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South Atlantic Natural Capital Project: Argentine shortfin squid value chain analysis for the Falkland Islands

REPORT COMMISSIONED BY SAERI FOR THE SOUTH ATLANTIC NATURAL CAPITAL PROJECT

HARTE, BORBERG, AND SYLVIA

Argentine shortfin squid (*Illex argentines*) value chain analysis with an emphasis on the Falkland Islands

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Executive Summary

Despite challenges, the Illex (*Illex argentinus*) fishery presents new opportunities for Falkland Island fishing companies. This research investigates the potential economic and financial benefits to the Falkland Islands of greater engagement (e.g. ownership in harvesting operations, sales and marketing ventures) in the Illex fishery and associated value chains. The findings contribute evidence to a programme of natural capital assessment (NCA) being implemented by the UK Joint Nature Conservation Committee (JNCC) and conducted by the South Atlantic Environmental Research Institute (SAERI) in the UK South Atlantic Overseas Territories. Funded by the Foreign and Commonwealth Office (FCO) managed Conflict, Stability and Security Fund (CSSF), the work sits under its Environmental Resilience programme which includes objectives to integrate natural capital considerations into economic and social development planning.

Squid comprise one of the world's largest fisheries. The annual global trade value of squid and cuttlefish ranged from a low of $2.56 billion USD in 2007 to a high of $3.89 billion USD in 2016. Illex is the second largest cephalopod fishery in the world and is primarily harvested in the Argentine Exclusive Economic Zone, Falkland Islands Conservation Zones, and the high seas of the Southwest Atlantic. Catches in Argentine waters, on average, make up half the total catch and catches in the Falkland Islands and high seas each average one quarter of the total annual harvest. The average annual total landed value for Illex in South America, the Falkland Islands, and the high seas from 2005-2016 was $597 million USD ranging from $301 million USD to $2,396 million USD.

Significant data limitations exist in tracking the Illex value chain and comparing it with competing chains and markets. This is due largely to the lack of accessible data and reports, and the complexity of global squid markets including size of the resource, and number of countries and firms harvesting, shipping, processing, refreezing, wholesaling, importing, exporting, and retailing. There is little published data on harvesting, processing or wholesale and retail cost for Illex. The limited data suggest there is wide variation in harvesting costs depending on stock size and scale of fishing operations and, to a lesser extent, fuel and labour prices. Squid processing is labour intensive and Asian processing costs may be up to ten times lower than processing costs in the West.

There is relatively good data on prices at harvester, processor, and import/export levels. However, value chain profit margins are difficult to determine due to the absence of published data, especially cost data. Preliminary analysis indicates that primary harvester gross profit margins (excluding fixed costs, taxes, and fees) may vary from 32% to 44%. Processor gross profit margins range from 19-34% which are typical margins in the food and seafood industries and wholesale margins range from 14-67%. Margins in Asia, however, may be higher due to low labour and regulatory costs.

There is huge variability in catches of Illex in Falkland Islands waters, ranging in recent years from a low of 44 tonnes in 2009 to 357,722 tonnes in 2015 and falling to 2,360 tonnes in 2016. Catches in Falkland Islands waters are a function of stock recruitment and prevailing oceanographic conditions in late summer and early autumn (mid-February through May). A fundamental question is whether Falkland Islands companies could develop production and marketing strategies to successfully address this variability and associated financial risk. Unlike other Falkland Islands fisheries, local companies have a more arms-length relationship with the fishery, and dominant international fleets – especially Taiwan and Korea - act as local agents for foreign fishing fleets rather than active partners in the fishing enterprise. No Falkland Islands company has experience operating jiggers, although there is some trawling for Illex.

Conversely, many Falkland Islands fishing companies have relationships and investment in loligo squid business operations and value chains in southern Europe. Since Spain imports Illex from China, Southern Europe may be a key market for Illex sales and value chain investment. The EU imported an average annual total of 68,196 tonnes of Illex from 2008-2017. Among EU countries, Spain imports

the highest volume of Illex, comprising roughly 50% of imports in 2017, followed by Italy at 20%, and Portugal at 10%. The EU annual imports of Illex (Spain, Italy, and Portugal combined) from 2008-2014 ranged from 6 to 30% of global Illex landings. In 2017, the largest source of Spain's Illex imports was China (44%), followed by Argentina (36%), and the Falkland Islands (8%); while most of Italy's Illex imports were from Spain (51%) and Argentina (46%); and Portugal's imports from Spain (56%) and China (40%).

Given the variable catches in the fishery, Illex has yet to enter the Falkland Islands Individual Transferable Quota system. Entry would provide an economic incentive for local companies to become more invested in the fishery and develop Asian facing harvest/value chain strategies and/or more European facing business models with potentially higher costs but in established markets.

Structured correctly, there is moderate to high potential profitability for Falkland Islands companies in Illex value chains subject to a variety of risks that include:

- Stock variability and ability of companies to capitalize on boom years and minimize consequences of bust seasons;
- Limited direct experience with harvesting and marketing Illex in high volumes; and
- An expanding unregulated high seas fleet and no prospects in the near to medium term for SW Atlantic Regional Fisheries Management Organization to manage the fishery.

Given the paucity of data and hence limited analysis, yet very evident potential for greater Falkland Islands engagement in the fishery, further in-depth investment focused on production, marketing, and value chain profiling (including country visits) is warranted before companies make major investment, production, management, and marketing moves in the Illex fishery.

1. Introduction, Background and Project Objectives

The South Atlantic Environmental Research Institute's (SAERI) Natural Capital project commissioned this study to investigate the potential economic and financial benefits to the Falkland Islands of greater business engagement in the Illex (*Illex argentinus*) fishery and associated value chains. This engagement could include greater Falkland Islands company ownership and involvement in harvesting operations and sales and marketing ventures. The Illex squid fishery is, by volume and value, the largest in the Falkland Islands. Except for the Illex fishery, there are limited opportunities for further fisheries expansion, and of the major fisheries, it is the one fishery in which Falkland Islands fishing companies are the least engaged.

The following study provides data, analysis, findings, and recommendations to assist the Falkland Islands in developing strategies for greater engagement in the Illex fishery. The study uses economic and value chain analysis to help understand markets for Illex and related squid products and determine the potential for expanding the Falkland Islands engagement in the fishery.

The report includes the following major sections:

- Study Background and Objectives;
- Methodology;
- Fishery and Market Overview;
- Value Chain Analysis;
- Economic Analysis;
- European Markets; and
- Findings and Recommendations.

1.1 Background

Argentine shortfin squid (*Illex argentinus*), referred to as Illex in this report, is an abundant oceanic squid occurring in the temperate and subtropical waters in the Southwest Atlantic Ocean (Figure 1). Adults are commonly found near the bottom, between 100 to 600 m depth. Illex have a short lifespan of about one year, with several seasonal spawning populations. Annual abundance is highly variable.

Figure 1. Geographical distribution of *Illex argentinus* (Source: FAO, http://www.fao.org/fishery/species/3565/en).

The Illex fishery occurs on the high seas and on fishing grounds in Argentinian and Falkland Islands waters. The Argentine and Falkland Islands Governments each manage the fisheries in their own

waters with limited cooperation or communication due to a sovereignty dispute between Argentina and the United Kingdom over the Falkland Islands. Harvesting is conducted by specialized jigger vessels at night where lights are used to attract squid and they are hooked on jigs operated by continuously rotating drums. Up to 100 vessels can operate in Falkland Islands waters and hundreds more fish on the high seas and on Argentinian fishing grounds (FIG, 2018). A much smaller volume of Illex is caught by trawling.

Fishing is the Falkland Islands largest economic sector, accounting for 39.4% of GDP in 2015 and 58.5% of GDP in 2016. The Falkland Islands Government receives revenue from quota fees and from company taxation paid by fishing companies. Given the importance of fishing to the Falklands Islands economy and to FIG revenue, it is vital that the sector remains profitable and viable.

Two species of squid make up the majority of the Falkland Islands total fishery catch, Illex and *Doryteuthis gahi* (Patagonia squid also known as Falklands calamari) (FIG, 2018). Of the major Falkland Islands fisheries, the Illex fishery has the least engagement by local companies, with the majority of annual licenses held by South Korean and Taiwanese fishing fleets. This contrasts to the Falklands calamari fishery where Falkland Island fishing companies are fully engaged in harvesting, export and sale in international markets. The Illex fishery may provide an opportunity for fisheries expansion by Falkland Islands companies.

The management of Illex squid is challenging, which explains why direct Falkland Islands private sector involvement is limited:

- The recruitment and arrival of the stock to the Falkland Islands fishing grounds is extremely variable, ranging in recent years from a low of 44 tonnes in 2009 to 357,722 tonnes in 2015 and falling to 2,360 tonnes in 2016 (FIG 2018);
- The species is highly migratory with distant water fishing fleets harvesting on the high seas, in the Argentinian Exclusive Economic Zone, and in the Falkland Islands Interim and Outer Conservation Zones;
- Increased exploitation rates and variation in oceanographic conditions have led to high fluctuations in abundance over the past 20 years in the Falkland Islands (FIG, 2018);
- Cooperation with Argentina over the management of shared fisheries, including Illex, has been limited.

Contemporary arrangements for management of the Illex fishery include:

- Local companies have an arms-length relationship with international fleets – acting more as local agents for foreign fishing fleets than active partners in the fishing enterprise. No local company has experience operating jigger fishing vessels, the major gear used to catch Illex in the Southwest Atlantic. There is some trawling for Illex by Falkland Island fishing companies.;
- Revenue from Illex fishing licenses comprise up to 50% of FIG's total fisheries income (FIG, 2018);
- Unlike all other fisheries managed by the Falkland Islands Government, Illex has yet to enter the Falkland Islands Individual Transferable Quota system, Licenses to fish for Illex are issued annually by the Falkland Islands Government to vessels. Under the Individual Transferable Quota, Falkland Island Companies, rather than the Government hold long term rights to access fisheries; and
- In poor Illex years, FIG has issued refunds of license fees to international companies and borne the risk from licensing vessels to harvest this variable stock. The extent to which this risk would be transferred to Falkland Islands operators could impact on the viability of value chain participation.

1.2 Study objectives

Despite challenges, Illex presents new opportunities for Falkland Islands fishing companies and the wider maritime sector. This research investigated the potential economic and financial benefits to the Falkland Islands of greater engagement (e.g. ownership in harvesting operations, sales and marketing ventures) in the Illex fishery and associated value chains.

