The Black-faced Spoonbill in Xinghua Bay:
A Catalyst for Responsible Development

LA 205: Environmental Planning Studio, Spring 2016
Department of Landscape Architecture and Environmental Planning
University of California, Berkeley

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Introduction to the Bird and the Bay

Cristina Bejarano

Each year, the Landscape Architecture 205 Environmental Planning Studio at UC Berkeley studies the endangered Black-faced Spoonbill habitat throughout East Asia and chooses a new site to analyze within its habitat area. Over four weeks in the Spring of 2016, the LA205 studio partnered with Spoonbill Action Voluntary Echo (SAVE) International to analyze and evaluate a set of recent Chinese regional government planning initiatives as proposed for Fujian Province in China.

The coastal region of Fujian Province, and specifically the sub-region of Fuzhou, where the proposed new development would be located, provides observed wintering and migrating sites for the spoonbill. Any development that could alter such sensitive habitat warrants careful evaluation.

Informed by SAVE's expertise on the spoonbill, we focused our analysis on planning documents generated by two Chinese ministries, the Ministry of Housing and Urban-Rural Development and the Ministry of Environmental Protection.

While we focused primarily on Donggang Harbor and the adjacent villages of Xinghua Bay, we also looked at larger scales, including Xinghua Bay as a larger ecosystem, Fujian's economic goals as a province, and China's role in the global community. These four scales will be explored throughout the analysis and recommendations chapters.

We began by gathering a range of questions related to the proposed development, as part of a brainstorming process with the researchers in the studio.

The key questions we surfaced were as follows:

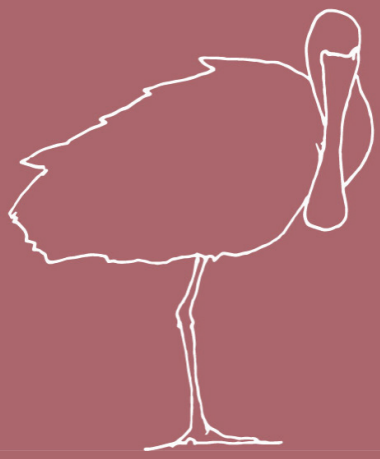
- To what extent is it acceptable to lose the various land typologies in the area, such as mudflats, fishponds, agricultural lands and mangrove forests?
- Is the proposed nature reserve adequate, and is it sited appropriately?
- Should the proposed water systems, drainage, and connection to bays and rivers be restructured or not?
- Is it appropriate to fill any part of the bay, or should this be prohibited?
- Are the current industry proposals appropriate to the area, and are there better alternatives?

The Black-faced Spoonbill has been observed both migrating through and wintering in various areas around Donggang Harbor in Xinghua Bay.

- Can we devise alternatives which achieve the same economic goals but in a more sustainable and ecologically sensitive way?
- What are the implications of anticipated sea level rise for the proposed development?
- What is an acceptable proposed relationship to the spoonbill?
- Are there opportunities for towns around the bay to coordinate efforts to preserve the landscape?
- Could the planned development be relocated? Are there more appropriate locations for it?
- What if any changes in planning policy would improve this proposal and others like it in the future?
- What is the current health of the bay? Can we find a solution to improve it?
- What are the implications and opportunities for tourism? Is tourism a viable industry in this area? Who are the likely tourists?
- What are the mobility and transportation patterns for future tourists? How would they access the area?
- What are the likely impacts on local quality of life?

Motivated by these questions, the following chapters present our collected research and supplemental studies, in addition to various recommendations we composed for the future of the Black-faced Spoonbill in the Xinghua Bay.

Chapter 1
Regional Context and Ecological Analysis



1.1
Spoonbill Geometries and Habitat Analysis in Xinghua Bay

Joseph Burg and Stephen Pye

The Black-faced Spoonbill, *Platalea minor*, is a large shorebird that feeds on small fish and crustaceans in the shallow waters of the eastern coast of Asia. The spoonbill completes an annual migration between breeding sites on the Korean peninsula and various overwintering locations farther south. Although found in many areas throughout this range, the species is endangered. Habitat loss is a major factor in the species' decline, although disease, poor water quality, and other factors also contribute. The population of the bird has slowly been recovering from historic lows. A recent study by BirdLife International estimated that while there were less than 500 birds in 1990, there were more than 2,500 birds in 2014. Conservation efforts have aimed to preserve wetland and shore habitats for the birds along their migration route.

Fig. 1.1-1 *The Black-faced Spoonbill is an endangered species with about 1600 adults reported in 2012.*

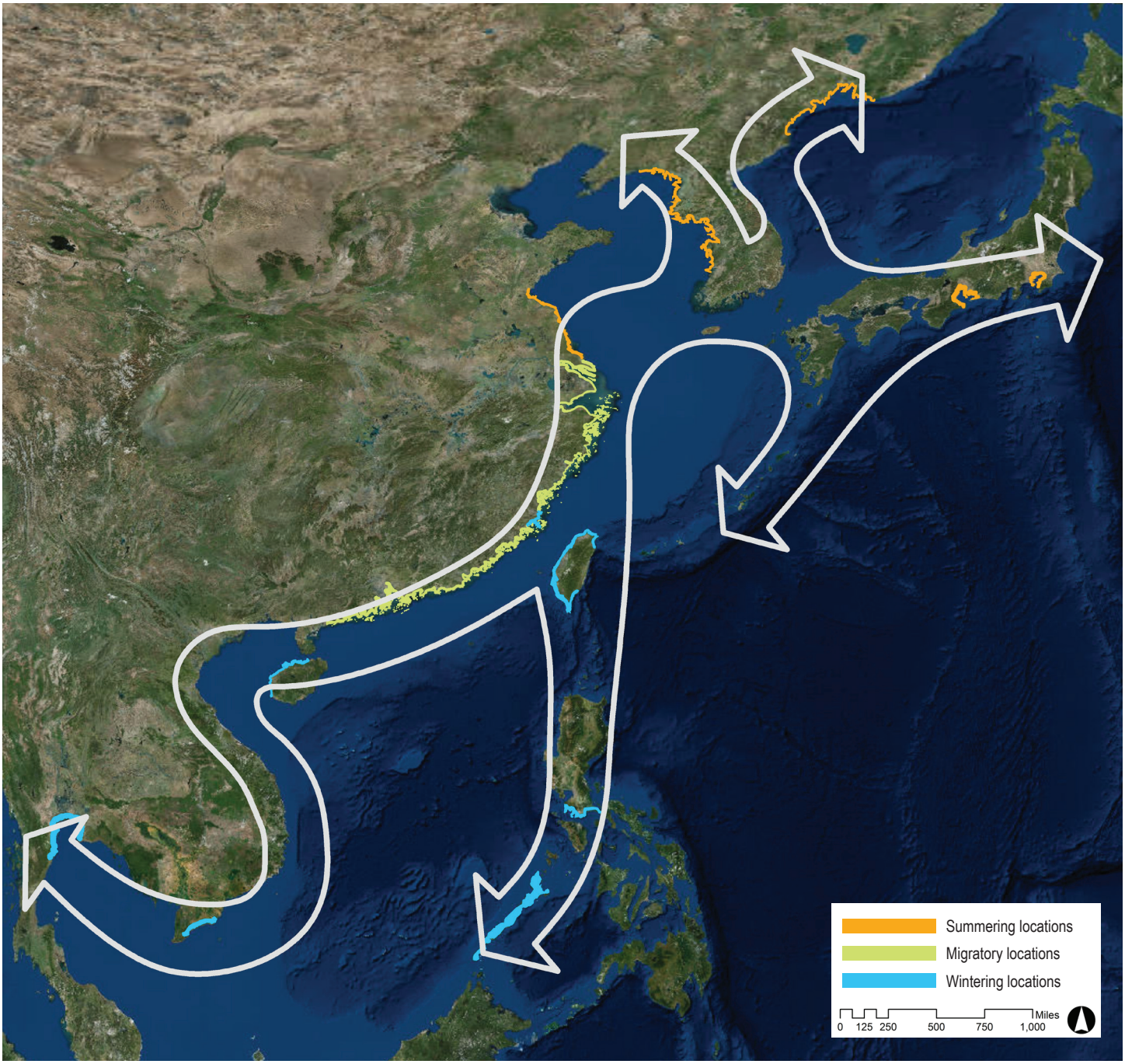


Fig. 1.1-2 *The migratory patterns of the Black-faced Spoonbill throughout East Asia, initially developed by SAVE, and transposed over an aerial.*

Xinghua Bay, located in Fujian province, along the coast of China immediately west of Taipei, Taiwan, serves as both a migratory stop and overwintering location for spoonbill. During four years of surveying, Jie-Feng et al. found that between 40 to 60 birds overwintered at Jiangjing Huaqiao Farm, an aquaculture operation in on the northern shore of the bay. An additional 130 to 220 birds used the same farm as a migratory stop (2009). The Xinghua Bay Provincial Nature Reserve has been proposed to protect this habitat, but the core habitat the birds are currently using is threatened by the 2015-2030 Fuzhou New Area Plan. Google Earth imagery shows that fill has already begun in the large pond where spoonbill have been observed roosting. Beyond the farm, habitat loss is projected to reduce many areas in the bay that the birds need to roost and feed. These areas include fish ponds and mudflats, which are used both by the birds and local citizens for aquaculture practices. Our analysis focuses on the habitat that exists in this region today, and on what may remain if the development plan is fully implemented by the Chinese government in the future.

Fig. 1.1-3 *Jiangjing Huaqiao Farm, a large-scale government-run fish farm, is an important feature of the spoonbill habitat area.*

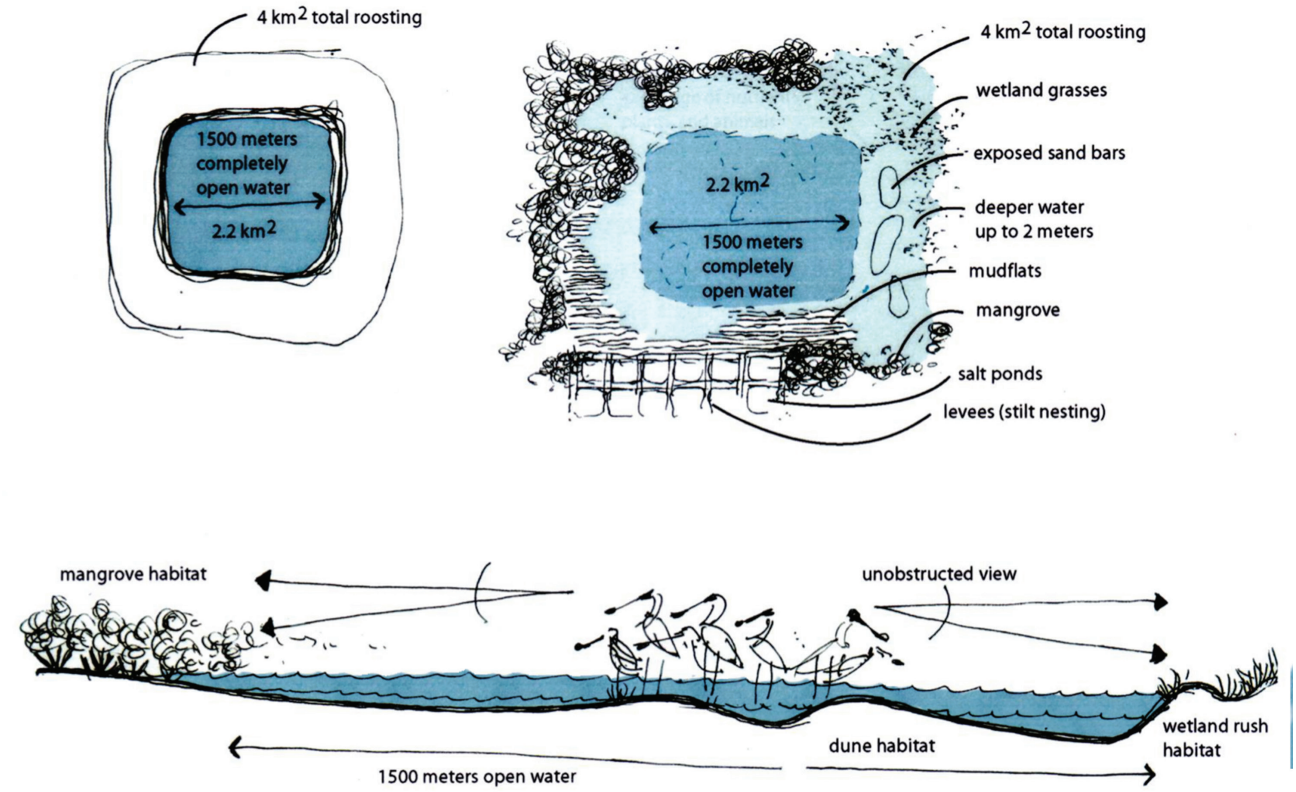


Fig. 1.1-4 *Spoonbill geometries developed by Randy Hester and Marcia McNally, used as a reference for testing the likelihood of successful habitat locations.*

Spoonbill Geometries

To better understand the habitat conditions and 'geometries' (that is, the distances, depths, and other physical dimensions of their preferred habitat) of the spoonbill within Xinghua Bay, we reviewed literature and information regarding their habitat needs and observed habitat types. This research led us to the conclusion that two primary habitat types exist within Xinghua Bay: mudflats and fish ponds. While fish ponds offer the most suitable roosting habitat for birds, both mudflats and fish ponds offer suitable feeding habitats (Jie-Feng et al. 2009). The birds may also fly short distances to find feeding habitat, which were observed as being between three and eight kilometer flight ranges. SAVE estimates the spoonbill's feeding range at three kilometers, however Jie-Feng et al. report observing spoonbill traveling up to 8 kilometers to feed in Xinghua Bay (2010). SAVE also estimated other physical characteristics necessary for good spoonbill habitat that we used in this study. The spoonbill is a relatively shy bird, and is scared by disturbances (noise, harassment, etc.) within 500 to 700 meters of their roosting sites. Roosting sites themselves are largely open bodies of water, no deeper than 20 centimeters, and free of tall vegetation that may conceal predators. According to SAVE, the open water area must be approximately 1500 meters in any direction, ideally within a larger open area of greater than four square kilometers that offers protection from predators and disturbance, as illustrated in Figure 1.1-4. We utilized feeding flight ranges and habitat needs to determine the best areas in Xinghua Bay for spoonbill persistence.

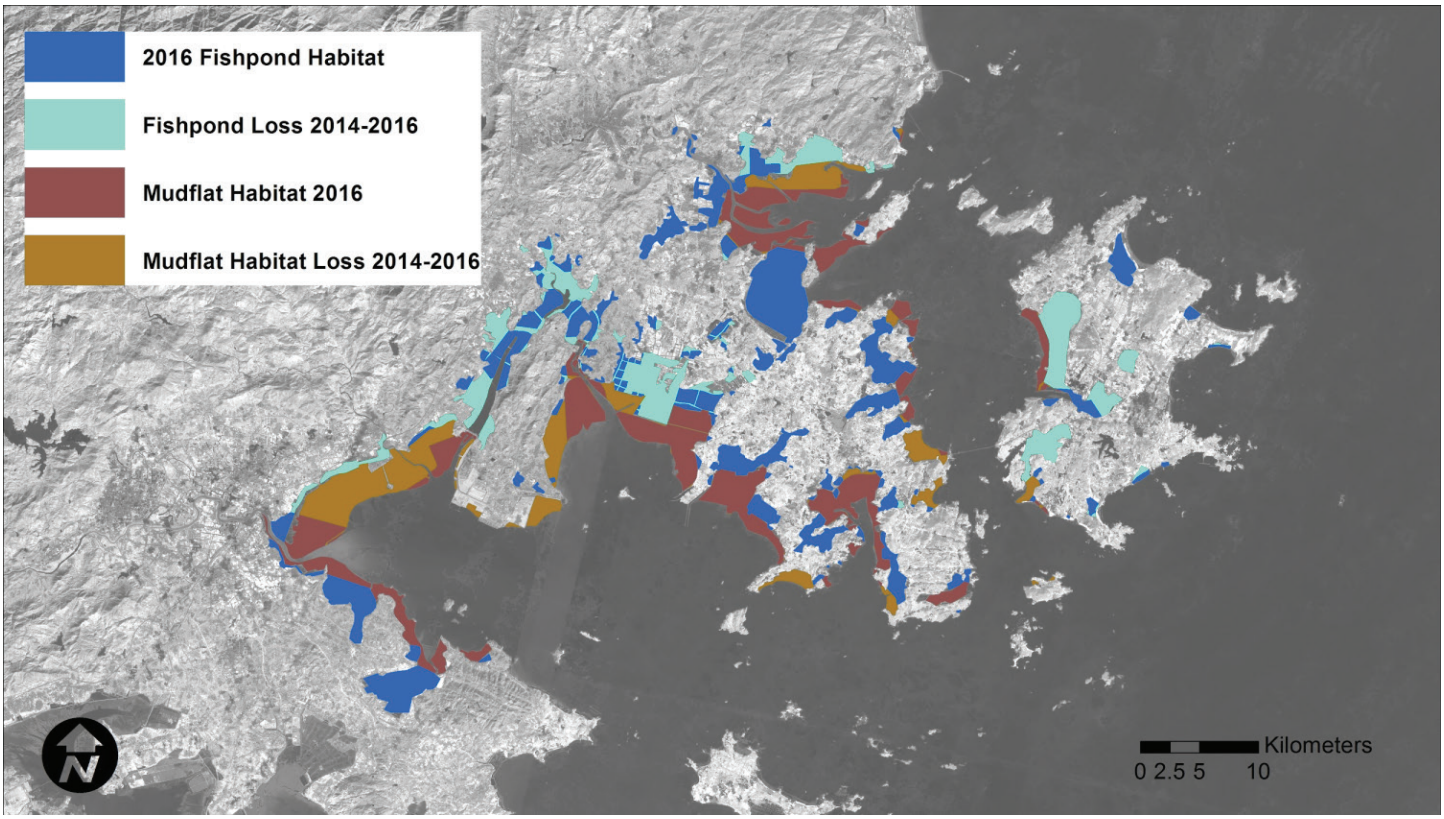


Fig. 1.1-5 *Extent of fishpond and mudflat habitat in the Xinghua Bay region, including areas at risk of development*

Spatial Analysis

Mudflats and fishponds are widespread landscape features in the Xinghua Bay area. We utilized LANDSAT 4-band imagery to classify ponds and mudflat areas by performing a '4,3,2' reordering of the imagery bands. This classifies water, hard features, and living vegetation in contrasting colors, allowing the user to easily identify these different features. After producing this imagery display, we digitized ponds and mudflats as two separate feature classes for three different years in which good imagery was available: 2008, 2010, and 2014. We then calculated the habitat area in our region of study. We observed a decrease in the area of both habitat types, primarily due to construction of roads and expanding urban areas, illustrated in Figure 1.1-5.

Comparing pre-development habitat conditions to the areas soon to be impacted by the planning proposals:

- 33% Reduction in fish pond area
- 36% Reduction in mud flat area
- Near 100% loss of mangroves

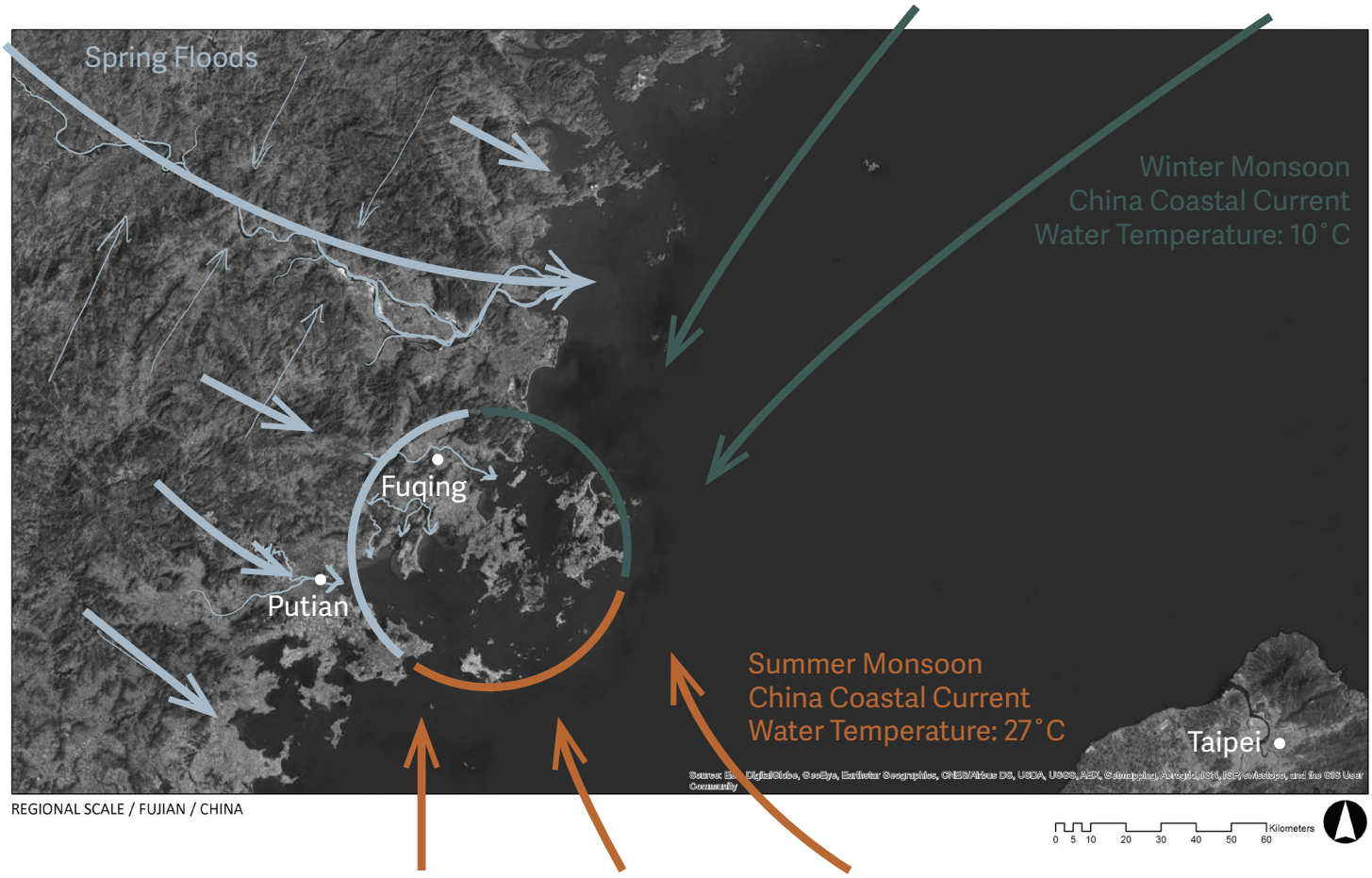


Fig. 1.2-1 *Climate attributes of three defined seasons*

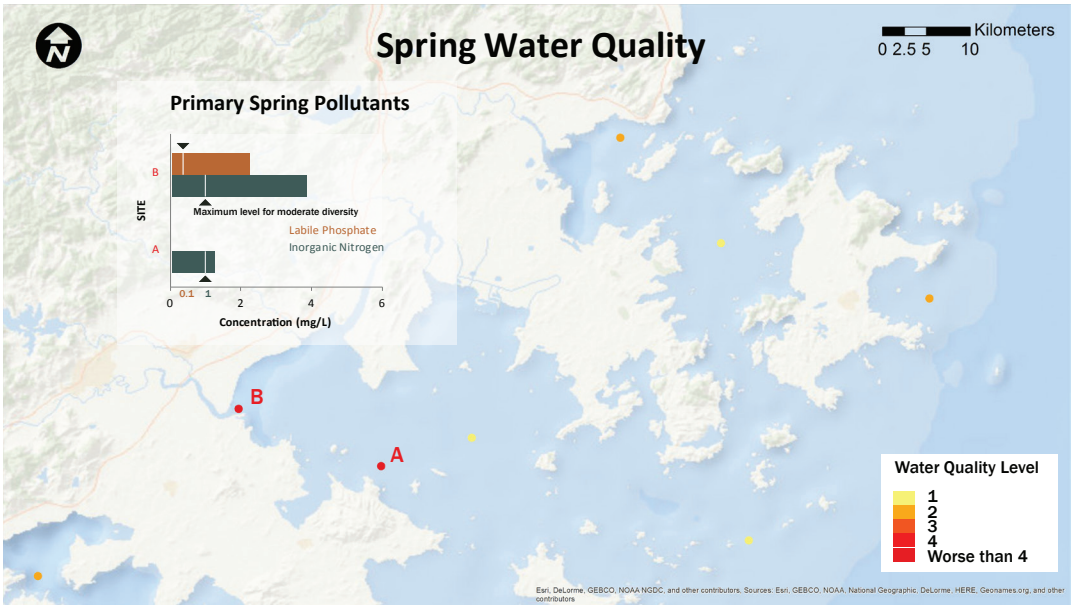
1.2
The Interconnected Ecologies of Xinghua Bay

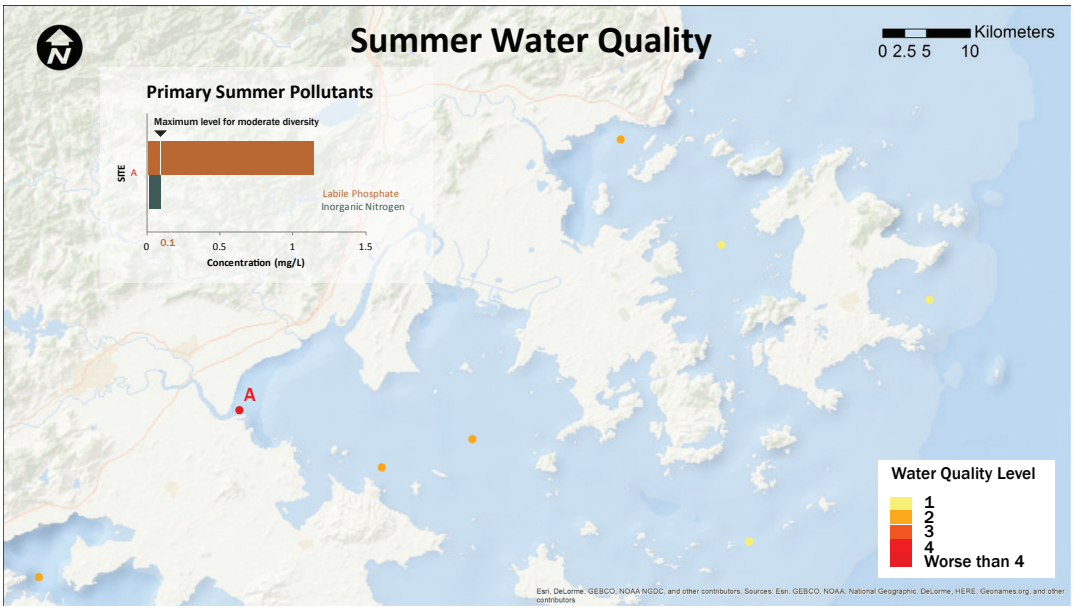
Justyn Huckleberry and Peter Trio

Xinghua Bay is composed of an array of ecological and anthropogenic functions which result in a deeply interconnected network. The relationships of this network will emerge as each of the diverse parts is analyzed and understood. Solutions can then be tested with a greater understanding of the social, economic and ecological impacts. In analyzing the climatic patterns in the area, it is found the bay is a part of a much larger system. Solutions to improving the seasonal water quality by phytoremediation will be explored. Through analysis of the aquaculture industry, the relationship with water quality and the economy will help guide more feasible solutions. By working with each of these parts synergistically, process-based solutions can be tested with the common goal of increasing the vitality of Xinghua Bay.

Climate

The climate of Xinghua Bay can be broken into three main seasons, the Spring Wet Season, Summer Monsoon and Winter Monsoon. Spring rains saturate the watershed and bring a flux of freshwater through the cities, agricultural fields, aquaculture ponds, and finally into the bay. In addition to the abundance of freshwater these rains carry pollutants (from the urbanized cities), chemicals (from the agriculture fields) and suspended solids (from the aquaculture ponds). During the Summer Monsoon the China Coastal Current brings warm waters from the south allowing water levels to reach 27 degrees Celsius in the bay. During the Winter Monsoon, the China Coastal Current reverses bringing cooler waters from the north along with contaminants from the more urbanized watersheds of the coastal north. Typhoons are also common to this region and come from the north, south and west depending on the season. These storms, which have been increasing in intensity and frequency, heavily disrupt the existing aquaculture industry often resulting in the loss of human life and immense economic impacts.





