Progress with European Spiny Lobster Culture

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Llywodraeth Cymru
Welsh Government
Y Gronfa Pysgodfeydd Ewropeaidd: Buddsoddi mewn Pysgodfeydd Cynaliadwy
European Fisheries Fund: Investing in Sustainable Fisheries
Marine Institute
Foras na Mara
The FISHMONGERS' Company
NATURAL ENGLAND

Status

- Classed as “Vulnerable” by IUCN – ‘a species likely to become endangered unless circumstances threatening its survival and reproduction improve’.
- High ecological, conservation and socio-economic relevance to UK and Europe. Identified for priority conservation action in the UK Biodiversity Action Plan (BAP) under the Natural Environment and Rural Communities Act 2006.
- Species of Conservation Importance with a conservation objective of recovery within several Marine Conservation Zones (MCZs) (Natural England, 2017).

- England landings have been falling from a peak in 1969 at over 100 tons (Hepper, 1977) to only 12 tons in 2014 (MMO, 2017).
- South coast Ireland – large numbers of juveniles (Tully, 2019 pers. com.)
- Signs of recovery in Devon and Cornwall – reasons unclear.
- In N. Wales, 3 individuals landed in 2019

Published data on *P. elephas*

Kittaka and Ikegami, 1988; Kittaka & Abrunhosa, 1997; Kittaka 1997; Kittaka, 1994; Kittaka et al., 2001

Summary:

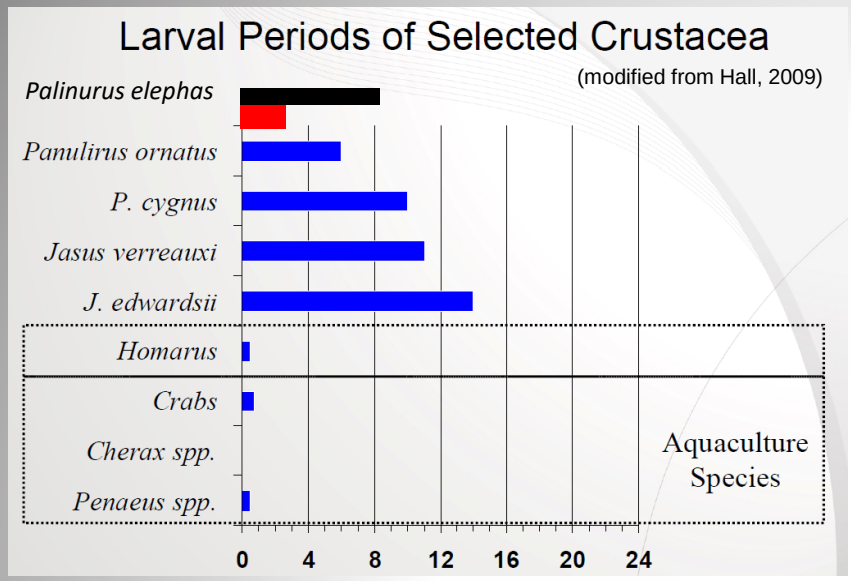
- phyllosoma hatch at a more advanced stage cf other spiny lobster sp.
- in more than 10 years of trials survival in culture was poor with up to 70% mortality to Stage II phyllosoma.
- White gut syndrome - a significant issue during phyllosoma culture – antibiotics used but survival still low
- poor performance on Artemia feeds - fish larvae gave superior results
- secured 5 pueruli in 65 days
- moulted into juveniles in an average of 39 days (total 104 days).

Positive Farming Attributes of *P. elephas*?

Corsica market June 2012 - €65 / kg

- spiny lobsters meet several key criteria for RAS production
- high market price €40 - 120 / kg whole (Groeneveld et al., 2013)
- strong export market - red colour - Japan and China
- readily breed in captivity
- adapts readily to pelleted feeds
- length of the larval period can be reliably reduced

- communal species with no evidence of cannibalism among adults
- no cannibalism between phyllosoma
- no competition from EU farmed production (hatchery high entry point)
- European capture fishery down 90-95%
- highly sensitive species to fishing pressure
- very slow recovery from overfishing



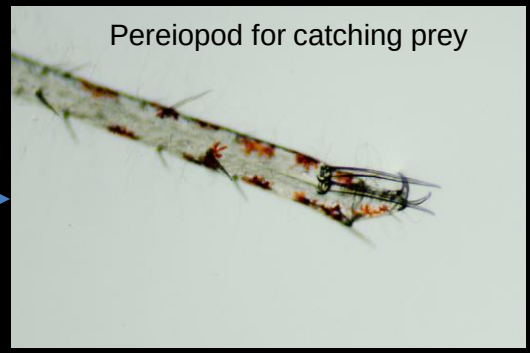
- under culture conditions *P. elephas* has the shortest larval period to juvenile of any spiny lobster sp
- plasticity of *P. elephas* phyllosoma and pueruli

