



The effect of eco-certification on demand: The case of MSC-certified Norway lobster

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ABSTRACT

We investigate if Marine Stewardship Council (MSC) certified Norway lobster fishing vessels in Sweden got higher prices and sold larger quantities after certification was introduced in 2015. Using detailed daily panel data and exploiting the fact that the same fishing water contains both certified and non-certified vessels, we use a difference-in-difference model for analysing demand effects of MSC-certification. We find a price premium the first months after the launch of the certification scheme for the initial adopters. However, this price premium dissipates over time and is mainly found for trawler vessels. For trawlers, we also find a negative effect on sold quantities the first months after certification but a positive effect a few years after certification. Creelers, on the other hand, got a positive effect on quantities sold both immediately after certification and after a few years. No general effect of MSC certification is found on neither prices nor quantities when the entire period January 2012 – January 2018 is investigated.

1. Introduction

The overexploitation of resources and lack of sustainable management is well documented in the fishery sector (Worm et al., 2009; FAO, 2020; Amason et al., 2009). Although regulatory responses have attempted to address the sustainability issues, and that some progress has been made, the actions taken so far has not been enough to reverse the global trend of overfished stocks (FAO, 2020). As an alternative to mandatory regulation, eco-certification has been developed as a market-based response to the overexploitation of natural resources.

The idea behind eco-certification is to give producers demand-driven incentives to adopt more sustainable production methods. Eco-certification programmes evaluate production practices and if these meet certain environmental criteria, producers can become certified and get the right to label products with an eco-label. Eco-labelling informs consumers about product characteristics that otherwise would have been impossible to detect, e.g. sustainable fishing methods. Given that there exists a demand for sustainable products, producers can be motivated to use eco-certification as a differentiation strategy that results in economic benefits such as price premiums or increased sales. Hence, in theory eco-certification has both environmental and economic benefits.

In practice, the benefits of eco-certification are more unclear.

Certification generally comes at a cost for the producer. For example, production practices need to be adapted to the eco-standard criteria, and the assessment and annual auditing are paid by the producers. When costs are high in relation to the benefits, there is a risk that eco-certification is not a viable option for many producers, which in turn limits the possible environmental benefits. For example, it has been shown that producers already meeting certification criteria (Blackman and Rivera, 2011), and larger and more wealthy producers that more easily can cover the fixed costs of certification (Kilian et al., 2006) are more prone to obtain certification. High certification costs are also among the main concerns of fishers considering future eco-certification (Goyert et al., 2010).

The aim of this study is to investigate the economic producer-level benefits of eco-certification in the fishery sector. Specifically, using a difference-in-difference model, we analyse if Marine Stewardship Council (MSC) certified Norway lobster (*Nephrops norvegicus*, hereafter referred to as Nephrops) fishers in Sweden get higher prices and sell larger quantities after certification was introduced in 2015. MSC is the most common eco-certification scheme in the fishery sector today. MSC sets standards for sustainable fishing that fishers can certify to but also standards for the supply chain to make sure that certified products are traceable. Certification to the MSC fishery standard is voluntary and

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open to all wild-capture fisheries. Independent third-party certifiers assess the fisheries to determine if the MSC standard demands are satisfied. If a product is to carry the MSC label in a supermarket, the fisher must be MSC certified and all other actors in the supply chain handling the certified product must be MSC chain-of-custody certified. In 2020, there were 409 certified fisheries in 53 countries and more than 18,000 MSC-labelled products available to consumers (MSC, 2020).

The introduction of MSC certification in the Nephrops fishery serves as an excellent case for analysing producer-level effects as certification is individual instead of general. This means that vessels fishing in the certified waters must actively choose to get MSC certified. If certification had been general, all vessels active in the certified waters would have become certified. The fact that both certified and non-certified vessels are active in the same waters gives us the possibility to use a control group that is very comparable to the treated (certified) group. Our study focuses on effects for the initial adopters of certification, i.e. vessels that chose to get MSC-certified at the start of the certification program in 2015, and our control group consists of vessels active in the same fishing waters that chose not to get MSC-certified during the studied period. We follow the vessels from 2012 to 2018 and are therefore able to analyse effects of MSC certification over time. Specifically, we investigate if short- and long-term effects of MSC certification differ. Our dataset contains detailed information on daily ex-vessel prices, quantities sold and qualities of the products sold. This makes it possible to control for unobserved heterogeneity through vessel fixed effects, for common time trends through daily fixed effects and quality differences within the Nephrops segment. In addition, we analyse if the fishing method affects the effect of MSC certification. In Sweden, creel-fished Nephrops are perceived as being of higher quality than trawled Nephrops and receive a price premium on the market (Hammarlund et al., 2022). The possibilities to get a price premium may be greater for a high quality product with less elastic demand. We therefore investigate if the effect of MSC certification on price and quantities sold differs between creel-fished and trawled Nephrops.

To date, the empirical evidence on producer benefits of eco-certification in the fishery sector is limited. The literature has instead focused on the consumer side and several studies have found that consumers have preferences for sustainable seafood and could be willing to pay premiums for sustainable products in Europe, the US and Japan (e.g. Johnston et al., 2001; Jaffry et al., 2004; Johnston and Roheim, 2006; Brécard et al., 2009; Uchida et al., 2013; Vitale et al., 2017). It has also been shown that retailers try to take advantage of these preferences by charging a higher price for MSC-certified fish products (Roheim et al., 2011; Asche et al., 2015; Sogn-Grundvåg et al., 2013, 2014). Although retailer MSC price premiums tend to vary between species (Asche and Bronnmann, 2017), markets,¹ and retail chains (Asche et al., 2015), they are often found to be around 10%. Further, studies have shown that product longevity in grocery retailers generally is longer for MSC-labelled products than for un-labelled products (Sogn-Grundvåg et al., 2019) and that the price of imported fish becomes less sensitive to changes in imported quantities after MSC certification (Roheim and Zhang, 2018).

In the case of eco-certified seafood, there is little previous research on ex-vessel price premiums or other producer-level effects of eco-certification. Chang (2012) uses survey data to investigate the effects of the Taiwan Good Agriculture Practices Program on the income of aquaculture producers. A positive income effect of eco-label use is found but it is more pronounced for producers at the higher percentile range of the income distribution. Wakamatsu (2014) analyses the market segmentation effect of MSC certification of Japanese flounder. Results show that the market becomes more segmented after certification, meaning that the certified fishers face fewer competitors. Bellchambers et al.

