An overview of organic aquaculture in Italy

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Abstract

The total Italian organic aquaculture production in 2015 was of 2347 t, and it accounted for almost 1.1% of the total Italian aquaculture. This situation is comparable with that of other western countries, where organic production accounts for about 1.5 – 2% of the total aquaculture production. Between 2013 and 2014, the number of organic fish farms in Italy more than doubled, that is, from 17 to 41 farms. Most of these organic fish farms are located along the Adriatic coast and in North East Italy (Veneto region), and the main farmed species in that period was blue mussel, followed by gilthead sea bream and rainbow trout. Organic aquaculture is generally considered a promising and growing sub-sector of aquaculture in Italy and in other European countries, and a number of supporting research initiatives have recently been implemented by the Italian Ministry of Agriculture and Forestry. However, despite these efforts, a clear fact has emerged: only a small percentage of Italian fish farmers demonstrated any interest in producing organically until 2013. The demand for organic aquaculture products in Italy is increasing, particularly among people that are regular organic food consumers. However, there are a number of critical aspects that still need to be addressed: the difficulty of introducing organic aquaculture products into large-scale retail operations, the high prices of the key fish feed ingredients, the difficulties in adapting Directive (EC) 710/2009 to aquaculture and the application of long-term marketing strategies. This paper tries to provide a realistic perspective of organic aquaculture, and thus includes not only the proximate causes (i.e. technical and regulatory aspects) of the current production, but also the remote historical, geographical, political and arithmetical reasons.

Keywords	organic aquaculture; consumer information; Italian aquaculture; aquaculture products; organic fish farm
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Suggested reviewers	Leo Nankervis, Mattew Slater, Costas Perdikaris, Patrick Williot, Giuseppe Lembo, Umberto Luzzana, Ioannis Paschos
Opposed reviewers	Marco Saroglia

Submission Files Included in this PDF

File Name [File Type]

Aquaculture BIO Italia - Answer to reviewers - April 19th 2019.docx [Response to Reviewers]

Sicuro 2019 - Org aquac - Highlights.docx [Highlights]

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Research Data Related to this Submission

There are no linked research data sets for this submission. The following reason is given:
This manuscript is a review and I did not use any personal research data. I only analyzed aquaculture production data from different countries

Comments from the editors and reviewers:
-Reviewer 1

-
-Reviewer 2

- The key information on Italy is some four years out of date - surely, much has changed since then.

I question some of the assertions in the paper, not least that the UK was the first organic fish producer in 2009 (l. 68). Aarset, Tveteras and Norwegian and UK colleagues had been researching and producing papers for a decade on the subject - see Aarset, B. *et al.* (2004). The European consumers' understanding and perceptions of the 'organic' food regime. The case of aquaculture. *British Food Journal*, 106, 93–105. It is also inconsistent with the statement you make in l. 263, where you state that 'Italian organic aquaculture is more than 20 years old ..'; this surely then predates 2009 by a decade.

Also, I dispute the fact that 100% of Irish farmed salmon and trout is organically produced, despite the BIM report.

English and grammar still require an overhaul e.g.

l. 50. '.. it is useful to consider Italy in an ..'.

l. 78. '.. in Europe is Ireland, which is ..'.

Dear Reviewer 2,

thank you for your comments (in red) on my manuscript, here my answers to your questions.

The key information on Italy is some four years out of date - surely, much has changed since then.

I already updated references on Italian aquaculture in the last version of the manuscript (Di Marco et al., 2017), however, following your suggestions, in order to give to the reader a most possible updated description of Italian organic aquaculture, I searched new references, reports and articles eventually published in the last months, particularly in Italian. I did not find more recent data on production that are still referred to those of 2015, but I found new data on number of the farms, that confirm previous ones. The number of organic farm is still of 41 (see attached table)

I introduced following sentence in the manuscript:

"Recent data on organic fish farms (SINAB 2014; SINAB 2015) indicated an unexpected increase to 41 farms in 2014 with a successive stationary phase until 2017 (SINAB, 2018), thus showing an increase of more than 140%."

I integrated these results in the manuscript and I updated Fig.2

The most relevant documents I found are:

-a project on organic aquaculture product consumers BIOBREED (2016) (http://www.biobreed.it/BioBreed/HOME.html) carried out by Italian Council for Agricultural Research and Economics which become to the Italian Ministry of Research and University (MIUR)

- an Italian report of SINAB 2018 (http://www.openfields.it/sito/wp-content/uploads/2018/09/Bio-in-cifre-2018-_-Anticipazioni.pdf) where I found updated information about Italian organic aquaculture farms (see table 9). This document is particularly interesting for organic aquaculture in Italy, in fact I already consulted previous issues of 2015 and 2014 (SINAB (2014). BIO in cifre 2014 1-81 Available at http://www.sinab.it/sites/default/files/share/OK!!.pdf (In Italian); SINAB (2015) BIO in cifre 2015 1-94 Available at http://www.sinab.it/sites/default/files/share/OK!!.pdf (In Italian)

Sentence introduced in the manuscript:

positive aspect recently resulted by the project BIOBREED (http://www.biobreed.it/BioBreed/HOME.html) is the positive consumer's perception of organic aquaculture products as reaction to a general negative sentiment of conventional aquaculture products. Italian consumers believe that pharmaceutical treatments are strongly reduced in organic aquaculture (Pulcini & Capoccioni 2018)..