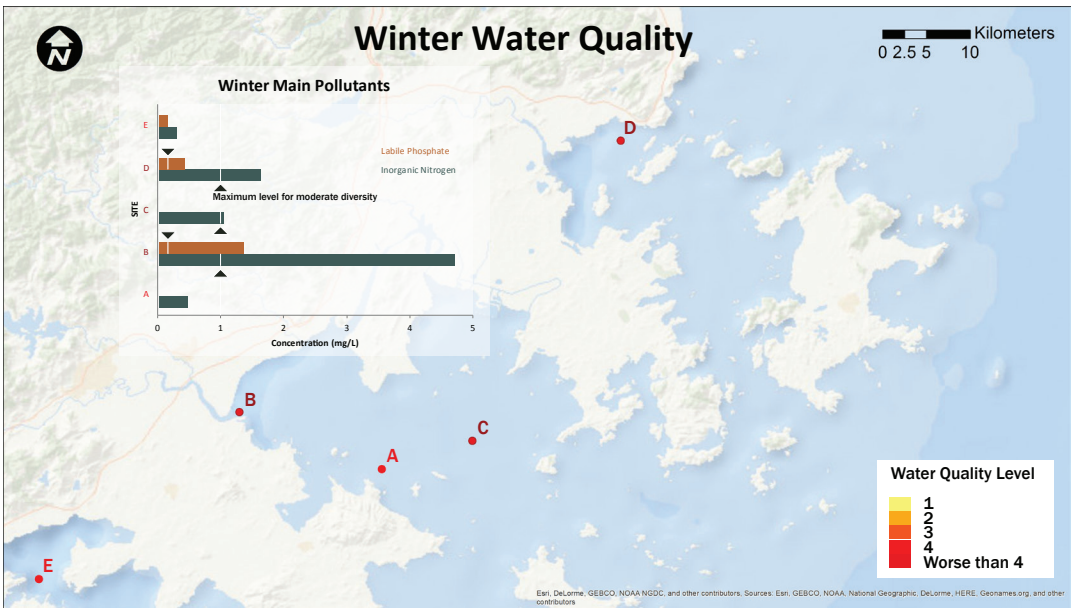


Fig. 1.2-2 *Water quality levels in Xinghua Bay were measured based on various test sites over three distinct seasons, Spring, Summer and Winter.*

Water Quality

As the maps in Figure 1.2-2 show, the water quality of Xinghua Bay and surrounding areas depends on the seasons, adjacent geomorphological characteristics, and local industry. China has 5 levels of water quality:

- Level 1 – Best quality of water, suitable for marine fish, marine sanctuaries and rare and endangered marine life protected areas.
- Level 2 – Suitable for aquaculture areas, swimming, or sea sports.
- Level 3 – Applies to general industrial water area and is too polluted to use for consumption or recreation.
- Level 4 – Applies to marine port waters and developmental areas and have a high level of pollutants.
- Worse than level 4 – Sites are likely to have very high levels of primary pollutants as the following analysis shows.

In spring, the wetter time of year, two of eight sites shown on the map are worse than level 4. During this time of year the rains from the upper watershed heavily influence water quality as discussed in the previous section. This could explain the proximity of the sites that are worse than level 4 to the mouth of one of the larger rivers feeding the bay – the Mulan Brook.

In summer only one in eight is worse than level 4 and in winter, the drier time of year, 2 of the 5 sites are sampled level 4 and the remaining 3 are worse than level 4. This could be an indicator of the seasonal patterns previously discussed as well as industrial patterns. To the north of Xinghua Bay lies multiple heavily used marine ports and industrial hubs. The point directly adjacent to the aforementioned river, Mulan Brook, is always worse than level 4. It is likely that this site is an accumulation of nutrients both from upstream sources and at the mouth of the river.

Based on the data, the primary pollutants that affected water quality were labile phosphate and inorganic nitrogen. Labile phosphate is any phosphate molecule that can be taken up by an organic organism. Inorganic nitrogen includes ammonia, nitrate, nitrite, and atmospheric nitrogen. These nutrients typically originate from agriculture, stormwater, wastewater, and industry. The presence of these pollutants can lead to harmful algal blooms (HAB), or more colloquially, red tide. An occurrence of an HAB results in the production of toxins and a decrease in dissolved oxygen and is sometimes associated with large-scale fish die-offs. In an area that we hope to be important spoonbill habitat in the future, the presence of harmful toxins that are biologically available throughout the food chain could be harmful for the species and others as well.

Aquaculture

The Fujian Province is one of the top producers of aquaculture in the country of China. The province also has the second longest coastline and remains as one of the least developed coastlines in the country. Along with the recent pressures of industrial urbanization, there have been significant changes in the aquaculture industry over the past two decades. Traditionally the aquaculture industry was primarily in the form of offshore fishing, this has dramatically changed since the 1980's as a variety of inland aquaculture (fishponds) and shoreline mariculture (saltwater fish farms) have been utilized to increase a growing global demand.

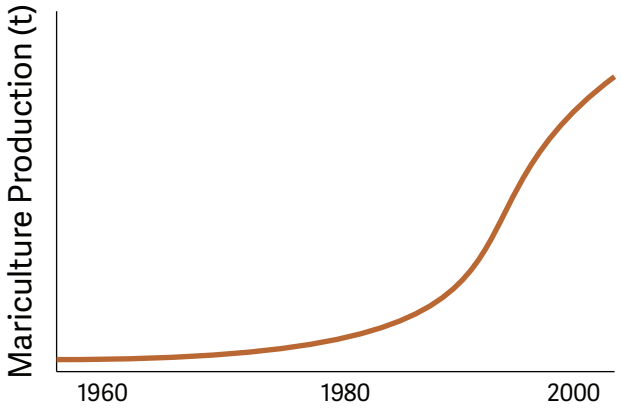


Fig. 1.2-3 *Mariculture Production in China, as derived from Feng, 2005 to illustrate the change in Chinese Coastal Waters.*

The city of Fuqing (20 kilometers north of Xinghua Bay) was the focus of a 2007 *New York Times* article that listed the region at the top of an aquaculture export ban for traces of illegal veterinary drugs. Upon further investigation it was found that the water quality of the fish ponds was so poor, that fish farmers had to resort to the use of illegal drugs in order to keep their fish stock alive. The degradation in water quality is likely due to the exhaustive development of inland aquaculture, which has strained the watershed of its vitality. The concern of water quality ranked consistent with a survey conducted in 2015, given to 150 fish farmers throughout the three primary aquaculture provinces. With water quality, food safety, animal welfare and regulatory compliance all followed suit as the four main concerns for surveyed fish farmers.

Top concerns from the farmers

1. Water Quality
2. Food Safety
3. Animal Welfare
4. Regulatory Compliance

Mariculture Production		Mariculture Exports
1. Shandong		1. Shandong
2. Fujian		2. Liaoning
3. Guangdong	vs.	3. Guangdong
4. Liaoning		4. Zhejiang
5. Guangxi		**5. Fujian**
6. Jiangsu		6. Hainan

Fig. 1.2-4 *Based on research from Ortega, D. L. et. al. and Fao, R.*

With Fujian ranking as the second province in terms of mariculture production, it ranks fifth in terms of exports. Based on information gathered from other sources, it is plausible to assume the lack of exports is due to the poor state of quality not fit for exportation. If this assumption is held true, it means the poor grade of aquaculture is a major source of food for the Chinese citizens. Posing as a public health concern for residents in the region, it also provides as an opportunity for Fujian to reposition itself as a leader in sustainable aquaculture exports, increasing the health and economy of the region. There is a wide array of aquaculture typologies, which can be found along the surrounding coast of Xinghua Bay, as Figures 1.2-5 and 1.2-6 show. These start with a gradient of agriculture fields (upland), freshwater fishponds (at the base of the watershed), to shoreline saltwater fish ponds (along the coast).

Fig. 1.2-5 *Common species to Xiamen Sea Area, and a collection of aerial views of the region as seen on Google Earth, 2014.*

Upon reaching the coast there is typically a mudflat zone, which is utilized for oyster farming. This zone is still heavily dependent on manual labor and therefore has tight constraints where it can be positioned along the coast. Within protected coastal zones there are large swaths of seaweed farming which support a robust seaweed industry in China. There are also mariculture cages, which are floating fishing settlements tied together with cages within the water. These informal settlements do not have modern plumbing and pose an environmental and health concern as human sewage is disposed directly into the open water being farmed. Three key aquaculture species are *Laminaria japonica* (Kelp), *Lateolabrax japonicus* (Japanese Sea Bass) and *Saccostrea cucullata* (Natal Rock Oyster). The vitality of Xinghua bay is heavily dependent on the water quality and climate of the region. Offshore fishing ports can be found scattered around the region with the greatest density found in the islands of Fuqing. Though present, the offshore fishing ports appear to be dwarfed in size compared to the immense amount of aquaculture farming in the region.

Phytoremediation

Phytoremediation could be an important solution for the Xinghua Bay which could exist synergistically with aquaculture operations. Phytoremediation utilizes green plants to remove or degrade contaminants, such as nutrients, harmful toxins, and heavy metals, in soil or water. It is much less expensive than many conventional forms of water remediation. There are many different approaches to phytoremediation, but here we will focus specifically on treatment wetlands, seaweed,

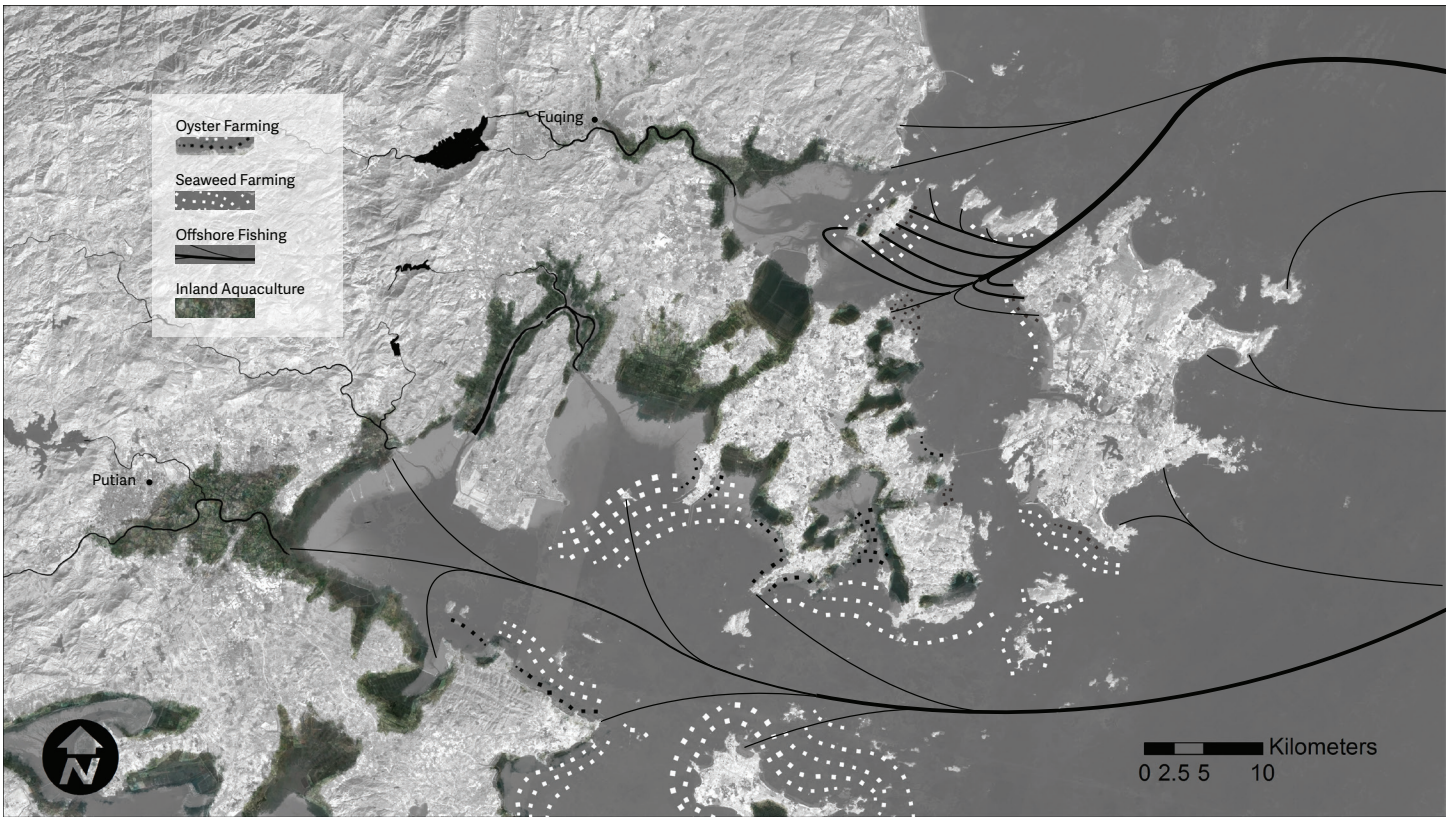


Fig. 1.2-6 *Existing Distribution of Aquaculture Types in Xinghua Bay*

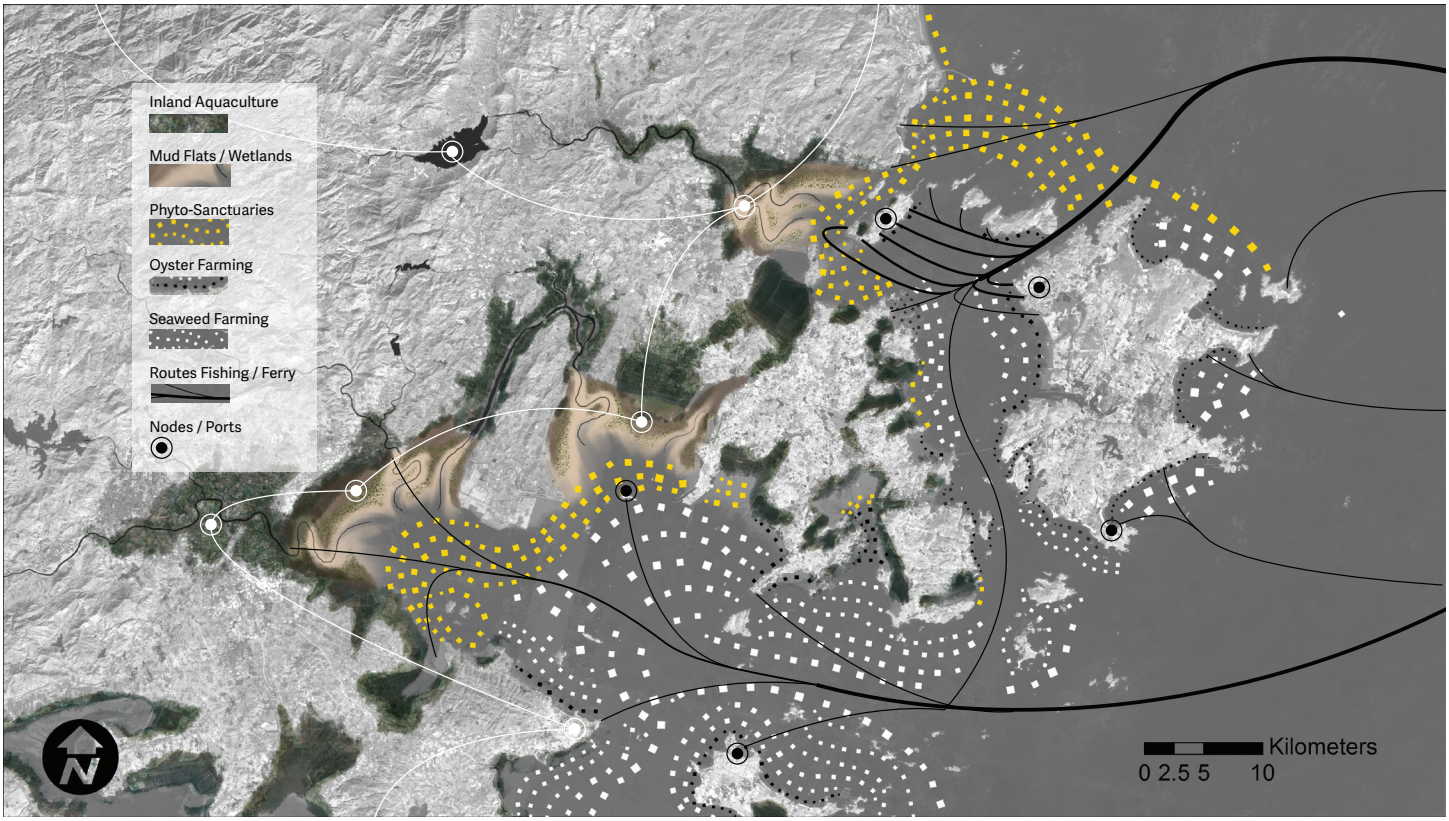


Fig. 1.2-7 *Proposed Distribution of Aquaculture Types in Xinghua Bay*

and mangroves. Treatment wetlands, a series of pond systems, have been shown to be 70-90% effective in nitrogen removal and up to 80% effective in the removal of phosphorous. Additionally, they have been shown to increase cost-effectiveness by 2-8 times. This has to do primarily with reduced maintenance costs due to low artificial energy inputs and the absence of wastes to be disposed of when compared to traditional water treatment facilities. Seaweed phytoremediation, and various forms of macroalgae such as *Gracilaria lemaneaformis*, are successful because of their uptake of heavy metals. Finally, mangroves have been shown to be effective in the removal of inorganic nitrogen, however, not effective in the removal of phosphorous.

Although the water quality of Xinghua Bay is very poor, there are modes of increasing the health of the water sediment and ultimately, the ecosystem that grows from it. Phytoremediation has been shown to be effective both biologically and economically. By coupling phytoremediation of the waters with more stringent environmental policy that diminishes point-source pollution and industrial operations adjacent to water bodies, the Xinghua Bay will be a healthy, vibrant habitat for many species in the future.

Conclusion

Water quality is key to the vitality of Xinghua Bay, which affects the ecology, industry and overall livelihood of its residents. While aquaculture is heavily dependent on water quality, the practices of the industry also have a major impact on it. The fluctuation of toxicity levels related to seasonal climate patterns demonstrate the complex stewardship required to maintain strong bay health.

Xinghua Bay has an opportunity to emerge as a leader in ecological development that could set a precedent for other coastal zones of the Fujian Province. Initiatives to save the Black-faced Spoonbill share many of the same concerns as the existing aquaculture industry in resisting the urban development for the region as it is currently presented in the 2015-2030 Fuzhou New Area Plan.

As the climate changes, sea levels rise, and typhoons increase, it will become more critical than ever to preserve the ecological protections that this ecosystem provides to the local economy. Figure 1.2-7 shows a new proposal for the organization of aquaculture types in Xinghua Bay that would aid phytoremediation, protect the shoreline from extreme weather events, and at the same time preserve the main shipping corridors in the region. This recommendation will be elaborated further in Chapter 4.5.

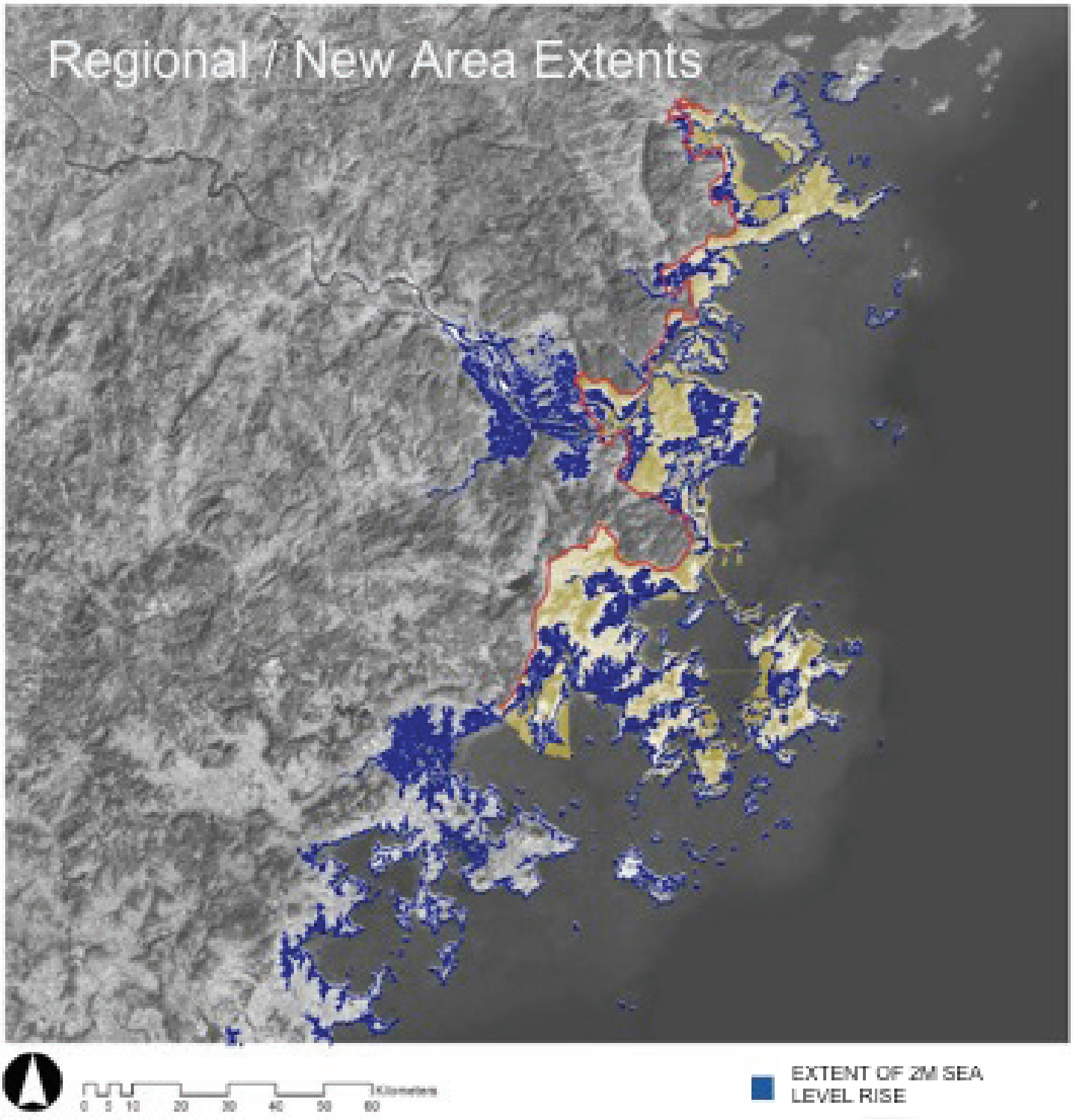


Fig. 1.3-1 *Coastal extents of the Fuzhou region, overlaid by a two-meter increase in sea level rise.*

1.3

The Impacts of Sea Level Rise

Cristina Bejarano

The Intergovernmental Panel on Climate Change (IPCC) has described a range of possible future scenarios for anthropogenic impacts on the global climate. The 2014 IPCC report included projections for the increase of global mean sea level (GMSL) based on those potential scenarios, as seen in Figure 1.3-2. More recent studies demonstrating faster-than-expected melting of glaciers in Antarctica suggest that the increase in GMSL may be as much as double what the IPCC report suggests, and happen twice as fast.

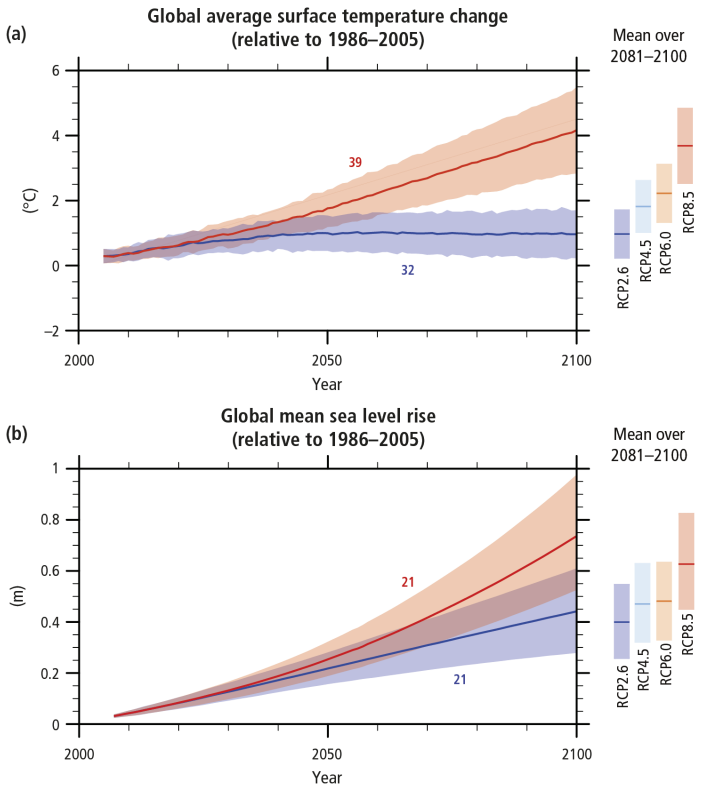


Fig. 1.3-2 *Future projections from the 2014 IPCC report*

We analyzed existing topographical and hydrological patterns in the area of proposed development in Fujian Province to understand the local impacts of the projected rise in sea level. Using average high-tide shoreline elevation as a base level, we evaluated increases of one and two meters of sea level rise, as seen in Figures 1.3-3 and 1.3-4.

Current hydrologic tidal patterns in the Dongang Harbor area see diurnal fluctuations of about five meters. This tidal pattern shapes the coastal mudflat edge that is essential Black-faced Spoonbill habitat. It's also essential to local aquacultural farming methods, which harness the tidal flows via a series of channels, locks, and levees. The existing aquacultural typology could adapt to a mean sea level increase more easily than other forms because the system is inherently adaptable and often gets updated after typhoon damage or in response to changes in consumer market trends.

Fig. 1.3-3 *Average high-tide shoreline of Donggang Harbor in 2015 (above), overlaid by a one-meter increase in sea level rise (below).*

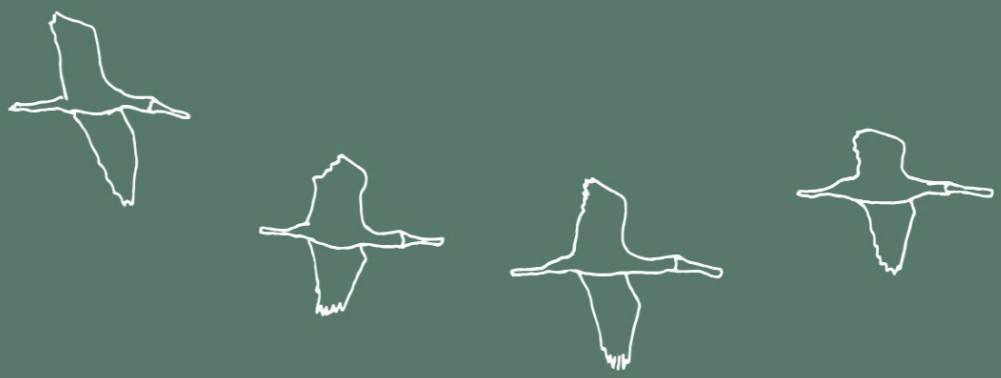
These aquaculture systems work in concert with the surrounding mudflat habitats, relying on them as a natural protection buffer during storms.

When we overlaid sea level rise projections on areas we identified as historic village centers, we saw a clear complementary fit. Most likely due to past patterns of typhoon storm surges, human settlements historically have existed only on the higher elevations. These patterns are not maintained by the current development plan, as will be presented in Chapter 3. The alternative proposals in Chapter 4 use these historic settlement trends as an organizing principle for development and habitat preservation.

Fig. 1.3-4 *Two-meter increase in sea level rise (above), overlaid by the main road network of the 2015-2030 Fuzhou New Area Plan proposal (below).*

As shown in Figure 1.3-4, almost all of the proposed development is located in an area that will be impacted by two meters of sea level rise. Consideration of the local effects of climate change and increase in global mean sea level was a glaring omission from the proposal planning documents. To prevent future disasters, natural buffers must be retained as soft armoring along the coasts, existing adaptable developments should be maintained, and new developments near the coasts should be designed to adapt to changing sea level. The proposed development has enormous potential for environmental destruction and irreversible negative impacts on the area, which we will expand on in the following chapters.

