Environmental Development xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Environmental Development

journal homepage: www.elsevier.com/locate/envdev

The onset and withdrawal of the rainy season in Thailand and their effects on oyster farming

Panu Trivej*, Kamphol Kesjinda

Kasetsart University, Thailand

ARTICLE INFO

Keywords:
Oyster
Monsoon
Onset
Withdrawal
Global warming
Rainy season

ABSTRACT

Oyster farming is among the main economic activities in eastern Thailand. The timing of when to harvest and to seed the new mollusk larvae is determined by the salinity of the river, which in turn depends on the influence of the monsoon. The harvest has to be carried out before a mass of fresh water flows down the river in July. The farmers seed the larvae for the next year's products in December. Global warming potentially extends and intensifies the rainy season, disrupting the harvest cycle and harming oyster products. This research attempts to predict when the rainy season will end by looking at the relationship between the onset of the season in May and the withdrawal in October. Based on statistical analysis, years with an early onset have a late withdrawal, and years with a late onset have an early withdrawal. This knowledge can help farmers decide when to seed the mollusk larvae, and is a useful adaptation tool in dealing with the effects of global warming.

1. Introduction

The oyster is an important agricultural product of Thailand. Oyster farming originates in the eastern provinces. It is believed that the local people learned the technique from Chinese immigrants eighty years ago. Throughout Thailand, oyster farms cover an area of about 3 million square kilometers, producing 18 thousand tons of oysters in 2013, of which 14 thousand tons come from eastern Thailand alone. Per square kilometer, oyster farms here are twice as productive as the rest of the country.

Three commercially important species of oysters are *Saccostrea commercialis*, *Crassostrea lugubis*, and *Crassostrea belcheri*. The latter two are bigger, naturally produced and captured. While these species commanda higher market value, only the first is generally cultured. Once harvested, *S. commercialis* can be shucked, that is, to have its shell removed, and frozen to exploit distant markets.

Oyster farms in eastern Thailand are located at the mouth of the Welu river (Fig. 1). The site provides a hard, stable bottom of intertidal flats which can support heavy collectors for spat attachment and growth (Tanyaros, 2015). The preferred farming method is suspension culture. The practice is popular in Japan, the United States and Europe. Oysters grow fast and give high yields because they can grab food easily, consume little energy, and encounter few pests. Also unlike other methods, farmers face a smaller sedimentation problem.

The Welu is a natural border between Chanthaburi province and Trat province. Its approximate length is 88 km. The mouth of the Welu is a well-known site for oyster farming. The farms here alone produced 40 million USD worth of oysters in 2013. Their economic value is in fact even more than that since oyster farms famously attract tourists too.

Oyster seeding begins around December when farmers purchase oyster larvae, stick them to concrete stabs, string the stabs together, and tie them to a bamboo raft (Fig. 2). The oysters take about six months to mature, and the harvest is in June, give or take a

* Corresponding author.
E-mail address: p2trivej@yahoo.com (P. Trivej).

https://doi.org/10.1016/j.envdev.2018.05.002
Received 27 July 2017; Received in revised form 15 May 2018; Accepted 15 May 2018