Updated references

Pulcini D, Capoccioni F (2018). Il consumo di pesce allevato e biologico in Italia (*in Italian*). Edizioni Bet Multimedia pp 66. Available on line at http://www.biobreed.it/BioBreed/HOME_files/Il%20consumo%20di%20pesce%20allevato%20e%20Biologico%20in%20italia.pdf

SINAB (2018) BIO in cifre - Anticipazioni 2018 1-94 Available online at http://www.openfields.it/sito/wp-content/uploads/2018/09/Bio-in-cifre-2018-_-Anticipazioni.pdf (In Italian) pp 28

Tabella 9

Aziende di acquacoltura biologica, anni 2016 e 2017

	2016	2017
TOTALE NAZIONALE	40	40
VENETO	15	15
EMILIA ROMAGNA	15	11
PUGLIA	3	2
FRIULI VENEZIA GIULIA	1	2
LOMBARDIA	1	2
SARDEGNA	1	1
CALABRIA	1	1
TRENTINO ALTO ADIGE	1	1
UMBRIA	1	1
CAMPANIA	0	1
LAZIO	0	1
MARCHE	0	1
PIEMONTE	1	0

(Fonte SIB)

I question some of the assertions in the paper, not least that the UK was the first organic fish producer in 2009 (l. 68). Aarset, Tveteras and Norwegian and UK colleagues had been researching and producing papers for a decade on the subject - see Aarset, B. et al. (2004).

I corrected the paragraph and I introduced following sentence in the manuscript:

First European organic farms of salmon were accredited according to an IFOAM standard in 1999 (Aarset *et al.* 2004). In the following period, the United Kingdom was one of the leading country and in 2009

The European consumers' understanding and perceptions of the 'organic' food regime. The case of aquaculture. British Food Journal, 106, 93–105. It is also inconsistent with the statement you make in l. 263, where you state that 'Italian organic aquaculture is more than 20 years old ..'; this surely then predates 2009 by a decade

I don’t understand completely the meaning of this comment, however, considering that we are in 2019 and fish organic production started in 2000 (see line 191 … “Organic aquaculture production in Italy started in 2000 – 2001, with a few trout farms that were certified by independent certification bodies (AAVV, 2001) …” it is about 20 years ago, so I cannot find anything wrong in that sentence.

English and grammar still require an overhaul e.g.

l. 50. ‘.. it is useful to consider Italy in an ..’.

l. 78. ‘.. in Europe is Ireland, which is ..’.

I sent again the manuscript for a second English revision, to the lecturer that I cited in the acknowledgment. I re-introduced all the English corrections she suggested me

Also, I dispute the fact that 100% of Irish farmed salmon and trout is organically produced, despite the BIM report.

I have just reported in the manuscript what is indicated in that report (BIM report), I did not find different information about organic aquaculture in Ireland.

Best regards,

Benedetto Sicuro

An overview of organic aquaculture in Italy

Benedetto Sicuro[1]*

Highlights of the manuscript

Organic aquaculture in Italy is considered a promising sector however it never reaches expected previsions and shows a stationary low level of production (1.1% of total aquaculture production in 2015).

Blue mussel, gilthead sea bream and rainbow trout are the most important organically farmed species in Italy, and most of the organic fish farms are located along the Adriatic coast and in North East Italy.

The high costs of certification and fish feeds, the bureaucracy, the higher prices and the lack of appropriate marketing strategies are the main practical obstacles for Italian organic aquaculture.

