut from aquaculture overproduction (Sumaila *et al.* 2005).

How about the potential contribution of sablefish farming to employment in BC? In the absence of data, a look at salmon farming data may be instructive. Currently, between 3 to 5 on-site full time positions are required on a typical salmon farm (AXYS Environmental Consulting Ltd 2002), and this may reflect the expected employment needs for a typical sablefish operation. Therefore, the approximately 80 active salmon farms in BC (4^{th} largest farm salmon producer in the world) provide approximately 320 full time on-site jobs at any one time. Regardless how successful the development of sablefish aquaculture is in BC, it

is unlikely that it will come close to rivaling farm salmon production and therefore we consider overall value via direct employment to be negligible.

CONCLUDING REMARKS

A decrease in the price of sablefish will ultimately follow an increase in sablefish supply to the market from aquaculture. This decrease will be at the expense of both sablefish farmers and fishers in Canada but beneficial to sablefish fish consumers, which in the case of sablefish are mainly Japanese. Thus, benefits are exported while Canada sits with the potential cost.

At lower aquaculture production levels, there may be small economic gains to be made if BC engages in sablefish farming under different ecological externality (impact) assumptions. But the gains quickly disappear, moving into losses as aquaculture production levels increase.

Rather surprisingly, our study shows that a ban by BC on sablefish farming would actually be beneficial to the province, if BC wild sablefish landings can be marketed in a way that would allow it to command a price premium of about 20-25% above farm product.

Given the experience of salmon aquaculture in BC, sablefish farming is unlikely to add to (i) BC and Canada's GDP, (ii) export earnings, and (iii) number of people employed, in the sablefish sector of BC's economy.

Arguments in support of sablefish aquaculture could only have merit if rewards in the offing were greater than the potential risks. The economic analysis in this paper demonstrates that the chances of BC achieving appreciable gains from engaging in sablefish farming is very low. There is currently a push by some key decision makers for the introduction of industrial sablefish aquaculture industry in BC. The message from this study is that policy makers need to tread gently because while the risks may be big, the potential gains are not. In fact, our economic analysis may understate potential risks by ignoring risk to other secondary species and the marine habitat as a whole, whose potential environmental costs are not captured by this analysis.

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Table 1. Assumed global farmed sablefish production, BC farmed sablefish production and BC wild sablefish landings under the assumptions of medium and high ecological externalities (t).

Global farmed	BC farmed	Wild landings Medium externality	Wild landings High externality
-	-	2,796	2,796
1,000	100	2,778	2,759
2,000	200	2,759	2,722
3,000	300	2,741	2,685
4,000	400	2,722	2,648
5,000	500	2,704	2,611
10,000	1,000	2,611	2,426
20,000	2,000	2,426	2,056
30,000	3,000	2,241	1,686
40,000	4,000	2,056	1,316
50,000	5,000	1,871	946

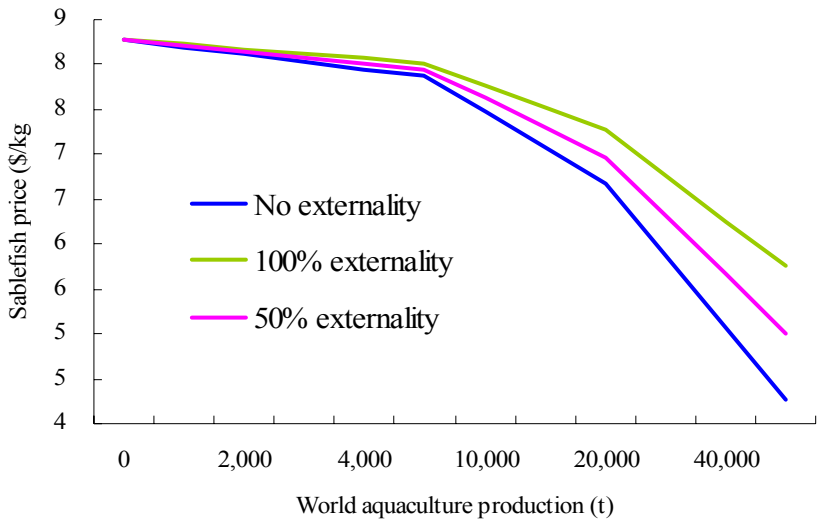

Figure 1. Global sablefish prices under different ecological externality assumptions.