- phyllosoma Stage I (TL 2.5mm) to final phyllosoma stage (TL 20-24mm).
- demonstrate a range of behavioural and physiological changes

- phyllosoma adapted for capture and killing of live prey

Culture success requires serial changes in:

- tank design for different phyllosoma stages
- specific water quality parameters
- feed type and nutrient profile



Progress with feed development

Development of an artificial feed is essential

- early formulations either totally unattractive or resulted in intense aversion
- identified some key physical and feed attractant properties
- pellet remains acceptable to the phyllosoma >24h after immersion
- technique allows delivery of probiotics and key nutrients
- a high sensitivity and interaction of both culture environment and feed quality on survival, growth, intermoult duration and instar size
- a nutrient deficiency is not necessarily detected until a later phyllosoma stage - feeding simply slows and then stops – but larvae may still continue to live for several weeks?

- No antibiotics used in any trials.
- 2018 trials: Phyllosoma survival: Stage I – III = 67%; Stage III – V = 78%. Feeding slowed, trials terminated at Stage VII.
- 2019 trials: Phyllosoma survival: Stage IV – VIII = 54%. Cultures continued to final phyllosoma Stage at day 65
- *feed still requires improvement to secure more uniform development of cultures*

- immediately prior to final moult to puerulus, final stage phyllosoma undergo a 3-4 day period of non-feeding while the gut retracts from the cephalic shield (first described by Ventura et al., (2015) in *Sagmariasus verreauxi*).

- final stage phyllosoma moulted into pueruli at 76 days (16C). (Kittaka : puerulus 65-69 days, 16-18C)
- pueruli moulted into juvenile lobsters in 16-17 days at 16C (total 92 days) cf (~104 days – Kittaka).
- pueruli - a pinkish/white colour (not fully transparent).

Palinurus elephas - 10 day juvenile (1.5cm TL) and 5 day puerulus

- no obvious feeding by pueruli
- pueruli can become benthic immediately
- juveniles undergo first moult at 24 days at 19-20C
- no aggression between juveniles or pueruli

- in *Panulirus ornatus* growth and feeding response higher, possibly due to social cues, in juveniles reared communally rather than individually (Marchese et al., 2019)

Eventual Opportunities with *P. elephas*

In cooperation with fishing cooperatives:

- possible high value seafood species for diversification of EU coastal aquaculture
- potential support for fishery restoration "*Captive rearing and release is also a possibility – decline has been so great that restoration is needed" (Hiscock et al., 2011)*
- international need for hatchery and ongrow RAS technology for spiny lobster culture to address the very significant non-sustainable fishing/culture practices.

Climate Change

Key global lobster fisheries in decline - climate change impact on larval development and recruitment (Fitzgibbon et al., 2012; Pecl et al., 2014; Cetina-Heredia, 2015) e.g. *Homarus americanus, (*Wahle et al., 2015; Greenfield, 2019), spawning behaviour in *Panulirus cygnus* (Lestang et al., 2015), weakening tidal currents and degraded juvenile settlement habitat for *Jasus edwardsii* (Wilkin & Jeffs, 2011; Hinojosa et al., 2015).

Poaching and overfishing

West coast rock lobster fishery, *Jasus lalandii*, S. Africa, 2% historical levels (Pillay, 2016).

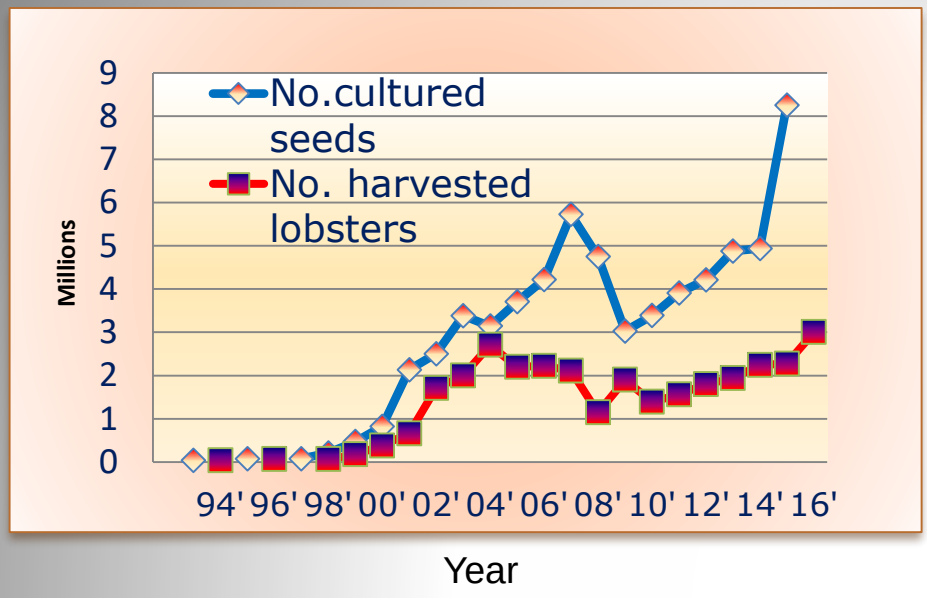
Red rock lobster, *Jasus edwardsii*, 'functionally extinct' in the Hauraki Gulf, New Zealand (Dickey, 2016).