An overview of organic aquaculture in Italy

Abstract

The total organic aquaculture production in Italy in 2015 was of 2347 t, and it accounted for almost 1.1% of the total aquaculture production. This situation is comparable with that of other western countries, where organic production accounts for about 1.5 – 2% of the total aquaculture production. Between 2013 and 2018, the number of organic fish farms in Italy has more than doubled, that is, from 17 to 41 farms. Most of these organic fish farms are located along the Adriatic coast and in North East Italy (Veneto region), and the main farmed species in that period was blue mussel, followed by gilthead sea bream and rainbow trout. Organic aquaculture is generally considered a promising and growing sub-sector of aquaculture in Italy and in other European countries, and a number of research initiatives have recently been implemented by the Italian Ministry of Agriculture and Forestry. However, despite these efforts, a clear fact has emerged: only a small percentage of Italian fish farmers demonstrated any interest in producing organically until 2017. The demand for organic aquaculture products in Italy is increasing, particularly among those people who regularly consume organic food. However, there are a number of critical aspects that still need to be addressed: the difficulty of introducing organic aquaculture products into large-scale retail operations, the high prices of the key fish feed ingredients, the difficulties in adapting Directive (EC) 710/2009 to aquaculture and the application of long-term marketing strategies. This paper tries to provide a realistic perspective of organic aquaculture, and thus includes not only the proximate causes (*i.e.* technical and regulatory aspects) of the current production, but also the remote historical, geographical, political and arithmetical reasons.

Keywords: certified productions, European aquaculture, Italian aquaculture, organic aquaculture, quality of products, rainbow trout,

Introduction

Organic aquaculture answers an urgent and common demand of consumers for better quality seafood and a sustainable use of marine resources (Subasinghe *et al.* 2009; Turchini *et al.* 2009; Tusche *et al.* 2011). For this reason, in these last 20 years, in Italy and in Europe, consumer awareness about organic foods and organic fish production has promoted the diffusion of various types of seafood eco-endorsements, such as eco-labeling and certification (EU, 2014; Mente *et al.* 2011; Mente *et al.* 2012). The main aspect that makes organic aquaculture different from conventional aquaculture is the fish nutrition, which directly addresses consumer needs, food safety and environmental concerns (Ballester-Moltó *et al.* 2017; Komas *et al.* 2014; Mente *et al.* 2011; Mente *et al.* 2012). A crucial issue is the reduction of fishmeal and fish oils in fish feeds with two main objectives: the use of: (a) sustainable sources of fish meal and (b) alternative vegetal feedstuffs (Menghe *et al.* 2006; Lund *et al.* 2011). In some cases, the limitations imposed in the use of fish feed ingredients can cause an even higher environmental impact than conventional aquaculture (Ballester-Moltó *et al.* 2017).

From its beginning, organic aquaculture (like almost any other organic production sector) has often been depicted as having positive possibilities and expected growth, that is, of up to 40 % (AA. VV. 2001; Mansfield, 2007; Prein *et al.* 2012; Nizza 2012; Di Marco *et al.* 2017), but it has rarely passed 1 or 2 % of the total aquaculture production.

But is organic aquaculture in Italy really so promising and increasing, as has repeatedly been stated ? What is the realistic perspective of organic aquaculture in Italy and in other developed countries? Are the difficulties in the application of national rules the only reasons that can explain this low production ?

In order to try to answer to these questions, it is useful to include Italy in an international and European context, and to briefly consider the historical, geographical, political and social reasons that can explain this situation. In other words, to understand the real perspectives of organic aquaculture in Italy, or elsewhere, it is important to include the proximate and remote causes of the current status of organic aquaculture in the discussion. The analysis of the Italian status of organic aquaculture may serve as a comprehension and prevision model for other developed countries that, taken together, represent the area that could undergo the greatest increase in organic aquaculture in the future.

In light of the general upward trend of organic aquaculture products on the European market, the aim of this paper has been to review the organic aquaculture situation in Italy, and to consider the main driving forces that regulate this sector.

The role of European aquaculture

Blue mussel was the main organic production species in Europe in 2015 (Fig.1), followed by Atlantic salmon, carp, sea bass and sea bream. In 2010 and 2011, salmon and trout were the principal species organically farmed in Europe, while in Norway, organic salmon was 1.3% of the total production in 2012 (Zubiaurre, 2013).

First European organic farms of salmon were accredited according to an IFOAM standard in 1999 (Aarset *et al.* 2004). In the following period, the United Kingdom was one of the leading country and in 2009 the production of organic salmon was 4% of the total salmon farmed in the country. Ireland was the largest European producing country of organic salmon in 2012, with 9.600 t of production (Zubiaurre, 2013), and reached 22000 t in 2015, thus representing almost 50% of the total European production. Organic aquaculture products are increasingly important on the Swiss market; a growth of 35% of market volume was observed from 2008 to 2009. A total of 7 organic trout farms produce about 300 t of organic trout in Switzerland (Kilcher *et al.* 2011). Organic aquaculture production has recently started in Greece (Perdikaris and Paschos 2010; Polymeros *et al.* 2014), and it is also beginning in Turkey (Kayhan & Olmez 2014) and in Scandinavian countries (Paisley *et al.* 2010). The only abnormal case in Europe is Ireland, which is the leading country for organic salmon production in Europe, where the production of organic salmon was 69% of the total salmon production and organic trout was 30% of the total trout production in 2012 (Zubiaurre, 2013) and successively reached 100% of production. This extraordinary progress is exclusively due to a change in legislation. In fact, the entire Irish farmed salmon production (13.000 t in 2015) is obtained according to an organic standard, that is the Annual Aquaculture Survey 2016 issued by the Irish Sea Fisheries Board (BIM). (http://www.eumofa.eu/documents/20178/84590/Study+report_organic+aquaculture.pdf). The Irish case indicates that the harmonization of rules at a European level is a crucial issue for the future of organic aquaculture. For this reason, it is important to point out the efforts of the European Commission, which amended the previous regulation on organic