Chapter 2
Analysis of the Planning Proposals



2.1
Introduction to the Planning Proposals

Cristina Bejarano

The planning documents we studied were developed by various levels of Chinese government to outline the future development of the Fuzhou sub-region of the Fuqing province. In addition to reviewing the overall plan, we also focused specifically on the Donggang Harbor (also called Jiangyin Bay in the planning documents) on the north side of Xinghua Bay.

2015-2030 Fuzhou New Area Plan

The 2015-2030 Fuzhou New Area Plan outlines the major goal of the policy initiative "to further deepen and broaden the cross-strait exchanges and cooperation, ... [and] to promote the scientific development of Fuzhou."

To accomplish this goal, the plan identifies land use changes in the area that will introduce major industrial facilities and lead to the construction of new warehouses, transportation systems including harbors and highways, and ultimately new residential and commercial areas nearby. Historical hydrologic patterns would be reconfigured, and a new grid of development would be overlaid over the existing fish ponds and mudflats that currently form a soft buffer along the coast. This buffer protects the area from storm surges, and more importantly, provides various ecosystem services from endangered species habitat to water filtration and bioremediation.

The plan also identifies "Ecological Resources" including wetlands, mudflats, mangroves, inland forests, water reservoirs, and others. While the level of detail and accuracy is questionable when comparing these maps to recent aerial photography, the intention of outlining wetland protection areas is clear. The fact that there are conflicts within the same plan between the areas outlined as wetland protection and the areas set aside for industry and surrounded by highways is alarming. This, in addition to the analysis of aerial photography in the area, suggests that there is a disconnect between the environmental planning efforts and the economic goals in the region.

2012-2030 Blue Economy Industrial Park Plan

In order to understand the 2015 Fuzhou New Area Plan, it was important to also review the 2012-2030 Blue Economy Industrial Park Plan, which outlines the fully-built vision for the area in greater detail. While the full 2012 proposal was not adopted in the 2015 document,

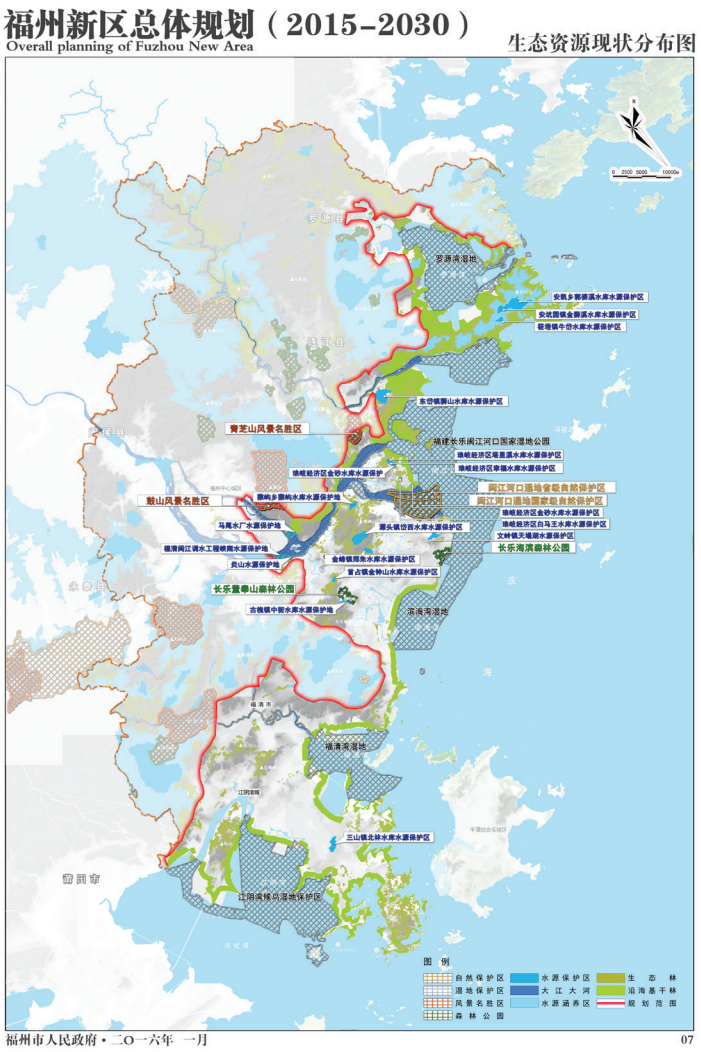
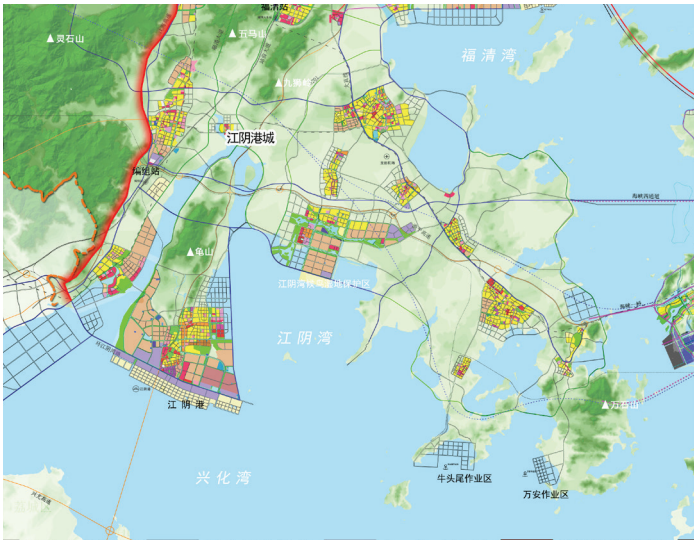


Fig. 2.1-1 *Full extent of the 2015-2030 Fuzhou New Area Plan: Construction and Land Use Planning diagram (left) and Ecological Resources Protection diagram (right).*



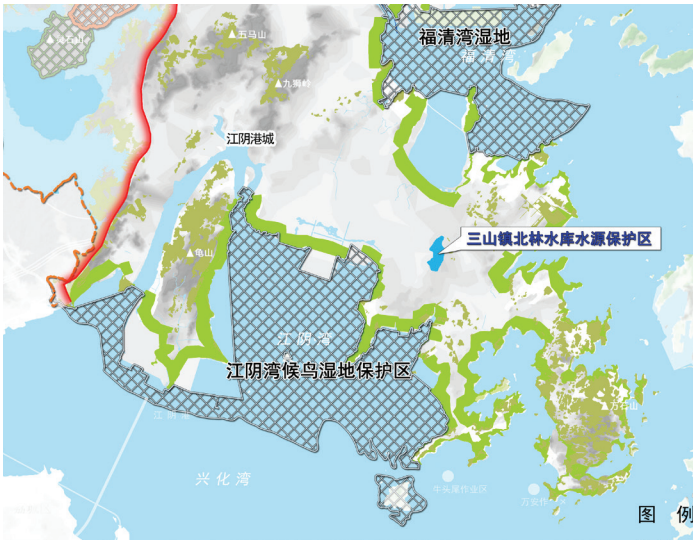


Fig. 2.1-2 *Detail of the Donggang Harbor in Xinghua Bay in the 2015-2030 Fuzhou New Area Plan: Construction and Land Use Planning diagram (left) and Ecological Resources Protection diagram (right).*

Fig. 2.1-3 *Renderings from the 2012-2030 Blue Economy Industrial Park Plan (above and below)*

it's clear that the organizing principles and intentions of the 2012 proposal will guide the 2015 developments in the future.

The renderings from the 2012 documents are included here as a reference, as are the planning principles (transcribed by the students), and various diagrams which explain the decisions that lead to the plan's organization.

While the specifics of the company names are not included, the 2012 documents are written to emphasize the potential for attracting Taiwanese investors who might be interested in various types of marine extraction, desalination technology, and/or aluminium refinement.

In reviewing the planning proposals, it became clear that a major goal at the national and global level is for this area to compete directly with Taipei to bring Taiwanese investment back to mainland China. However, the extent of the environmental impact at the local level in order to accomplish this goal seems to have been disregarded.

The following chapters will evaluate the level of impact posed by the planning proposals at the regional scale, at the harbor scale, and at the scale of the Black-faced Spoonbill.

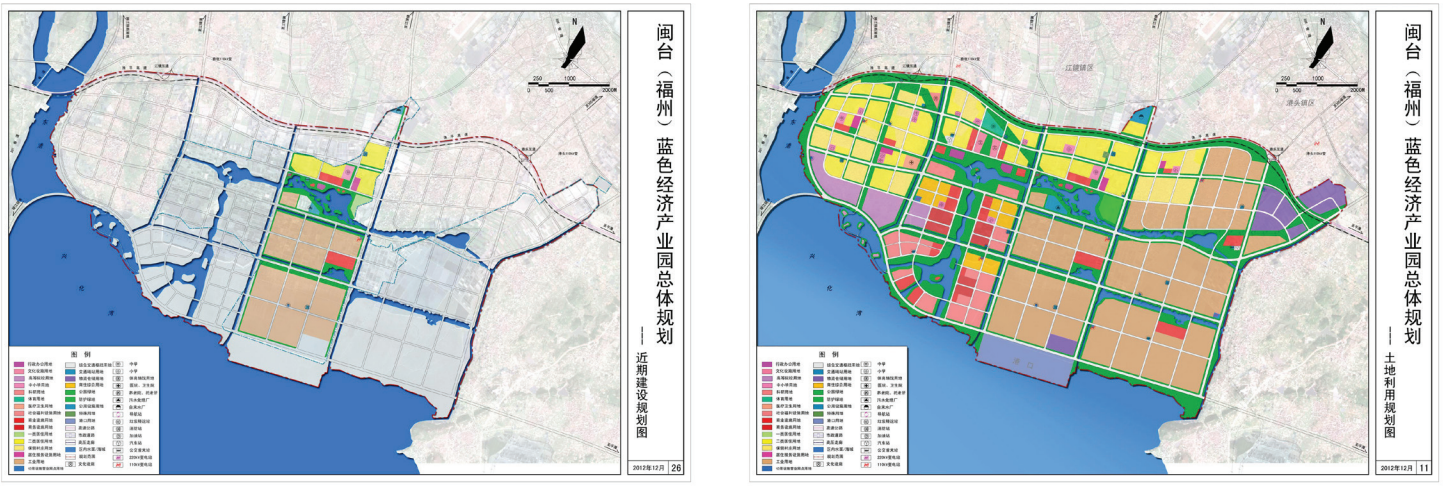


Fig. 2.1-4 *The first phase and later build-out as proposed by the 2012-2030 Blue Economy Industrial Park Plan*

1. Residential areas are located further away from the nuclear power plant (close to the existing residential locations in the west).
2. The southeast industrial and warehouse areas located in the 5-10 km buffer zone of the nuclear power plant.
3. Skyscrapers and high density buildings should be in the south to be out of the flight path for planes landing at the nearby airport.
4. The existing canals and fishponds will be maintained to create a waterfront development edge.
5. Electricity and power infrastructure should be built along roads and canals to avoid cutting through blocks.
6. The harbor should be located at the deepest part of the sea.
7. There should be distribution centers (Port Authorities) at the highway and the harbor.

Fig. 2.1-5 Principles from the *2012-2030 Blue Economy Industrial Park Plan (as transcribed by the students)*

Fig. 2.1-6 *Renderings from the 2012-2030 Blue Economy Industrial Park Plan*

2.2
Understanding the *Fuzhou New Area Plan* at the Regional Scale

Andrew Cumine and Tomas McKay

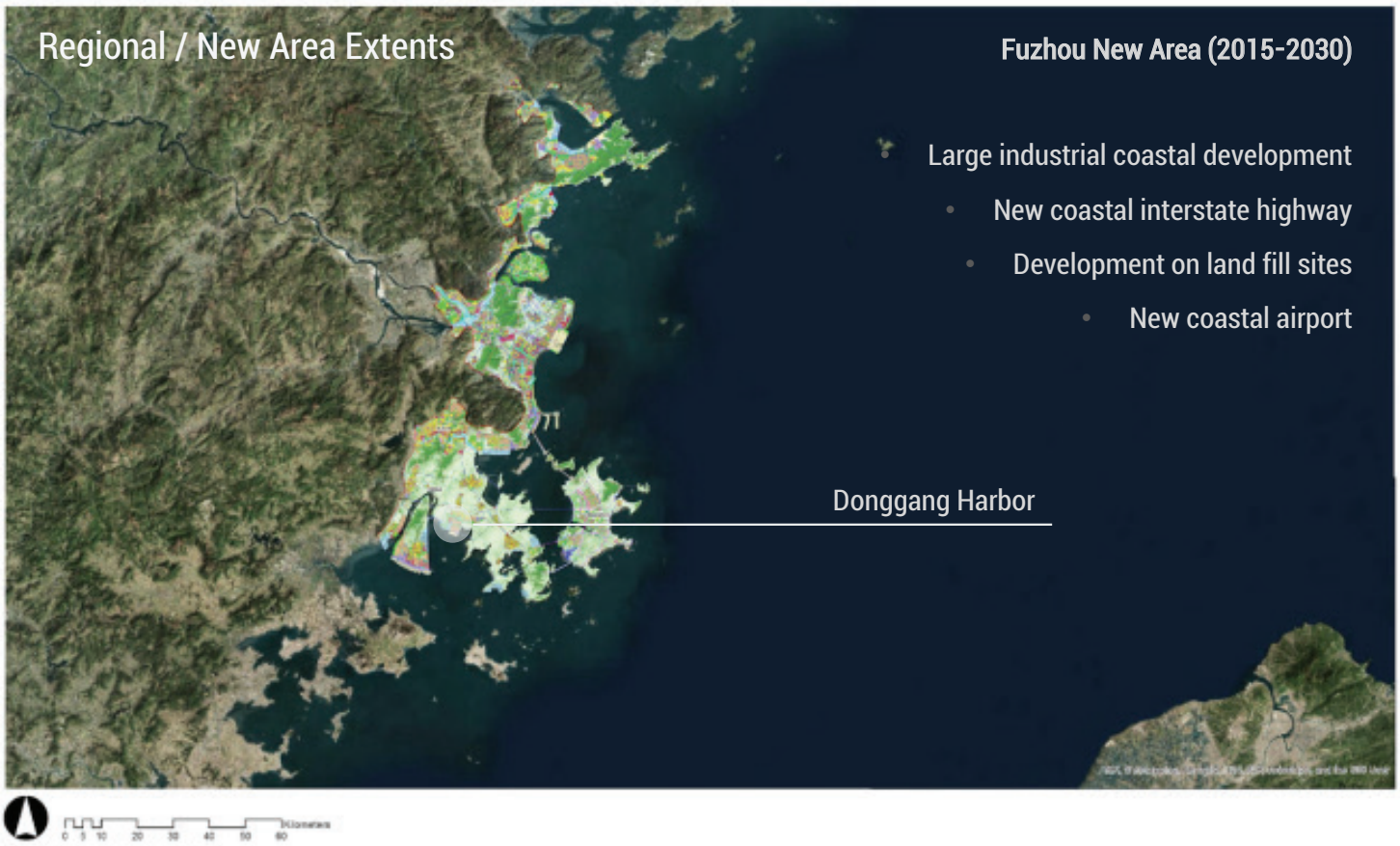
In the 250 km long stretch of coastline—that we have called the Regional Zone—the magnificent landscape of southeast China is fully revealed. The region near the shore has a sequence of historical and culturally rich sites that could be integrated in a scenic route where culture, nature and the great ambition of the Chinese people can be displayed to tourists and adventurers. Planning now for a future landscape that is sensitive to the memory of the ancient culture of Fuzhou is a huge opportunity for the region, environmentally but also economically, and the proposed 2015-2030 Fuzhou New Area Plan completely ignores this opportunity.

Before exploring the impacts of the Fuzhou New Area Plan at a local level in relation to Xinghua Bay, it's important to understand this large-scale provincial level development which stretches over 15 years and along approximately 1/3rd of the Fujian Province's coastline, at the regional level.

From an environmental perspective one key feature of the proposal is that the majority of industrial development is occurring, and would continue to occur, immediately adjacent to the coastline, with this likely to have a significant detrimental effect on species habitat and the coastal environment. To provide a sense of scale the development of the New Fuzhou Area is the equivalent of developing an area larger than the bay area of San Francisco, USA.

The Fuzhou New Area zone has a shallow shoreline that gives great opportunities to the major sea production of mollusks, seaweeds and fish-ponds. The complexity of the shoreline also provides a wide range of ecological services that dynamically change with the fluctuating tides and seasonal variation.

A 1960 survey of historic mudflats present in the area also showed an extensive area of shallow waters, see Figure 2.2-3. These mudflats have been filled in and altered drastically in past years by numerous government-sponsored, large-scale developments along the shoreline. Ironically, these same developments which distorted the former shoreline, are now at risk and threatened by sea level rise which will deeply affect the lowest lying settlements.



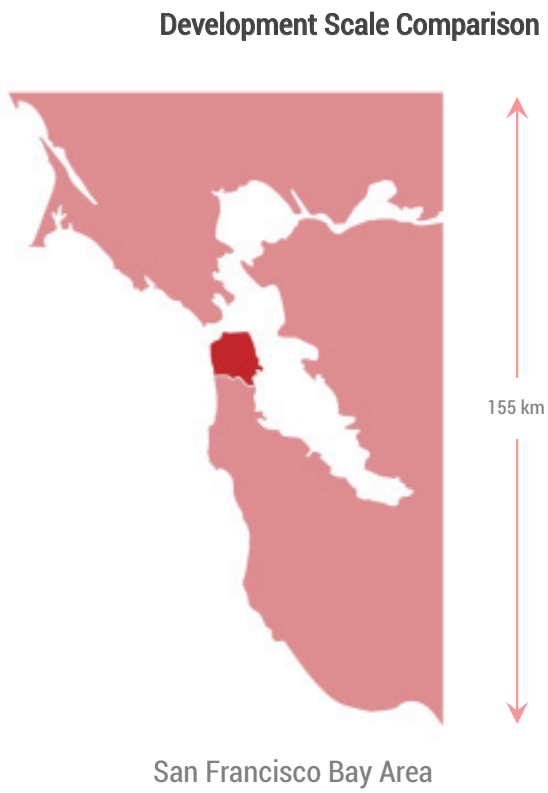
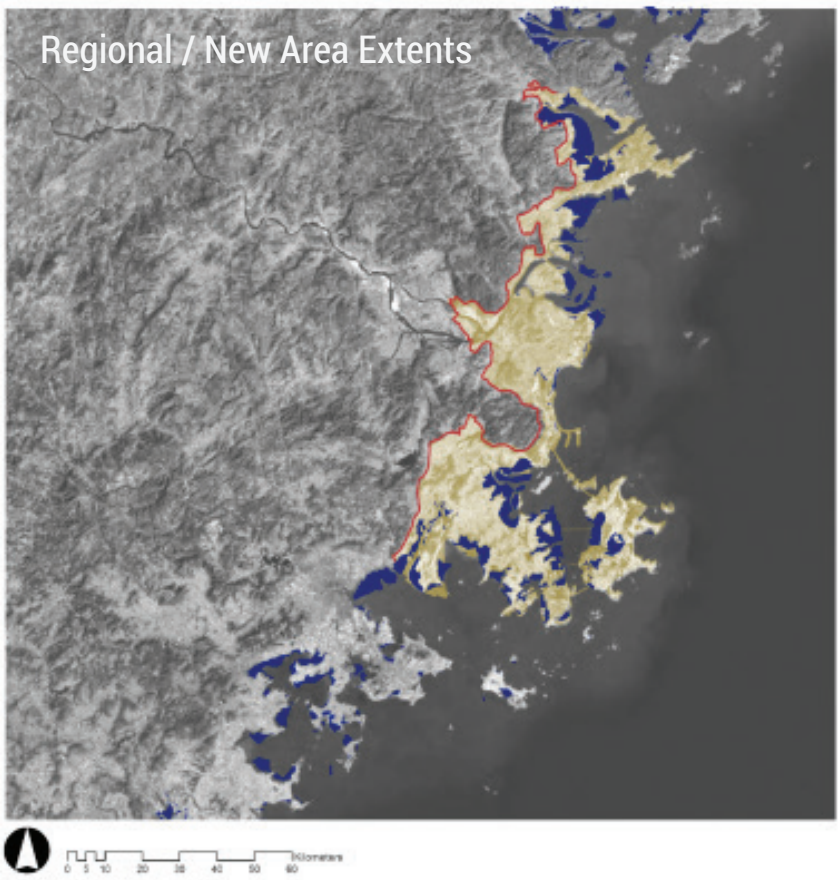


Fig. 2.2-1 *Scale comparison of the Fuzhou New Area Plan and the San Francisco Bay Area*



Historical mudflats

Historical extent of coastal **mudflat**s (1950-60)

Fig. 2.2-3 *Historical mudflats compared to the extents of the Fuzhou New Area Plan.*

In addition to analyzing the proposed Fuzhou New Area Plan, we also researched and mapped out existing landscape assets that are present within the province. These included large-sized existing national scenic areas & reserves, key historical and cultural sites that tourists currently visit, and the main transportation infrastructure networks. Through identifying such locations and networks we hope to develop the foundation to an alternative sub-provincial wide development strategy that would improve the ecological function of the Fuzhou New Area Plan in the future.

2.3
Understanding the *Fuzhou New Area Plan* at the Harbor Scale

Cristina Bejarano and Ari Frink

The proposed developments in the 2015-2030 Fuzhou New Area Plan would be a dramatic change for the region, and would have a great impact on the Donggang Harbor in particular. Mudflats, fish farms and slowly urbanizing rural villages would be transformed into a bustling industrial metropolis vision in the future. Over 12 square kilometers of mudflats along the harbor would be filled in, and high-density housing and commercial development, alongside high-impact industrial plants, would be built on the newly-created land. This development proposal, while being oriented around mixed-use urban principles with the incorporation of canals and green edges, has several fundamental challenges that pose a severe threat to the success of the plan, and more importantly, has the potential to devastate the larger region's ecosystem. By analyzing the existing conditions, and evaluating the changes outlined in the planning proposals, we can then make informed recommendations and alternative development proposals.

Analyzing the existing conditions

To analyze the proposals, it was important to first understand the existing conditions of the area. Our spatial analysis was designed to discover the character of the place, including the existing historically-valuable buildings and landscapes. This work was completed in ArcGIS and Adobe Illustrator.

Based on aerial photography, the team codified various land cover types as indicated by distinct patterns and textures in the aerial images. Many of these land cover types are easily distinguishable based on water coverage and more easily understood when overlaid with topographic data. As you can see in Figure 2.3-2, the main patterns were grouped into aquaculture, agriculture/dryland, new urban growth, and historic village cores based on the textures in the aerial photographs. Within these four major land cover groups there are many variations, including thousands of family burial lands arranged along the edges of the agriculture/dryland group. By creating this general codification, it was possible to understand the larger patterns of the existing developments across the area, as seen in Figure 2.3-1.

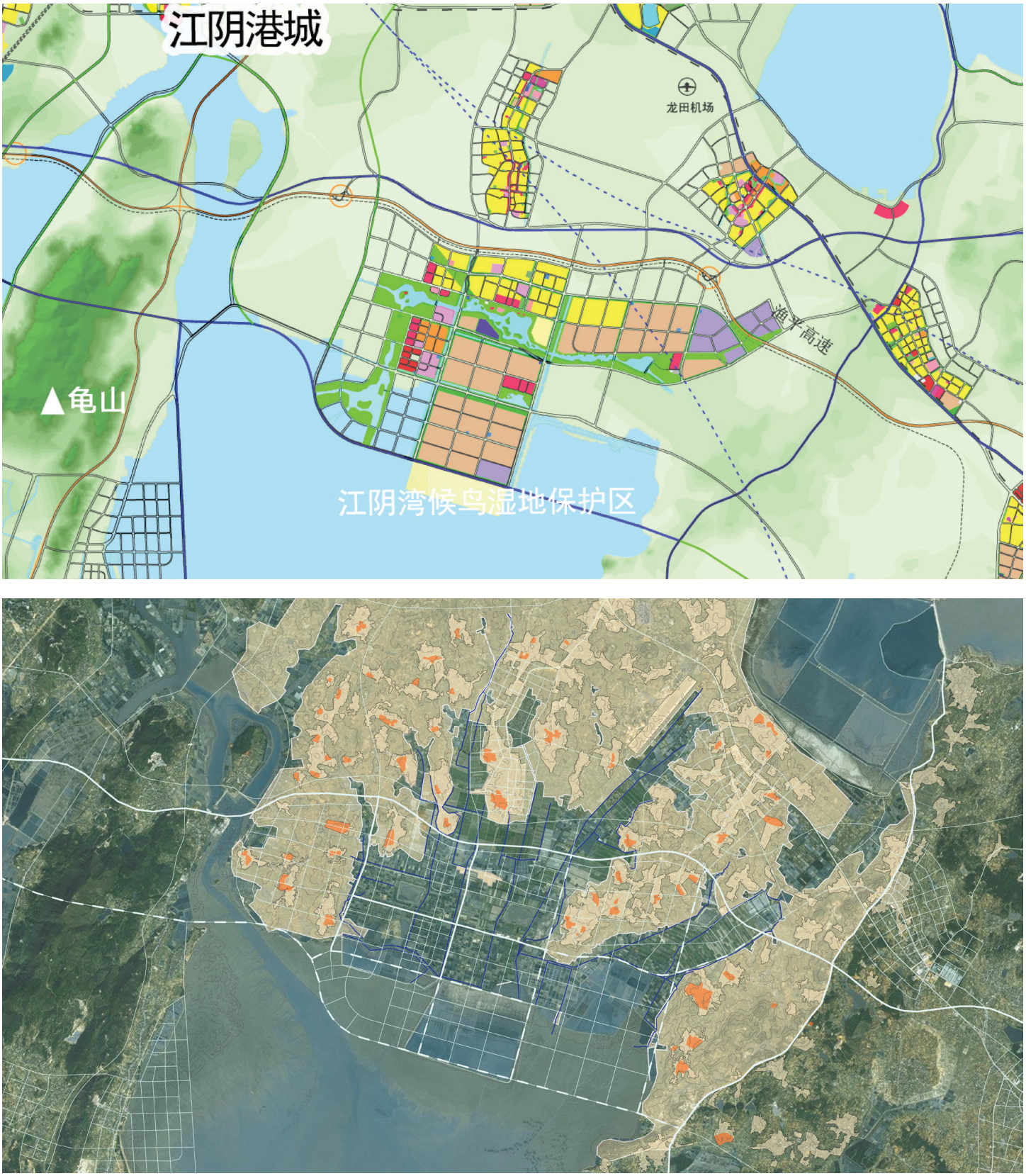


Fig. 2.3-1 *Donggang Harbor (also called JiangJin Bay): Comparing the 2015-2030 Fuzhou New Area Plan (above) at the same scale to the existing conditions of the area (below). The orange areas show historic village centers, the next ring shows recent urban growth, and the lightest beige shows the extents of dry land/agricultural land cover.*

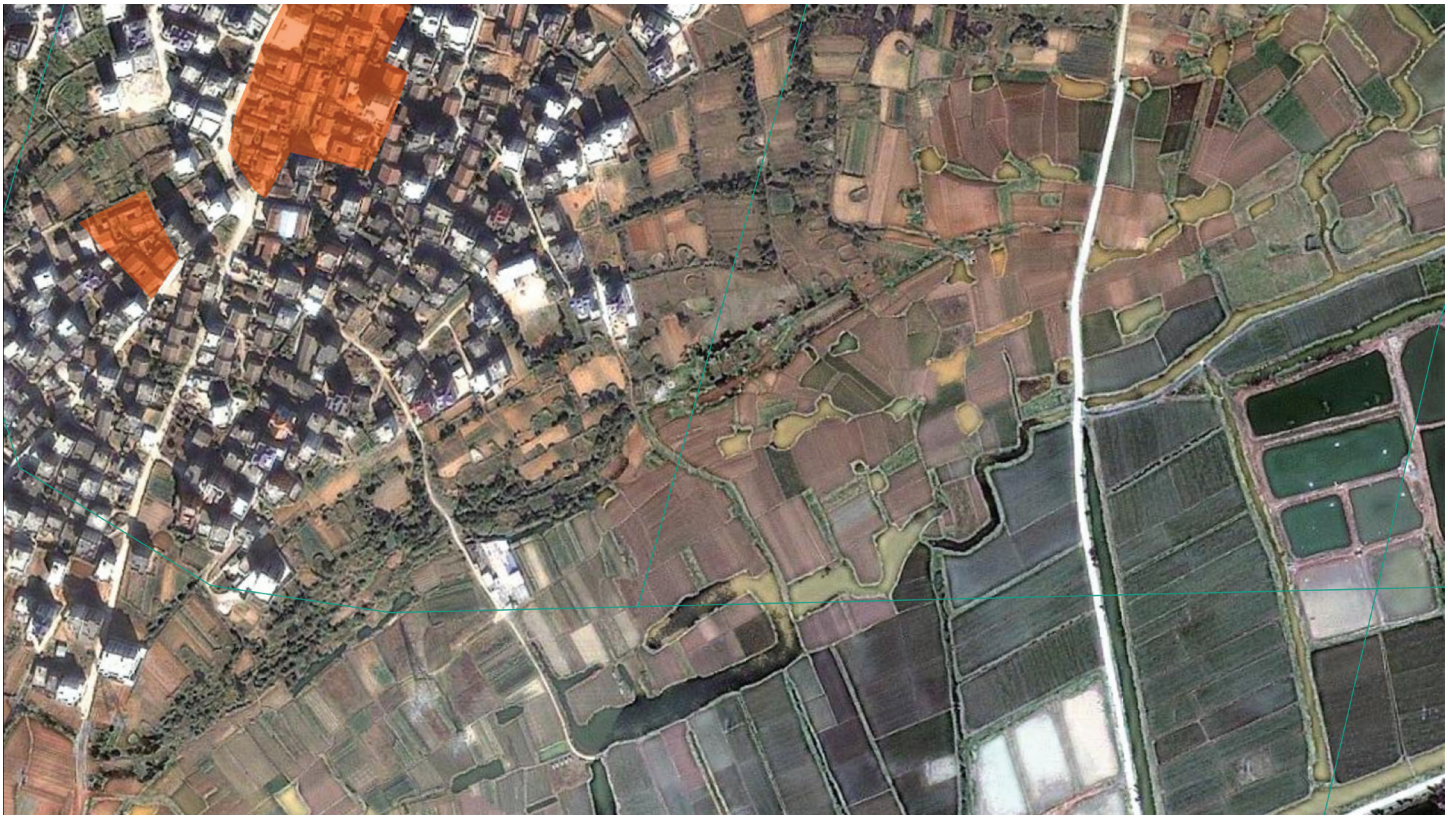


Fig. 2.3-2 *This example shows a range of textures and how they were codified based on the four major land cover types: orange is the historic village core, surrounded by a beige color which is new urban growth, then you see dry land/agricultural areas which include the U-shaped burial sites, followed by a canal which delineates the edge of the aquacultural ponds.*

The following are some of the key observations revealed by our land cover analysis. This, in addition to the concerns already outlined related to endangered species habitat, overall bay health, sea level rise, and regional political efforts, informed our recommendations and alternative development proposals.