(2016) analyse benefits and challenges of MSC certification of lobster fisheries in Australia and Mexico. Although no price premium of MSC certification is present in neither Australia nor Mexico, social and political benefits of certification are found. MSC certification is claimed to have helped the Australian lobster fishery access the European market and to have assisted in addressing federal requirements for export fisheries. In Mexico, MSC certification provided benefits such as federal investments in infrastructure and basic amenities (e.g. electricity) in fishing villages as well as better bargaining power for the fishery. Carlson and Palmer (2016) report social benefits of MSC certification in developing countries while price premiums and market access effects are found to be limited.

Blomquist et al. (2015a) use a difference-in-difference approach to estimate the price effect of MSC certification of the Swedish Baltic cod fishery. They find no evidence of a producer-level price premium after certification. Blomquist et al. (2020) estimate the ex-vessel price effect of the suspension of the MSC certification for the Swedish Baltic Sea cod fishery. Using a difference-in-difference approach, they find a price premium of about 11% for small-size cod prior to the suspension but no premium for larger-sized cod. Also using a difference-in-difference approach, Stemle et al. (2016) estimate the effect on ex-vessel prices of MSC certification of different species of Alaskan salmon, Alaskan halibut and Kyoto flat-head flounder using difference-in-difference analysis. A price premium is found for chum and pink salmon, and flathead flounder, while no premium is found for sockeye, chinook and coho salmon, and halibut. Finally, Fernández Sánchez et al. (2020) investigate the price effect at port of MSC certification of the artisanal common octopus fishery in Asturias, Spain. Using bivariate analysis, they find that average annual prices of octopus is 15% higher at ports with MSC-certification than prices at ports that are not MSC-certified. When using fixed-effects regression analysis they find a price premium at MSC-certified ports of 25%.

Based on the limited and mixed empirical evidence, it is difficult to draw any general conclusions on the effect of MSC certification on producers. It is clear that a price premium at retailer level need not be transmitted to producers. In cases where there is a documented price premium at the producer level, it appears to vary between species and markets but also between qualities of the same species. The difficulty of finding a price premium of eco-certification at producer level when it exists at retailer level has been attributed to buyer-driven value chains that make producers price takers (Carlson and Palmer, 2016). Previous research also shows that a large supply of certified products could decrease prices (Rotherham, 2005; Ankamah-Yeboah et al., 2019). Evidence of additional producer-level benefits, apart from price, is limited. Still, benefits such as less competition (Wakamatsu, 2014) or market access (Bellchambers et al., 2016) are interesting as they show that price may not be the only decisive factor behind the decision to certify. Reports of retailers controlling market access also exist. Many large retailers in both Europe and North America have committed to only source sustainable seafood (Roheim and Zhang, 2018). For example, major seafood buyers such as Unilever and Wal-Mart have decided to source their fish from MSC-certified fisheries (Carlson and Palmer, 2016). Demands on sustainability are generally high also on the Swedish market for seafood. The two major retailer chains, ICA and Coop, both aim to sell sustainably-sourced seafood only (ICA, 2021; Coop, 2021). For example, Coop demands MSC-certification for frozen Nephrops but accepts non-MSC-certified fresh Nephrops if they are creel-fished or fished with a selective trawl in certain waters (Coop, 2020). This means that certification may sometimes be needed to maintain a client base or to access new markets.

In comparison to most previous studies that econometrically estimate the effect of MSC certification on producer-level, our study does not solely focus on possible price premiums but also analyse effects on sales. This gives us a more complete picture of the producer-level benefits of eco-certification in the fishery sector. It is, for example, possible that increased sales can compensate for a lack of price premiums, which

¹ For example, differences between the UK (Sogn-Grundvåg et al., 2014) and German (Bronnmann and Asche, 2016) markets have been found.

could help explain why fishers that do not receive a price premium still choose to get eco-certified. Because MSC certification could make it possible to reach new buyers (that demand certification) while also keeping old buyers (that do not demand certification), certification may lead to increased sales. Further, it is possible that buyers of certified food are larger and demand larger quantities, exemplified by large retailers demanding certification (Roheim and Zhang, 2018), which also could increase sales when certified.

Another important difference from the above-mentioned studies is that we compare effects for certified vessels to effects for non-certified vessels active in the same fishing water. In previous analyses, this has not been possible since certification has been general and all vessels in the certified fishing water have been certified. By choosing to analyse Nephrops we also focus on a luxury product that may exhibit different demand effects than previously analysed non-luxury fish products such as cod (Blomquist et al., 2015a; Blomquist et al., 2020) and salmon (Stemle et al., 2016). In contrast to other species on the Swedish market for fish, Nephrops are sold on a market with many buyers (mainly in auctions). Hence, there is limited buyer power in the value chain and fishers are therefore expected to receive higher mark-ups from certification than on markets with few buyers, such as the market for cod in southern Sweden (Blomquist et al., 2015b). Interesting is also that there is limited supply of the certified product since the Swedish Nephrops fishery was the first Nephrops fishery in the world to get MSC certified (MSC, 2021) and the fishery is subject to a quota. Lastly, our study contributes by investigating effects of MSC certification over time. This is important, as there is an evident risk that price premiums decrease as the supply of certified products increase. The pressure from buyers to be certified may also increase over time. A representative of a producer organization of Swedish fishers confirms that it has become increasingly important to be certified to access all parts of the market (Malin Skog, personal communication, May 29, 2018). Hence, the effect on both prices and sales of MSC certification may change over time.

The rest of the paper is organised as follows. Section 2 presents the Nephrops fishery in Sweden and the introduction of MSC certification. In Section 3, we describe the empirical estimation strategy and the data used. Section 4 presents the results of the empirical estimations and in Section 5 we conclude the paper.

2. The Swedish Nephrops fishery and MSC certification

The Nephrops fishery is one of the most important fisheries in Sweden as it accounts for about 15% of the value of total first-hand sales from Swedish commercial fisheries and around 50% of the value of the shellfish market (Hammarlund et al., 2022). Fishing takes place in the waters between Sweden and Denmark, also known as Skagerrak and Kattegat, see Fig. 1.

