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Complexity of public interest in ethical
analysis of genomics:

Ethical reflections on salmon
genomics/aquaculture

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Abstract

The purpose of this paper is to describe the use of focus groups to support ethical analysis of public interests related to genomics and biotechnology. The objectives are to describe the moral dimensions and perspectives of the issues raised by participants, to assess the information required to support informed dialogue about the issues, and to describe some necessary components of ethical analysis of these issues. This represents one stream of research of the overall project, Democracy, Ethics and Genomics; Consultation, Deliberation and Modeling.

The specific topic for this paper is salmon genomics and aquaculture. Although ethical debate and the social issues raised by research and technology cannot be separated from the specific context, our use of salmon genomics and aquaculture in this paper is primarily intended to illustrate an approach to ethical analysis of policy and social issues that involved qualitative public consultation methods, in this instance focus groups. Comparing the insights derived from the qualitative and group-oriented methods to other approaches such as surveys and deliberative polling will demonstrate the different methods' goals, strengths and weaknesses for ethical analysis, public dialogue and policy.

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Theoretical Background

Keulartz et al lament the ‘technology blindness’ of ethics that results from the focus of the discipline on people and the regulation of their actions. Ethicists have traditionally focused on the values, norms and principles that hold society together. In contrast they argue that the moral order is influenced just as much by material objects in the form of technologies that enable social action. In their view:

... applied ethics has insufficient insight into the moral significance of technological artifacts and systems and that it therefore cannot cope adequately with the dynamic character of our technological culture’ (p25)

Moreover, emerging technologies are typically evaluated in negative terms that emphasise their capacity to constrain autonomy rather than enable new forms of social encounter and experience.

While Keulartz and his colleagues make a convincing case for the need for a broader approach to the evaluation of new technologies, Zoloth focuses on the timing of the evaluation of novel technologies. In the context of stem cell research Zoloth insists that:

Moral vision has to precede research or we will be constantly in a reactive legal position, seeking to justify what is already unfolding, or struggling to find a political move or linguistic turn to all political peace.
(p236)

Zoloth proposes that Applied Ethics needs to embrace exodic thinking, which insists on looking 'beyond the horizons that keep appearing before us as science develops' (p233). In practical terms, these arguments suggest that Applied Ethicists need to identify and test methodologies capable of evaluating emerging technologies and must be able to provide a thicker description of the social context of technologies than has traditionally been possible³.

Justice theorists writing in *From Chance to Choice: Genetics and Justice* have identified the first problem of justice as the question of how to be sufficiently inclusive in defining the public interest (Buchanan, et al, 2000: 263).

Reflecting a growing concern among feminists, social scientists, and public interest groups, Susan Sherwin (2001), has argued that "...when approaching complex policy matters, we should actively seek out moral perspectives that help to identify and explore as many moral dimensions of the problem as possible" (Sherwin, 2001: 18, 30). This evolving notion of public representation seeks to give voice to the breadth of interests among citizens rather than seeking demographic or statistical representation (Burgess, 2004). Representing diverse perspectives to enhance the notion of public interest that informs how issues are defined is not the same as demographic

³ Keulartz et al suggest that both moderate and radical variants of Science and Technology Studies achieve a richer description of context, but also suggest that STS remains agnostic about the technologies it describes. The case they make is that ethics informed by the pragmatic tradition that is informed by context may be more fruitful.

representation. The point is to understand underrepresented or unarticulated perspectives, not to assign frequencies to well-articulated or pre-conceived perspectives. This form of representation in ethics requires substantive engagement with the values and meanings that may not readily be represented in the market or dominant culture, or in many approaches to public consultation or education. Important clarification may come from perspectives that are widespread in a population but are unarticulated in mainstream discourse. Despite the tradition in ethics of considering all logically possible alternatives, critiques of narrow analysis of ethical issues demonstrate that it is necessary to engage in empirical study and dialogue to identify novel and ethically relevant perspectives (cf., Kelly, 2004). Given unequal access to policy debates and other forms of the “collaborative framework,” a central problem is how to adequately represent the full diversity of views or interests in ethical issue definition and analysis.

