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Tracing actors, arguments and life cycle thinking in the controversy over the sustainability of the Swedish West Coast shrimp (*pandalus borealis*).

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REPORT NO. 2016:17

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Göteborg, Sweden 2016

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SUMMARY

'Controversy mapping' can provide insights about issues related to actors, their networking, and governance where the interpretation of science is at stake. In turn, these insights can be useful for advocacy processes, collective problem-solving and decision-making. In order to explore the potential of controversy mapping, a case study was conducted for the North prawn (*Pandalus borealis*), which was the main subject of a controversy that started in 2014 on the West Coast of Sweden. A temporary stabilization in the controversy was reached in May 2016 when WWF endorsed the Marine Stewardship Council labeling for the also red-listed and red-lighted prawn. We used 'controversy mapping' from the scientific humanities, following the methodology suggested by Venturini (2010) and Latour (2012). The method allows to tracing of statements, literatures, and actors involved in a controversy. By assembling these elements, we described the process of the controversy and identify the networks that 'wrestled' over the scientific interpretation of the (same) data on population size for the Swedish West coast shrimp. Using network visualisation and analysis softwares, we map the extent of the actor networks in the controversy, and analyse the roles and influence of different actors. The material gathered was subsequently analysed through a life cycle lens in order to see how the controversy played out in the shrimp's product chain organization. This shows advocacy actors seeking to enrol the consumption system in order to protect the shrimp, resulting in many reactions from production system actors. Based on the findings, we discuss implications for life cycle thinking and life cycle management of product chains. Among else, we suggest that controversy study can help product chain actors better understand their production and consumption system. This in turn may support shared conflict resolution and problem-solving, for example, in product chain roundtables.

Latour, Bruno. "Mapping controversies: syllabus 2012 -13." MediaLab. Science Po. Retrieved from www.medialab-dev.sciences-po.fr October 15, 2015.

Venturini, Tommaso. "Diving in magma: How to explore controversies with actor-network theory." *Public understanding of science* 19.3 (2010): 258-273

Keywords: ecolabelling, wildlife, controversy, shrimp fishing, *pandalus borealis*, life cycle assessment (LCA), production and consumption system, Sweden

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RESUMEN

El 'mapeo de controversias' es una herramienta que busca identificar los actores, sus redes y temas relacionados con gobernanza en situaciones donde la ciencia está siendo sujeta a distintas interpretaciones. Estos conocimientos pueden ser útiles para la incidencia en política, la resolución colectiva de conflictos y la toma de decisiones, en general. Con el fin de explorar el potencial del mapeo de controversias, se realizó un estudio de caso para el camarón del Mar del Norte (*Pandalus borealis*), que fue objeto de una controversia a comienzos de 2014 en la costa oeste de Suecia. En mayo de 2016, la controversia fue neutralizada cuando WWF apoyó el etiquetado entregado por el Marine Stewardship Council para el camarón que en 2015 había sido incluido en la lista de especies amenazadas de la Unión Internacional para la Conservación de la Naturaleza (IUCN por sus siglas en inglés) y en la categoría de "No la consumas" de la versión sueca de la guía de consumo responsable de WWF. El estudio utilizó el "mapeo de controversias", una herramienta de las humanidades científicas, siguiendo la metodología sugerida por Venturini (2010) y Latour (2012). El método permite rastrear declaraciones, literatura de apoyo y actores involucrados en una controversia. Al juntar todos estos elementos, describimos el proceso de la controversia e identificamos las redes que se enfrentaron en términos de la interpretación científica de los (mismos) datos sobre el tamaño de la población del camarón sueco en la costa oeste. Usando software para la visualización y análisis de redes, trazamos el alcance de las redes de actores en la controversia y analizamos los roles y la influencia de diferentes actores. El material recogido se analizó posteriormente desde la perspectiva del ciclo de vida con el fin de ver cómo la controversia se desarrolló en la organización de la cadena productiva del camarón. Esto evidenció que actores defensores del medio ambiente buscaron involucrar a diferentes actores de la etapa de consumo en su campaña por proteger el camarón, dando lugar a muchas reacciones de los actores de la etapa de producción. Con base en los resultados, se discuten las implicaciones para el estudio del ciclo de vida y su gestión en el marco de cadenas productivas. Entre otros, sugerimos que el estudio de controversias puede ayudar a los actores de la cadena de productos a comprender mejor su sistema de producción y consumo. Esto, a su vez, puede apoyar la resolución de conflictos, por ejemplo, a través de mesas redondas para cadenas de productos.

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Palabras clave: ecoetiquetado, vida silvestre, controversia, *pandalus borealis*, pesca del camarón, life cycle evaluación de ciclo de vida, sistemas de producción y consumo, Suecia.

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SAMMANFATTNING

Kartläggning av kontroverser kan ge insikter i ämnen med aktörer, nätverk och styrning och där vetenskapliga tolkningar står på spel. I sin tur kan dessa insikter bli användbara i påverkansprocesser och för kollektiv problemlösning och beslutsfattande. För att undersöka nyttan av kontroverskartläggning som metod genomfördes en studie om västkusträkan (*Pandalus borealis*) som blev ämnet för en kontrovers som började 2014 på den svenska västkusten. En tillfällig stabilisering i kontroversen nåddes i maj 2016 då WWF gav sitt stöd åt en miljömärkning av Marine Stewardship Council till den då samtidigt rödlistade och rödmärkta räkan. Vi använder kontroverskartläggning från forskningsområdet vetenskaplig humaniora, och vi följer metodiken såsom den beskrivs av Venturini (2010) och Latour (2012). Metoden möjliggör spårandet av påståenden, litteraturer och aktörer inblandade i kontroversen. Genom att samla dessa element kan vi beskriva kontroversens process och identifiera de nätverk som 'brottas' med den vetenskapliga tolkningen av (samma) data om storleken på västkusträkans population. Med hjälp av verktyg för analysera och visualisera nätverk kan vi se hur kontroversens nätverken ser ut och vilka roller och inflytande olika aktörer har. Det samlade materialet analyserades även ur ett livscykelperspektiv för att undersöka hur kontroversen faller sig i organiseringen av räkans produktkedja. Denna visar att påverkansaktörer försöker värva konsumtionsystemets aktörer för att skydda räkan. Detta leder till många reaktioner på aktörer i produktionsystemet. Avslutningsvis diskuterar vi nyttan av kontroversstudier för livscykelänkande och -management av produktkedjor. Vi föreslår, bland annat, att kontroversstudier kan hjälpa aktörer att bättre förstå de produktion- och konsumtionsystem de deltar i. Möjligen skulle kontroversstudier också vara användbara i ihop med rundabordsamtal för produktkedjeaktörer då gemensam konflikt- och problemlösning eftersöks.

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Keywords: miljömärkning, kontrovers, räkfiske, *pandalus borealis*, livscykelanalys (LCA), produktion- och konsumtionsystem, Sverige

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Prologue



‘Shrimps or not—it’s up to you’ stated our local Göteborg newspaper in April 2015. It was about the sustainability of eating the locally fished shrimp. That made both an intriguing and provocative statement, especially for a scholar of sustainability assessment methodology—is there really no way of telling what’s what with the sustainability of the Swedish West Coast shrimp?

The April article was just one in the flurry of news related to shrimp fishing on the Swedish West Coast, a matter that had been a steady source for drama in the news for a couple of years. Clearly, there was a complex and challenging governance problem at hand, one which no one seemed to have full insight. We thought we should make an attempt at drawing a more coherent picture of the situation and see the role of sustainability assessments in all this, if any.

During research in the program Populating the life cycle perspective, we had come in contact with Actor Network Theory and the scientific humanities. We had already put Actor Network Theory to good use for adding descriptions of actor networks to flow system models (e.g. Baumann et al 2015), but the methods of controversy mapping remained to be explored from a life cycle perspective. The shrimp situation showed up as a suitable study object: it had all the elements of a good controversy and given the topic of the controversy, i.e. sustainability of the shrimp, there could be links to life cycle assessment since LCA is used both for ecolabelling and more general environmental analysis of production and consumption systems.

We were fortunate enough to receive funding from the Adlerbertska foundation, giving us time and opportunity for 'Diving in Magma', which is what Venturini (2009) called his text on how to explore controversies with Actor Network Theory. So we dove... and learned to swim. Here is our account, perhaps more of a dog-paddle account than a smooth breast-stroke account, but bear with us, we are still learning.

December 2016,
Göteborg & Bogotá,

Henrikke & Juana.

1. No shrimps in the *town of the shrimp*¹!?

In February 2014, news about the local shrimps made unsettling reading in the Gothenburg newspapers and papers from other cities on the Swedish West coast. It made waves also into national papers, radio and TV. The West coast shrimp, elsewhere known as the deep-sea prawn (*Pandalus borealis*), fished in the Skagerrak, Kattegat and the Atlantic, had received a 'red light' in the 2014 edition of the WWF Sweden consumer fish guide.

Many actors involved with the shrimp industry expressed their reactions in the news. There were those who heeded the warning, consumers, politicians and some retailers that expressed their concern about fishing practices and their intention to take action. Then again, most fishermen, other politicians and social figures challenged the guide's advice, invoking other sources that gave opposite signals regarding the sustainability of the shrimp. Opinions multiplied and propagated through the media.

To understand the agitation, one needs to know that people in Gothenburg and on the Swedish West coast take their seafood very seriously. Shrimp sandwiches and shrimp binging ('räkfrossa') are iconic examples of the local food culture. What is special about the local shrimp is that it is wild-caught, usually at night, and cooked on board in salty water to be sold on the market in the morning. Unsold shrimp at the end of the day become ingredient for cooking and salads. 'Fresh and never frozen' could be its slogan. In 2013, the city hosted the World Food Travel Association conference, and to illustrate to fame of the local shrimp, a quote of the association director, Eric Wolf, is indicative:

"I'm so glad we chose Gothenburg to host our next World Summit. It's a great city, with history, architecture, proximity to the sea and beautiful landscape, warm and friendly people and *the world's most delicious shrimp sandwich* [our ital.]. What more could we ask for?"²

¹ 'Welcome to the town of the shrimp' - text on a banner advertising the city of Gothenburg at the Landvetter airport in 2012 (tweet by @alexschulman)

² From pressrelease Tuesday, October 09, 2012 (accessed May 2016)
<http://www.visitsweden.com/sweden/Pressroom/Local-press-rooms/US/Press-releases/Press-releases-2012/Gothenburg-choosen-to-host-2013-World-Food-Tourism-Conference/>

WWF's arguments for their warning were presented in the media, not only by the person responsible for marine and fishing issues, but also by the organization's director together with more officials. The arguments for giving a red light to shrimp consumption included the halving of the shrimp stock in the last 5 years, weak management and inadequate controlling according to Håkan Wirtén, director of WWF Sweden (Göteborgs-Posten 2014).



Figure 1.1. Shrimp culture, clockwise from top-left: navigating the shrimps to your table at Restaurant Råkan, entrance sign of the restaurant, buying shrimp from the fishermen, a classic shrimp sandwich, a variety of shrimp salad, logo of the Swedish Shrimp Academy.

Later that year, 2014, other events contributed to increasing the controversy. In June, for example, the control authority was able to catch on film a vessel illegally dumping shrimp in the middle of the sea, one of the practices WWF had pointed as justifying the red-lighting. This sort of dumping had been made illegal under a new control strategy issued by the Swedish Agency for Marine and Water Management (Havs- och Vattenmyndigheten, HaV) and the Coast guard (Kustbevakningen), partly in response to the concerns raised by WWF (Havs- och Vattenmyndigheten 2014; Kustbevakningen, 2014).



Despite these efforts to improve the management of the fishery, WWF again red-lighted it in the 2015 version of their consumer guide.

Despite these efforts to improve the management of the fishery, WWF again red-lighted it in the 2015 version of their consumer guide.

Figure 1.2. Map of fishing areas. The Swedish West Coast shrimp fishing takes part mostly in the IIIa waters, which covers the Kattegat, Skagerrak and the Norwegian Deep.

In 2015, the controversy was less present in the media, but that does not mean there were no new developments. In April, a new announcement, this time coming from an academic institution linked to an international conservation organization, the International Union for the Conservation of Nature (IUCN), added a new element to the discussion. Artdatabanken, the Swedish institutional node of IUCN ‘red-listed’ the *Pandalus borealis* under the category ‘Near Threatened’, although it could have been classified as ‘Vulnerable’ given the reduction in the biomass since 2005 according to the report (Artdatabanken 2015). However, the seasonal cycles of the shrimps led Artdatabanken to stay with ‘Near Threatened’ for the time being. This classification was based on an analysis of the biomass of the stock between 2005 and 2014 showing a decrease around 30-50% (Artdatabanken 2015). These findings apparently supported WWF’s warnings from 2014 and 2015.

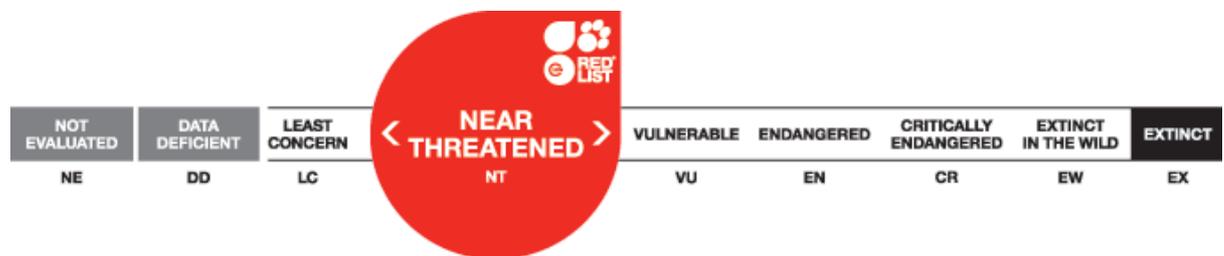


Figure 1.3. The IUCN redlist categories.

However, those opposing the consumer guide classification said that the concerns by WWF were not real since the European Commission, through the International Council for the Exploration of the Sea (ICES), had increased the ‘Total Allowable Catch’ (TAC) for the *Pandalus borealis* in the areas for the Skagerrak and Kattegat fisheries in 2013 (Søvik & Thangstad 2013). The ICES is an organization providing yearly advice to the European Commission authority on fishing regarding the amount of catch that should be allowed for different species. Their advice is based on the input provided by different working groups composed of scientists from different countries and organizations. In the following years, 2014 and 2015, the ICES advice on total allowable catch for *Pandalus borealis* in the West Coast waters increased significantly from 6000 tons max. in 2014, to 10.900 tons in 2015 and 21.500 tons in 2016 (ICES 2013, 2014, 2015). These numbers were used by those opposing WWF warnings to controvert their callings in the press.

Before the numbers for 2016 from ICES were released in November 2015, a new development in the controversy took place. In mid-October, it was announced by the Marine Stewardship Council and the Gothenburg’s Fish Auction that the

Skagerrak, Kattegat and the Norwegian Deep fishery for *Pandalus borealis* was certified under the Marine Stewardship Council principles and criteria for sustainable fishing under its version 1.1 (DNV-GL 2015). Since the red-lighting and the red-listing were still in effect, the certification was awarded under specific observations that were to be reviewed in 2016.

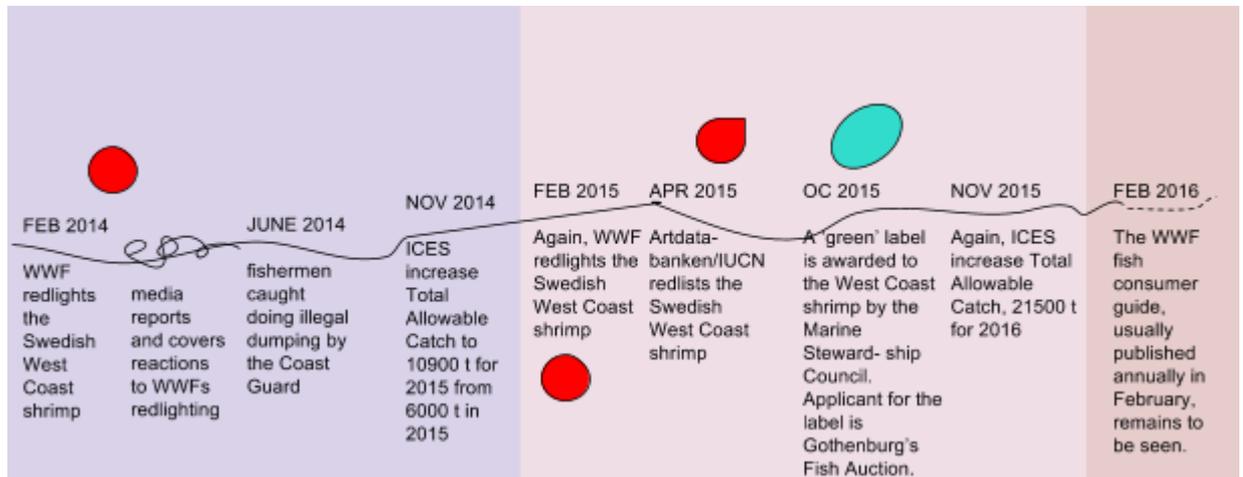


Figure 1.4. Timeline of the controversy.

Table 1.1. TACs and quotas. A total allowable catch (TAC) is recommended by ICES for the *pandalus borealis* for the waters IIIa (Skagerrak and Kattegat) and the waters IIa & IV (Eastern North Sea). TACs are shared between countries in the form of national quotas. Relevant for the controversy are the TACs and the Swedish quotas for waters IIIa (Skagerrak and Kattegat), but sometimes the total TACs and quotas are referred to in the debate.

<i>Pandalus borealis</i> (tons)	2013	2014	2015	2016
ICES: TAC waters IIIa & IVa east*	5800 t	6000 t	10900 t	21500 t
EU: TAC waters IIIa**	6650 t	6650 t	7630 t	12208 t
EU: TAC waters IIa & IV**	3058 t	2446 t	3270 t	2246 t
SUM EU TAC	10708 t	9116 t	10900 t	14454 t
Swedish quota waters IIIa**	1243 t	1243 t	1 426 t	2282 t
Swedish quota waters IIa & IV**	91 t	73 t	98 t	73 t
SUM Swedish quota	1334 t	1316 t	1524 t	2355 t

* Data from ICES 2013, 2014, 2015

**Data from http://ec.europa.eu/fisheries/cfp/fishing_ruts/tacs/index_en.htm

Why is it a good controversy?

According to Venturini (2010), "controversies are situations where actors disagree (or better, agree on their disagreement)" (p. 261). Controversies have a set of characteristics that are relevant for their identification:

- Actors in controversies are of all different types;
- Controversies allow the social to show how it can change and how unstable it can be;
- Simplifications are impossible to apply when formulating a controversy;
- Issues controverted are debated, questioned; and
- Controversies are indeed conflicts between different actors.

In sum, the authors provide a list of elements that could indicate the existence of a controversy: great and diverse group of actors; dynamic formation and break of alliances; where simplicity is a trick; where fights and arguments are the toughest.

Venturini goes on to provide a number of characteristics that make a controversy appealing to map. First, the controversy has to be alive at the moment when its analysis starts. This means that actors involved in it are actively discussing, providing input, reacting to what others say or do not say. In the case of the shrimp controversy in West Götaland, new developments (contradictory ones, one may say, making the topic quite heated) appeared during the work documenting them in this project — reading the morning paper soon became an exercise in alertness.

A second element that makes a controversy good for study is how recent it is. In our case, and as was presented in the first section of this introduction, the controversy started in early 2014 and the most recent elements were added by November 2015. At the moment of the writing of this report, a new version of WWF's consumer fish guide should be released and it is expected it will take into account all the developments from the past year.

Current and overheated controversies tend to be very complex and bound like climate change, meat consumption and cancer or migration. Venturini recommends, instead, focusing on easy-to-bound topics. Our controversy is sector-specific and place-specific, allowing for easy delimitation of the actors. In our case, we address the fishing sector in Sweden; specifically we are focusing on

the shrimp fishing industry in Västra Götaland during the last couple of years. This is particular enough but also broad to make it interesting and relevant.

Finally, although secretive controversies might be appealing, the suggestion is to avoid them. Choosing a controversy about shrimp fishing in Sweden should be public enough to allow for appropriate data collection and analysis.

Our aim for mapping the shrimp controversy

Sustainability issues is worth studying in their entire complexity—the series of events, the many different positions, the tensions between different actors, their respective approaches and understandings evidence this complexity. Actor Network Theory and its tools for mapping controversies provide elements to develop comprehensive descriptions of sustainability problems in society without reducing them to simplicity. With the help of digital media and interpretative inquiry techniques, deep insights about multi-faceted issues can be gained. Such insights can, among else, inform better decision-making. Our curiosity in this approach and its techniques is, however, the first reason for undertaking this project. Once the controversy mapping is done, we will discuss what kind of practical applications are feasible.

A secondary reason is an interest in exploring the extent to which the tools of our home discipline, Industrial Ecology and Environmental Systems Analysis, are present in the controversy. For example, there could be references to Life Cycle Assessment, which is often used for ecolabelling. Alternately, it could be possible to find LCA studies that describe different shrimp fishing techniques or fisheries management, or people making references to some of the Life Cycle Impact Assessment methods for resource use. Our search for LCA and related tools is carried out after the mapping of the controversy as such, and is thus performed as a separate and exploratory analysis.

We will produce a set of maps and graphs to illustrate the complexity of the case. After the introduction about the sustainability controversy over shrimps in Gothenburg and vicinity, the report proceeds with an introduction to the theoretical framework of controversy mapping and an explanation of the mapping controversies method. Then follows a number of chapters based on the empirical data collection with descriptions of the many layers of the controversy. After analysis, findings, discussion and conclusion, comes an epilogue reflecting on the fate of the shrimps.

2. Controversies: a theoretical background

Mapping controversies provides a new perspective about the social; instead of looking into matters of fact it focuses on *matters of concern* as key realms for social construction (Latour 2005, Venturini 2012). Matters of concern are unfinished issues under construction by many actors that interact through different devices. On the other hand, matters of fact are disputes that have been settled using scientific devices and that are no longer subject of questioning. Controversies reflect issues that are being discussed, that have not been settled yet because the different acting entities are still deciding where to go and who to mix with.