Landings of Nephrops by Swedish vessels have been relatively constant since the mid-1980s (SwAM, 2018). An increase in landings in recent years is related to the lowering of the minimum landing size in 2016 that was part of the implementation of the landing obligation in the European Union (Hornborg et al., 2017).² To increase transparency, the quota was also changed from a landings quota to a catch quota, i.e. from 2016 the quota also includes discards (ICES, 2017). The result of the new policies was that landings of small Nephrops increased causing total landings to increase. Table 1 shows the total Swedish Nephrops quota, landings and the share of quota in landings from 2012 to 2018. In 2017, weekly quotas were replaced by a system with yearly quotas. Under the new system, vessel owners get a yearly quota in the beginning of each year and can lease or transfer quotas between each other in each calendar year (SwAM, 2016a).

Commercial fishing for Nephrops requires a fishing license and a

special permit for either trawl or creel fishing (SwAM, 2016a). The number of creels per fisher is restricted and creel fishing is only taking place between the Swedish coastline and the trawl border, see Fig. 1. (Hornborg et al., 2017). The use of different gears results in two different varieties of Nephrops on the market: trawled and creeled. Creeled Nephrops are perceived by many consumers to be of higher quality as they are larger and less damaged than trawled Nephrops (Hornborg et al., 2017, Eriksson, 2006, Ilona Miglavs, personal communication, February 8, 2021). Creeled Nephrops therefore have higher prices on average (Hornborg et al., 2017). A buyer at a fish auction also tells that creel-fished Nephrops are sold to a specific part of the market with restaurant owners and small fish traders (Mikael Sjövall, personal communication, February 4, 2021). First-hand sales of Nephrops take place on the Swedish west coast and 80–90% of the catch is auctioned out at the two largest fish auctions in Sweden in Gothenburg and Smögen, see Fig. 1 (Hammarlund et al., 2022).

The Nephrops fishery was MSC certified on 27 January 2015 after a 2-year assessment period. Compared to other fisheries (such as the eastern Baltic cod fishery) the certification is individual rather than general meaning that the MSC certification covers only participating vessels. Certified vessels are allowed to fish with creels, grid trawls or seltra trawls (a selective trawl used by multi-species fisheries) (FCI, 2015).³ To cover the initial certification, a fee of 2500 SEK per vessel was charged. Later, the producer organization (SFPO) paid back the fee and charged 1 SEK per kilo sold (Robert Skymne, personal communication, May 29, 2018). In addition to these direct costs, fishers have indirect costs of certification, as they were required to fill in bycatch diaries (SFR, personal communication, November 15, 2012).

MSC managed the register of vessels that joined the certification in the beginning but the register was taken over by the SFPO in the second half of 2015. Vessel lists from the first half of 2015 are available on the MSC webpage (MSC, 2021) and show that 69 vessels chose to join the certification scheme on 27 January 2015 and by 2 July 2015, 80 vessels had joined. After 2 July 2015 there are no more available vessel lists of participation, although the dates of vessels joining in 2016–2018 are available at the producer organization in notification letters from fishers. Unfortunately, some of the documents are incomplete making it difficult to get exact participation dates for all vessels that joined the scheme. A participation list from the producer organization on 23 January 2018 shows that 123 vessels had joined at this date.

3. Material and methods

3.1. Data

We use daily sales-note data from the Swedish Agency for Marine and Water Management (SwAM). The data contain observations of sales from different vessels on a trading day. For our main analysis we use a period that covers 1 January 2012–23 January 2018, meaning that our data period starts around three years before the first vessels joined the scheme and ends about three years after MSC certification was introduced.

Quality indicators are provided in the sales-note data and are complemented with information about gear type (creel or trawl) from logbook data provided by the SwAM. Quality indicators show if the Nephrops were alive when sold and whether they were whole or if only the tail was sold. Size measures are not given as such but we have information on the number of Nephrops per kilo sold. Sales of less than 20 Nephrops per kilo are the most common in our data set (82% of all observations). As discussed above, the minimum landing size was lowered in the beginning of 2016, which affected prices and sales. When

² The minimum landing size refers to the carapace length of the Nephrops. The length was lowered from 40 mm to 32 mm in 2016.

³ The fishery is highly selective as catches almost entirely consists of Nephrops. When fishing with creels and selective grid trawls (the majority of catches) around 97% of catches are of Nephrops (Bergenius et al. 2018).

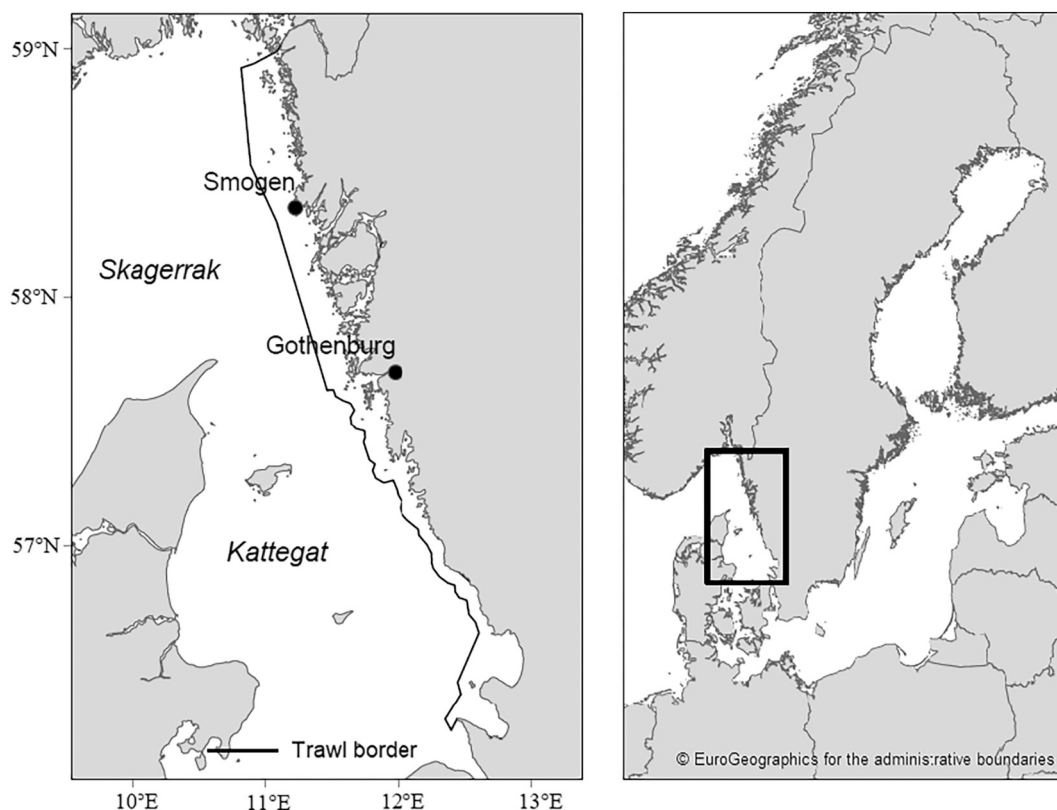


Fig. 1. Map of the Swedish west coast where fishing for Nephrops take place. Source: Hammarlund et al. (2022).

