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# *Pandalus montagui* in the West Greenland offshore shrimp fishery 2011–2016.

by

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## Abstract

Logbook data from 2011–2017 was analysed to elicit information on the occurrence of *Pandalus montagui* in the West Greenland fishery for *P. borealis*. *P. montagui* is unreliably reported in logbooks: some fleet segments never report it in logbooks, and in others, some ships log catching *montagui* on unconvincingly rare occasions while others log it far more often and apparently more accurately. A very few vessels report *montagui* on average as high as 0.1–100% of their catch of *borealis*. The reported catch of *montagui* averaged 2.98% of that of *borealis*, varied from year to year and could be as high as 5.18%. Catch composition is verified at the point of sale and the weight of *montagui* is not withdrawn from the vessel's quota for *borealis*.

*Montagui* was caught in shallower waters than *borealis.* Few *Pandalus montagui* was caught north of 68°20'N; to the south it is frequently caught at the margins of the gullies between the banks. Some fishing grounds for P.*montagui* are small and well defined, at some location there are a direct fishery of *montagui,* with caches amount more than 70%, but at most hauls the species is almost always caught as mixed catches with *P. borealis*. For individual vessels, catching *montagui* is episodic and comes in bursts interspersed with periods, often long, when *montagui* is not caught. These episodes might be prolonged by vessels seeking to eke out their quotas of *borealis.*

## Introduction

A trawl fishery for the cold-water prawn or Northern Shrimp *Pandalus borealis* is prosecuted on the West Greenland continental shelf. A related species, *P. montagui*, known as the striped pink shrimp or Aesop shrimp, also occurs in those waters, with a distribution that overlaps that of *P. borealis*, and is liable to be (by-) caught in the fishery. The stock of *P. montagui* appears to persist, although no measures for regulating the catches of this species in the West Greenland fishery have been enacted. The Greenland Self-Government has asked the NAFO Scientific Council for advice on measures that might be taken in the fishery for the Northern

Shrimp *Pandalus borealis* in West Greenland that would ensure that the stock of *Pandalus montagui* would remain within safe biological limits.

The present document is intended to contribute to this discussion by presenting some characteristics of the distribution of the species and of its occurrence in the fishery according as it has been possible to find them out from an analysis of fishery logbooks.

## Material and Methods

Logbooks were selected for offshore vessels fishing in West Greenland on licences for Northern Shrimp (PRA) for 2011–2016; in connection with the assessment of *P. borealis*, logbook data is downloaded annually from a confidential database maintained by the Greenland Fishery and Licence Control (GFLK) and used to update confidential registers kept by the Greenland Institute for Natural Resources (GN). The data headers identify the ship in several ways, of which the radio call-signal is that most used by GN in analysing data; data lines define the date, the start and end times and positions of the haul, the gear used, and the catches and discards of several species. The paper logbooks used give little space for detailed recording, particularly of bycatches.

The data has not been exhaustively analysed for this document. Annalysed catch rate and staock estimates is available in Rigét 2017). Five vessels are identified having catches with significant proportions of *montagui* and summarised their distribution by depth, by time, and by area, and attempted to draw provisional conclusions on the behaviour of the fishery and the distribution of the species. There might some uncertainties of the reliability of the data as regards *absolute* values, such as missing reporting in the logbooks. In general, the quota drawdown is the sold weight of *P. borealis*, excluding *montagui,* and is therefore apt to be less than the logbook-recorded catch.

## Results

*Coastal fleet* - catches of *montagui* relative to *borealis*

The coastal fleet of small trawlers fishes bulk shrimps landed for shore processing in Greenland, does not record *montagui* separately in logbooks. When the catch is landed and its sale is negotiated, the catch is sampled to evaluate its quality and price, the proportion of *montagui* being one of the determinng factors, and information on catches of *montagui* in the coastal fishery is therefore only available from sales sheets. Reported by-catch of *P. montagui* from coastal vessels, range from 58 – 757 tons, 2011 to 2016, and were in general much low than compared to those of offshore (Table 1 - sales slips).

The coastal fleet fishes principally in 5 statistical areas. Areas 1 and 2 are Hare I., Vaigat and Disko Bay, where *P. montagui* has very seldom been recorded by the West Greenland trawl survey, and catches in these two areas probably contain little *montagui*. However, area 3 in the mouth of Disko Bay, area 7 in the Holsteinsborg Dyb, and area 13 in Julianehåb Bay all contain sites in which *montagui* occurs, sometimes in high densities both absolutely and relative to *borealis*. Catches by the coastal fleet in these areas will sometimes contain admixtures of *P. montagui.*

*Offshore fleet* - catches of *montagui* relative to *borealis*

In trawlers with on-board processing, *montagui* and *borealis* are not weighed separately; the catch is sampled from the holding tank and the proportions of the two species are estimated. From the final weight of the combined catch, the weights of the separate species can be reckoned. In the offshore fleet, practice varies. Some companies have markets that will take *montagui* on almost an equal footing with *borealis*; others take stronger measures to avoid catching *montagui*. Therefore the status of *montagui* can vary from being an unwanted bycatch through being a retained bycatch to being a targetted species. Among other effects, this means that the average proportion of *montagui* varies from ship to ship. All were sea-going trawlers of about 500 GT or more, mostly factory trawlers with permission to process (at most 75% of) their catches on board,

although there were two freezer trawlers. The vessels fish for *borealis* in areas where *montagui* tends to occur, and will also tolerate catches with high, or very high, proportions of *montagui*. This is especially true when ships start to run short of quota for *borealis*; they then turn to *montagui* as a way to continue fishing.

Eleven offshore vessels submitted logbooks, with information on *P. montagui,* in the West Greenland shrimp fishery between 2011 and 2016. Among the eleven vessels that recorded catches of montagui, the records varied, and some appeared to be of doubtful reliability. Five of those vessels reported reliable information on by catch of *P. montagui*. The annual logbook reported catch of *P. montagui* usually ranged from 1.53 % to 5.18%, of the reported catch of *P. borealis*, but with some year-to-year variation and large deviations in some years. For the past 6 year,proportion of by-catches of *P. montagui* have been considerably higher than observed in the period from 2001 to 2010, which averaged near to 0.5% of the reported catch of *P. borealis* (Table 1). In 2011 and 2014 *montagui* was reported less than 2% of borealis (Table 1). The 6-year average ratio was 2.98%.