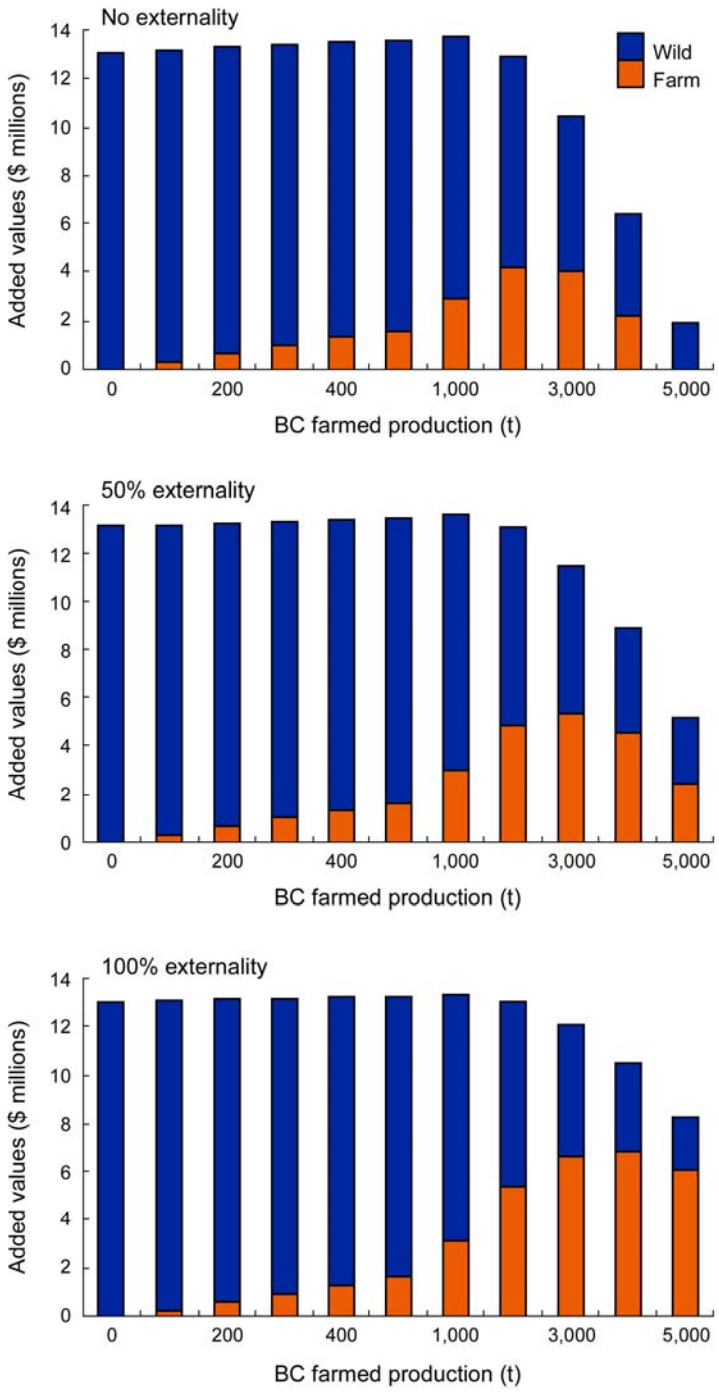

Figure 2. Net benefits from sablefish aquaculture and wild sablefish fishery to BC under assumptions of: (1) no; (2) medium; (3) high ecological externalities.

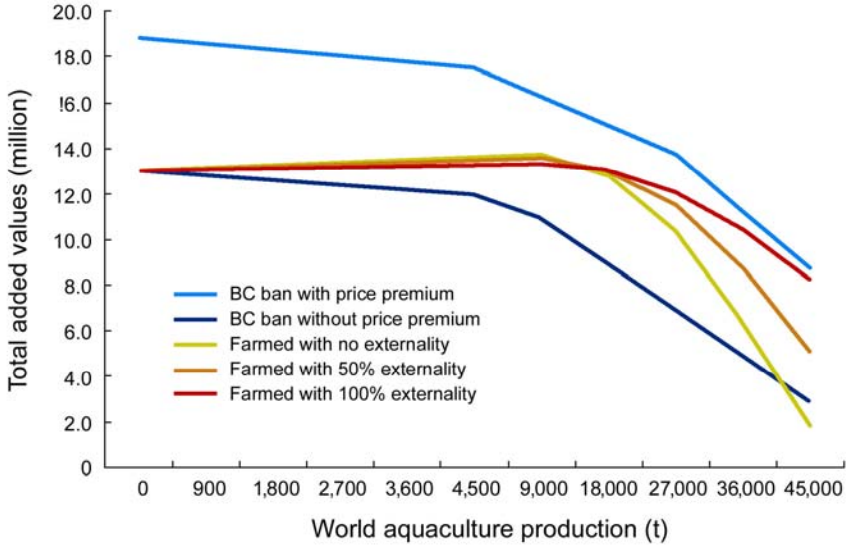

Figure 3. Net benefits to BC from wild and farmed sablefish fishery with and without BC aquaculture ban, aquaculture with and without ecological impacts.