Single haul of illegally captured lobster amounted to nearly 5000 tails

Threat from aquaculture - Vietnam and Indonesia spiny lobster fisheries

- fattening of lobster juveniles in Vietnam = US$65 million for 1500-2000 tonnes pa production. During 2012, Indonesia production was 61 tonnes (US$2 million) (Jones, 2015).
- only simple cheap equipment needed to capture and fatten seed lobsters so is ideally suited to coastal villages. However, lobster grow-out in Indonesia has declined 95% since 2012 despite increased seed catch. The focus is on seed sales (Jones 2018).
- harvest rates grew from 0.5 million pa in 1999 to current levels >10 million pa.
- overseas aid assisted an industry that is entirely dependant on wild caught juveniles.

Juvenile Mortality



Typhoon Damrey, 2017

- annual juvenile mortality rate increasing, encouraging increased harvesting
- mortality from puerulus to juvenile is 40–60% sometimes 100%
- with a 10% juvenile mortality annual production could be doubled without increasing seed harvest (Jones, 2015)
- sector is entirely dependent on supplies of *trash* fish. Based on 1,500 tonnes production pa this results in 225 to 615 tonnes of nitrogen released annually (Jones, 2015)

Environmental Impact

NhaTrang, Vietnam.

Significant plastic waste from cage sector while organic pollution causes disease:

- 82% of farmers using up to 13 different antibiotics at a rate of >5kg/tonne of lobster produced (Hedberg et al., 2018)
- several antibiotics listed as “critical” and “highly important” for human medicine (WHO) used prophylactically and routinely
- no effect on the survival of the stock or profit of the farm
- farmers live on cage farm – harvest fish and shellfish from cages - risk for the spreading of human antibiotic resistant pathogens

The ARC Research Hub for Commercial Development of Rock Lobster Culture Systems

IMAS rock lobster project granted $5 million in Australian Research Council funding

BRUCE MOUNSTER • MERCURY • NOVEMBER 12, 2014 11:09AM

BE THE FIRST TO RESPOND

TASMANIA has become a world leader in rock lobster farming techniques, thanks to an Institute of Marine and Antarctic Studies research project.

The four-year-old project to develop a commercial hatchery at IMAS's Taroona laboratories was yesterday granted an extra $5 million in Australian Research Council (ARC) funding.

The project has built on 15 years of research, during which scientists worked out how to breed and rear lobsters in captivity.

Tasmania has become a world leader in rock lobster farming techniques.

The project aims to restock local fisheries and pave the way for lobster farming

Financial backing from US restaurant company the Darden Group. $5m – Australian Research Council

Univ. Tasmania closed cycle of 3 spiny lobster species (Battaglene, 2015).

Hatchery Production of Southern Rocklobster in Tasmania

Scientists at the University of Tasmania recently produced Australia's first hatchery-reared Southern Rocklobsters from eggs, an important achievement in the move towards sustainable farming of lobsters.

Dr Arthur Ritar and Dr Greg Smith examining phyllosoma culture.

"The hatchery larval period was only 12 months and we expect to further reduce this with improvements in husbandry, nutrition and system design," Dr Ritar said.

"Lobsters have several attributes that make them suitable for aquaculture in that they are highly sought after and achieve a premium price in the market.

"The juveniles are hardy, suffering few diseases in captivity, and can tolerate relatively high stocking densities and exhibit

on lobster propagation, with funding from their Rocklobster Enhancement and Aquaculture Subprogram. Initial efforts were concentrated on the capture of lobster puerulli and juveniles from the wild and their grow-out for farming in land-based tanks. However, it quickly became apparent that while lobsters survived and grew well in captivity, large-scale aquaculture could not rely on exploiting the wild resource because supply was highly variable from year to year and the larvae were very difficult

HOT SPOTS

:: Australia's first hatchery-reared Southern Rocklobsters from the egg

:: Larval period reduced from 2 years to 12 months

:: Larval rearing program well ahead of schedule

The larval rearing program funded by FRDC is well ahead of schedule. This is attributed to a better understanding and control of larval health.

"Minimising bacterial diseases has been crucial to our success and

Lobster industry shake-up predicted after Tasmanians find 'holy grail' of aquaculture. H. Aird & E. Gramenz, 8 Oct., 2016

"It's very exciting ... because it's basically one of the holy grails of aquaculture because it is such a long and difficult larval cycle.“ (Smith, 2016).

Green light given for world's first onshore lobster farm in Tasmania. Undercurrent News Sep. 5, 2019

First pilot P. ornatus hatchery under construction. Further $45million will be invested in research and development, building and operating the pilot-scale hatchery over the next two to five years.

Sincere thanks to:

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