The following steps were undertaken as part of this project:

1. Conducted general market research and provided profiles of the products, associated industries and markets for Illex squid;
2. Described and mapped the Illex value chain by: a) Identifying business operations (functions), chain operators and their linkages, as well as the chain supporters within the value chain; and b) Quantifying and describing the value chain, attaching numbers to the basic chain map;
3. Conducted an economic analysis of the value chain by determining:
    a) The value added along the stages of the value chain;
    b) The cost of production and;
    c) Where possible the income of operators;
4. Benchmarked the economic performance of the value chain against competing chains in other countries or similar industries; and
5. Discussed opportunities for expanded involvement in the value chain by Falkland Islands fishing vessels.

2. Method

Value Chain Analysis (VCA) is a type of economic and financial analysis that can estimate possible benefits flowing to the Falkland Islands from increased participation in the Illex fishery and associated upstream business activities. It is a way to understand relationships and linkages among buyers, suppliers, and related market actors for this regionally significant fishery.

VCA can help identify constraints and opportunities for greater economic benefits and competitiveness through Falkland Islands engagement in this fishery. It can assist the targeting of institutional and policy actions to promote increased local engagement. Using commonly accepted VCA methods and available data, we assessed the performance of Illex and other related squid value chains and explored opportunities and barriers to increased Falkland Islands engagement with these value chains.

2.1 Study Area

Illex occur in the Southwest Atlantic between 22°S and 54°S, from Brazil to Southern Argentina, and east to the high seas and Falkland Islands (Figure 1). The Falkland Islands fishery consists of two regions, the Falkland Islands Interim Conservation Zone and Falkland Islands Outer Conservation Zone (Figure 2).

2.2 Data and Methods

Significant data limitations exist in tracking the Illex value chain and comparing it with competing markets. This is due largely to the lack of accessible data and the complexity of global squid markets including size of the resource, and number of countries and firms in harvesting, shipping, processing, refreezing, wholesaling, importing, exporting, and retailing. According to a detailed report on the arrow squid fishery by McKinna et al (2010):

"the data recording mechanisms [for squid] have not kept pace with this trend of moving fish around the world, meaning it is difficult to track import/export flows and processed/value-added differences, or to determine the true origin and destination of products."

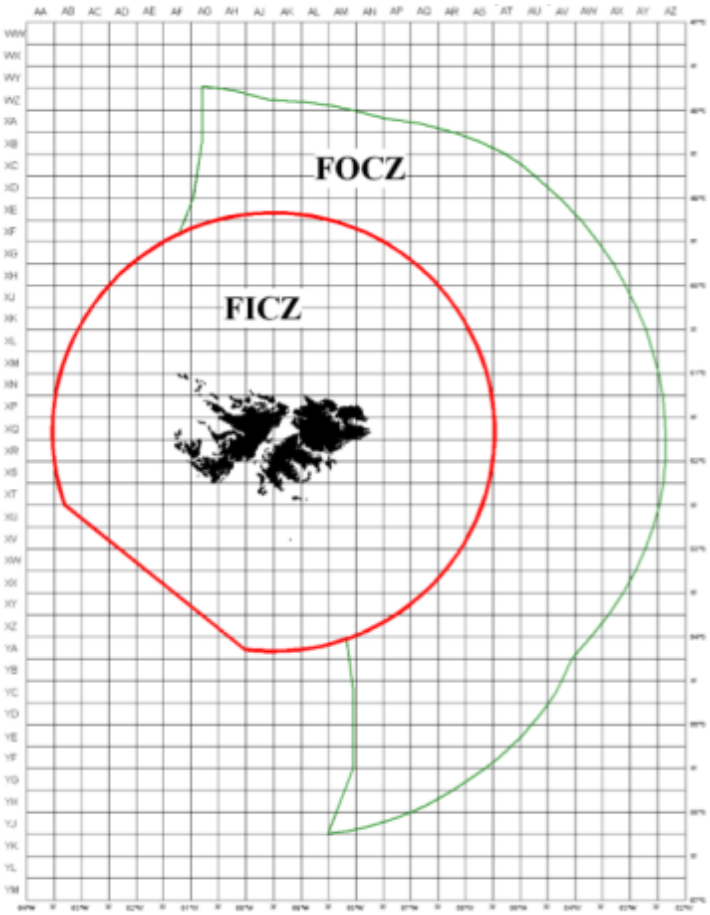

Figure 2. Map of the Falkland Islands Interim Conservation Zone (FICZ) and Falkland Islands Outer Conservation Zone (FOCZ) (Source: FIG, 2018).

We addressed data gaps by looking across databases and broadening our queries from looking exclusively at Illex to including the HS Code for squid and cuttlefish to capture trends in the global squid market. The following databases and reports were drawn upon as follows:

- Sea Around Us: http://www.seaaroundus.org/
    - This database was used to evaluate Illex ex-vessel landings in terms of volume and value across the main capture regions: Argentine EEZ, Falkland Islands Conservation Zones, and the high seas. This data base, compiled and updated by the University of British Columbia is the only one freely available providing comparable time series data across these regions using a consistent method.
- The Observatory of Economic Complexity (OEC) commodity trade data: https://atlas.media.mit.edu/en/profile/hs92/030749/
    - This database and visualization tool was used to identify major global trade patterns for squid using HS Code 030749 (squid and cuttlefish frozen, dried, salted or in brine). For all of the HS data used throughout the site (1995 - 2014) the Atlas used the BACI International Trade Database. The original data came from the United Nations Statistical Division (COMTRADE), but was cleaned by the BACI team using their own methodology of harmonization.
- FAO fishbase: http://www.fao.org/fishery/statistics/global-commodities-production/en
    - The database contains statistics on the annual production of fishery commodities and imports and exports (including re-exports) of fishery commodities by country and commodities in terms of volume and value from 1976 through 2014. It was used to explore Illex import and export data, with a limitation that for many countries in Asia and North America, the database identifies squid trade more broadly but not for Illex.

- Fisheries Research and Development Corporation and McKinna et al. 2010. Improving the efficiency of Southern Squid Jig Fisheries.
    - This detailed report on the on New Zealand arrow squid fishery incorporated a simple value chain analysis which was used to fill in gaps as needed.

3. Overview of the Illex Fishery and Markets

Global squid production is comprised of two main families, the Ommastrephidae and Loliginidae. Biomass is dominated by Ommastrephidae, with five main species harvested commercially: *Todarodes pacificus* (Japanese flying), *Nototodarus sloanii* (New Zealand arrow), *Illex argentinus* (Argentine shortfin), *I. illecebrosus* (northern shortfin), and *Dosidicus gigas* (Humboldt or jumbo); with the first four species inhabiting Atlantic and Pacific western boundary current systems (Arkhipkin, 2015). Large quantities of Loliginidae also comprise a substantial portion of global squid catch (Table 1).

Illex is the most abundant commercial squid species in the Southwest Atlantic, occurring in temperate and subtropical waters between 22ºS and 54ºS (Arkhipkin, 2015). It is the second largest cephalopod fishery in the world, and is primarily harvested in the Argentine EEZ, Falkland Islands Interim and Outer Conservation Zones, and the high seas (Table 1, Table 2, Figure 3). Individual countries manage catch within their own EEZs. Argentina lands more than any other country (33%), with China, Taiwan, and Korea each catching between 17-23% (Table 2).

The species consists of several distinct populations and cohorts, all of which have annual life cycles. The Southern Patagonian Stock, the largest of these subpopulations migrates into Falkland waters between February and June. In cold years, Illex may not migrate as far south as Falkland waters.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Todarodes pacificus	528,523	504,438	487,576	447,820	411,644	388,087	429,162	403,722	408,188	357,590
Todarodes sagittatus	1,915	3,163	954	594	574	526	1,112	774	980	973
Nototodarus sloanii	44,862	63,096	57,383	108,437	96,398	89,403	73,921	56,986	47,018	33,413
Illex argentinus	750,452	540,414	503,625	178,974	287,590	703,804	955,044	837,935	261,227	189,967
Illex illecebrosus	5,699	5,527	10,583	28,103	13,837	21,619	10,479	20,090	22,912	20,660
Illex coindetii	2,596	2,559	2,006	2,264	5,533	4,650	4,132	4,573	4,349	3,889
Ommastrephes bartramii	23,870	14,947	18,964	11,478	14,430	9,401	22,156	24,400	36,000	16,800
Dosidicus gigas	244,955	412,431	402,045	834,754	779,680	871,359	688,423	895,365	642,855	815,978
Martialia hyadesi	117	2	37	59	3	0	4	0	4	0
Doryteuthis (Loligo) gahi	76,865	36,411	76,746	42,180	70,721	52,532	59,405	58,545	48,027	71,838
Doryteuthis (Loligo) opalescens	85,829	72,879	39,330	39,596	55,732	49,205	49,447	36,599	92,376	129,936
Doryteuthis (Loligo) pealeii	14,211	16,684	11,929	13,537	16,967	15,899	12,327	11,400	9,293	6,689
Loligo reynaudii	3,373	7,406	7,616	7,306	10,362	6,777	9,948	8,329	10,107	10,068
Loligo forbesii	70	140	536	261	272	472	721	664	455	554
Loligo vulgaris	2	2	2	1	3	5	7	7	6	22
Sepioteuthis lessoniana	5,574	5,826	6,333	5,500	3,811	3,584	3,646	4,528	4,523	4,526
Loliginids	198,893	218,551	261,907	209,894	209,110	202,616	206,861	208,218	216,658	236,499
Onykia (Moroteuthis) ingens					109	22	68	34	87	36
Moroteuthis robusta					5	13	6			
Berryteuthis magister				1,132	1,068	1,084	48,981	54,868	60,639	59,306
Various squid (Loliginidae, Ommastrephidae, other families)	230,214	281,935	317,097	303,241	327,225	316,989	337,574	356,864	372,825	430,416
Total	2,218,020	2,186,411	2,204,699	2,235,131	2,435,074	2,746,047	2,913,424	2,938,860	2,238,529	2,389,160

Table 1. Global squid production by species from 2001-2010 (source: Arkhipkin, 2015; data from FAO).

