CEPF Final Project Completion Report

Organization Legal Name	Hainan Hele-crab Conservation Center
Project Title	Co-development of biodiversity, community and livelihood in Xiaohai, Hainan.
CEPF GEM No.	CEPF-038-2015
Date of Report	Period of Reporting: 2015.6.1-2016.5.31 Date of Report Submission: 2016.11.15

CEPF Hotspot: Indo-Burma Hotspot

Strategic Direction: 6, which seeks to engage key actors in mainstreaming biodiversity, communities and livelihoods into development planning in the priority corridors.

Grant Amount: US$19,906

Project Dates: 2015.6.1 - 2016.5.31

1. Implementation Partners for this Project *(list each partner and explain how they were involved in the project)*

1.1 Wanning municipal government:
- Provided statistics and history documents for the survey of Xiaohai's ecology and livelihoods;
- Provided government development plans about the Xiaohai area;
- Hosted a multilateral seminar on Xiaohai's ecology, including a discussion on the proposed protection plan, and the promotion of sustainable livelihoods;
- Considered the project suggestions in the latest government development plan.

1.2 Local communities：
- Provided information for the survey of Xiaohai's ecology and livelihoods;
- Helped accomplish the practical manual for eco-friendly hele-crab farming;
- Discussed about the proposed protection plan for Xiaohai's ecology;
- Adopted the eco-friendly hele-crab farming instead of the traditional shrimp farming.

1.3 Experts from Hainan Birding Watching Society, Ocean and Fishery Department of Hainan University, and Hainan Academy of Ocean and Fishery Science:
- Participated in the survey of Xiaohai's ecology and livelihoods;
- Discussed about the proposed protection plan for Xiaohai ecology;
- Helped accomplish the practical manual for the eco-friendly hele-crab farming.

Conservation Impacts

2. Describe how your project has contributed to the implementation of the CEPF investment strategy set out in the ecosystem profile

The project of co-development of biodiversity, community and livelihoods in Xiaohai, Hainan falls under Strategic Direction 6, which seeks to engage key actors in mainstreaming biodiversity, communities and livelihoods into development planning in the priority corridors.

The key actors who can directly influence development planning in the Xiaohai area are the local government and the communities. The project has engaged both of these stakeholder groups in carrying out a survey of Xiaohai's ecology situation, developing a protection plan, and in exploring sustainable livelihoods such as eco-friendly hele-crab farming and eco-tourism.

Through these activities, the project has contributed to the development of a common viewpoint among environmental organizations, local government, and local communities about the significance and urgency of protecting Xiaohai's natural environment and promoting more sustainable livelihoods in the area's development plans. In addition, the project has mainstreamed biodiversity, communities and sustainable livelihoods of Xiaohai area into the latest government development plan.

3. Summarize the overall results/impact of your project

3.1. The government and communities are aware of the significance and urgency of protecting Xiaohai's natural environment;

3.2 The government has declared to establish a Xiaohai wetland park or nature reserve before 2019;

3.3 More communities are abandoning polluting prawn farming, and taking up eco-friendly hele-crab farming as a more sustainable livelihood option;

3.4 The proposal of the project including ecological protection plan of Xiaohai, the promotion of eco-farming hele-crab and eco-tourism has been written into the latest released government development plan of Xiaohai area.

Planned Goal (as stated in the approved proposal)
Agriculture and tourism development in Xiaohai is undertaken in a manner that is not destructive to the local environment, biodiversity, communities, or livelihoods.

4. Actual progress toward Goal at completion
Through this work, we have made significant progress towards the project goal.

Planned Objectives (as stated in the approved proposal)

1. A detailed protection plan which enjoys broad support from government and local communities is produced, based on up-to-date information on the status, values, and threats to Xiaohai's natural environment;

2. The benefits of hele-crab eco-farming are understood and adopted by communities in Xiaohai;

3. The potential for eco-tourism is recognized by the Xiaohai tourism development plan.

5. Actual progress toward Objectives at completion

All objectives were satisfactorily achieved at completion.

6. Describe the success or challenges of the project toward achieving its goal and objectives

Communication with the government and local communities takes a lot of time. The government tends to not provide the statistics and materials that reveal that the Xiaohai environment and livelihoods are rapidly deteriorating. And it is difficult to get Xiaohai development plan from the government department. Some farmers, due to the fear of economical loss, not only refuse the option for the eco-friendly hele-crab farming as a sustainable livelihood, but also persuade other neighbors to refuse our help.

After the project, the local government admits that our activities helped them get a more comprehensive understanding of the situation that the Xiaohai development plan is facing. In addition, a more feasible plan mainstreaming biodiversity, communities and livelihoods into Xiaohai development planning has been designed and published by the government.

7. Were there any unexpected impacts (positive or negative)?

Activities 1.2 (carrying out a survey of recent and historical changes to Xiaohai's ecology), and 1.3 (carrying out a field survey of Xiaohai's ecology) both took us much more time than we had planned.

Activity 2.1 (carrying out a survey of livelihoods in Xiaohai) could not be finished before Nov 30th, 2015. The questionnaire about the livelihoods of the farmers could not be recorded very well if the farmers answered the questionnaire on their own. Detailed and reliable statistics need to be recorded through interviewing the farmers one by one, which is very time-consuming.

Regarding Activity 1.5 (Hold a multilateral seminar on Xiaohai's ecological situation, including a discussion on the proposed protection plan, and the possibility of establishing a wetland park or nature reserve. The seminar will be attended by government officials and experts representing the project partners.), the local government insisted on only attending the seminar held in their name, and only invited the experts they were familiar with. As a result, the seminar was held at the government council chamber on April 28th, 2016. It was rather an internal meeting among the key parties who had actual influence on the development plan of Xiaohai area, such as Wanning local government, Hainan Government Ocean and Fishery Department, and the

experts who took part in designing the Xiaohai development plan. We were not allowed to invite other experts to join the seminar.

Project Activities and Deliverables

Objective 1 (as stated in the approved proposal):
A detailed protection plan which enjoys broad support from government and local communities is produced, based on up-to-date information on the status, values, and threats to Xiaohai's natural environment.

Activities	Deliverables
Activity 1.1: Train 10 researchers in ecological survey techniques	10 researchers trained
Activity 1.2: Carry out a survey of recent (through fieldwork) and historical (through a literature review) changes to Xiaohai's ecology.	Survey completed. Results documented in a survey report.
Activity 1.3: Carry out a field survey of Xiaohai's ecology, in collaboration with local government, environmental organizations, research institutions, and local communities.	Survey completed. Results documented in a survey report.
Activity 1.4: Use the results of survey work to draft a biodiversity and ecosystem protection and restoration plan for the Xiaohai area.	Protection/restoration plan drafted.
Activity 1.5: Hold a multilateral seminar on Xiaohai's ecological situation, including a discussion on the proposed protection plan, and the possibility of establishing a wetland park or nature reserve. The seminar will be attended by government officials and experts representing the project partners.	Seminar held. Seminar outputs used to inform final version of the protection plan.

8. Describe the activities implemented and deliverables met under Objective 1

Activity 1.1: We trained 17 researchers including members of HHCC, Hainan Bird Watching Society and Hainan Academy of Ocean and Fishery Science, about the identification of birds and flora and the arrangement for each route of birds and flora surveys.

Activity 1.2 and Activity 1.3: these both took us much more time than we had planned. The results are documented in a survey report (in Chinese) -- see Chapter 1 in Appendix 1.

Activity 1.4: Protection/restoration plan was drafted (in Chinese) – see Chapters 2 in Appendix 1

Activity 1.5 was not carried out as we had planned. The local government insisted on only attending the seminar if it was held in their name, and only invited experts that they were familiar with. As a result, the seminar was held at the government council chamber on April 28th, 2016. It was rather an internal meeting among the Wanning local government, Hainan Government Ocean and Fishery Department, and the experts who took part in designing the Xiaohai development plan. We were the only non-governmental organization to attend the seminar. Nevertheless, the protection plan put forward by the CEPF project was fully discussed and accepted by the local government and key participants.