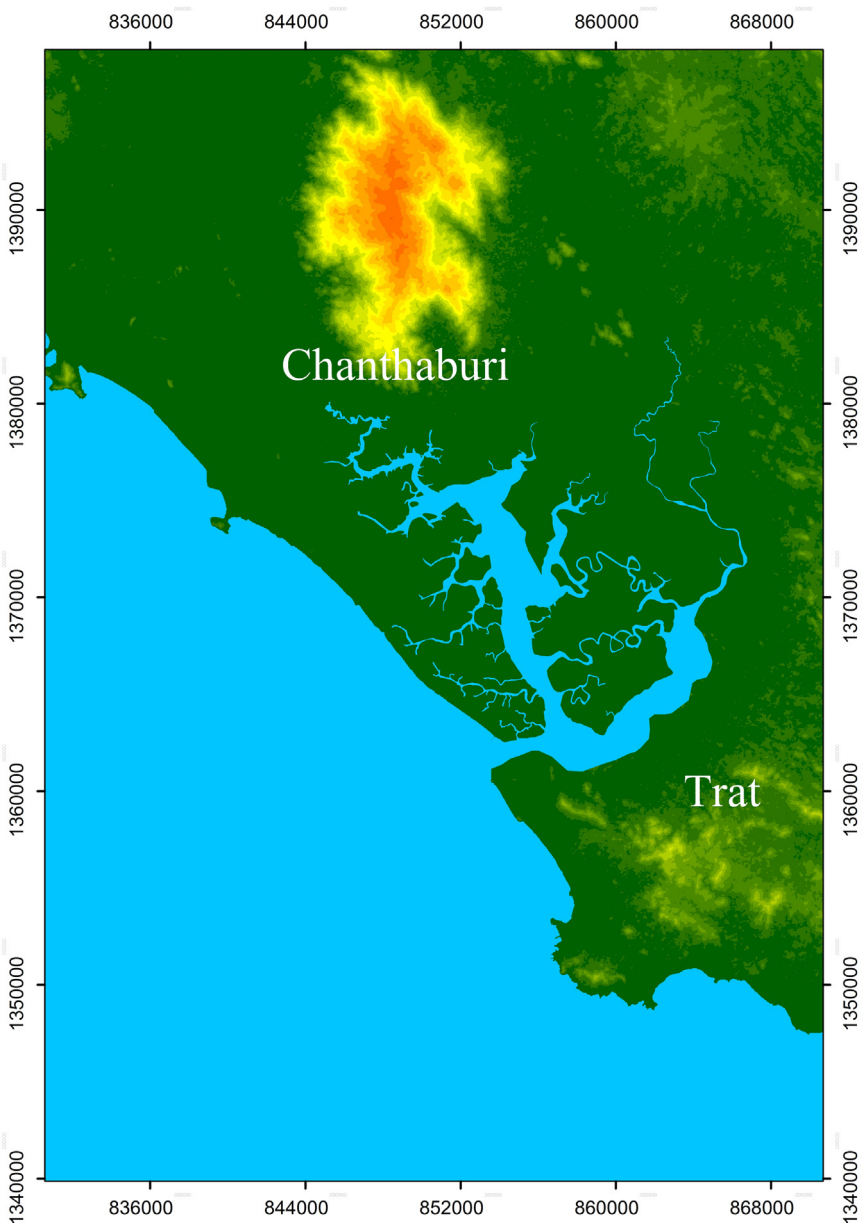

Fig. 1. The Welu River of eastern Thailand.

few weeks. The problem, however, is that in July, oysters will start to fertilize, with males releasing sperm and females releasing eggs. These activities consume a lot of energy, and afterward oysters will become emaciated, no longer fit for harvest, and have to be kept for another year. Unable to sell their products, not only will the farmers lack money to run the farms, but keeping the leftover oysters also incurs extra costs.

Lately leftover oysters have become increasingly common. It has been harder and harder for farmers to time their harvest cycle properly. We present the hypothesis that global warming may be one of the causes.

The effects of anthropogenically induced climate change vary from region to region (Hu et al., 2000). In the Indochina peninsula, the overall effect is the lengthening of the rainy season with more intense rainfall and a higher probability for extreme weather events (Hu et al., 2000). These factors combined, especially the lengthening of the season, affect oyster farms since the harvest cycle is regulated by the salinity of the river, which in turn depends on the amount of rainfall.

Our aim is to build a simple prognostic tool to determine the appropriate time for oyster seeding. This adaptation tool can help farmers deal with the changing climate. It is based on statistical analysis between the onset date of the monsoon and the withdrawal date. The advantage of this method over numerical simulation is its simplicity; we can make a forecast without any intricate computational equipment. Since the onset is an everyday phenomenon which directly influences farmers, the knowledge regarding the