Agriculture, aquaculture, and the supporting hydrologic patterns

The vast extent of aquaculture in the area revealed a relatively flat topography, aided by an intricate system of canals, locks and weirs built within the landscape to take advantage of the powerful wave forces from the daily ocean tides. Further inland, it's clear the the agricultural patterns rely on this hydrologic system as well.

The 2015 Fuzhou New Area Plan proposes a main canal corridor oriented parallel to the bay which would block the powerful flow of the tides and prevent the sediment and particulates in the water from flushing out to the bay as it does currently and has historically.

Fig. 2.3-3 *This photograph was taken of the wetlands along Donggang Harbor in 2013.*

Fig. 2.3-4 *Images of a common family burial site with a horse-shoe shape arranged along agricultural fields and downhill from homes.*

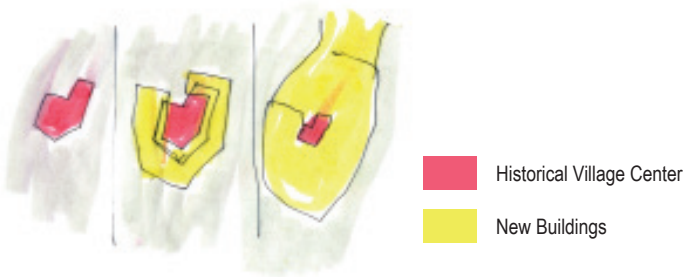
The proposal, even only in its first phase, would obstruct the hydrologic system that supports the aquaculture and agricultural farms nearby, not to mention the sensitive wetland habitats that support the Black-faced Spoonbill, which will be discussed in Chapter 2.4.

Traditional Burial Sites

Across the landscape, many locations within the agriculture/dry-land zone are used for human burial. As can be seen in the aerial photograph, Figure 2.3-2, these graves are U-shaped and located next to agricultural fields just outside of the villages. Traditionally, the family that worked the farm would be buried on the same land as their ancestors. Now that many descendants have moved to cities and have left the agricultural industry, traditional burial maintenance and ownership practices are changing as well. Most city-dwellers are now cremated, though many families still have a connection to their family graves.

If the current plans go forward, many of these burial sites would be displaced or destroyed and local residents with family burial sites would oppose the proposal if they understood that

Urban Growth Detail Over Time - Nanzhengcun Village in 2000 and 2015



2000 Historic Core Size	25.49 hectares
2015 Historic Core Size	5.63 hectares
Percent change	78% loss in the historic core of villages

Fig. 2.3-5 *Urban growth patterns in the area show that the number of historical buildings is quickly fading, with only very few remaining in the villlage cores. Nanzhengcun shows a 78% loss in the last 15 years.*

their family graves would be damaged. The burial sites are going to come under pressure from development in the future, no matter which plan takes shape, but this process should be undertaken transparently and thoughtfully with the local community.

Historic Architectural Traditions

Though the plan proposes that most of the initial industrial development occur on fish ponds and wetlands, there are several parts along the northern and western edges of the development which will be built over existing villages.

Each existing town along the development's periphery has a core of buildings that are built using traditional building techniques, which we identified through aerial photos and can be easily differentiated from the newer buildings based on the roof type. These buildings are tied to an agrarian tradition, with a courtyard used for food preparation. Many of the historic buildings have already been lost, with some villages having lost around 75% of their historic area to new urban development, as seen in the Nanzhengcun example. This new growth is taking place organically along arterial roads and the edges of villages, and must be actively guided in a way that protects the historic village centers.

Fig. 2.3-6 *Examples of the historic buildings in the area. In this case the walls are made using oyster shells.*

Fig. 2.3-7 *New buildings in the area are being developed along the edges of the villages and along arterial roads. Any new proposal should actively guide urban growth.*

2.4
Impacts of the *Fuzhou New Area Plan* on the Black-faced Spoonbill

Joseph Burg and Stephen Pye

As was identified in Figure 1.1-4, the fishpond and mudflat habitat areas which are suitable for Black-faced Spoonbills in the Xinghua Bay region are largely at risk of development under the 2015-2030 Fuzhou New Area Plan.

Furthermore, the wetland protection area outlined in the 2015 Fuzhou New Area Plan, shown in Figure 2.4-2, will not be an effective habitat for migrating or overwintering spoonbill. Whether the development plan is altered (as will be recommended by the proposals in Chapter 4.6) or not, a larger network of reservation sites will be necessary to support the Black-faced Spoonbill habitat in the region.

Nearby Habitat Locations

Therefore, our next step was to use our mapping of surrounding habitat to identify other possible reserve sites in the area that would not be drastically impacted by the proposed development. These regions work together as a network and should be identified as sensitive habitat in future proposals.

To identify potential reserve sites in the region, roosting habitat areas, such as fish ponds, of less than four square kilometers were removed from the map. This process generated only three regions that could serve as potential alternative reserve locations based on size. In order to understand the relative value of our four potential reserve sites, now including the existing reserve location for comparison, we also estimated the area of feeding habitat accessible to birds roosting on the parcel.

We then buffered these habitat areas using two methods to determine what feeding habitat, areas of mudflat, and ponds would be accessible nearby.

1. Centroidal buffer: This method generated centroids for the two-kilometer habitat areas. We used these centroids as the buffer feature, producing a three-kilometer buffer and an eight-kilometer buffer for each habitat centroid. In logical terms, this method represents the flight distance for spoonbills if the birds are roosting in the central areas of the habitat.

2. Polygonal buffer: This method used a three-kilometer and an eight-kilometer buffer around the habitat shape or polygon itself. This produced a wider flight area and would represent birds beginning their flight from the edges of the polygon.

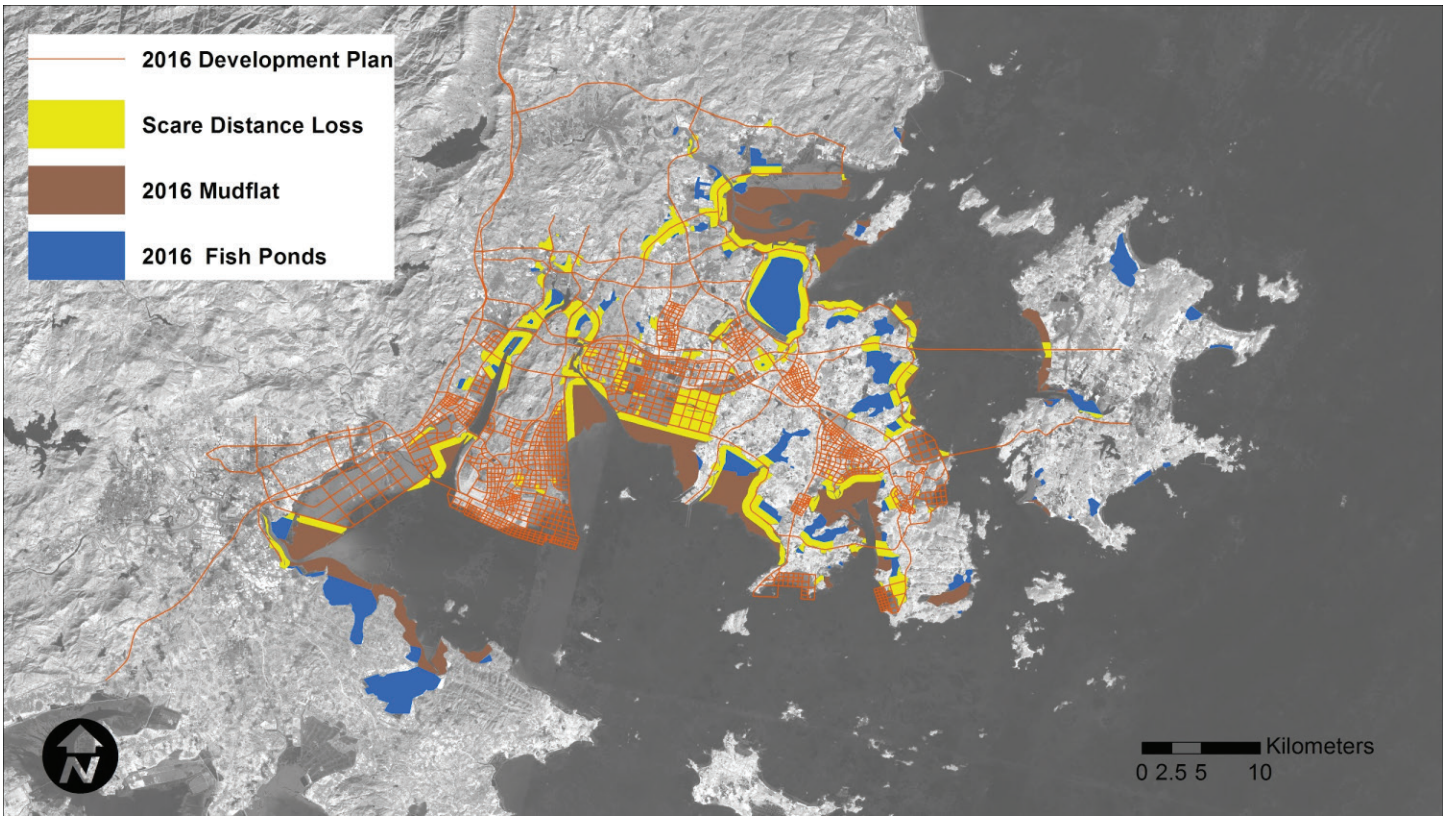


Fig. 2.4-1 *Once the New Area Plan development is overlaid on what remains of mudflat and fish pond habitat areas, and buffers are generated around major roadways, very few regions for spoonbills remain. (Scare distance does not represent absolute loss.)*

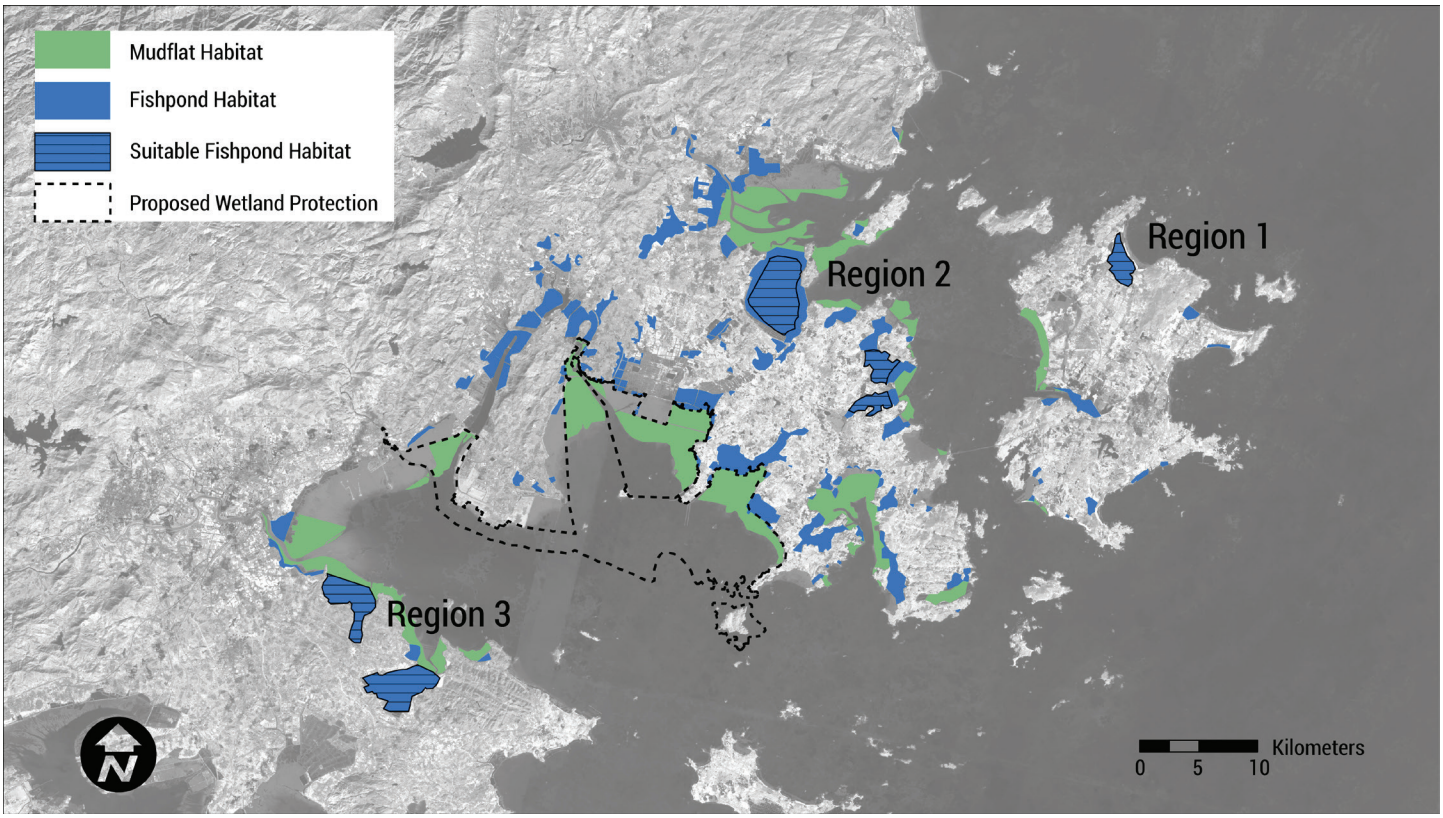


Fig. 2.4-2 *Nearby viable habitat regions if the proposal is not altered*

Habitat Type	Existing Reserve	Region 1	Region 2	Region 3
Spoonbill observations?	Yes	No	Yes	No
Feeding habitat within 3 km (ha)	10,100	500	6,300	4,100
Feeding habitat within 8 km (ha)	17,300	1,000	14,600	5,500

Fig. 2.4-3 *Evaluation of nearby habitat regions, see map in Figure 3.4-2*

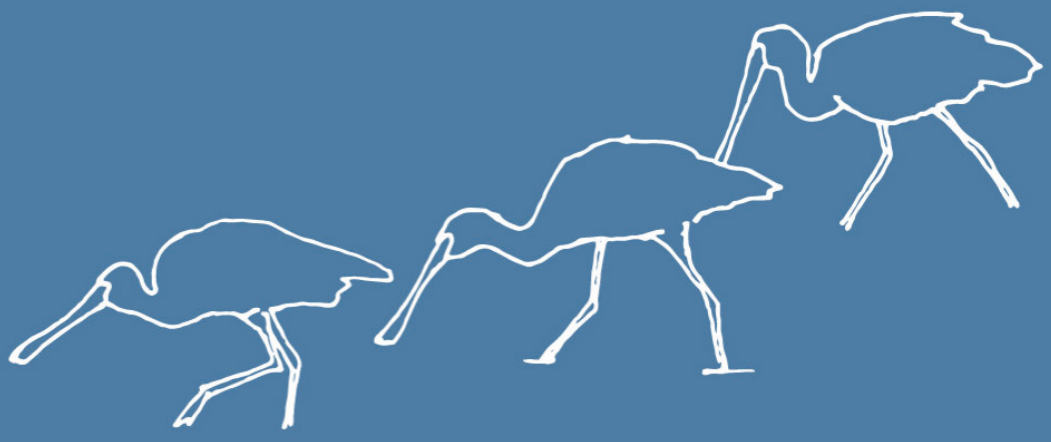
We determined that a polygonal buffer was the optimal method to use because it best approximated the amount of feeding habitat that a spoonbill would have access to while flying over potentially developed land.

None of the surrounding regions we identified could completely replace the roosting and feeding habitat currently used by the spoonbills in Xinghua Bay. Since aerial imagery indicates that parts of the 2015 Fuzhou New Area Plan may already be under construction, it is all the more important to identify and protect other key sites for spoonbills in the Xinghua Bay area. Of the regions we identified, Region 2 would be a priority. A small number of spoonbills have already been observed in the area and it offers the most potential feeding habitat under the current development scenario. It is also near the existing reserve, perhaps facilitating spoonbill movement to the new site.

These spoonbill habitat regions are important to protect as part of a larger network of migration and wintering sites for the bird. In the following chapter, various alternative proposals for the Donggang Harbor include a larger reservation area, that expands this network by protecting more fish ponds on site.

Fig. 2.4-4 *Black-faced spoonbills feeding in rice fields.*

Chapter 3 Policy and Law



3.1
Law, Community, and Environmental Policy: Challenges and Opportunities

Angela Mimica, Min Yuan and Lauren Bergenholtz

Introduction: Environmental Regulation in China

China is at a crucial juncture in terms of environmental regulation, law, and policy. Since the 1979 opening of trade liberalization, industrial development and market reforms in China have generally been accompanied by significant environmental destruction, including soil contamination and erosion, water and air pollution, and rapid habitat loss. "These environmental issues are not confined to China's borders: pollution linked to China's development contributes to several international environmental problems, including global climate change, acid rain, and the depletion of ozone in the stratosphere" (Ma & Ortolono, 2000). Recent changes seeking to strengthen environmental policy are promising, yet appear to have limited enforceability. "A significant gap exists between the goals embodied in China's environmental laws and regulations and actual levels of environmental quality, and this gap appears to be widening…" (Ma & Ortolono, 2000).

All of these dynamics are at play in Xinghua Bay, where industrial development and bayfill threaten to destroy tidal mudflat that provides feeding and roosting habitat to the endangered Black-faced spoonbill. This study addresses the larger legal and political framework that enables such development to occur in Xinghua Bay (and China, more generally), and seeks to propose means by which environmental law can be mobilized through social networks to achieve a more ecologically resilient future for Xinghua Bay's Black-faced spoonbills as well as local (human) residents.

Guiding questions:

1) What Chinese environmental laws or regulations are potentially applicable to the case of development in Xinghua Bay? To what degree are environmental protections enforceable, given the administrative power structure in China?

2) Considering the limited enforceability of environmental regulations in China, how can an understanding of social networks lead to more sustainable development in Xinghua Bay that benefits both ecology and local community?

Fig. 3.1-1 *The Processes of Change in China: Industrialization, Environmental Impacts, and Increased Regulation*

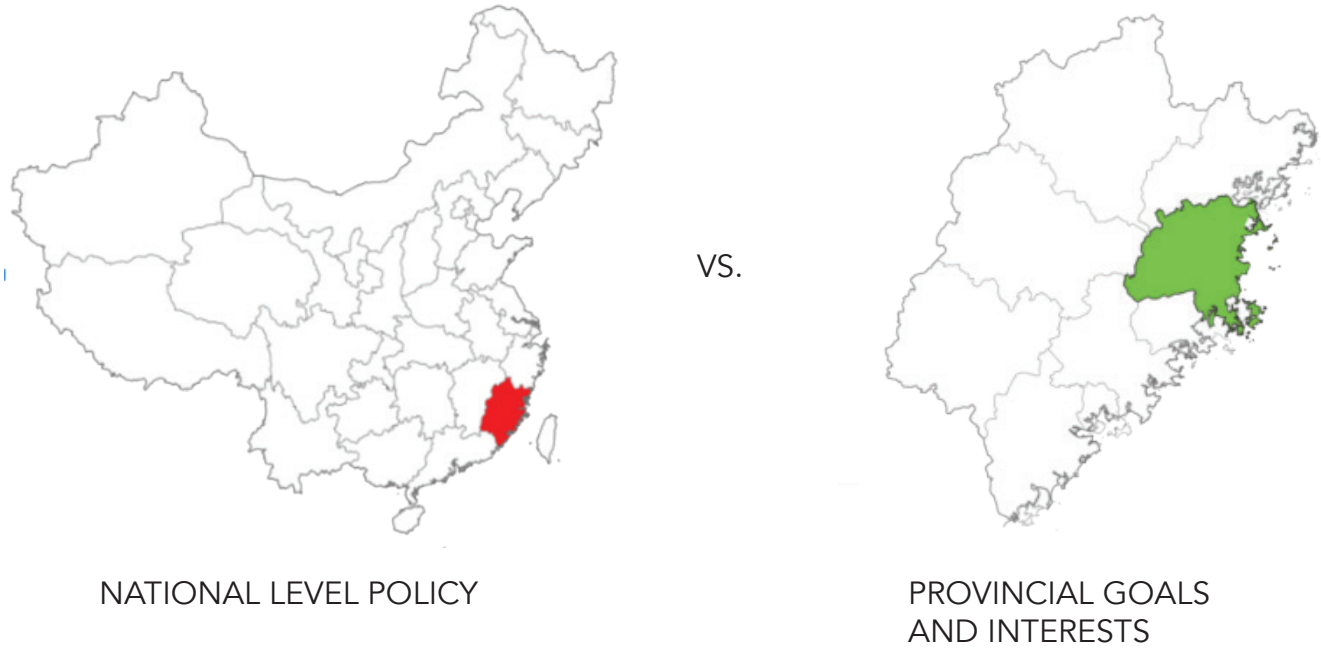


Fig. 3.1-2 *Political map of China with Fujian province highlighted in red (left), compared to a map of Fujian province with Fuzhou highlighted in green (right).*

Chinese Governmental Structure: A Brief Overview

Rapid industrialization in Xinghua Bay is the product of a larger administrative hierarchy, in which economic development is generally privileged over environmental protections. China's leading political institutions include the Communist Party and its military; the States, led by the State Council, to which the Party delegates day-to-day administration of the country (Zhou, 2010); and the National People's Congress (NPC), China's unicameral legislature (Lawrence & Martin, 2012). The public theater of the NPC's work is centered on its 10-day-long annual full session (because the annual full session of the congress is so brief, much of the NPC's work is undertaken by its Standing Committee). It is held every March and attended by all of the NPC's nearly 3,000 deputies. The Chinese People's Political Consultative Conference (CPPCC) system officially exists to engage in "political consultation" with the Communist Party, perform "democratic supervision" of the Party, and "participate in the deliberation and administration of state affairs." It gives selected prominent citizens an approved platform to make suggestions about aspects of public policy (Lawrence & Martin, 2012).

Besides China's leading political institutions, Chinese political and administrative system is organized into a strict vertical pyramid structure. The basic points originate in Beijing and are then deployed across the territory, which is split into different interlinked administrative territorial levels (state; provinces, autonomous municipalities, special administrative regions or autonomous regions; municipalities or counties; towns or villages (Rémi, 2014). According to the Chinese Urban and Rural Planning Act (in effect since January 2008), the Chinese urban planning system consists of two tiers: the master plan and the detailed plan. The top tier is the master plan that outlines the general land use pattern of a city, usually has a planning horizon of 20 years and should consider long-range development strategies (Chen, 2009). The key that explains this hyper-functionalist urban machine is the absolute priority given to accelerated growth set by the central Chinese government in the 1980s, involving maximizing the growth in Gross Domestic Product (GDP) at all of the territorial levels in the country.. The whole of the current political and administrative system in China has been shaped with this aim in mind (Rémi, 2014) and any concern of an environmental or social nature is marginalized.

In order to understand the proposed New Industrial Park in Xinghua Bay and larger scale development plans in the Fujian Province, we must consider this larger administrative structure. Fujian Province is currently a largely agricultural region, but is poised to become rapidly industrialized. This is due in part to its proximity to Taiwan and its geographic position along the China's coast. Yet plans for industrialization are at odds with the preservation of habitat, the health of coastal watersheds, and the continued existence of many forms of traditional agriculture and aquaculture practices. In theory, Chinese environmental law should offer protections against certain types of industrial development in this region. The following focus of our research has looked into the specific provisions of three laws relating to environmental protection relevant in the case of Xinghua Bay, and their likelihood of enforcement.

Environmental Policy in Xinghua Bay: Applicability and Habitat Protection

In 2015, the CPCCC modified and significantly strengthened China's existing Environmental Protection Law (EPL), such that the new law "is perceived as the most progressive and stringent law in the history of environmental protection in China" (Zhang & Cao, 2015). It contains broad provisions for the regulation of air and water pollution, and includes stipulations for increased penalties for environmental offenses. It also includes incentives to support the development of "environmental protection industries," a category defined in the law. The law also contains protections for whistleblowers and asserts the rights of citizens to critique

or challenge the accuracy of environmental impact reports (EIR's) while also increasing accountability for local governments and agencies to enforce environmental protections (Zhang & Cao, 2015). These provisions work in tandem with the Law on Appraising Environmental Impacts, which establishes legal liability for fraudulent environmental assessments.

Many of these regulations are potentially applicable or relevant to development in Xinghua Bay and the threat posed by industry to Black-faced spoonbill habitat. Article 29 of the 2015 EPL is of particular interest; this article calls for the establishment of ecological redline zones in areas that are ecologically sensitive, constitute rare or endangered habitat types, or are used as habitat by species recognized as being endangered. Protections for coastal habitat are also supported by the Marine Environment Protection Law, which states that

> "the State Council and the coastal local people's governments shall adopt effective measures to protect typical and representative marine ecosystems such as mangroves, coral reefs, coastal wetlands, islands, bays, estuaries and important fishery waters, protect sea areas where rare and dying out marine organisms are naturally and densely scattered, protect habitats of marine organisms having important economic value, and protect marine natural historic relics and natural landscapes having great scientific and cultural significance."
>
> Marine Environment Protection Law of the People's Republic of China, 1999.

Xinghua Bay should clearly fall within these protections because it is not only an estuary and important fishery, but also a key point on the Black-faced Spoonbill's migratory flyway.

Despite the seemingly wide range of policies that should in theory support the protection of Black-faced spoonbill habitat in Xinghua Bay, enforcement of environmental protection in practice is often difficult. In large part, Chinese environmental law is applied retroactively in the case of penalizing polluters rather than proactively preventing contamination or habitat destruction. Although Black-faced Spoonbills are inhabiting Xinghua Bay, the presence of this endangered species poses no recognized legal barriers to development, despite clear provisions within the above laws. The case of the New Industrial Park at Xinghua Bay follows a larger pattern of development in China, whereby development is privileged above protection and the local administrative desire to achieve short-term economic targets wins out over long-term ecological and community health.