Of the eleven vessels in the fishery, five recorded reliable catches of *P. montagui* in at least 1% of hauls. The annual catches, by those vessels, averaged 2212 tons from 2011 to 2016, with exceptional high catches at 4190 tons in 2013 (Table 2). Proportion of P. montagui catches caught by the "five good vessels" amounted on average 72% of the total by-catch, with extremes at almost 91% in 2015 (Table 3). Number of hauls with catches of *montagui* increased over years to 499 hauls in 2016 – only exceed by 543 hauls back in 2013. *Montagui* standard catch rates are estimated for 2001 to 2016, and can be found the Rigét 2017

*Distribution by area*

The *"five good vessels"* conducted their shrimp fishery in 11 statistical areas, whereas most catches are taken in Area 0 (North), Area 4, Area 3 (Vest of Disko Bay), Area 6 and Area 7 (Holsteinsborg Dyb) (Figure). Less catches are obtained south of 66°N. However, North of 66°N by-catch is only conducted in the 68°20'N and mainly in Area 7 (Holsteinsborg Dyb), whereas *P. montagui* catches are frequently fished in Areas 8 – 13 in southern part of the West coast.

Figures 2–9 give a comprehensive and consistent picture of the distribution of catches of *P. montagui*, relative to the catch of *borealis*, by the fishery along the West Greenland coast, as indicated by the "five good vessels". The catches with significant fractions of *montagui* are distributed between about Kangaatsiaq at 68°15'N and south to about 61°N. There is a marked area of concentration of catches near shore off Kangaatsiaq, in the gully between north-east Store Hellefiskebanke and the coast, but catches with large fractions of *montagui* hardly occur north of there. The species is rare north and west of Store Hellefiske Banke—where the fishery for *borealis* is intense and productive. From the southern part of the Sukkertoppen Dyb and south to about Paamiut *montagui* is more frequently a higher proportion of the catch, mostly along the edges of the gullies between the banks, and less frequently in their deeper centers. These vessels reported some fishing in Julianehåb Bugt in 2011–2016.

It might be considered as direct fishery on *montagui*, when proportions exceed more than 50% of *P.borealis* (personal comm; Mads Nedergaard, GFLK). Positions of were *montagui* composes more than 50% of the total catch, is situated near shore Kangatisaq 68°15' N, offshore in Holsteinsborg Dyb (66 – 67°N), from Sukkertop Dyb (65°) and south to Julianehåb Bugt (60 – 61°N) (Figures 2–9).

The information on catches from the West Greenland trawl survey tends to confirm these distributions. However, the survey is not designed to study the distribution, or estimate the biomasss, of *P. montagui.* Shallow-water stations added to the shrimp survey to provide information on the stocks of groundfishes also inform on the distribution of *P. montagui* relative to that of *P. borealis* (Siegstad 2015).

*Distribution by depth*

*Pandalus montagui* is known to favour shallower waters than *P. borealis,* and this distinction has been consistently recorded in trawl surveys in West Greenland (Siegstad 2015). The depth distributions of the catches obtained by logbooks reported by the "f*ive good Vessels*" are consistent with this. Catches of P. *montagui* start shallower than 100 m, are relatively evenly distributed between about 170 and 280 m, and decrease quite abruptly in deeper waters (Fig. 10).The median catch depth is 217 m. *Borealis* appears first in small amounts at about 130 m, but its distribution extends to deeper than 400m. Its median catch depth in 2011–2016 has been 267 m, 50 m deeper than *montagui*. Its deep limit is less marked than that for *P. montagui*—its depth ogive is more sinuous. These distributions are of catches, not of available biomass or relative density, so they might reflect fishing preferences as well as the relative abundance of both Pandalus species.

*Distribution in time*

By-catch of *P. montagui*, at the level of the individual vessel, is very sporadic (Figures 11a-e and Figure 12).Vessels can go long periods without reporting any *P. montagui*, and then for periods of weeks having frequently catches with high proportions. This could sometimes be a result of perhaps unintentionally encountering an area with higher densities of *montagui*, but could also, or at other times, result from intentionally fishing known *P. montagui* areas, likely because of a shortage of borealis quota. The 6-year average of catches of *P. montagui* has strongly seasonal pattern. Catches of *P. montagui* increasing from January to June (Figure 12I. In late summer and early fall they decrease, but the year-to-year deviations which given the episodic nature of catches by individual vessels is not surprising.

## Discussion

*Pandalus Montagui* is almost alway caught in mixed catches, nevertheless sometimes directly tagged. At the moment, the fishery for *montagui*—to the extent that it is at all a directed fishery—appears to be regulated only by the quota drawdowns due to the invariably accompanying catch of *borealis*.

According to meet MCS demands, bycatch of P. *motagui* are not allowed to exceed 2% of the total annual catches in the shrimp fishery. Over the past six year's proportions by-catch of *P. montagui* of the reported catches of *P. borealis.* This development requires that trawlers in the shrimp fishery either decrease their annual catches on *P. montagui* or require biological advice and a separate MSC certification for the species.

Measures to ensure that the stock of *montagui* remains within safe biological limits might be:

- Exploring methods for assessing data limits stocks.
- Applying available models – e.i SPICT (result are available in Rigét and Burmeister, 2017).
- Designate P.*montagui* as a bycatch species within the existing regulations, with accompanying strictures on continuing to fish in the same place if bycatch proportions exceed a prescribed limit. This would essentially close the present (semi-directed fishery for *montagui* and unless one of the following two suggestions were adopted would make *montagui* a completely protected species in spite of its commercial value.
- Set TAC limits on P. *montagui based on adaptive management approach*. I.e. develop this as a regulated fishery. It is unlikely that any quantitative assessment of *P. montagui* would be possible in near future, no assessment of the stock would resulting in strong indices of the stock biomass, but will relies on trends based on data poor indies from both the survey and commercial fishery.