9. Repeat point 8 above for each Objective in your approved proposal

Objective 2: The benefits of hele-crab eco-farming are understood and adopted by communities in Xiaohai.

Activities	Deliverables
Activity 2.1: Carry out a survey of livelihoods in Xiaohai (focusing on farming of hele-crab and prawns)	Survey completed. Results documented in survey report.
Activity 2.2: Use survey results to produce a report on more sustainable livelihood options for people living in Xiaohai.	Report on more sustainable livelihood options.
Activity 2.3: Produce a manual on eco-friendly hele-crab farming	Manual produced, and 1000 copies distributed to farmers in Xiaohai
Activity 2.4: Encourage communities of farmers in Xiaohai to make use of eco-friendly hele-crab farming practices.	Report on the promotion of hele-crab eco-farming as a sustainable livelihood and its effect on the ecology of Xiaohai.

Activity 2.1 could not be recorded well by the questionnaire, because farmers could not answer the questionnaire in a correct way on their own, and detailed and reliable statistics need to be recorded and checked through interviewing the farmers one by one, which is very time-consuming. We interviewed about 20 of them covering four major communities of Xiaohai. See Chapter 3 in Appendix 1.

Activity 2.2 showed that the option for eco-friendly hele-crab farming is more profitable compared with shrimp farming, which yields less than 300 kilogram per mu (0.0667 hectares) in most area of Xiaohai due to the deterioration of water quality.

Activity 2.3 and Activity 2.4 have promoted eco-friendly hele-crab farming in a major farming area called Wuchang of 258 hectares, and nearly 10% of the area totally complied with the manual without any direct farming pollution to Xiaohai natural wetland area – see Chapter 3 in Appendix 1 and Appendix 2.

Objective 3: The potential for eco-tourism is recognized by the Xiaohai tourism development plan.

Activities	Deliverables
Activity 3.1: Provide input to the Xiaohai tourism development plan, and promote understanding within the local government of the benefits of protecting Xiahai's biodiversity and ecology by developing an "eco-tourism theme" highlighting Xiaohai's biodiversity, natural environment, threats, and historical culture.	Written input provided to the Xiaoha tourism development plan. Xiaohai eco-tourism theme designed.
Activity 3.2: Conduct pilot Xiaohai eco-tourism activities for local people, including half-day boat tours of the local area and biodiversity.	Pilot eco-tourism activities conducted. Report written on the potential of eco-tourism to become a sustainable livelihood option.

Activity 3.1 and Activity 3.2 designed three themes and routes for eco-tourism of Xiaohai, such as strolling or jogging among the expansive beauty of Xiaohai natural wetland and mangroves, parent and kids experiencing the popular science for eco-friendly hele-crab farming as a sustainable livelihood, and feeling the harmonious scenery in an old fishing village with beautiful coastline. – see Chapter 4 in Appendix 1.

We successfully organized at least one tour for each route:
- "Upmarket business jogging tour" for a group of MBA students
- "Parent-children weekend natural education tour" over several weekends, in collaboration with Hainan Squirrel School (also a CEPF grantee), and another nature education group to lead weekend tours of about 30 persons at a time.
- "Bird-watching fans for biological tour" carried out for members of the Hainan Birdwatching Society. The tour was conducted the same time as the bird survey.

All routes for eco-tourism of Xiaohai were popular among these groups and showed a promising income as a sustainable livelihood option. We would also consider tailor-made tours for groups with specific request and interest, assessing the objective and outcome to be in line with our own.

10. If you did not complete any activity or deliverable, how did this affect the overall impact of the project?

All activities and deliverables have been completed.

11. Please describe and submit any tools, products, or methodologies that resulted from this project or contributed to the results

The economic analysis and comparison is an effective way to promote a sustainable livelihood. By analyzing and comparing the average income, production cost, and potential loss between shrimp farming and eco-friendly hele-crab farming, the economic analysis is a persuasive way to promote eco-friendly hele-crab farming in the area where shrimp farming yields under 300 kilogram per mu (0.0667 hectares). – Please refer to Appendix 1 for description of tools, methodologies and results.

Benefits to Communities

12. Please describe the communities that have benefited from CEPF support

*Please report on the size and characteristics of communities and the benefits that they have received, as a result of CEPF investment. Please provide information for all communities that have benefited **from project start to project completion**.*

	Community Characteristics											Nature of Socioeconomic Benefit								
								Size of Community												
Community Name	Subsistence economy	Small landowners	Indigenous/ ethnic peoples	Pastoralists / nomadic peoples	Recent migrants	Urban communities	Other*	50-250 people	251-500 people	501-1,000 people	Over 1,001 people	Increased access to clean water	Increased food security	Increased access to energy	Increased access to public services (e.g. health care, education)	Increased resilience to climate change	Improved land tenure	Improved recognition of traditional knowledge	Improved representation and decision-making in governance forums/structures	Improved access to ecosystem services
Wuchang	Yes	Yes	Yes								Yes	Yes	Yes					Yes	Yes	Yes
Houan		Yes	Yes						Yes			Yes	Yes					Yes	Yes	Yes
Hele		Yes	Yes						Yes			Yes	Yes					Yes	Yes	Yes
Gangbei		Yes	Yes							Yes		Yes	Yes					Yes	Yes	Yes

*If you marked "Other" to describe the community characteristic, please explain:

Lessons Learned

13. Describe any lessons learned related to organizational development and capacity building.

During the project, we cooperated with local government, communities and environment protection institutions to achieve three objectives, and 11 kinds of activities in different fields, and interacted with each other. HHCC has gained the capacity for designing and conducting a project with the cooperation of the government and non-governmental organizations. We are able to build a bridge to mainstream biodiversity, communities and livelihoods into development planning of Xiaohai area.

We learned to use reports, photos and videos to showcase our project to the media.

14. Describe any lessons learned related to project Design Process *(aspects of the project design that contributed to its success/shortcomings)*

The survey of the ecological situation and livelihoods of Xiaohai included many fields, but we did not focus on some key indicators. As a result, the survey was wide-ranging and time-consuming but was not persuasive. We need to learn to design our project with clearer indicators to guide our project members and partners to work efficiently, and make sure every activity meets its objectives.

15. Describe any lesson learned related to project Implementation *(aspects of the project execution that contributed to its success/shortcomings)*

Ensure timely and constant communication with the government and local communities throughout the whole project. The aim of the project is to obtain broad support from the government and local communities in the protection plan of Xiaohai biodiversity and the sustainable livelihoods. And the key to win support is to keep timely and constant communications with the government and local communities in all activities.

In order to promote eco-friendly hele-crab farming as a sustainable livelihood in a widespread way, it has to make more income than shrimp farming, otherwise we should persuade the government to give a subsidy policy to it.

16. Describe any other lessons learned relevant to the conservation community

There were four major communities with different situations around Xiaohai area. Due to the travelling distance and time required for interviewing each member, the communication with each community became a both cost and time consuming job, including the survey of ecological situation and livelihoods of Xiaohai, the promotion of eco-friendly hele-crab farming, and the government's development policy towards sustainable livelihoods.

We concluded that it is difficult to keep a regular track of their livelihoods by our own project team interviewing each of them, and members of each community are more easily and open to communicate with each other. The promotion of eco-friendly hele-crab farming would be more convincing if shared by successful eco crab-farmers. Thus, we might try to recruit at least one member of each community and some proactive eco-crab farmers to join our team to become our staff members or volunteers, training them to deliver the communication task for us.

Sustainability / Replication

17. **Summarize the success or challenges in ensuring the project will be sustained or replicated**

Since its establishment in 2013, HHCC had been ecologically farming hele-crab on its own, and using the benefit to cover overheads. After the CEPF project, HHCC will continue to monitor Xiaohai's natural environment and promote eco-friendly hele-crab farming as a sustainable livelihood. HHCC will also continue to promote eco-tourism, as a way of educating people to appreciate and have concern for Xiaohai's natural environment. Eco-tourism income will also be used to support conservation activities.

Following the completion of the CEPF project, the government has declared to establish a Xiaohai wetland park or nature reserve before the year of 2019. HHCC will use the survey report and the protection plan as the basis for applying for government financial aid and other environmental funding for further survey. It will also seek to cooperate with more environmental organizations and local communities in order to help the government to implement the protection plan and make sure the wetland park or nature reserve successfully established before 2019.