Table 1
The Swedish Nephrops quota, landings and share of quota in landings 2012–2018.

	2012	2013	2014	2015	2016	2017	2018
Swedish quota (TAC) in tons	1578	1367	1320	1398	2893	3343	3087
Landings in tons	1360	1134	1268	1132	1350	1404	1823
Share of quota in landings	86%	83%	96%	81%	47%	42%	59%

Sources: SwaM (SwAM, 2021a, 2021b).

examining the price data we see a clear price drop for the smaller Nephrops, i.e. sales of more than 20 per kilo, in 2016. As the change in landing sizes makes comparison of prices and sales of the smaller individuals difficult during the studied period, 2012–2018, our analysis only includes sales of less than 20 Nephrops per kilo, i.e. the largest individuals in our data set.

We focus on the initial adopters of the certification scheme (vessels that joined the scheme on 27 January 2015) and compare these to vessels that did not join the scheme during our studied period (vessels that are not registered as MSC certified on 23 January 2018). There are two main reasons why we focus on the initial adopters. First and most importantly, we know on which date these vessels joined the scheme but information on exact dates when many of the other vessels joined is uncertain.⁴ Second, by focusing on the initial adopters we are able to investigate how the effects of MSC certification evolves over time. After cleaning the data (see the Online Appendix for a full description), we

⁴ Although certification notes have been handed in to the producer organization by vessel owners, some of these notes are incomplete and we suspect that there may be vessel notes missing in the register.

find 65 vessels in the initial adopters group and 56 vessels in the control group (the non-adopters). Hence, our sample contains 121 vessels in total. During the investigated time period these vessels catch just over 50% of the total Swedish Nephrops catches.

In Table 2 we present basic statistics for our sample. We first focus on the number of vessels, landed quantities and prices received for initial adopters versus non-adopters. Noticeable is that the initial adopting trawlers have larger landings after 27 January 2015, i.e. after certification was introduced, whereas non-adopting trawlers have smaller landings. For creelers we find the opposite pattern, smaller landings for adopters and higher landings for non-adopters. Table 2 also shows that the price increase for creelers is similar for initial adopters and non-adopters. For trawlers, the price increase is somewhat higher for non-

Table 2
Initial adopters versus non-adopters.

	Initial adopters		Non-adopters	
	Creel	Trawl	Creel	Trawl
Number of vessels ^a	13	51	33	19
Total quantity (tons) before 27 January 2015	81	1527	314	231
Total quantity (tons) after 27 January 2015	72	1712	356	215
Average price/k (SEK) before 27 January 2015	126	100	125	97
Average price/k (SEK) after 27 January 2015	147	108	148	111
Average quantity (tons) per vessel before 27 January 2015	6.19	29.94	9.53	12.14
Average vessel length before 27 January 2015	9.88	15.38	10.03	15.21
Average gross tonnage of vessels before 27 January 2015	7.73	49.61	8.34	50.16
Share sold live before 27 January 2015	0.05	0.02	0.04	0.02

Source: Own calculations based on data from SwAM.

^a Note that five vessels in our sample are defined as using both gears, these vessels are excluded from Table 2 but included in the empirical estimations below. We are able to include them in the estimations since we know which gear was used on a specific day.

adopters. Moreover, quantity per vessel is larger for initially adopting trawlers than for non-adopting trawlers (30 tons compared to 12 tons) meaning that adopting trawlers catch considerably more than non-adopting trawlers. For creelers, quantity per vessel is slightly larger for non-adopting vessels. We can also see that, for both trawlers and creelers, initial adopters and non-adopters are similar in size, weight and the share of sales that consists of live Nephrops.

We also investigate landed quantities per week for our sample and relate this to how vessels use their quota. It is important to examine quota use since we want to investigate possible effects on sold quantities of MSC certification. If the quota is limiting for the fishery there is no room to adjust the landings if demand increases. Investigating effects on sales of certification would then not be meaningful.

As described above, the Nephrops fishery was regulated by weekly quotas until 2017 when yearly quotas were introduced. Fig. 2 shows that for an average vessel (trawler or creeler) landed quantities vary substantially over the year. For an average vessel, the weekly quotas were rarely filled. For creelers, the quota was 1200 kilos per week in 2012–2016 and 3200 kilos per week in 2016 (3000 from 12 September) (SwAM, 2011, 2015, 2016b). As seen in Fig. 2, the weekly catch per creeler only occasionally reaches above 200 kilos, which is substantially below the weekly quota limits. For trawlers, quotas differ depending on whether a grid trawl or another trawl is used. The majority of our vessels use the grid trawl and the weekly quotas for this type of trawl varied between 1400 and 4000 kilos per week during the period with weekly quotas (i.e. until 2017) (SwAM, 2011, 2013, 2015, 2016b). As can be seen in Fig. 2, the average trawler rarely catch more than 600 kilos per week, which is considerably below the quota limits. We also check if the quota ceiling was exceeded by the vessel that had the largest catch each week. For creelers, we find only one week were the vessel with the largest catch exceed 1200 kilos. Similarly, for trawlers, it is very unusual to exceed quota limits.