## Acknowledgement

Many thanks to our former colleague Michael Kingsley for inspiration to this SCR Doc, from an older version of this document.

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Table 1. *Pandalus montagui* in the West Greenland shrimp fishery: annual reported catches of *P. borealis* and *P. montagui* in 1997–2016 by all vessels in the West Greenland fishery.

| Year | Catch P borealis | Catch P montagui | Sales slips | Total catch | Proportion Montagui |
|---|---|---|---|---|---|
| 1997 | 63913 | 348 | | 64261 | 0.54 |
| 1998 | 54356 | 856 | | 55212 | 1.58 |
| 1999 | 70098 | 3 | | 70101 | 0.00 |
| 2000 | 76349 | 241 | | 76591 | 0.32 |
| 2001 | 81060 | 720 | | 81780 | 0.89 |
| 2002 | 105474 | 184 | | 105658 | 0.17 |
| 2003 | 100963 | 793 | | 101756 | 0.79 |
| 2004 | 135212 | 789 | | 136002 | 0.58 |
| 2005 | 147687 | 504 | | 148191 | 0.34 |
| 2006 | 150533 | 1419 | | 151952 | 0.94 |
| 2007 | 139657 | 1966 | | 141623 | 1.41 |
| 2008 | 153888 | 89 | | 153977 | 0.06 |
| 2009 | 135028 | 53 | | 135082 | 0.04 |
| 2010 | 128108 | 1168 | | 129276 | 0.91 |
| 2011 | 122659 | 2324 | | 124983 | 1.89 |
| 2012 | 115964 | 3121 | 203 | 119288 | 2.69 |
| 2013 | 95379 | 4944 | 114 | 100437 | 5.18 |
| 2014 | 88764 | 1357 | 58 | 90179 | 1.53 |
| 2015 | 72254 | 2027 | 757 | 75038 | 2.81 |
| 2016 | 84356 | 3176 | 182 | 87713 | 3.76 |

Table 2. Annual reported catches in tons of *P. montagui* by five vessels with reliable reporting of by-catch.

| Vessel | 2011 | 2012 | 2013 | 2014 | 2015 | 2016* | Total 2011 - 2016 |
|---|---|---|---|---|---|---|---|
| 4 | 755 | 78 | 206 | 112 | 127 | 496 | 1775 |
| 5 | 55 | 269 | 114 | 286 | 912 | 510 | 2147 |
| 6 | 563 | 395 | 812 | 36 | 108 | 29 | 1944 |
| 7 | 53 | 198 | 1076 | 293 | 210 | 461 | 2292 |
| 8 | 160 | 996 | 1982 | 553 | 335 | 1086 | 5111 |
| Total | 1587 | 1936 | 4190 | 1281 | 1693 | 2583 | 13269 |

Table 3. Proportion of total the by-catch of *P. montagui* by five vessels with reliable reporting 2011 to 2016.

| Year | Total catch P montagui | Proportion of total catch of 'P. montagui |
|---|---|---|
| 2011 | 2324 | 68.29 |
| 2012 | 3324 | 58.24 |
| 2013 | 5058 | 82.83 |
| 2014 | 1415 | 90.53 |
| 2015 | 2784 | 60.79 |
| 2016 | 3358 | 76.93 |

Table 4: Number of hauls with P. montagui conducted by the “five good vessels” from 2011 to 2016.

| Year | Number of hauls by "Five good vessels" | All hauls by the offshore fleet | Proportion of hauls conducted by "five good vessels" |
|---|---|---|---|
| 2011 | 170 | 230 | 74 |
| 2012 | 325 | 539 | 60 |
| 2013 | 543 | 694 | 78 |
| 2014 | 322 | 353 | 91 |
| 2015 | 474 | 568 | 83 |
| 2016 | 499 | 632 | 79 |

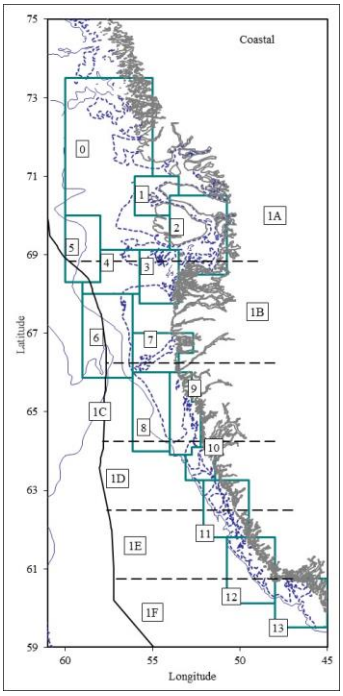



Fig. 1. Map showing the statistical fishing are along the West coast of Greenland.

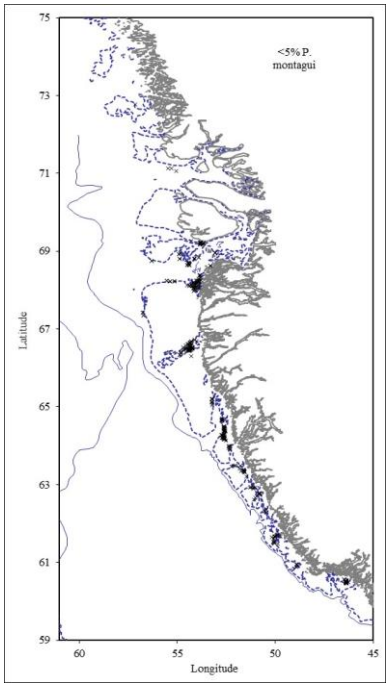



Fig. 2. Pandalus montagui in the West Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes less than 5% of the catch.

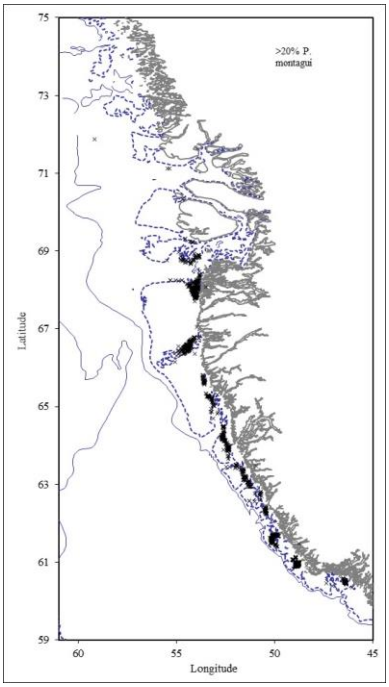



Fig. 3. Pandalus montagui in the w¨West Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes at least 20% of the catch.