The ethical and political assumptions of this research are that the range of interests relevant to determining the public interest in genome research and biotechnology must be described with sufficient inclusiveness before the nature and scope of policy decision can be determined. The inclusiveness requirement is best served by an approach that is exploratory in its recruitment and method. The objectives are to identify the range of interests a diverse set of participants consider relevant to defining the public interest in genomics and biotechnology. This will in turn support the identification of additional important participants and information that are necessary to support an informed and inclusive analysis.

In this paper we describe the use of focus groups for the prospective evaluation of an emerging cluster of salmon genomic scientific studies and technologies. While much of this research is already underway, it has yet to be translated into technological applications, nor has it been the focus of significant controversy.

It was recognized that if we are to make a strong case for methods that allow for greater representativeness and inclusiveness in the ethical evaluation of technologies, then the results of our work need to be compared to a reasonable benchmark. The benchmark was derived from two sources, reflecting the predominant approach in bioethics: principlism, informed by context.

Drawing on the principlist tradition, Kaiser and Forsberg developed an ethical matrix for identifying the issues relevant to fisheries management. They use Mepham's re-characterisation of Beauchamp and Childress's principles of bioethics to generate a matrix for biotechnological applications. Kaiser and Forsberg's matrix uses justice, dignity (for autonomy) and well-being (for non-maleficence and beneficence), and applies them to the groups affected by fisheries decisions—fishers, fishing industry, other users of sea and coast, society, consumers, future generations and the biosphere. As with the use of principle-based analysis suggested by Beauchamp and Childress, the identification of ethical components, which could be understood as *prima facie* interests or entitlements, reveals the ethical dimensions of an issue without assigning a specific moral weight to any of the interests.

In order to provide rich context for this study our team prepared background documents on salmon genomics and aquaculture. The salmon genomics

paper included a summary review of the ethical dimensions of salmon genomics, with the intent of establishing a broad scope of issues to be considered. The paper, “Lots of Fish in the Sea: Salmon aquaculture, genomics and ethics (Power, 2003), reviews literature on the cultural and economic importance of salmon, the state of aquaculture and salmon genomics internationally, assessments of effects on the environment and wild stocks, local, national and transnational governance, and public attitudes. Based on that literature review the following ethical issues were identified:

- harms to the natural environment and wild fish stocks relating to farm escapes;
- harms to the natural environment, wild fish stocks, and fisheries due to disease;
- food security;
- respect for boundaries; specifically, respecting cultural and other ‘in principle’ objections for example those based on a belief in the integrity of the organism or respect for First Nations’ objections to the perceived violation of a cultural icon.
- respect for individual choice;
- safety for human consumption; and
- lost opportunities (trade-offs).

Both the principlist framework, modified from bioethics and the rich contextual description provided by the literature provided benchmarks against which our results could be evaluated. The group chose to use

focus groups as the mechanism for revealing the range of interests relevant to salmon genomics and aquaculture. In the final section of this paper, we evaluate the added value of this methodology against the principalist framework and the contextual description provided by the literature review.

Methods

Focus groups provide an opportunity for participants to stimulate each other's participation, thereby reducing the need for the moderator to introduce excessive amounts of information that risk directing the discussion. Focus groups encourage participants to interact on a topic, shaping the resulting dialogue and stimulating each other to clarify meaning rather than to merely reporting static opinions or presuming that they use words and phrases in the same way. The structure of the discussion and the topics raised reflect how the participants think and feel about the topic. Focus groups are unique social events whose analysis cannot be generalized to a population. Yet how topics are organized in relation to each other, particularly across different focus groups, reflects a wider social discourse and the expertise of the participants in their roles as citizens as well as consumers (Kerr, Cunningham-Burley, Amos, 1998; 1998a). Only open-ended methods like focus groups are able to capture this structuring, since more formalized methods tend to provide the structure for the discussion or responses.

