Centre for Environment Fisheries & Aquaculture Science

Cefas

Lobster Parasite Analysis

May 2022

Author(s): Redacted **Date in format: 28th June 2022**

This publication is available at www.gov.uk/government/publications www.cefas.co.uk

Cefas Document Control

Submitted to:	Redacted Domestic Fisheries & Reform, Defra
Date submitted:	11/07/2022
Project Manager:	Redacted
Report compiled by:	Redacted
Quality control by:	Redacted
Approved by and date:	Redacted
Version:	1.0
Recommended citation for this report:	Redacted Lobster Parasite Analysis, Cefas Reports

Version control history

Version	Author	Date	Comment
0.1	Redacted	28/06/22	First draft
0.2	Redacted	02/07/22	QA
0.3	Redacted	07/07/22	Review
1.0	Redacted	11/07/22	QC - FINAL

Contents

Figures

1. Executive Summary

- This report provides an overview of the literature available on the lobster parasite *Nicathoë astaci* and confirms presence of this parasite in lobsters sampled from North Yorkshire.
- This study invstigated five lobsters from a wholesaler in Staithes, North Yorkshire. The gills of three of the lobsters were infested by the parasitic copepod *Nicathoë astaci.*
- Two of the lobsters were heavily infested, however these levels of infestation would not necessarily cause mortality.
- Lobsters have been shown to cope with high parasite loading (266 parasites per lobster being recorded in Scotland).
- Intensity of infection has been reported to vary between soft- and hard-shelled individuals, with lower numbers of mature adult parasites reported in soft-shelled lobsters.
- Parasite infests soft-shelled lobsters; parasite is shed when the lobster moults.

- Infection is not usually associated with mortalities, However, elevated mortality has been reported in lobsters from holding facilities in France.
- No other abnormalities were observed in the lobsters examined.

2. Introduction

Following reports of increased incidence of parasites in the gills of lobsters in North Yorkshire a small-scale study was undertaken to investigate. This report provides a review of the literature available on the gill parasite, details the sampling, provides images, and details the associated pathology observed in lobsters sampled from the region.

Nicathoë astaci is a nicothoid copepod that has been reported to infest European lobsters (*Homarus gammarus*) since the 1800s. Commonly referred to as the "lobster louse" it has been shown to be distributed in the eastern Atlantic Ocean from as far north as Scotland and Norway and as far south as Portugal (Davies et al. 2014). Female *N. astaci* are commonly observed attached to the gills of lobsters. The adult female consists of three parts, a cephalothorax, a thorax which bears two lateral expansions or wings and an abdomen which carries two oval egg sacs (see Fig 1). Egg sacs can contain several hundred eggs. Males have not been observed to date. Mason (1959) studied the development cycle of these parasites and showed that final stage copepodids possessed spermathecae containing sperm. Female-biased sex ratios are reported to be common in copepods (Gusmão & McKinnon 2009), However, it is also possible the parasites are intersex (Michaud et al. 1999). The complete lifecycle of the parasite is unknown.

N. astaci attaches to the gill filaments via its mouthparts, using a vacuum mechanism to attach and feed upon host haemolymph (Shields et al. 2006, Davies et al. 2014). Attachment of the parasite leads to damage in the gill filaments and a host response of melanisation and haemocytic infiltration around the sites of parasite attachment (Wootton et al. 2011). The parasites are shed when the lobster moults, the parasite being removed as the outer covering of the gills is shed, leaving the gills clean (Mason 1959, Shields et al. 2006).

Lobsters have been shown to cope with very high parasitic loads. In a study by Wootton *et al*., (2011) a highly variable intensity of infection was shown between individuals ranging from 4 – 137 copepods/lobster in lobsters sampled from Lundy Island, UK. Mason (1959) showed that the intensity of infection varied between soft- and hard-shelled individuals sampled from Scottish waters, reporting mean numbers of parasite per lobster ranging

from 0 – 55 in soft/fairly soft shelled individuals and 23 – 266 in hard shelled individuals. Differences were also shown between numbers of juvenile and adult parasites, adult parasites being more commonly observed in hard shelled lobsters. Female parasites with small wings but without egg sacs were found almost entirely on lobsters which had recently moulted (Mason, 1959).