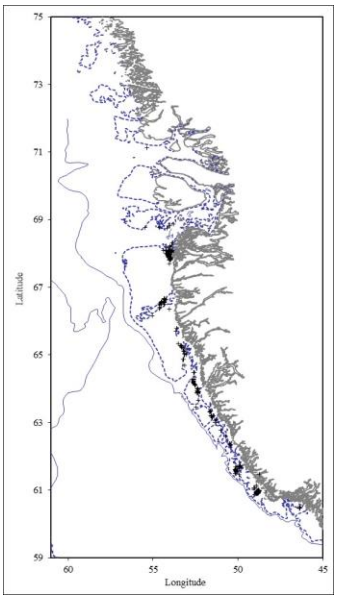



Fig. 4. Pandalus montagui in the west Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes more than 30% of the catch.

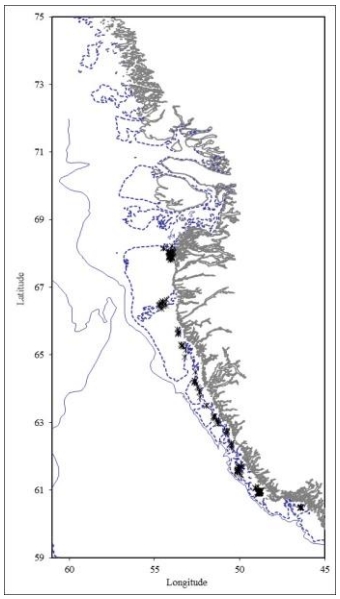



Fig. 5. Pandalus montagui in the west Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes more than 40% of the catch.

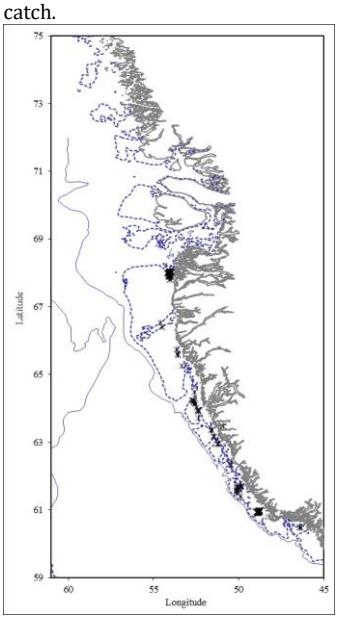



Fig. 5. Pandalus montagui in the west Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes more than 50% of the catch.

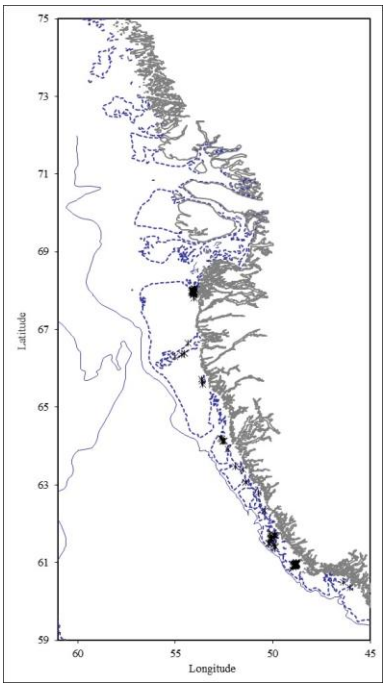



Fig. 6. Pandalus montagui in the west Greenland shrimp fishery. Position of in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes more than 60% of the catch

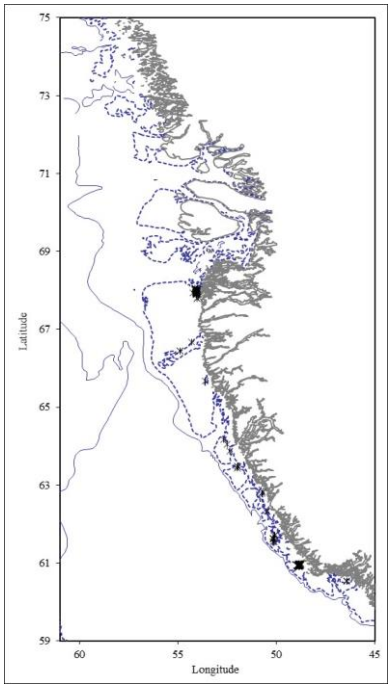



Fig. 7. Pandalus montagui in the west Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes more than 70% of the catch.

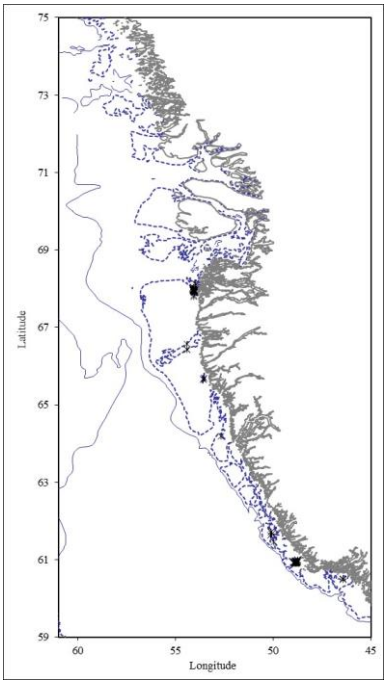



Fig. 8. Pandalus montagui in the west Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes more thant 80% of the catch.