Fishery revenue is the main income source for the Falkland Islands Government, with squid comprising over 75% of landings and Illex fishing licenses making up roughly half of total fisheries income (FIG, 2018). Illex are fished principally by specialist squid jigging vessels from South Korea

and Taiwan (Table 2). Most of Falkland Islands Illex landings caught by trawling are exported to Spain (FIG, 2018; OEC, 2016).

Fishing Zone and Vessel Flag	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
High Seas	**63,186**	**202,140**	**357,341**	**300,266**	**104,995**	**50,601**	**43,501**	**86,479**	**184,358**	**424,128**
Belize	4		159							
Cambodia						66	799	1,183	1,025	
Taiwan	63,182	202,140	357,181		104,995	50,536	42,702	85,296	183,334	424,128
United Kingdom				300,266						
Argentina	**208,586**	**428,790**	**409,048**	**460,444**	**135,734**	**133,963**	**97,810**	**174,931**	**243,641**	**214,519**
Argentina	186,274	372,192	296,056	324,255	93,327	109,789	97,810	121,059	243,641	214,519
China	22,313	56,598	112,992	136,189	42,407	24,173		53,872		
Brazil (mainland)	**451**	**292**	**345**	**389**	**37**	**46**	**50**	**49**	**49**	**49**
Brazil	451	292	345	389	37	46	50	49	49	49
Chile (mainland)	**1**	**3**	**4**	**4**	**1**	**0**	**1**	**1**	**1**	**2**
China	0	1	1	1						
Korea (South)	1	2	3	2	1	0	1	1	1	2
Falkland Isl. (UK)	**35,275**	**173,070**	**316,005**	**210,127**	**37,253**	**29,319**	**98,204**	**114,000**	**175,441**	**344,277**
Belize	81		3,044							
Cambodia						122	1,489	2,207	1,911	
China	4,423	14,522	30,470							
Estonia	175	480				13	99	377		
Falkland Isl. (UK)	93	1,050	537	442	8	67	2,828	572	650	2,873
Ghana		1,244								
Korea (South)	17,137	98,931	153,294	126,270	17,206	13,278	34,952	45,916	72,708	135,506
Panama	194	1,375	1,896							
Sierra Leone						110		443		
Spain	95	4,473	5,870	3,197	3,099	2,310	2,028	509	2,798	9,516
Taiwan	12,957	50,980	120,859	80,006	16,939	13,278	54,982	63,971	95,052	185,296
United Kingdom		15	35	211	0		4	6		36
Vanuatu	120					142	1,821		2,322	11,051
Uruguay	**12,113**	**27,363**	**38,031**	**10,897**	**1,586**	**2,375**	**1,468**	**1,431**	**1,261**	**2,356**
China	4,370	11,086	22,131							
Uruguay	7,743	16,277	15,900	10,897	1,586	2,375	1,468	1,431	1,261	2,356
Grand Total	**319,613**	**831,657**	**1,120,773**	**982,128**	**279,605**	**216,304**	**241,033**	**376,891**	**604,752**	**985,332**

Table 2. Total *Illex argentinus* landings (in tonnes) by fishing zone and vessel flag, in descending order of average landings, from 2005-2014 (data source: Sea Around Us).

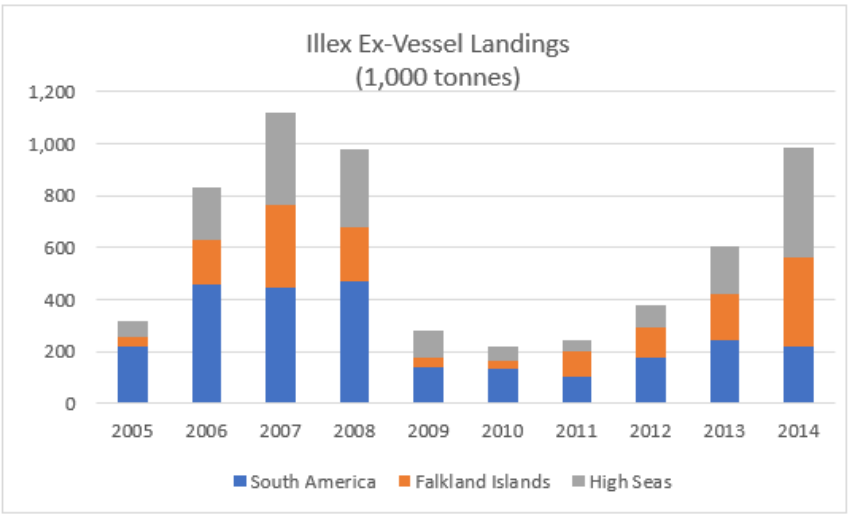

Figure 3. Total annual ex-vessel landings (1,000 tonnes) of *Illex argentinus* in the Southwest Atlantic by region, 2005-2014 (data source: Sea Around Us).

3.1 Illex Product Profile

Illex are primarily caught at night by jigging with bright lights, similar to many large-scale fisheries for both ommastrephids and loliginids. Squid jigging takes place in surface waters between 0 and 50 m (Safina, 2017). The jigging method causes little damage to the squid skin and can be sold as a higher value product (Arkhipkin, 2015).

Squid are typically frozen whole on board the fishing vessel, often after grading according to size (Arkhipkin, 2015). In some cases, on-board processing includes removal of the viscera and the "tubes" and "tentacles" (mantles and brachial crowns) before freezing. In the Falkland Island fishery over 92% of Illex are frozen whole onboard the fishing vessel (Laptikhovsky et al., 2006). When catches are low, squid are gutted, otherwise they are frozen whole in blocks.

Illex squid are transported as frozen blocks to processing facilities. Most squid processing occurs in China, but the Falkland Islands trawl-caught Illex is exported primarily to Spain for processing. At processing facilities, the blocks are thawed and the squid are processed for the wholesale market. Illex is commonly sold as Argentine shortfin squid, "squid" or "calamari" (FDA 2016), and are primarily imported frozen (60%), whole or cleaned, or are separated into rings and tentacles or tubes (mantles). Larger Illex squid offer a higher premium by processors because they have higher recovery rates and cost less to process by volume (McKinna et al, 2010).

Although larger Illex squid are typically used for higher value processed products for human consumption, smaller ones (100-300 grams) can be more profitable if sold as bait. Illex are commonly imported by the United States as bait for swordfish and other big game species, and are preferred to the northern shortfin squid (*I. illecebrosus*) due to their larger size and thicker tube wall (http://floridasportfishing.com/squid-school/).

There are also recent developments in the production and marketing of new value-added squid products. For example, according to an Intrafish interview with the Spanish processer Congalsa, shortages in the Illex market and resulting higher prices have driven some processors to produce "pre-formed" squid rings which are made from a mixture of giant squid, Alaskan pollock, water, and starch (Intrafish, 2018). Ommastrephid squid are now being used by the nutraceutical industry to produce omega-3 fatty acid supplements for human nutrition (Arkhipkin, 2015).

3.2 Associated Industries and Markets

Global Squid Market

Market prices for a given squid fishery (and the fishers and buyers in that fishery) are subject to global squid market dynamics, with fluctuations due largely to supply (McKinna et al, 2010). Large amounts of stock can be held in freezers, allowing international traders to speculate and possibly create "artificial" shortages and gluts (McKinna et al, 2010). As with all global trade, squid market prices are also subject to currency fluctuations.

Given that Illex is part of the global squid market, we looked at the global trade value and major trade patterns of squid and cuttlefish (frozen, dried, salted or in brine, HS Code 030749) from 2007-2016, identifying major exporters and importers and their trade partners.

The annual global trade value of squid and cuttlefish ranged from a low of $2.56 billion USD in 2007 to a high of $3.89 billion USD in 2016 (OEC). The top exporters were China (26%), India (10%), Indonesia (6.8%), Morocco (6.6%), and Spain (6.3%) (Figure 4), a trend that has held over the past decade. Trade partners for these top exporters in 2016 included:

- China exported squid primarily to the US (19%), Thailand (15%), Hong Kong (9.2%), the Philippines (7.6%), and Italy (5.7%).

- India exported to Vietnam (24%), Spain (22%), Thailand (12%), Italy (10%), and the US (6.3%).
- Indonesia exported to China (45%), Vietnam (22%), Thailand (9.6%), Other Asia (6.3%), and Italy (5.6%).
- Morocco exported to Spain (65%), Italy (18%), Japan (6.4%), Thailand (4.5%), and China (2.4%).
- Spain exported to Italy (48%), Portugal (17%), France (9.3%), Germany (5.5%), and Croatia (5.4%).

The Falkland Islands annual exports of squid and cuttlefish ranged from $88.4 million USD in 2009 to a high of $195 million USD in 2016, making up 5% of the global export value (Figure 4). The majority of Falkland Islands trawl-caught squid is Falklands calamari rather than Illex and 80-90% of Falkands calamari is exported to Spain.

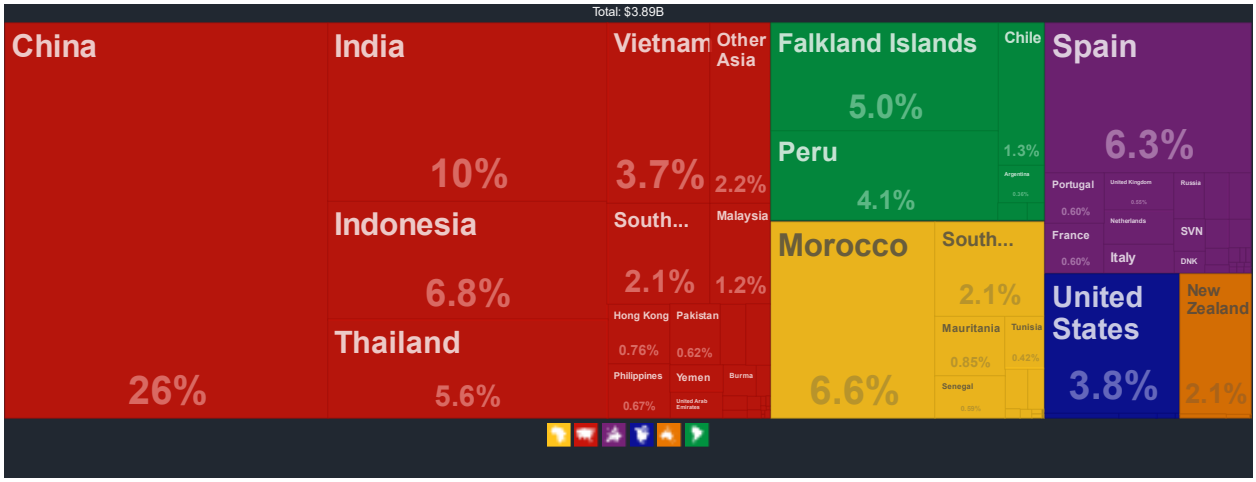

Figure 4. Proportion of global export value by country for squid and cuttlefish, 2016 (Source: Observatory of Economic Complexity, https://atlas.media.mit.edu).