In sum, we conclude that the average vessel did not get close to the weekly quotas limits in the period when weekly quotas were used and that it is in fact unusual that any vessel exceed the quota. We also see in our data that supply is highly variable throughout the year and related to seasonal demand. Landings as well as prices (see Fig. 3 below) are e.g. higher in August (when the traditional crayfish parties are held) and around New Year's Eve. This indicates that it may not be worth fishing all available quota (e.g. a weekly quota) when prices are low. A representative from the producer organization confirms that fishers stop fishing earlier in the week if the price is too low. He also confirms that quotas were not binding in the Nephrops fishery during the investigated period, regardless of quotas being weekly or yearly (Peter Ronelöv Olson, personal communication, March 24, 2021). Although other

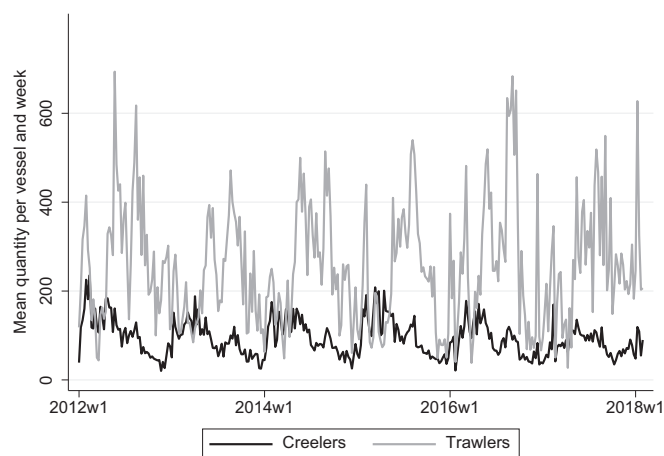


Fig. 2. Mean quantity in kilos caught per vessel and week for creelers and trawlers.

Source: Own calculations based on data from SwAM.

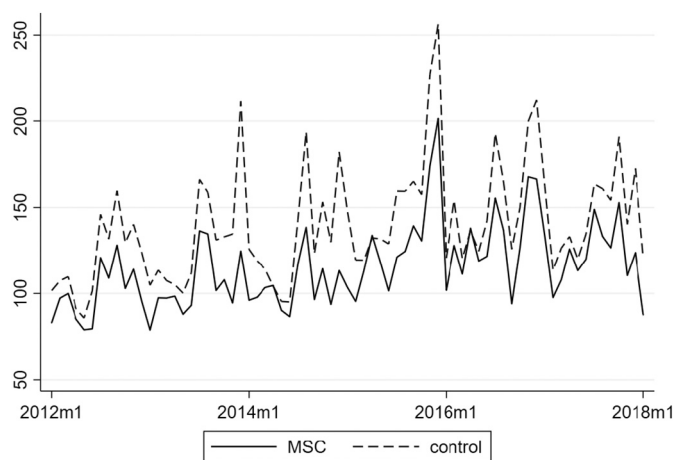


Fig. 3. Monthly average prices (price/k in SEK) January 2012 – Jan 2018.

limitations than the quota (e.g. number of creels and area limitations for trawl fishing) or weather conditions may affect the amount of catch that is landed each week, there appears to be scope for fishers to adjust landings depending on market demand.

3.2. Method

Our aim is to investigate if MSC-certification affects ex-vessel prices and quantities sold. We therefore estimate the differential effect of MSC-certification on the treated group (MSC-certified vessels) compared to a control group (vessels that are not certified). To do so we use a generalized difference-in-difference (DID) design that is analysed by estimating a two-way fixed effects regression model:

$$Y_{id} = \alpha + \delta MSC_{id} + \beta \theta_{id} + \mu_i + \tau_d + \epsilon_{id} \tag{1}$$

Our outcome variable, Y_{id} , is the ex-vessel price per kilo or sold weight of Nephrops from vessel i on day d . MSC_{id} is a dummy variable taking the value 1 if vessel i is MSC-certified on day d , and zero otherwise. θ_{id} is a vector of control variables. Our control variables are dummy variables for different quality characteristics ($Alive_{id}$ and $Tail_{id}$) and for the two main landing harbours (Gtb_{id} and Smo_{id}). $Alive_{id}$ takes the value 1 if the Nephrops were alive when sold and 0 otherwise. As alive Nephrops are considered the freshest, they tend to be sold at a higher price. $Tail_{id}$ takes the value 1 if only the tail was sold and 0 if the Nephrops were sold whole. When only the tail is sold the price tends to be lower than when selling whole Nephrops. Gtb_{id} (Smo_{id}) takes the value 1 if the landing harbour was Gothenburg (Smogen) and 0 otherwise. Seafood landed in Gothenburg and Smogen are sold at auctions which makes the price setting mechanism more flexible than in other harbours where no auctions are held. We also have vessel fixed effects, μ_i , and date fixed effects, τ_d . Lastly, ϵ_{id} is an idiosyncratic error term. The date fixed effects control for common time variations for all vessels such as seasonality or business cycles while the vessel effects control for vessel-specific time-invariant effects such as abilities of captain and crew, and gear type.

We investigate how prices and sales are affected over time by estimating the following equation:

$$Y_{id} = \alpha + \gamma_1 MSC1_{id} + \gamma_2 MSC2_{id} + \gamma_3 MSC3_{id} + \gamma_4 MSC4_{id} + \beta \theta_{id} + \mu_i + \tau_d + \epsilon_{id} \tag{2}$$

In Eq. 2, we use 4 different dummy variables to investigate the effect of MSC certification in different time periods. All other variables in Eq. 2 are defined as above. We examine four different time periods after certification that we call very short run, short run, medium run and long run (see Table 3). $MSC1$ takes the value 1 in period 1 for certified vessels and zero otherwise. This means that $MSC1$ is 0 for certified vessels in periods 2–4 and in the pre-certification period. $MSC1$ is always 0 for

Table 3

Time periods examined.

		Start	End
1	Very short run	27 January 2015	30 June 2015
2	Short run	1 July 2015	30 December 2015
3	Medium run	1 January 2016	31 December 2016
4	Long run	1 January 2017	23 January 2018

non-certified vessels. Variables MSC2-MSC4 are constructed in the same way but periods of interest are then 2–4 Note that the time periods are different in length, the idea is to investigate short run effects in more detail than long run effects.

As mentioned previously, creeled Nephrops are often perceived to be of higher quality than trawled Nephrops. Hence, it is interesting to investigate if the effects of certification are different for the two varieties of Nephrops (creeled and trawled). Thus, we interact the MSC-dummy with a dummy for creeled Nephrops.