By describing how different actors connect through different devices, controversies cartography can contribute to improving the understanding of complex issues. First, it can help the researcher to better understand the constellation of participants in the controversy in a detailed way. Second, it reveals the positions of such actors in respect to each other and to the matter at hand. Finally, if combined with other analysis connected to governance, organization and management, can provide insights for developing strategic options at different levels. Mapping controversies provides the researcher with a way to reveal different associations between actors and translation processes that happen in the journey towards a settling of the debate.

Central concepts for Actor Network Theory and to controversy mapping

Mapping controversies is a tool developed to illustrate the concepts and ideas behind Actor Network Theory (ANT). This theoretical approach aims at providing insights on how to trace associations between actors (Latour 2005). Such associations happen between humans and non-humans. The ANT wants to understand how these two categories interact to produce a result, to provide a performance.

Translation

One of the key concepts used in Actor Network Theory is that of *translation*. According to Latour and Callon (1981), translation is a process that comprises all the actions by which an entity they call actor gains the right to represent someone else; it is the process that turns the *I* into the *We*. Such actions include the most diverse mechanisms that range from violence to subtle acts of persuasion such as science.

Translation processes are also dependant on who and where they come from. As the authors express it: "... what makes the sovereign formidable and the contract solemn are the palace from which he speaks, the well-equipped armies that surround him, the scribes and the recording equipment that serve him." (p. 284). This is a key element to consider when analysing translations, that is, what is the 'weaponry' used by the forces that aim to capture the rest. The act of translation allows micro-actors or forces to become great macro-actors, and this depends on how much of reality they can hide from public scrutiny through different mechanisms. Macro and micro actors are no different, they are both complex and in order to understand one, the other needs to be analysed as well.

Callon and Latour (1981) define such actors as:

"any element which bends space around itself, makes other elements dependent upon itself and translates their will into a language of its own. An actor makes changes in the set of elements and concepts habitually used to describe the social and the natural worlds. By stating what belongs to the past, and of what the future consists, by defining what comes before and what comes after, by building up balance sheets, by drawing up chronologies, it imposes its own space and time. It defines space and its organization, sizes and their measures, values and standards, the stakes and rules of the game—the very existence of the game itself. Or else it allows another, more powerful than itself, to lay them down." (p. 286).

When studying controversies, these two elements are key to identify: which actors, whether micro or macro, are part of the dispute, and what are the translation processes the micro-actors have used to construct macro-actors that shape the new reality.

The scallops case

Callon (1984) illustrated these concepts in his study about the scallops in the St Brieuc Bay. There he shows how to use the concept of translation in order to

understand how science and technology shape power relationships in a specific case. Callon (1984) followed the attempts made to domesticate scallops in the St Brieuc Bay in France as a means to increase production through the production of scientific knowledge and technology. Interest in this particular case came from the fact that a commercially highly attractive stock was decreasing, impacting the lives and economy of fishermen. Therefore, it was imperative to look for alternatives pertaining to the controlling of cultivation of this product.

Using this case, Callon wanted to explore how scientific knowledge about scallops in St Brieuc Bay helped shape new social relationships among different actors. In order to achieve this, Callon followed three scientists and their process to create knowledge about the scallops and translate it into improved conditions for the local fishermen. In the process, the scientists became the representatives not only of the scallops themselves, but of many other 'actants' too, translating their claims into an understandable language for the rest of the network. Such translation is what Callon explored, how intentions, behaviour and relationships of scallops, fishermen and the St Brieuc community came to be transformed into a prosperous business.

Before starting the analysis, Callon pointed out the need to overcome three difficulties that may appear when analysing science and technology from a social perspective:

1. First, it is necessary to avoid the naturalization of science and technology or ignoring the fact that science and technology actors have their own understanding of social and power structures.
2. Second, social and natural sciences have similar roles in the analysis of the controversy given the fact that neither is undebatable, certain and unequivocal.
3. Third, the actors in the controversies, besides having positions on the topic, have identities, which play a role in the controversy, and they need to be incorporated in the analysis.

Callon also provides a set of principles for the researcher to follow in order to overcome these difficulties:

- A. agnosticism towards all arguments presented by the subjects;
- B. generalized symmetry, which translates into using a single registry when referring to social and scientific/technology arguments; and finally,

- C. free association, which refers to the need of acknowledging that social and natural phenomena are interconnected—thus, they are not independent.

The process of translation, as described by Callon (1984), followed four stages:

Problematization: the main actor in the story needs to define a problem and a network of other actors that are related to the scientific and technological challenge. They also establish how these actors would be benefited by solving it, making it necessary for these actors to follow the scientists or in more accurate terms, they indicate what are the associations needed to overcome the situation at present.

Interessement: this phase is defined by the author as "[...] the group of actions by which an entity [...] attempts to impose and stabilize the identity of the other actors it defines through its problematization. Different devices are used to implement these actions." (p. 204).

Enrolment: in this stage, proving or discarding the hypothesis the actors made about each other tests the interessement. The enrolment depends on many factors that need to be included in the negotiations for bringing the actors to become what they are supposed to be.

Mobilisation: this step refers to how well the represented actors will follow what their 'representatives' have expressed. It also refers to the mechanisms by which the representatives are decided, elected or self-appointed, which affect how well the represented will follow. It depends on how well equivalences are established in order to successfully communicate the will of the represented to other actors.

Once a process of translation is completed, it starts to be controverted, which according to Callon means that "the representativity of the spokesman is questioned, discussed, negotiated, rejected, etc." (p. 211). As a result of the controversy, the different stages of translation are altered and a new translation is built.

3. Methods

Controversy mapping

Mapping controversies is a tool that was developed to apply Actor Network Theory to socio-technical debates. Its objective is to facilitate observation and description of issues related to technology, science and politics in such a way that their complexity is not threatened by pre-existing frameworks, perspectives or methods. In order to secure this, in the article by Venturini (2010), a set of principles to conduct controversy cartography are stated:

"You shall not restrain your observation to any single theory or methodology; you shall observe from as many viewpoints as possible; [and] you shall listen to actors' voices more than to your own presumptions." (p. 260).

When observing controversies in the socio-technical sphere, a key concept is that of *second-degree objectivity*. Objectivity, as usually understood, is a key element when doing research—it could be defined by asking the question of how close the observer is to the observed and therefore, to what extent is s/he able to tell what is 'true' from 'false' about that object. This is a key element in natural sciences, and allegedly, natural scientists are quite objective whilst social scientists or researchers dealing with humans cannot be objective in the same sense due to the fact they are as human as the object under observation.

Instead of looking for agreements (matters of fact), second-degree objectivity looks for disagreements, or in other words, for multiplicity of views about a specific object (matters of concern) (Venturini 2012). This type of approach results in an openness to a myriad of views, but it also requires the ability to give each view its 'proper' place in the map. Such properness depends on three elements: *representativeness* (how many actors subscribe to it), *influence* (position of the actors subscribing to the viewpoints or if they are 'obligatory passage points') and *interest* (disagreeing minorities or arguments related to the topic).

These maps also need to exhibit two basic properties: *traceability* and *aggregability*. Traceability refers to the possibility to move backwards in the

translation process in order to retrieve the complexity of the controversy and understand how the final representation conveys it. Aggregability aims at simplifying the amount of data gathered in such a way that it summarizes the complexity of the controversy. The abundance of digital tools and media today allows researchers to build maps that represent controversies, that are traceable and aggregate using a wide range of sources: search engines to search the web; emails and other sources of data that are not findable through search engines, such as chats, teleconferences; offline digital files shared via offline devices. Although the digital world seems to be omnipresent, it is not. Great quantities of information are available in digital form, but large communities are not yet part of this sphere and still have key roles in controversies, which needs to be acknowledged by the researcher.

Following these principles, Venturini (2010) and Latour (2012) provided guidelines to trace controversies in the digital era by suggesting a series of steps to be followed:

1. **From statements to literature:** this translates into mapping the supporting references for controversial affirmations.
2. **From literature to actors:** these references come from different actors that are connected to other actors in an intricate network.
3. **From actors to networks:** this refers to identifying the different relations that connect the actors observed in the controversy, how these connections appear and disappear.
4. **From networks to cosmos:** here the cartographer looks for the motivation behind the actors, the desire behind their behaviour, the meaning of their actions.
5. **From cosmos to cosmopolitics:** this step refers to the observation and description of how different meanings in the controversy prevail or fail.

We follow this approach to address the controversy at hand. However, some adjustments have been made in order to accommodate to the information available and the particular dynamics of this debate. To begin with, we added a preparatory stage, following the method suggested by Latour (2015), from media to statements. Then we stopped at step 4 as it closes the descriptive part of the methodology. Instead, we added our own layer to the analysis, in order to evaluate how the controversy played out in the product chain, as a means to provide insights for dealing with product life cycle governance issues.

Preliminary results were discussed with experts in the area of life cycle assessment, seafood and sustainability.

Our adjusted set of steps are described in figure 3.1.

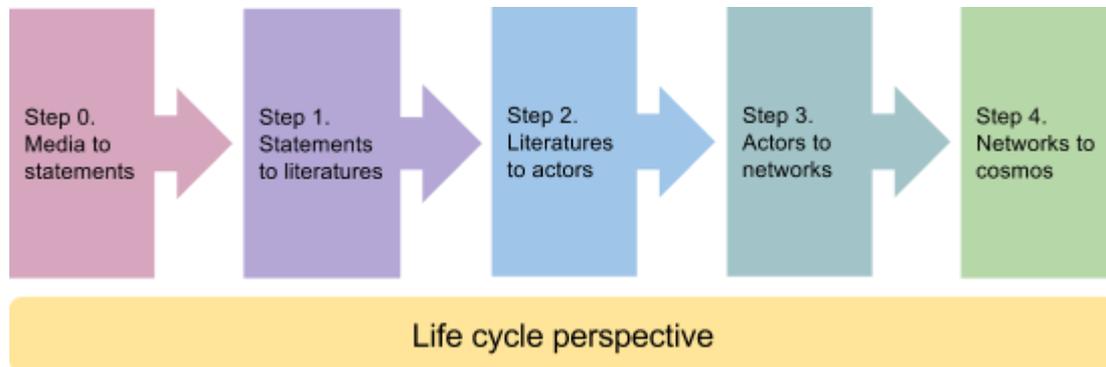


Figure 3.1. Procedure for mapping and analysing the controversy over the Swedish West coast shrimp.

Social network analysis and visualization

Once the empirical data was collected through the methods of controversy mapping, tools for analysis and visualization were used. One way we do this is by doing a social network analysis, here, following the approach of Easley & Kleinberg (2010). According to these authors, a networks is a set of elements that are connected through reciprocal relationships that are known as links. Such relationships can be of different nature that depends on the context of the particular network—this is referred to as the structure of the network. Other relevant aspects are the behavior and the dynamics of the network, or how it evolves over time, but this is not part of this research project.

Structural aspects of networks are studied with graph theory, which provides a description of network properties. Following Easley & Kleinberg (2010), graphs or networks are made of **nodes** and **edges**. Nodes refer to the elements that are connected, and edges are the links or relationships that connect them. These relationships can be directed, when one element has an influence over the other one, or undirected, when there is no directionality in the relationship. Other elements that are relevant in a network structure are paths, cycles, connectivity and components. These elements also open the door to aspects such as length of the paths or degrees of separation.

A key aspect when analyzing a network is **centrality** (Grandjean 2015). This author provides four different types of centrality measures that are useful to

understand a network structure. First is *degree centrality*, which refers to the number of connections a node has; second, *closeness centrality* referring to how close a node is to the rest of the network; *betweenness centrality* is another type of centrality that measures how much a node acts as a bridge; and *Eigenvector* measuring the connectivity to well connected nodes. These metrics provide insights on what elements play relevant roles in the analyzed network and are useful for understanding its features and processes.

In order to visualize the different networks at hand, two softwares were used. Gephi 0.8.2 (<https://gephi.org/>) is a free software available online that provides an interface to map networks. CitNetExplorer (<http://www.citnetexplorer.nl/>) is a free software developed to trace connections between scientific references.

Linking the controversy to life cycle studies

One of the research questions guiding this project is the feasibility of using a tool from scientific humanities to complement life cycle studies. To begin with, we want to see how the network around the North prawn controversy is connected to the research network working on life cycle approaches on crustacean fishing — many of these researchers are located in West Sweden and in Denmark and are thus close to the location of the controversy. This led us to do an additional inquiry into the relationships between the controversy literatures and the LCA literature. Here, we identified relevant LCA publications related to the North prawn in scientific databases. Together with the literatures referred to in the controversy, we had two bodies of literatures that could be studied as bibliometric networks where texts are linked via citations. For this analysis, we used CitNetExplorer (<http://www.citnetexplorer.nl/>).

Data collection

Following the approaches previously described, data was collected through a variety of methods, including review of online media, scientific databases and interviews. The information was then organized in spreadsheets, where it was coded to enable the building of the data sets used to create the network maps and the bibliometric analysis. (Descriptions and summaries of the texts involved in the controversy are available in the appendix.)

The first step when grasping a controversy is to carefully listen for *floating statements* and see who is involved in them and what are they based on. A natural place to start listening is the media, newspapers, radio, television and blogs.

Regarding the shrimp controversy on the West coast of Sweden, the journey started with identifying keywords related to the controversy, searching the internet and also setting alerts for updates in news or blog posts in search engines. We selected the following:

Key words searched for
Hållbart räkfiske (sustainable shrimp fishing)
Nordhavsräkan (North Sea prawn)
Räkfiske sverige (shrimp fishing Sweden)
Shrimp fishing sweden
Sustainable fishing sweden
Västkusträkan (West coast shrimp)

The alerts were set up from early October 2015, ending in early November the same year.

Once the main sources of information were detected, the actors in each source were identified. It is important to point out that there were actors mentioned in the media but no statement was specifically assigned to them, while other actors explicitly stated their viewpoint. For the analysis, only the second group was considered. Their statements were then documented and classified, resulting in 13 categories. Each statement was coded under a particular category.

After the identification of the different viewpoints, the inquiry moved towards more 'solid' places. Such places are composed of by texts and references used by actors to support their perspectives. First, a list of the directly quoted documents was created. Then, each of the documents available was reviewed and the ones these referenced in turn were identified. This collection of literatures, which we here call the controversy literatures, is what is related to the literature on life cycle analysis of crustacean fishing. With both sets of information, a bibliometric analysis of cross-references, co-citation and shared references was conducted using CitNetExplorer.

Data analysis

Using the data collected, several network analyses were conducted using tools such as Gephi and CitNetExplorer software. First, and as suggested by Venturini (2012) viewpoints were analysed in terms of three aspects: *representativeness* or how many actors are behind each viewpoint; *influence*, or what type of actor expresses different viewpoints; and *diversity*, or how many types of actors and

sectors are linked to each viewpoint. Each actor was assigned a maximum of three viewpoints and a minimum of one depending on the information available in the sources. Each actor was thereby linked to one or more of the 13 categories of statements. Second, viewpoints were analysed in light of the references they are supported by—this gives a view of how “solid” these arguments are. Finally, a network analysis was conducted for the actors identified in the controversy. To achieve this the following steps were taken:

- Definition of the nodes and edges, where nodes are actors and edges refer to the type of connection to be explored. In this case, actors could be connected through viewpoints and shared document references.
- Preparation of data sets: data set preparation was the most time-consuming activity involving the translation of raw data into codes and the definition of the links.
- Running of algorithms: this was done using the software Gephi.
- Centrality measures: the main centrality measure used was *degree centrality*.
- Interpretation: based on the results and input from experts on our preliminary findings, some statements are made about the networks in the controversy.

4. Results

From media to statements

The first step towards untangling a controversy, according to Latour (2015), is to identify the statements in the main outlets where controversies are recorded. As mentioned in the previous section, the focus of this research was online sources of discussion: news media, blogs and social networks. Using the predefined keywords the following results were obtained:

- "[hållbart räkfiske](#)": 5 articles
- "[nordhavsräkan](#)": 89 articles
- "[räkfiske sverige](#)": 0 news
- "[shrimp fishing sweden](#)": 0 news
- "[sustainable fishing sweden](#)": 0 news
- "[västkusträkan](#)": 38 articles

In total, 129 articles were identified in the web, which were screened for statements, resulting in 262 entries being recorded in our database.

From the total number of entries included in the database, 169 actors were identified. 65 of these actors made a total of 80 explicit statements in media, thus they become the main focus of the analysis. The remaining 104 were only mentioned in the different pieces with no statements attached to them. Since statements are the departing point for the mapping controversy tool, only the first group was considered.

In our database, we had twelve fields collecting the necessary information of the different actors (table 4.1.) in order for us to conduct the subsequent network analyses.

Table 4.1. Database fields and definitions

Field	Definition
Source	Link to the article
Media	Name of the outlet
Date	Date the article was first posted

Actor	Human or non-human
Type	Animal, artifact, individual, institution, organization, project, regulation or report
Influence	Defined as how big the audience an actor has: low, low-medium, medium-high, high.
Sector	Academia, fishermen, government, NGO, private
Statements	Explicit viewpoint assigned to each actor in the different sources they are mentioned.
Viewpoints 1/2/3	Coded positions (max. 3)
Literatures	References cited by the actors
Product chain position	Where the actor is located in the shrimp product chain: context, fishing, retail and use.
Link to the product life cycle	Whether the actor is directly or indirectly linked (handles) to the shrimp product flow

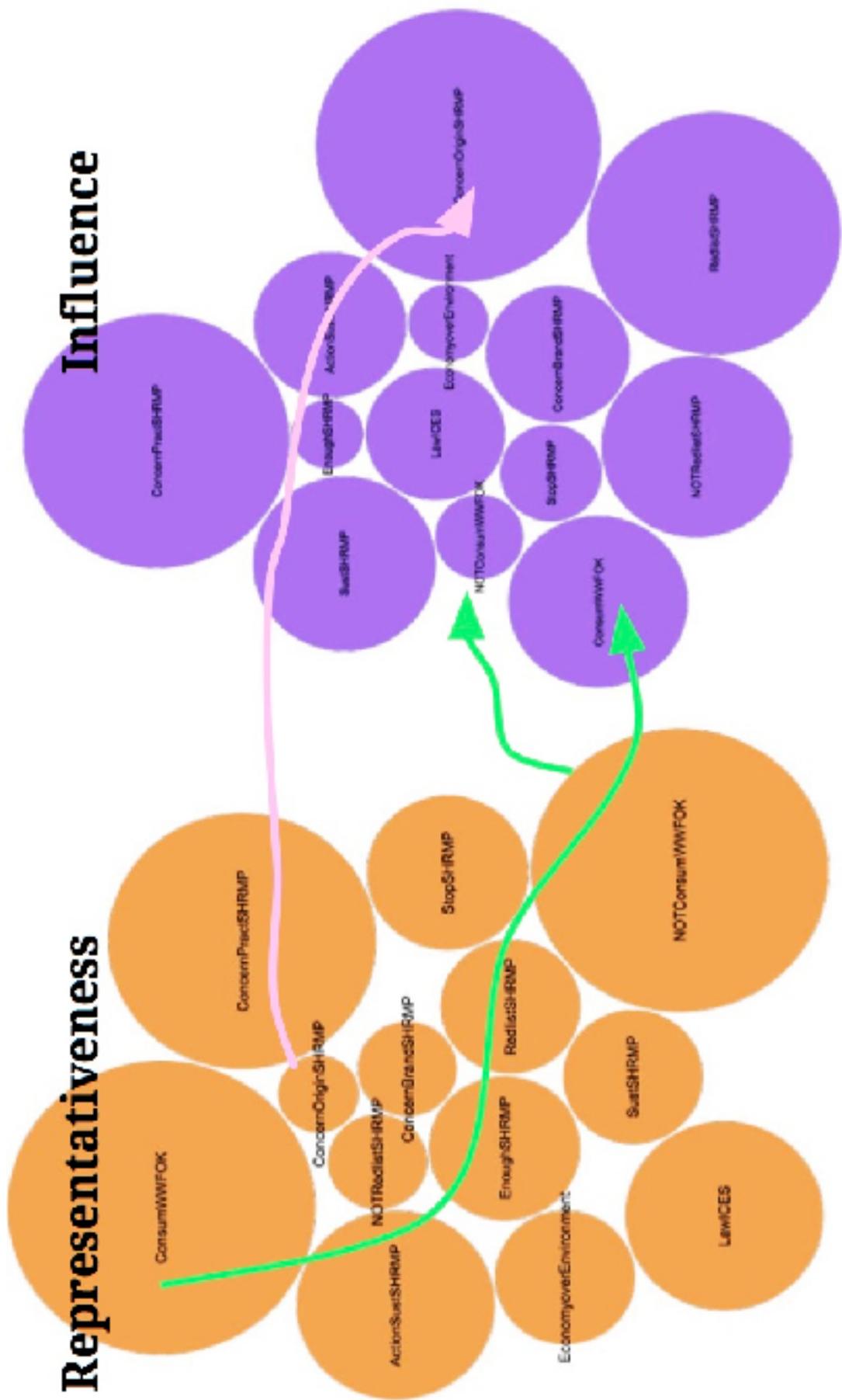
A key step in the codification process was the classification of statements into categories of viewpoints—this was done bottom-up in an empirically grounded fashion. The thirteen viewpoints identified are presented in table 4.2. For each actor entry in the database, a maximum of 3 viewpoints were identified.

Table 4.2. Coding categories for the viewpoints

Code	Explanation
ActionSustSHRMP	Action needed and taken to make shrimp fishing sustainable
ConcernBrandSHRMP	Concern about brand
ConcernOriginSHRMP	Concern about origin of the shrimp
ConcernPractSHRMP	Concern about the fishing practices
NOTConsumWWFOK	Consumer guide by WWF is NOT relevant
ConsumWWFOK	Consumer guide by WWF is relevant
EconomyoverEnvironment	Economy is more relevant than environment
LawICES	ICES is the 'law'
RedlistSHRMP	Shrimp should be redlisted
NOTRedlistSHRMP	Shrimp should NOT be redlisted
StopSHRMP	Stop eating west coast shrimp
EnoughSHRMP	There is enough shrimp to fish
SustSHRMP	There is sustainable shrimp

Once all entries were coded, we analysed the viewpoints as Venturini (2012) suggested in terms of conducted in *representativeness* by the number of actors behind a statement; *influence* by what type of actor support each of the arguments; and *diversity* to see which arguments have widespread support among many actors and which come from more 'lone voices'. From this, we obtain the first controversy maps.