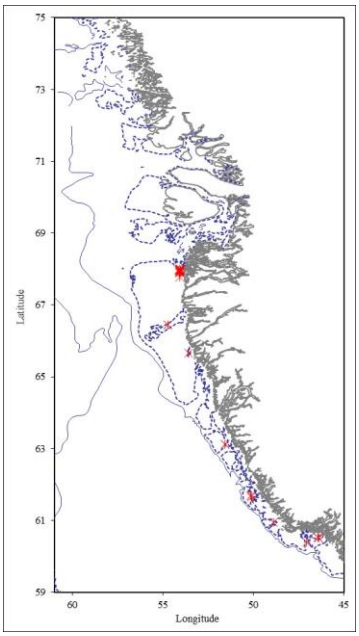



Fig. 9. Pandalus montagui in the west Greenland shrimp fishery. Position of hauls in 2011 – 2016 reporting catches of *P montagui*, in which montagui composes 90 to 100% of the catch.

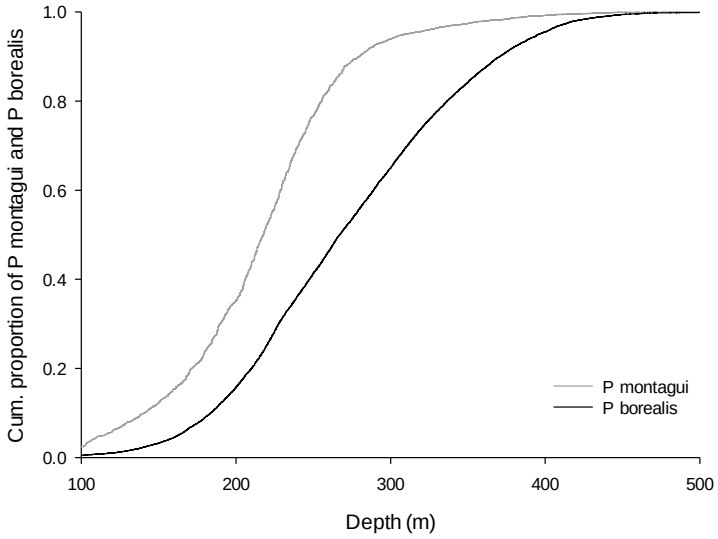



Fig. 10. *Pandalus montagui* in the West Greenland shrimp fishery: cumulative distributions by depth of catches reported by "*five good vessels*", *P. borealis* totaling 213 Kt and of *P. montagui* totaling 13.3 Kt in 2011–2016.

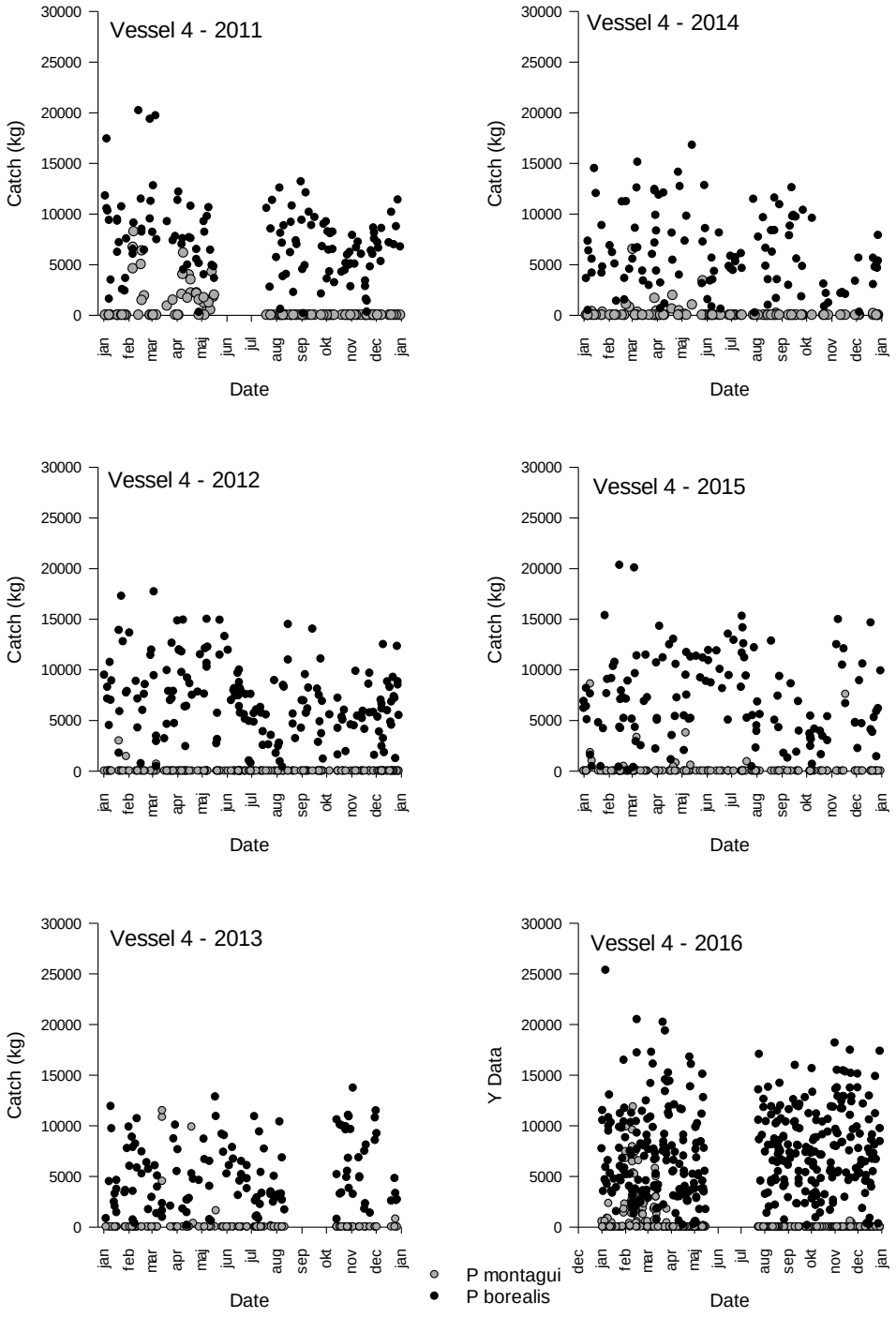



Fig. 11a. *Pandalus montagui* in the West Greenland shrimp fishery: episodic catching of *P. montagui*: catches of *P. montagui* and *P. borealis* by date for two ships considered '*Five good vessels -reliable reporters' of P. montagui*.