91 production (EC 88/2008) and produced a new regulation in April 2016 (EU 2016/673).
92 This regulation contains more restrictive rules on the introduction of non-organic
93 juveniles into organic farms, both for fish and bivalves, as well as an updated list of feed
94 additives. These rules make the separation between conventional and organic farming
95 clearer in all the productive phases and could improve fish feed quality, considering that
96 it is a central issue for modern organic aquaculture (Ballester-Moltò *et al.* 2017).
97

98 **Low numbers mean instability and turbulence: an unexpected mathematical side of**
99 **the question**

100 As the total number of organic farms can be considered as a physical system, it could be
101 useful to consider whether this system is stable or not. In terms of system dynamics, it is
102 easy to consider this system as a pendulum that oscillates about the equilibrium position.
103 This equilibrium position is the current number of organic fish farms in Italy (or in
104 Europe or elsewhere). Being composed of a low number of elements (*i.e.* Italian organic
105 farms), this system is inherently unstable, as a small increase or decrease in the number of
106 farms could result in a great oscillation (Tab. 1), which can easily cause either the end of
107 the system or its transition to a new equilibrium position. This analogy helps to clarify
108 why it is difficult to estimate organic aquaculture productions.
109 In Europe, the number of organic farms was about 75 in 2011 (EU, 2014). Therefore,
110 only a few new farms per year influence the estimated growth to a great extent (Tab. 1).
111 The growth of organic aquaculture has been relevant in relative terms, but not in absolute
112 terms, and this fact has probably created excessive expectations. Even though there are
113 no official statistics on organic aquaculture production at present, if the production

114 volumes are considered, it is likely that very few new farms have been founded or
115 converted from conventional to organic throughout Europe in the last few years (Fig. 3).
116 For example, in Greece there were 3 organic fish farms until 2013, and in Switzerland
117 there are currently only 7 organic trout farms.
118
119 **A snapshot of the Italian aquaculture situation: the effect of intra-sectorial forces on**
120 **organic aquaculture**
121 Organic aquaculture, by definition, is a modern extension of aquaculture, and it is based
122 on an upgrade of the existing conventional aquaculture productive processes. For this
123 reason, a brief description of the current situation of Italian aquaculture is useful to fully
124 understand the status and potentialities of organic aquaculture.
125 Italian aquaculture is structured in the same ways as in other European countries, that is,
126 it is largely based on a few species: namely, three finfish, rainbow trout (*Oncorhynchus*
127 *mykiss* Walbaum 1792), European sea bass (*Dicentrarchus labrax* L.), gilthead sea bream
128 (*Sparus aurata* L.), and two bivalve species, Mediterranean mussels (*Mytilus*
129 *galloprovincialis* L.) and Manila clams (*Venerupis philippinarum* Adams & Reeve, 1850)
130 (Bronzi *et al.* 2012). The production of rainbow trout reached 36000 tons in 2013, while
131 the sea bass and gilthead sea bream volumes were 6300 and 6100 tons, respectively, and
132 bivalve marine farming production reached 88000 tons. The overall value was € 393
133 million in 2013 (MiPAAF 2014). Italy is the main European producer of Manila clams
134 (24600 tons in 2013), while other fish species with promising perspectives are sturgeons
135 for caviar production, grey mullets (*Mugil sp.*), which are extensively farmed for the
136 production of salted roe, also known as “bottarga”, and meagre (*Argyrosomus regius*