In 2016, the top importers of squid and cuttlefish were Spain (17%), Italy (13%), Thailand (8.4%), China (8.2%), and the United States (7.6%) (Figure 5). These major import trends have held over the past decade, although the relative proportion of squid imports by Japan has declined. In 2016, major trade partners for these top importers were as follows:

- Spain imported primarily from the Falkland Islands (25%), Morocco (25%), India (13%), Peru (8.8%), and China (7.4%).
- Italy imported from Spain (22%), Thailand (17%), China (11%), Morocco (8.6%), and India (7.9%).
- Thailand imported from China (45%), India (15%), Vietnam (13%), Indonesia (7.7%), and Peru (5.4%).
- China imported from Indonesia (38%), US (20%), South Korea (11%), New Zealand (9.3%), and Peru (5.4%).
- US imported from China (65%), India (8.5%), Thailand (6.4%), Other Asia (6%), and South Korea (4.8%).

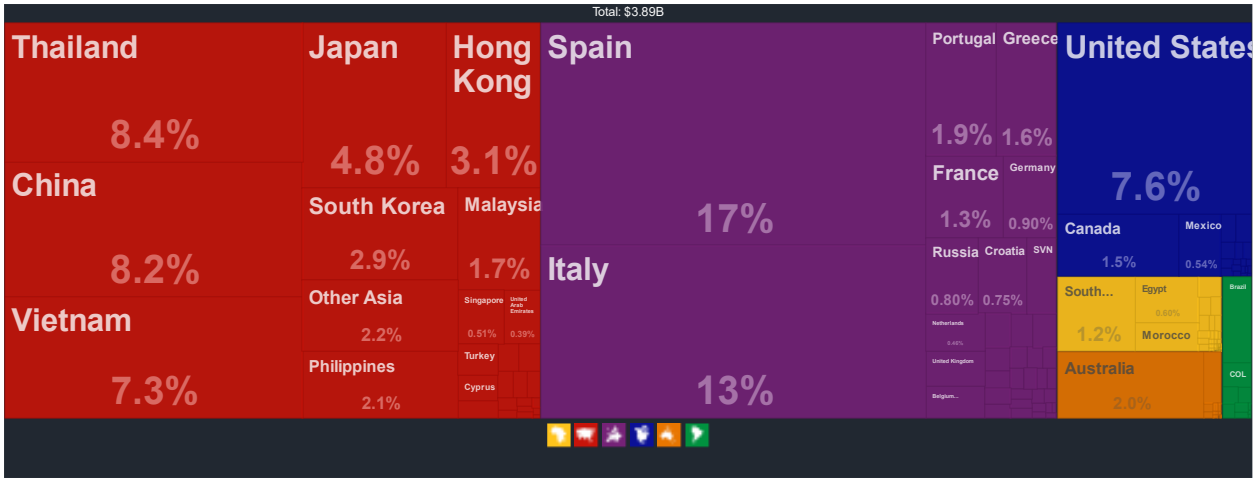

Figure 5. Proportion of global import value by country for squid and cuttlefish, 2016. (Source: Observatory of Economic Complexity, https://atlas.media.mit.edu).

Competing Species

The top three commercial squid species by global catch volume include Illex, jumbo flying squid (*Dosidicus gigas*), and Japanese flying squid (*Todarodes pacificus*). These are competitive and partial substitute species and their market prices are interdependent (Figure 6). Illex and Japanese flying squid are more popular, especially in European and US markets (Undercurrent News, 2018); however in recent years characterized by low supply and higher Illex prices, China and other Asian markets have been using smaller jumbo flying squid and red oceanic squid (*Ommastrephes bartarmii*) as cheaper alternatives (Undercurrent News, 2018; FAO GlobeFish, 2016).

As jumbo squid is the species with the highest global catch, and therefore strongly influencing the Illex market, we evaluated exports of squid and cuttlefish (HS Code 030749) from Peru and Chile, the top jumbo squid producing countries. We also evaluated the New Zealand Arrow squid fishery (*Nototodarus sloanii* and *N. gouldi*), a similar squid in terms of markets to Illex (McKinna et al, 2010).

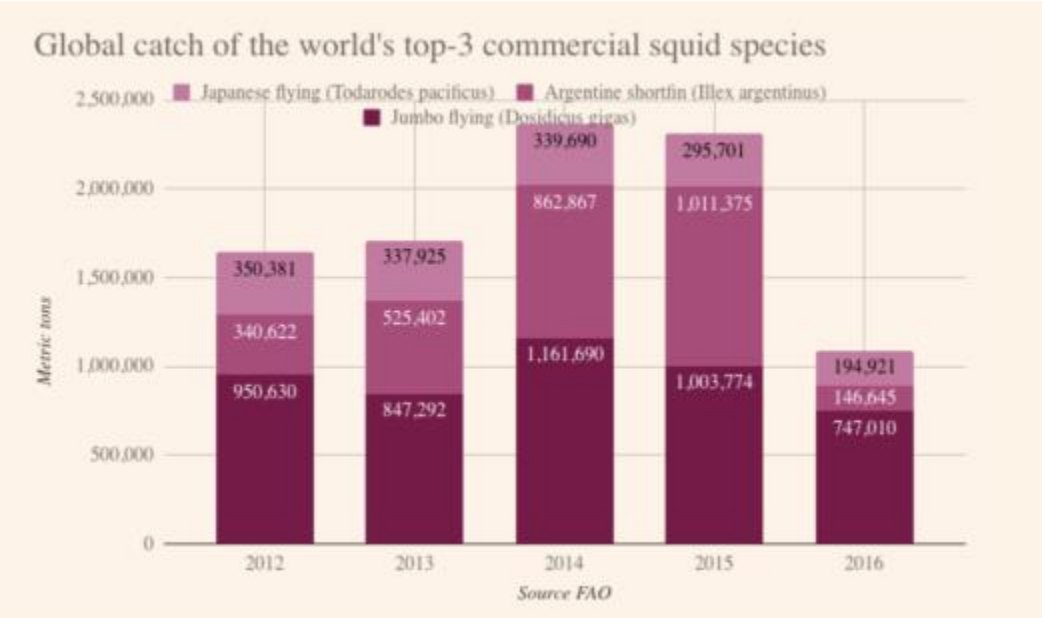

Figure 6. Global catch of the world's major commercial squid species (Source: Undercurrent News, 2018; https://www.undercurrentnews.com/2018/10/12/chinese-jumbo-flying-squid-catch-a-great-harvest-as-processors-ponder-use-as-illex-todarodes-substitute/).

Jumbo Flying Squid

Jumbo flying squid (*Dosidicus gigas*), commonly referred to as Humboldt squid, is the largest cephalopod fishery in the world (McClure, 2015). Squid occur in the Eastern Pacific with major fisheries off the coast of Peru and Chile, where the squid are landed mainly by artisanal jigging vessels (McClure, 2015). Jumbo squid are also landed on the high seas outside of the Peruvian and Chilean EEZs by Japanese, Korean, and Chinese vessels (Arkhipkin, 2015). After a decline in Illex stock in 2001, the Chinese distant-water mechanized jigging fleet entered the fishery, operating outside the Peruvian and Chilean EEZs (Chen et al, 2008).

Over the past decade, Peruvian exports of squid and cephalopods have ranged from a low of $96.4 million USD in 2009 to a high of $245 million USD in 2014. Peru exports squid primarily to Europe (50% of exported value) and Asia (37% of landed value). Spain has remained Peru's largest trade partner over the past decade, with 24-38% of squid and cuttlefish export by value going to Spain. In 2016, 37% of squid and cephalopods by value were exported to Spain and 11% each to China and Thailand (Figure 7).

Chile exports substantially less squid and cephalopods than Peru, with exports ranging from $11.8 million USD in 2007 to a high of $51.9 million USD in 2016 (roughly 15-30% of Peru's export value). Chile exports primarily to Asia, and this is dominated by exports to South Korea (54% in 2016) (Figure 8). This trend has held since 2011, but prior to that most Chilean exports went to Venezuela with a high of 94% in 2009.

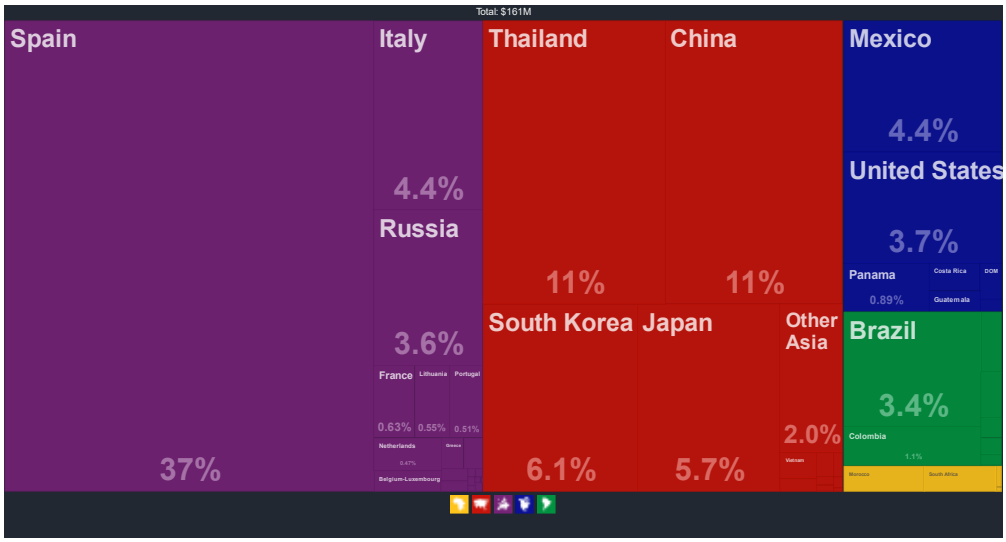

Figure 7. Proportion of Peruvian export value by country for squid and cuttlefish, 2016. (Source: Observatory of Economic Complexity, https://atlas.media.mit.edu)