Figure 4.1. (on next page). Viewpoints according to *representativeness* (right) and *influence* (left). Size of circle is proportional to the numbers of actors behind a viewpoint (right) and the size of the audience of the actors for each viewpoint (left). Comparison show that the most frequently heard statements are not the same as those put forward by people with influence.



Representativeness

Evident from figure 4.1., some viewpoints are more represented than others. In this particular case, two arguments have support by the greatest number of actors: ConsumWWFOK, i.e. the WWF consumer guide is relevant (45%) and the opposite NOTConsumWWFOK, i.e. the WWF guide is *not* relevant (42%)³. On the one hand, there is the position that this instrument, the consumer guide, is indeed relevant for decision-making and should be taken seriously. On the other, there are the actors who perceive this effort as confusing and lacking a robust background, rendering it useless for making purchasing decisions.

Next these two is the position expressing concern about the fishing practices for the West coast shrimp (ConcernPractSHRMP 34% of the actors). The opposite argument SustSHRMP, implying there is sustainably fished shrimp, only has 9% of actors supporting it. Next in terms of representativeness comes ActionSustSHRMP (18%) which refers to positions advocating for actions to make shrimp fishing on the Swedish West coast sustainable. Against this argument are positions such as EnoughSHRMP, counting support from 11% of the actors in the controversy.

Further arguments supporting measures against fishing include StopSHRMP (12%), RedlistSHRMP (9%), ConcernBrandSHRMP (5%) and ConcernOriginSHRMP (3%). On the opposite side are EconomyoverEnvironment (9%) and NOTRedlistSHRMP (5%).

It can be concluded here that the two most represented arguments are opposing ones and refer to the relevance of WWF's warning regarding shrimp fishing on the Swedish West coast. The dispute has also opened the opportunity for actors to express their several opinions related to the matter at hand—these seem to be equally unsettled.

Influence

Although knowing the number of actors supporting a given position is interesting, as Venturini (2012) reminds us, not all actors have the same power. Hence, the viewpoints expressed by an actor come across differently to their audiences. To address this aspect, each actor was ranked between 1 and 4, where 1 indicated low influence and 4 high influence. Influence is measured here in terms of the size of the audience an actor can reach. Individuals with no

³ Percentages here do not add up to 100% since an actor can support up to 3 arguments.

institutional/organisational representation were ranked 1 since the size of their sphere of influence is modest; individuals associated with academia and private organisations were ranked 2; individuals from the local government, from companies and other organisations were ranked 3 and organisations and government officials from the national/international level, public figures were ranked 4.

In order to calculate the level of influence for each argument or viewpoint (VP), the number of times an argument (VP_i) was mentioned by actor j was multiplied by the influence of the actor (IA_j) and then added up. As a result each viewpoint obtained a score that allowed us to rank them.

The resulting ranking is shown on the right side in figure 4.1. From this, it is possible to say that the viewpoints expressing concern about the origin of the consumed shrimp (ConcernOriginSHRMP) and the practices for fishing (ConcernPractSHRMP) are coming from more influential actors. After these two positions, we find another pair of opposing viewpoints. On the one hand is the argument supporting the classification of the Swedish shrimp in the red category (RedlistSHRMP) and on the other, the voices that claim that this is too extreme (NOTRedlistSHRMP).

In terms of the most represented viewpoints mapped in the left side of figure 4.1., those about the WWF consumer guide, it is here possible to see that ConsumWWFOK is supported by more influential actors than the opposite, NOTConsumWWFOK. Finally, viewpoints that claim the predominance of economic aspects over environmental aspects and the fact that there is enough shrimp are supported by less influential actors.

Diversity

The last element in the analysis of viewpoints as suggested by Venturini (2012) is what he calls diversity, i.e. how many different types of actors and sectors support any given argument. According to the author, not only the arguments that are supported by many different actors should be included in the analysis but also those lonely voices that tend to disagree with the majority.

For the diversity analysis, we analysed the arguments by sector (private, NGO, government, fishermen and academia) and type of actor (individuals, organizations and institutions). It shows which arguments have diverse proponents and which have proponents who are more alike.

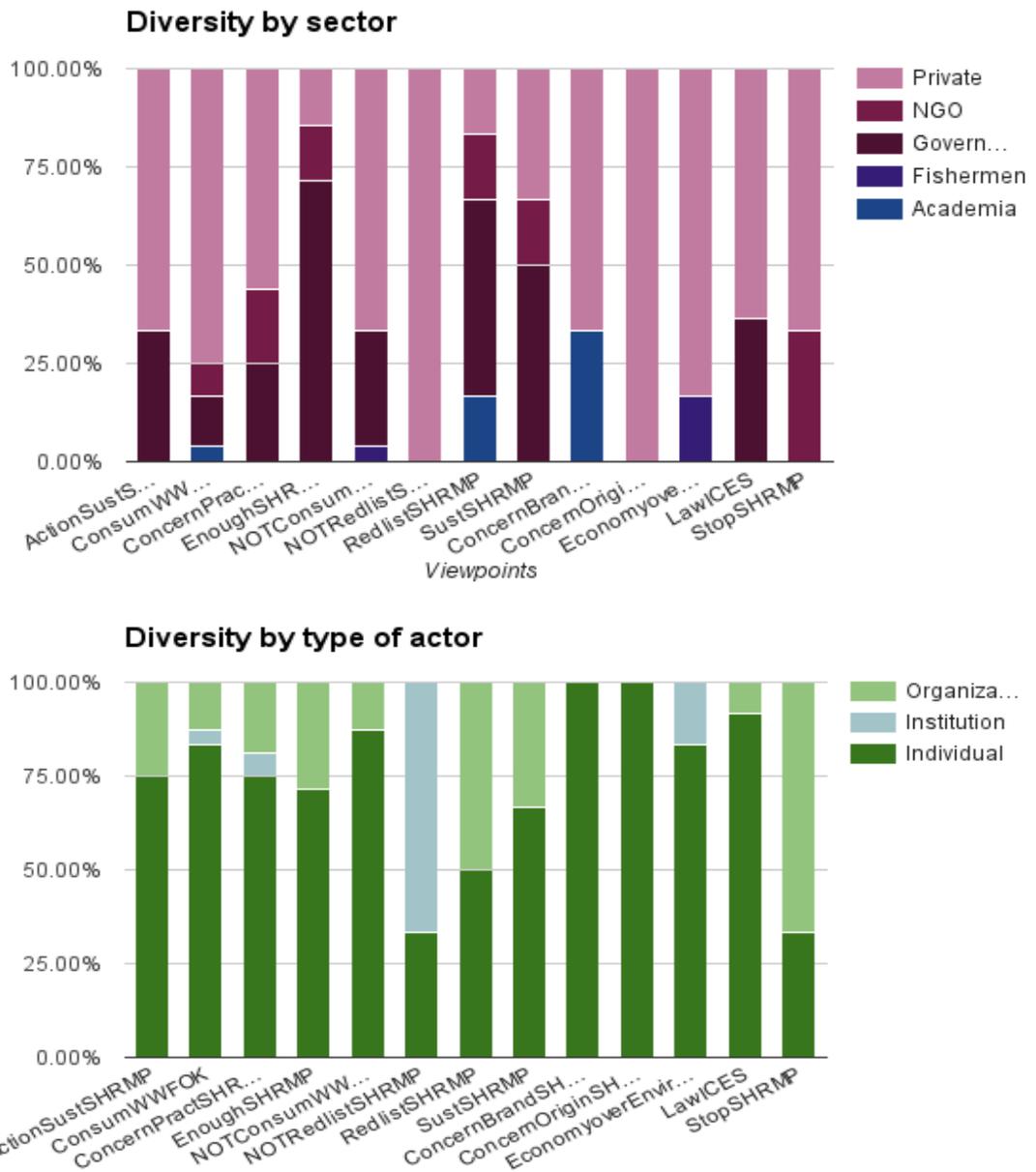


Figure 4.2. Diversity of actors for each viewpoint. Diversity by sector (top) and diversity by type of actor (bottom).

When analysing by sector, the argument about the relevance of WWF's consumer guide (ConsumWWFOK) is shown to have support in 4 out of 5 different sectors. The same goes for the viewpoint supporting the red-listing of the product (RedlistSHRMP). However, this last argument was clearly challenged by the private sector making it relevant to consider it in the analysis.

Other perspectives voiced more uniquely and need considering include the argument that economic aspects are more important than economic (EconomyoverEnvironment), the concern about the origin of the shrimp (ConcernOriginSHRMP), the need for actions towards sustainable fishing

(ActionSusSHRMP), the concern about the impact on Gothenburg's brand (ConcernBrandSHRMP), the preeminence of law over consumer guides due to the scientific basis (NOTConsumWWFOK) and the call for stopping shrimp consumption (StopSHRMP). This shows that many sectors bring their concerns into the debate, adding complexity to the issue.

By type of actor, only two arguments are put forward by all actor types and have thus diverse backing. The first is the viewpoint highlighting the relevance of WWF's consumer guide (ConsumWWFOK); the second one is the one raising concern about shrimp fishing practices (ConcernPracticesSHRMP). Arguments put forward by only one type of actor, here individuals, are concerns about the impact of the red light on the brand associated with Gothenburg (ConcernBrandSHRMP) and the concern regarding the origin of the shrimp (ConcernOriginSHRMP). Remaining arguments are found across two types of actors.

Viewpoints along the shrimp product life cycle

Here, we analyse the statements by looking at who says what at different points in shrimp product chain. For the analysis, we model a simple product chain consisting of fishing, retail and use, together with surrounding actors.

To do this we mapped the different statements against actors and against a simplified version of the shrimp product chain: context, fishing, retail and use. The total 80 statements (classified in 13 categories) made by 65 actors were laid out in this schematic product chain. The result is shown in figure 4.3.

Actors in the retail step are the most skeptical about WWF's warning about shrimp fishing sustainability, but some still state it is relevant. The fishing stage exhibits the most diverse viewpoints. The context element of the product chain also exhibits opposite views regarding the main topic of the controversy, the reliability of WWF's warning. Users of shrimp are the more supportive of the organization's perspective.

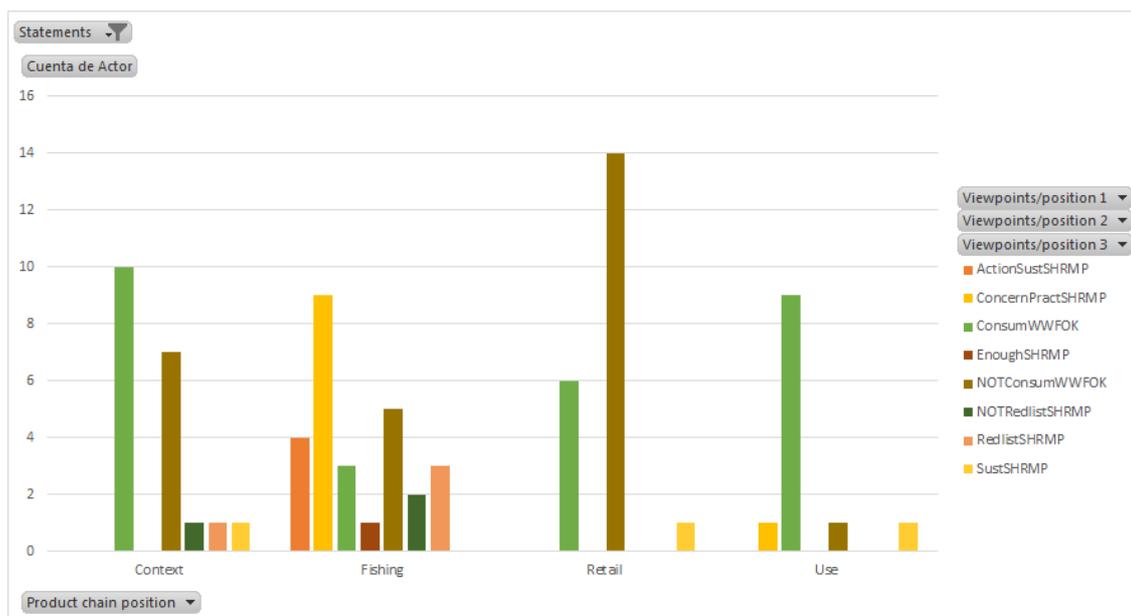


Figure 4.3. Statements at the different stages of the shrimp product chain.

The controversy by its statements

Based on this first analysis on the different viewpoint expressed by the actors involved, it is possible to draw the following conclusions about the controversy and matters of concern:

- The controversy revolves mainly around the relevance of WWF’s warning regarding the sustainability of shrimp fishing on the Swedish West coast. The notion that WWF’s Consumer guide is relevant is the viewpoint most frequently encountered in the public debate and with the most diverse support, but has relatively fewer proponents among people with influence.
- Highly influential actors share the concern about the sustainability of North sea prawn fished on the Swedish West coast and support actions such as the red-listing of the species and the red light by WWF, although the WWF guide as such is of lesser interest.
- The opposite notion, that the WWF Consumer guide is not relevant nor useful, is almost as frequently stated in the debate, but this viewpoint is has less diverse support. The voices questioning this and similar measures are more singular. These argue, for example, that there are analyses more scientific than WWF’s, and that the debate should not only be about the environment but also about the economy and the well-being of fishermen, and the impact on local traditions.

- The use stage in the product chain is clearly the most supportive to WWF's suggestion. The upstream part of the product chain and its context show a more mixed response towards the WWF consumer guide, where retail and context elements of the product chain present the most divergent views. While the consumption system is supportive to WWF's measure, it is in the production system where the opposing viewpoints are concentrated.

From statements to literatures

Once the main arguments or viewpoints were identified and characterized, one proceeds to looking at sources to such perspectives. To do so, it is necessary to identify in detail what references, i.e. the literatures, the actors call upon to support their views. By identifying the literatures, one can see what other networks are invoked as support and allies to the controversy.

Going through the statements, we found a group of texts used as sources and collected in the list below. These texts make up a core group of references in the controversy, and include voluntary standards for fishing, regulation at the national and international levels, scientific reports on the state of marine resources and reporting from projects on improvements to fishing practices. We tried to access all these documents but did not succeed in all cases. A description of each document available is in the appendix. Here, we describe the links between statements and literatures in the controversy.

1. [HaVs control strategy](#)
2. [ICES report 2013](#)
3. [Motivation for trawling ban in Kosterhavet](#)
4. [KRAV procedures](#)
5. [MSC certification for Sweden Skagerrak, Kattegat and Norwegian Deep-cold water prawn](#)
6. Nordic Choice Hotels guide (Not available)
7. [Quota regulation](#)
8. [Red list artdatabanken](#)
9. [WWF fiskguiden](#)
10. WWF-FRV project on selective gear (Not available)
11. Fishermen's union's assessment (Not available)

In order to find the most pertinent documents to the controversy, we mapped the literature against the different viewpoints (see figures 4.4 and 4.5). From this simple analysis, it is possible to conclude that two documents are used to support most of the arguments/statements present in this controversy: the ICES report 2013 (Ulmestrand et al. 2013) and the WWF consumer guide on fish (WWF 2015).

After the ICES report and the WWF consumer guide, the Nordic Choice Hotels purchasing guide and the WWF-FRV project report on selective gear for shrimp fishing are the next prominent reports. Less cited sources are the assessment

conducted by the fishermen's association, mentioned by one of its members, and the quota regulation established by the European Union, enforced by Havs- och vattenmyndigheten in Sweden. Also in this third group is the certification documents developed by DNV to support the MSC-labelling process started by the Gothenburg's Fish Auction.

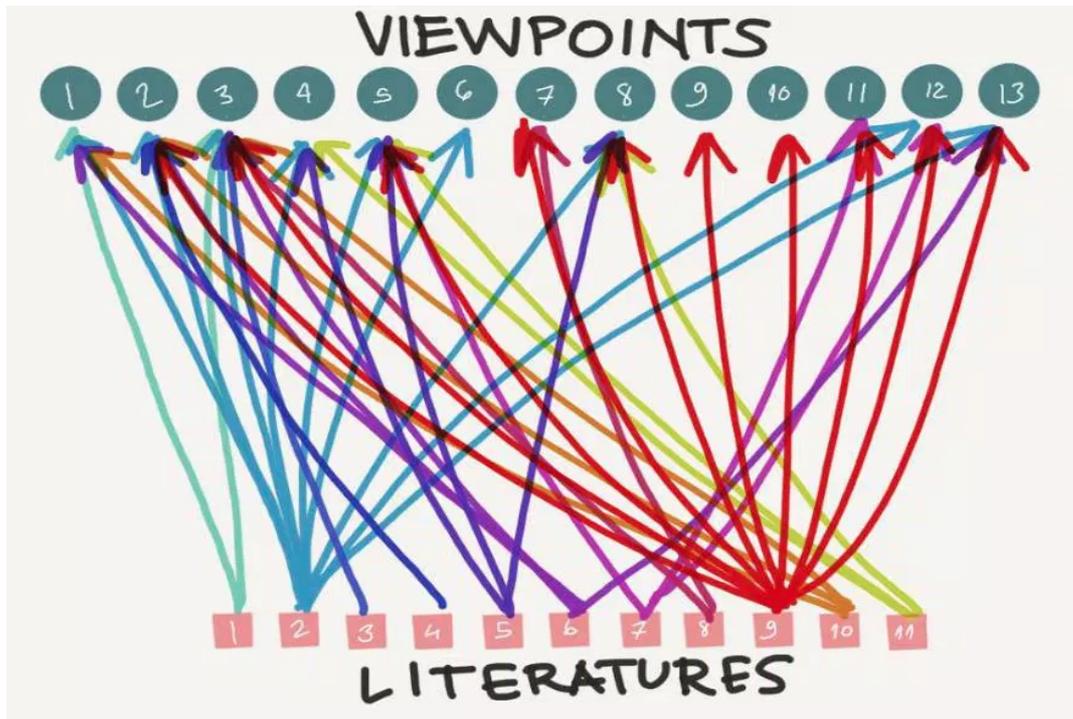


Figure 4.4. Connections between the literatures (11 texts) and the 13 viewpoint categories.

Most of the arguments and viewpoints presented in the controversy are supported by technical reports that are mainly based on secondary information, which has gone through different interpretation processes by the actors producing them and the actors quoting them. This leads to a transformation of the message intended by the original authors. How the information plays out in the discussion depends on who the actors are, their interests and the role they play in the debate. This becomes evident with the manner the ICES report 2013 is quoted by both sides in the controversy regarding the relevance of WWF's warning.

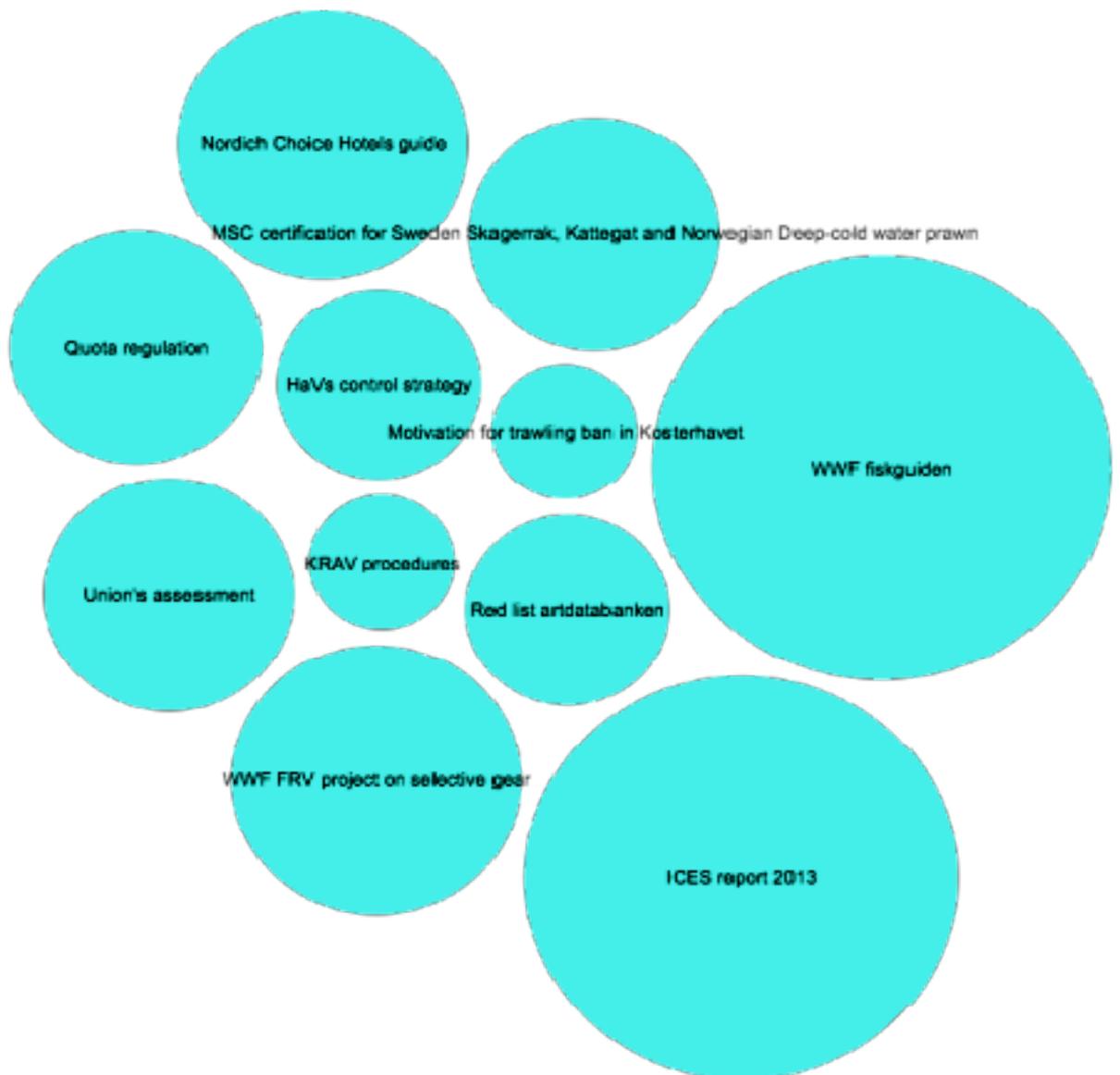


Figure 4.5. Literatures by the number of viewpoints referencing them

Extended literature of the controversy

A number of documents are directly drawn into the controversy by the actors who refer to these for support to their arguments. These documents are in turn supported by other reports, articles and documents. As suggested by Venturini (2010) and Latour (2012), we also traced this second-order literatures in order to acquire a wider picture of the network of supporters around the different viewpoints.