Recruitment for the purpose of generating diversity of perspectives requires consideration of at least two issues. First recruitment must involve people who are not typically engaged in the debates related to the policy issues. Second,

recruitment must involve people who may have interests, but are often excluded by the usual means of voicing or promoting interests in policy debates.

The study design involved five focus groups composed of participants drawn from common backgrounds. The first segment was composed of two groups (Random1 and Random2) who were randomly recruited by a consulting firm using random digit dialling. The second segment recruited participants with a direct professional interest in the area of salmon genomics; they were recruited using targeted research into the relevant organisations and by soliciting recommendations from individuals known to the research team. The first of these three groups (NGO) was composed of individuals recruited from a mix of non-governmental organisations. The second group (Fund/Res) was composed of individuals who work for funding organisations and researchers directly involved in salmon genomics. The third group (Reg/Acad) was composed of academics and regulators with a direct professional connection to salmon genomics.⁴

The structure of the consultation must permit participation without requiring participants to justify their views to such an extent that they feel inhibited. By focusing on the notion of interests as perceptions of entitlements and emphasizing that both hopes and concerns are to be described, participants are encouraged to state their views openly. Ethical analysis of the interests

⁴ Focus groups or other forms of consultation are sometimes unacceptable for a group to express its interests. For example, the ongoing negotiation of political interests creates a broad distrust of activities related in any way to fisheries among BC First Nations communities. We had to cease attempts to set up a focus group or other methods of seeking First Nations input, instead interviewing members of a public commission representing First Nations' fishing interests to develop and understanding of both resistance to dialogue and the perspectives of First Nations' people toward salmon genomics.

raised in this research contributes to the structuring of later deliberative public events based on a robust understanding of the range of public interests held by diverse people.

There are several features of communication that can inhibit unrestricted expression of interests. For instance, if the distribution of technical knowledge between participants is uneven, participants may hesitate to identify interests that would demonstrate their superficial understanding or ignorance. For this reason the groups were relatively homogenous in terms of background technical knowledge.

The focus groups were implemented by professional facilitators and the meetings were recorded, transcribed and coded by the same team. Following a brief introduction to genomics, the facilitators provided the participants with the following explanation of the task:

Now what we'd like to switch to is spending a bit of time thinking first about the hopes or potential benefits the salmon genomics might have to society ... so what I'd like you to do is just spend a few minutes thinking quietly to yourself. There's some paper and pencils there for you to just jot down a few thoughts that you might have, and then we'll go around the room and see what everybody comes up with. So what do you think might be some of the potential benefits? What would you hope to see coming from this?

Hopes and concerns related to the technology were addressed separately and the introduction provided by the facilitators to concerns substituted “concerns”

for “hopes” in the above text. The focus group transcripts were coded using QSR N6 by one of the facilitators and were checked by the one of the authors (JT) for consistency.

Themes

Analysis of the focus group transcripts revealed a number of themes that appeared to varying degrees across the five groups. In this analysis we focus on the themes relevant to the following three questions:⁵

1. What novel interests or issues are identified?
2. What information is important to a well-informed discussion of the interests and issues?
3. What interests require special attention to inclusiveness?

We will return in the discussion to consider the implications of the analysis of the three themes for the organization of ethical analysis to fairly represent interests and issues.

Novel interests or issues

The extent to which the focus groups raised interests or issues that might otherwise have been overlooked will be assessed in the discussion. The following analysis captures articulations of participants’ perceptions of entitlements (interests) or issues (points of contention). While it is unlikely that groups will raise wholly original interests or issues, the perception that they are relevant to salmon genomics may be novel, or may indicate the

⁵ The full report of the focus groups will be published elsewhere, and available as a working paper prior to the workshop.

importance of including perspectives and information that related to these issues, whether through public dialogue, further research, or ethical and policy analysis. It is also interesting that these interests suggest that, to some extent, all the focus groups generated a fairly complex and sophisticated depiction. The themes are organized under eight headings. The themes are described in much greater detail in a separate report.