18. **Summarize any unplanned activities that are likely to result in increased sustainability or replicability**

The government has declared to establish a Xiaohai wetland park or nature reserve before the year of 2019 (see Chapter 2 in Appendix 1). Therefore, more detailed survey will be needed in order to gain solid evidence and support for the qualification of wetland park or nature reserve.

As a result, HHCC has applied to the government special fund to continue the survey of Xiaohai ecology and biodiversity for half a year, and keep promoting eco-friendly hele-crab farming in the next three years.

HHCC helped Xiaohai communities build the Eco-friendly Hele-crab Farming Association, and got funded by the association to continue exploring and promoting it as a sustainable livelihood for Xiaohai aquaculture.

We gave publicity to the project, made sure the media and public pay attention to the activities we are doing, and gained public support, as a way to address the government's doubts about the project.

An article titled *Xiaohai Zhi - about the historical changes of Xiaohai and its threat of polluting livelihoods by prawn farming* was published and directly read by more than 2,000 people in Wechat, including many government officials (they personally shared the article to more people), and reprinted by other media.

A saloon called "Xiaohai Talk" was held at Haikou, the provincial capital, to share with experts and public about the importance of Xiaohai biodiversity.

Safeguards

19. If not listed as a separate Project Component and described above, summarize the implementation of any required action related to social and environmental safeguards that your project may have triggered

Not applicable.

Additional Funding

20. Provide details of any additional funding that supported this project and any funding secured for the project, organization, or the region, as a result of CEPF investment

Donor	Type of Funding*	Amount	Notes
SEE foundation	B	100,000 CNY	The survey of Xiaohai livelihood, and promotion of eco-friendly hele-crab farming
Ocean and Fishery Department of Wanning Local Government	C	1,500,000 CNY	The design of eco-friendly hele-crab farming development plan, at Wuchang, Xiaohai

** Categorize the type of funding as:*

A Project Co-Financing (other donors or your organization contribute to the direct costs of this project)

B Grantee and Partner Leveraging (other donors contribute to your organization or a partner organization as a direct result of successes with this CEPF funded project)

C Regional/Portfolio Leveraging (other donors make large investments in a region because of CEPF investment or successes related to this project)

Additional Comments/Recommendations

21. Use this space to provide any further comments or recommendations in relation to your project or CEPF

In 2016-2017, we will cooperate with Guangxi Mangroves Research Center to research a co-development natural system for mangroves restoration and eco-friendly hele-crab farming in pond rebuilding in Wuchang, Xiaohai.

Information Sharing and CEPF Policy

CEPF is committed to transparent operations and to helping civil society groups share experiences, lessons learned, and results. Final project completion reports are made available on our Web site, www.cepf.net, and publicized in our newsletter and other communications.

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Appendix 1

Ecological conservation and sustainable aquaculture development in Xiaohai, Wanning, Hainan – CEPF final project completion report

CEPF 结项调研报告

万宁环小海地区生态保护与产业可持续发展

汇报单位：海南万宁和乐蟹保育中心

二〇一六年十一月

第一章 万宁环小海地区生态情况调研

1.1 基本情况

1.1.1 基本地理信息

环小海地区位于海南省万宁市东部，属于滨海平原和沿海滩涂地带，有太阳河、龙首河、龙尾河等 8 条主要河流(流域面积达 1112.6km2)，以及十多条小支流，拥有大面积的河流湿地，河流汇入形成小海泻湖，目前泻湖总面积约为 38km²，是我国最大的热带泻湖湿地，目前没有建立任何保护区。

1.1.2 水文情况

小海平面型态呈葫芦状，南北长约 10km，东西宽 3.5-7.5km，腹大口小，湖底平浅，大部分区域水深 1-1.5 米，最深 4 米，目前水质主要为劣四类，湖底沉积物为黑色泥质沙。小海泻湖处于海陆交汇的特殊地理位置，受河流和海水的交互影响，因而在水文特征和生态体系上具有特殊性，从出海口至小海的河口入海处，盐度递减，形成潮水咸水带和径流淡水带，使小海孕育了丰富的营养盐，具有高生产力的特点。

1.1.3 城镇信息

小海周边有万城、后安、和乐三个沿海城镇，常住居民约 15 万人。

1.1.4 生物多样性

小海拥有大面积的河口湿地和泻湖湿地，丰富的水生植物和水生生物，还拥有和乐蟹、港北对虾、后安鲳鱼等著名的渔业资源。

1.1.5 规划开发

随着万宁东扩战略的实施，环小海经济开发区已经确立，政府制定了土地利用总体规划，正在制定土地利用详细规划，这是小海湿地保护与可持续发展的威胁，更是机遇。

1.2 生态威胁及原因分析

1.2.1 生态持续恶化

1）水质恶化

如今小海水质从八十年代的一类水降为如今的劣三类至四类，属于严重污染程度，如今水体交换不畅，1.8 万亩池塘的养殖污染、周边 15 万常住居民生活污水的排放，都使小海水质处于持续恶化状态。

2）湿地面积减少，功能退化

小海河流在近二十年来的径流量持续减少，流域和滩涂面积持续下降，泻湖湿地面积也从 80 年代的 49²km 减少到 38²km，20 多年内减少了 22%，平均水深也从 80 年代的 3 米多减少到了如今的 1 米。

3）生物多样性锐减。

小海泻湖在 80 年代还生长大量水草和红树林，是生物多样性丰富程度的重要指标，如今水草、红树林几乎灭绝，越冬鸟类逐年减少，小海的水生生物种类和数量也大量下降。

1.2.2 原因分析

1）历史的错误规划和过度开发；

上世纪 70 年代以来，由于小海洪涝频发，政府在未经仔细规划论证下，发动了太阳河、官栈河分洪改道工程，口门北汊及南通道的封堵工程，龙首河、龙尾河、南山河的裁弯取直工程，以及小海周边的围垦，河道上游的开矿和采石等，直接导致了注入小海的径流量、纳潮量减少而来沙量增加，使小海由原来的冲淤平衡向淤填方向发展，加之放纵的围垦滩涂对小海湿地的破坏，导致湿地面积不断减少。小海通道口门不断缩窄、淤塞，严重影响了小海的泄洪、纳潮和水体交换，使小海渐渐成为死水，失去自净能力，加之周边长年的滩涂种养污染和生活污水的排放，使小海水质在短短二十年间从一类水恶化到劣四类，也直接导致了生物多样性的锐减。

2）保护理念和制度的长期缺失，小海生态缺乏关注和重视。

小海周边至今未成立任何保护区，小海周边的开矿、挖沙、采石，滩涂种植、养殖、及捕捞缺乏管制，长期的开发放任模式使得小海生态持续恶化。

两次国家以及数次省级的湿地调查工作中，小海均被边缘化，也未被列入中国重要湿地名录，加之对小海环境日常监测工作的长期漠视，原始监测数据零散，在时间、范围、关联性上均缺乏概括力，无法展开针对性的保护工作。政府和当地社区均忙于开发小海，长期忽视基础保护工作，外界对小海生态恶化程度缺乏足够认识和重视，导致小海缺乏关键行动者去引领推动生态保护工作。

1.3 生物多样性调研

1.3.1 调研方法

调查一共有 17 个人，其中和乐蟹保育中心成员 5 人，观鸟会成员 10 人，海南海洋与渔业科学院 2 人，分两组进行，一个是植物组，一个是鸟类组，两组走的路线不一致。植

物组，调查鸟类调查一共对小海的六个水鸟栖息比较多的点进行了调查，基本上覆盖了小海。调查方法采取路线调查法为主，植物结合标本的采集和拍摄照片进行，鸟类结合样点法和拍摄照片的方法来进行。通过相关文献查阅及标本鉴定，鸟类还可以通过鸟类观察和鸟鸣声来识别记录鸟的种类、数量及小生境，对植物和鸟类的种类进行统计，列出万宁小海植物和鸟类名录。