The analysis of the controversy's first-order and second-order literatures allowed us to make several observations. First, the primary literature exhibit different

levels of support in terms of number of references to the second-order literature. Documents such as the ICES report from 2013 and the MSC certificate for the Swedish *Pandalus borealis* fishery make use of a great number of references. In contrast, literatures such as the WWF consumer guide, the quota regulation document from the Havs- och Vattenmyndigheten and the KRAV standards do not reference any documents. Artdatabanken's 2015 Redlist includes a small list of references. This allows us to link the viewpoints with the number of references used to support their argument (see figure 4.6).

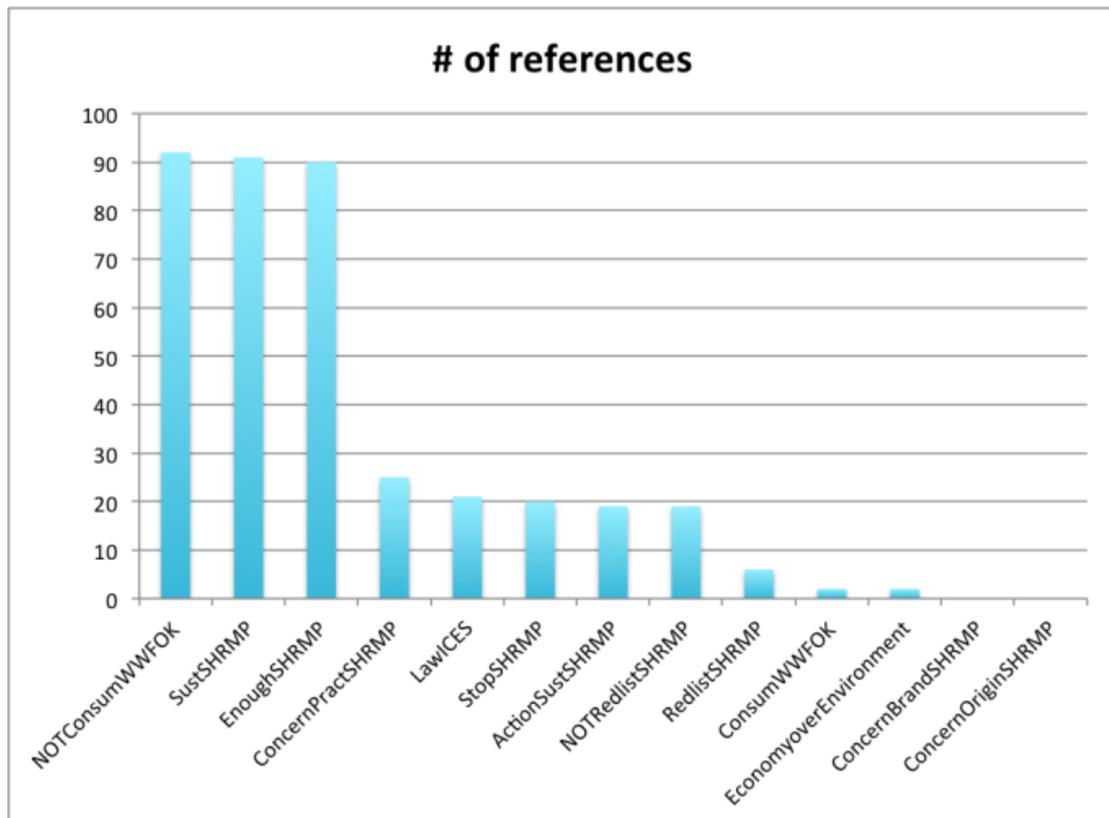


Figure 4.6. Number of references supporting each viewpoint.

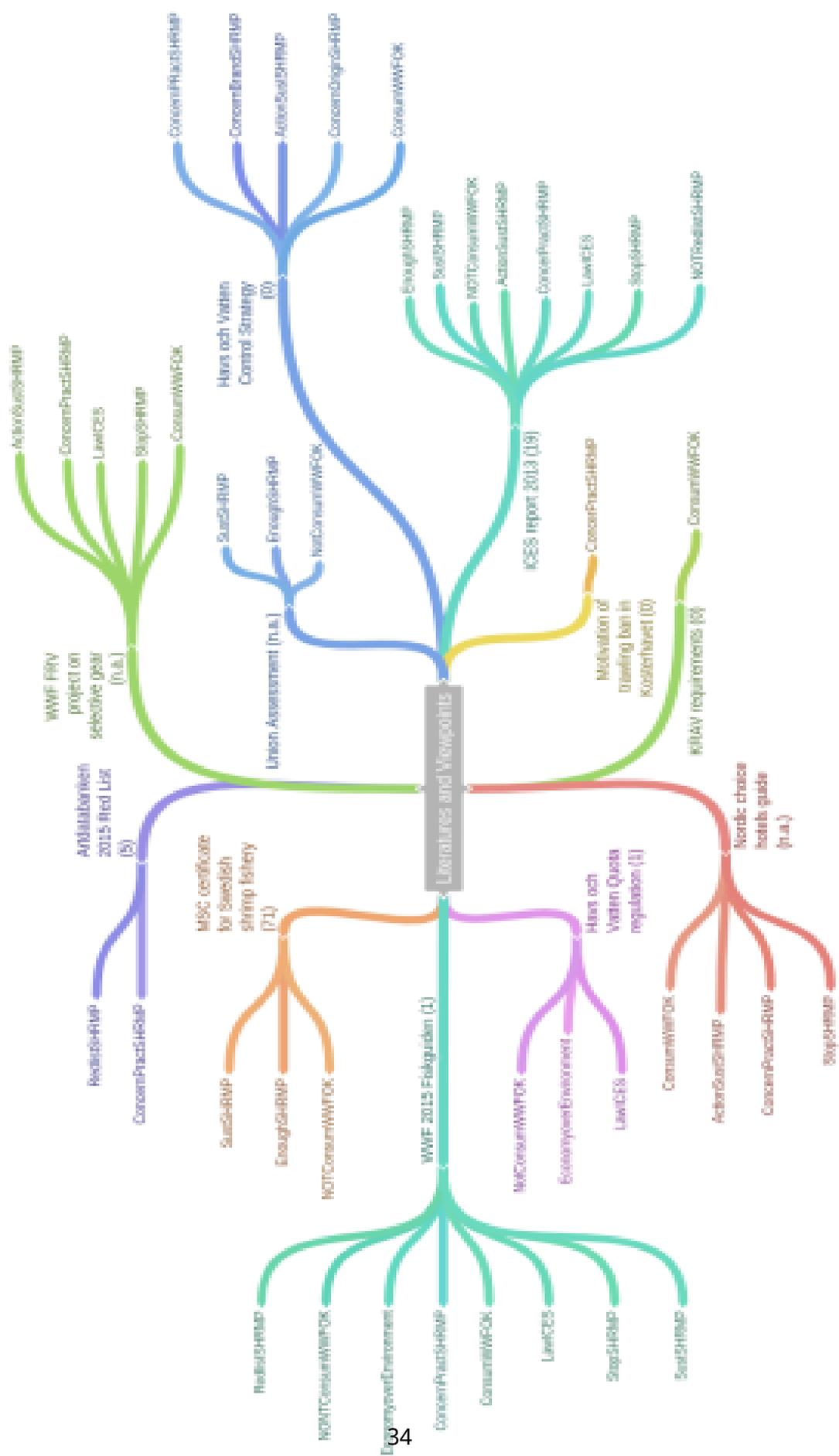
In figure 4.6., it can be seen that the viewpoints with the greatest support in terms of number of references are the arguments suggesting that there is no problem with the *Pandalus borealis*, while the argument supporting WWF's consumer guide warnings have considerably fewer references. Other viewpoints, such as those expressing concern over the origin of the shrimp, the role of the shrimp as a brand for Gothenburg or the relevance of economics over environmental concerns are in the same situation.

A second observation concerns the type of texts that make up the second-order literatures. The ICES 2013 report cites a number of technical reports (19) created by its working groups on different topics. The MSC certificate is refers to a large

number (71) of other texts, including technical reports by ICES and other scientific bodies, peer-reviewed articles and regulatory documents. Artdatabanken's 2015 Redlist document is also based in similar documents, and also includes the ICES reports in its reference list.

The links between each primary literature and viewpoints is mapped in a tree figure. This shows how many viewpoints are supported by each literature. In turn, the number of references used to support the literature is provided (in parentheses are the number of references behind it).

Figure 4.7. (next page). Literatures linked to different viewpoints.



Literatures — links to the Life Cycle perspective

In order to chart the network of controversy and life cycle texts, we explored the links between the two bodies of literature through analysis and visualisation with the CitNetExplorer tool.

For this, we first needed to the LCA group of literature: documents of life cycle studies related to the Swedish West coast shrimp. Searches were conducted in Web of Science, Scopus and Google Scholar using the following keywords:

- Shrimp LCA
- *Pandalus borealis* LCA
- Shrimp life cycle assessment
- *Pandalus borealis* life cycle assessment
- LCA + shrimp(s) + sweden/kattegat
- Shrimp LCA Sweden
- Shrimp LCA Kattegat

The search results were further filtered by looking for the articles addressing wild catch of shrimp or prawns from a life cycle perspective. Wholly Asian studies thus were excluded given they are not geographically relevant for this research. Finally, in order to be able to use the bibliometrics software CitNetExplorer, only the records available in Web of Science can be used. In all, we identified 20 references that were also found in Web of Science. This body of literature was then related to the controversy literatures.

The references from the controversy were also searched in Web of Science. From this search, only 25 (out of 100) publications were found owing to the fact that a lot of material were technical reports and regulatory documents and thus not included in the Web of Science. The references in the technical reports were reviewed for scientific references, but all of them referred to previous technical reports that were not available in Web of Science.

In total, we explored citation links between 45 publications (listed in Appendix), of which 25 were controversy-related texts and 20 LCA texts, using the CitNetExplorer software (see figures 4.8 ad 4.9.a-c). Three groups can be identified in terms of citation nets. The timeline shows the chronology of the publications (the oldest at the top of the graph); lines show citation links down to the citing articles. The two groups to the left consist of publications related the controversy's viewpoints. On the far right is the group of publications with an

LCA approach, where publication starts around 2003. Between groups 1 and 2 there are no connections but between group 2 and 3 a connection appears. This means that a link between the literatures invoked in the controversy and the LCA literature appears in 2010 when Fet et al (2010) cite Collie et al (2000) (figure 4.8.). More links appear when zooming in (figures 4.9.a-c).

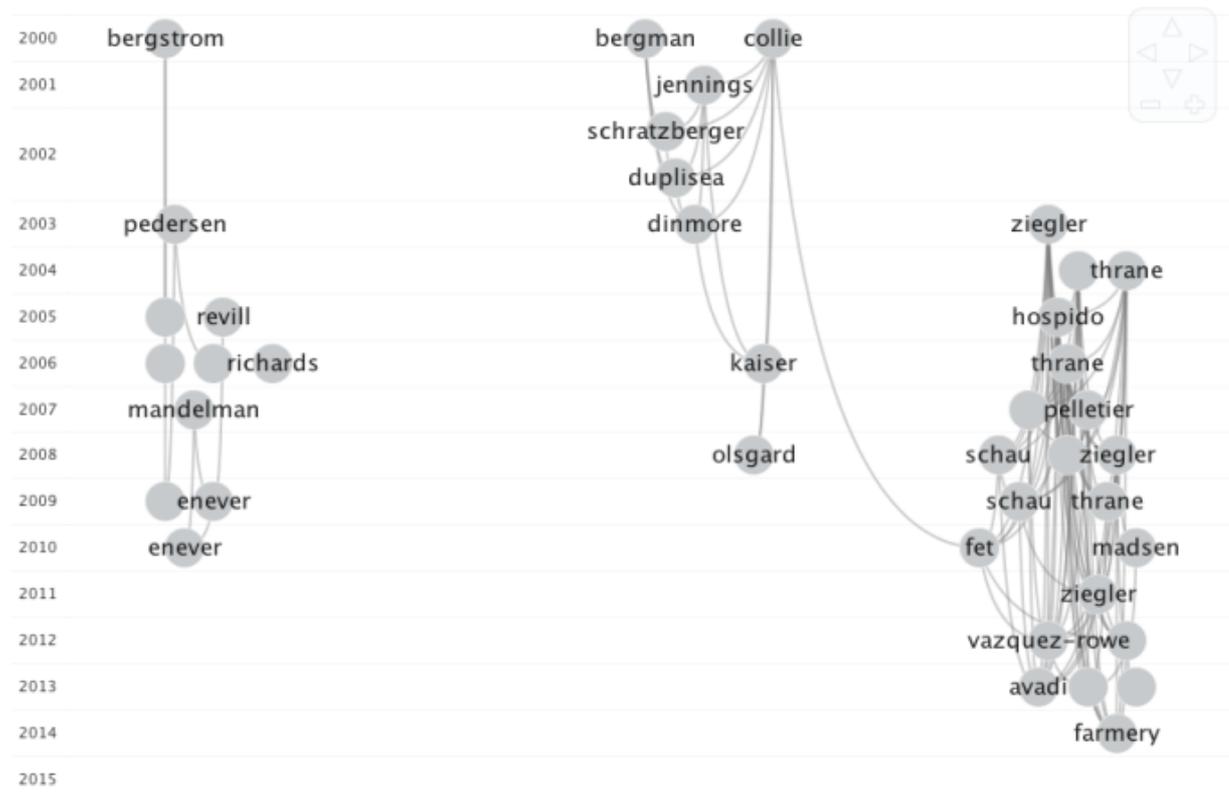
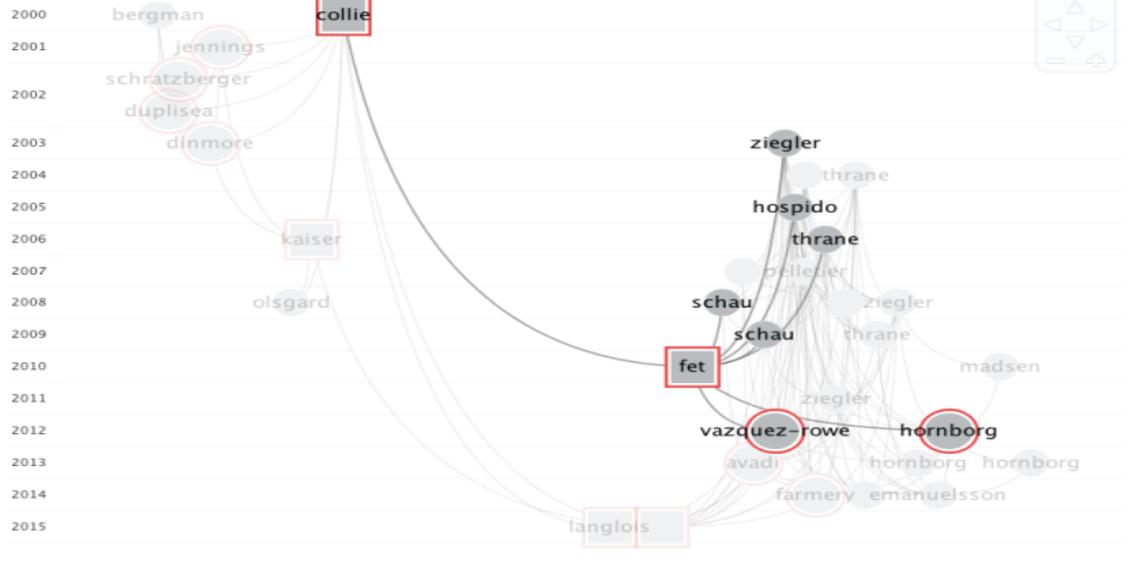
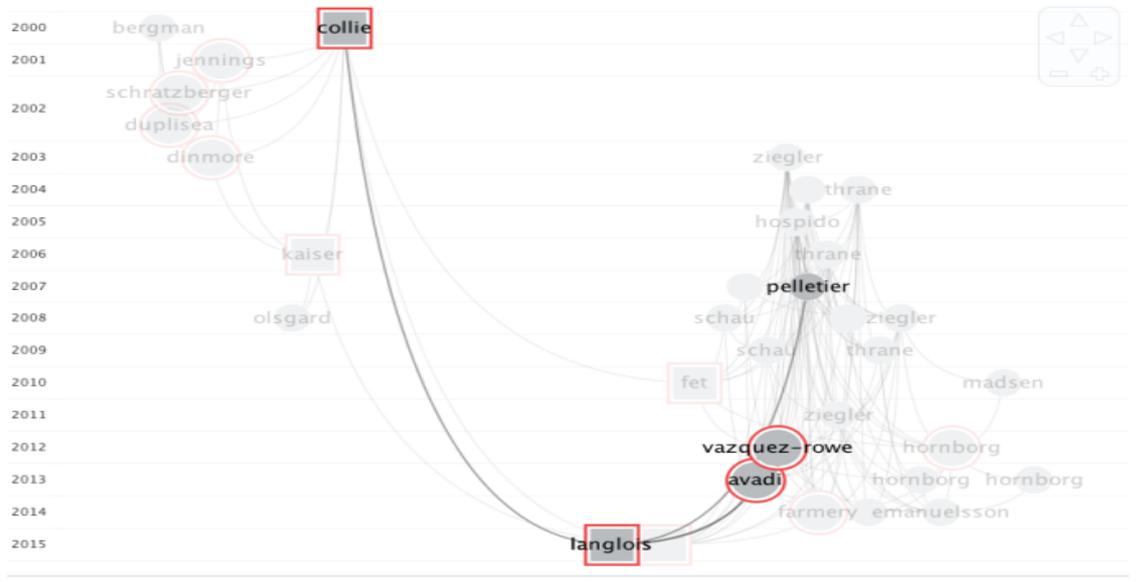
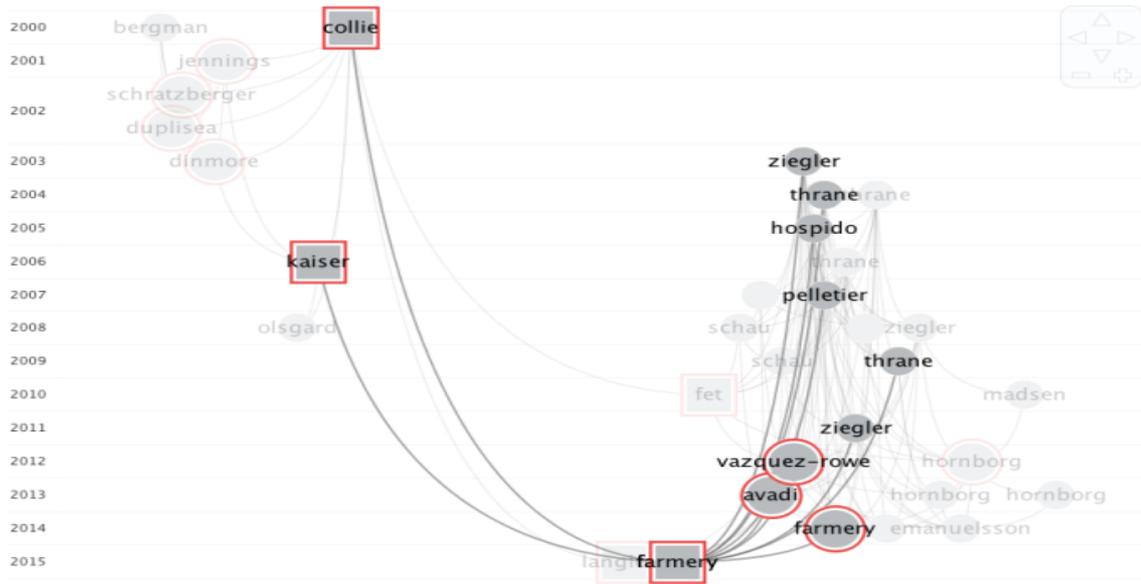


Figure 4.8. Citation nets. The two groups to the left are citations nets for literatures that appear in the controversy; to the far right is the group of LCA texts. One link between the LCA literatures and the controversy literatures appears at this level of resolution, Fet et al (2010) citing Collie et al (2000).

Zooming in on the right side of figure 4.8, we find in total three links as shown in figures 4.9.a-c: Farmery et al (2015) citing and Kaiser et al (2012); Langlois et al (2011) also citing Collie et al (2000) in figure; and, Fet et al (2010) making the first link to Collie et al (2000).

Figure 4.9.a-c (next page). Citation nets at higher level of resolution. Three links are shown, from first to most recent link (bottom to top).



From the chronology in the citation nets it becomes clear that the LCA literature has benefited from the literature supporting viewpoints in the controversy, but not the other way around. This is particularly interesting since a large number of LCA publications are contemporary or were published before of some of the articles used in the controversy.