> "Enforcement and implementation of the law may be foiled by a lack of capacity and by conflicts of interest… Local governments (which are often more interested in economic growth) keep a firm grip on the staffing and financing of the environmental protection bureaus and hence on their decision-making" (Wang, 2010).

Despite these barriers to environmental protection, we still remain optimistic regarding the mobilization of these laws in the preservation of habitat in Xinghua Bay. Their utility may reside less in their enforcement through traditional legal means, but perhaps more as a barometer for understanding changing social values in China. Through an understanding of social networks related to Xinghua Bay, we believe in these laws can take on greater persuasive power than is currently granted to them in the more formal administrative climate. The following portion of our investigation will examine networks of actors, power, and interests in and related to Xinghua Bay, and will propose a set of empowerment methods that can potentially move the region to a more resilient ecological and economic future.

Actors, Power, and Interests in Xinghua Bay: Stakeholder Analysis and Methods for Empowerment

Given this complex scenario, where in addition to the multiple levels of the governmental structure there are also private corporations, entrepreneurs, NGOs, and locals, it is necessary to unpack the actors map and understand each actor's interests in order to develop strategies for action. That will allow NGOs like SAVE in collaboration with local citizens to identify what arguments can be more effective and to whom these arguments should be addressed. These arguments are not necessarily rhetoric ones: all the analysis and proposals developed in this studio have implicit and explicit arguments. The stakeholder analysis can be a very useful tool to know what to do with this material and draw the next steps and actions.

A Stakeholder Analysis is the process of identifying the individuals or groups that are likely to affect or be affected by a proposed action, sorting them according to the impact the action will have on them, and ranking their power to influence or make decisions about this action. This information is used to assess how the interests and abilities of those stakeholders should be addressed in a project, plan, policy, program, or other action (Chevalier, 2001). There are many methods to make a Stakeholder Analysis and for this report we chose the power-interest matrix. This method is adequate in the context of a project or plan, and is simple enough to be performed from a distance — without any interviews or inside knowledge of each group or agency. It must be noted that a stakeholder analysis is qualitative, and given its subjectivity should be viewed as a hypothesis. In this case, the sources were papers about the topic, internet articles and news reports.

The analysis was developed in relation to the 2015-2030 Fuzhou New Area Plan proposal. For this, we adapted the typical matrix— which distinguishes between "interested" and "not interested" in the project analysis— distinguishing between actors "benefited by the project" and "actors negatively impacted, or harmed, by the project." When there are actors that we believe to not be affected by the project, but would be against it, we consider them to be negatively affected because the project would oppose their principles or values.

In the matrix, "power" ('y' axis) measures the actors' legal or political standing over the project, and their possibilities to foster, block or change it. It is qualitatively valued from 1 to 10. Stakeholder "interest" ('x' axis) is represented in a range of positive to negative values, running right to left, and is valued as:

+3: The project highly benefits them, in their functioning or goals
+2: The project benefits them in an important level, but their fundamental functioning or goals do not depend on the project
+1: The project benefits them in some aspects
0: The project does not harm nor benefit them
–1: The project harms them in some aspects
–2: The project harms them in an important level, but not affecting their fundamental functioning or goals
–3: The project highly harms them in their functioning or goals.

After the analysis, we could identify that the government agencies have polarized interests in relation to the 2015-2030 Fuzhou New Area Plan. On one side, the ministries related to the environmental issues: Ministries of Environmental Protection, Land and Resources, Forestry and Agriculture, in addition to the Oceanic administration. On the other side, are the ministries whose work is more related to growth and economic development: Ministries of Development and Reform Commission, Housing and Urban-Rural, Transport, Water and Resources, and Central Government. This is replicated in the three levels of the government —National, Provincial and Municipal—but while the national agencies tend to be more neutral about the project, being closer to the center

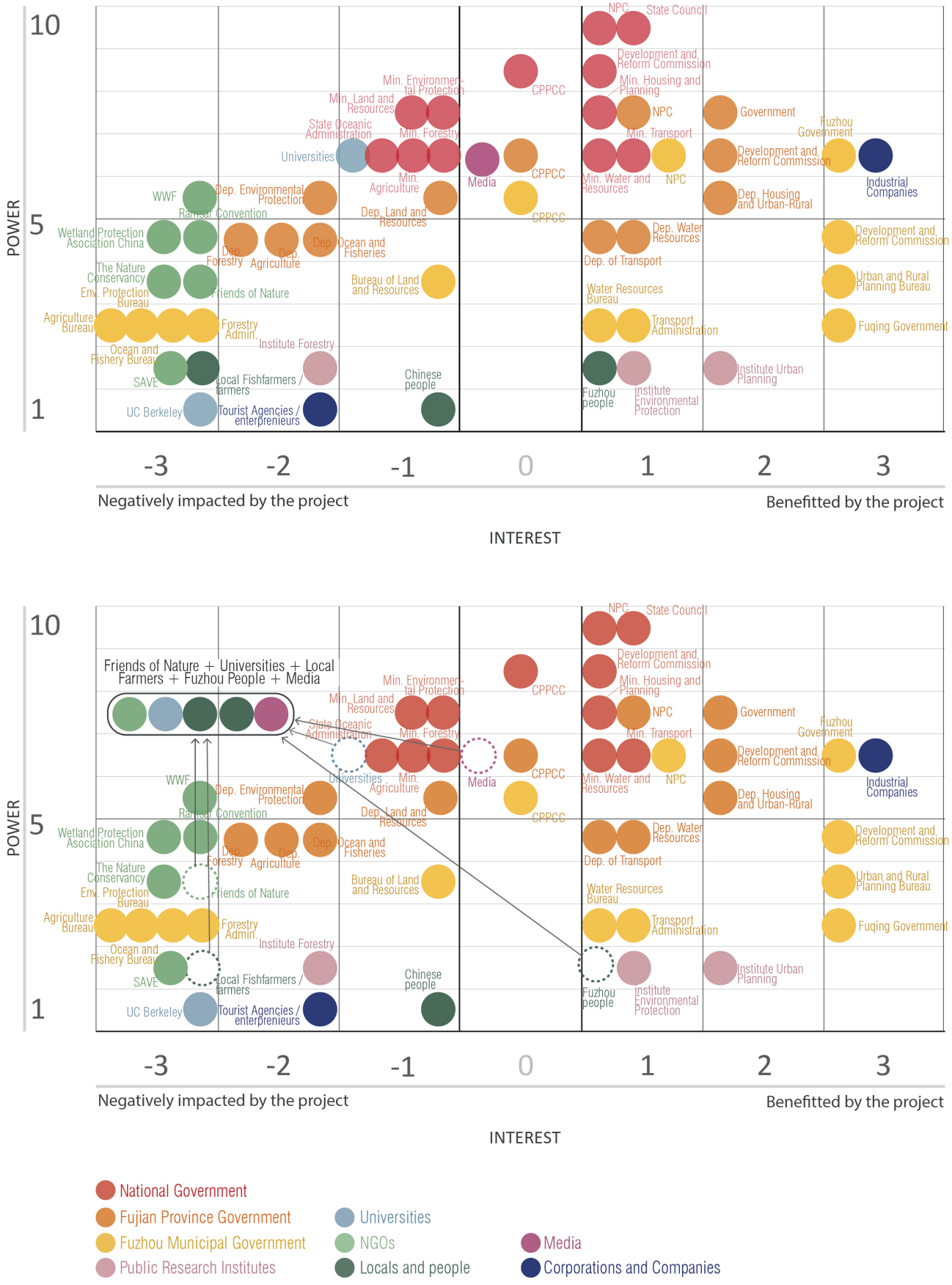


Fig. 3.1-3 *Stakeholder analysis helped to identify potential important partnerships*

in the stakeholders map, at the provincial and municipal levels, the polarization accentuates. This is because the implementation of plans and programs is the responsibility of local agencies, and their political success depends on concrete results. The level of power decreases from the central to the local levels, therefore we can see a pyramidal structure: central government agencies are more neutral and powerful, while local levels are more polarized in their interests and less powerful. They are followed by the Research Institutes: public agencies that produce research to support government decisions: Institute of Forestry, Institute of Environmental Protection and Institute of Planning.

An important actor is the Chinese People's Political Consultative Conference (CPPCC). In relation to the project it is absolutely neutral and as we will see next in the analysis of a precedent case of environmental conflict, they can play an important role in the arbitration.

On the other side, are private actors, NGOs, academy and locals. The environmental NGOs are concentrated in a position of low power and negatively impacted by the project. Big NGOs with agencies in China—like WWF and the Ramsar convention—seem to have relatively more power, followed by Chinese NGOs like Friends of Nature, and by specific NGOs like SAVE.

We can see the position of locals and people divided, depending on the scale: while local fish-farmers and farmers who live in the site of the project are negatively affected by it because it will generate displacement and direct contamination, people from Fuzhou would perceive the project as something positive, given the economic growth related to it. People from the rest of the country would feel more affected by the project given a general awareness about the environmental problems.

In the private sector, there are industrial companies that will have future production sites in the proposal and are important stakeholders; very benefitted and with a high level of power. On the other hand, there are existing and potential tourism agencies and local entrepreneurs whose main activity would be totally affected by the industrial development.

A final stakeholder group is the media, that includes communication media but also social media, whose power of influence can be very strong. This actor, or group of actors, is explained further in the proposed strategies.

Fig. 3.1-4 *A photograph taken of the protesters at the PX Plant protest in Xiamen City*

Precedent study: Protest against Xiamen PX Plant

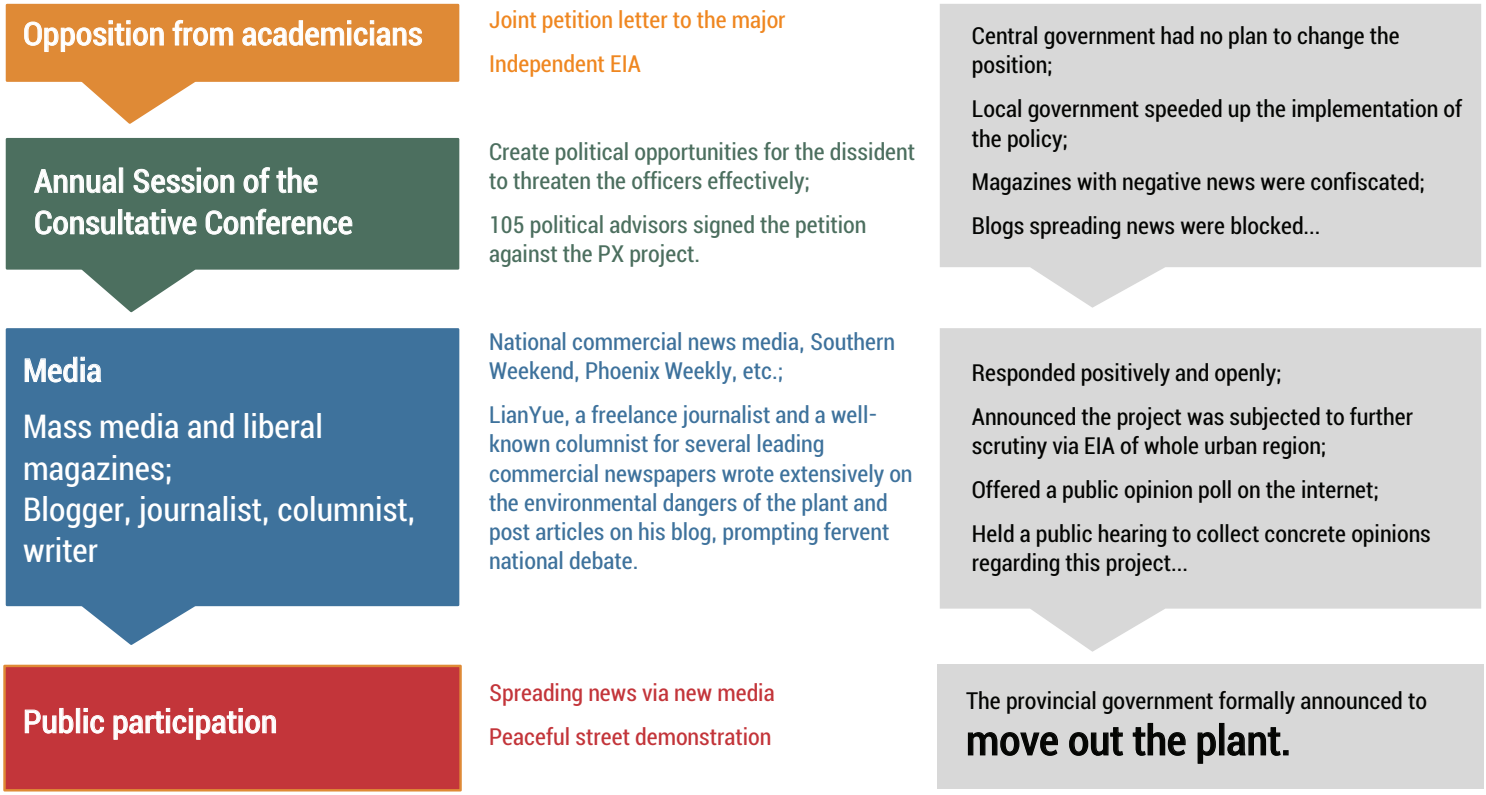


Fig. 3.1-5 *Outlining the events of the PX Plant Protest*

Precedent Study: the PX Plant Protest in Xiamen City

For the past several years Chinese scholars have viewed the Anti-Para-Xylene Plant Protest in Xiamen City as the largest social protest in China since 1989, and a milestone for China's environmental and democratic movement. It shows the social influence of public participation in the promotion of the EIA system and prevention of environmental conflicts (Gu & Tao, 2007). This precedent has highlighted the value of research by Chinese academics and its role in revealing the impacts of industrial pollution. Our study seeks to obtain the support of local universities in the extents of the Blue Economy Industrial Park. There are five academics in Fujian Province's universities who are current members of the National Committee of Chinese People's Political Consultative Conference (CPPCC). They have the ability to attend annual sessions and have the opportunity to submit proposals, just as Prof. Zhao Yufen had done in the Xiamen precedent. These five academics are professors in the fields of chemistry, ocean engineering, ocean and earth science, biology and law. In addition, there are more than one hundred members who are also academics, some of which are presidents of the country's top universities. A few members have the prestigious status of academician of the Chinese Academy of Sciences and the Chinese Academy of Engineering. Collectively, these scholarly individuals could have a strong impact on a national scale.In order to help facilitate change it is important to create a platform for discovering and spreading news. Traditional media often keeps silent, insinuates, and even

appears ambivalent when facing institutional barriers. The solution lies in online media, which facilitates the movements' outset and evolution outside the system (Zhou, 2014). One key online strand which could push movements forward is freelance and commentators, like LianYue, whose extensive writings the events in Xiamen caught the nation's attention and prompted fervent debate.

Proposed Strategies

We identify two main types of strategies in relation to the stakeholders map: One is empowering, which would focus on less empowered or unrepresented stakeholders and improve their capacity to be part of the decision making. For that, the main actions are networking and association: to connect local farmers and fish-farmers, Fuzhou people, Friends of Nature, Universities and Media.

Another strategy is to raise awareness, and its more powerful tool is information. It assume that many stakeholders that consider themselves benefited from the project, therefore support it, do not know all the negative impacts that the project generates. That apply both for authorities and the public. The actions taken by SAVE should point to provide evidence to authorities and the public consider the big picture, with all the negative impacts that the project have in the environment, society and long term development. In the present research, we developed in more detail mechanisms of action framed in this strategy.

Mechanisms of Action

Given the precedent of the PX Plant protest, and the methods of stakeholder analysis discussed, we believe that efforts to prevent environmentally damaging development plans at Xinghua Bay must begin by raising awareness and strengthening networks of communication between involved parties. We recommend that SAVE (or other involved parties) begin with a two part approach: a formal letter writing campaign and the construction of a dynamic social media presence that uses succinct and compelling graphics that can be easily circulated across multiple online platforms including microblogs and other social networks. These actions will make policy and decision-makers to be more informed and more aware of the importance of environmental issues in a long-term sustainable development.

Existing environmental laws and policy provide a basis on which to construct arguments opposing the proposed development projects in Xinghua Bay. These appeals, in the form of official letters from SAVE, are best directed to provincial authorities and individuals at academic institutions that have the power to act politically (through the CPCC or otherwise). We believe that an argument that critiques and challenges the existing EIA for the development possesses the greatest clarity and strength, given the provisions of the 2015 Environmental Protection Law. The existing EIA fails to acknowledge the presence of Black-faced spoonbills at/adjacent to the development site. As an endangered species protected under law, their presence should prompt a reassessment of the environmental impact statement.

Appeals circulated on social media can take a more general stance, and can make community based as well as ecological arguments. The examples below are focused on protecting the Black-faced Spoonbill, but we would also encourage involved parties to mobilize arguments that take a more anthropocentric stance, such as drinking water or irrigation water contamination, harmful impacts to aquaculture, and the degradation of cultural landscape heritage.

Microblogging using platforms such as Weibo is enabling a new and powerful channel of communication for Chinese people to express themselves (Zhou, 2011). Users can focus on and discuss current affairs, retweet good news and reveal wrongdoing in local government or other official bodies. Compared with good news and positive coverage reported by official news agency, users sometimes prefer bad news,

黑面琵鹭与工厂无法共存！

阻止中国铝业进驻兴化湾：保护黑面琵鹭和当地居民！

Fig. 2.1-6 *Example of a potential social media campaign graphic.*

黑面琵鹭需要栖息空间！

保护它们在兴化湾的栖息地：拒绝海湾围填！

Fig. 3.1-7 *Example of a potential social media campaign graphic.*

Microblog

41 of the 52 stakeholders set up an account at Sina Weibo

Good news
Mouthpiece media microblogs

Bad news
Weibo users sometimes prefer bad news, commentary and re-tweeted news about hot topics

The Culture of Weibo: 'Surrounding Gaze'
'The Surrounding Gaze is changing China, paying close attention is power'

'Dancing in fetters'

Microblogging on BFS

Topic	Fre.	Read
BFS SAVE/Berkeley	2	17,500
BFS watching in Xinghua Bay	3	1,170
BFS protection	4	149
Local history	1	381
Total	10	19,200

The hottest posting (within 48h)

Platform	Read	Forward
Sina Weibo	6,132	25
Wechat	731	169

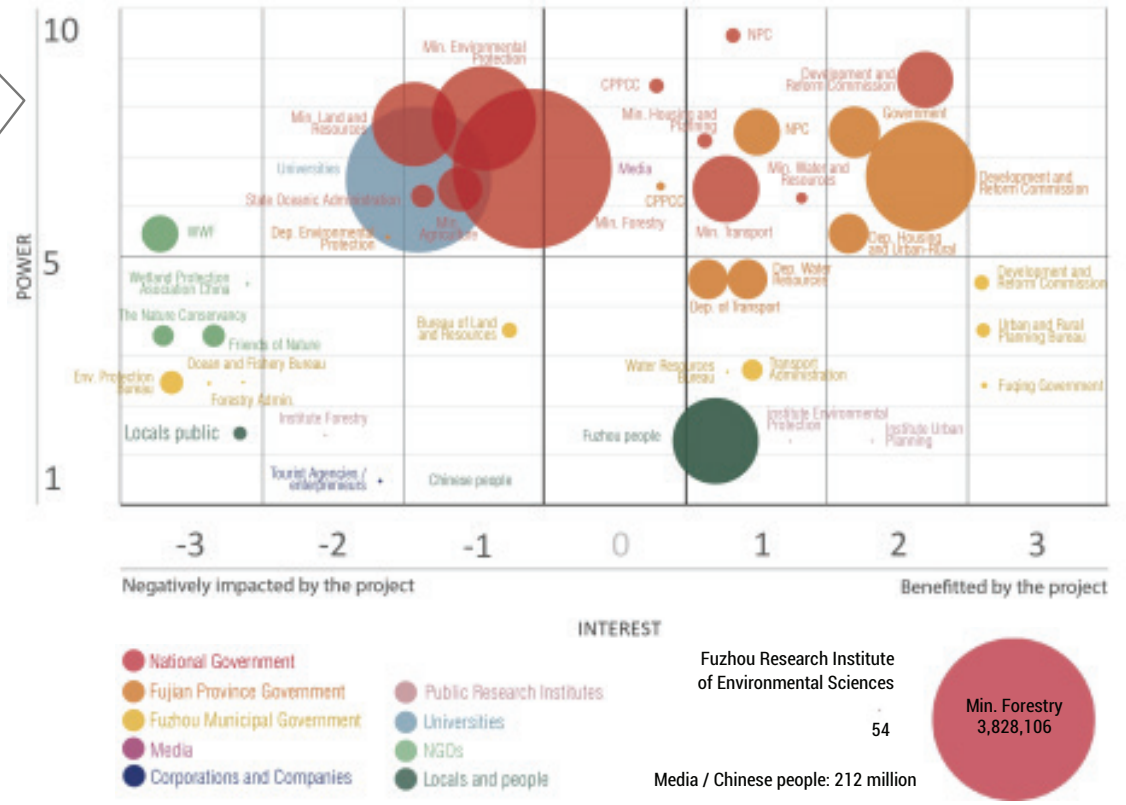


Fig. 3.1-8 *Microblogging as a strategy to protect the Black-faced Spoonbill*

commentary and re-tweeted news. Topics such as social inequality, corruption, food safety, disasters, poverty and scandals have become more popular, especially when the state media keeps silent or resorts to misrepresentation. Weibo makes it possible for people to express their positions and demands, and though each of their statements are small, taken together, they can amount to a formidable show of public opinion.

Forty one of the fifty two stakeholders have launched their site at Sina Weibo. For example, Xinghua News Agency, the traditional national media, began to use microblogging at the 2011 'Two Sessions' of the NPC and CPPCC. The size of bubbles stands for the volume of the followers of stakeholders which varies from 54 to more than 3 million. Stakeholders who are against the industrial park could compete with those which support the industrial park, for they not only have similar power, but also have similar volume of followers. Thus public participation may change the course of events such the Blue Economy Industrial Park.

Chapter 4
Alternative Development Recommendations

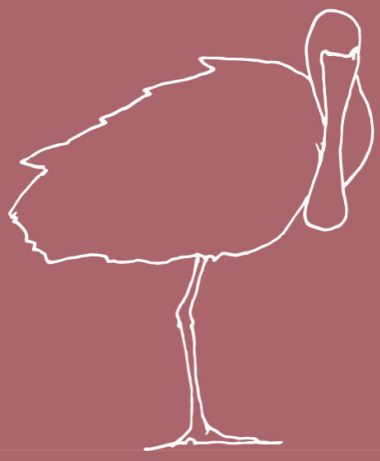


Fig. 4.1-1 *Donggang Harbor rendering by Tomas McKay*

4.1
Alternative Strategies and Their Importance

Cristina Bejarano

The previous chapters have carefully reviewed the habitat needs of the endangered Black-faced Spoonbill, the current health of Xinghua Bay, future sea level rise projections in the area, regional and global policies and laws that protect ecologically sensitive land, and the Fuzhou planning proposals.

We felt it was important not only to evaluate and measure potential successes or failures of planning proposals and their context, but also to formulate a new strategy based on what we learned and on the data we gathered. Here we transition to recommending alternative proposals. Having explored and researched the context for the plans at local, regional and global scales, our alternative proposals attempt to bridge global and regional economic goals with local tactical development strategies to ensure long-term prosperity and health for both human and non-human species in the region.

After analyzing the planning proposals and existing conditions of the area at a wide range of scales, the class developed a range of alternative proposals focused on four main strategies:

- Ecotourism
- Agriculture/Aquaculture preservation
- Landscape bio-remediation
- Habitat preservation and limited development

These four strategies will be outlined in the following chapters through various proposals that, while related, function at different scales.

4.2

Ecotourism in China

Ian McRae

The following analysis of ecotourism in China will discuss the problems that have arisen over the years in order to highlight areas of opportunity to implement more successful alternatives in the future.

In 1956, China established its first nature reserve, and within 40 years the country had 1,276 areas that carried this status. By the end of 2006, China had 2,395 protected areas that covered about 15% of the nation (Ministry 2007). There was a belief that large-scale development and environmental protection can go hand-in-hand, but unfortunately concerns for the environment were pushed aside at the detriment of local population's health and well-being. Today, many of these 'protected' regions are not fully recognized by different stakeholders and the environmental quality continues to be degraded as new development and industry takes hold.

There has been a marked shift in environmental perceptions on both a local and regional scale, as China has begun to make efforts to pursue more sustainable solutions to reconcile environmental protection with economic growth (Liu 2008). This is highlighted by Chinese officials working in collaboration with the Paulson Institute, a research center based in Chicago, to undertake a trial Chinese National Park system in nine provinces over the next three years (Wong 2015). The hope is that these parks can collectively manage the ecologically rich regions of China and become a source of great national pride and environmental education.

One of the planned trail parks will be in the Wuyishan area, a mountainous coastal region in the Fujian Province. Accompanying this effort will be Doug Morris, a retired manager with a 40-year career in the United States National Park Service (USNPS). He is a member of the non-profit, Global Parks, a group involved in advising foreign governments on creating national parks. The real challenge will be in getting the Chinese public to not only share in these natural treasures, but also protecting them at the same time. There are already existing precedents in China, such as Huanglong alpine park, where money-making ventures by tourism companies are prioritized over conservation efforts (Wong 2015). Parks such as this are already valued and utilized, but it is important that these sites become more formally recognized and that this recognition is respected to ensure long-term ecological and environmental resilience.

One of the biggest challenges that has exacerbated the governmental efforts to protect China's natural treasures are the large variety of departments involved in management that are not well integrated or connected. There are instances where a National Wetland Park is managed by the State Forestry Administration, a National Water Reserve Park is managed by the Ministry of Water Resources, and a National Geopark is managed by the Ministry of Land Resources. There are also instances where a protected site can fall under multiple jurisdictions that are managed by multiple governmental agencies that do not communicate well with one another. One solution would be to devise a national strategy which involves a clear definition of ecotourism and some common aims such as criteria for determining management guidelines and the spatial extent of ecotourism (Wenjun 2000).

This deficiency in clear management objectives is most apparent when looking at China's reserve system. Reserves are classified into three categories — Natural Ecosystem Reserve, Wildlife Reserves, and Natural Monument Reserves — but these categories are based on ecological definitions, not management objectives, such as the amount of human use allowed. In addition, these categories do not acknowledge the value of ecosystem services and this is a missed opportunity to set aside regions for their inherent ability to provision and regulate.

Distribution of Economic Benefits

As mentioned earlier, conservation often comes second to touristic ventures at already existing ecotourism sites due to the limited funding by the Chinese government. Globally, developed countries average about $893/sq km of funding for federally protected land and in China this number is $113/sq km, which is less than the average for developing countries. This fiscal pressure put on China's nature reserves to fund themselves tends to intensify the environmental degradation of the very natural resources that tourists come to visit.

One reason for this is that many of the nature reserves operate tour businesses in addition to their management responsibilities, which stretches thin their abilities to properly protect the reserves. According to the regulation of the People's Republic of China on Nature Reserves, "Tourism developed in reserves has to be authorized by reserve management administration." A consequence of this is that reserves often exclude other practitioners from the tourism operations which effectively creates a monopoly. This either limits or excludes the local population from reaping the economic benefits of ecotourism (Wenjun 2000). The ability of the reserves to exclude local interests from the opportunities created by ecotourism highlights the unequal distribution of benefits to local stakeholders.

Case Study: Wolong Nature Reserve for Giant Pandas

A case study of the Wolong Nature Reserve for Giant Pandas illustrates that currently most ecotourism ventures are implemented in a top-down approach that often brings in operators, laborers and resources from outside the locality. In addition, there are few transparent mechanisms for locals to become engaged in the process so that they can best position themselves for the changing local economy. Street vendors have expressed discontent with the reserve authority and claim that there is corruption that excludes them from obtaining more profitable locations for business (Guangming 2008).