1.3.2 调研结果

1）鸟类的调查结果

第一次调查时间从 2015 年 6 月 10 日到 2015 年 6 月 25 日，这次调查共记录到 37 种鸟类，一共 1138 只。其中水鸟 19 种，共 1027 只，占全部记录的 90%。国家级二级保护鸟类有三种，分别是褐翅鸦鹃、栗喉蜂虎和褐耳鹰。栗喉蜂虎也是珍贵的鸟类，该物种已被列入国家林业局 2000 年 8 月 1 日发布的《国家保护的有益的或者有重要经济、科学研究价值的陆生野生动物名录》。

第二次调查时间从 2016 年 1 月 1 日到 2016 年 1 月 15 日，统计共记录到 49 种鸟类，共 2901 只。其中水鸟 28 种，共 2504 只，占全部记录的 86%。国家级二级保护鸟类有三种，分别是褐翅鸦鹃、黑翅鸢和褐耳鹰。

两次的调查结果显示，小海周边地区的水鸟数量大，是候鸟迁徙的重要通道，是候鸟觅食的地方，所以对于小海和周边环境的保护是非常必要的。而且两次调查发现鸟岛是白鹭和苍鹭重要的夜栖息地，每天的傍晚都会有大批鹭鸟回到鸟岛休息。

2）植物的调查结果

经过调查统计到万宁小海的植物共有 150 种，其中海漆、卤蕨和白骨壤属于红树植物。由于小海周边养殖业的发展，围海养虾，导致水草、红树林几乎灭绝，了解万宁小海的红树植物有哪些，然后种植一些本地红树，防止红树灭绝，保护生态环境。

表一、万宁小海春季水鸟调查名录：

序	种	数量	英文名	拉丁名
1	暗绿绣眼	6	JAPANESE WHITE-EYE	*Zosterops japonicus*
2	八哥	6	CRESTED MYNA	*Acridotheres cristatellus*
3	白鹡鸰	7	WHITE WAGTAIL	*Motacilla alba*
4	白鹭	918	LITTLE EGRET	*Egretta garzetta*

5	白头鹎	16	LIGHT-VENTED BULBUL	*Pycnonotus sinensis*
6	白胸翡翠	1	WHITE-THROATED KINGFISHER	*Halcyon smyrnensis*
7	斑文鸟	66	SCALY-BREASTED MUNIA	*Lonchura punctulata*
8	苍鹭	69	GREY HERON	*Ardea cinerea*
9	草鹭	1	PURPLE HERON	*Ardea purpurea*
10	池鹭	10	CHINESE POND-HERON	*Ardeola bacchus*
11	大白鹭	259	LARGE EGRET	*Casmerodius albus*
12	大嘴乌鸦	1		
13	戴胜	1	EURASIAN HOOPOE	*Upupa epops*
14	鹗	1	OSPREY	*Pandion haliaetus*
15	褐翅鸦鹃	2	GREATER COUCAL	*Centropus sinensis*
16	褐耳鹰	1		
17	褐柳莺	3	DUSKY WARBLER	*Phylloscopus fuscatus*
18	鹤鹬	2	SPOTTED REDSHANK	*Tringa erythropus*
19	黑翅鸢	2	BLACK-WINGED KITE	*Elanus caeruleus*
20	黑喉石即	5	COMMON STONECHAT	*Saxicola torquata*
21	黑卷尾	2	BLACK DRONGO	*Dicrurus macrocercus*
22	红喉鹨	1	RED-THROATED PIPIT	*Anthus cervinus*
23	红脚鹬	10	COMMON REDSHANK	*Tringa totanus*
24	红嘴巨鸥	1	CASPIAN TERN	*Sterna caspia*
25	红嘴鸥	120	LAUGHING GULL	*Larus ridibundus*
26	虎纹地鸫	1	SCALY THRUSH	*Zoothera dauma*
27	环颈鸻	230	KENTISH PLOVER	*Charadrius alexandrinus*
28	黄鹡鸰	1	YELLOW WAGTAIL	*Motacilla flava*
29	黄眉柳莺	1	YELLOW-BROWED WARBLER	*Phylloscopus inornatus*
30	灰背椋鸟	8	WHITE-SHOULDERED STARLING	*Sturnus sinensis*
31	灰鹡鸰	2	GREY WAGTAIL	*Motacilla cinerea*
32	家燕	114	BARN SWALLOW	*Hirundo rustica*
33	金眶鸻	120	LITTLE RINGED PLOVER	*Charadrius dubius*
34	蓝矶鸫	2	BLUE ROCK-THRUSH	*Monticola solitarius*
35	栗尾鳽	2	CINNAMON BITTERN	*Ixobrychus cinnamomeus*
36	麻雀	30	EURASIAN TREE SPARROW	*Passer montanus*
37	牛背鹭	2	CATTLE EGRET	*Bubulcus ibis*
38	普通翠鸟	5	COMMON KINGFISHER	*Alcedo atthis*
39	普通鸬鹚	1	GREAT CORMORANT	*Phalacrocorax carbo*
40	青脚鹬	12	COMMON GREENSHANK	*Tringa nebularia*

41	鹊鸲	2	ORIENTAL MAGPIE-ROBIN	*Copsychus saularis*
42	扇尾沙锥	2	COMMON SNIPE	*Gallinago gallinago*
43	小白腰雨燕	1	HOUSESWIFT	*Apus affinis*
44	须浮鸥	800	WHISKERED TERN	*Chlidonias hybrida*
45	岩鹭	6	PACIFIC REEF-EGRET	*Egretta sacra*
46	泽鹬	40	MARSH SANDPIPER	*Tringa stagnatilis*
47	中白鹭	3	INTERMEDIATE EGRET	*Mesophoyx intermedia*
48	珠颈斑鸠	1	SPOTTED DOVE	*Streptopelia chinensis*
49	棕背伯劳	4	RUFOUS-TAILED SHRIKE	*Lanius isabellinus*

表二、万宁小海夏季鸟类调查名录：

序	种		英文名	拉丁名
1	八哥	5	CRESTED MYNA	*Acridotheres cristatellus*
2	白鹭	186	LITTLE EGRET	*Egretta garzetta*
3	白头鹎	6	LIGHT-VENTED BULBUL	*Pycnonotus sinensis*
4	苍鹭	21	GREY HERON	*Ardea cinerea*
5	池鹭	1	CHINESE POND-HERON	*Ardeola bacchus*
6	大白鹭	446	LARGE EGRET	*Casmerodius albus*
7	大杓鹬	1	FAR EASTERN CURLEW	*Numenius madagascariensis*
8	戴胜	1	EURASIAN HOOPOE	*Upupa epops*
9	翻石鹬	3	TUVU STONE	*Arenaria interpres*
10	褐翅鸦鹃	1	GREATER COUCAL	*Centropus sinensis*
11	褐柳莺	1	DUSKY WARBLER	*Phylloscopus fuscatus*
12	鹤鹬	1	SPOTTED REDSHANK	*Tringa erythropus*
13	黑翅鸢	3	BLACK-WINGED KITE	*Elanus caeruleus*
14	黑卷尾	8	BLACK DRONGO	*Dicrurus macrocercus*
15	黑尾塍鹬	5	BLACK-TAILED GODWIT	*Limosa limosa*
16	黑嘴鸥	1	SAUNDERS'S GULL	*Larus saundersi*
17	红脚鹬	30	COMMON REDSHANK	*Tringa totanus*
18	红颈滨鹬	40	RUFOUS-NECKED STINT	*Calidris ruficollis*
19	灰背椋鸟	4	WHITE-SHOULDERED STARLING	*Sturnus sinensis*
20	矶鹬	1	COMMON SANDPIPER	*Actitis hypoleucos*
21	家八哥	1	COMMON MYNA	*Acridotheres tristis*
22	家燕	45	BARN SWALLOW	*Hirundo rustica*
23	栗喉蜂虎	6	BLUE-TAILED BEE-EATER	*Merops philippinus*
24	栗尾鳽	2	CINNAMON BITTERN	*Ixobrychus cinnamomeus*