N. astaci can only infest recently moulted, soft-shelled lobsters, the parasite attaching to the host before the gills harden (Mason 1959, Shields et al. 2006). Mason (1959) also reported a seasonal rythym in the release of larvae by adult female parasites with two peaks of release, one of which was shown to correspond with the lobsters' main moulting period and the second with a subsidiary moulting period of younger lobsters.

N. astaci infection is not usually associated with mortalities. Lobsters are thought to compensate for any putative reduction in respiratory function with an increase in concentration of circulatory haemocyanin (Davies et al. 2015). However, elevated mortality has been reported among lobsters in holding facilities in France, lobsters shown to have high parasite loads (Davies et al. 2015).

3. Methods

Cefas obtained a sample of 5 lobsters from a merchant in Staithes, North Yorkshire. Lobsters had been kept in holding tanks prior to collection on 25/05/22.

3.1. Sampling details

Lobsters were transported to the Cefas Weymouth laboratory for sampling. Four of the lobsters were dead upon arrival. The remaining live lobster was humanely euthanised using the Crustastun™ electrical stunning device. All 5 lobsters were dissected: hepatopancreas, gill, heart, gonad, antennal gland, and muscle tissues were removed and fixed in Davidson's Sea water fixative for histology. Additional samples of gill were fixed in 95% ethanol for light microscopy, whole gill filaments were examined using a Leica M125 stereoscope.

3.2. Histology

Fixed samples were processed to wax in a vacuum infiltration processor (Leica Peloris) using standard protocols. Sections were cut at a thickness of 3-5 µm on a rotary microtome and were mounted onto glass slides before staining with haematoxylin and

eosin (H&E). Stained sections were analysed by light microscopy (Nikon Eclipse E800) and digital images were taken using the Lucia™ Screen Measurement System (Nikon, UK).

4. Results

Lobsters were examined for presence of gill parasites upon collection, the carapace being lifted to reveal the gills. Three of the 5 lobsters sampled were shown to possess gill parasites. The intensity of infection varied between these individuals. One lobster displayed low level infestation (Fig 1A) with parasites observed on a few gill filaments. In contrast 2 of the lobsters displayed a heavy infestation with multiple parasites observed attached to each gill filament (Fig 1B&C). Total number of parasites per lobster was not recorded.

Upon dissection individual gill filaments were removed for observation under the stereoscope. Multiple parasites could be seen attached to the surface of the gill filament; egg sacs observed protruding from the gill surface (Fig 1D). Parasites which became dislodged displayed the characteristic structure described for *N. astaci*, a central cephalothorax containing the mouthparts where the parasite attached to the gill filaments, a lateral expansion or wing on either side and two oval egg sacs (Fig 1D).

Tissues were examined histologically; parasites could be identified within the sections of gill tissues, situated between the gill filaments (Fig 1 E&F). Damaged gill filaments were observed in the vicinity of these parasites, tips of the gill filaments appearing necrotic. The site of attachment for the parasite was also observed, parasite no longer attached in section. Haemocytic nodules consisting of a central melanotic core were surrounded by a sheath of haemocytes at the periphery of the gill filament, just underneath the cuticular layer (Fig 1F). Mild thickening of the cuticle was also observed adjacent to the site of attachment.

No abnormalities were detected in the remaining tissues of any of the lobsters sampled.