137 Asso, 1801). Bivalve farming is deeply rooted in Italy, and it is particularly developed
138 along the Adriatic coast, with the Manila clam farms mainly being located in North East
139 Italy. The annual fish consumption in Italy is currently less than 20 kg per person, and it
140 is the first time in this century that the annual fish consumption has reached such a low
141 value, with a negative trend of -4% from 2002 (ISMEA, 2013). Moreover, fish
142 consumption is much lower in Italy than in other European countries, such as Portugal
143 (60 kg), Spain (49 kg) and France (33 kg).
144
145 **The regulatory aspects of organic aquaculture in Italy: the role of politics**
146 One of the most important aspects that has influenced the diffusion of organic
147 aquaculture in Italy and throughout the world is the adoption of shared and standardized
148 procedures (Bronzi *et al.* 2011; Szeremeta *et al.* 2010). The introduction of standardized
149 procedures has been perceived as crucial from the very beginning of modern Italian
150 aquaculture (Roncarati *et al.* 2008), and several farmers voluntarily decided to apply
151 internal rules in order to standardize quality, but these practices were only spontaneously
152 adopted by farmers until 1999. Since 2001, an Italian consortium that represents the main
153 stakeholders in the Italian fishery sector for the promotion of fish and seafood
154 consumption (UNIPROM), has organized and promoted research initiatives on organic
155 aquaculture and formulated a preliminary production protocol for organic aquaculture
156 (AAVV 2001). This protocol was based on the FAO Code of Conduct of Responsible
157 Fisheries (FAO 1995) and on Directive (EC) 1804/1999. Later, Directive (EC) 710/2009,
158 which is the regulatory document for organic aquaculture in Europe, was adopted in Italy
159 in July 2010. The Italian Ministry of Agriculture and Forestry supported the adoption of

Directive (EC) 710/2009 and constituted a permanent committee on organic aquaculture (AAVV, 2012). Directive EC 710/2009 introduced fundamental new indications, such as an organic logo and a clear list of ingredients for fish feeds. The principal institution involved in organic aquaculture certification in Italy is ICEA (Ethical and Environmental Certification Institute). Currently, the main food chain that diffuses organic fish is "ALMA VERDE BIO" (www.almaverdebio.it). Clear labeling is a crucial point for the future of organic aquaculture. Since the introduction of organic products onto the market, European consumers have appeared confused about the meaning of the term "organic" and are largely unaware of the certification processes (Aarset *et al.* 2004). Feucht and Zander (2014) showed that, even in Germany, where there is a deeply-rooted tradition of organic food consumption, there was still a necessity to improve organic fish labeling and communication with consumers.

Organic aquaculture productions in Italy

The total production of Italian organic aquaculture was of 2347 t in 2015, which represents 1.1% of the total Italian aquaculture production. In the past, organic aquaculture in Italy was at a constant level, that is at 1.5 – 2% of the total aquaculture production. Blue mussel was the main species organically farmed in 2015, with 2000 tons of production, while gilthead sea bream was the first fish farmed species, with a production of 153 t; rainbow trout is the second organically farmed species, with a production of 90 t (http://www.eumofa.eu/documents/20178/84590/Study+report_organic+aquaculture.pdf). The internal Italian demand for organic aquaculture products was already noticeable

183 when organic fish production began in Italy (Defrancesco, 2003), and in the last few
184 years, a willingness to pay a premium price for organically farmed fish has been noticed
185 (Maurarcher *et al.* 2013). Organic productions are well known by Italian consumers, and
186 Italy is in fact ranked 3rd in the world, after Australia and Argentina, for the use of
187 certified soil in organic agriculture production (AA VV 2012). Overall, the number of
188 agriculture organic certified farms in Italy increased from 48,269 in 2011 to 49,709 in
189 2012 (Ribeiro *et al.* 2010), and now represents 25% of the total European organic
190 production. Italian organic agricultural and livestock products are mainly exported to
191 Northern Europe. Organic aquaculture production in Italy started in 2000 – 2001, with a
192 few trout farms that were certified by independent certification bodies (AAVV, 2001). In
193 the subsequent years, some organic gilthead sea bream and European sea bass farms were
194 founded, following the application of a specific regulation for organic fish farming, that
195 is, Directive (EC) 710/2009 (Defrancesco 2003). Italian organic aquaculture production
196 was originally based on just a few aquaculture farms, but the number increased to 17
197 farms in 2013, thus showing a comparable situation with most other European countries.
198 Recent data on organic fish farms (SINAB, 2014; SINAB 2015) indicated an unexpected
199 increase to 41 farms in 2014 with a successive stationary phase until 2017 (SINAB,
200 2018), thus showing an increase of more than 140%. The small number of farms and this
201 sudden increase in 2014 make it difficult to clearly interpret this trend. However, this
202 number represents 5.1 % of the total number of Italian aquaculture farms, and it is
203 noticeably higher than the European percentage of 1.3% (with the exception of Ireland).
204 Should this trend be confirmed, it could indicate a quite positive change in perspective
205 that is in contrast with the rest of Europe (EU, 2014). Italian organic farms are mainly