The controversy by its literatures

Based on these different maps it is possible to draw some preliminary conclusions:

- The viewpoints expressing that the alarm raised by WWF is inaccurate are presented with the greatest number of references for support. The supporting literatures is made up by technical reports, regulatory documents, and peer-reviewed publications.
- It is evident that there is no apparent correlation between the robustness of a text and its invocation by actors. Well-referenced literatures such as the ICES report 2013 and more weakly referenced reports such as the WWF fish guide are used equally by the actors in the debate.
- The traceability of sources is not evenly distributed among literatures, but this seems not to affect the trust by the audiences. What was found in the case of WWF fish guide was that we were not able to access the sources for the guide, not even when asking directly. In contrast, all the documents behind literature for the ICES report 2013, the MSC certification and the Red List are open to the public. Unavailability to references raises questions about accountability and transparency of instruments such as WWF's fish guide, and we wonder how declaration of references would affect the social role of the guide.
- The link between the controversy and the LCA literatures is that the peer-reviewed publications appearing in the controversy have later been used by LCA related publications on shrimp and wild-caught seafood. LCA-related literatures have thus not been considered in the publications used to support the different viewpoints.
- LCA is a common tool for ecolabelling and product sustainability assessments (Baumann & Tillman 2004). Moreover, many of the LCA

publications are authored by researchers in Scandinavia or even in Göteborg where much of the controversy takes place. Even so, the LCA literature plays no visible role in the controversy. The absence of LCA references in the controversy could have various explanations, such as missed opportunities of science communication, disinterest from news media, methodological limitations or the studies being inappropriately framed for public discourse. Elucidating on the reasons for this absence would require further study and analysis. Nevertheless, the question remains: What could be the contribution of LCA studies to such a controversy, if any?

From literatures to actors

Identifying the full set of actors involved in the controversy requires the analysis of both the statements and the literatures behind the statements. In this section, we identify and describe these actors. This shows that the types and numbers of actors involved in the controversy is greater than the number of actors that voice various viewpoints.

Ten types of actors

The first suggested categorization refers to the type of actor, some human, others not. We identified ten categories, described as follows.

Animal: the shrimp

In the literature and media, many different words were used to refer to the main protagonist of the controversy, the Northern prawn. In figure 4.10., the numerous expressions used to refer to her are mapped.



Figure 4.10. Word cloud of the different references made to the shrimp (*pandalus borealis*) in the media regarding the controversy.

According to (FAO, n.d.), this species lives in the northern portions of the Atlantic and Pacific oceans. It's habitat ranges from 20 to 1330 mts depth in the bottom clay and mud. This species has a particular life cycle. They are born as male and they end their lives as females around four to seven years later.

Reproduction occurs between June and October with hatching of larvae the following Spring. Their behavior depends on several physical factors such as temperature, salinity, substratum and depth (Bengström 2000). In figure 4.11, the life cycle of the shrimp is presented in the context of different fishing methods used to catch shrimp at different life stages.

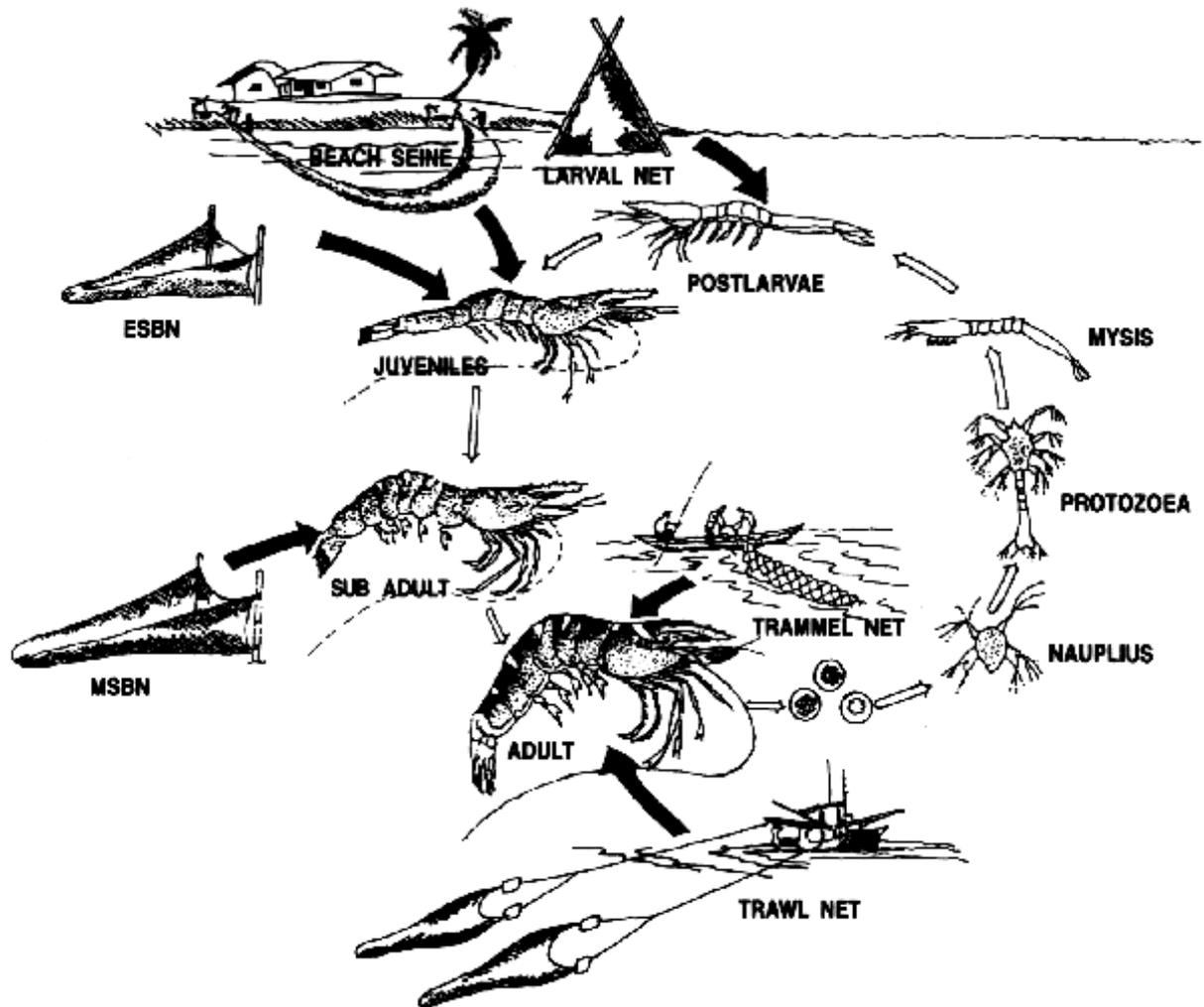


Figure 4.11. Overview of the shrimp life cycle and fishing technologies. Source: <http://www.fao.org/docrep/x5625e/x5625e02.gif>

Artifacts: trawling

In the specific case of the *Pandalus borealis* from Skagerrak, a prominent element in shrimp fishing is trawling technology. Trawling has been the preferred technology for shrimp fishing in this area of the world. Gillet (2008) presents a description of how this gear has changed over the years to allow for a more efficient and sustainable fishing process although its transformation hasn't been dramatic. According to him, trawling wasn't specifically developed to catch shrimp, but was adapted when the main target, finfish, was depleted. In

Skagerrak, demersal trawling (trawling close to the seafloor) is used, which results in discrimination of shrimp caught by sizes in an often automatized process (Ziegler et al 2015). Figure 4.12. explains how the device works.

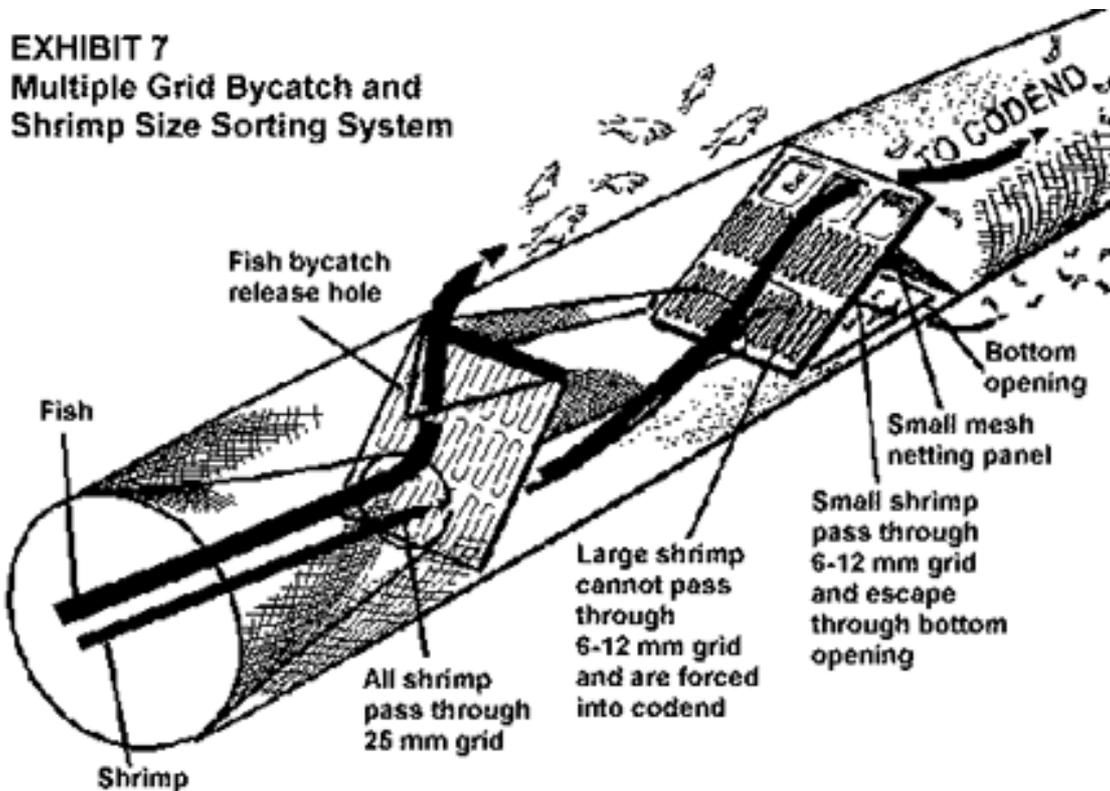


Figure 4.12. Demersal trawling gear for selecting shrimp by size. Source: http://www.crimond.com/sites/default/files/ex7_e.png

Human individuals

During the controversy, many individuals were interviewed in media, expressing their opinions on the topic at hand. Individuals, according to Callon & Latour (1981), are often representatives of macro-actors and play a role in translation processes. It depends on whom they are speaking on behalf of—this will determine if a micro-actor (an individual) will turn into a macro-actor. In our review of the media, 75 individuals were identified, coming from different sectors, with different levels of influence, and therefore with different roles in the controversy.

From a lifecycle perspective, the actors are found at various stages in the product chain. Some of these actors are in direct contact with the product flow of the shrimp (e.g. fishermen and retailers), while others have only indirect contact (e.g. academia and government authorities).

Institutions

Institution, as used here, refers to informal yet established social arrangements, such as the 'market', the 'demand' or 'consumers'. Although they are assigned a viewpoint by the media, it is very difficult to really assess what these institutions stand for. In media, approximately 10 such institutions were mentioned. The statements they were assigned with, if they were, were not considered.

Organizations

This type of actor refers to formally established organizations, either private, public, academic or social. Examples include Havs- och Vattenmyndigheten, WWF, ICES, etc. Such actors are the result of many interactions over time but are considered to have agency on their own. Organizations have individuals that speak on their behalf. When such people speak as representatives of an organization, their voices are heard by a larger audience than the one usually addressed.

Organizations can be directly or indirectly involved with the product flow and can have many different roles in the organization of the product chain.

Place

Controversies often have a geographic dimension. In this particular case, the controversy takes place on the West coast of Sweden, more specifically in the ports where shrimp is landed, the marine areas where fishing is controlled as well as the places of sale and consumption. In the media, two places were explicitly mentioned: Kosterhavets National Park and small harbors on the Swedish West Coast.

Projects

Only one project was mentioned in the media as being part of the controversy. A project is considered a type of actor since it is a collection of ideas, individuals, organizations and resources of its own. It is not uncommon to hear individuals present themselves as belonging to a project instead of an organization. In this sense projects were defined here as actors.

Region

As mentioned before, geography is a key part in a controversy especially when referring to natural resources that are unequivocally tied to the land. In this controversy, regions are also considered as actors since they are summoned by

spokespeople when stating a viewpoint. In this particular case, 'region' refers to countries since fishing is divided between national states. On a more local level, we find municipalities. In this controversy, at least three countries are involved, and several municipalities and cities.

Regulation

Laws, regulations or rules are also considered here as actors since they have an impact on the behavior of other actors and are in turn, affected by the decisions of other actors. They are the result of the interaction of many factors and are protagonist of this controversy since they affect the sustainability of fishing activities. Here, several regulations were identified: the quota system for fishing defined by the EU, rules on landing, certification rules, among others.

Reports

Reports are documents that present different types of information, that have various objectives and end up yielding different results. Also reports are protagonists in this particular controversy. On the one hand is the annual WWF consumer guide to sustainable fishing, on the other is the annual ICES report on shrimp. Another relevant report is the Artdatabanken Report 2015. Reports are key devices to 'translate' information, knowledge to different audiences.

Actors by mentions, with statements and voices

We have identified 10 different categories of actors in the controversy. To see the extent to which these are part of the controversy, we analyse in what way they are present in the public debate.

When looking at which of these get mentions in the media, we find that some are mentioned more frequently than others. In terms of mentions of actors in the media, figure 4.13 presents the results. Mainly individuals, organizations and animals were mentioned.

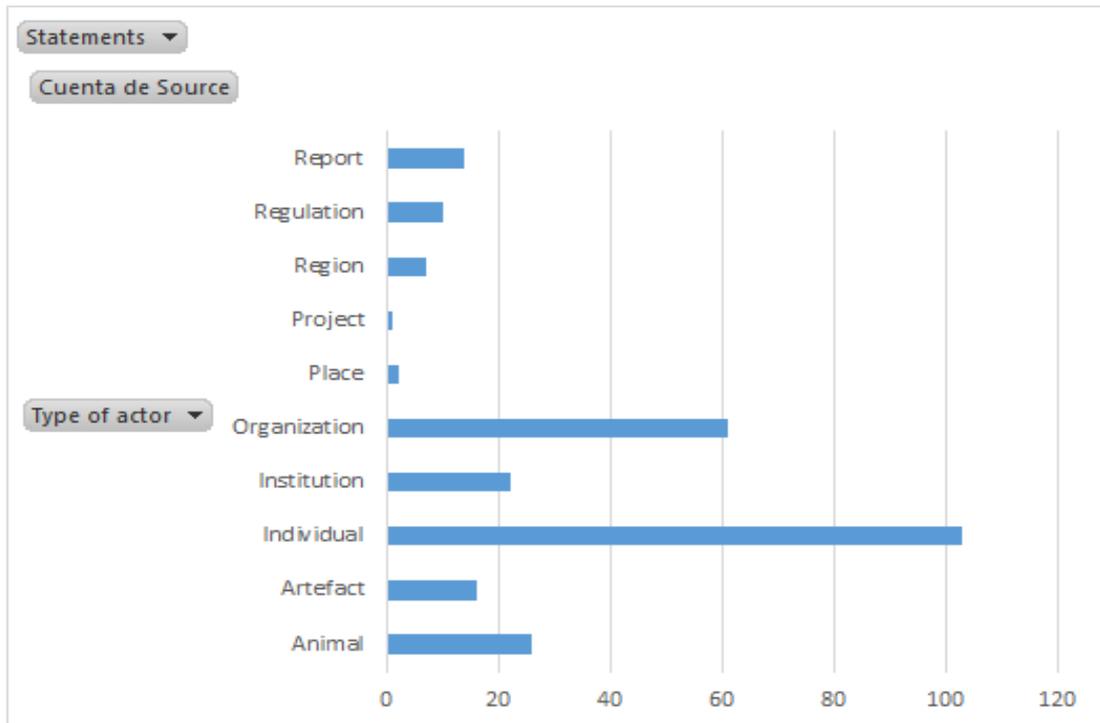


Figure 4.13. Media mentions distribution according to type of actors.

Restricting the analysis to actors making explicit statements, several types disappear, with individuals, institutions, organizations and reports remaining (see figure 4.14).

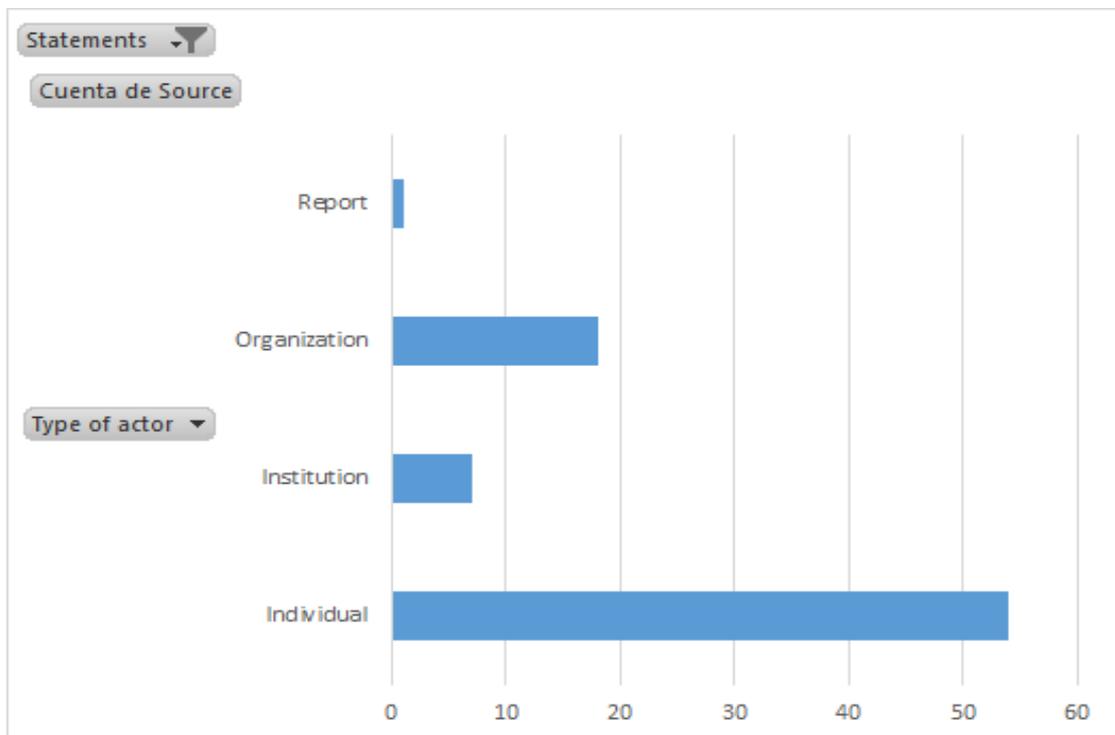


Figure 4.14. Number of statements by category of actor.

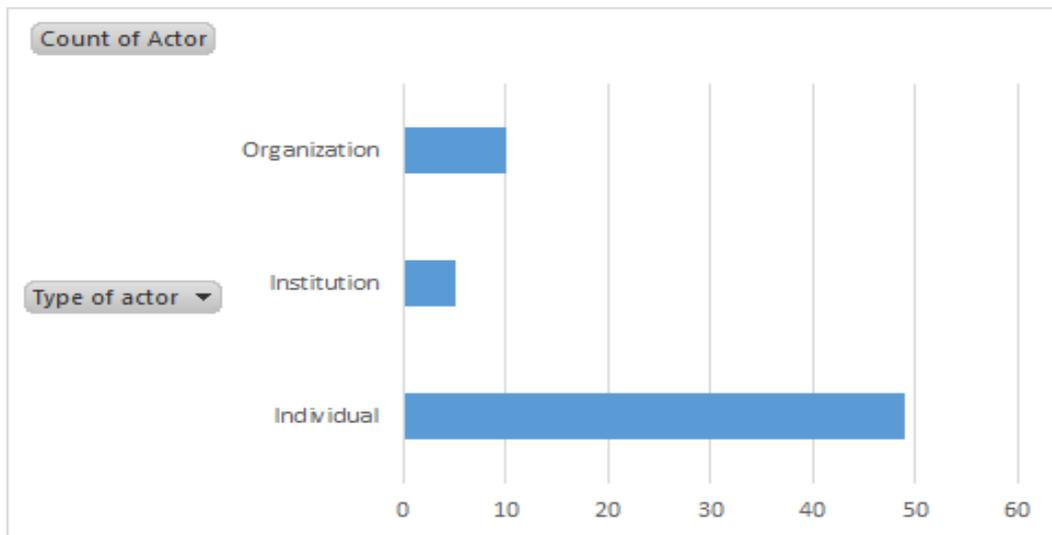


Figure 4.15. Number of actors with voices in the controversy, by category of actor.

From figures 4.14 and 4.15, we find that there are around 80 statements made by around 65 actors with a voice in the controversy. We refine the analysis further by classifying these actors by sector and influence (figures 4.16 and 4.17) before continuing to the analysis of the position of present actors in the product chain.

Sector, here, refers to the affiliation of the actor—it can be private, government, academia, media or an NGO. For actors, such as wild animals and places, no sector was identified.

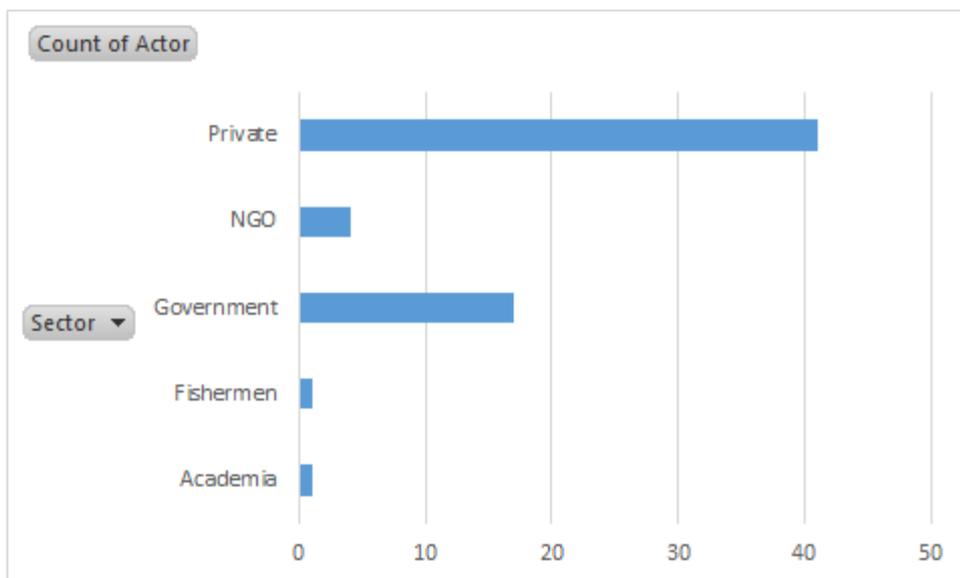


Figure 4.16. Distribution of actors by sector.