25	林鹬	3,2 只繁殖羽	WOOD SANDPIPER	*Tringa glareola*
26	麻雀	4	EURASIAN TREE SPARROW	*Passer montanus*
27	牛背鹭	26	CATTLE EGRET	*Bubulcus ibis*
28	翘嘴鹬	4	TEREK SANDPIPER	*Xenus cinerea*
29	鹊鸲	4	ORIENTAL MAGPIE-ROBIN	*Copsychus saularis*
30	四声杜鹃	2	INDIAN CUCKOO	*Cuculus micropterus*
31	铁嘴沙鸻	55	GREATER SAND PLOVER	*Charadrius leschenaultii*
32	弯嘴滨鹬	1	CURLEW SANDPIPER	*Calidris ferruginea*
33	小白腰雨燕	10	HOUSESWIFT	*Apus affinis*
34	鹰鸮	1	BROWN HAWK OWL	*Ninox scutulata*
35	泽鹬	200	MARSH SANDPIPER	*Tringa stagnatilis*
36	珠颈斑鸠	5	SPOTTED DOVE	*Streptopelia chinensis*
37	棕背伯劳	7	RUFOUS-TAILED SHRIKE	*Lanius isabellinus*

表三 万宁小海植物名录：

序	中文名	*拉丁名*
1	茅瓜	*Solena amplexicaulis (Lam.) Gandhi*
2	水飞蓟	*Silybum marianum (L.) Gaertn*
3	大尾摇	*Heliotropium indicum*
4	白花丹	*Plumbagozeylanica L.*
5	越南悬钩子	*Rubus cochinchinensis Tratt.*
6	浅裂锈毛莓	*Rubus reflexus Ker var. hui (Diels apud Hu) Metc*
7	牛筋藤	*Malaisia scandens (Lour.) Planch.*
8	山油柑	*Acronychia pedunculata (L.) Miq.*
9	倒吊笔	*Wrightia pubescens R. Br.*
10	阴香	*Cinnamomum burmanni （Nees et T.Nees）Blume*
11	斜叶榕	*Ficus tinctoria Forst*
12	竹叶榕	*Ficus stenophylla Hemsl*
13	白树	*aequoreum Hance*
14	琼崖海棠	*Calophyllum inophyllum L.*
15	一点红	*Emilia sonchifolia (L.) DC.*
16	蜈蚣草	*Nephrolepiscordifolia(L.)Presl*
17	矮紫金牛	*Ardisia humilis Vahl*
18	飞机草	*Chromolaene odorata L.*
19	破布叶	*Microcos paniculata Linn*
20	大百步	

21	九节	*Psychotria rubra (Lour.) Poir.*
22	毛稔	*Melastoma sanguineum*
23	海南链珠藤	*Alyxia hainanensis*
24	鸭脚木	*Schefflera octophylla (Lour.) Harms*
25	岭南山竹子	*Garcinia oblongifolia Champ. ex Benth.*
26	半边莲	*Lobelia chinensis Lour.*
27	海南狗牙花	*Ervatamia hainanensis Tsiang*
28	大叶野扇花	*Sarcococca ruscifolia staptvar. Chinen sis (Franch) Rehd.Et.Wils*
29	蔓九节	*Psychotria serpens Linn.*
30	山蒟	*Piper hancei Maxim.*
31	参薯	*Rhizome of Winged Yam*
32	假鹰爪	*Desmos chinensis Lour.*
33	紫金牛	*Ardisia japonica (Thunb) Blume*
34	猪肚木	*Canthium horridum Blume*
35	扭肚藤	*Jasminum elongatum (Bergius) Willd.*
36	短柄羊角藤	
37	羊角藤	*Morida umbellata sub.obovata*
38	海南玉叶金花	*Mussaenda hainanensis Merr.*
39	纤枝槌果藤	*Capparis viminea Hook. f. et Thoms*
40	槌果藤	*Capparis zeylanica Linn.*
41	绢毛飘拂草	*Fimbristylis sericea (Poir.) R. Br*
42	黑嘴蒲桃	*Syzygium bullockii (Hance) Merr. et Perry.*
43	方枝蒲桃	*Syzygium tephrodes*
44	海南轴榈	*Licuala fordiana*
45	豆腐紫	
46	五桠果	*Dilleniaceae*
47	紫玉盘	*Uvaria macrophylla Roxb. var. microcarpa （Champ.） Finet et Gagnep.*
48	光叶紫玉盘	*Uvaria boniana*
49	美花菜豆树	
50	假黄皮	*Clausena excavata Burm. f.*
51	冬青	*Ilex chinensis Sims*
52	桃金娘	*Rhodomyrtus tomentosa*
53	毛黄肉楠	*Actinodaphne pilosa (Lour.)Merr.*
54	多香木	*Polyosma cambodiana Gagnep.*
55	柳叶密花树	
56	苦郎花	
57	海芒果	*Cerbera manghas*

58	细叶裸实	
59	单叶蔓荆	*Vitex trifolia L. var. simplicifolia Cham.*
60	海南茄	*Solanum procumbens Lour.*
61	樟叶素磬花	*Jasminum cinnamomifolium Kobuski*
62	闭花木	*Cleistanthus sumatranus (Miq.) Muell. Arg.*
63	红花地胆头	*Elephantopus scaber L.*
64	野菠萝	*Pandanus tectorius Sol.*
65	草蔻	*Alpinia katsumadai Hayata*
66	锈荚藤	*Bauhinia erythropoda Hayata*
67	叶被木	*Streblus taxoides (Heyne) Kurz*
68	翻白叶	*Potentilla fulgens Wall*
69	越南叶下珠	*Phyllanthus cochinchinensis*
70	野牡丹	*Melastoma candidum D. Don*
71	华南省藤	*Calamus rhabdocladus Burret*
72	腋花藤	
73	光叶紫玉盘	*Uvaria boniana*
74	小叶买麻藤	*Gnetum parvifolium (Warb.) C. Y. Cheng ex Chun*
75	胶樟	*Litseaglutinosa(Lour.)C.B.Rob.*
76	白藤	*Calamus tetradactylus Hance*
77	黑面神	*Breynia fruticosa (Linn.) Hook. f.*
78	大青	*Clerodendrum cyrtophyllum Turcz.*
79	丁公藤	*Erycibe obtusifolia Benth.*
80	南蛇藤	*Celastrus orbiculatus Thunb.*
81	文殊兰	*Crinum asiaticum L. var. sinicum (Roxb. ex Herb.) Baker*
82	响铃豆	*Crotalaria albida Heyne ex Roth*
83	阔苞菊	*Pluchea indica Less.*
84	飞扬草	
85	蜂巢草	*Leucas aspera (Willd.) Link*
86	虎尾草	*Chloris virgata Swartz*
87	海漆	*Excoecaria agallocha Linn.*
88	香附子	*Cyperus rotundus L.*
89	海南榄仁	*Terminalia hainanensis*
90	犁头尖	*Typonium divaricatum(L.)Decne*
91	多枝钩儿茶	
92	滨木患	*Arytera littoralis Bl.*
93	刺葵	*Phoenix loureiroi Kunth*
94	乌桕	*Sapium sebiferum (L.) Roxb.*
95	向步苓	