4. Results

We use two outcome variables: the mean price per kilo on a particular day sold by a particular vessel and the quantity sold by a particular vessel on a particular day. First, we investigate average effects of MSC certification over the entire studied period (Jan2012-Jan2018). Columns 1 and 2 in Table 4 show results for prices and quantities, respectively. As can be seen, there are no significant effects of MSC certification on neither prices nor quantities sold for the vessels that initially adopted the MSC certification. However, all control variables are highly statistically significant and behave as expected. Only selling the tail has a negative effect on both price and quantity sold, while the other controls (Alive, Gtb and Smo) have positive effects on the outcome variables.

Columns 3 and 4 in Table 4 show how the effect of MSC certification changes over time. MSC1 - MSC4 are effects of MSC certification in the four different time periods defined in Table 3, where MSC1 is the effect in the very short run, MSC2 is the effect in the short run, MSC3 is the effect in the medium run, and MSC4 is the effect in the long run. Each coefficient is interpreted as the difference in each period and the base

Table 4

Effect on price and sold quantity of MSC certification.

	1		2		3		4	
	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity
MSC	1.037	4.173						
	-3.311	-2.723						
MSC1			16.329***	-8.331*				
			-4.086	-4.879				
MSC2			-10.513**	4.624				
			-4.555	-4.324				
MSC3			3.671	4.35				
			-3.648	-3.707				
MSC4			-0.779	8.414**				
			-3.653	-3.399				
Alive	7.465**	13.877***	7.282**	14.220***				
	-2.868	-3.796	-2.934	-3.884				
Tail	-29.503***	-110.410***	-29.802***	-110.040***				
	-3.14	-8.09	-3.14	-8.093				
Gtb	21.908***	30.609***	22.060***	30.398***				
	-5.567	-5.239	-5.569	-5.194				
Smo	15.592***	27.570***	15.558***	27.588***				
	-5.174	-6.951	-5.146	-6.921				
	-25.035	-22.368	-25.119	-22.469				
Daily effects	Yes	Yes	Yes	Yes				
Vessel effects	Yes	Yes	Yes	Yes				
N	48,618	48,618	48,618	48,618				
R ²	0.63	0.45	0.63	0.45				

Note: Standard errors are clustered on vessels. * p < 0.10, ** p < 0.05, *** p < 0.01.

period, i.e. the period before 27 January 2015 when MSC certification was not available.

As regards prices, results in column 3, there is now evidence of a statistically significant price premium in the very short run, i.e. the period just after certification was introduced. In the second period, the short run, we instead find a negative effect on prices meaning that the price premium is no longer there when more vessels join the labelling scheme. In the medium and long run there is no longer a price difference between initial adopters and non-adopters (the coefficient is insignificant). When it comes to quantities, column 4 in Table 4 shows a negative effect of MSC certification in the very short run but a positive effect in the long run. No significant effect is found in the short run or the medium run. Coefficients on control variables in columns 3 and 4 are very similar to those in columns 1 and 2. Note that it is not possible to take the average of the MSC1-MSC4 variables to obtain the aggregated effect. This is because the number of observations differ in the different time periods. The medium and the long run are significantly longer than the first two time periods. This means that the later time periods dominate the aggregate results.

Table 5 shows the effect of MSC certification for creelers and trawlers. Trawlers are the baseline category and the interaction terms (e.g. MSC1*creel) show the additional effect for creelers. There are no significant effects of MSC certification neither for trawlers or creelers when the whole time period is examined (columns 1 and 2). When different time periods are examined separately in columns 3 and 4, effects are found on both price and quantity. The most interesting time period is the very short run where effects of certification are different for trawlers and creelers. In the very short run, trawlers get a relatively large price premium while creelers do not. Trawlers also get a negative effect

Table 5

The different effects of MSC certification for trawl and creel fishers.

	1		2		3		4	
	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity
MSC	1.650	4.438						
	(3.667)	(3.063)						
MSC*creel	-4.536	2.092						
	(3.996)	(4.613)						
MSC1					24.056***	-17.199***		
					(4.625)	(4.460)		
MSC1*creel					-23.860***	28.165***		
					(5.547)	(10.296)		
MSC2					-10.895**	4.661		
					(4.827)	(4.699)		
MSC2*creel					-0.776	-0.266		
					(6.930)	(5.004)		
MSC3					4.825	4.712		
					(4.000)	(4.247)		
MSC3*creel					-3.162	1.521		
					(4.188)	(5.523)		
MSC4					-0.929	10.379***		
					(4.039)	(3.766)		
MSC4*creel					-4.057	-5.760		
					(5.489)	(3.744)		
Alive	7.524**	14.484***	7.274**	14.965***				
	(3.034)	(4.015)	(3.119)	(4.118)				
Tail	-29.481***	-110.221***	-29.999***	-109.535***				
	(3.189)	(8.110)	(3.181)	(8.102)				
Gtb	20.478***	30.940***	20.727***	30.518***				
	(6.059)	(5.760)	(6.068)	(5.700)				
Smo	14.793***	27.817***	14.763***	27.762***				
	(5.409)	(7.232)	(5.386)	(7.171)				
Constant	117.675***	-19.403	117.839***	-19.736				
	(25.355)	(22.560)	(25.446)	(22.669)				
Daily effects	Yes	Yes	Yes	Yes				
Vessel effects	Yes	Yes	Yes	Yes				
N	46,250	46,250	46,250	46,250				
R ²	0.63	0.45	0.63	0.45				

Note: Standard errors are clustered on vessels. * p < 0.10, ** p < 0.05, *** p < 0.01.

on quantities sold while creelers get a positive effect on quantities sold in the very short run. There are no differences in estimated effects for trawlers and creelers in the other time periods. For both vessel groups, we see a negative effect on prices in the short run and a positive effect on quantities in the long run (i.e. the additional effect of creel is insignificant).

4.1. Sensitivity

The difference-in-difference methodology relies on the common trends assumption, i.e. the outcome variable should follow similar time trends for the treated and the control group in absence of MSC certification. This assumption is untestable since the treated group is only observed as treated. However, one way to check this assumption is to graphically examine price trends for initial adopters (treated group) and non-adopters (control group). If price trends are very different before the introduction of certification, the non-adopters are not a credible control group and the estimates presented above may be biased. Fig. 3 shows the monthly average prices (in SEK) received by MSC-certified vessels (initial adopters) and the non-certified control group for the period January 2012 – January 2018. The MSC-certified vessels and the control group appear to follow similar trends both before and after certification was introduced in the beginning of 2015. This is also true when examining quantities, see Fig. A1 in the Online appendix. That price trends of the two groups are similar before certification is reassuring since it indicates that the common trends assumption holds.