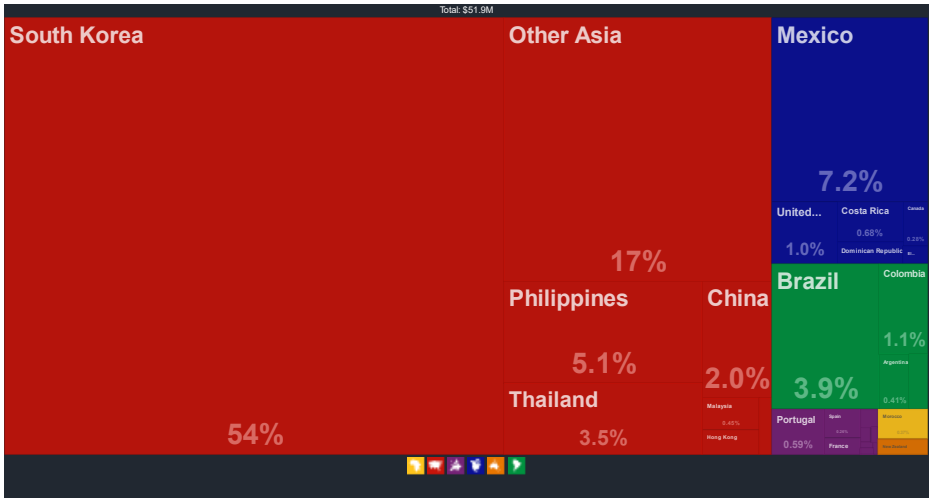

Figure 8. Proportion of Chilean export value by country for squid and cuttlefish, 2016. (Source: Observatory of Economic Complexity, https://atlas.media.mit.edu)

New Zealand Arrow Squid

Two species of squid contribute to the New Zealand squid fishery, *Nototodarus sloanii* and *N. gouldi*, both referred to as New Zealand Arrow Squid. Squid fishing occurs primarily in the austral summer from January through May. According to Fisheries New Zealand (2018), it is a low-value and high-volume fishery with foreign vessels dominating the fleet. Squid often ranks among New Zealand's top five exports; however it is similar to the Falkland Islands Illex fishery in that it is a highly variable and unpredictable fishery, resulting in fluctuating export revenues.

Over the past decade, New Zealand exports of squid and cuttlefish have ranged from a low value of $27.4 million USD in 2015 and a high of $80 million USD in 2016 (OEC). In 2016, 37% was exported to China, followed by Greece (15%) and Spain (14%) (Figure 9); with some fluctuating trade partners over the past five-plus years. Prior to 2016, Australia's imports were higher, ranging from 10-20%.

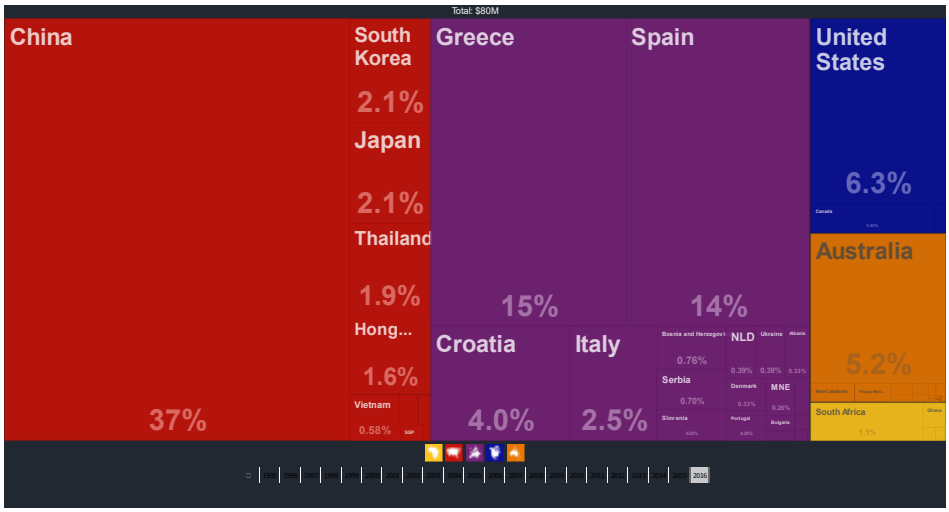

Figure 9. Proportion of New Zealand export value by country for squid and cuttlefish, 2016. (Source: Observatory of Economic Complexity, https://atlas.media.mit.edu)

4. Illex value chain

4.1 Business Operations/Functions

Producers (license holders/fishers)

The majority of Illex caught in Falkland Islands waters are landed by licensed jigger vessels from Taiwan and South Korea, comprising 67% and 24% of landings, respectively, in 2017 (FIG, 2018). Over the past five years (2013-2017) the average jig fleet size was 104 vessels (FIG, 2018). A small portion of Illex is landed by the Falkland Islands trawl fleet, comprising less than 5% of 2017 landings. The catch season occurs from February to June, often peaking in March and April. The jigger fleets follow the squid, fishing both in the Falkland Islands waters as well as on the high seas.

In the Falkland Islands fishery over 92% of Illex are frozen whole on the fishing vessel (Laptikhovsky et al, 2006).

Transport Companies

Illex is usually transshipped to reefer vessels in sheltered waters in the Falkland Islands and then either freighted to Montevideo, Uruguay for onward shipping to processors in Asia and Europe or transported directly for processing in Europe or Asia.

Processors and Storage

Companies from various countries around the globe will purchase Falkland Islands frozen squid and then thaw, process, and refreeze it. The majority of global squid landings, including those caught by jigger in the Falkland Islands, are processed in China and Taiwan to take advantage of low labour costs. Spain is also a major player in the processing of squid. The majority of squid landed by the Falkland Islands trawl fleet are exported to Spain (ranging from 83-96% from 2007-2016), with Falkland Islands Illex comprising 8% of Spain imports of Illex in 2017 (European Commission, 2018).

Larger Illex are processed into cleaned tubes, rings, tentacles, and flowers (pineapple cut tubs pieces) for human consumption; while smaller or damaged squid are often sold unprocessed for bait.

Once discharged in Port and processed, Illex is held in cold storage until sold. In European markets holding times depend on the company pricing strategy as well as volumes. Companies need to have stocks to meet client demand but try to keep stocks at minimum levels.

For Illex the holding times are variable given volatility in volumes. It has been reported that in high catch back to back years holding times can exceed 18 months. Average holding time is estimated to be three to six months (Pers. Comm. Falkland Islands fishing company).

Wholesalers

Wholesalers typically buy products in bulk from the processor and sell to retailers. Many seafood systems are vertically integrated where wholesalers also function as the processor and distributer to retail and food service outlets, which results in a less transparent value chain.

Retail

Squid are sold retail for human consumption around the globe to restaurants, grocery stores, and other food service sectors in all product forms from whole unfrozen to frozen processed and value added. A bait market also exists for Illex, with the smaller and lower value Illex often graded out for bait. In the arrow squid fishery, it was reported that the bait market is about 10-15% lower than the food market (McKinna et al, 2010).

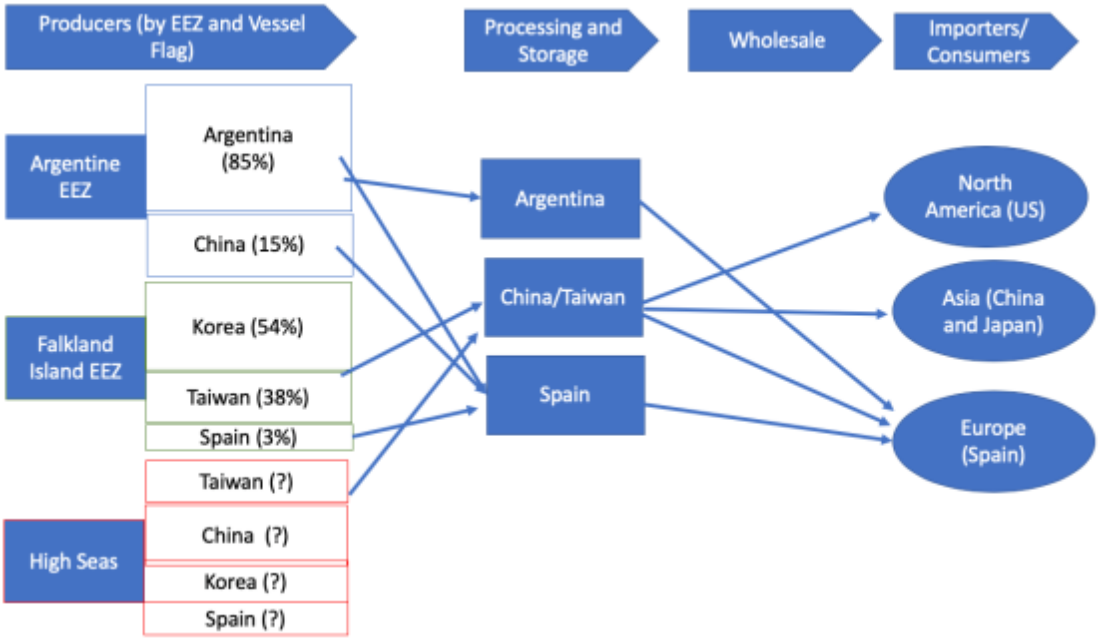

Figure 10. Depiction of the *Illex argentinus* value chain (note data on high seas catches is unreliable so is not included. Chinese flagged vessels are thought to take the majority of high seas catch.

5. Illex Economic Analysis

5.1 Cost of Production

Producers (license holders/fishers)

Catch per unit effort (CPUE) for the Falkland Islands jig fleet was calculated in metric tonnes per day, based on the total number of days fished in a year and the total annual landings for 2014-2017, as reported in the Falkland Islands Fisheries Bulletin (FIG, 2018). During this period, there was a wide range in CPUE from one tonne/day in 2016 (a particularly low catch year) to 41 tonnes/day in 2014 (Table 3).

CPUE varies greatly within a given season and for different vessels. Where the annual average CPUE was 11 tonnes/day in 2017, vessels landed less than 1 tonne/day early and late in the season, averaged closer to 15-25 tonnes/day at the peak, with some vessels landing as high as 117 tonnes/day (FIG, 2018).