96	酒柄箭	*Atalantia buxifolia(Poir.)Oliv*
97	宿苞厚壳树	*Ehretia asperula Zool. et Mor.*
98	黄椿木姜子	*Litsea variabilis Hemsl.*
99	大罗伞树	*Ardisia hanceana Mez*
100	大叶野扇花	*Sarcococca ruscifolia staptvar. Chinen sis (Franch) Rehd.Et.Wils*
101	黄叶树	*Xanthophyllum hainanense Hu*
102	宿苞厚壳树	*Ehretia asperula Zool. et Mor.*
103	罗志藤	*S. suaveolens Roxb.*
104	火灰山矾	*Symplocos dung Eberh. et Dub*
105	厚叶素馨	
106	桂叶素磬	
107	狗骨柴	*Diplospora dubia (Lindl.) Masam.*
108	娃儿藤	*Tylophora floribunda Miquel*
109	多刺山黄皮	*Fagerlindia depauperata (Drake) Tirveng.*
110	浓子茉莉	*Fagerlindia scandens (Thunb.) Tirveng.*
111	长花轴耳草	*Hedyotis exserta Merr.*
112	葶花水竹叶	*Murdannia edulis*
113	涩叶藤	*Tetracera asiatica (Lour.) Hoogland*
114	高脚钱线	
115	无根藤	*Cassytha filiformis L.*
116	刺篱木	*Flacourtia indica*
117	了哥王	*Wikstroemia indica (Linn.) C. A. Mey*
118	长春花	*Catharanthus roseus （L.） G. Don*
119	山菅兰	*Dianella ensifolia(L.)DC*
120	铁芒萁	*Dicranopteris linearis*
121	山橙	*Melodinus suaveolens Champ. ex Benth.*
122	刺葵	*Phoenix loureiroi Kunth*
123	毒根斑鸠菊	*Vernonia cumingiana*
124	泊宾莎	
125	箭党花椒	
126	水葫芦	*Eichhornia crassipes*
127	黄槿	*Hibiscus tiliaceus*
128	海棠木	*Calophyllum*
129	卡开芦	*Phragmites karka (Retz.) Trin. ex Steud.*
130	空心莲子草	*Alternanthera Philoxeroides（Mart.）Griseb.*
131	毛蓼	*Polygonum barbatum Linn.*
132	女菀	*Turczaninowia fastigiata (Fisch.) DC.*
133	海刀豆	*Canavalia rosea (Sw.) DC.*

134	榆木	*Ulmus pumila L.*
135	大叶水蓑衣	
136	水龙	*Ludwigia octovalvis (Jacq.) Raven.*
137	虎尾草	*Chloris virgata Swartz*
138	羽芒菊	*Tridax procumbens L.*
139	水芫花	*Pemphis acidula J. R. et Forst.*
140	小花百步	
141	菝葜	*Smilax china L.*
142	杨叶肖槿	*Thespesia populnea(L.) Soland. ex Correa*
143	海南槐	*S.tomentosa L.*
144	银毛树	*Argusia argentea (L. f.) H. Heine*
145	避霜花	
146	崖县球兰	*Hoya liangii Tsiang*
147	箬竹	*Indocalamus tessellatus (Munro) Keng f.*
148	海漆	Excoecaria agallocha Linn.
149	卤蕨	Acrostichum aureum Linn.
150	白骨壤	

第二章 环小海地区的生态保护与产业发展方案

根据调研结果，并结合政府规划资料及实施的相关项目，将关于环小海地区生态保护与产业发展的方案论述如下：

2.1 总体定位

万宁市政府 2015 年 12 月 4 日发布《万宁市城镇内河（湖）水污染治理三年行动方案》，定位万宁小海潟湖湿地在三年内既 2018 年底建成占地 3800 公顷的市级湿地公园或保护区。

2.2 生态保护方案

根据调研结果，结合《万宁市国民经济和社会发展第十三个五年规划纲要》、《万宁市城市总体规划（2013-2030）》、《万宁市总体规划（空间类 2015-2030）》等政府规划及相关项目，生态保护方案主要如下：

- 增加水动力，加大水体交换量，激活水体；
- 采取综合措施，削减入海污染物，改善水质；
- 综合采用生态修复手段，修复受损生态系统，恢复生机；
- 划定生态红线，设立自然保护区，防患未然。

具体为：

1）加强河流湿地污染治理和保护。目前政府已经开展万宁市河网水环境整治工程，加强太阳河流域和东山河流域综合治理与水系连通。积极推进小海生态整治修复工程，严格控制滩涂围垦和围填海，防止自然湿地面积缩小。严格保障小海水体环境执行二类海水水质标准，禁止养殖污水废水、生活生产污水直接排入小海；落实太阳河径流回归工程，增加小海淡水补充量，提升小海自净能力；疏通小海、老爷海口门或开辟新的入海通道，增加纳潮量，改善水流条件。

2）生态系统与空间管制方面，重点修复小海地区整体生态环境。通过“一带、五廊、五源、多点”的生态安全格局，其中一带为滨海生态景观带，依托海岸资源，保护沿岸的海防林、沙滩和潟湖，形成滨海生态带；五廊：龙首河生态廊道、龙尾河生态廊道、太阳河生态廊道；五源包括小海生态源区。龙首河、龙尾河、太阳河口小海河口湿地为禁止建设区，小海省级地质公园和太阳河、东山河为限制建设区。小海执行二类海水水质标准，疏通小海或开辟新的入海通道，改善水流条件。

2.3 可持续产业发展方案

根据调研结果，结合《海南省万宁市旅游产业发展总体规划》、《万宁市“十三五”海洋经济发展规划（2016--2020）》、《万宁市海洋功能区划（2013—2020 年）》及相关实施项目，可持续产业发展方案如下：

1）养殖产业上，需要警惕过度建设加工产业，充分考虑小海岸线的开发承受能力。

在大的战略规划上，尽管政府把海洋产业空间布局方面为“一带两海三组团”。以小海西北岸为中心，按照“前港后厂”的发展理念，建设以农产品、海产品资源加工为主、以高新技术支持的临港加工区，进一步完善港口码头基础设施建设，增强其对临港工业发展的承载力，使其与临港工业布局和规划相适宜，把港口和工业园区打造成产业发展平台，通过招商引资，大力发展以农产品加工，水产品加工，船舶修造为重点的加工业。建议需要警惕过度建设，充分考虑小海岸线的开发承受能力。

2）养殖产业上，大力推动生态环境建设，规范池塘养殖，转变生产模式，推广和乐蟹生态养殖，减少养殖污染。

小海开发建设方面，采用生态环境建设工程，包括三分渔民工程、小海出海通道疏通工程、规范小海鱼排养殖工程，以及环小海旅游经济区工程等。

改造小海乌场、后安、和乐、港北等几大养殖区等传统池塘，建立池塘排污处理体系，推广和乐蟹生态养殖，规范池塘养殖操作规程，给予养殖户一定的资金支持，推动养殖户转变生产模式，保证稳定的养殖收益，同时减少养殖污染。对于英豪半岛等红树林生态核心区，应对适当退塘还林。

3）生态旅游产业：

通过系统规划建设逐步将万宁建设成为滨海旅游城市、热带风情体验地、滨海养生度假旅游目的地和中国优秀旅游城市。目标市场以国内市场为主体，海外入境客源市场为支撑，按照地理区域出游方式和功能可以进一步细分。旅游产品包括文化旅游、海洋旅游、休闲农业和生态旅游。

小海是《海南省海洋功能区划(2011—2020 年)》中划定的一级类海洋功能区，以城市生活和旅游娱乐功能为主，可结合小海生态综合整治，适度开展休闲渔业旅游和潟湖生态旅游等活动，促进渔民转产转业，满足万宁城市发展需要。

小海形象定位为万州内海、渔都港湾，功能定位为集休闲运动、度假、娱乐、餐饮为一体的旅游圈，以小海生态环境治理为突破口，整合环小海区域的渔村、水域和渔家生产生活活动，建设特色渔家风情城镇和渔家风情村，完善配套旅游服务体系，构建环小海旅游圈。根据政府规划意见，主要划分为“两道四区三镇多点”，两道即环小海风景道和专用

水上旅游通道；四区即城市开放空间区、渔都港湾区、休闲娱乐区、高端度假区；三镇即开发建设三个毗邻小海特色渔家风情城镇-和乐镇、后安镇、万城镇；多点即多个特色渔家风情村。

重点打造含乡村休闲旅游在内的旅游产品，大力推进农业与旅游的融合发展；乡村地区通过项目开发，结合特色化农业生产高或农村经济，培育乡村旅游业；积极推进小海生态整治修复工程，构建集休闲运动、度假、娱乐、餐饮为一体的环小海旅游圈。

第三章 发展可持续产业——和乐蟹生态养殖

3.1 小海对虾与和乐蟹养殖收益对比

通过对养殖户的养殖情况进行调查研究，对比传统高污染的对虾养殖与和乐蟹生态养殖的养殖成本、利润空间，从而通过向养殖户推广收益更高更稳定的和乐蟹生态养殖，转变养殖方式，降低养殖污染。