In Fig. 4 we examine daily prices around the introduction of the MSC certification (1 December 2014 to 1 March 2015). The vertical line marks the introduction of MSC certification on 27 January 2015. After certification is introduced there is clearly less variation in prices than before and the difference between the control group and the MSC-certified vessels becomes smaller. This supports the findings of a price premium in the very short run (see Table 4). Fig. 3 also shows that demand for Nephrops is high in December due to Christmas and New Year's Eve. A price drop in January is expected and is not related to MSC certification.

The main estimation results are based on a data sample that only contains sales of less than 20 Nephrops per kilo due to the change of regulation concerning the minimum landing size in 2016 mentioned above. We perform a robustness check to see if including other size categories would change our main results. Including all size categories in the sample gives us a dataset of 60,598 observations in contrast to the previous 48,618 observations. We also introduce a dummy variable ($Small = 1$) to control for the smaller size categories and an interaction term between $Small$ and years 2016–2018 to control for the effect of the lowering of the minimum landing size. In order to save space, estimation

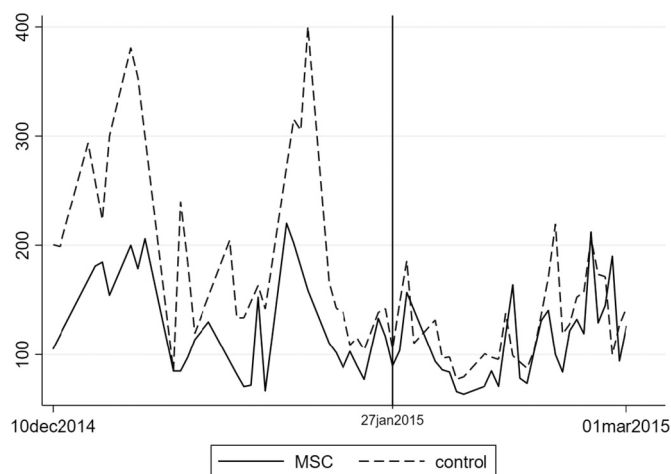


Fig. 4. Daily group average prices (price/k in SEK) for the treated group and the control group around the introduction of the MSC-certification.

results can be found in Table A1 in the Online appendix. We conclude that including all sizes does not change the main results in Table 4 but the size of coefficients of interest tend to be smaller.

Further, we test our results by finding a set of “twin observations” of prices and quantities that are compared before and after the introduction of the certification scheme. We run a regression where the difference in average price between landings from treated and control vessels is the dependent variable and the period after MSC certification is introduced as the independent variable. A similar model is run for average quantity. Average price (quantity) on a specific landing day, for a specific gear type (creel or trawl) and a specific vessel size class for treated and control vessels are thus compared. The vessel size class variable is created by classifying vessel lengths into different categories (0–10 meter, 10–12 meters, 12–18 meters, 18–24 meters and 24–40 meters (used to classify vessels in the European Union). Also, the dummy variables alive, tail, gtb and smo are used to make comparisons between similar landings, i.e. only landings of the same quality landed in the same harbours are compared. Estimation results can be found in Table A2 in the Online appendix. The results show that both the effect on price and quantity are insignificant, which confirm the results in Table 4.

All our above estimations use vessels that do not get certified during our examined period as the control group. As a robustness test of our results, we change the control group by including vessels that get certified between July 2015 and January 2018. Since information on joining dates for many vessels are incomplete, as mentioned above, we choose to only use information on which vessels that joined during the investigated time periods. This makes us able to estimate the MSC effects for the initial adopters over time using a control group that includes different vessels depending on the time period examined. For example, when estimating the MSC effect in the very short run we include all vessels that are not certified in the very short run in the control group. Note that this means that we are not able to change the control group when the entire time period is examined as only the original control group remains uncertified in the long run. Obviously, progressively changing the control group has drawbacks when it comes to comparability but this exercise solely aims to investigate if our main results for the initial adopters hold when using all available data. We find that the main results from Table 4 still hold but coefficients change somewhat, which could be expected since the control group is not the same. Estimation results can be found in Table A3 in the Online appendix.

Further, we examine if our results change if we increase the sample size. Again, we exploit that we know which vessels that joined during the different time periods. We run a regression to investigate the general effect of MSC certification (i.e. eq. 1) but expand the treated group with vessels that join the certification scheme during the four studied periods. For example, in period 2 the treated group consists of the initial adopters and those that joined during period 1 and 2. All vessels that are not certified at a specific point in time are part of the control group. This new sample has 69,843 observations. Note that exact dates of when vessels joining are not used for other vessels than the initial adopters. Table A4 in the Online appendix shows the results when including all joining vessels in the sample. The main conclusions are the same as in our original analysis. There are no effects of MSC certification on price or quantities and coefficients on control variables are very similar to the original analysis.

A possible problem when analysing effects of MSC certification is that vessels select if they want to certify or not. This problem is impossible to avoid when it comes to voluntary certification schemes such as MSC. The estimations above all include vessel fixed effects, which means that characteristics of the vessel and crew are accounted for as long as they do not change over time. If the expected outcome of not certifying does not change over time for vessels that choose to certify and the same applies to vessels that choose not to certify the fixed effects model will not be biased. However, if there are differences that change over time that are correlated with the outcomes, there may be a problem with selection bias if vessels that never join would have been differently

affected had they joined compared to those that actually joined the certification scheme. One way to find vessels that are likely to be even more similar to the initial adopters than the non-adopters is to use vessels that choose to join the certification scheme during our investigated periods (see [Table 3](#)).

For the first year of certification, we can use vessels that joined after the initial adopters to create alternative control groups to check the robustness of our results. Assuming that vessels that joined later are very similar to the initial adopters, we estimate two regressions. In the first regression, we estimate the effect of being MSC certified in the very short run, i.e. in the period immediately after certification was introduced, from 27 January to 30 June 2015. We use vessels that joined in the periods we call the short run, medium run and the long run for the control group (32 vessels). In a second regression, we investigate the MSC effect in the very short run and the MSC effect in the short run. We use vessels joining in the medium run and the long run for the control group (22 vessels). We believe that the number of vessels joining in 2017 (the long-run) are too few (5 vessels) to get reliable results so we abstain from estimating a regression for more than two periods (the very short run and the short run).