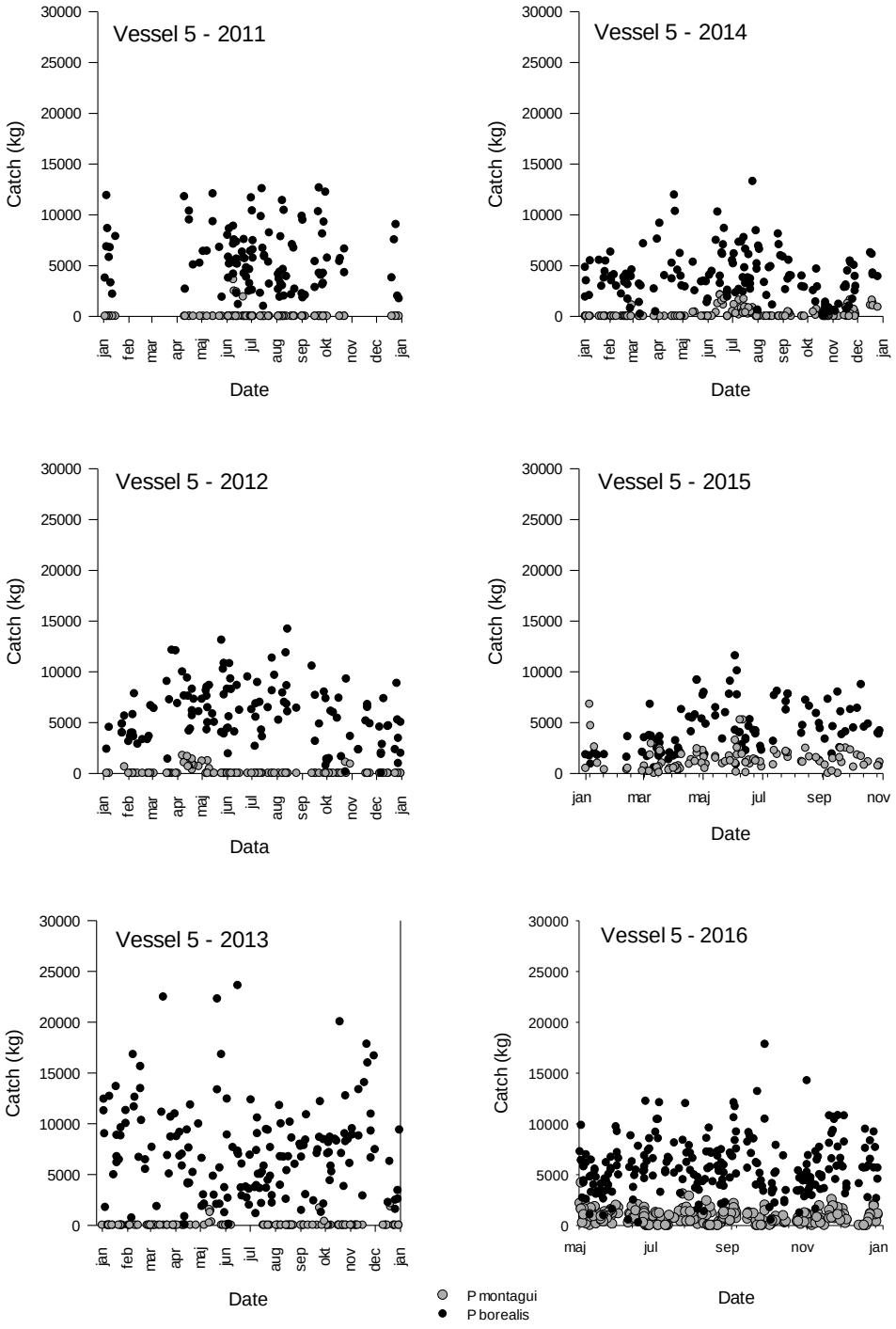



Fig. 11b. *Pandalus montagui* in the West Greenland shrimp fishery: episodic catching of *P. montagui*: catches of *P. montagui* and *P. borealis* by date for two ships considered '*Five good vessels -reliable reporters' of P. montagui*.