1）和乐蟹与对虾养殖收益分析

通过抽样调查发现，平均一口 14 亩的池塘，养殖和乐蟹每造可产 120 斤，一年 2 造，年收入达 30.2 万元，扣除 11.5 万元的成本，可盈利 18.7 万元，亩均盈利达 1.3 万元，利润率达 62%。

与之相对比，养殖对虾每造可产 500 斤，一年 3 造，年收入达 35.7 万元，扣除 20.3 万元的成本，可盈利 15.4 万元，亩均盈利为 1.1 万元，利润率为 40.7%，收益明显低于和乐蟹养殖。

将和乐蟹与对虾的市场价格、养殖成本、亩产量等数据进行对比计算发现：若对虾亩产量在 600 斤/造以下，则收益低于和乐蟹；若对虾亩产量在 600-900 斤/造水平，则收益与在基地内养殖和乐蟹收益等同；若对虾亩产量在 1000 斤/造以上，则对虾收益高于和乐蟹。

每 14 亩池塘和乐蟹与对虾养殖年收益对比

	收益	成本	盈利	亩均盈利
对虾	35.7 万元	20.3 万元	15.4 万元	1.1 万元
和乐蟹	30.2 万元	11.5 万元	18.7 万元	1.3 万元

2）环小海地区养虾经营难以为继，转养蟹是必然趋势

目前调研区域自西向东分为三个片区，分别为靠近太阳河河口、淡水补给相对充足的西部集庄片区，淡水补给一般、靠近陆地的中部乌场片区以及淡水补给较差的东部春园片区。乌场片区及春园片区的对虾亩产均低于 500 斤，亩均盈利都低于 1.1 万元，且养虾发病率高；集庄片区的亩产也仅约 600-700 斤，亩均收益约 1.5~1.8 万元，发病率一般。显而易见，对虾的养殖收益普遍低于同片区的和乐蟹养殖收益，对虾养殖已经陷入难以为继的局面，转养蟹是必然趋势。

养殖池塘总体养殖情况

养殖规模（亩）	养殖成功率

对虾	蟹类	鱼类	其他	赚钱	平本	亏钱
72%	18%	6%	4%	16%	26%	58%

基地养殖池塘各片区养殖情况

	对虾亩产	亩均盈利	发病情况
集庄片区	600-700 斤	1.5-1.8 万元	发病率一般
乌场片区	300-400 斤	0.5-0.8 万元	发病率较高
春园片区	400-500 斤	0.8-1.1 万元	发病率较高

3）环小海局部地区养虾尚能维系，转养蟹具有潜力

位于小海出海口的港北养殖区，现有养殖池塘 4880 亩，其中对虾养殖占 89%，养殖成功率普遍平本，对虾亩均产量为 700-1000 斤，每亩年盈利为 1.8-2.4 万元。

但是由于养殖对虾的污染较高，随着小海污染的进一步加剧，水质的逐步退化，富营养化趋势的加剧，并且盐度也会逐步下降，养殖对虾的成本与死亡率均会进一步上升，届时养殖对虾的利润会急剧下降，因此，从长远角度上，转养蟹也是具有潜力的。

港北养殖区总体养殖情况

养殖规模（亩）			养殖成功率			亩均产量	每亩年盈利
对虾	石斑鱼	其他	赚钱	平本	亏钱		
89%	9%	3%	23%	52%	25%	700-1000 斤	1.8-2.4 万元

3.2 和乐蟹生态养殖模式的说明与对环境污染的分析

3.2.1 和乐蟹池塘生态养殖操作规程

在和乐蟹池塘养殖过程中，通过制定严格的生产操作规程，从清塘管理、蟹苗投放、饲养管理、膏蟹养殖、日常管理记录、病害防治到收获，引导养殖户实现生态养殖，降低发病率，杜绝抗生素等药物污染，减少养殖污染排放。

①清塘管理

清塘管理分两步：首先要晒塘、清淤、池塘修整，排干池塘内积水，对堤坝渗漏进行填补；其次要进水、消毒、培水，要在晴天上午 8 时候进行。

②蟹苗投放

蟹苗投放有一定的要求，蟹种要选用本地国家和乐蟹原良种场繁育的人工蟹种和天然捕捞的蟹种，要选择体质健壮、规格整齐、肢体完整、爬行迅速、反应灵敏、无病无伤的青壳蟹苗，并经检疫合格。放养的时间、放养数量、放养规格因养殖模式、上市规格和时

间要求不同应灵活掌握，甲壳宽 0.4cm～5cm 的蟹苗放养密度 10500 只/hm²～2250 只/hm²；混养池放养密度减半。放养应选择晴朗天气，上风头、多点放养，风浪大、阴雨天不宜放苗，同时注意养殖池的盐度与苗种来源地的盐度差应小于 5，温度差应小于 2℃。

③饲养管理

饲养管理要考虑水质控制和饲料投喂。水质控制方面，要视水质情况，适时换水，养殖期间前期以添水为主，中后期换水应根据实际需要而定，日换水量 10%～30%，并逐渐添加淡水，保持后期盐度控制在 7～10。和乐蟹摄食情况应通过放置池内的饲料观察网观察，并随时调整投饲料量。

④膏蟹养殖

膏蟹养殖对放养密度和饲料投喂有严格的要求。要选用壳宽 8cm 以上，体重 150g 以上已交配的雌蟹。在 12 月至次年 2 月，放养 35000～50000 只/hm²；3～5 月和 9～11 月，放养 25000～35500 只/hm²；6～8 月，放养 12000～22000 只/hm²。以投喂带壳的鲜活低值贝类为主，日投饲量为蟹体重的 20～30%；其它饵料的日投饲量则一般为蟹体重的 10～15%。每天投饲 2 次，早晨和傍晚各 1 次。在膏蟹培育的整个过程中，水质的有效管理和调控就特别重要，应定期对盐度、水温、透明度、溶氧量、pH 值、亚硝酸盐、氨氮等主要水质因子进行监测，维护良好的生态环境。

⑤日常管理记录

养成期间，要按《水产养殖质量安全管理规定》的格式做好养殖生产记录和用药记录。

⑥病害防治

病害防治方面，要采取以下措施：干塘清淤消毒；放养优质苗种；投喂优质饲料；定期使用微生态制剂和水质改良剂，通过换水、增氧等手段改善水质并保持温度，盐度的相对稳定；发现患病死蟹应及时捞出，采取相应措施，传染性病害死蟹应做深埋处理。

⑦收获

和乐蟹规格雄蟹大于 200 克以上时，雌蟹大于 150 克以上时或性腺充满甲壳 80%～90%时，和乐蟹（膏蟹）可适期收获，用流网、蟹笼、排水、干塘等方法起捕，捆绑后和乐蟹（膏蟹）应在洁净海水吐沙 0.5h。

3.2.2 对虾与和乐蟹生态养殖污染的对比分析。

通过一年的养殖对比，传统对虾养殖户一年养 3—4 造，每造清塘排出的污泥体积达到约为 70 立方米，直接排入小海。污泥主要成分为虾的粪便、尸体及残饵等难以降解的

残留有机物，并且在虾发病时投放的抗生素等残留的违禁药物也会和污泥一块排到小海，造成极大的养殖污染。

而和乐蟹生态养殖，在低密度混养对虾、鲻鱼等情况下，加之投放各种衍生共生的浮游生物、螺贝等生物的共同作用，构建多物种混养、自循环的生态模式，蟹的粪便、尸体、残饵等被水中的滤食性鱼类、虾类、贝类所消化，有利于最大限度降低养殖过程中的有机残留，降低养殖污染。和乐蟹生态养殖模式一年仅养殖 2 造，每造清塘排出的污泥不超过 20 立方米，并且不含任何抗生素等药物残留，经过专门的积泥池沉淀暴晒后，才将达标污水排放到小海。

因此，经过一年的养殖对比，成片区的推广和乐蟹生态养殖将能极大降低周边的养殖污染，有效改善小海水质。

第四章 探索可持续产业——小海生态旅游

4.1 小海生态旅游设计初衷

设计小海生态旅游线路和内容，让游客感受小海潟湖特有生态景观，了解小海生态历史变迁、小海红树林生态系统以及和乐蟹生态养殖知识等，通过尝试组织节假日亲子团体验小海生态旅游线路来总结经验，探索未来小海生态旅游如何更好的结合小海生态保护与和乐蟹池塘生态养殖推广，使小海生态保护、社区增收、 产业发展能共同创造更大的生态价值。