Commercial Influence on Research

One member of the random group asked the moderator to distinguish between genomic research and modification in the form of new commercial products:

**V1 Now the ethical question we're asking, was whether it's useful to do research genomics, or was it whether it's useful to actually change the genomic make-up of fish? Because I think that there's nothing wrong with the research but there's quite a lot wrong with the practice.*

The practices associated with commercial activities appear to be the problem, not genomics per se, particularly where the practice is driven by a profit motive.

Participants in the second random group questioned the motives behind the research underway and the political favours it involves. The people in control may have narrower interests that mean they do not consider the wider public good. Corporate interests may make judgements about the risks that are a problem: the example of Firestone's choices about whether to recall car tires is used. The NGO group made a similar point about the motives of

corporations. Other participants argued that there is too much hysteria in the press about the impacts of research. Members of the one of the expert groups suggested that there have been changes in the way that research occurs so that scientists have to try and make profitable applications quickly:

V3: But I think that that has been systematically cut by the need, and this is where the motivation comes in, to find a product that you can market and make profit from, and jump from the smallest level of understanding to implementation as quickly as humanly possible.

Genetics is considered a classic example of this phenomenon; new products are created while the research is still underway. The research environment is much more competitive today so there is less collaboration and nobody is looking at the aggregate impacts. Research is done with the end in mind:

**V5 Because they already have the end in mind. We want you to do research to get us here. The end is defined. And if you don't do that we're not funding you, because this is what we want the end product to be. You get us there.*

The profit motive is creating a society that is 'out of control' and is driving development of aquaculture. This raises wider concerns about whether governments are under the control of corporations. Both the Res/Promo and the Reg/Acad groups expressed similar views about the commercial funding of basic research although the latter group thought that the predominance of public funding was sufficient to ensure that wider interests were considered.

Technological Imperative: Conflation of Genomics and Transgenics

There was a tendency among the Random and Researcher/Funder groups to evaluate genomics on the basis of the effects of transgenic salmon. A detailed analysis of the segments of transcripts on this topic is in press (reference and working paper posting). Briefly, while a number of participants asked direct questions about whether specific examples counted as 'genomics' in many cases, participants described their hopes and concerns about the field by drawing on examples of transgenic applications. In these cases a subset of the class of activities under the banner of genomics, involving transgenic applications was conflated with the entire class.

Foreign ownership

A concern identified by both the random and the NGO groups related to foreign control of fish farms. Participants felt concerned because foreign firms have narrower interests and because economic benefits are exported. Specifically, British and Norwegian companies dominate aquaculture in BC and use the province as a laboratory. The view was expressed that these companies were kicked out of Europe because of the effects of aquaculture and now they threaten sports fishing. This affects the broader context within which any commercial salmon genomics applications would be used:

V1 So taking this into genetics is just one more step, so this resentment builds with this foreign interest in aquaculture.

It was argued that foreign ownership limits control over fish farming activities:

**V3 It takes away our local control. I mean all we can do is create laws. We can't necessarily have social impact on it when, you know, the ownership isn't B.C. bred.*

Further, if the business model for delivering new genomic technologies follows the lead of Monsanto, involving contracts for sterile organisms, this creates greater dependency for local operators. In a closely related theme⁶, participants in the random group discussed wider distributional issues. In the context of commercial fishing there is a need for equal access to fishing sites. The current licensing regime means that fish just belong to a limited number of people. The same respondent emphasized the need to ensure that the benefits that come from salmon genomics, such as enhanced nutritional value, are equally accessible to all. Finally, because money is invested within BC, local residents should benefit before Americans. Information about the benefits of genomic and other health research should be made more accessible than it is now.

The Res/Promo group recognised that aquaculture relies on the privatisation of common property. This raises wider concerns about the claims of fishing interests over wild stocks:

**V4 And it really is an ethical question, who owns it and who gets the benefit from it. I mean it's the same question as genomics. Who owns them and who gets the benefit? They're a natural resource. Are they a natural resource? Are they a private resource?*

⁶ Unequal access to benefits and resources

There are related issues about who owns the products of genomic research under the current system and one respondent draws on comparisons with gold prospecting.