Year	Number of jig licenses	Total days fished	Landings (tonnes)	CPUE (tonnes/day)
2014	160	7041	291,760	41
2015	106	8278	332,862	40
2016	104	1714	2,303	1
2017	106	6055	63,849	11

Table 3. Number of Falkland Islands squid jig licenses, number of days fished, landings, and CPUE for 2014-2017 (Data source: FIG, 2018).

Vessel Operation Costs:
Fishing vessel operation costs vary widely, with diesel and labour being the primary source of variability, and cost rate when calculated on a per volume basis is highly dependent on catch rate. In addition to costs being highly variable, very few well documented studies on costs for squid jigging vessels were found. To account for this high variability and uncertainty, we included a range for cost rates of $350 - $500 USD/tonne, based on several sources. Cost rate was calculated as USD per tonne in order to compare it with landings and import/export data.

McKinna et al (2010) came up with several cost scenarios and we used the one that most closely represented the Falkland Islands catch rate and sell price. A 10 tonne catch selling at $1,000/tonne comes to $440 USD/tonne based on labour at 25% of cost share, diesel at $1,700, and $200 for jigs and lines. Given that this estimate is based on much smaller vessels (20 meters), this is likely a high cost rate when compared to the Illex jig fishery. That said, Villasante and Sumaila (2010) reported a cost per unit effort of $534 USD for the Argentine Illex fishery based on costs of a standard vessel; however, it is unclear what unit of effort was used. Based on these findings, we used $500 USD/tonne as the upper end of the range for our cost rate. We used $350 USD/tonne as the lower end using a broad assumption that larger vessels are more efficient than the smaller vessels included in McKinna et al's estimate and to better account for the average CPUE of 23 tonne/day in the Falkland Islands from 2014-2017 (Table 3).

Revenue:
The sell price, or revenue, was calculated from the Sea Around Us ex-vessel landing data from 2005-2014. The average annual value per catch volume of Illex from South America EEZ, Falkland Islands EEZ, and the high seas from 2005-2014 was $1,287 USD/tonne in real 2010 $ (Figure 11) Illex prices are variable however, dependent not only on Illex supply but also on the global squid market (FAO Globefish, 2016; Undercurrent News, Oct 2018) and the USD exchange rate (Zhanua Seafood, 2018).

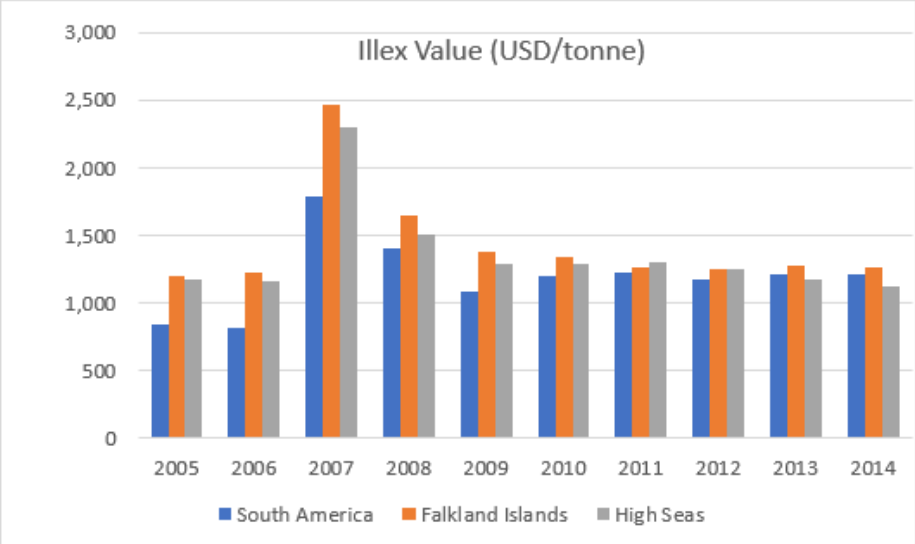

Figure 11. *Illex argentinus* value (USD real 2010 value) per catch volume (tonne), 2005-2014 (data source: Sea Around Us).

Transport Companies
Squid are shipped by reefer vessel from the Falkland Islands to Asia or Europe for processing. Based on discussions with Falkland Islands companies the cost of reefer transport for frozen squid to Vigo, Spain is US $350 /tonne ex-stevedores which adds US$25/tonne. This equates to $0.375 per kg.

Processors and Storage

Squid processing is labour intensive and most landed squid is shipped to China for processing due to low cost labour. One source indicated that it costs 10-15 times more to process a kg of squid in the United States than in China due to higher labour costs, taxes, and health insurance (e.g., $3.50/kg in the U.S. versus $0.25/kg in China) (NPR, 2016).

It is also a particularly difficult segment of the value chain to quantify because it is a highly volatile sector, and there is a lack of transparency that makes it difficult to locate accurate records of processing costs (McKinna et al, 2010; NPR, 2016). With a growing middle class and rising standards, Chinese labour costs are increasing and some have speculated that squid processing may shift to other Asian countries with lower labour costs.

What remains unknown, however, is the cost to process squid in Spain, where the Falklands export most of their trawl caught Illex. Spain has the largest fish processing industry in Europe and has been expanding its squid processing capacity. One processing firm, Fesba, is now processing 6,000 tonnes per year (a 12-15% increase from the prior year) and is also doubling its cold storage capacity, with an expected revenue of EU28 million (Undercurrent News, Sep 2018).

We used China's processing cost of $250 US/tonne as the lower bound for our cost estimate and doubled that and used $500 as a general estimate of processing cost outside of China.

The processing recovery rate (or conversion ratio) is essential to consider when calculating profit, with squid having a rough conversion ratio of approximately 0.6 (FAO http://www.fao.org/3/a-bt963e.pdf.) This means that 40% of the volume of squid purchased by processors does not make it to the wholesale market as "squid" (e.g., it becomes fishmeal, animal foods, mixed bait, or waste). This rate will vary based on the size of the squid (with larger squid presumably having a higher conversion ratio) and the wholesale product forms.

We could not find cold storage costs for Asia, but discussion with Falkland Island companies give these indicative figures for Spain/Europe. There is a discharge cost for unloading the vessel and entry exit charge which is €34/tonne (~US $39 /tonne) and includes the first 15 days in the coldstore. After the first 15 days the current rates are €7.90 /tonne/15 days (~US$ 9/tonne/15 days). Average holding time is estimated to be three to six months. This would give an average cost, including discharge of US$ storage cost of US$84 to US$138 per tonne of Illex.

Revenue

Determining the processor revenue was challenging because it is difficult to determine if squid being imported is processed or unprocessed. The value of $2,488.80/tonne was calculated based on imports of Illex by Italy from 2005-2014 (FAO FIGIS) and based on the assumption that Italy is importing processed squid.

Wholesale

Wholesale costs including freezer storage and transportation were estimated at US$108/tonne. Costs were assumed to be similar to wholesale costs for that of Falklands calamari. The cost was estimated based on personal communications with companies that wholesale Falklands calamari.

Revenue

Wholesale revenue is also difficult to locate as squid often are not identified to species between the wholesale and retail market. A 2017 article from Undercurrent News reported the average price of Chinese processed squid to the US (excluding loligo), and from 2005 to 2016 the price ranged from $2,950 USD/tonne in 2005 and a high of $4,350 USD/tonne in 2011 (Undercurrent News, Mar 2017). This range was used to calculate wholesale profit.

5.2 Profit and Profit Margins

Based on limited available cost and revenue data described in section 5.1, we conducted a broad-based value chain calculation of profit and profit margins for Illex producers and processors (Table 4). Note that given the complexity of squid markets and the range of functions and transactional arrangements along the value chain, these estimates are approximate. The following data were included:

- Vessel Revenue: $1,287/tonne (based on average annual ex-vessel landings from 2005-2014)
- Vessel Operating Costs: $350 - $500 USD/tonne
- Transport Costs: $375 /tonne (included as a producer cost): Squid are shipped by reefer vessel to Europe or Asia. Estimated cost to Vigo, Spain is an approximate estimate.
- Offloading and Discharge Costs: $39/tonne (included as a processor/first receiver cost):
- Processor Revenue: $2,488 (based on the average value of imports by Italy from 2005-2014)
- Processor Costs: $250 - $500 USD/day (based on estimate of processing costs, labour and capital, in China and doubling that for a rough upper estimate to account for higher labour costs in Spain).
- Processor Conversion factor: 0.6. However, note that precise conversion factors depend on product form. Note that some Illex is processed on the fishing vessels and that processor or first receiver may not incur the costs associated with conversion and processing.
- Wholesale costs: Includes 6 month storage costs of $36/tonne.
- Wholesale Revenue: $2,950 - $4,350 USD/tonne

Supply chain link	**Producer**	**Processor/First Receiver**	**Wholesale**
Revenue (Sell Price, USD/tonne)	$1,287	$2,489	$2,950 - $4,350
Conversion factor related costs (approximately 0.6 for processing)	NA	$515	NA
Total Cost (USD/tonne)	$725 - $875	$289--$539	$108
Gross Profit (USD/tonne)	$412 -$562	$250 - $437	$348 - $1753
Gross Profit Margin (%-excludes fixed costs and taxes)	32-44%	19%-34%	14%-67%

Table 4. Provisional estimate of profit and profit margin for the Falkland Islands Illex squid jig fishery based on descriptions of cost and revenue.

This analysis can be compared to New Zealand arrow squid margins. McKinna et al. (2010) developed the following estimation of gross margins (which include costs and profits) for New Zealand arrow squid.

Supply chain link	Boat	Processor	Wholesaler	Retailer
Buy Price $/kg	N/A	$3.00	$5.30	$6.63
Sell price $/kg	$3.00	$5.30	$6.63	$8.01
Gross Revenue	N/A			
Margin ($)	N/A	$2.30	$1.33	$1.99
Margin (%)	N/A	43%	20%	23%

Table 5. The above table is taken from McKinna et al's arrow squid report (2010) and is based on an ex-vessel sale price of $3000/tonne; this stands in contrast to Illex average annual ex-vessel value of $1,287 USD/tonne from 2005-2014 (Sea Around Us).