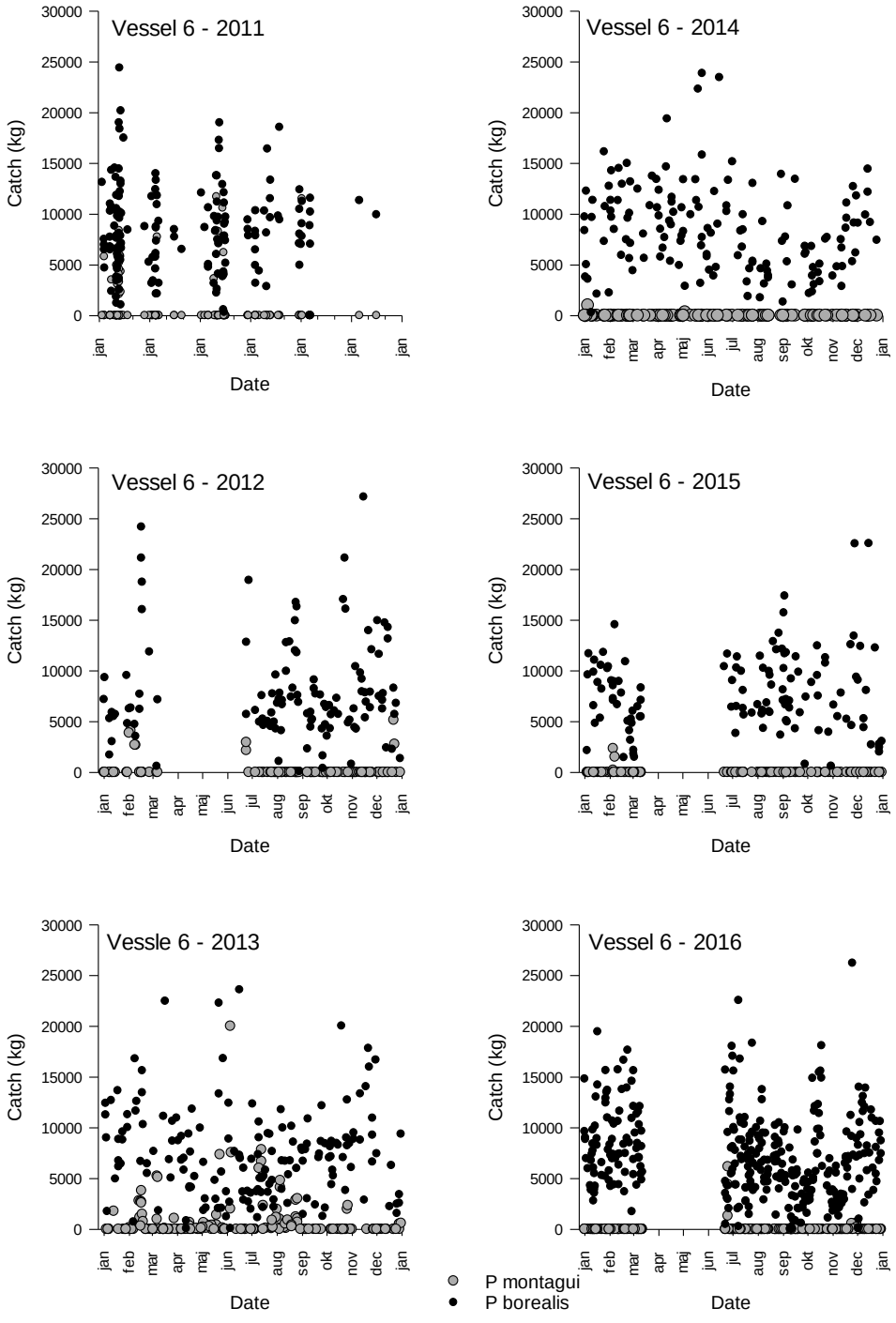
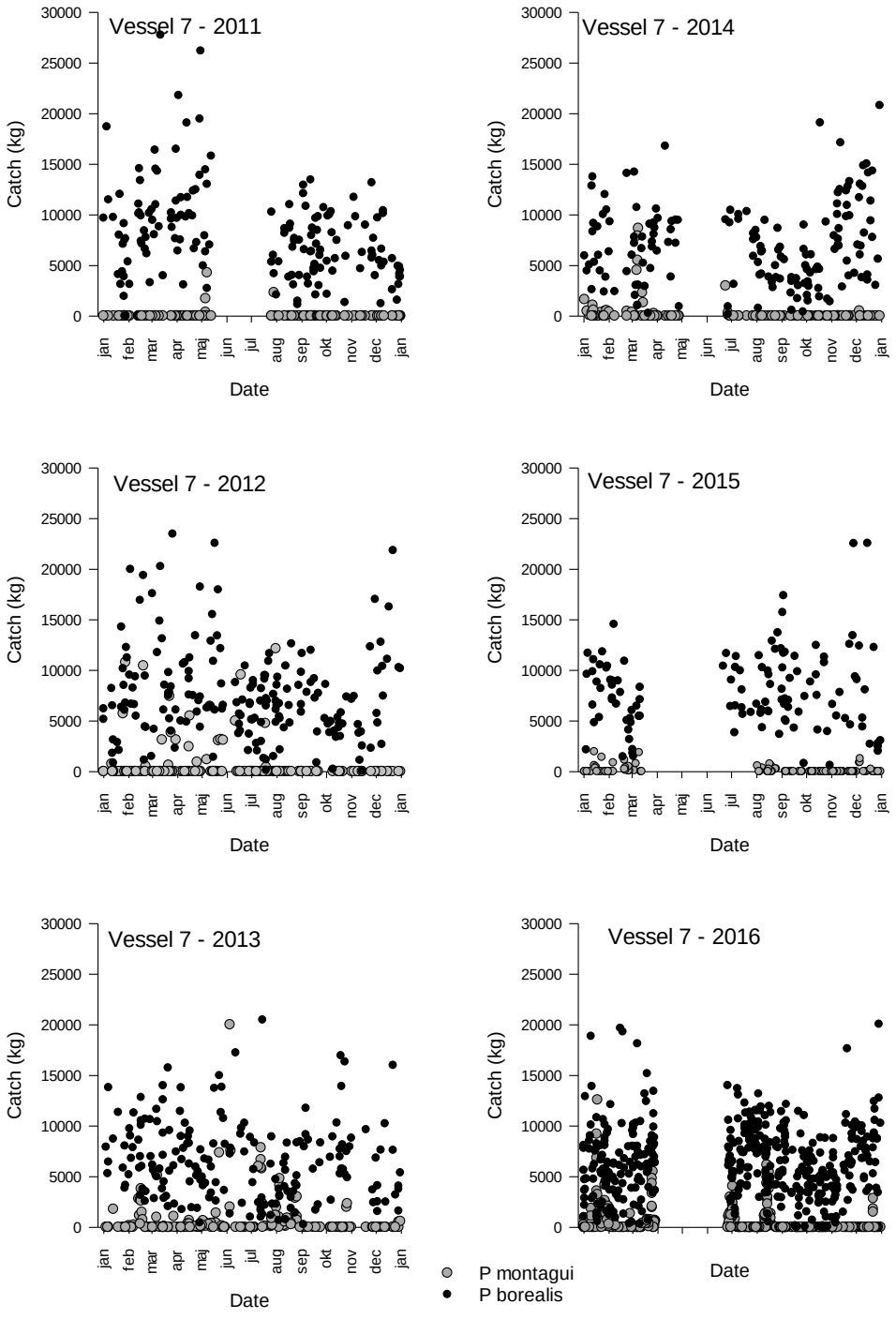



Fig.11c. *Pandalus montagui* in the West Greenland shrimp fishery: episodic catching of *P. montagui*: catches of *P. montagui* and *P. borealis* by date for two ships considered '*Five good vessels -reliable reporters' of P. montagui*.