Impacts on Culture and Society: First Nations and Commercial fishers

Both the NGO and the Reg/Acad groups raised concerns about the impact of fish farming and genomics on First Nations in particular. Direct instrumental impacts included the harvesting of feed fish, which may affect First Nations access to those stocks over time, changing their culture, society and economic base.

Other cultural concerns were also raised. It was felt that creating a 'Frankenfish' may diminish the magical properties associated with salmon. Salmon are critical to the spiritual well being of BC first nations so harm to the fish will harm the community as a whole (although it was recognized that some first nations have established joint ventures with aquaculture companies).

Participants argued that fish farming may provide employment although the participants debated whether this was relevant to genomics. On the other hand, it was recognised that genomic research directly employs people and that increases in economic growth through farming that may offset losses in the fishing sector. In addition, it was argued that aquaculture may make more fish available for sport fishing creating more jobs in the service sector that are more stable than commercial fishing (although it was questioned whether the jobs would be accessible to fishermen). Farming may provide higher paying jobs and more job security. Work in genomics should be higher paid because

it requires higher educational levels, although there was also a concern that the transition to new kinds of work will not provide employment for fishermen. More broadly, a participant in the Res/Fund group argued that aquaculture, supported possibly by genomics, will help create new coastal communities in BC that are less transient than communities supported by logging and fishing. More stable communities reduce divorce rates, improve infrastructure etc. The participant used the example of Norwegian government's support for aquaculture as a way to underpin communities. There was a lengthy discussion in the Res/Fund group about the extent to which commercial fishing supports only transient worker both in the Alaskan and the BC fisheries. Stable communities create responsibility and ownership and help build community.

Negative public perception and NGOs as an “industry”

The second random group expressed concerns about negative public perceptions of salmon genomics, drawing on an analogy with the hysterical public perception of AIDS when it first appeared. Other groups pointed to the complexity of genomics and the limited understanding the public has of the field. The Res/Promo group pointed out that even experts in the field have a hard time understanding all of the developments, so the public is going to find it especially difficult. The Reg/Acad group suggested that the lack of public understanding of the field makes the area subject to spin.

In one conversation, participants in the Reg/Acad group discussed the special status accorded to Salmon in Canada and the fact that there is an NGO industry focused on the species.

*V5 *The NGOs are an industry because they all draw pretty decent salaries being anti-aquaculture, because salmon is a religion here, they can make a lot of money by –*

*V1 *It has an emotional component that makes it suitable for this.*

*M *What do you think makes it a religion?*

*V5 *On this coast it's always been the wild -- this incredible Walt Disney sort of picture of the mighty salmon forging it's way up our pristine rivers, you know. And it's just this whole –*

*V1 *Myth.*

*V5 *-- myth. Yeah, Disneyesque sort of view of salmon on the west coast.*

*M *And how does that play into this conversation?*

*V5 *Because the aquaculture is the antithesis of that. It's a caged domestic animal. It's not a wild free salmon. It's not "organic".*

Negative public perceptions focus on genetic drift and displacement of native species. These perceptions have a negative effect on the marketability of the product. Because of a lack of science in the policy and regulatory process one participant argued that:

'V5 People are going to go with their emotions'.

In other cases, the Reg/Acad group suggested that there is active fear mongering about Frankenfoods. Citizens lack understanding of the science of

risks although it is not clear that even if the science was complete that decisions wouldn't still be political.

Salmon as food “tainted by association”

The view emerged that a whole class of technologies could be tainted by association with negative perceptions of genetically modified organisms:

**V2 if the public viewpoint is that genetically modified organisms are bad, and by association the salmon aquaculture industry uses genetically modified organisms, then it spreads to aquaculture products and in fact even into other salmon products.*

This could result in a decline in all areas associated with salmon production. In addition, misperceptions that salmon are constantly fed antibiotics could scare people towards other meat sources where animals are fed antibiotics in much higher volumes.