It should be noted the Illex processing margin of 19-34% in this Falkland Islands study is lower than the 43% margin reported by McKinna et al. (2010), however it was not clear if their margin

incorporated cost or processing conversion factor (i.e., it may have been based on revenue rather than gross profit). This lower rate may also be due to the fact that the 0.6 conversion rate assumes no value for the waste products. The 14% to 67% variability in wholesale rates reflects the different supply chains at play with Illex and uncertainty of data associated with value chain in Asia. For the Falkland Islands, a figure of around 20% would be consistent with the McKinna study if supply chains were European rather than Asian oriented..

5.3 Product Value

Illex prices

Landed value by year and fishing zone

The average annual total landed value for Illex in South America, the Falkland Islands, and the high seas from 2005-2014 was $597 million USD. The value naturally coincides with the catch fluctuations during that same period (Figure 12), with the highest value landed in 2007 at $2,396 million USD, and the lowest value in 2005 at $301 million USD (Figure 3). The value of Illex (USD/tonne) generally does not significantly vary by catch region (Figure 11).

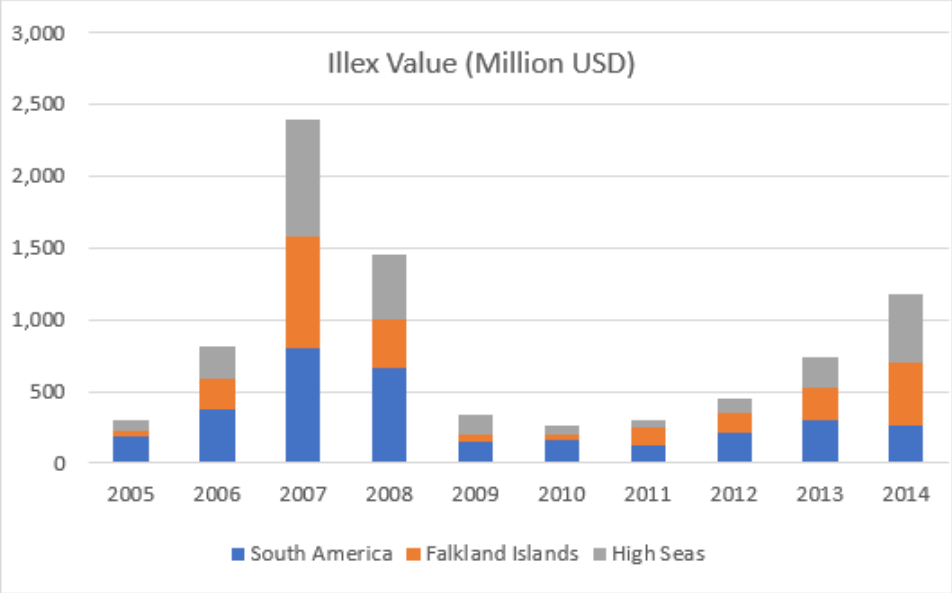

Figure 12. Total value of *Illex argentinus* catch in million USD (Real 2010 value), 2005-2014 (data source: Sea Around Us).

Value by product type

Data on trade value by product type were found only for Argentina exports, and is thus used as a proxy for the broader Illex market. In the FIS 2018 Market Report of Illex exports, the price per tonne was highest for squid tentacles without beaks or eyes ($5,493 USD/tonne) followed by clean tubes ($4,000 USD/tonne), whole squid ($2,482 USD/tonne) and skinless squid rings ($1,400/tonne) (Table 6).

Product Description	October 2017			Percentage variation from October 2016		
	Tonnes	Thousands of USD	Average price USD/tonne	tonnes (%)	Thousands of USD (%)	Average price (%)
Whole Illex squid	136	338	2,482	75.6%	114.1%	21.9%
Skinless Illex squid rings	0	0	1,400	-75.4%	-71.1%	17.7%
Illex squid tubes	-	-	-	65.8%	74.1%	5.0%
Illex squid beaks, roes, gonads and pieces	-	-	-	-64.7%	-53.6%	31.4%
Illex squid tentacles without beaks or eyes	37	202	5,493	-17.8%	-8.5%	11.3%
Illex squid clean tubes	0	0	4,000	-47.5%	-23.6%	45.6%
Other Illex squid	-	-	-	75.5%	140.2%	36.9%
Total	173	541	3,123	67.2%	92.9%	15.4%

Table 6. Argentine exports of Illex squid by product description for October 2017, and percentage variation from October 2016 (Source: FIS Market Report, January 2018).

6. European Markets

EU Imports

The EU imported an average annual total of 68,196 tonnes of Illex from 2008-2017, ranging from 47,242 tonnes in 2012 and a high of 97,972 tonnes in 2008 (Figure 13). Among EU countries, Spain imports the highest volume of Illex, comprising roughly 50% of imports in 2017, followed by Italy at 20%, and Portugal at 10% (data source: Eurostat). The EU annual imports of Illex (Spain, Italy, and Portugal combined) from 2008-2014 ranged from 6 to 30% of total global Illex landings (Figure 14).

In 2017, Spain imported the most Illex from China (44%), followed by Argentina (36%), and the Falkland Islands (8%); while most of Italy's imports were from Spain (51%) and Argentina (46%); and Portugal's imports from Spain (56%) and China (40%) (Figure 15). Similar trends were found in 2018.

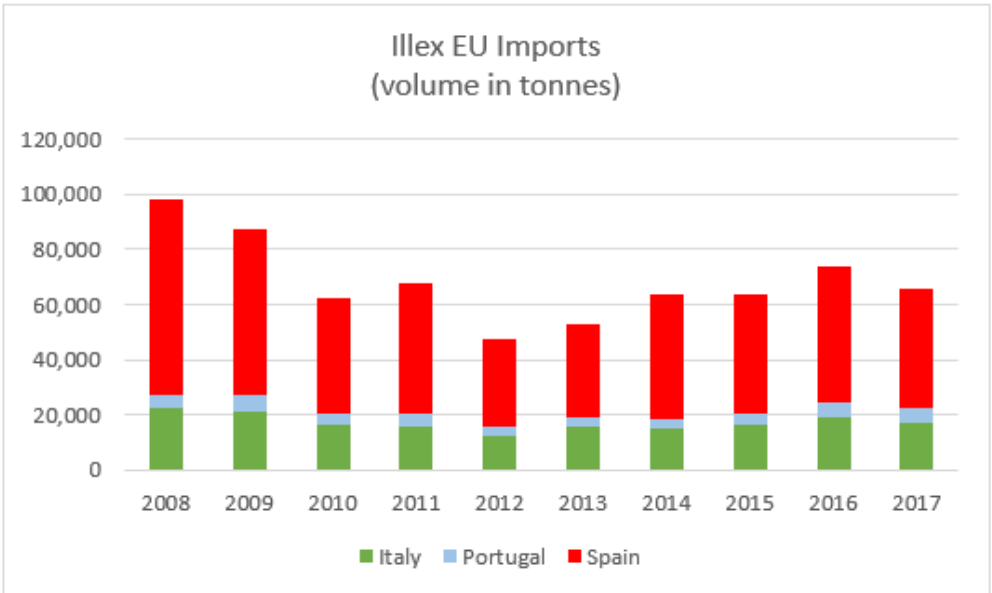

Figure 13. Illex imports by the top EU importing countries from 2008-2017 (Source FAO FIGIS).

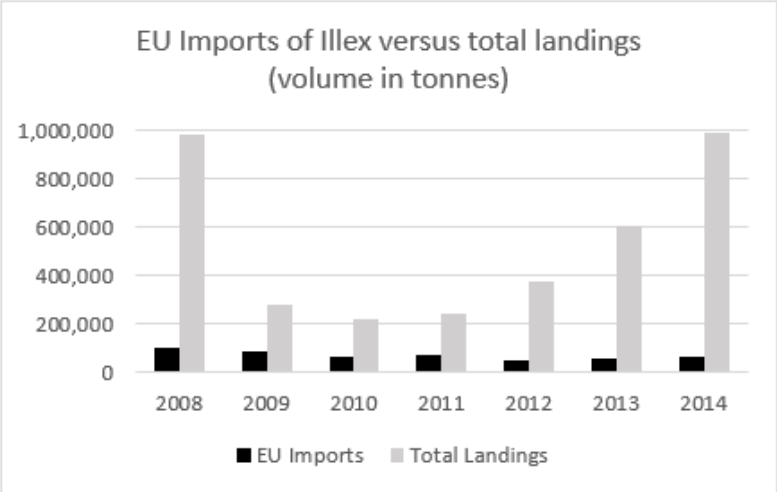

Figure 14. Volume of EU imports (in tonnes) of Illex (Spain, Italy, and Portugal combined) versus total Illex landings from 2008-2014 (data sources: FAO FIGIS for EU imports, Sea Around Us for landings).

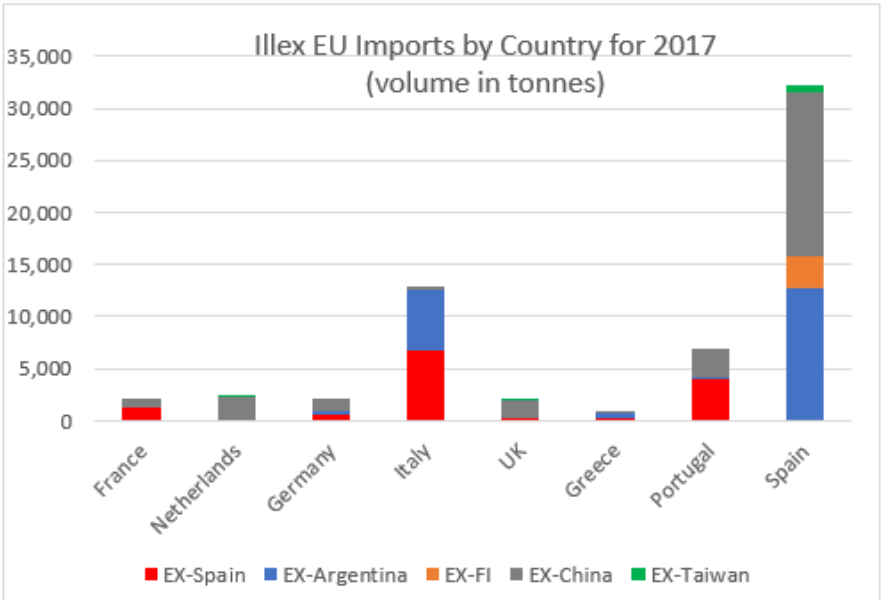

Figure 15. Volume (in tonnes) of Illex trade by European import country on the x-axis and the country from which it was imported (export countries are denoted by "EX"). Spain is the only EU country with reported Illex imports from the Falkland Islands (FI) in 2017 (data source: Eurostat).