The results reported in [Table A5](#), in the Online appendix, support our main findings ([Table 4](#)). In model 1 (for the very short run) there is a positive effect on price for initial adopters and it is slightly larger than in our original analysis (18.18 SEK per kilo compared to 16.33 SEK per kilo in [Table 4](#), model 3). The effect on quantities is negative just like in our original analysis, although it is larger (−14.95 compared to −8.33 in [Table 4](#), model 4). The second model (for the short run) is also in line with our original model. We find that the effect on price is positive in the very short run and insignificant in the short run. Regarding quantities there is a negative effect in the very short run and insignificant in the short run, just like in the original analysis. In sum, the results are similar to what we found in our original analysis using the non-adopters as our control group.

5. Concluding discussion

This paper investigates the effects of MSC certification on two producer-level outcomes: ex-vessel prices and quantities sold. Using detailed daily data on Swedish Nephrops fishing vessels we examine if the introduction of MSC certification on 27 January 2015 resulted in price premiums or increased sales for the MSC-certified vessels relative to the non-certified vessels active in the same fishery. Our analysis focuses on the initial adopters of certification and follow these vessels and a control group three years before and three years after certification was introduced (January 2012–January 2018). Price and quantity effects are estimated using a difference-in-difference approach. The results show that no general effect of MSC certification can be found on either prices or quantities. However, when examining how effects of MSC certification evolve over time we find a price premium the first months after the launch of the certification scheme. This price premium dissipates over time and is mainly found for trawler vessels. For trawlers, we also find a negative effect on sold quantities the first months after certification but a positive effect a few years after certification. Creelers, on the other hand, got a positive effect on quantities sold both immediately after certification and after a few years.

In order for it to pay to be certified, producers must get benefits of certification that outweigh the costs. The most obvious benefit is the price premium. Previous literature on MSC certification have shown that certification does not necessarily result in price premiums at the producer-level and for Swedish Nephrops this seems to be the case. Price premiums may also change over time. [Rotherham \(2005\)](#) and [Ankamah-Yeboah et al. \(2019\)](#) suggest that price premiums may disappear over time as the supply of certified products increase. Our results are in line with this as we see a price premium in the first months after certification but not in the following periods when more vessels join the scheme. With a large amount of certified Nephrops on the market and low

substitutability between certified and non-certified Nephrops, it is more likely that the price will drop.

If there are no long-run benefits in terms of higher prices, we would then perhaps see that fishers are leaving the scheme after the initial period. However, more vessels join the certification scheme after the initial months, and continue to do so during the following three years that we study. It is therefore unlikely that a potential price premium is the driving force for certification.

The literature points to benefits from MSC certification such as maintaining access to markets or finding new markets. With buyer-driven value-chains where producers are price takers there might not be a price-premium of MSC certification at the producer level ([Carlson and Palmer, 2016](#)). To gain access to large wholesalers it may be necessary for fishers to be certified. Wholesalers in turn must adapt to large buyers in the private and public sector that often have procurement policies including commitments to buy environmentally friendly seafood. An MSC representative confirm that procurement policies put pressure on wholesalers to buy MSC certified seafood (Louise Valentin, August 12, 2021). This, in turn, put pressure on fishers to get MSC certified. Producer organisations as well as first-hand buyers therefore regard market access as the most important reason for fishers to obtain MSC certification (Malin Skog, personal communication, May 29, 2018; Ilona Miglavs, personal communication, February 8, 2021).

It is possible that there is a link between the benefits of market access and the quantity effects in our study. Large grocery stores and wholesalers usually require large quantities. If market access to larger buyers requires certification, it is more likely that fishers that supply large quantities are certified. We see some evidence of this; over time certified vessels supply larger quantities than non-certified vessels. In particular, we see that creelers that, on average, supply smaller quantities sell larger quantities when certified.

Despite the benefits of gaining access to the market for certified Nephrops there are fishers that chose not to become certified. In fact, prices are in general higher for non-certified Nephrops since these are more often fished with creels and buyers and consumers find them to be of higher quality. Creelers Nephrops, especially if they are large, are often sold directly to restaurants. Stakeholders confirm that some creel fishers are known for their superior quality (Ilona Miglavs, February 8, 2021, Peter Ronelöv Olsson, personal communication, June 21, 2021), that the supply of larger individuals is limited and that the price of these is often very high regardless of MSC certification (Mikael Sjövall, personal communication, February 4, 2021).

Thus, there appears to be two quite different markets for Nephrops in Sweden. One for trawled Nephrops that are mainly sold in large quantities to wholesalers where MSC certification is becoming increasingly important for market access. Then, there is another market for creelers high quality Nephrops that are mainly sold to smaller buyers where MSC certification is less important. This segmented market could explain why it was mainly trawlers that joined the certification scheme when it was first introduced (80% of the initial adopters were trawlers). It could possibly also explain why the lower-quality trawled Nephrops got a higher price premium from certification in the very short run. Our results are, somewhat, contrary to those of [Asche and Bronnmann \(2017\)](#) showing that that cod got a significantly higher retailer MSC price premium than the more low-end species Alaskan Pollock. On the other hand, our results are in line with [Blomquist et al. \(2020\)](#) who show that small-sized cod on the Swedish market receive a price premium from MSC certification whereas large-sized cod does not. [Blomquist et al. \(2020\)](#) argue that it is plausible that their results can be explained by the fact that cod of different sizes are sold to different markets with different valuations of MSC certification.

Finally, it is possible that there are differences in certification costs for vessels affecting the will to certify. Although variable costs are the same, it may be easier for larger vessels (trawlers) to spread fixed costs of certification, e.g. for learning how to fill in by-catch diaries, over more units. This might also be the case if a fisher owns more than one vessel.

However, the costs of certification are mainly variable so any fixed costs might be of less importance in our case.

In theory, eco-certification can have both environmental and economic benefits. Still, our case shows that economic benefits might not be easy to detect and in some cases, it may not pay off to certify despite supplying a sustainable product.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ecolecon.2022.107661>.

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