Broader food controversies such as BSE create real distrust of genetic modification but it was also noted that the science is incomplete:

V3 And I think because of the European trauma, you know, they're still suffering from the post-traumatic syndrome of BSE and all these things, I can understand if I'm a European I'm suspicious of government and I'm suspicious of scientists, you know, the government scientists.

Participants in the Reg/Acad group were concerned that negative perceptions of GM salmon could spread to other technologies and to other production systems:

**V2 Wild fishery, everything. You'd see decline and everything and it's like being tainted, you know, the entire thing. And certainly, I mean, V5 could speak better to this. I mean, the minute that any health concerns come up for any seafood product, they all take a nosedive in terms of consumption. It just spreads among. The general public is -- you know, views seafood as essentially one product.*

This statement indicates both the sensitivity of the public to salmon genomics and a scientist's understanding of the public. In this case, the public is perceived to have only one taxonomic category that is filled by all seafood products. Participants added that the government in BC says public perception is not their concern and leaves it to industry to deal with this area.

Welfare of Salmon as organisms or species

The Reg/Acad groups suggested that the welfare of research animals is becoming a concern:

V2 So, no, welfare of fish is definitely becoming a much greater topic. Killing, you used to kill the fish however you want, and now in Europe there are set standards for how you cull fish, and those standards are coming to Canada as well.

These welfare concerns could extend to whether it is acceptable to modify fish physiologically.

**V3 So the ethics is there. I think scientists don't have the right to do or generate any monsters or Frankenfish. We do not have the right, I think.*

According to this group, the process of inserting genes is still random and creates large quantities of deformed fish. While it is similar to breeding processes, 'there's more chance that you create monsters', which are not seen outside the laboratories. The concern is that we don't have the right to create these monsters in the process of producing a viable line. Another participant pointed out that lots of unviable fish are created in selective breeding and are 'trashed'.

Cloning in particular could alter salmon's natural instincts so that they may no longer be able to breed in freshwater, if at all. Tampering with nature is unnatural and could create food that is dangerous to human health as well as to the species themselves.

**V4 It's unnatural.*

**M And what are some of the potential risks, do you think, of tampering with nature?*

**V4 Well, the food could be dangerous to human health.*

Changing nature risks upsetting the balance among species. Lack of certainty and the moral concerns are strongly intertwined. We might not know about the impacts of changes for hundreds of years. You can't then put the 'genie back in the bottle'

Examples for past dangers of human intervention include germ warfare that resulted from biological research. There is also a question of whether lessons have been learned from early cases like GM corn and monarch butterflies.

This view is also expressed as a lack of respect for the living organisms involved:

**V5 I believe that every living thing is there for a reason and we don't have the right to go and change it. It's just we have to learn -- you have to understand that they have rights too, like we need to respect that right. I don't know.*

NGO participants also focused on the rights of organisms to have their genetic integrity respected. The discussion of the rights of organisms was framed in relative terms; humans see themselves as being on the top of a hierarchy and as having the right to manipulate other organisms that have been here longer than us and this is a source of danger. NGO participants questioned this hierarchy arguing that we can't modify humans so why can we modify organisms that can't provide consent?

Others argued that genomic research involving Salmon may be of less concern than research involving sheep, since the former are less sentient:

**V3 I think it's significantly important. When they talk about whales what's the first thing they mention? How intelligent they are. When they want you to -- when they anthropomorphize a whale, the first thing they do is they give it a level of intelligence. If you start with salmon, where do you stop?*

A similar implicit taxonomy was expressed as the view that salmon are not as aesthetically attractive as other animals, although the respondent tempered this view:

**V4 They may be under the radar as far as "Oh, well, it's only a salmon, it's not cute, I don't really care."*

There was a negative perception of activities that modify salmon for research purposes. This research may have an immediate good in mind but unknown

long-term effects. This code, closely related to 'Improved food quality and yield', focused on interventions that could improve the resistance of salmon to a range of illnesses and parasites, but also to human influences and climate change. The discussion referred to both wild and farmed salmon. Wild stocks and species could benefit from salmon genomics and aquaculture as a result of the reduced pressure on wild stocks that might result from getting farms out of the oceans.