Next, actors were separated by their level of influence, as defined earlier (see figure 4.1). Influence refers to the size of the audience the actor potentially can

affect. It can be null when there is no audience, low and low medium when the actor has a rather small group, s/he talks to and medium high to high when the audience is considerable. In figure 4.17, the statements are classified by the type of influence the declaring actor has.

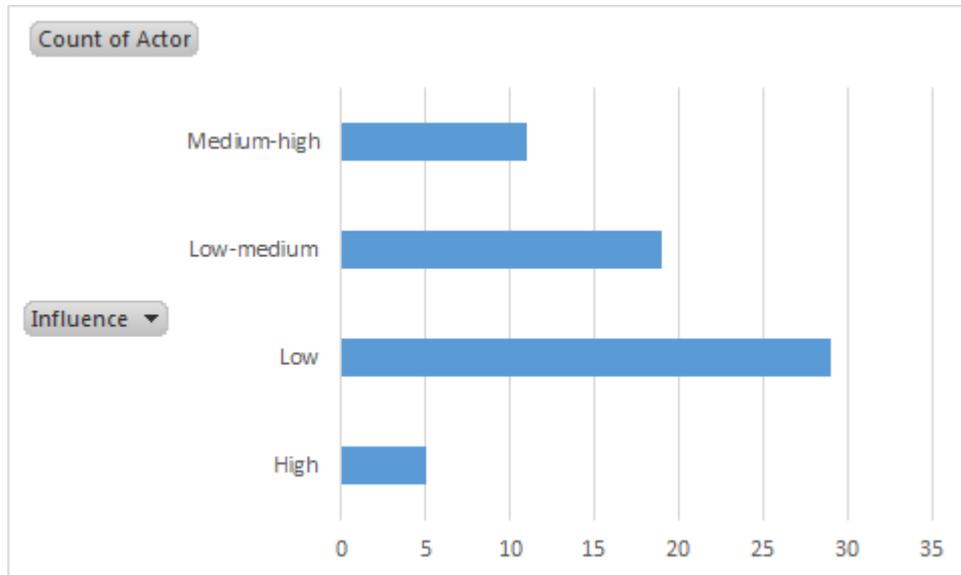


Figure 4.17. Distribution of actors by level of influence.

Product chain actors—a life cycle analysis of actors

Finally, actors were classified according to their position in the shrimp product chain. For this we conceptualized the product chain as consisting of three main stages and an contextual one: *fishing* involving all the activities at sea; *retail* referring to commercialization of the product; *use* referring to consumption; and, the category ‘context’ for everyone else expressing a viewpoint but who does not participate in any of the former activities. This last category – it includes, for example, academia, NGOs and government.

The best represented stage of the product chain was ‘fishing’ (57%). Given the fact that the controversy revolved around the practices in this step, it could be expected to be well represented in the media. The other two steps were equally represented, while contextual actors had more chances to express their opinions than the former two.

The controversy by its actors

The actor graphs provide the following results:

- Individuals (39%) were the main protagonist of the different media pieces created regarding the controversy followed by organizations (23%) and

animals (10%). Other elements like technology, regulations and report were also present but not as frequently as the above mentioned.

- In media, private actors was the most present group (57%), followed by government (27%) and non-governmental organizations (17%). Academia was quoted only in very few places (5%).
- Of all the actors in the media, 35% were classified as having medium-high influence and 14% as having high influence. Common actors with low to medium influence represented only 33% of the mentions in media.

Based on this, the following remarks can be made:

- Influential individuals from private sector shaped the public debate by being consulted by media outlets. Lesser-influential actors had less space in these outlets to express their viewpoints.
- Although academic input is key to give perspective in this kind of debates, they were poorly represented in published media.
- The notion of a simple product chain perspective is present in the public debate since actors from different life cycle stages are engaged.
- Among the actors present, those in the production system dominate in numbers and numbers of viewpoints over those in the consumption system. However, it is the actors not involved directly with the product flow (contextual actors) have a 'loudest voice' in this controversy. This is interesting since the greatest support for the WWF guide's advice was found among actors in the consumption system.

From actors to networks

So far, we have been able to identify a set of actors, their positions or viewpoints regarding the controversy at hand and the supporting literatures. Based on this, we can move on to explore the networks using analyses social network analysis and various visualization tools.

The network analysis is made for different connections between actors. First, connections through viewpoints were analysed, i.e. what actors share the same viewpoints. Second, connections via literatures were analysed. An actor with a viewpoint referring to a text invokes, in turn, other actors and become thus connected via the literatures.

Actor-nets by viewpoints

This first map (figure 4.18) shows the connection between actors in terms of shared viewpoints. According to our analysis the actors (nodes) share between 0 and 40 connections. This means that some actors do not share any viewpoint with any other actor, while there are others who share perspectives with up to 40 different actors. The spatialization algorithms used for this network were Fruchterman Reingold (25.000, 10, 10) in order to untangle the random initial layout. This visualization allows for quick identification of clusters/communities based on dense connections (Grandjean 2015).

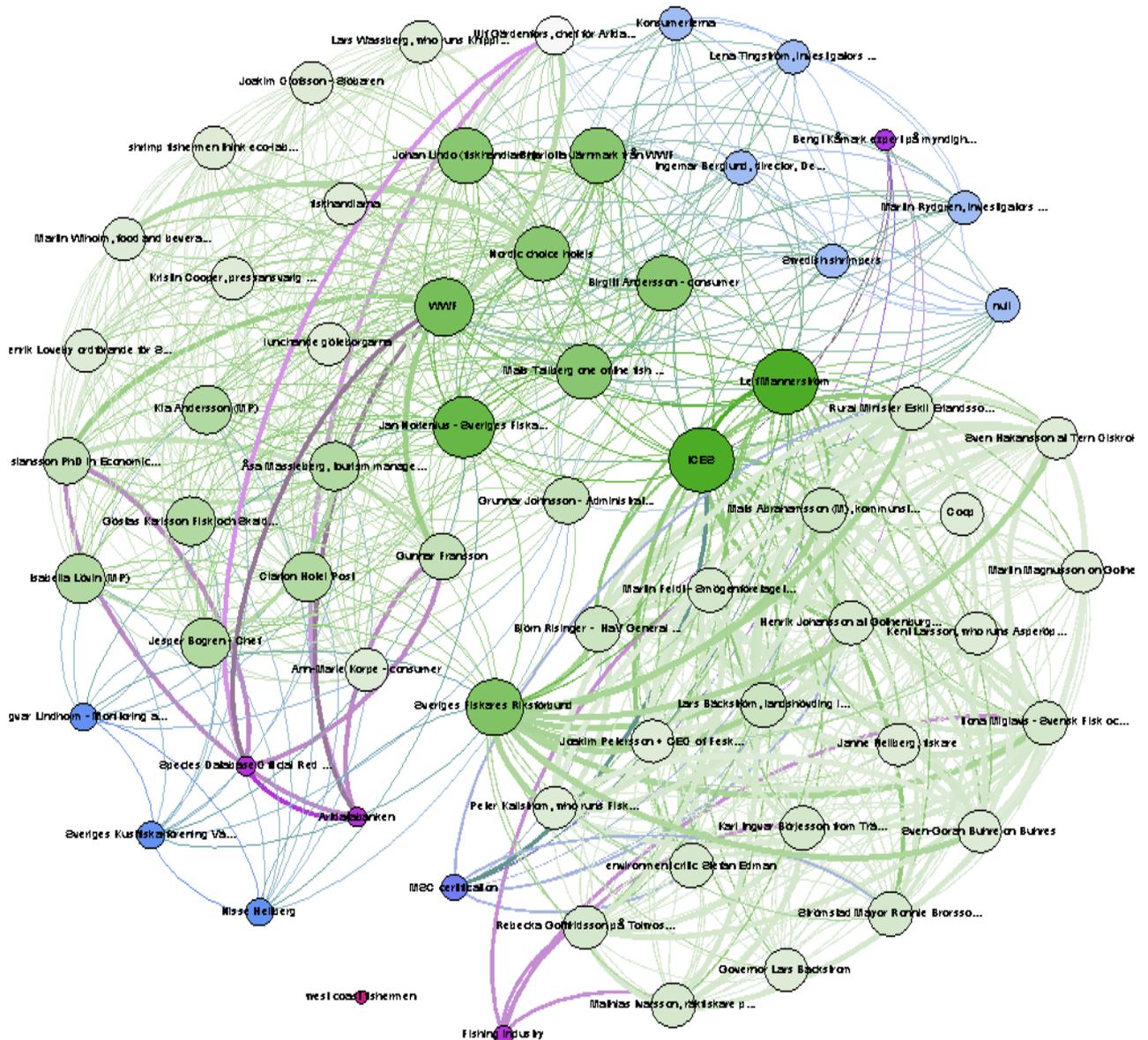


Figure 4.18. Visualization of actors connected through viewpoints. Two clusters appear. Colouring indicate the number of connections: the darker the green, the greater the number of shared and connection viewpoints.

Two clusters appears from the analysis (figure 4.18). One centers around WWF’s perspective on shrimp fishing on the Swedish West Coast (to the left), and it includes mainly private individuals and organizations. The other, to the right, revolves around ICES, the fishermen’s organization and the public figure Leif Mannerström (a celebrity chef, known locally as restaurant owner and from national TV shows). There one also finds the government, public figures and fishermen actors.

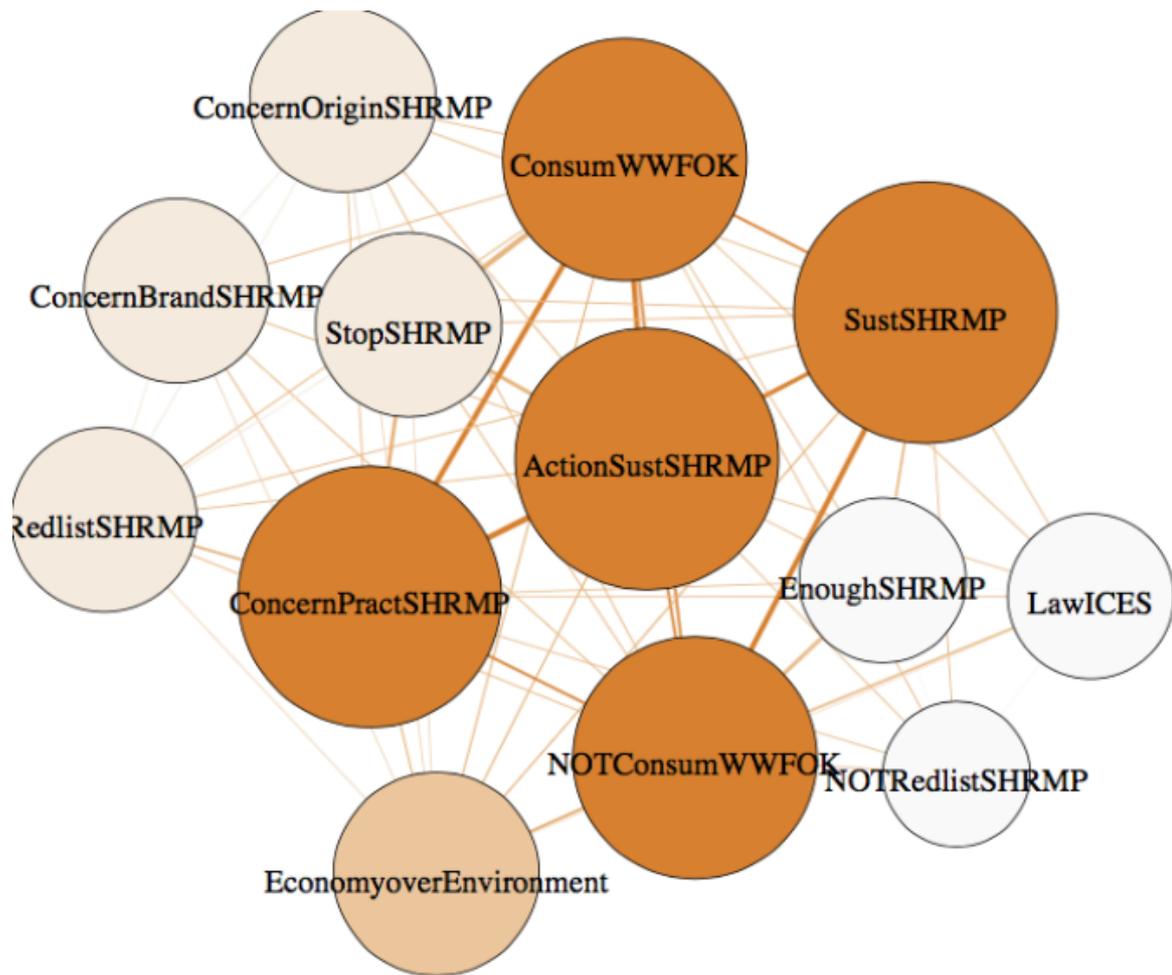


Figure 4.19. Map of viewpoints sharing literatures. Size and colour indicate number of connections through literature.

In the second map (figure 4.19), connection of viewpoints through literatures is presented. Two viewpoints are connected if they are supported by the same literature (main publications). Here, we used the same algorithm, Fruchterman Reingold (25.000, 10, 10), with the same goal of organising the original layout. The different viewpoints share up to 12 publications with another one.

Four main groups appear in this map based on their centrality degree, i.e. the amount of connections they have. The viewpoints in dark orange share more supporting publications than the lighter ones. The white viewpoints have very few connections with other nodes. This brings out the core viewpoints in the controversy: the two opposing pairs of viewpoints, the relevance or not of the WWF consumer guide and the notions that shrimp is sustainable or that fishing practices are cause for concerns.

Actors and literatures

This last map shows how the different actors identified from the statements in the media share literatures. Here, a link between two nodes represents a shared literature. At most two actors share 20 references, while in some cases they do not share any. The different colours represent the sector each actor comes from: private (red), governmental (pink), NGO (yellow).

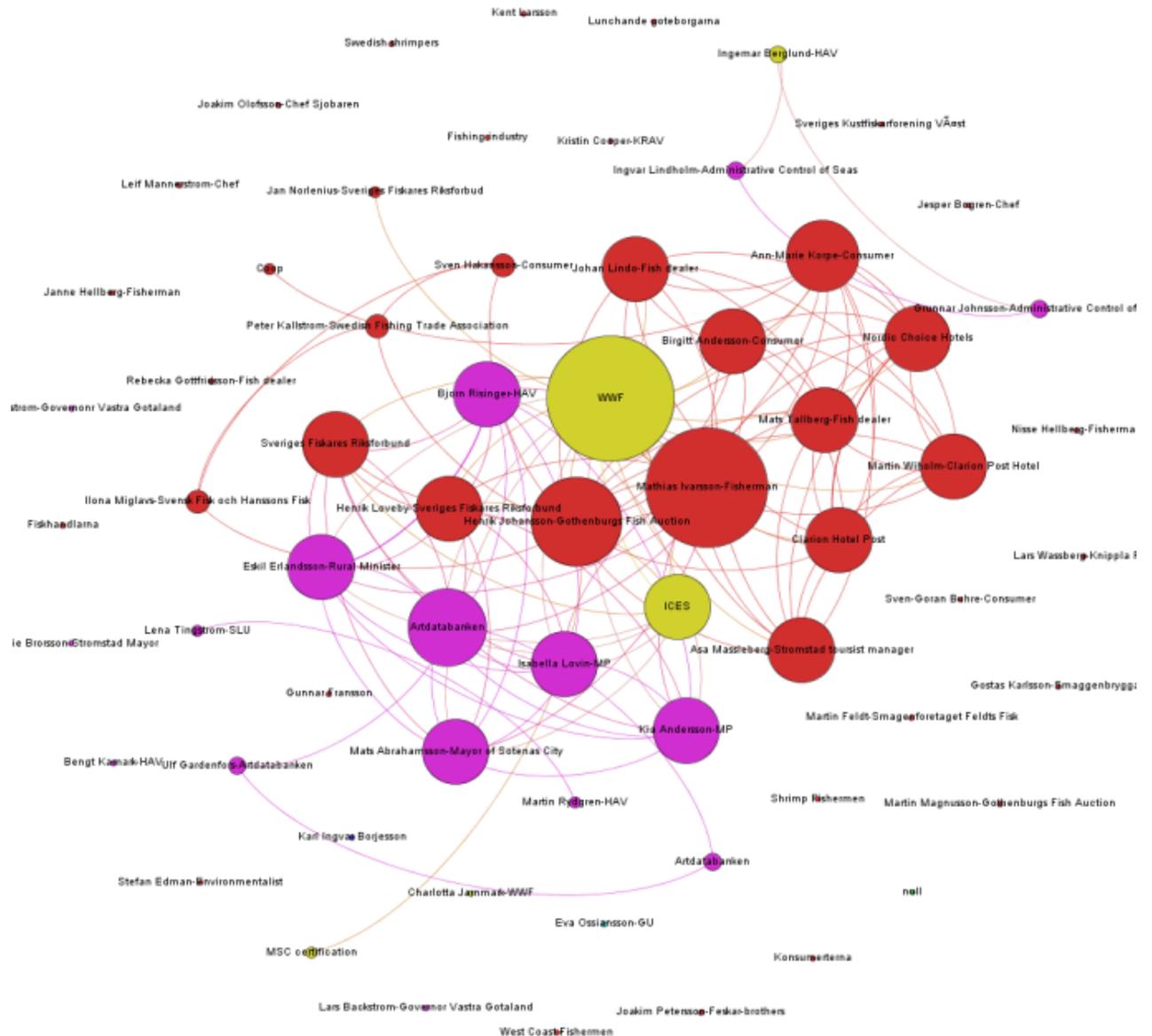


Figure 4.20. Map of actors connected through literatures.

Figure 4.20 shows that there are two groups, one with a tight network of links and another one floating around without any connections. In the first group, two actors show the highest level of degree centrality, in terms of number of edges:

WWF and Mathias Ivarsson (fisherman). In the second group are the actors whose statements and literatures are not used by any other actor.

The controversy by its networks

From the network maps and analyses in this section, it is possible to identify several features of the controversy:

- There are two opposing sides in the controversy. Given the number of issues brought up in the debate, it could have been possible with more camps, but the network map in figure 4.18 clearly show two clusters.
- The actor-network on both sides of controversy calls on a supporting actor-network through the literatures. Such networks are created on the basis of science and knowledge, and bring together different people, different institutions, different resources around a specific topic in a way they is not easily to be aware of.
- The way opposing viewpoints use the same sources suggests differences in interpretation of the same sources.

From networks to cosmos

The last step in the process of mapping controversies is understanding the ideologies behind the statements, arguments and connections. Ideologies are expressed through the *meaning* that actors provide to these elements (Venturini 2010). Such meaning can only be suggested as it is not explicitly revealed in the literature or through the interviews.

In this particular controversy, two pairs of opposing viewpoints came to the fore: the reliability (or not) of WWF's warning and the sustainability (or not) of shrimp fishing on Sweden's West coast.

The first dispute touches upon elements such as the legitimacy of authority in society. For example, how much legitimacy could a non-governmental organization have when providing consumers with advice on what to buy or not? Or, put differently, how robust are the conclusions in WWF's report compared to those in sources used by the government. On a higher level, this dispute addresses the role of authority based on scientific facts in society.

The other dispute, the controversy about the actual sustainability of shrimp fishing on the West coast of Sweden gets connected to topics of culture, livelihoods and the traceability of products. Some actors express the importance of knowing where such a relevant product comes from; others assume that the system works and that shrimp is thus fished sustainably. The meaning of their statements and their associations could be understood in relation to their level of trust in different institutions. The cosmos is of one side is that we as consumers have a responsibility to make informed choices to guarantee the sustainability of much appreciated products; the cosmos of the actors on the other side is appears to be on that transfers that responsibility to the institutions build by society.

In sum, several cosmoses can be suggested in this particular controversy:

- 'Authority to affect consumers decision can only come from governmental institutions' vs. 'civil society organizations and non-governmental organizations play a key role in decision making at the societal level'.
- Scientific knowledge is *the* legitimate source of knowledge and advice.
- 'Stewardship of natural resources is a responsibility of citizens' vs. 'stewardship is a responsibility of institutions'.

As suggested by the Scientific Humanities and the Mapping Controversies method, we have here presented as much information as possible in a way that tries to minimise our room for interpretation. Now that all the maps are in our heads, all the networks, the nodes and the links, we can move forward and analyse how the different aspects of the controversy, especially the translation processes, affect the environmental sustainability of our main protagonist, the Swedish West coast shrimp.

5. Analysis

By following the different steps set out by Venturini (2010) and Latour (2012, 2015) interesting findings arise. On the one hand, the controversy apparently revolves around the sustainability of shrimp fishing. However, when going deeper into the discussion, following arguments and viewpoints, it becomes possible to see that a large part of the disagreement centers on the legitimacy of one actor's call to stop consumption of shrimp from a particular stock. In addition, there is a smaller controversy nested within it, one that centers on the fact whether not there is enough shrimp.

Going back to Callon (1986), the controversy at hand is not so much about the sustainability of shrimp fishing practices—there seems to be an apparent agreement regarding what makes shrimp fishing practices sustainable, which is not under discussion, making it a *matter of fact* in this context. What comes out as the *matter of concern* is the legitimacy of an advice given by a certain actor or the “scientific knowledge” behind that advice.