An alternative to overcome this issue is to implement ecotourism in a bottom-up approach that favors local participation. Another option would be to emphasize eco-tourism on a more local scale, though it might not be as large of an industry, it would be more conducive with the ecologies and the potential ecosystem services provided. If a region is increasingly populated with local residents and tourists then the environmental processes may be overwhelmed and unable to mitigate the impact of that size population. An example would be

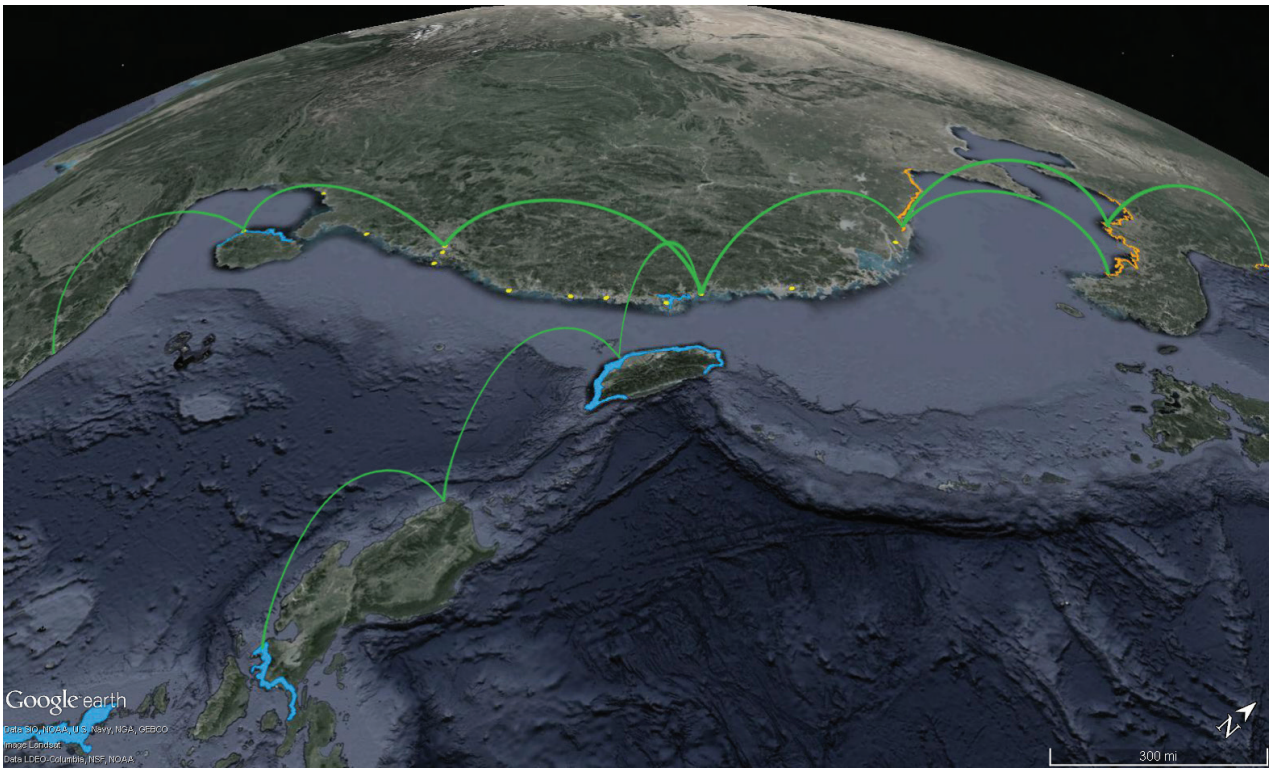


Fig. 4.2-1 *Connecting nature reserves throughout the region not only benefits the endangered spoonbill, it also supports a network of ecotourism that would be economically beneficial to the area.*

the aquaculture industry which has the capacity to filter and improve the water quality. If upstream agricultural practices and other waste contributing activities overwhelm the capacity of aquaculture then there will be a progressive deterioration of water quality.

There are three primary types of business generated from ecotourism: hotels/restaurants, souvenir shops, and infrastructural construction. These different forms of business are often divided by the four major types of stakeholder: rural residents, farmers, urban residents, and the reserve staff. Distribution of these different business practices are often uneven though, with a majority of investment and operation coming from reserve staff and outside interests. Rural residents typically took the low-skilled temporary jobs that earned a relatively lower salaries and outsiders tended to dominate the higher-skilled positions (cooks and managers). Only 25% of the 1500 ecotourism jobs created were taken by local farmers.

This uneven distribution of economic benefits can be seen in the large divide between the yearly income per capita of rural residents compared to that of the reserve staff in the same year. Rural residents on average earned about 1400 yuan per year ($169/year) which was less than one-fifth of the reserve staff's average annual income. It has been estimated that the yearly income generated from ecotourism in the Wolong Nature Reserve accounted for only 2.9% of a rural households' annual income. These figures are significant because though the majority of economic benefits in ecotourism often go to outside stakeholders, the primary responsibility of the cost of conservation falls on the rural residents.

Some additional reasons for the economic disparities stem from the fact that most rural households were poor and had no extra funds to invest in ecotourism, or those that did still needed help to guide their investments due to low educational level. It is this low education

of rural farmers that has contributed to the low rate of local employment because ecotourism often requires skills different from farming. If this is truly the case, then there may be a need for mechanisms to be put in place that help to introduce new complementary industries, instead of ones that completely replace previous industries such as farming.

This study also revealed that the underutilization of local resources went beyond employment opportunities and was also true for local agriculture. In the case of the Wolong Nature Reserve, rural residents produced about 7000 tons of cabbage and 500 tons of potatoes, most of which was exported and sold to adjacent cities. At the same time, local hotels and restaurants were spending about 80% of their budget on food from outside sources. This is a missed opportunity to coordinate between farmers and business which could ultimately save on shipping costs and make more money available for other expenditures (Guangming 2008).

Assessment and Mitigation of Negative Environmental Impact

Most environmental impact assessments (EIAs) for proposed tourism projects use one of three methods:

Sorensen Network: a common method employed in environmental impact assessment to identify the potential direct and indirect environmental impacts of ecotourism and to analyze the effects of ecotourism activities on marine environments and their causes.

Integrative Ecological Sensitivity (IES): assessing the environmental impacts of tourism at nature reserves through evaluating the interrelationships between multiple ecological characteristics of landscapes and ecotourism activities.

Contingency Evaluation Method (CVM): a widely used non-market valuation method, has been employed to assess the economic value of environmental commodities with several applications. (Ming Su 2014).

One precedent to learn from would be the story of the Ordos Relict Gull, a threatened species, 60% of whose global population used to nest at one site in Inner Mongolia. In 2000, the Inner Mongolian Garden Ecotourism Resort was developed in and around the Ordos Relict Gull Reserve. Tourism activities were focused on gull watching during the peak nesting season, but also included speedboat racing, sand skiing, sand motor biking and fishing. Within three years of the resort's construction, there were more than 260,000 visitors in the month of June alone. This explosion in tourists and invasive recreations dramatically impacted the local Ordos Relict Gull nesting population. In 1998 there were 3,594 nests counted and this number dropped to zero by 2004. Fortunately the local population did not go extinct, but instead migrated to an alternative nesting site about 90 kilometers to the northeast (Zhang 2008). It can be seen that the presence of a poorly implemented ecotourism strategy effectively drove away the very feature that was supposed to bring in tourists.

In order to successfully implement and protect portions of the environment in China, the government needs to create transparent and readily implementable steps that seek to remedy the issues highlighted above. The government needs to look to other nations' efforts to replicate the National Parks model, but do so in a way that does not jeopardize the resilience of that environment and also ensures a more equal distribution of economic benefits to the local residents of the region. In addition, previous efforts to introduce eco-tourism in China that have failed should be analyzed more closely in order to avoid making the same mistakes again.

4.3

Regional Scenic Routes Proposal

Andrew Cumine and Tomas McKay

Fuzhou is at a critical moment in defining its future condition and it is vital for the region to realize that economic development must go hand-in-hand with ecological restoration. In understanding the future environmental condition of the region, it is pertinent to consider and devise an alternative approach to development that combines both the landscape assets of the past while addressing the changing shoreline condition in creating both an ecologically and economically successful landscape for the region.

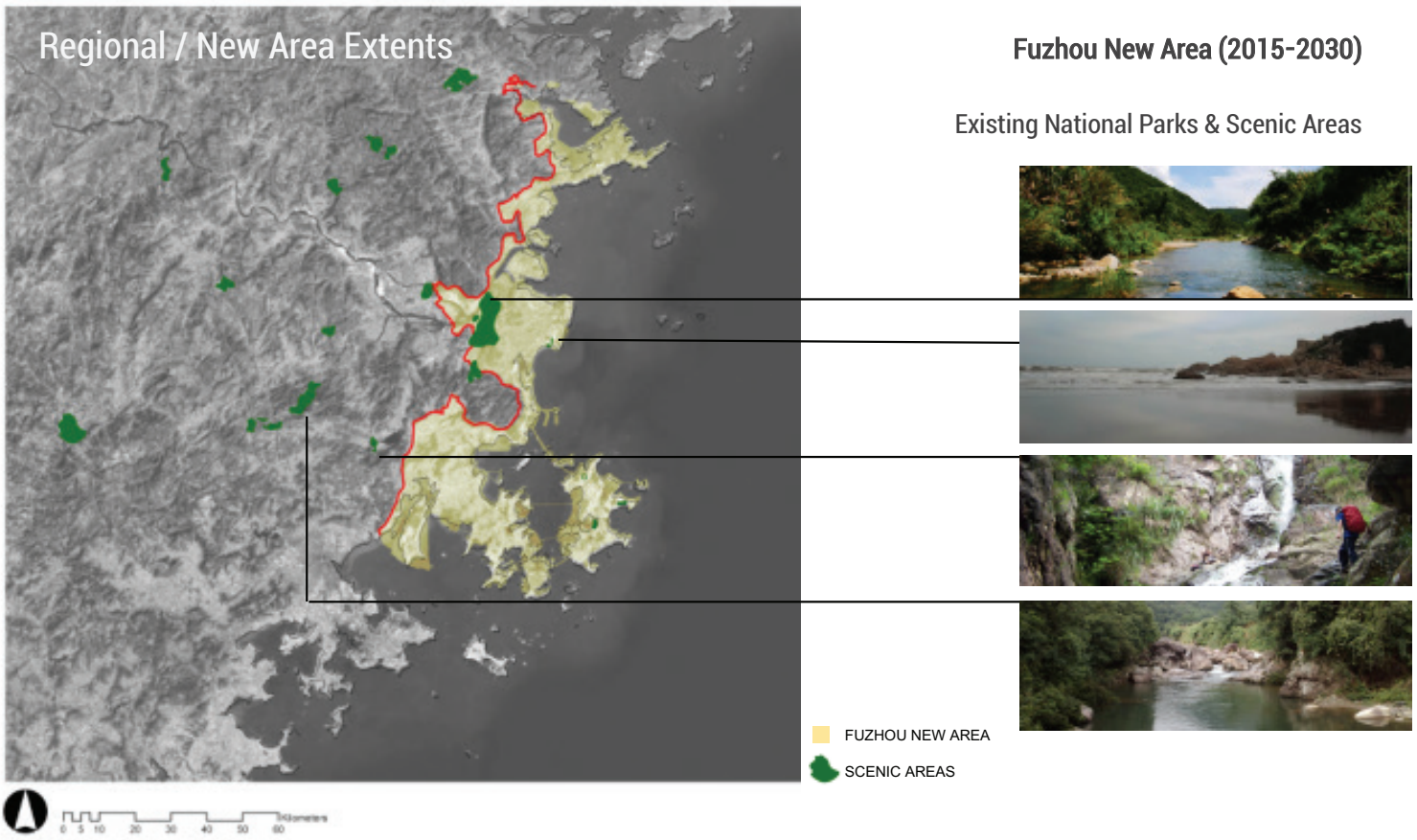
With a greater comprehension of the contextual framework for development in this region our alternative sub-provincial strategy looks to address some of the ecological and economical issues highlighted through the creation of an eco-tourism-orientated Scenic Route.

In preparing for sea level rise, the Scenic Route will also be accompanied by a Wetland Plan. This plan aims to improve the shores capacity to protect the region's interior from sea level rise through the creation of new habitat and vegetation enhancement. Such improvements will also mean environmental restoration and new habitat for thousands of birds that migrate along the coast of China and Taiwan. The plan considers the use of the Spoonbill geometry parameters for defining the scale of intervention – this being the need for shallow waters and a range of 6 kilometers for conservation areas.

Therefore, the Wetland Plan will address sea level rise and restore habitat functions as part of the same action. But in this double target effort, the Plan also tried to expose the natural beauty of the Province and the rich resources available.

The location and extent of the Wetland Plan is informed by the relation between the historic loss of mudflats and the threat that the shore faces from sea level rise. An extensive conservation plan for the shoreline is also incorporated into the Wetland Plan; with present habitat being protected, and with new habitat needed for shoreline protection being created.

Rare birds and habitats in conservation areas are becoming scarce resources that over time will become more attractive to tourists and form the foundations to an increasing ecotourism economy. The presence of a diverse range of birds could also serve as indicators of water quality, a healthy ecosystem, and an increase in the scenic value and general vitality of the shoreline.



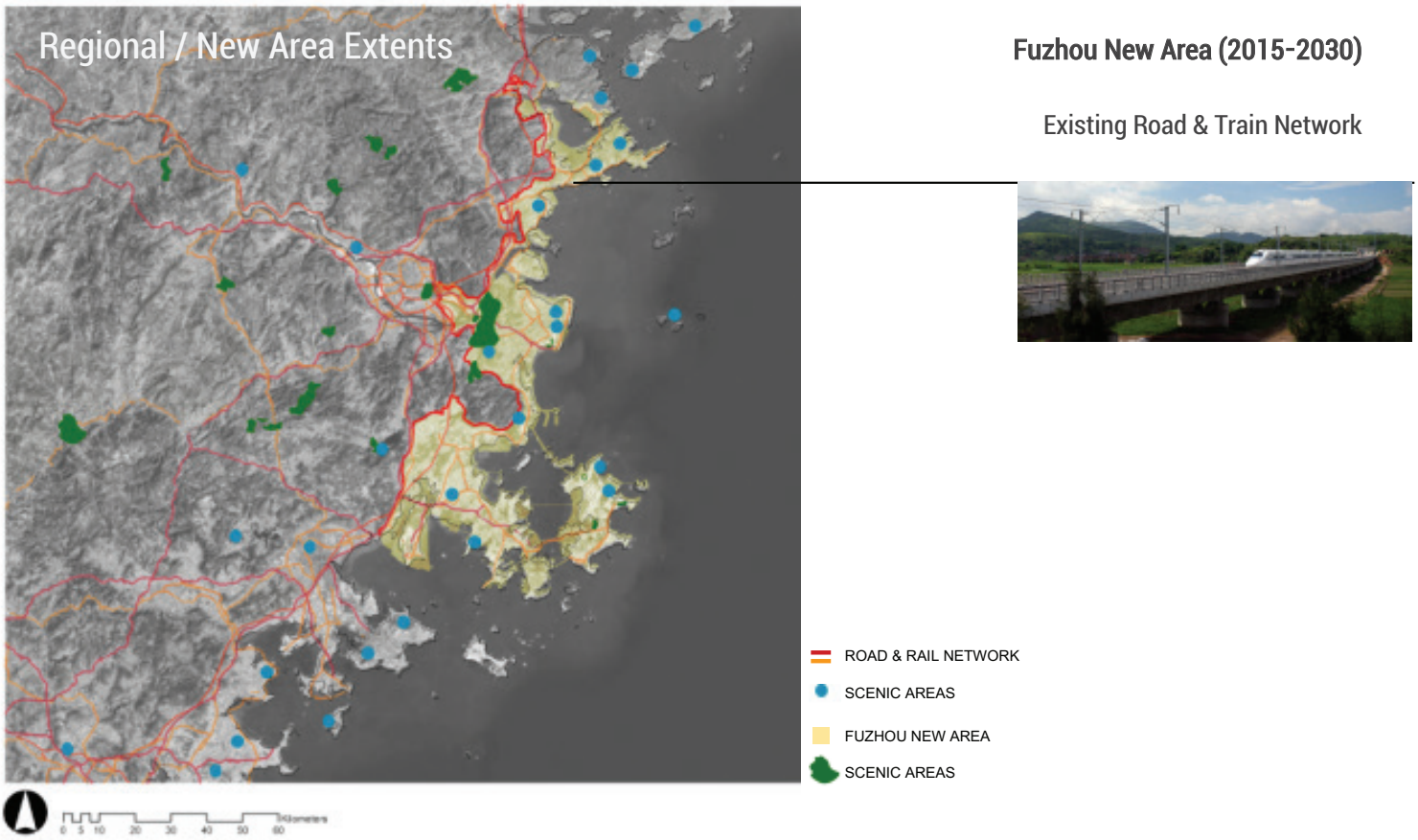


Fig. 4.3-1 *Existing national parks, scenic areas, tourist sites, and major road and rail networks of the Fuzhou area.*

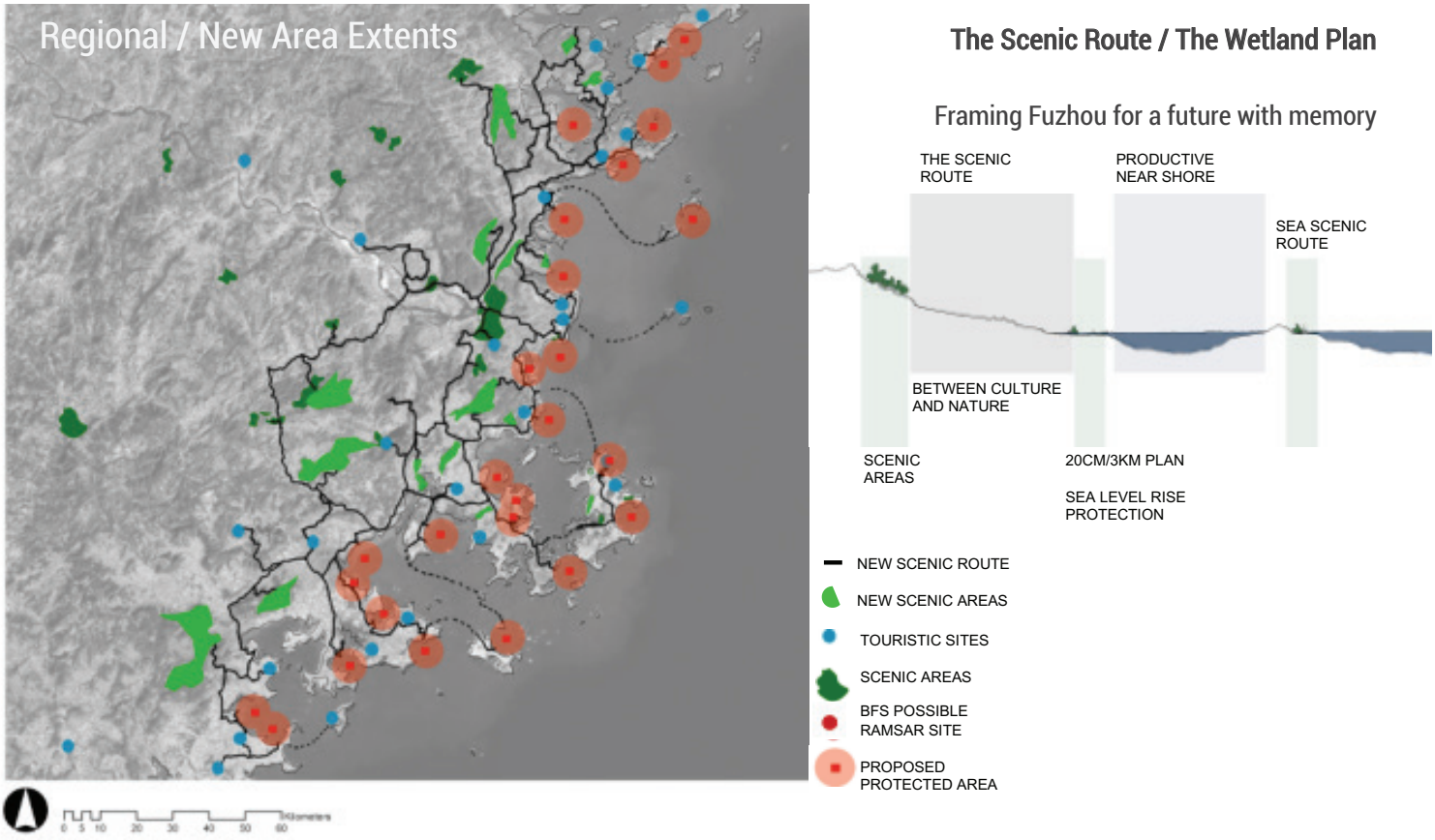


Fig. 4.3-2 *The Scenic Route proposal connects and expands the existing network of parks and transportation networks to encourage both an increase in environmental protection and ecotourism.*

Globally, ecotourism is becoming a keystone in new sustainable developments and a great improver of international image. In Fuzhou, nature and culture has the opportunity to be linked and experienced together, when both ancient settlements and ecosystems depending on the shoreline's condition become a part of the same scenic route narrative. Although nature-based tourism represents a relatively small portion of the tourism market globally, it is recognized to be one of the fastest expanding markets (Scheyvens, 1999; Eagles, 1997). Ecotourism is a sub-market of nature-based tourism that has received much attention in developing countries and economically impoverished regions around the world. Ecotourism is an agent of change (Wall, 1997) and, as such, it has been linked to resource protection policies, protected area conservation efforts, sustainable development initiatives, and regional and community development strategies. As an ever-expanding market it could form the foundation and focus for new government policies, both nationally and regionally.

Finally, it should be highlighted that an alternative development approach that combines both the landscape assets of the past while addressing the changing shoreline condition of the future would also provide an attractive environment for local residents and visitors.

The scenic route will connect scenic areas and tourist sites with a resourceful and environmentally rich shoreline. Culture, society and ecology will all be recognized, in a manner that provides economical stimulus to the region. Such an alternative approach provides a comprehensive and sustainable way to look to the future while making visible the greatness of China.

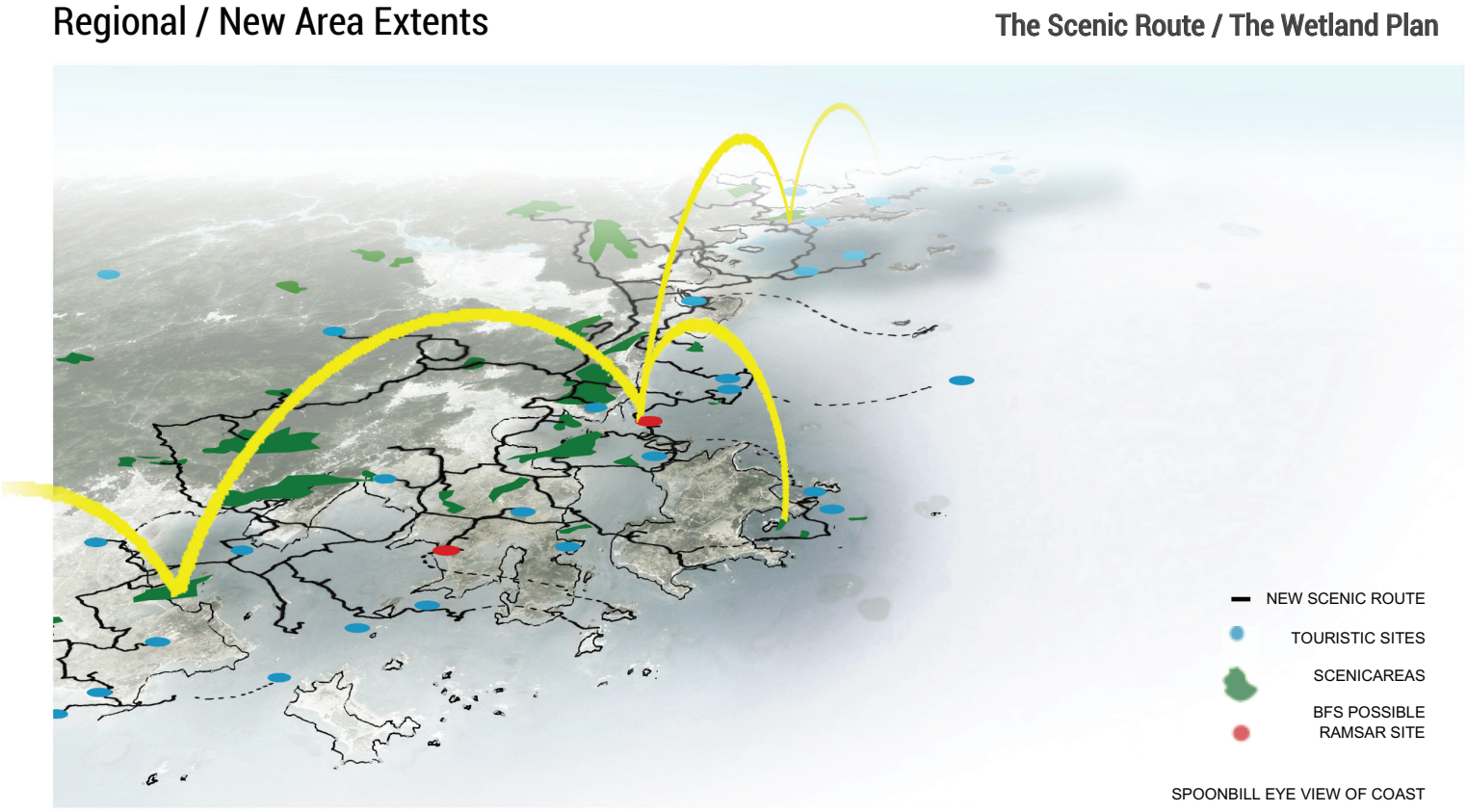


Fig. 4.3-3 *This proposed Scenic Route would connect parks, other tourist sites, and newly dedicated Ramsar wetland sites, including habitat for the Black-faced Spoonbill (BFS).*

4.4
Agricultural and Aquacultural Preservation

Benjamin Lamb

With the preservation of agricultural and aquacultural land, China has an opportunity to increase the economic livelihoods of a significant percent of its population, protect suitable habitat for endangered species, all while creating a more resilient food system. On a national scale China has been transforming into an export-oriented economy. This has increased China's dependence on the buying power of foreign markets, and has thus made the country susceptible to global recessions. By protecting agriculture, China has the opportunity to determine food prices, while following one of the United Nations Development goals of promoting sustainable agriculture.

Fujian province specifically has significant income at risk from the destruction of its agricultural land. If the province transitions to industrial land use, the diversity in crops and sophisticated agricultural methods, which were developed over centuries, could be lost. Many of these practices are associated with ethnic minorities, involve prominent roles for women, and are sustainable in nature (Dean 2010).

Furthermore, there is growing evidence that large-scale developments are based on a false economic projection. In Shanghai, the One City Nine Towns plan has been determined to be a failure, unsustainable, and clearly is an example of misguided planning. Julie Sze, a professor at UC Davis, describes in detail the failure of one of these villages, An Ting. "'Most houses in An Ting new city have been sold. There are only 100 units that are not sold.' The problem is that most buyers did not move in... Although the original plan was to attract thirty thousand people, the actual population was so low that the only kindergarten in An Ting could not open for lack of students" (Sze 2015). Thus, despite the selling of houses in these new developments, it is clear that there is no actual demand for them to be inhabited. Instead they are a tool for investment, a commodity of upper middle class Chinese.

The preservation of agricultural and aquacultural land will coincide with increased viability for individual farmers and their families. If the government allows farmers the right to harvest and maintain their land, they will inherently do so in a sustainable and culturally determined way. There may be a higher profit margin to be made by scaling up agriculture, and introducing heavy machinery and monoculture practices, but these transitions come with a cost to the

Fig. 4.4-1 *Many farms in the area have been consolidated into large monocrop fields.*

environment (Norse 2015). Unfortunately, Chinese policy has largely been aimed at scaling up agriculture, and not preserving individual farming techniques. "The 1997 National Ninth Five-Year Plan for Environmental Protection and Long-term Program for 2010 addressed the need for more large-scale agricultural production and less emphasis on small-scale family operations" (Shi 2010). Furthermore, Chinese legal attempts at preserving agricultural land have been ineffective at doing so. "In 1998, China revised the Land Management Law by requiring each province to designate at least 80% of its cultivated land as 'basic farmland,' which must be preserved. But the new law is still subject to local manipulation and internal contradictions" (Lin 2005).