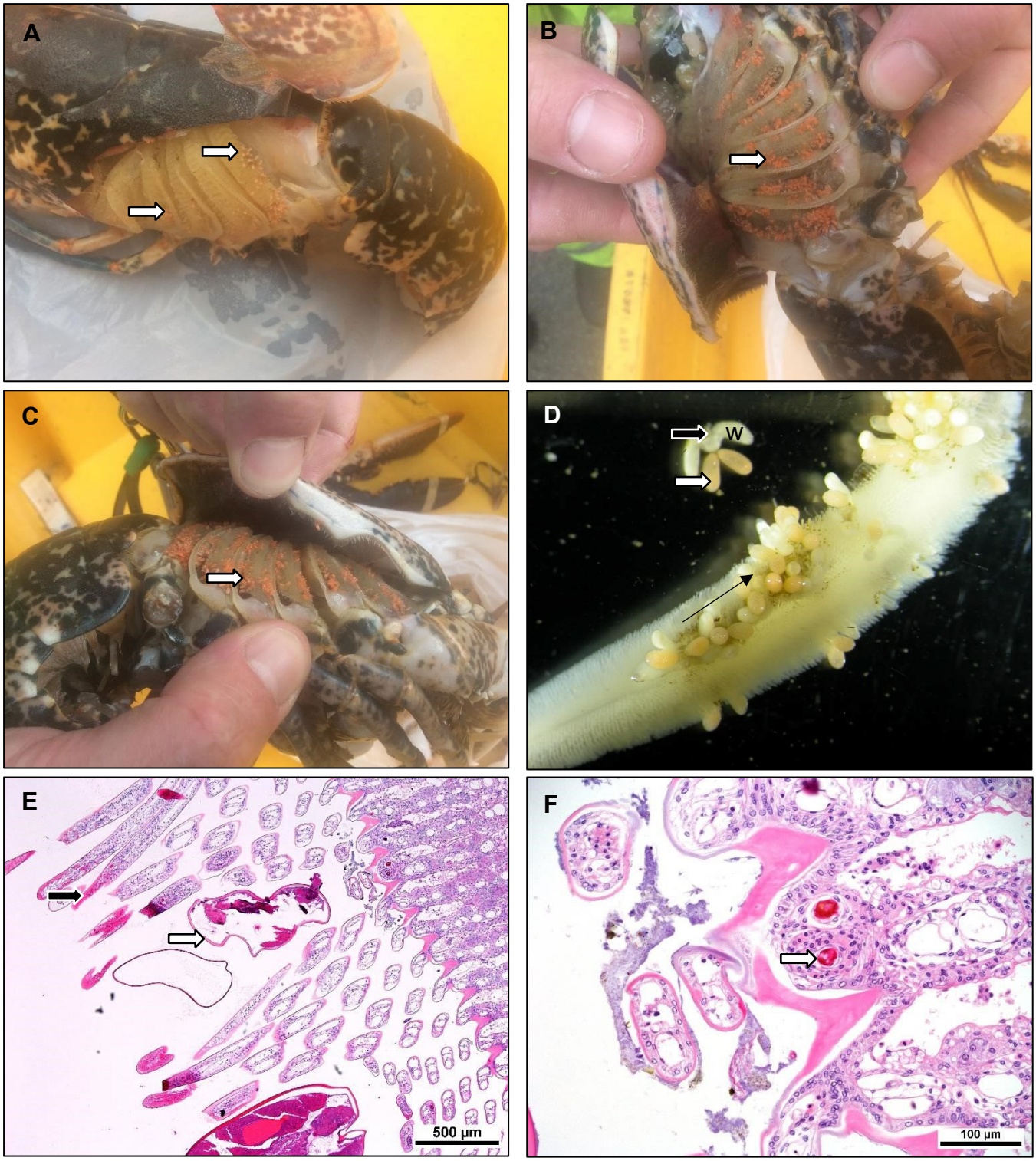

Figure 1. A - C. Copepod parasite *Nicathoë astaci* attached to gill filaments within the branchial chamber of lobsters (images provided by John Worswick). Note the variation in intensity of infection, low level (A) and high level (B-C). D. Morphology of adult female *N. astaci* detached from gill filament showing cephalothorax (black arrow), wings on either side of the thorax (w) and egg sacs (white arrow). Egg sacs from female parasites still attached to gills can also be seen along the gill filament (line arrow). E. Damaged gill filaments (black arrow) can be seen in vicinity of *N. astaci* parasites (white arrow). H&E Stain. Scale bar = 500 µm. F. Site of attachment of parasite, haemocytic nodules consisting of central melanotic core (white arrow) surrounded by a sheath of heamocytes. H&E Stain. Scale bar = 100 µm.