V3 *Well, yeah, they could let the natural salmon go out and feed the whales and whatever else, they can eat that, and we can eat the farm fish.*

Participants in the Res/Fund group felt that fish farming may be more effective than fisheries closures for protecting wild stocks. One participant argued that because fish farming has reduced the cost of salmon it has relieved poaching pressure on wild salmon stocks that existed when a stolen fish could sell for up to \$200. Genomics could ensure that if limited a gene pool makes salmon in farms vulnerable to attack, that there are resistant strains ready to replace them. In the words of one of the Reg/Acad participants:

And again I think that links into the diversification. I think we have the ability to create or at least to recognize different groups of populations to be able to make sure that they're banked for the future. And we can't do that without having genomic information. We need to be able to profile all the different fish out there so that we can create a nice bank for, you know, future disasters.

If escaped salmon breed with wild salmon, this loss of natural instincts could cause natural runs to collapse.

Environmental concerns and benefits

Participants in the first public group argued that fish farming that is on land 'doesn't seem natural', although it was suggested that they may be in land tanks because of pollution in the ocean. Salmon could end up harbouring a disease in this unhealthy environment where you have the possibility of 'mad salmon'. Diseases spread because the environment is not natural for the salmon and if there is no natural selection then the diseased salmon mix with the healthy ones. One participant drew on an analogy with caribou runs that are attacked by wolves: the healthy survive.

Participants from all groups except the NGO group suggested that salmon genomics and aquaculture might have broader environmental benefits. For instance 'modification' could produce environmental benefits if fish farms could be concentrated into smaller areas or moved onto land, thereby reducing pollution. Others argued that fish farming is a more efficient way of producing food, that is less wasteful than commercial fishing which involves by-catch ('ugly fish') and also catches dolphins. In addition, the impacts of pollution from fishing boats could be avoided and fish farming allows for more control over production and less waste. Participants in the random groups argued that salmon left for sport fishing and recreation generated much more economic value. The broader benefits included reducing pressure on wild stocks and freeing up more wild fish for feeding bears.

Participants identified a range of other related environmental impacts of genomics.

- “visual” pollution or offensive odours from fish farms when they are introduced may reduce the value of properties or conflict with people who had moved into the area for aesthetic reasons.

- using genomics to create low cost or non-animal proteins might make salmon farming more acceptable and take the pressure off wild stocks.
- GM material 'getting out' through predators who consume salmon
- impacts of fish farm owners shooting seals, sea lions and birds that feed on farmed salmon.
- Applications of genomics to ensure that farmed salmon are sterile (this would address some concerns about escapement)
- modified salmon may result in altered disease vectors.
- environmental impact of using fish meal from south America for salmon farms;
- possibility that the fishery was being used sustainably and that if it wasn't used for salmon, it would be used for something else.

These themes identify a range of interests and issues as well as stakeholders that are important to analysis or discussion of the interests and issues raised by the participants.

Information important to a well-informed discussion

There are several types of information that are important to a well informed analysis or dialogue about the issues and interests characterized above.

Some of the information is obvious, such as research on the environmental effects, and food safety of transgenic salmon and aquaculture. But some information relevant to the issues and interests may be less obvious, including effects of aquaculture on cultures and societies, animal and species welfare effects of genome research and any transgenic applications; possible positive

uses of genomic research for the benefit of salmon and the environment; the influence of commercialization on research and or cultural prestige and financial investment in NGOs on their influence and activities.

Participants important to an inclusive analysis and dialogue

There are several groups who are clearly important participants because they have special entitlement to the interests identified and therefore should participate in dialogue and analysis that attempt to assign relative weight to these interests. Some, such as First Nation and perhaps commercial fishers require special approaches in order to be engage. Other interests inevitably require surrogates, such as interests in the welfare of salmon, and long term environmental effects for future generations.