If the main dispute revolved around WWF's legitimacy for red-lighting the Northern prawn on Sweden's West coast, the louder voices from the government and industry (e.g. Agriculture Minister Eskil Erlandsson or Leif Mannerström) were arguing about the accuracy of red-listing the shrimp by other actors such as Artdatabanken. This turns the debate to a slightly different direction away from actors and closer to science. Arguments related to red-lighting/red-listing support or doubt if shrimp is in danger; they refer to the evidence or lack of it about the state of the stock. What can be said here is that organizations and public figures apparently were more concerned about science and evidence-based viewpoints than regular individuals.

While the disputes about the shrimp stock and the legitimacy of WWF's advice went on, measures that lead up to the ecolabelling of shrimp fishing were being prepared. The ecolabelling appears simultaneously as a contestation and an endorsement of WWF's warnings—fishing (however, more controlled) is awarded the ecolabel while the shrimp stock also gets better management. A temporary stabilization of the controversy is achieved even though it holds a paradoxical combination of ecolabel and red-light. All the while WWF endorses

the ecolabel, the red-light remains, seemingly a stark reminder of that new data about the shrimp stock has the possibility to shift the situation once more.

In the scientific humanities, a way of summarizing the socio-technical history of an artifact is by tracing its socio-technical associations on one axis and the socio-technical arrangements for substituting it on the other axis (Latour 2015). For this controversy, we chart the associations and substitutions to our main protagonist, the Swedish West coast shrimp. This leads to figure 5.1.

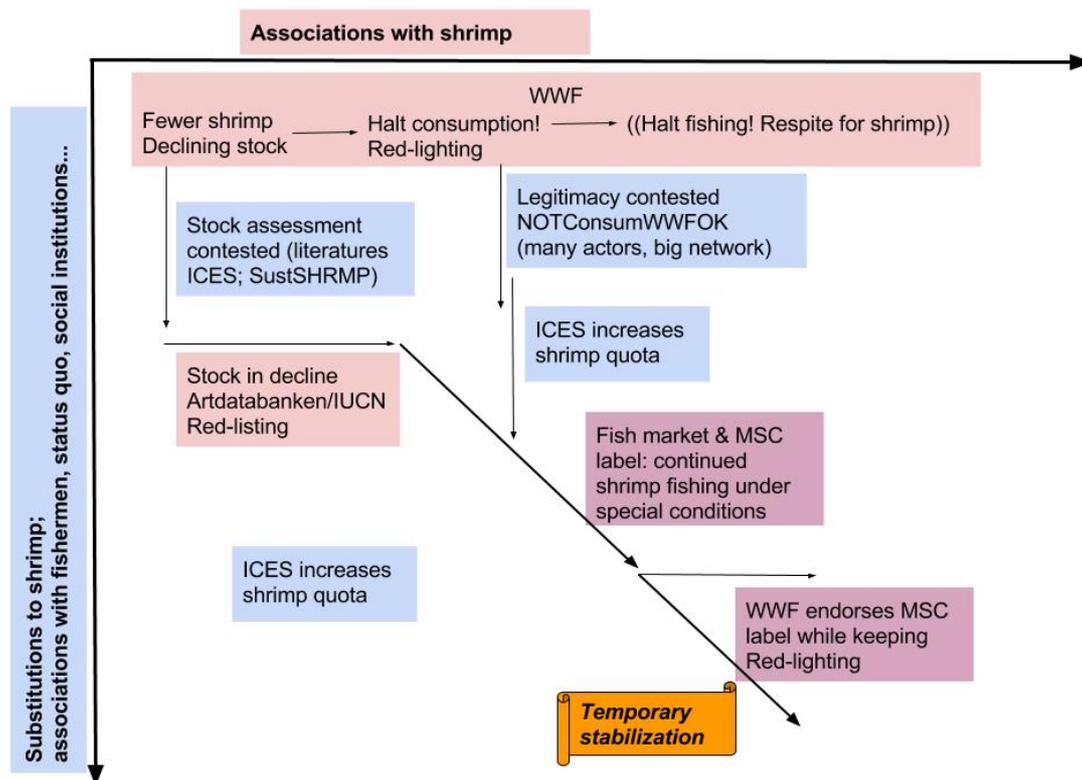


Figure 5.1. Summary of the controversy as associations (pink) and substitutions (light blue) to the shrimp. A compromise (diagonal, purple) with association to both the shrimp and fishermen appears yet a paradox (bifurcation) remains as both eco-labelling and red-lighting are in force.

The life cycle perspective in the controversy

A product life cycle perspective can be noted in the controversy—many actors of the product chain are present in the public debate, albeit to varying extents. The discussion clearly focused on one stage of the product chain, i.e. the fishing. Both the viewpoints of WWF and Artdatabanken pointed out the problems during the fishing phase: the situation of the stock, the lack of control and the poor management practices all happen there. However, some of the actors we interviewed also pointed out problems at other stages of the product chain, such

as the peeling process might not follow sustainability principles as required for the fishing stage. Missing voices from the product chains result in a bounded understanding of the sustainability of the shrimp. A product life cycle perspective itself is helpful in identifying the whole chain of actors and thus which of those were missing in the public debate.

Although the action of the red-lighting from WWF is directed at consumers and is aimed at affecting practices in another stage of the chain, i.e. fishing, it still misses the opportunity to achieve a life cycle perspective. Even if most life cycle stages are present in the controversy, coherent life cycle thinking or life cycle management is not possible to identify. Nonetheless, the life cycle is visible in the controversy since some of the participants come from the downstream part of the chain. Actors such as retailers and consumers intervene in the discussion even though they might seem disconnected from the fishing phase. By entering the controversy, these actors provide the perspectives of other parties of the chain who otherwise might have not been consulted in the public analysis of the sustainability of the Swedish West coast shrimp. In this sense, the mapping of this controversy allowed us to study how different parts of the chain interacted. Here, the conceptualization of the product chain as *a production and a consumption system* became useful. What started with a message from the WWF to the consumption system led to a vigorous reaction from the production system.

Another contribution of controversy mapping towards a better understanding of the Swedish west coast shrimp product chain relates to the identification of the many actors that indirectly affect the functioning of the product chain. The direct life cycle actors in a product chain are the providers of raw materials, the actors that process such materials, the distributors and the consumers as well as end-of-life handlers. However, during the mapping process, we identified many other actors with no direct role in managing the product flow but who still affect the product chain organization, its functioning and outcome through their influence on the direct actors. Here, we find such actors as the media, governmental and non-governmental organizations, and influential individuals. These different actors exert a type of influence on consumers, producers and distributors, through different devices. Media, which includes traditional outlets such as newspapers, radio and television, provide a platform for advocates of different viewpoints, but it determines how much exposure a particular perspective gets, which in turns affects the perception of audiences. Governments intervene in the product chain through regulation and enforcement strategies as ways to force a specific outcome onto the different stages in the chain. They also

define the price indirectly through the quota regulation, the permits for vessels, etc. Finally, non-governmental organizations are also part of the context of the product chain by playing different roles, including fiscalization.

However, and as already mentioned, it was raised by some of the interviewees during the data collection process that relevant actors were left out and were not visible in the public controversy. Such actors represented particular parts of the product chain, e.g. the peeling companies or distributors different from Gothenburg Fish Auction. This shows how media turns into an actor in the controversy by deciding who has a worthy perspective and who doesn't. From an actor-network perspective, our main source for empirical material, media is then a key player in the translation process regarding the sustainability of shrimp fishing in the Swedish west coast.

Translations happening in the controversy

Translation is the process that allows a network to be represented by a single entity, which can in itself be an individual or another network (Callon & Latour 1981). In this controversy, we encounter many translation processes. The way media translate and represents the controversy rests on a number of translations, many previous ones that have happened in layers. Such translations are perpetrated by scientific bodies, non-governmental organizations, governments, universities and even public figures. In such processes many voices are lost, especially those of non-human actors since the former are the ones translating their viewpoints, the perspectives of the shrimp, of the other species being affected by the shrimp fishing. The gears that have to be replaced or the technological devices that need to be used to enforce the law.

On some level, one can view the controversy as a struggle around the translation of what is and who can represent the sustainability of *Pandalus borealis* fishing in Swedish waters (the arrows in figure 5.1). It started with the warning from WWF that asked the question if shrimp fishing was sustainable in this particular area in 2013. As presented earlier, this is the first step, *problematization*, in the translation process according to Callon (1986). This question had been asked continuously since 2000 by this particular actor and in order to answer it they developed a methodology based on particular approaches. In this way, WWF set the problem and fulfilled the stage of problematization.

The second stage proposed by Callon (1986) is interessement or how to make different actors interested in their project. WWF's approach as illustrated earlier aims at engaging consumers and retailers to stop buying species under a red light classification. They also need to engage scientist to provide the scientific basis for their guide. Media is also relevant for reaching out to the target audience.

However, when it comes to the third stage, enrolment, the process slips out of WWF's control as many other actors contest both the stock assessment made by WWF and the action of delivering consumer advice. And a controversy develops. Although WWF is a friend of shrimps, it appeared as an 'enemy' to the fishing industry to many actors, and even unnecessarily so according to some. However, WWF and the shrimp get an ally when the Artdatabanken publish the Swedish redlists. What we see as the next development is that another set of actors, the Fish Market and the Marine Stewardship Council, presents a new fishing program for the local shrimp with among else observers on-board the fishing vessels. This measures attempts to be a friend with both the shrimp and the fishermen. The WWF offers eventually an endorsement to the MSC label in May 2016 all the while keeping its red light for the shrimp stock. The enrolment seems temporarily halted. Whether or not WWF, the original spokesperson for the shrimp, maintains its endorsement probably depends on new and positive data on the shrimp stock. So, at the end of our project, we cannot see that the translation process has arrived at its fourth and final stage, mobilization, i.e. the ensuring that the spokespersons are properly representative of the stated entity, which is the shrimp in this case.

6. Conclusions

Mapping controversies helps pinpointing the issue(s) being disputed. A quick look to the media gave impression that the discussion was about the sustainability of shrimp fishing in Sweden's West coast, however that was not the issue. After investigating the controversy, we could unveil the topics being discussed: the legitimacy of certain actors' strategies towards improving sustainability. Inside this dominant theme in the controversy, a smaller one was nested, one about shrimp stock assessments. Although the legitimacy of WWF is challenged, the trust in public institutional authority is not without weaknesses. The controversy brings about some changes, initiated by WWF and brought to some kind of stabilization by the Fish Market and MSC, not by the marine authorities.

Moreover, the method allowed us to evaluate how relevant 'scientific knowledge' was in shaping opinions in this debate. What was discovered here was that although scientific knowledge is key in such discussions, people did not look for it when backing their opinions. Instead they turned to reputation and 'good-will' when looking for references. Some actors seem to believe more in the reputation of sources than the robustness of their claims. We also note that LCA scholars with local expertise on fishing methods and the fishing industry were not visible in the controversy.

In this controversy, the same information has been interpreted in different ways leading, sometimes, to opposite perspectives. There are several reasons for different interpretations: 1/ different analytical timeframes when looking at stock data (changes over 5 yrs vs. over 10 yrs), 2/ different understanding of stock & reproduction dynamics /recruitment, 3/ inclusion or not of things that affect reproduction dynamics, such as illegal practices, 4/ looking at stock or population, i.e. different slices of a shrimp ecosystem.

The difficulties arising of not having a unified technical language becomes evident in this controversy, which adds to the complexity of the issue. This is expressed in the positions of three actors: WWF, ICES and Artdatabanken. For example, Artdatabanken use a 10 year perspective when analysing the same data

that ICES use. However, ICES use a 5 year perspective on the same data set. It is for us not possible to fully understand the consequences of these differences due to lack of information.

From an environmental systems analysis perspective, it is peculiar to note that the 'life cycle' of the *alive shrimp* and the 'life cycle' of the *product shrimp* are so separate. The controversy brings to light the need to look at both the 'biological production' of shrimp and the industrial conversion for consumption in a life cycle perspective. This calls for an examination of the framing of environmental systems studies and definitions of system boundaries. Based on our findings, we would welcome a development that combines biological, production and consumption systems. That would also give the shrimp itself a more prominent role in any sustainability analysis of shrimp fishing.

7. Relevance of controversy study for the Industrial Ecology field

Industrial ecology is a research field that concerns itself with the study of material and energy flows through industrial systems with the aim of creating more sustainable systems. Industrial systems is broadly defined, for example as production and consumption systems. A study of the shrimp flow in the form of a product chain places it thus within Industrial Ecology, but it also contributes to a lesser travelled strand of industrial ecology research, i.e. qualitative studies on flow governance.

Controversy and actor-network in Industrial Ecology literature

Interest in controversy is not new in Industrial Ecology, but research seems to be limited. In the few publications 'controversy*' is found, it appears as a general term, often for something the authors note or speculate on in their studies. We found only two publications that can be said to explore a controversy in some depth, and conducted in order to further the methodologies in Industrial Ecology. Similar to our case, these two also related to life cycle assessment. In the study by Bengtsson & Tillman (2004), the discussion centered on the use of wastewater sludge on farmland and the consequences of different values for the impact assessment step in LCA. In another study by Boholm & Arvidsson (2013), issues in relation to nanosilver are mapped. In both studies, a limited controversy mapping is carried out, focusing on a systematic analysis of viewpoints without going into constellations of actor-networks. It is concluded in both studies that the LCA methodology is insufficient when it comes to value-laden issues in addition to facts (Bengtsson & Tillman 2004) and that its impact assessment methods cover many but not all matters of concern, e.g. public health and bacterial resistance in relation to nanosilver (Boholm & Arvidsson 2013). Both studies can be said to be attempts at understanding the capacity of LCA methodology in a social controversy. Our intention here is somewhat different: our focus is 'controversy mapping' as a methodology and how this can inform the governance and management of product chains.

The impulse towards studying controversy in a product chain context was provided from an earlier study on product chain organization of certified and non-certified cocoa (Afrane et al 2013). This cocoa study revealed that actors held divergent views on governance and priorities for sustainability and socio-economic development. Although there was no apparent controversy in the studied cocoa system, we could foresee other cases where conflict and controversy could surface. With increasing pressure on natural resources, better understanding of the socio-material dynamics of product chains becomes necessary for peaceful and sustainable development.

Interest in product chain management is also found in the field of Life Cycle Management. Focus in most LCM research is, however, on the corporate actor. In this case, we see that there are numerous actors involved in what becomes the governance of the product chain. More multi-actor studies would be a welcome addition to the field.

Possible contributions from controversy study to Industrial Ecology

Sustainability of product chains depends on the practices of multiple and diverse actors, their interaction on the material aspects of the product flow and the context. Controversy studies together with related methods in the scientific humanities provide excellent means to understanding actor-networks necessary to create product flows and the power relations within these. We see that this body of methodologies can provide ways for extending studies of Life Cycle Management beyond the corporate actor and inroads for multi-actor studies, where governance is not down to a single actor.

Moreover, mapping controversies can also help practitioners in product systems better understand their contexts. Possibly, this could improve interactions between product chain actors and the outcomes from governance and sustainability efforts in product chain. In a mapping of Product Chain Organisation (Baumann et al 2013), the mapping of the flow of product/material through a value chain forms the basis for an investigation about the roles and relationships of the actors creating the product flow. Therefore the PCO approach is both qualitative and quantitative and relates actors to environmental impacts. The point of the PCO approach is to inform us on the sustainability of different governance options. In this study, governance changes happens through a controversy. Another possibility could have been to organize facilitation

between actors through a Product Chain Roundtable, but this has yet to be tested as a governance mechanism to effectively identify and address issues related to sustainability of product chains.

Epilogue

Our project ended before the controversy was over, leaving us with a paradoxical situation in which a red-listed shrimp also is eco-labelled, but the final word had not been said. Whether or not the ecolabel and/or the red-listing will remain depends on audits, on-board observations, stock assessment, the weather, and possibly also on full moons. What does the shrimp have to say about all this?? What does she think about the efforts to save her? Would she feel safe, be impressed, endorse them? This is difficult to know — we are not very good at talking ‘shrimp’.

From what we know about the shrimp’s life, humans are one of the predators; she is also a popular feed with many fish (some of which end up as by-catch). If we are to fish her too effectively, not only the population of shrimp is affected, but that of many other species, and so the ecosystem as such.

Maybe the shrimp would have told us to cast our investigative net wider so that also Danish and Norwegian media would have been covered—after all, we share the same stock according to ICES. We would then have seen that the Swedish controversy made waves in the Danish and Norwegian debates. They were wary of developments in the Swedish crisis which they wanted to avoid. For example, a dumping of shrimp prices after the WWF redlighting had not resulted in sales increase in Sweden, indicating that many consumers indeed heeded WWF’s warning⁴. That became a costly lesson for the fishing industry, one that they did not wish to repeat in our neighbouring countries.

Many measures were discussed and taken, especially in Norway: modification of the fishing gear (e.g. introducing the ‘røkkerist’), new rules on minimum size of fished shrimp (from min 6 cm to min 7 cm), and weekly quotas during the sensitive Summer season. The duty to land everything caught (no dumping) had been in place in Norway already for several years. Internationally, ICES continued meeting with the North Atlantic Fisheries Organization to specifically

⁴ <http://www.aftenbladet.no/lokalt/Rokkerist-kan-redde-reka-fra-boikott-50230b.html>
(Stavanger Aftenblad Lokalt 4. Desember 2014 13:20)

discuss shrimp stocks, assessment and indicators in September 2016⁵. Among else, new benchmarks when determining Total Allowable Catch were discussed. Moreover, the Swedish quota for 2017 was reduced compared to that of 2016.

*Table E.1. Swedish quotas for *pandalus borealis*, 2016 and 2017. Source: <https://www.havochvatten.se/hav/fiske--fritid/yrkesfiske/kvoter-och-fiskestopp/kvoter-i-ast-erhavet-2017.html>*

Pandalus borealis	Swedish quota 2016	Swedish quota 2017
Skagerrak / Kattegat	2054 ton	1309 ton

The shrimp is born as a male and it takes two to three years before it changes sex to become a female. In order for a shrimp to spawn, it needs to survive a number of years. Fishing of young shrimp introduces discontinuities in their reproductive circle. Increasing minimum size of fished shrimp helps survival of young shrimp. Also, fishing shrimp with roe also introduces discontinuities in their reproductive cycle. There are thus many interactions between the shrimp and humans that can risk our co-existence. And who is to decide on this co-existence? Surely, this cannot only be down to the actors in the production system, however it is difficult to be a mindful consumer. Nevertheless, the controversy showed that step follows on step, resulting in some form of product chain governance that in this case seem to point in a good direction for the shrimp. A paradox such as that of the eco-labelled and red-listed shrimp also holds potential for, in the words of Czarniawska (2001), hopeful paralogy.

⁵

<http://ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2016/NI-PAG/scs16-17%20NIPAG%20Report%202016.pdf>

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Appendices

Summaries of core literatures

1. The ICES report
2. The WWF consumer guide
3. MSC certification
4. KRAV procedures
5. Red list Artdatabanken

References in citation analysis with CitNetExplorer

Core literatures

The ICES report

One of the most popular statements found in the media was the one dismissing the relevance of the consumer guide developed by the WWF (NOTConsumWWFOK). This statement was based on the fact that there was another source, 'more scientific', that provided the opposite advice to the guide. Such source is the report that [International Council for the Exploration of the Sea](#) (ICES) presents every year related to the stock of *Pandalus Borealis* in the areas of Skagerrak and the Norwegian Deep (Divisions IIa and VIa East).

The report

This report focuses on providing scientific information about stock assessments for the *pandalus borealis* species in the different regions where relevant for ICES country members. For each stock they provide an brief introduction describing the fisheries, an explanation of the input data, the results of the assessment, a conclusion about the statement of the stock, projections and research recommendations. This report also includes other relevant matters for the working group.

The authors

The authors are [Mats Ulmestrand](#) from the Swedish University of Agricultural Sciences. No further information is available on his areas of research or expertise. According to Google Scholar he has 19 published articles.

[Munch-Petersen, S](#) is a professor emeritus at the [National Institute of Aquatic Resources at the Technical University of Denmark](#) at the section of Ecosystem based Marine Management. He has 17 authored articles according to Google Scholar.

[Søvik, G.](#) works at the Institute of Marine Research in Norway. Her main area of research is shellfish and she belongs to the Benthic resources and processes group. In Google Scholar she has authored 22 articles.

Finally, [Eigaard, O](#) is also part of the National Institute of Aquatic Resources at DTU. His research is connected to technological developments in commercial fisheries, the resulting changes in vessel fishing power, and the implications hereof for a sustainable

management of fisheries and fish resources. In Google Scholar he has authored 28 articles.

The organisation

ICES is an international organisation created in 1902 by the governments of Denmark, Finland, Germany, The Netherlands, Norway, Sweden, Russia and United Kingdom. To date ICES has 20 member countries: Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Russian Federation, Spain, Sweden, United Kingdom, and the United States of America.

Its mission is "to increase the scientific knowledge of the marine environment and its living resources and to use this knowledge to provide unbiased, non-political advice to competent authorities." (ICES, 2015a). Members of ICES and other international bodies can solicit advice and information on scientific and management matters to the council. Their input is based on the different activities conducted by the organisation which include dissemination, assembling and prioritisation of research related to ecological, political, societal, and economic issues.

The responsible body to develop the report on the Swedish west coast shrimp is the joint [NAFO/ICES Pandalus assessment working group \(NIPAG\)](#). This group is composed of thirty six scientist from a variety of fields and disciplines spanning from marine biology to mathematical modelling. Once a year the working group meets to prepare the scientific advice and management options regarding *pandalus borealis* stocks based on their assessment (NIPAG, 2015).

The report resulting from this meeting presents an introduction with a description of the historical situation of the fishery; the assessment data from commercial data, sampling data and survey data; assessment models and results; and recommendations for catchment, management and research.

The references

This report is built upon five main sources: [Munch-Petersen et al \(2013\)](#), Nielsen et al (2012), [Søvik et al \(2013\)](#), Søvik et al (2013a) and [Ulmestrand et al \(2013\)](#). In the figure below these publications are mapped with the articles citing them. These documents focus on different topics, for example Munch-Petersen et al. (2013) describe the discarding practices in the Danish Norwegian and Swedish fisheries in the area of study; Nielsen et al (2012) provide the stochastic length-based assessment model for the species stock assessment which is used in the report; Søvik et al (2013, 2013a) focus on the Norwegian fishery providing data on landing, management and other relevant aspects of

the fishery. Finally Ulmestrand et al (2013) present a detailed description of the Danish and Swedish fisheries in the area of interest.