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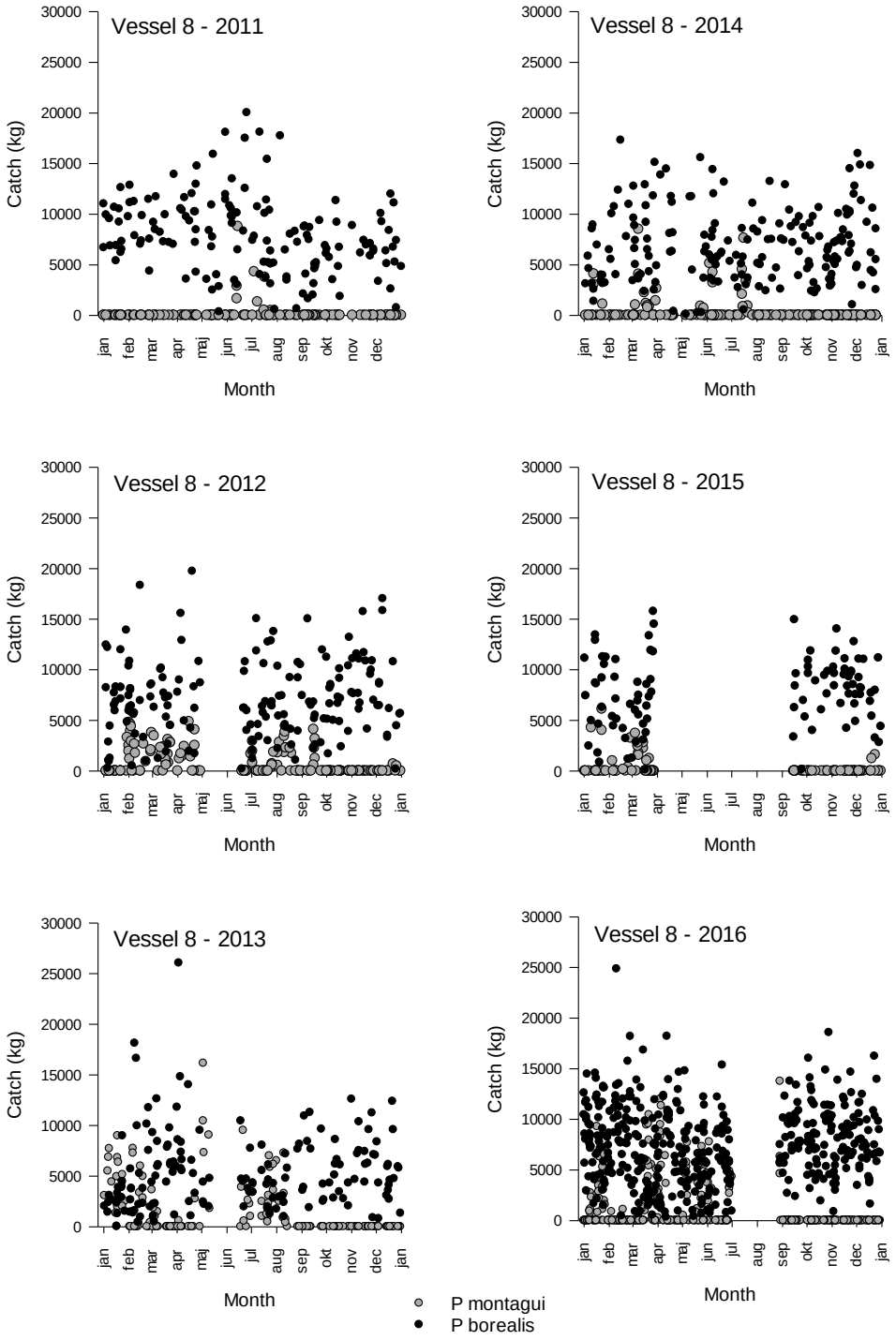


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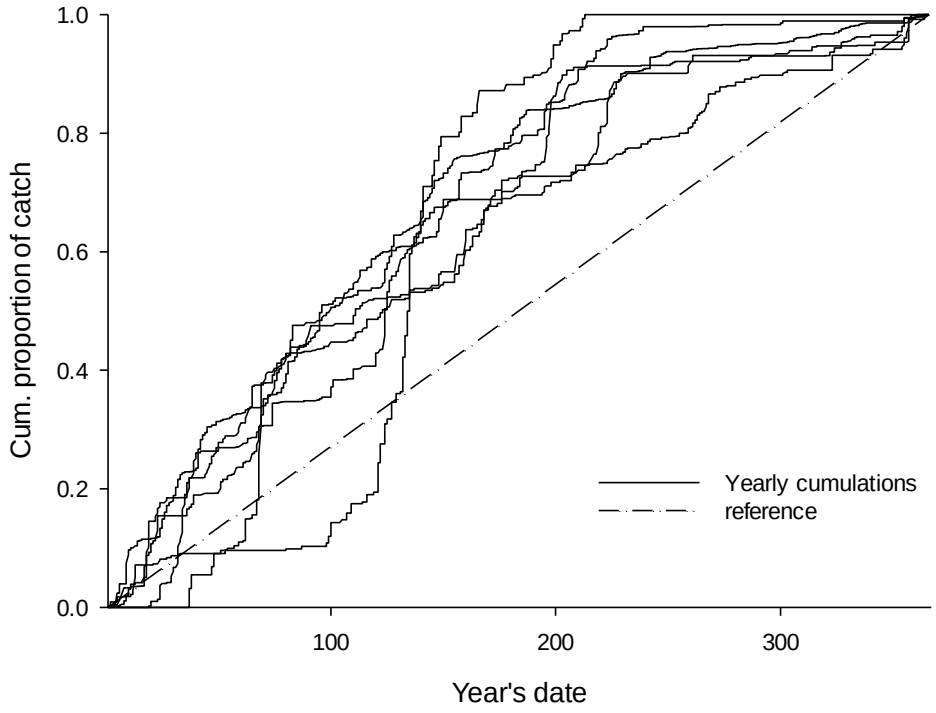


Fig.12. *Pandalus montagui* in the West Greenland shrimp fishery: seasonal distribution of catches of *P. montagui*, 2011–2016.