EU import prices for frozen Illex spp. (CN code 03074392) from China more than doubled between 2015 and 2017 (from a weekly average of 1,76 EUR/kg to 4,19 EUR/kg), but in 2018 weekly prices trended downward, averaging 3,65 EUR/kg in week 15 (Figure 16). These trends appear driven by global supply of Illex and its substitutes.

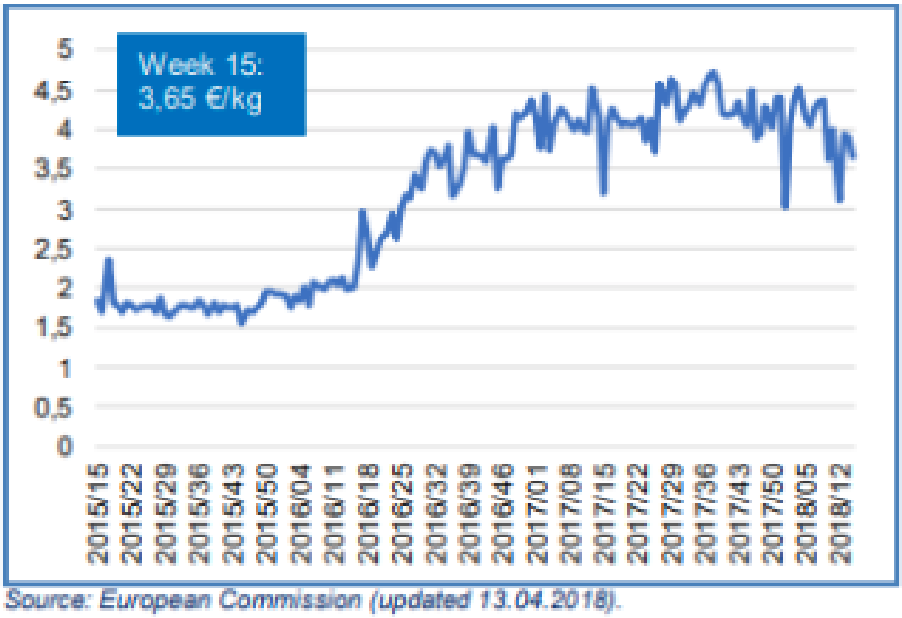

Figure 16. EU imports from China -Prices 2015-2018

7. Findings and Recommendations

This report provides an overview of Illex markets (production, processing, imports, exports) and an economic and value chain analysis subject to availability of data.

Key findings include:

Supply, Production, and Processing

- Squid and cephalopods comprise the globe's largest fishery. Illex is the second largest cephalopod fishery in the world, and is primarily harvested in the Argentine EEZ, Falkland Islands Interim and Outer Conservation Zones, and the high seas, with catches in Argentine waters, on average, making up half the catch and catches in the Falkland Islands and high seas each averaging one quarter of the total annual harvest.
- The Illex squid fishery is, by volume and value, the largest in the Falkland Islands. The majority of Illex caught in Falkland Islands waters are landed by licensed jigger vessels from Taiwan and South Korea, comprising close to 90% of landings.
- The recruitment and migration of Illex to Falkland Island fishing grounds is extremely variable, ranging in recent years from a low of 44 tonnes in 2009 to 357,722 tonnes in 2015 and falling to 2,360 tonnes in 2016.
- In the Falkland Islands fishery over 92% of Illex are frozen whole onboard fishing vessels.
- Companies from various countries around the globe will purchase Falkland Islands frozen squid and then thaw, process, and refreeze it. The majority of global squid landings are processed in China and Taiwan to take advantage of low labour costs, with Spain also being a relatively large player in the processing sector.
- The average annual total landed value for Illex in South America, the Falkland Islands, and the high seas from 2005-2016 was $597 million USD ranging from $301 million USD to $2,396 million USD.
- Larger Illex are processed into cleaned tubes, rings, tentacles, and flowers (pineapple cut tubs pieces) for human consumption; while smaller or damaged squid are often sold unprocessed for bait.
- While larger squid are typically used for higher value processed products for human consumption, smaller Illex (100-300 grams) can be more profitable if sold as baitfish.

Trade

- The annual global trade value of squid and cuttlefish ranged from a low of $2.56 billion USD in 2007 to a high of $3.89 billion USD in 2016 (OEC). The top exporters were China (26%), India (10%), Indonesia (6.8%), Morocco (6.6%), and Spain (6.3%).
- The top three commercial squid species by global catch volume include Argentine shortfin squid (*Illex argentinus*), Jumbo flying squid (*Dosidicus gigas*), and Japanese flying squid (*Todarodes pacificus*). These are competitive and partial substitute species and their market prices are interdependent.
- Most Illex caught are transported as frozen blocks to processing facilities in Asia and Europe. Most squid processing occurs in China. Illex caught by trawlers operated by Falkland Island companies are shipped to Spain for processing. At processing facilities, the blocks are thawed and the squid are processed into products for wholesale domestic and export markets.
- Illex is commonly sold as Argentine shortfin squid, "squid" or "calamari" into global markets. Larger Illex squid command a higher price by processors because they have higher recovery rates and cost less to process by volume.
- In 2016, the top importers of global squid and cuttlefish were Spain (17%), Italy (13%), Thailand (8.4%), China (8.2%), and the United States (7.6%).
- The EU imported an average annual total of 68,196 tonnes of Illex from 2008-2017, ranging from 47,242 tonnes in 2012 and a high of 97,972 tonnes in 2008. Among EU countries, Spain imports the highest volume of Illex, comprising roughly 50% of imports in 2017, followed by Italy at 20%, and Portugal at 10%. The EU annual imports of Illex (Spain, Italy, and Portugal combined) from 2008-2014 ranged from 6 to 30% of global Illex landings.
- In 2017, Spain imported the most Illex from China (44%), followed by Argentina (36%), and the Falkland Islands (8%); while most of Italy's Illex imports were from Spain (51%) and Argentina (46%); and Portugal's imports from Spain (56%) and China (40%).
- Market prices for squid are subject to global squid market dynamics, with fluctuations due to supply as well as demand. Large amounts of stock can be held in freezers, allowing international traders to speculate. As with all global trade, squid market prices are subject to currency fluctuations.

Economic factors and Value Chains

- Significant data limitations exist in tracking the Illex value chain and comparing it with competing chains and markets. This is due largely to the lack of accessible data and reports, and the complexity of global squid markets including size of the resource, and number of countries and firms harvesting, shipping, processing, refreezing, wholesaling, importing, exporting, and retailing.
- There is little published data on harvesting, processing or wholesale or retail cost for Illex. The limited data suggest there is wide variation in harvesting costs depending on stock size and scale of fishing operations, and to a lesser extent fuel and labour prices. Squid processing is labour intensive and Asian processing cost may be up to ten times lower than processing costs in the West.
- There is relatively good data on prices at harvester, processor, and import/export levels. The average annual ex-vessel value per catch volume of Illex from South America EEZ, Falkland Islands EEZ, and the high seas from 2005-2014 was $1,287 USD/tonne.
- Analysis of vale chain profit margins are difficult to determine due to the paucity of published data, especially cost data. Preliminary analysis indicates that primary harvester gross profit margins (excluding fixed costs, taxes, and fees) may vary from 32% to 44%. Processor gross profit margins range from 19-34% which are typical margins in the food and seafood industries and wholesale margins range from 14-67%. Margins in Asia, however, may be higher due to low labour and regulatory costs.

Key Issues and Recommendations

The findings from this preliminary study suggest production and marketing challenges which the Falkland Islands government and industry must consider in determining potential economic and financial benefits of greater business engagement in the Illex fishery and associated value chains. Some of these issues include:

- There is huge variability in recruitment and migration of Illex to Falkland Islands waters. In poor Illex years, the Falkland Islands Government has issued refunds of license fees worth millions of GBP to international companies and born the risk from this highly variable species. The extent to which this risk would be transferred to Falkland Islands operators could impact the viability in both primary production and to a lesser extent value chain participation. A fundamental question is whether Falkland Island companies can develop production and marketing strategies to successfully address this variability and risk. An obvious strategy is to develop Illex alongside existing and proven business channels for Falklands calamari.
- Squid constitute one of the globe's largest seafood species groups and are sold as commodity products in well developed markets with a variety of substitutable species. Squid markets can manage variability including unpredictable harvest from countries such as the Falkland Islands.
- Over time, increasing seafood demand from the world's expanding economies and growing population will most likely increase potential value and demand for squid species. This is especially true with respect to supply side factors given that the world's squid resources are fully harvested, and it is unlikely that substitute products, including from aquaculture, will be developed.
- Unlike other Falkland Islands fisheries, local companies have a more arms-length relationship with international fleets – especially Taiwan and Korea -acting as local agents for foreign fishing fleets rather than active partners in the fishing enterprise. No local company has experience operating jiggers, although there is some trawling for Illex.
- Conversely, many Falkland Islands fishing companies have relationships and investment in squid business operations and value chains in southern Europe. Since Spain imports Illex from China, for small to moderate harvest levels of Illex, southern Europe may be a "natural" market for sales and investment. However, for large production years, Illex volumes may overwhelm European demand and most likely will require exporting to Asia.
- The stock has yet to enter the Falkland Islands Individual Transferable Quota (ITQ) system which provides a strong economic incentive for local companies to become more invested in the fishery. Move to ITQ gives security for developing:
    - An Asian facing harvest/value chain strategy; and/or
    - A more European facing business model with potentially higher costs but established markets
- The results of this preliminary study indicate there is moderate to high potential profitability in Illex value chains, subject to a variety of risks that include:
    - Stock variability and ability of companies to capitalize on boom and minimize consequences of bust seasons,
    - Limited direct experience with harvesting and marketing Illex in high volumes, and
    - An expanding unregulated high seas fleet and no prospects in the near to medium term for SW Atlantic Regional Fisheries Management Organization to manage the fishery.
- Given the paucity of data and limited analysis, we suggest further in-depth investment focused on production, marketing, and value chain profiling (including country visits) before companies make major investment, production, management, and marketing moves in this fishery.

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