The conclusions

Based on this information and these studies, in 2013 ICES advised that total catches in the Skagerrak and Norwegian Deep of *Pandalus borealis* should not exceed 6000 t which translates in landings below 5426 t (ICES, 2013). In 2014, the advice from ICES increased to 10900 t maximum catch and 9777 t maximum landing. In 2015 the increase was even greater with a maximum catch of 21500 t and maximum landing of 18598 t. These numbers are reflected in the Total Allowable Catch and subsequent national quotas.

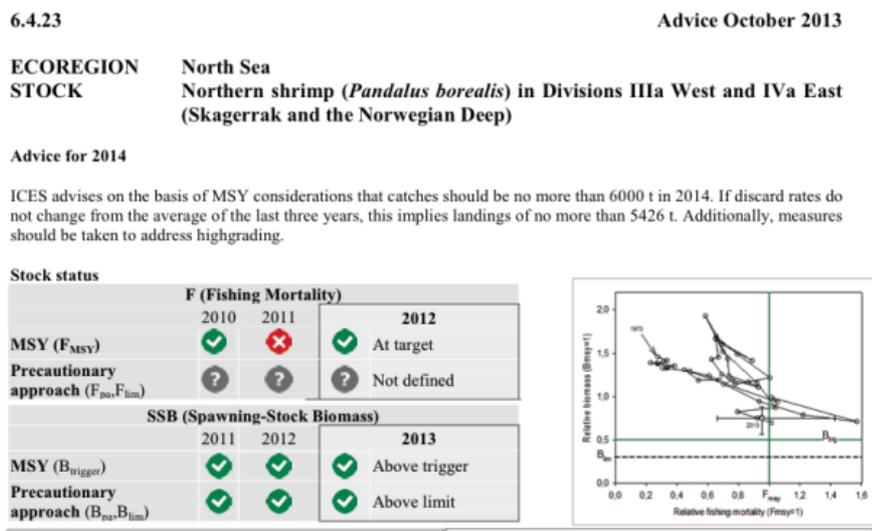


Figure App.1. ICES report 2013.

The WWF consumer guide

The second document most cited by the actors to support their statements was the consumer guide 2014 created by WWF. Consumer guides, particularly for seafood products, are a communication tool that “provides a ranking process, based on methodology and criteria that evaluate environmental and biological criteria of species, fisheries, or aquaculture practices.” (Roheim, 2009).

The guide

The WWF's fishing consumer guide provides a list of different species that are consumed by humans along with a ranking system based on traffic light. In its introduction the guide explains the system and provides advice on how to contribute to the sustainability of fish. Following this first chapter the guide provides advice for each species which contains a picture of the animal, a very brief description of it and fishing

methods and the traffic light system including the observations to each color (see figure above).

After the list, the guide provides brief information on different topics that might be of interest to the consumer: governance over fishing resources at European and national level, aquaculture, fishing methods and WWF mission. Finally, it provides a list of organisations related to the fish sector in Sweden that the consumer can contact for further information.

The authors

There are no individual authors referred in the guide, leading to the conclusion that it is an institutional report.

The organisations

1. WWF

According to [WWF website](#), their methodology for assessing seafood was developed in collaboration with the [North Sea Foundation](#) and the [Good Fish Foundation](#). However, there is no detailed information on how and who conducts the assessment for the different species. After consultation with WWF Sweden, it was clarified that this information is not publicly available (at the moment we are waiting for the notes from the evaluators).

WWF is one of the most recognised non-governmental organisations. It was created in 1961 by the Morges Manifesto, signed by individuals from Switzerland, France, Germany, Belgium, Poland, the U.S., the U.K., South Africa, Sweden, Netherlands and Sudan. Today, they are present in 150 countries through different projects.

The mission of the fund is to "stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable and promoting the reduction of pollution and wasteful consumption." (WWF, 2015a).

One of their global initiatives is smart fishing which aims at tackling the problems of overfishing. Their focus is on reducing the impact of fishing on marine and aquatic ecosystems through two strategies: promoting adequate fishing management, creating market incentives for sustainable fishing and directing funds towards livelihoods and long-term fisheries recovery (WWF, 2015b).

2. The North Sea Foundation

The foundation is a private non-profit organisation based in the Netherlands that was created in 1980. Their mission is to advocate for a sustainable North Sea and raise awareness about its value.

Its mission statement is "North Sea Foundation fights for life in the North Sea, as the sea itself has no voice. Our goal is a clean and healthy ocean, which absorbs outside influences resilient. A well-functioning ecosystem before laying the foundation. What can handle that system, determines the limits of sustainable human use. Some parts of the North Sea, we want to totally leave it alone." (Nordzee Stichting, 2015). They work on four areas: sea full of fish, the sea as a source of energy, clean sea and healthy sea.

3. The Good Fish Foundation

This is a new organisation started in 2014 with WWF as one of its partners which also include Research institute RIKILT, Wageningen University and Research centre, Vis van Henry, Amacore B.V., Bertus Dekker, Karel Hoeve, W.G. den Heijer & zn bv, Sligro, Makro, Excellence Fish BV, Aquacultuur Enkhuizen v.o.f., Maatschap Janssen van Maris, Aquaculture Consultancy and Engineering BV, Wageningen IMARES and Solid Aquaculture Solutions (SAS).

The mission of this organisation is to "to accelerate the transition to a sustainable seafood sector by promoting market demand for sustainable seafood and by assisting consumers and businesses throughout the seafood supply chain in making informed and responsible buying decisions." (Good Fish Foundation, 2015).

The references

Repeating the exercise done with the ICES report, we looked for references or data used in the guide and didn't find any. An additional search was conducted in order to find the methodology of the assessment that results in the guide. In WWF's website there is a [methodology document](#) for wild catch (fishing) available that explains the process to decide the color for each species.

However in this document, no references are available either. Therefore we turned to the expert in WWF Sweden, Inger Näslund to get further information on the scientific basis of the seafood guideline.

According to the information provided by her, the assessment is based on publicly available information such as the ICES advice and it is conducted by scientist specialised in the species being evaluated. They conduct the assessment and their conclusions are then translated into the different traffic lights.

However neither the names of the scientists nor the report they prepared are available to the public. Only their conclusions and the explanations of the decision regarding

traffic light can be directly requested to WWF Sweden (we are waiting for their answer).

The conclusions

For 2014 and 2015 the Swedish version of the fish guide marked shrimp from the North Sea, Skagerrak, Kattegat or the Atlantic as red which translates into "Avoid these fish and shellfish, as they come from unsustainable fisheries or farms which damage the environment and the species that live there." (WWF, 2015).



Nordhavsräkan lever på mjuka sedimentbottnar på 50–500 meters djup. Räkorna parar sig på hösten och honan bär de befruktade äggen, rommen, mellan benen hela vintern. Nordhavsräkan finns i stora delar av norra Atlanten. I svenska vatten hittas nordhavsräkan främst i de djupa delarna av Skagerrak, Kosterfjorden samt i Gullmarsfjorden där den fiskas med bottentrål. En fullvuxen nordhavsräka kan bli 16–17 cm lång.

LÅT BLI <ul style="list-style-type: none">• Om fångad i Nordsjön, Skagerrak, Kattegatt eller i Atlanten, oavsett fångstmetod	VAR FÖRSIKTIG <ul style="list-style-type: none">• Om fångad i Barents hav	
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Figure App.2. WWF Consumer Guide 2014

MSC certification

A key element to get a green light in WWF consumer guide is that the fishery is certified either by the Marine Stewardship Council (MSC), the Aquaculture Stewardship Council (ASC) or a local label such as KRAV in Sweden. Twice the Gothenburg's Fish Auction President and the representatives of the MSC mentioned the MSC certification standard.

On October 15th 2015, the Gothenburg's Fish Auction fishery operations were certified under MSC standard in its version 1.1, for 5 years. The certification is available for "all fishing operators targeting Cold water prawn (*Pandalus borealis*) in the ICES Divisions IIIa West and IVa East (Skagerrak, Kattegat and the Norwegian Deep) using bottom

trawl as harvesting method and operating under quota issued by authorities of Sweden." (DNV-GL, 2015).

The certification

The MSC certification is a program that aims at creating positive incentives for sustainable fisheries through influencing the market and purchasing decision-making. A successful certification process results in the MSC eco-label, which proves that the seafood product sold with it complies with the [MSC standards](#).

The standard requires that a fishery follows three basic principles: 1) healthy fish stocks; 2) that the fishery does not jeopardise the supporting ecosystem; and, 3) that management systems ensure the long-term future of all resources. The assessment that results in the eco-label is based on a scoring system where 31 questions are asked and answers scored. The minimum score to pass is 60 and the maximum is 100. An intermediate score is 80 (MSC, N.D.).

In order to get the certification, a fishery needs to find a certification body that is authorised to conduct the assessment against the MSC standard. The different steps are a pre-assessment, a full assessment, the certification, the annual audits and the re-assessment. Once all the full assessment is conducted and the determination is to recommend certification, the fishery gets it.

As mentioned earlier, the Gothenburg's Fish Auction applied for certification and obtained it in October 2015. In the following sections the [public report](#) presented by the certification body in charge of the fishery certification is analysed. This report presents the authors and reviewers, a description of the fishery, the evaluation procedure, traceability and the results.

The authors

Bert Keus, a Dutch independent consultant on fisheries. According to the report his areas of expertise include environmental impact assessments of fisheries in the Natura 2000 framework, fisheries management plans, natural resource policy, and programme and project evaluations. No publications on Google Scholar were found.

[Julian Addison](#) an international fishery consultants that worked for ca. 30 years as shellfish advisor for the U.K. government. His main areas of expertise are shellfish stock assessment, including fishery-independent methods of estimating abundance, crustacean behaviour in relation to capture in fishing gear, development of environmentally friendly fishing gear technology for both trawl and molluscan dredge fisheries and the environmental footprint of inshore fisheries. According to Google scholar, he has authored 19 scientific publications.

[Sigrun Bekkevold](#) is the last author of the report. She is a principal consultant at DNV-GL, the certification body. Her areas of work include research, innovation and business development within total utilisation of fish. No relevant publications were found in Google Scholar.

In addition to the authors, the report also has peer reviewers as part of the credibility process for the certification. The peer reviewers are David Bennett specialist in population dynamics and [Geir Hønneland](#) specialist in fisheries management in the North Atlantic and

The organisations

1. The Marine Stewardship Council

The [Marine Stewardship Council \(MSC\)](#) was created as an independent non-profit international organisation, by WWF and Unilever in 1997 as a measure to prevent overfishing and the depletion of marine resources. In 1998 the first version of the MSC standard for sustainable fishing was launched as a result of a year long consultation process. A Board of Trustees, with two advisory boards, the Technical Advisory Board and the Stakeholder Council govern the organisation.

2. DNV - GL

[DNV-GL](#), certification body for the MSC standard is a Norwegian consultancy firm that provides certification services to companies worldwide, among others. They have operations in over 100 countries and have over 15.000 employees. Their purpose as stated in their website is to safeguard life, property and the environment.

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The conclusions

The determination of the assessment team was to recommend the certification of the Skagerrak, Kattegat and the Norwegian Deep cold water prawn fishery given that it scored 80 points for the three principles. However such certification depends on six conditions and three recommendations.

Conditions are:

1. to define harvest control rules to reduce exploitation;
2. to maintain annual observer sampling for both trawl and trawl with tunnel gears;
3. to create legislation to fully protect coral reefs and deep sea sponge;
4. to implement special management measures to minimise the impact of the fishery in protected areas;
5. to collect information about interactions between fishing activity and VME habitats,
6. to implement measures to stop shrimp discarding.

Recommendations are related to research issues, education and information sharing that could help improve the management of the shrimp fishery.



Figure App.3. Certificate awarded to Gothenburg Fish Auction by MSC

KRAV procedures

As an alternative to improve the fishery sustainability after the red light from WWF's fish consumer guide, a group of fisheries applied to get KRAV certified. [KRAV](#) is the Swedish standard for organic production and it includes requirements for fisheries. It started in 1985 and as of today over 6000 products are certified under this scheme.

According to the media consulted, the process has not advanced in the way expected by the applicants due to shortage of personnel to attend the evaluation of the requirements.

The standards

Here we present a summary of the requirements from KRAV standard to fisheries. These standards consider production conditions, products and recipes, documentation and labelling. The main elements considered under KRAV are primary production, production aids and inputs, handling, storage and packaging, processing, sales and marketing, other products and inputs certified under other standards (The KRAV Association, 2015).

The standards have general requirements to be met independently of the type of activity or product to be certified. These general requirements are divided in two: basic quality assurance and packaging, social responsibility and energy. The specific requirements for fisheries apply to all the activities until landing. The other stages in the product chain are covered by other chapters.

Assessment of fisheries is conducted in two stages, first evaluates the condition of the stock, impacts on the surrounding ecosystem, management of the fisheries and level of environmental contaminants. Once this stage is approved by the KRAV Director following recommendation by the fisheries committee, an evaluation of the vessels and fishery equipment can be conducted. This step differs from other products since it is KRAV who approves the stock not a certification body.

According to the standard, a stock can be approved if it has a long-term management plan that has been positively assessed by ICES. However the stock needs to be checked against reference points or the Red List. The product also has to be approved by the Swedish National Food Agency through its Dietary Guidelines in order to be approved.

Regarding the vessels and fishing practices, KRAV prohibits trawling as a fishing method, which is the main one for northern shrimp. Therefore, in this particular case if the product is to be certified, damage to ecosystems needs to be assessed annually and reassessment will happen when alternative methods are developed.

The standard goes on providing requirements at a very detailed level regarding practices on board for equipment, storage and reporting

The authors

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The organisations

KRAV was an initiative of four organisations providing organic labelling for foods back in 1985. It was created following the requests from consumers and traders for a unified set of standards.

The references

The KRAV standards include national and international regulations regarding animal protection and environmental laws. They also comply with international voluntary frameworks such as the International Federation of Organic Agriculture Movements.

The conclusions

Fresh shrimp from the Swedish West coast is not yet certified using KRAV. There has been attempts but no progress is reported.



Figure App.4. *KRAV Standards 2015.*

Quota regulation

Every year a maximum amount of fish is defined for different regions following the Common Fisheries Policy defined by the European Union. In the particular case of the shrimp, that quota is defined based on the Total Allowable Catch (TAC).

The regulation

The regulation's objective is to define the fishing opportunities in the waters of the European Union and establish obligation for Union's vessels in waters not belonging to the Union. This includes catch limits (TAC), fishing efforts and fishing opportunities. In this sense the regulation defines the quota assigned to the Union, the member states or a third country.

The European Union divides the fishing areas in the Northern Sea according to ICES division. The area relevant for this controversy are Skagerrak, defined as "the geographical area bounded on the west by a line drawn from the Hanstholm lighthouse to the Lindesnes lighthouse and on the south by a line drawn from the Skagen lighthouse to the Tistlarna lighthouse and from this point to the nearest point on the Swedish coast" and Kattegat "the geographical area bounded on the north by a line drawn from the Skagen lighthouse to the Tistlarna lighthouse and from this point to the nearest point on the Swedish coast and on the south by a line drawn from Hasenøre to Gnibens Spids, from Korshage to Spodsbjerg and from Gilbjerg Hoved to Kullen". (EU 2015)

The regulation first defines the fishing opportunities for the Union, however some TAC need to be defined by member states following the EU principles. The document also defines landing conditions of catches and by-catches depending if a stock has or doesn't have a landing obligation and limits to fishing efforts. Besides these provisions, the regulation states prohibitions on specific species and data transmission. It also clarifies the conditions to fish in third-country waters.

The authors

[The Scientific, Technical and Economic Committee for Fisheries \(STECF\)](#)

The organisations

1. [The European Union](#)
2. The Scientific, Technical and Economic Committee for Fisheries
3. [ICES](#)

The conclusions

Until January 31 2016, the TAC for *Pandalus borealis* corresponding to Sweden in division IIIa is 1.426 tonnes and in divisions II and VI is 98 tonnes.

Red list by Artdatabanken

In October 2015, while the Skagerrak fishery was being MSC certified, the Swedish Species Information Center ([Artdatabanken](#)) issued the update of the Swedish Red List. This report provides insight on the relative risk animal, plant and fungi species face of going extinct in the country. The list is updated every 5 years and is based on the criteria provided by the International Union for the Conservation of Nature ([IUCN](#)). In this version the West Coast shrimp (*Pandalus borealis*) was classified as 'near threatened' (NT) sending a support signal to WWF's call through their consumer guide.

The report

The report is prepared by the Swedish Species Information Center every 5 years. Last version was presented in 2010. The 2015 version was launched in October in a pdf format and website format. Following the guidelines set up by the IUCN, it classifies species in the Swedish territory in the organisation's categories:

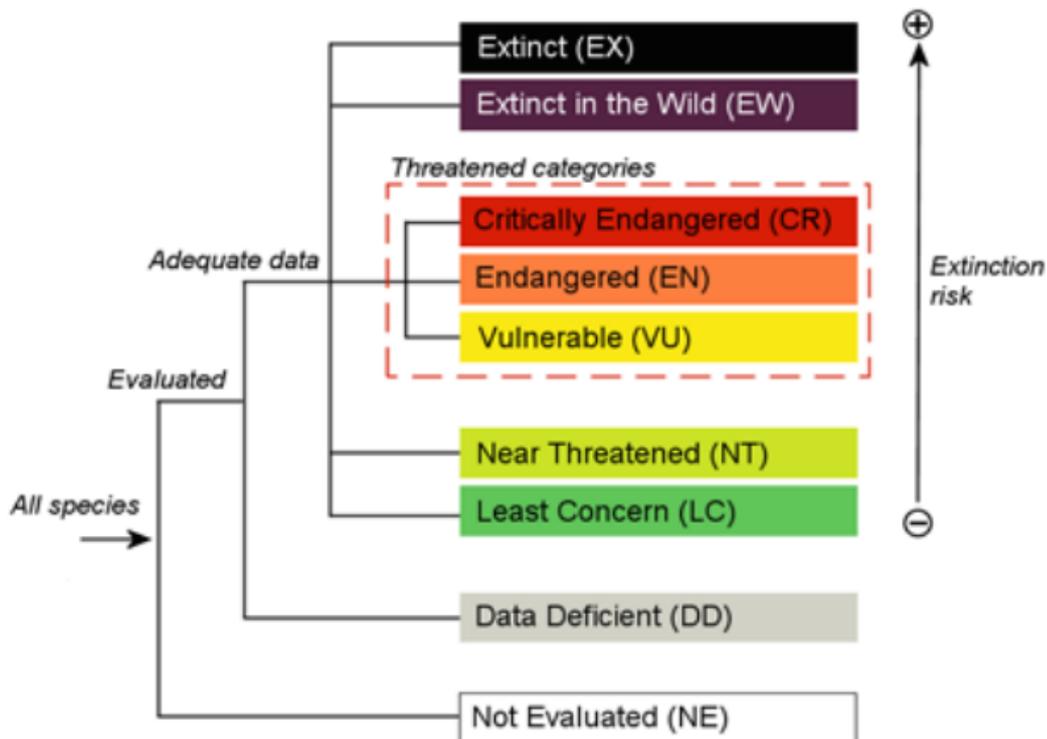


Figure App.5. IUCN red list categories (IUCN, 2012).

In the 2015 Swedish redlist, relevant categories are Regionally Extinct, Critically Endangered, Endangered, Vulnerable and Near Threatened.

For defining these categories the IUCN has selected 5 groups of criteria: reduction on population size (A), geographic range (B), small population size or decline (C), very small or restricted population (D) and quantitative analysis (E). For each of these criteria thresholds have been defined in order to classify the species in each category.

As mentioned before, the 2015 update of the Swedish redlist resulted in a Near Threatened classification for the [Pandalus borealis](#). The expert group at Artdatabanken based this decision on the analysis of the information collected by ICES:

"Biomass calculations, based partly on shrimp supervision of the Norwegian Institute of Marine Research, and partly on kilograms trawled of shrimp per hour, shows that the shrimp population has fallen by between 30 and 50% during the years 2005 and 2014 (relative biomass advice from ICES Working NIPAG, October 2014)." (Artdatabanken 2015).

This conclusion complies with criteria A of the IUCN for classifying a species as Near Threatened as it is stated in IUCN (2015). It is important to point out that Artdatabanken considered that the level estimated of decline (38%) would have required a Vulnerable classification. However, due to the fact that shrimp population is affected by natural cycles, it was put under NT.

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The organisations

1. [Swedish Species Information Centre](#)

Is a collaborative center at the Swedish University of Agricultural Sciences responsible for analysing and disseminating information about species and habitats in Sweden. Most of the center is based on Government's commissions usually in cooperation with NGO.

The center conducts different tasks including the evaluation of the conservation status of Swedish species; updating the nomenclature database; maintaining the Swedish Species Information System; providing expert advice regarding regulation implementation; research on ecology and biodiversity conservation; and international cooperation on the field of biodiversity.

2. [Swedish University of Agricultural Sciences](#)

SLU is a Swedish university focusing on the understanding and sustainable use and management of biological natural resources. It hosts the Swedish Species Information Center (Artdatabanken) providing the support for their activities.

3. [International Union for the Conservation of Nature - IUCN](#)

IUCN is a renowned international organisation working on environmental challenges and solutions. Governments and NGO are members and support their activities alongside other partners and volunteers. IUCN have six commissions working on relevant areas for the organisation. It has presence over 160 countries.

IUCN works on three areas: science, action and influence in order to achieve their goal. In the area of science, their more than 11.000 expert volunteers set up standards to monitor species extinction risk; action is implemented through conservation projects on the ground to promote sustainable use of natural resources. Finally, IUCN is a key player in international negotiations.

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The conclusions

According to the 2015 version of the center's Red List, the north sea shrimp (*Pandalus borealis*) is Nearly Threatened with risk of becoming Vulnerable depending on the upcoming population dynamics. This means that there are concerns about the risk of becoming extinct regarding the species.



Figure App.6. Sweden's Red List 2015.

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