4.2 小海生态旅游设计及探索

我们通过每个季度的探索，设计出三条小海生态旅游线路，分别组织了高端商务休闲旅游团、周末亲子科普团、观鸟生态达人团等参与并挖掘路线亮点。

1）慢跑、自行车游线（适合高端商务休闲旅游团）

线路：北坡太阳河口——乌场和乐蟹生态养殖池塘——英豪半岛红树林生态区——港北港口渔业小镇，全程 8 公里左右。

特点：欣赏沿途景致，观光游览为主。在北坡太阳河口，可以欣赏太阳河入小海的开阔壮美，到乌场和乐蟹生态养殖池塘可以观赏到小海最集中的池塘生产区，感受慢节奏的池塘农事人文景观；到英豪半岛红树林生态区，可以欣赏到沼泽、浅水和林木等多种自然景观，可观赏到落霞与千鸟齐飞、静水共长天一色的自然美景，亦可欣赏到开阔的水面和连绵不绝的红树；到港北港口渔业小镇可以感受小海潟湖出海口处船只往来，渔市人气热闹的小镇风光。

2）步行游线（适合周末亲子科普旅游团）

线路：乌场渔村——红树林河道——和乐蟹生态养殖池塘——小海闸口——渔人民宿特色餐饮等，全程约 3 公里。

特点：有导赏员深入讲解，充分体验小海生态与人文知识。到渔村感受早市的热闹；在红树林河道间，了解湿地之美，感受生物多样性的精彩，也了解农民传统智慧对红树林各植物的生活实用；在和乐蟹生态池塘边，可以看到和乐蟹横行之景，亲手学习捕捉和乐蟹，通过养殖户讲解切实了解到和乐蟹有趣的一生；到在渔人民宿，品尝新鲜的和乐蟹及当地美食。

3）水上游线（适合观鸟生态达人旅游团）

线路：后安鲳鱼养殖池塘——渔人码头——小海海上风光——小海潮汐通道——港北码头，全程 8 公里左右。

特点：充分亲水之旅，与和乐蟹、红树林亲近。在游船之上，饱览和乐蟹的一举一动，感受红树林的盘根错节及自然物种的神奇，尽情享受在连绵的滩涂上观鸟的乐趣，也可观赏到落霞与千鸟齐飞、静水共长天一色的自然美景。

Appendix 2

Manual on eco-friendly hele-crab farming

和乐蟹池塘生态养殖操作手册

一、清塘管理

1.1 晒塘、清淤、池塘修整；

排干池塘内积水，暴晒池底 7 日以上。对堤坝渗漏进行填补，修复防逃围栏设施，清除池塘周围杂草。

1.2 进水、消毒、培水；

晴天上午 8 时后开始投放如下药物：每立方米水体用 400g/m³～500g/m³的生石灰，用水化开后趁热泼洒全池或干撒，10 天后药性消失；每立方米水体用 20g/m³～25g/m³茶籽饼，使用前先将茶籽饼粉碎加入淡水浸泡 24 小时，稀释均匀后连水带渣一起泼洒，2 天～3 天药性消失。

注意：对蟹池死角及坑洼处、洞穴内要尽可能泼洒均匀。除害清池药物药性消失后，应及时进注海水，并保持水深 20 厘米～30 厘米，直至放苗前 2 天～3 天把池内水位增高到 1 米以上。

1.3 进水要求

水质符合 GB 11607 规定，养殖用水应符合 NY5052 的要求。养殖用水盐度范围为 6～25；水温范围为 18～3l.3℃；溶氧量应控制在 5mg/L 以上；pH 值范围为 7.5～8.9，氨氮 0.5mg/L 以下，硫化氢 0.1mg/L 以下，透明度 30cm～40cm。

二、蟹苗投放

2.1 蟹种来源

本地国家和乐蟹原良种场繁育的人工蟹种和天然捕捞的蟹种。

2.2 蟹种质量

选择体质健壮、规格整齐、肢体完整、爬行迅速、反应灵敏、无病无伤的青壳蟹苗，并经检疫合格。

2.3 放养密度

放养时间、放养数量、放养规格因养殖模式、上市规格和时间要求不同应灵活掌握。甲壳宽 0.4cm～5cm 的蟹苗放养密度 10500 只/hm²～2250 只/hm²；混养池放养密度减半。

2.4 放养方法

选择晴朗天气，上风头、多点放养，风浪大、阴雨天不宜放苗，同时注意养殖池的盐度，与苗种来源地的盐度差应小于 5，温度差应小于 2℃。

三、饲养管理

2.5.1 水质控制

视水质情况,适时换水。和乐蟹养殖期间前期以添水为主，中后期换水应根据实际需要而定，日换水量 10%～30%，并逐渐添加淡水，保持后期盐度控制在 7～10。高温或低温季节应提高塘内水位，暴雨后及时排去上层淡水。不定期投放微生态制剂和水质改良剂，改善水质和底质。

2.5.2 饲料投喂

投喂低值贝类和海捕小杂鱼虾时，要求低值贝类和海捕小杂鱼虾的质量必须新鲜、不腐败，投喂前用清洁水冲洗，用量参考表 1。和乐蟹摄食情况应通过放置池内的饲料观察网观察，并随时调整投饲料量。水温低于 18℃、高于 32℃时减少投饲量，12℃以下停止投喂。投饲地点选择在池塘四周的固定滩面上。早晚各投喂一次，傍晚占总投饲量的 60%～70%。

表 1 和乐蟹养成期不同生长阶段投饲率表

甲壳宽(cm)	日投饲率(%)
1～2	40
3～4	30
5～6	20
7～8	15
9～10	10～12

11 以上	5~8
注 1:日投饲率为每天投喂的饲料数量占池内蟹总重的百分比。 注 2:低值贝类应以实际出肉率计算	

四、膏蟹养殖

3.1 放养密度

选用壳宽 8cm 以上，体重 150g 以上已交配的雌蟹。在 12 月至次年 2 月，放养 35000～50000 只/hm²；3～5 月和 9～11 月，放养 25000～35500 只/hm²；6～8 月，放养 12000～22000 只/hm²。

3.2 饲料投喂

以投喂带壳的鲜活低值贝类为主， 日投饲量为蟹体重的 20～30%。 其它饵料的日投饲量则一般为蟹体重的 10～15%。每天投饲 2 次，早晨和傍晚各 1 次。

在膏蟹培育的整个过程中，水质的有效管理和调控就特别重要。应定期对盐度、水温、透明度、溶氧量、pH 值、亚硝酸盐、氨氮等主要水质因子进行监测，为采取水质管理和调控的有效措施提供依据，维护良好的生态环境，透明度控制在 20～25cm，溶氧量大于 3mg/L，亚硝酸盐低于 0.20mg/L，氨氮低于 0.20mg/L。

五、日常管理记录

养成期间，按《水产养殖质量安全管理规定》的格式做好养殖生产记录和用药记录。

六、病害防治

可采取以下措施：

a) 干塘清淤消毒，清塘药物及使用方法参见 NY/T 5277 的规定；

b) 放养优质苗种；

c) 投喂优质饲料；

d) 定期使用微生态制剂和水质改良剂，通过换水、增氧等手段改善水质并保持温度，盐度的相对稳定。蜕壳前交替使用生石灰 15mg/L、二氧化氯 0.2mg/L～0.3mg/L 消毒水体。

e) 发现患病死蟹应及时捞出查找原因，采取相应措施，传染性病害死蟹应做深埋处理。

f) 常见病害治疗方法见 NY/T 5277 的规定。

七、收获

和乐蟹规格雄蟹大于 200 克以上时，雌蟹大于 150 克以上时或性腺充满甲壳 80%～90%时，和乐蟹（膏蟹）可适期收获，用流网、蟹笼、排水、干塘等方法起捕，捆绑后和乐蟹（膏蟹）应在洁净海水吐沙 0.5h。