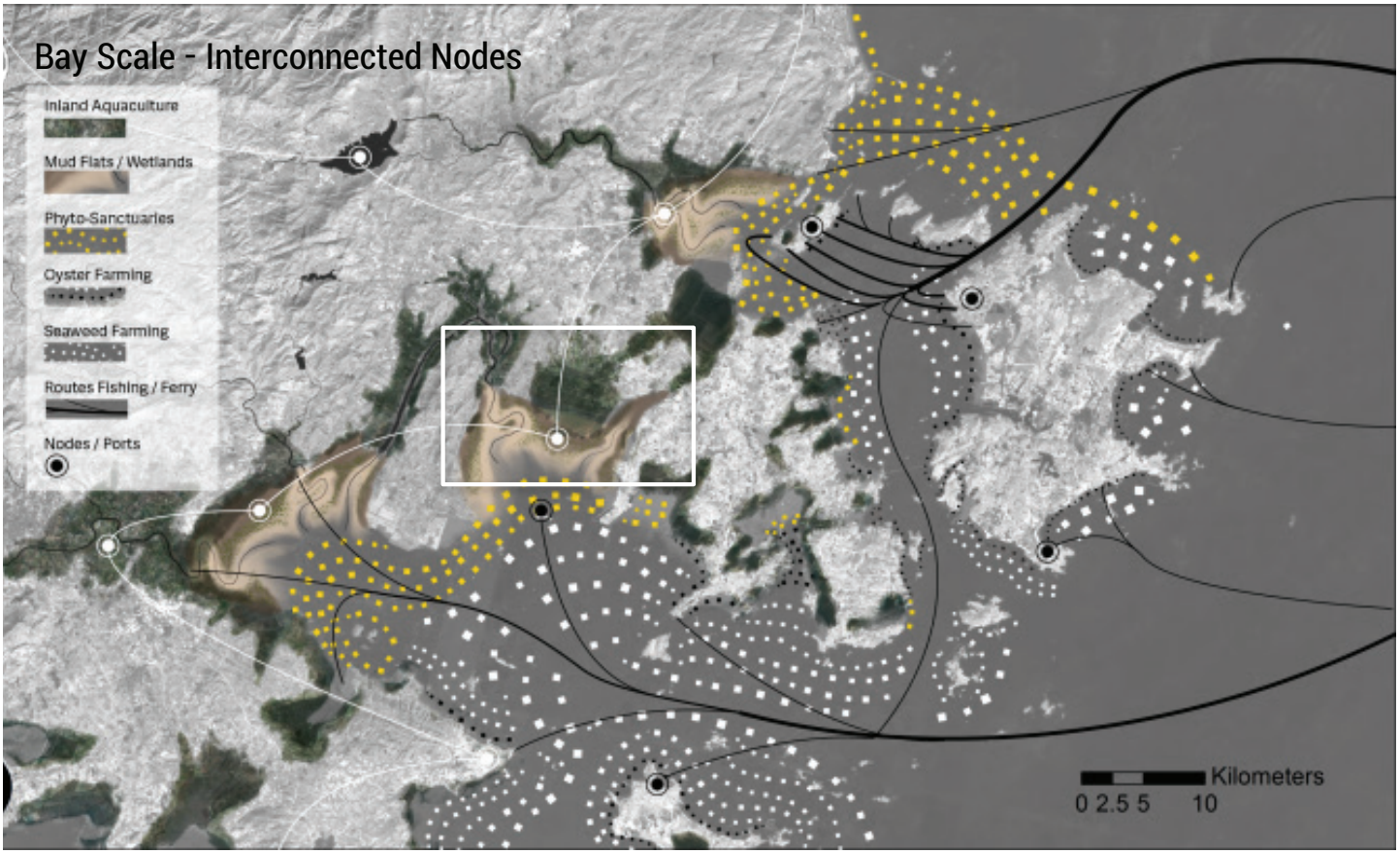
Any economic gains from the destruction of agricultural land, could be countered in part by income from tourism, which Fujian in particular stands to attract. Thus, by preserving the historic way of life of individual farmers, allowing families to continue to live on land and practice their cultural traditions, Fujian could be at the forefront of a new age in eco-tourism (Newton 2011).

4.5
Landscape Approaches to Sustain the Health of Xinghua Bay

Xinni Zhang

In the face of both existing and potential problems caused by ecosystem reclamation of tidal flats in Xinghua Bay, we came up with four landscape design approaches to promote bio-remediation and ensure the health of the bay long-term. Using the ecological analysis outlined in Chapter 1.2, we divided the coastline into four landscape proposals described by the scenarios below.

- Scenario 1 – Mangrove Habitat + Seaweed Farming
- Scenario 2 – Marsh Land
- Scenario 3 – Marsh Land + Oyster Farming
- Scenario 4 – Harbor/Floating Wetland



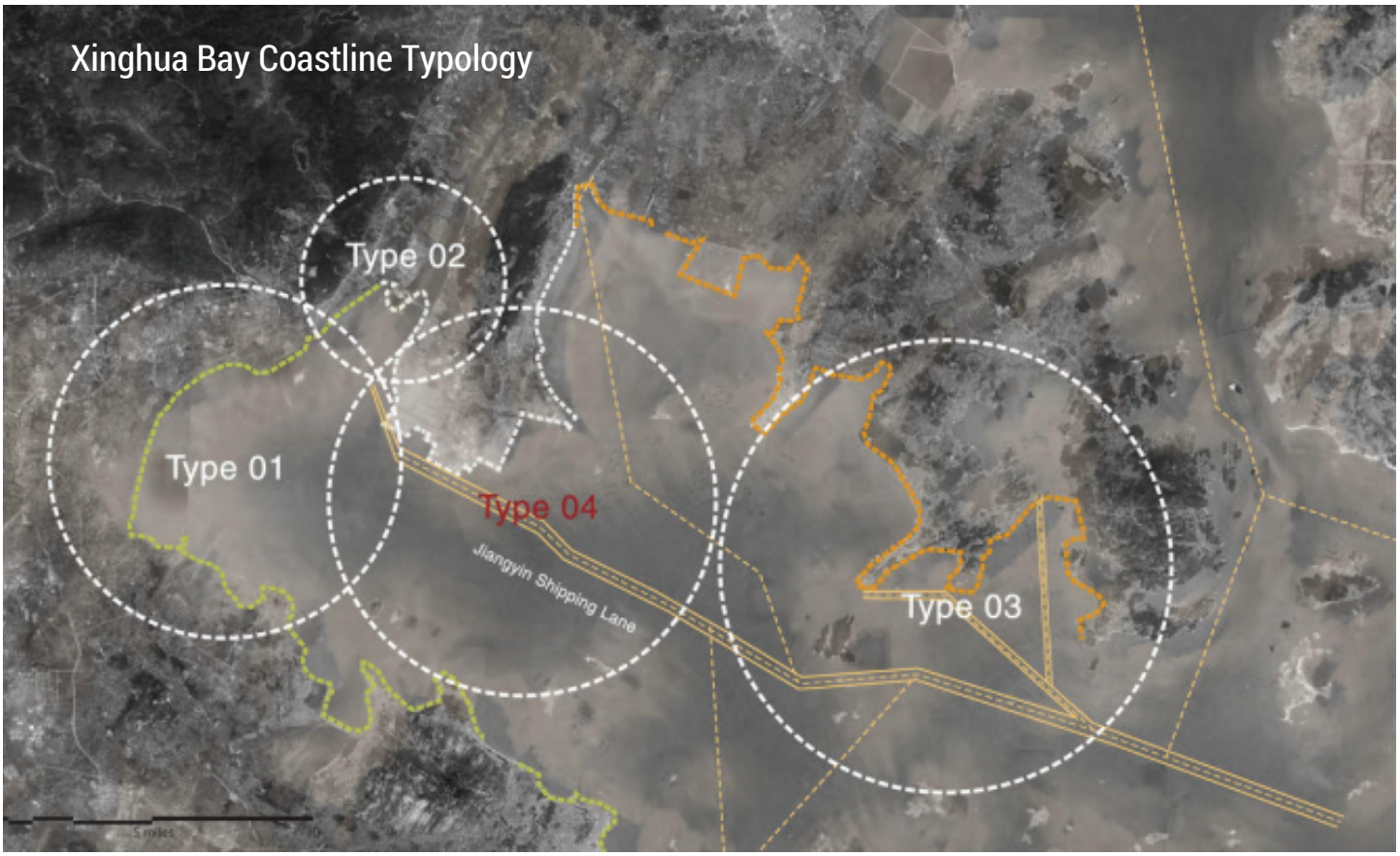


Fig. 4.5-1 *Based on our analysis of existing Xinghua Bay health, we selected four areas to explore potential landscape interventions that would aid bio-remediation and sustain long-term health.*

Type01-- Mangrove Habitat + Seaweed Farming

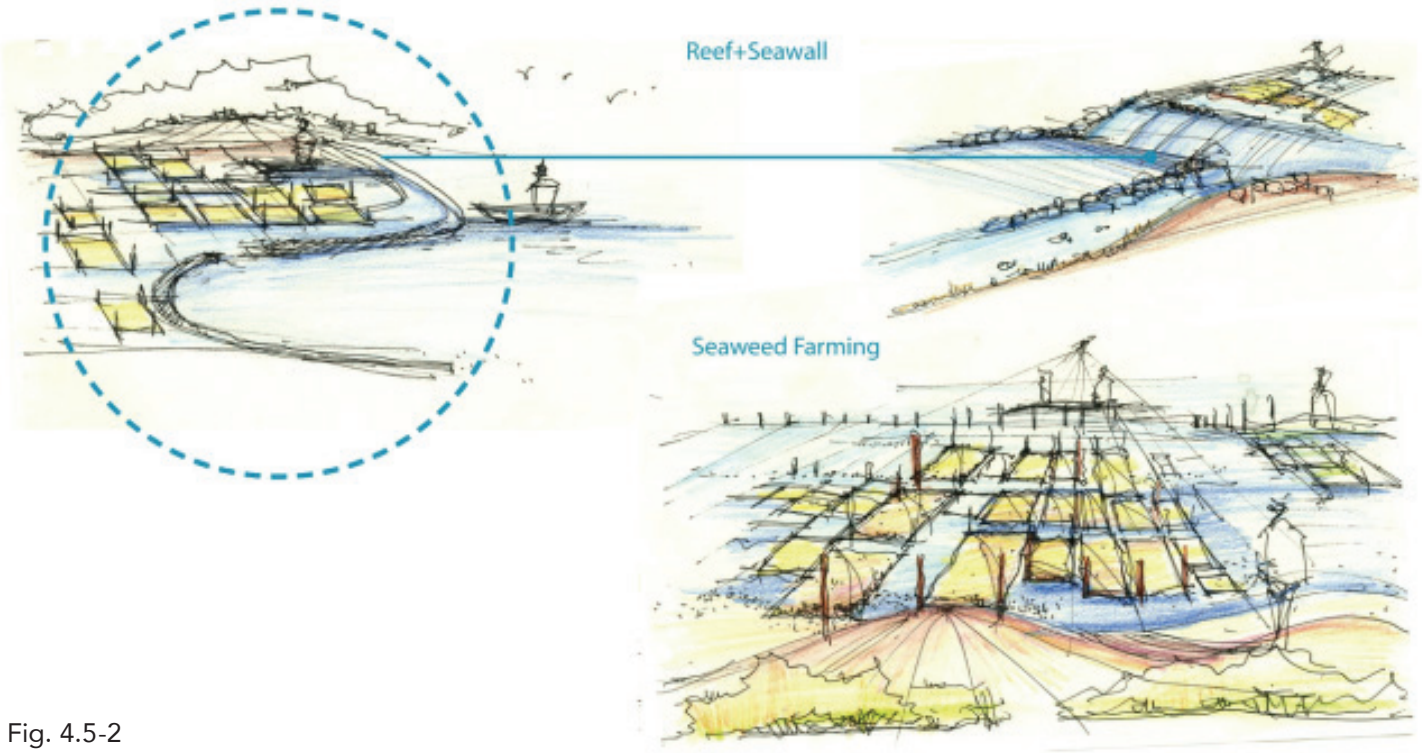


Fig. 4.5-2

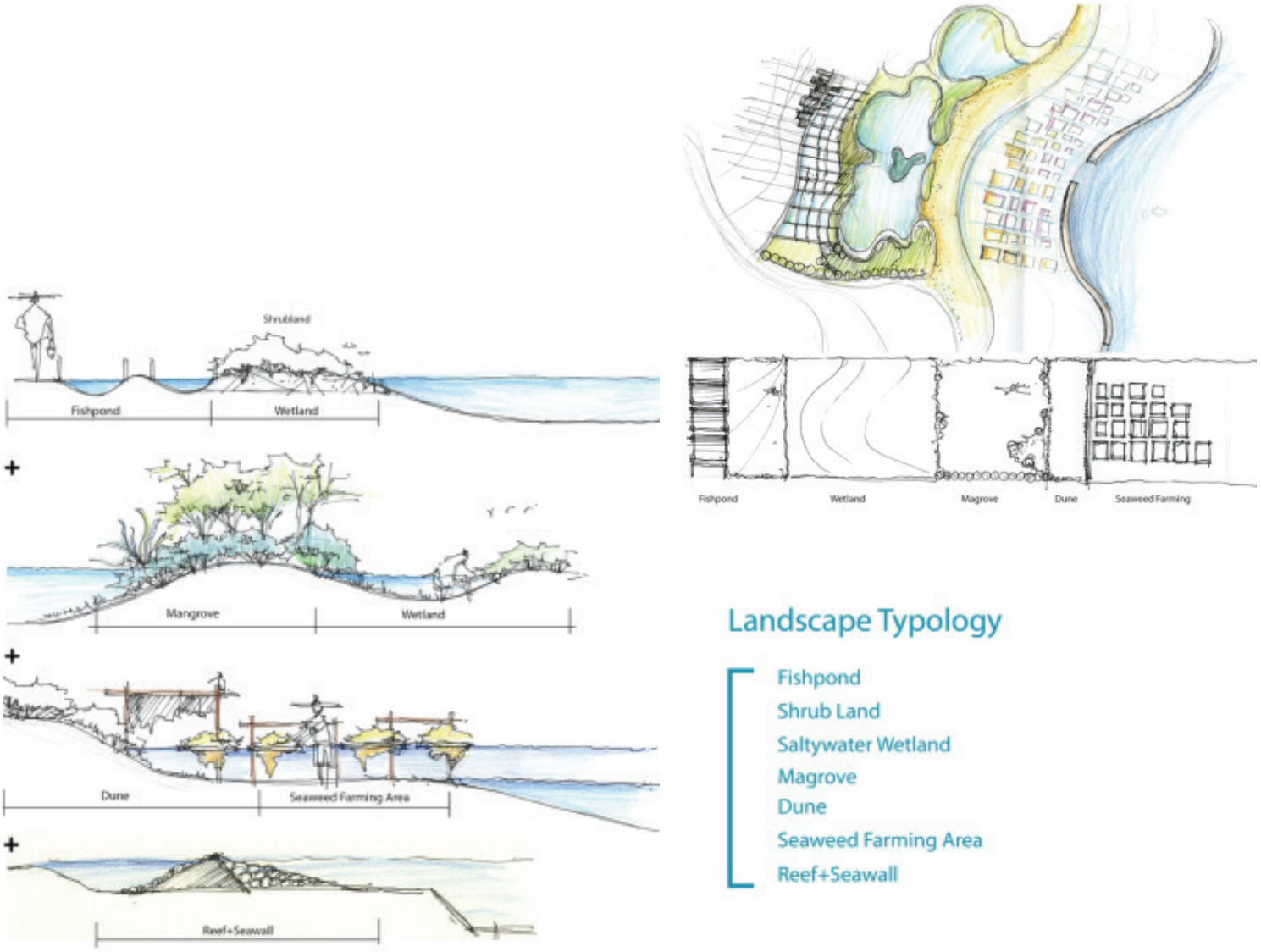
Mangrove Habitat + Seaweed Farming

In the 1960s, mangrove forests were mainly distributed west of Xinghua Bay. Mangrove habitat was found in Sanjiangkou, the Estuary of Qiulu, Xincuo and Keyu Island. However, reclamation and construction of the coastline has resulted in almost a complete loss of mangrove since the 1960s. Today, fishponds have replaced mangrove habitat along the coast of Xinghua Bay. Sea-level rise in Xinghua Bay has also posed a threat to the mangroves since they have a sensitive tidal range and therefore die when the water becomes too high. It is widely recognized that the mangrove banks have the largest ecological and social benefits when compared to other habitat types. In this case, we propose to recover the mangroves along the west coastline of Xinghua Bay.

This model includes 7 landscape typologies from inland (left) to the sea (right): Fishpond, Shrub Land, Wetland, Mangrove, Dune, Seaweed Farming Area, Reef+ Seawall.

Shrubland serves as a buffer between inland aquaculture and natural tidal flats, and creates wetland habitat for birds. Mangrove habitat is proposed between the salty water wetland and seaweed farming area. This will not only improve the local water quality but will enhance biodiversity. Seaweed farming has ecological advantages in terms of water quality and economic incentives. Additionally, it creates habitat for aquatic animals. It also provides a potential opportunity for tourists to experience a special kind of aquaculture.

A seawall is proposed on the edge of the tidal flat, but unlike typical seawalls, this design keeps the wall below the level of the water. It has the ability to calm water, reduce wave heights and prevent shoreline erosion. Since high velocity water will influence the mangrove habitat, the seawall provides better conditions for mangroves to survive. Calm water in turn encourages sedimentation, which help to replenish the mudflat and enhance maritime ecosystems.


Shrubland
Fishpond
Wetland
Mangrove
Wetland
Dune
Seaweed Farming Area
Reef+Seawall
Fishpond
Wetland
Magrove
Dune
Seaweed Farming
Landscape Typology
Fishpond
Shrub Land
Saltywater Wetland
Magrove
Dune
Seaweed Farming Area
Reef+Seawall

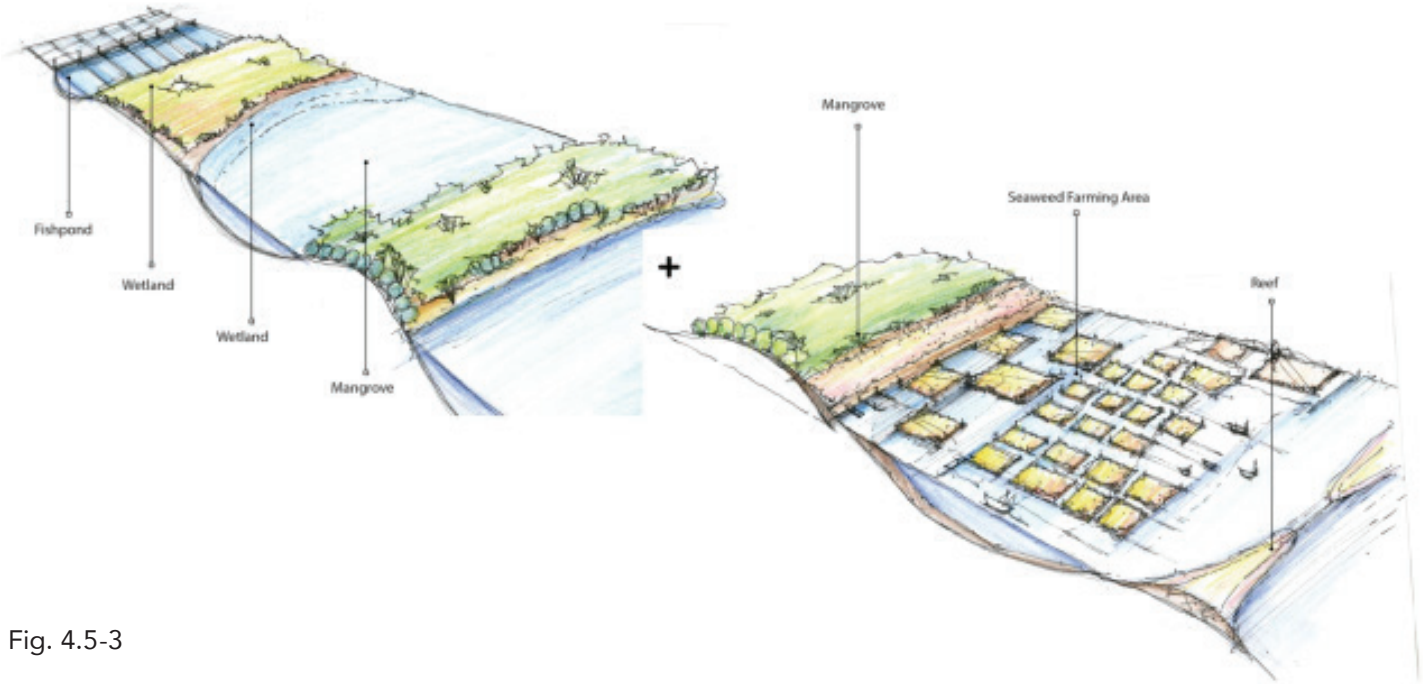

Fishpond
Wetland
Wetland
Mangrove
Mangrove
Seaweed Farming Area
Reef

Fig. 4.5-3

Type 02-- Marsh Land

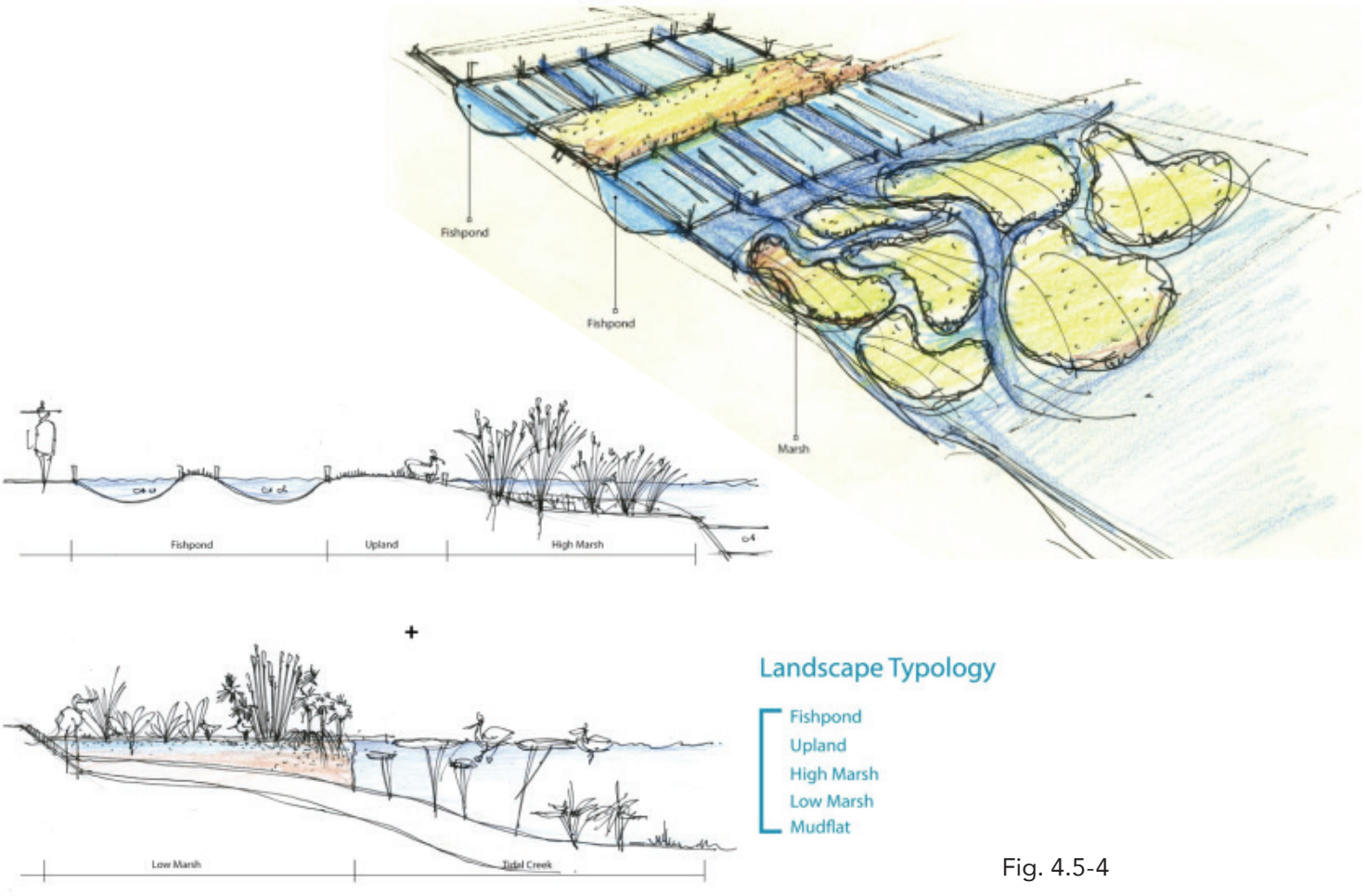


Fig. 4.5-4

Marsh Land

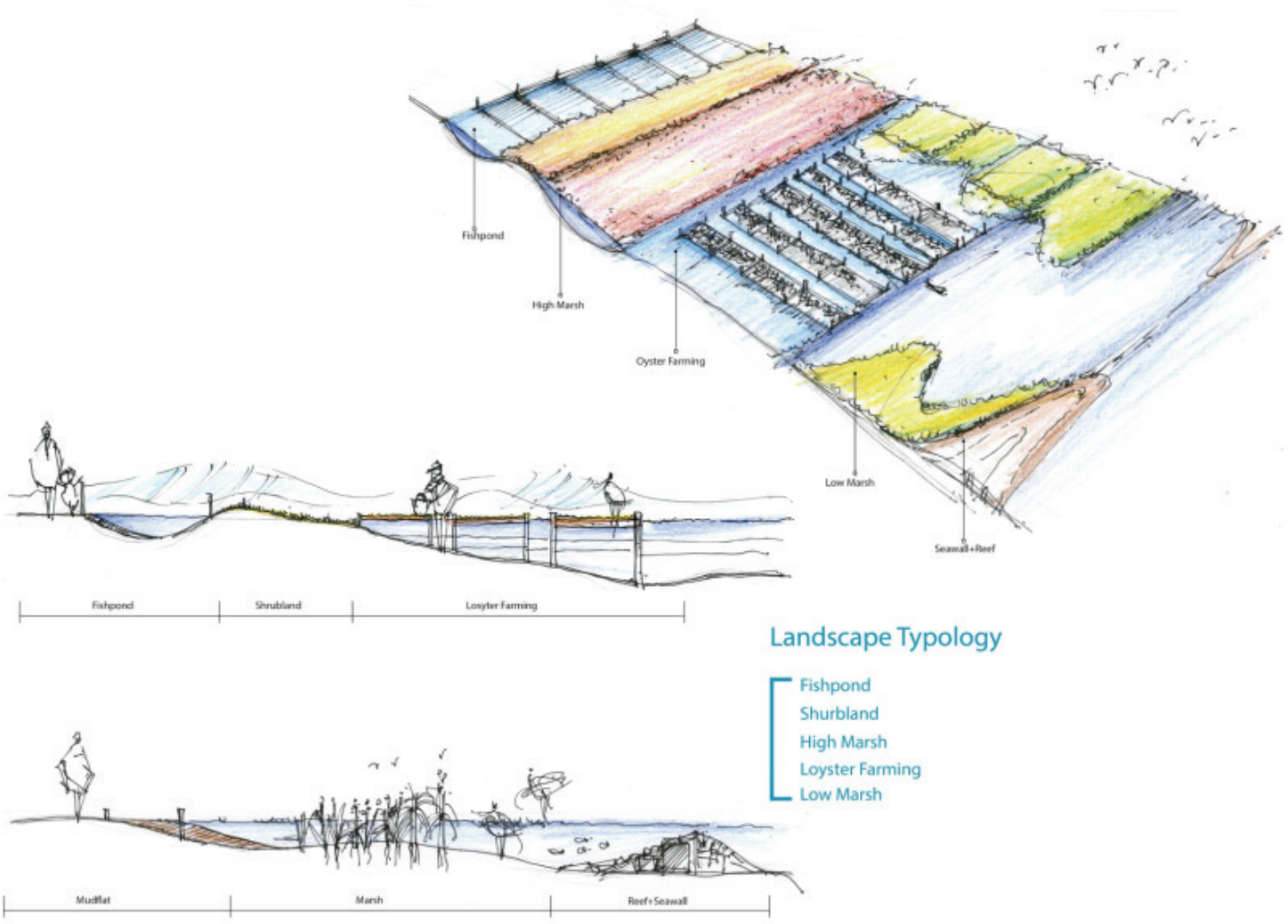
The tidal flat has been significantly reduced since 1959 because of past developments, and the Fuzhou New Area Plan continues in the same tradition. In contrast to this, our proposal works towards keeping the coastline as natural as possible and protecting the tidal flats. A large area of tidal flat along the coastline of Xinghua Bay could also be marshland.

Salt marshes serve as the transition from the ocean to the land, where fresh and salt water mix. Salt marsh plants are salt tolerant and adapted to water levels that fluctuate with the tide. Tides carry in nutrients that stimulate plant growth in the marsh and carry out organic material that feeds fish and other organisms.