206 located along the Adriatic coast (Fig. 2); the Veneto region (NE Italy) has the greatest
207 number of organic aquaculture farms and is also the leading conventional aquaculture
208 region. The most common organically farmed fish species is gilthead sea bream
209 (Castellini *et al.* 2014).
210 These data show that Italian organic aquaculture has an inner relationship with
211 conventional aquaculture. In fact, the most popular organic species are the most
212 frequently farmed conventional species, with the only difference concerning the produced
213 amount, in that organic gilthead sea bream production is higher than rainbow trout
214 production, while rainbow trout production is higher than gilthead sea bream in
215 conventional aquaculture . This fact can be explained considering that Italian rainbow
216 trout farming is currently managed with traditional techniques and with traditional
217 infrastructures, while marine aquaculture is a more recent activity and is consequently
218 more open to technological improvements.
219 It seems that the positive growth perspectives expected at the international level,
220 pertaining to organic aquaculture productions, such as that indicated by FAO, which
221 estimated a growth of 40 – 60% until 2012 (Prein *et al.* 2012) and an expected growth of
222 20% per year between 2010 and 2020 (Nizza, 2012), do not show similar trends for Italy.
223 Moreover, Italy is one of the countries with the highest numbers of processing plants for
224 organic fish
225 (http://epp.eurostat.ec.europa.eu/portal/page/portal/organic_farming/data/database), thus
226 indicating a good internal demand for organic aquaculture products and a strong modern
227 aquaculture specialization process (Guillotreau 2004).

228 Until 2013, organic aquaculture in Italy remained stationary at a low level, but this
229 situation was comparable with the situations of other western countries (IFOAM 2010b),
230 with the exception of Ireland (Fig. 3) (Budak *et al.* 2006; Defrancesco, 2003; Mente *et al.*
231 2011). Subsequently, from 2014 to 2017, the number of organic fish farms had
232 unexpectedly more than doubled, thus representing a radically different situation from
233 other European countries. The main explanation for this difference may be geographic
234 (the local conditions positively affected the transformation of conventional farms into
235 organic ones). In fact, if the distribution of organic farms in 2013 is compared with that
236 of 2014-2018 (SINAB 2014; SINAB 2015; SINAB 2018), it is clear that the increase in
237 the number of organic farms is principally due to the two regions, Veneto and Emilia
238 Romagna, in which the number of organic farms doubled in 2014. It is clear that there are
239 more opportunities for conversion from conventional to organic productions in areas in
240 which aquaculture has traditionally developed.
241 Although some recent studies in Greece and in Italy have shown that organic feeds
242 sustain a good performance of sea bass and sea bream (Di Marco *et al.* 2017; Mente *et al.*
243 2012), the diffusion of organic farming practices in small-size fish farms in Italy is
244 principally hampered by the high costs of certification and fish feeds (IFOAM, 2010b)
245 and by the excessive bureaucracy (SINAB, 2015). For instance, a cost-benefit assessment
246 in a European sea bass farm has recently shown that the costs of certification and fish
247 feeds are the main obstacles to the conversion from conventional to organic production
248 (Zacchino *et al.* 2014). The adoption of Directive EC 710/2009 has been a fundamental
249 achievement for Italian organic aquaculture and has promoted its diffusion, but there are
250 still some problematic aspects for the farmers: the sanitary treatments based on natural or

vegetal compounds and probiotics, the mandatory utilization of only local fish strains; the mandatory spatial separation between conventional and organic cultures during all the productive phases and the restricted use of water oxygenation (Trocino *et al.* 2012; Tulli *et al.* 2012).

From the commercial point of view, there are also some critical aspects that should be addressed: the difficulty of introducing organic aquaculture products into the large-scale retail trade, the higher prices, compared to conventional food products, and the application of appropriate marketing strategies, following the example of Denmark (see the ORAQUA project (2007-2010): http://www.icrofs.org/pdf/darcofIII/oraqua.pdf).

A positive aspect recently emerged by the project BIOBREED (http://www.biobreed.it/BioBreed/HOME.html) is the positive consumer's perception of organic aquaculture products as reaction to a general negative sentiment of conventional aquaculture products. Italian consumers believe that pharmaceutical treatments are strongly reduced in organic aquaculture (Pulcini & Capoccioni 2018). Italian consumers will need to be informed and a clear labeling, (according the EU and international standards) is imperative in order to control the abuse of such terms as "organic" and "biological" in aquaculture products.

Conclusions

Italian organic aquaculture is 20 years old, but it is often considered to still be in its infancy, and this review indicates that it will probably remain in this situation in the future. It can be stated that this is a physiological state, thus Italian organic aquaculture can be considered a "proportioned dwarf" in the aquaculture sector.

Blue mussel, gilthead sea bream and rainbow trout are the most important organically farmed species in Italy, and most of the organic fish farms are located along the Adriatic coast and in North East Italy.

The high costs of certification and fish feeds, the bureaucracy, the higher prices and the lack of appropriate marketing strategies are the main practical obstacles to Italian organic aquaculture.