Discussion

These issues and interests have been articulated in the literature, and so it cannot be said that they are not identifiable without the focus groups. But their occurrence in the focus groups suggests that they are important elements for inclusive public dialogue, ethical analysis and policy about salmon genomics. This is an important counterweight to attempts to narrow the range of issues related to a policy question so that the analysis is bounded, policy can be formulated, or to provide some limits to the information that must be provided participants in a deliberative process. In this section we compare the novel outcomes of the focus groups with the benchmarks derived from Kaiser and Forsberg's ethical matrix and the literature review.

The following novel interests or issues raised by the focus groups:

- Commercial Influence on Research

- Technological Imperative: Conflation of Genomics and Transgenics
- Foreign ownership
- Impacts on Culture and Society: First Nations and Commercial fishers
- Negative public perception and NGOs as an “industry”
- Salmon as food “tainted by association”
- Welfare of Salmon as organisms or species
- Environmental concerns and benefits

Across the groups, participants reflected on issues of commercial influence on research, technological and economic imperatives, foreign investment and the development of NGOs as having agendas that might interfere with their representations of the public interest. No discussion about more specific issues such as whether to permit genome research using knockout models or to permit the use of transgenic salmon in aquaculture will adequately deal with these larger issues that are inevitably part of the larger context for such policy formation and implementation. For example, how will the evolving knowledge and uses of salmon genomics shape responsibilities related to consumer choice and their relationship to civic responsibility and the environmental commons? Will developing knowledge that can improve the availability of salmon strengthen the responsibility to make that technology and product available, rather than to develop alternatives for which research is less advanced? Will the opportunities to meet needs for human health and survival make it more difficult to attend to other concerns such as environment or respect for cultural aspects? Could different decisions about what knowledge

to develop alter the shifting responsibilities and enable us to care for both human health and the environment?

In mapping out an ethical framework informed by pragmatism, Keulartz and colleagues suggest that ethicists must developed methods “to handle deep-seated value conflicts if the possibilities for consensus and compromise are eliminated.” (Keulartz et al. (2004: 22). The focus groups support such an approach by scoping in broad terms the range of issues that would need to be addressed. The issues will inevitably require a context that supports the maintenance and ongoing evaluation of tension between, for example, commercial investment in research and the direction of research to serve the public interest; encouraging investment and innovation while promoting access and research that serves commercialize needs. The issues raised by the focus groups emphasize the importance of recognizing these problems involve irresolvable moral conflict and require fallible but productive approaches, not merely ones that build toward forced consensus or resolution by power.

Most directly, the concern that the welfare and interests of First Nations and commercial fishers be considered suggests that serious attention must be paid to how these groups can be involved. Yet the emphasis on fair deliberation and decision-making must avoid both extremes of attributing moral primacy to the interests or these groups, or simply dismissing them as too self-interested or strategically weighted.

The focus groups identify interests or components of the ethical issues that are not represented by the matrix or the literature review. For example, the larger issues of commercial influence on research, the technological

imperative, and the role for considering effects on culture and society of groups are not likely to be raised by applying the matrix to a fisheries or genomics problem.

This is likely a reflection of the fact the scoping of the issues to which the principles or matrix is applied is often overlooked as the first step in an ethical analysis. In health care ethics, providing an experimental treatment option is often resolved when professionals agree that the risk and benefits are reasonable and the patient or appropriate surrogate are informed and voluntarily accept the treatment. Issues of whether the treatment poses unacceptable costs or risk to society, or the level of cost and inconvenience to the family usually requires re-analysis and is usually considered inappropriate at the level of individual patient care. The point here is that the focus on the problem to be assessed and resolved sets the context and therefore limits the range of interests that appear to be legitimate to the analysis. Fairness in access to home care or innovative care is not relevant to whether a patients' treatment is permissible; decisions about whether food is safe or an innovation is environmentally acceptable does not appear to raise issues about the influence of industry on research or the development of strategic interests by NGOs or particular stakeholders. Yet these are the very issues that the focus groups raised as relevant to salmon genomics and aquaculture.