This model includes 5 landscape typologies from inland to the sea: Fishpond, Upland, High Marsh, Low Marsh, Mudflat.

Upland exists along the border of marsh land. It is rarely flooded with saltwater and provides space for birds to stay. The high marsh lies between the low marsh and the marsh's upland border. A high diversity of herbs, shrubs, and even trees can exist in the high marsh area. The low marsh is located along the seaward edge of the salt marsh. It is usually flooded at every tide and exposed during low tide.

Type 03-- Marsh Land + Oyster Farming



Marsh Land + Oyster Farming

In the mudflat zone there is typically oyster farming, and we have created a model that allows for habitat and food industry to exist harmoniously. The coastline features a high diversity of aquaculture, which can be preserved as a landmark of Xinghua Bay. In this proposal, oyster farming is located between high marsh and low marsh, where it is flooded regularly. Low marsh serves as a green buffer, which also has the ability to raise some crops.

This model includes 5 landscape typologies from inland to the sea: Fishpond, Shrubland, High Marsh, Oyster Farming, Low Marsh.

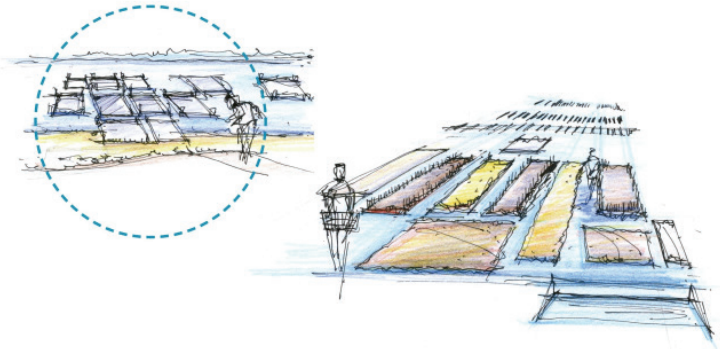


Fig. 4.5-5

Type 04-- Harbor/ Floating Wetland

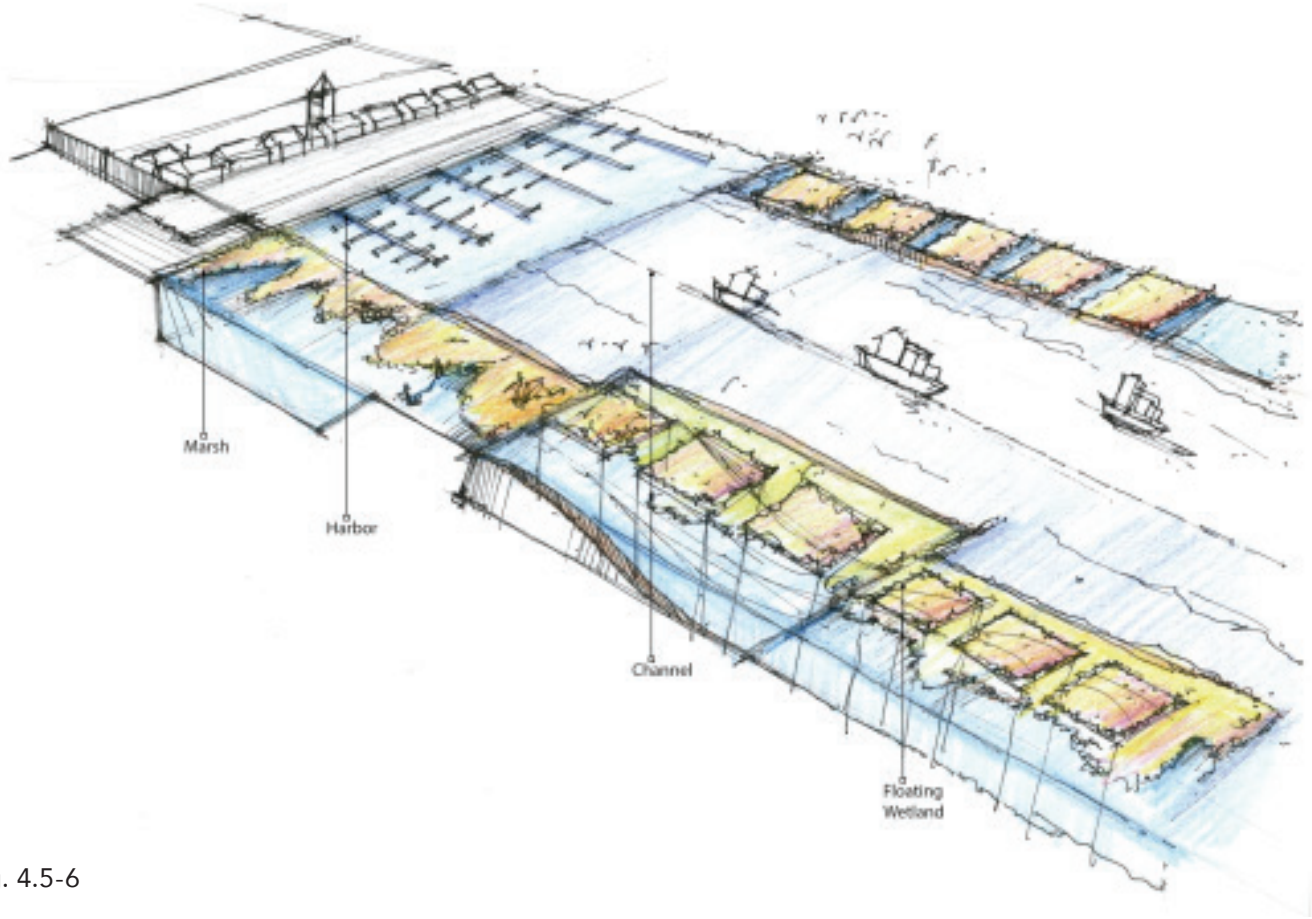


Fig. 4.5-6

Harbor / Floating Wetland

Jiangyingang is an important harbor in Fujian Province. The government plans to develop it as a deep-water harbor for overseas trade. The local government has developed Jiangyingang for almost ten years since 2006. They filled in the coastline and changed the mudflat into bare land for construction. Currently the coastline of Jiangyingang is mostly artificial and the shipping lane is already being used. In this case, we aim to figure out a balance between ongoing development and ecology. Floating wetlands are a special proposal for this zone.
A floating wetland is a man-made raft that floats on the water's surface and houses native wetland plants. These floating wetlands have plant, soil and root interactions similar to a natural wetland and provide homes to beneficial water-cleaning microorganisms. They also provide spaces for birds to stay when they migrate to another place.

The transportation channel and the floating wetland work together to create a buffer between natural habitat and economic shipping routes. This model is only implemented in the maritime area.

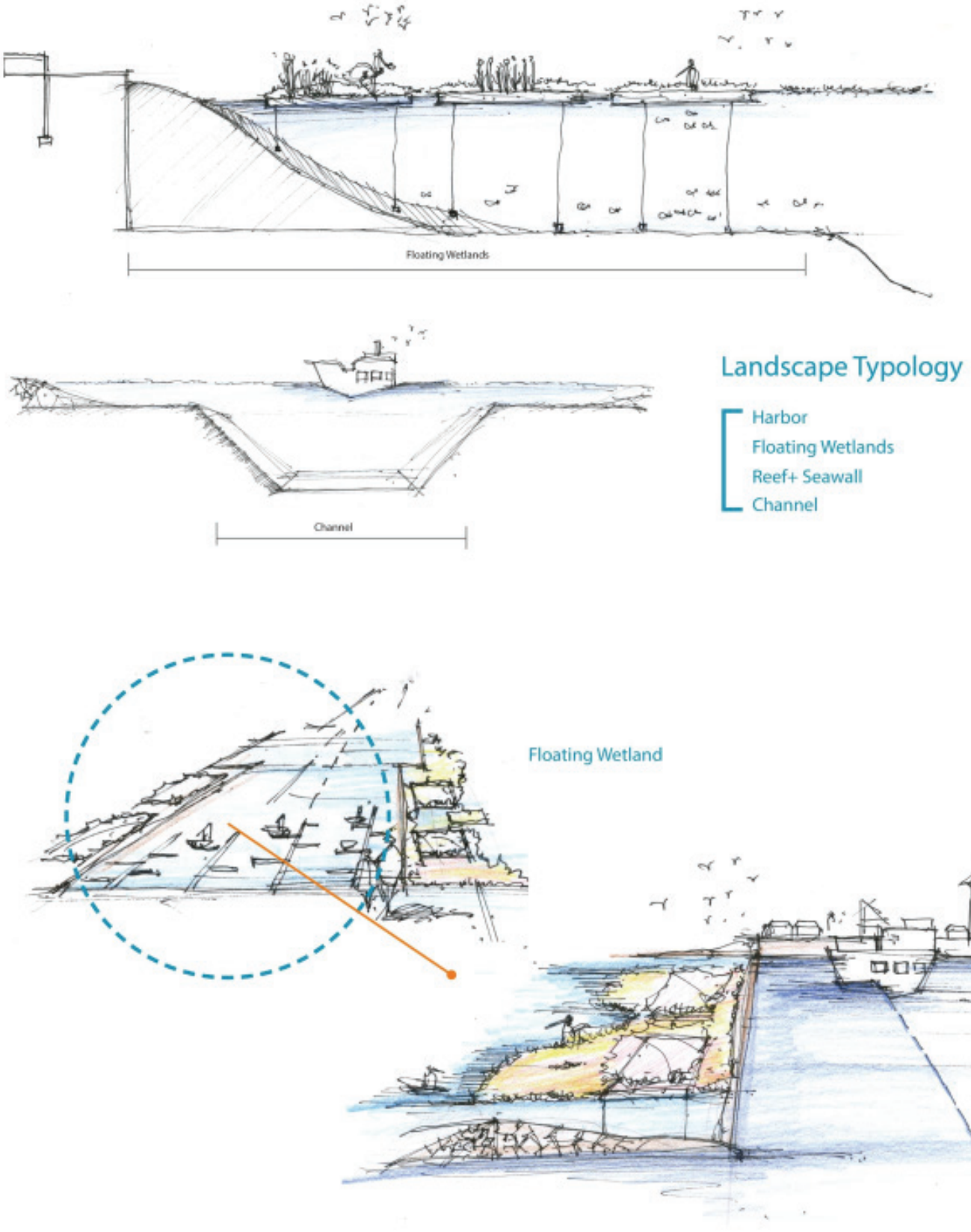

Floating Wetlands
Channel
Landscape Typology
Harbor
Floating Wetlands
Reef+ Seawall
Channel
Floating Wetland

Fig. 4.5-7

4.6
Habitat Preservation and Alternative Development Options

Cristina Bejarano, Ari Frink and Joseph Burg

Revising the Master Plan proposal

In evaluating the 2015 Master Plan, the UC Berkeley team found several opportunities to improve the ecological and economic resilience of the proposal. In addition to expanding the protected areas of the harbor, the following principles were used to inform the three alternative proposals compiled here:

1. HISTORY: Preserve historic village architecture
2. TOPOGRAPHY: Coordinate land use according to topographic character
3. WATER: Preserve hydrologic function by maintaining canals and buffer zones
4. SEA LEVEL RISE: Build defensible development, don't build on high risk land
5. HIGH VALUE PROPERTIES: Maximize building along canals, around historic neighborhoods, and the spoonbill reserve to increase high value properties,
6. ACCESS ROADS: Use the initial highways that are being built to protect development and spoonbill habitat from sea level rise
7. BUFFER: Use agriculture or canals as a buffer between industry and residential areas
8. ADJACENCIES: Maintain adjacencies between historic buildings and local farms
9. ECONOMIC DIVERSITY: Offer opportunities for multiple economies, industry AND ecotourism AND agriculture

In this series of studies, the plan was developed at the Donggang Harbor scale, and was also evaluated at the Xinghua Bay scale.

Habitat Preservation and Expanding the Protected Areas of the Harbor

Consistent between all three of the following proposals is the expansion of the protected habitat area for the Black-faced Spoonbill. Our strategy is to designate the entire sub-watershed in the east as a reserve that incorporates both the necessary roosting areas and the traditional farming techniques upstream that help maintain the health of the area overall. This strategy is expanded in Alternative Proposal C.

Another major theme in all the proposals is to encourage a diverse economic strategy through ecological and historic village tourism. By protecting the historic village core areas and local agricultural areas, one could imagine that this area could become a destination for those interested in seeing these landscape traditions.

This has been done successfully in the past, as in the Daxi Old Town example shown later in this chapter, which has both ecological and historic tourism. The combination of history and bird watching diversify both the tourism opportunities and the economic opportunities of the area.

Alternative Proposal A: Urbanized Canals + Inland Industry

The main goal of this alternative, Figure 4.6-1, is to allocate new development in areas that would be easier to defend from sea level rise, while protecting mudflats and agricultural traditions, and overall keeping the hydrologic armature of the site intact. By aligning the new residential and commercial developments along the canals, the high-value canal-oriented development which was originally being proposed in the 2015 Master Plan can still be developed, this time with a higher chance of continued success in terms of water quality. The 2015 Master Plan proposes a main canal corridor oriented parallel to the bay which would prevent the sediment and particulates in the water from flushing out to the bay as it does currently and has historically. Our proposal keeps the canals aligned perpendicular to the shoreline thereby offering a greater opportunity for success.

The industrial areas are inland, again to ensure their resilience to sea level rise, and to maintain proximity to the highway and rail transportation networks.

Alternative Proposal B: Vegetated Canals + Urban and Industrial Peninsulas

In this proposal, Figure 4.6-2, the mudflats and agricultural traditions would be preserved as a buffer along the canals and the new residential and commercial development would be built as an extension of the topographic peninsulas. While this option leaves the new development more exposed to the effects of sea level rise, the hydrologic systems remain intact farther inland and allow for green corridors to run through the development in a more prominent and substantial fashion.

Alternative Proposal C: Urban Growth Boundary + Decentralized/Relocated Industry

By establishing an urban development boundary based on topography, elevation, and traditional land use, this proposal as shown in Figure 4.6-3 would ensure that new development is exposed to minimal sea level rise risks. The traditional agricultural areas are protected and available as a transition area for new aquacultural practices as sea level rises. It's expected that the spoonbill habitat will also shift "uphill" as sea level rises; the protected area provides a long-term strategy for habitat migration in the area.

Industry in this proposal would be located within the urban infill areas in a decentralized fashion, or could be located in other regions, as identified in the "Regional Extents/New Area Plan" section.

Measuring Habitat Suitability of the Alternative Proposals at the Bay Scale

The goal in establishing an expanded protected area is to ensure that the Black-faced Spoonbill will continue to have the necessary habitat areas for future migration and wintering needs, while also offering a potential eco-tourism opportunity. By analyzing the proposed alternatives at the Xinghua Bay scale as shown in Figure 4.6-4, it's possible to see that while it may seem that the current reserve area is quite expansive, it does not protect essential fishpond habitat and only includes a small portion of the mudflat areas that will continue to diminish as sea levels rise.

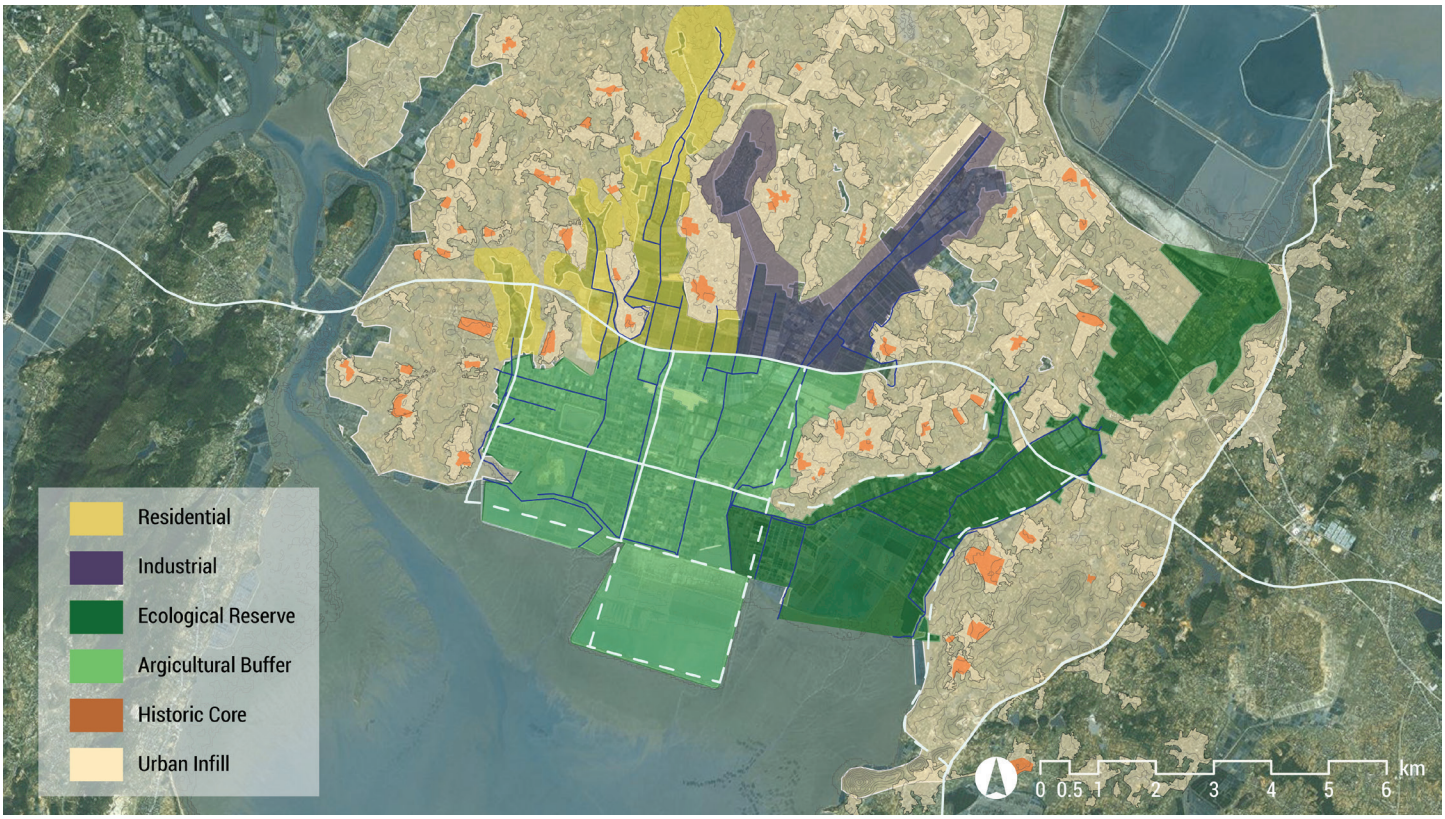


Fig. 4.6-1 *Alternative Proposal A: Urbanized Canals + Inland Industry*

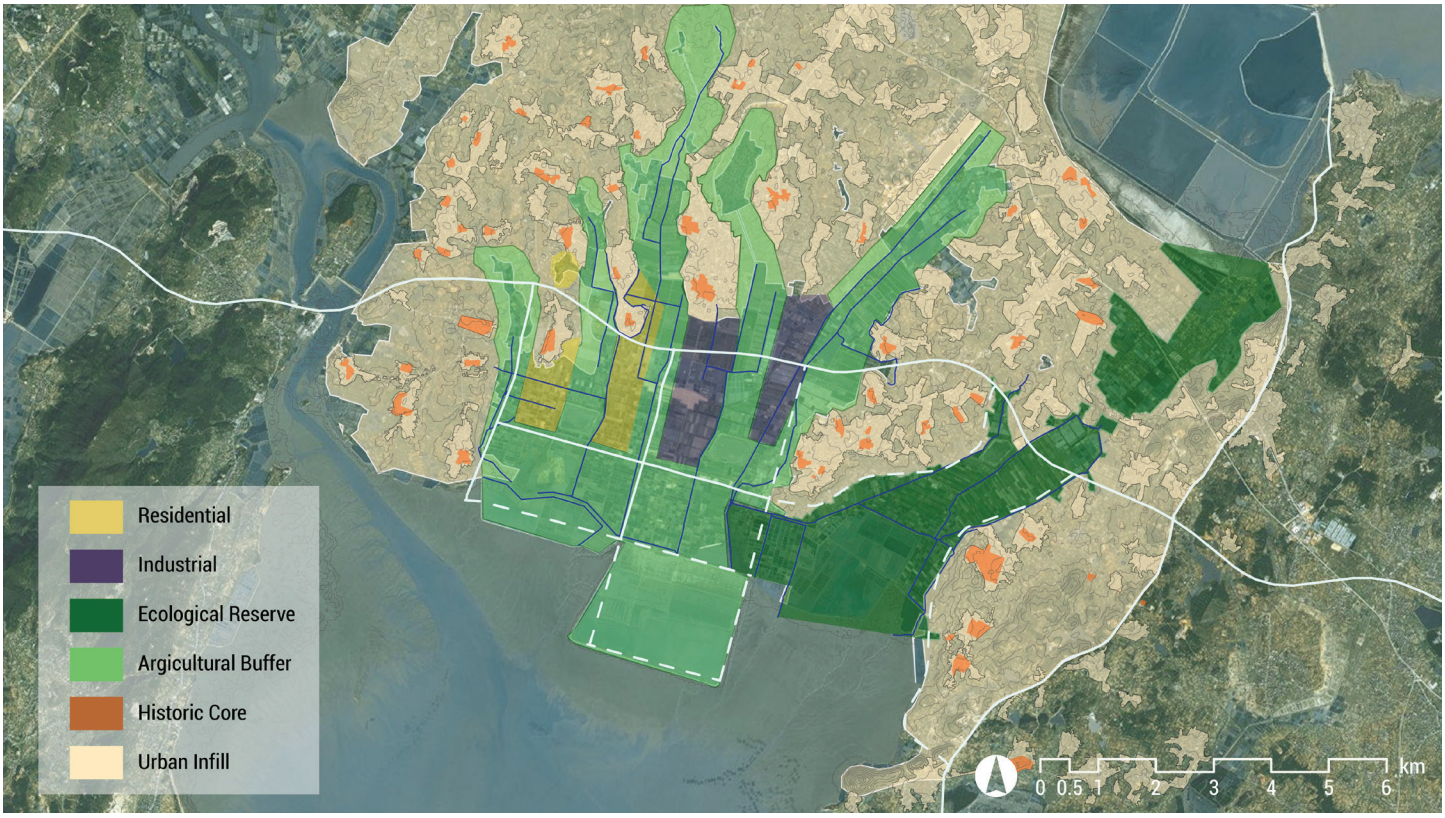


Fig. 4.6-2 *Alternative Proposal B: Vegetated Canals + Urban and Industrial Peninsulas*

Fig. 4.6-3 *Alternative Proposal C: Urban Growth Boundary + Decentralized/Relocated Industry*

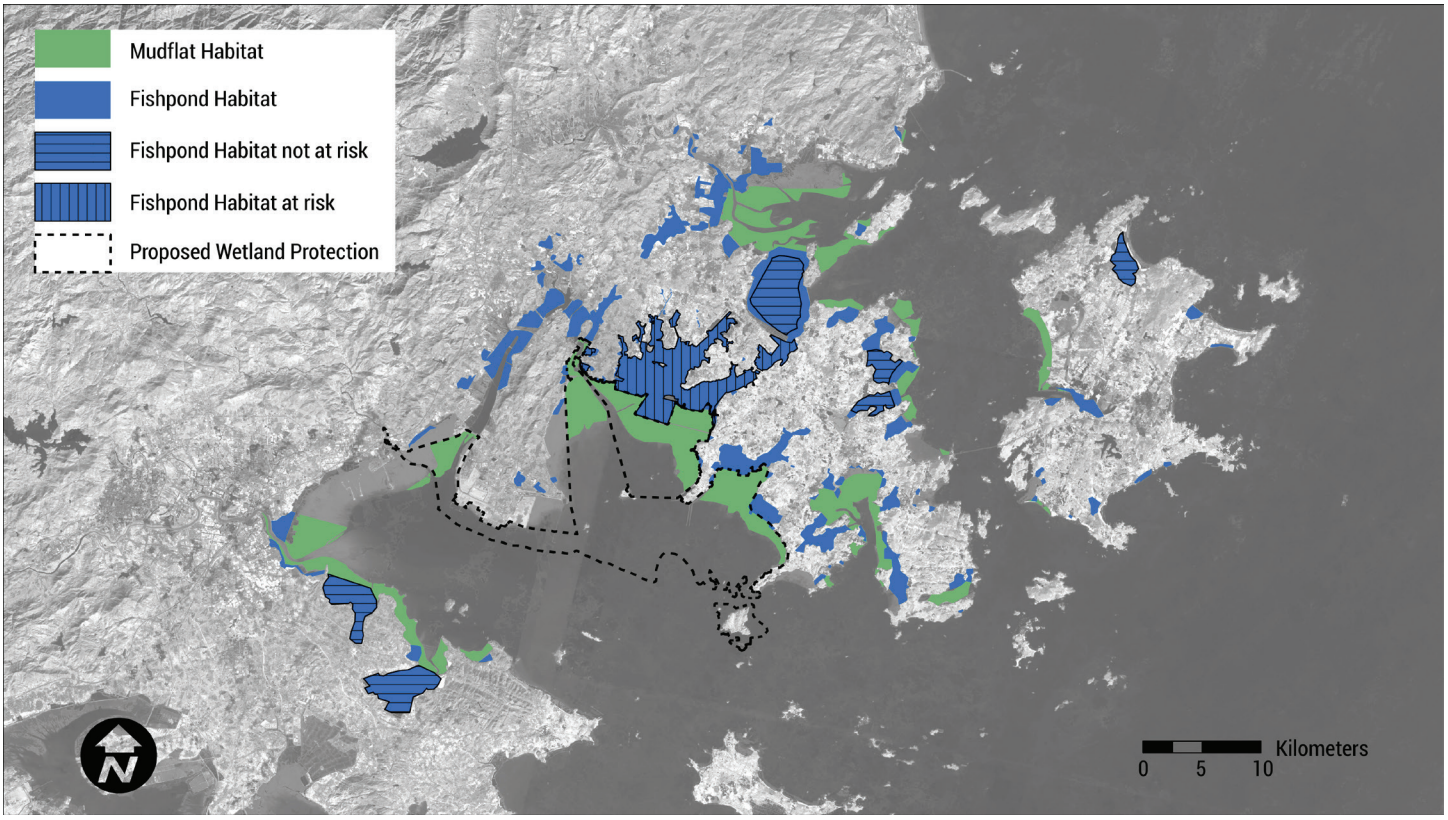


Fig. 4.6-4 *Mudflat and fishpond habitat if Alternative Proposal C (vertical hatch) is adopted, but all other developments proceed. Other nearby fishponds with suitable habitat (horizontal hatch). The previous preserve (dashed outline).*

Fig. 4.6-5 *Wuzhen is a city where tourists enjoy the canals. The town has been dubbed the "Venice of the East." The town relies on tourism to supplement traditional economic systems for the people in the region.*

Fig. 4.6-6 *Located in northwest Taiwan, the architecture in Daxi Old Town is preserved and has become a major tourist destination. The area provides a rustic, rural touring experience, but also has a bustling, walkable shopping district along the historic Daxi Old Street.*

Fig. 4.6-7 *Mai Po Nature Reserve receives 40,000 human visitors annually to its marshes, and 55,000 birds annually. It is located near Hong Kong and is also a Ramsar site.*

Precedent Examples

We collected precedent examples that were relevant to our understanding of the existing ecological conditions and that could match some of the development ambitions of the area in an ecologically sustainable way. We explored real-world examples of successful developments in the region that shared some of the strategies we proposed here. The examples include the preservation of historic canals in the city of Wuzhen in China, the preservation of historic buildings and shopping streets in Daxi Old Town in Taoyuan City, Taiwan, and the Mai Po Nature Reserve in Hong Kong.

Conclusion

Multiple strategies can work together to create a more ecologically healthy and economically viable Xinghua Bay. By combining the four main strategies of ecotourism, agricultural and aquacultural preservation, landscape bio-remediation, and habitat preservation, and by extending them over various scales, the alternative proposals offer a more holistic approach to future development in the area.

The Black-faced Spoonbill is a charismatic species that serves as an indicator of bay health in this region. By making sure that its habitat is secured, the alternative proposals are also ensuring that the region remains ecologically healthy long-term.

The key is to establish policies that focus on long-term sustainable economic growth, by emphasizing the importance of the protection of endangered species habitat, and the preservation of architectural and agricultural traditions, which ultimately support a diverse economy and healthy ecosystem.

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