It appears that the Italian rules for organic aquaculture production are probably too restrictive to promote organic farming, and this is just a part of the problem that affects aquaculture production in general. For this reason, the main policy implication is that a simplification should be introduced in order to sustain the internal production of organic aquaculture and the entire sector.

The show of optimism repeatedly reported in the previsions about organic aquaculture in Italy and in other developed countries should be tempered. The data of the last 20 years on organic aquaculture clearly show that its production is just a small percentage of the total aquaculture production.

In general terms, it is clear that the relationship between conventional and organic aquaculture can easily be explained in a context of evolutionary relationships. In fact, the emergence and diffusion of organic aquaculture show powerful analogies with the emergence of a new species, in a process of intra-specific separation, which is well known in biology. A new species (in this case organic aquaculture) originates from the former one (conventional aquaculture), in a gradual process that is driven by internal (aquaculture productions) and external (geographical and legislative) forces.

296 The vision and the perspective of the future of organic aquaculture would be greatly
297 improved if the scientific community were able to include the organic aquaculture
298 evolution in a general theoretical context, beyond the traditional boundaries of technical
299 considerations that dominate modern scientific literature.
300
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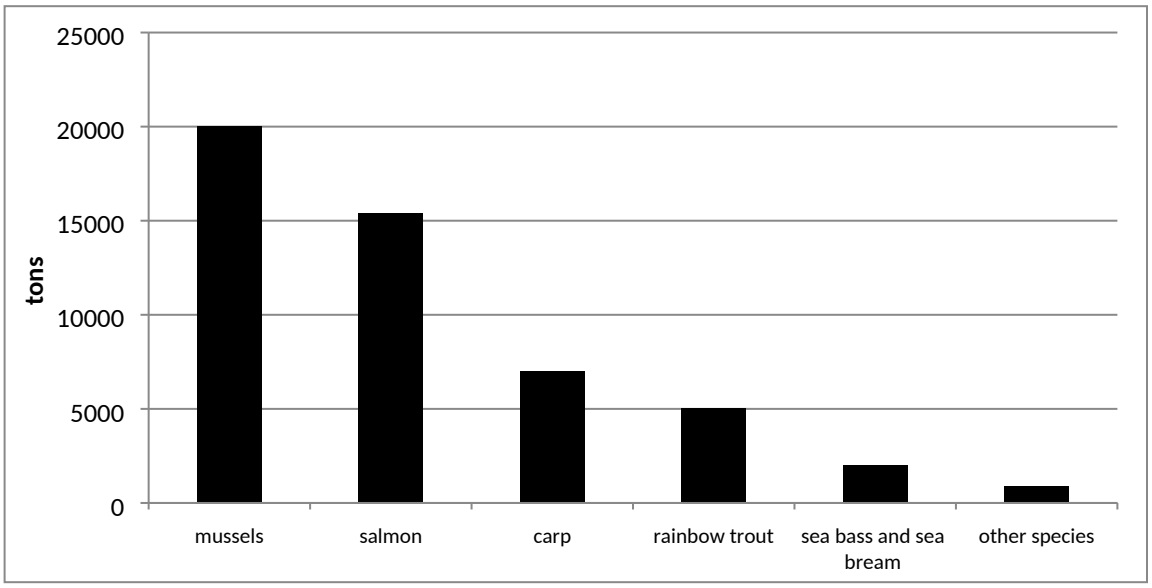
Fig. 1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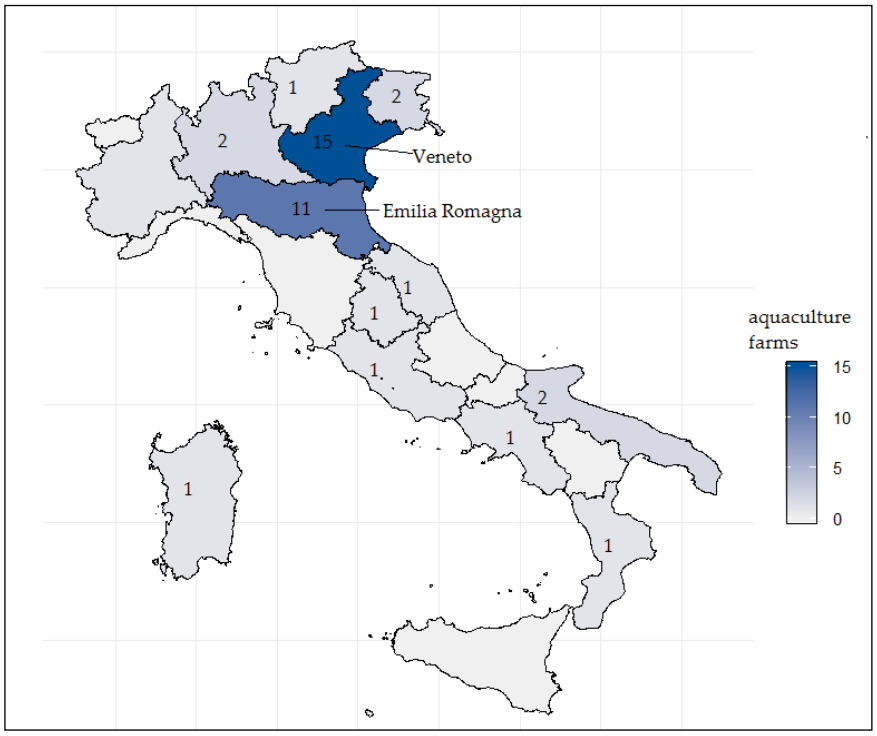
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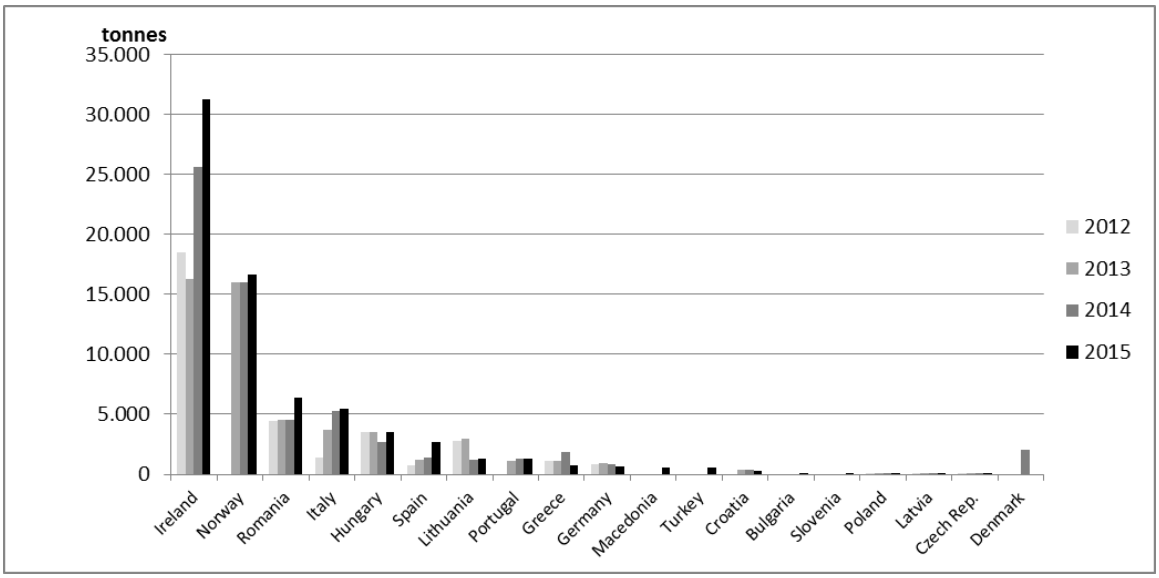
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Tab. 1 Annual relative increment (%) of organic aquaculture production in main European countries from 2012 to 2015