5. Summary

Three out of five lobsters sampled from a merchant in Staithes, North Yorkshire, were infested with the parasitic copepod *Nicathoë astaci.* The structure and size of the parasites attached to gills corresponded with the published descriptions of *N. astaci* (Mason, 1959; Shields et al. 2006; Wootton et al. 2011; Davies et al. 2014). Two of the lobsters sampled displayed a heavy level infestation with multiple parasites being observed distributed throughout each of the gill filaments. Heavy infestations have been previously reported in the literature with Mason (1959) describing 266 parasites per lobster in hard shelled lobsters. The lobsters sampled in this study showed a similar level of infestation. Infection with this parasite is not commonly associated with mortalities.

N. astaci infests the lobster at the intermolt stage, when the individual is soft shelled. The lobsters sampled in this study would have acquired this level of parasite during the last moult. Lobsters usually molt May to August, mature males every year, females evey second year. A subsidiary molting season has been reported in younger lobsters in November (Thomas, 1958). Parasites then mature within the gill chamber and release their larvae throughout the year but peak twice, the first in May or June and the second in November which coincides with the moult cycle of lobsters (Mason, 1959; Shields et al. 2006). The parasite is shed from the lobster during molting.

6. References

Davies CE, Thomas GR, Maffeis TGG, Wootton EC, Penny MW, Rowley AF (2014) Detailed surface morphology of the 'lobster louse' copepod, Nicothoë astaci, a haematophagous gill parasite of the European lobster, Homarus gammarus. J Inv Pathol 122:48-51

Davies CE, Vogan CL, Rowley AF (2015) Effect of the copepod parasite Nicothoë astaci on haemolymph chemistry of the European lobster Homarus gammarus. Dis Aquat Org 113:169-175

Gusmão LFM, McKinnon AD (2009) Sex ratios, intersexuality and sex change in copepods. Journal of Plankton Research 31:1101-1117

Mason J (1959) The biology of Nicothoë astaci Audouin and Milne Edwards. Journal of the Marine Biological Association of the United Kingdom 38:3-16

Michaud M, Thomas F, Becheikh S, Raibaut A, Shykoff JA, Renaud F (1999) Stagedependent decisions in a parasitic copepod practising environmental sex determination. Marine Ecology Progress Series 185:189-193

Shields JD, Stephens FJ, Jones B (2006) Pathogens, Parasites and Other Symbionts. In: Phillips BF (ed) Lobsters: Biology, Management, Aquaculture and Fisheries. Blackwell Publishing

Thomas, H.J. (1958) Some seasonal variations in the catch and stock composition of the lobster. J. Cons. Int. Explor. Mer 24:147-154

Wootton E, Pope E, Vogan C, Roberts E, Davies CE, Rowley A (2011) Morphology and pathology of the ectoparasitic copepod, Nicothoë astaci (‘lobster louse’) in the European lobster, Homarus gammarus. Parasitology 138:1285-1295

Centre for Environment Fisheries & Aquaculture Science

Cefas

We are the government's marine and freshwater science experts. We help keep our seas, oceans, and rivers healthy and productive and our seafood safe and sustainable by providing data and advice to the UK Government and our overseas partners. We are passionate about what we do because our work helps tackle the serious global problems of climate change, marine litter, over-fishing, and pollution in support of the UK's commitments to a better future (for example the UN Sustainable Development Goals and Defra's 25-year Environment Plan).

We work in partnership with our colleagues in Defra and across UK government, and with international governments, business, maritime and fishing industry, non-governmental organisations, research institutes, universities, civil society, and schools to collate and share knowledge. Together we can understand and value our seas to secure a sustainable blue future for us all and help create a greater place for living.

OGL

Pakefield Road, Lowestoft, Suffolk, NR33 0HT

The Nothe, Barrack Road, Weymouth DT4 8UB

www.cefas.co.uk | +44 (0) 1502 562244

disability confident EMPLOYER

LRQA CERTIFIED ISO 9001:2015

LRQA CERTIFIED ISO 45001