Country	2012 - 2013	2013 - 2014	2014 - 2015
Ireland	-12%	57%	22%
Norway		0%	4%
Romania	3%	-1%	41%
Italy	166%	44%	4%
Hungary	0%	-23%	31%
Spain	53%	15%	99%
Lithuania	10%	-61%	10%
Portugal		18%	0%
Greece	3%	66%	-61%
Germany	10%	-16%	-22%
Croatia		-16%	-12%

Figure captions

Fig. 1 Number of organic aquaculture farms in Europe in 2009, divided by species (IFOAM, 2010)

Fig 2. Number of organic aquaculture farms in Italy in 2017, divided by region (SINAB, 2018)

Fig 3. Number of organic aquaculture farms in Europe from 2012 to 2015.

An overview of organic aquaculture in Italy

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Running title: An over. Organ. Aquac. Italy

Dear Editor,

I have tried to reply to the reviewer 2 requests at my best

I carefully searched for recent articles about Italian organic aquaculture. I included updated references in the manuscript.

.

I sent again the manuscript for a professional English revision to a lecture, that I already acknowledged in the article, here her last email

“Dear Benedetto,

I am sending you the revised version. I have made a few suggestions that are perhaps not necessary, but might be useful to show the editor/referee you have paid attention to his/her comments. This person is probably not a mother-tongue (as deduced from his/her strange comments about grammar!). However, there were a few grammar mistakes in the version (e.g. where you forgot to remove a word). If you need a CV to send to him/her, I can send it to you. Let me know how this goes. “

I hope that the you and the reviewer2 will consider my corrections as definitive, but I am still available to re-correct my manuscript, if necessary.

Best regards,

Benedetto Sicuro