Classic case — “1313” Progressive Service for Guangdong Marine Ranches Ensures Zero Casualties and Minimal Property Losses During Super Typhoon Yagi (2024)

On September 6, 2024, Super Typhoon Yagi made landfall in Zhanjiang City, Guangdong Province, with a strength of force 17. It had an extreme intensity and caused severe wind disasters. In the central and western parts of Guangdong Province, as well as on the Leizhou Peninsula, the average winds of force 12–15 and gusts of force 15–17 were recorded. The maximum gust of 61.3 m s^{-1} was recorded in Nanshan Town, Xuwen County, the highest in Guangdong Province, surpassing that of Super Typhoon Rammasun. The wind with force 12 or above affected the land and coastal areas of Xuwen for up to 19 hours. The track of the typhoon swept across the gathering areas of marine ranches in Guangdong, causing huge damage. According to incomplete statistics from Guangdong's agricultural authorities, Typhoon Yagi caused total economic losses of 1.105 billion yuan in the fisheries and aquaculture in Guangdong, including about 650 ranch cages damaged (economic losses of 948 million yuan).

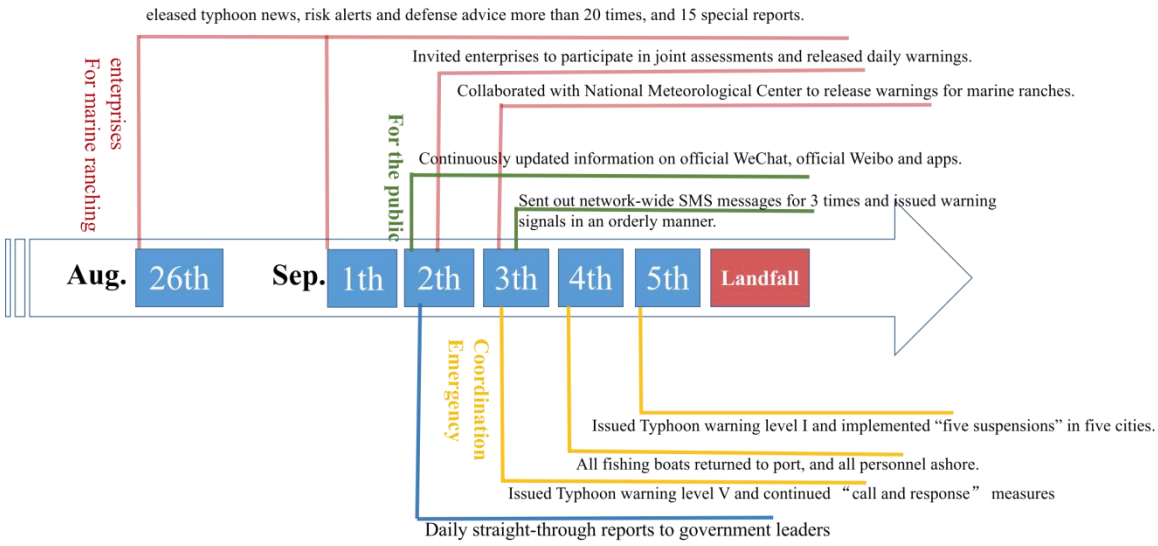

FIG. 1. Service process during Typhoon Yagi.

Risk management:

Through a province-wide comprehensive survey of meteorological disaster risk, Guangdong has mapped out the basic situation of meteorological disaster risk distribution and compiled a classified meteorological disaster zoning. Making full use of the survey results, it has successively carried out climate feasibility demonstrations for marine ranches such as Donghai Island, focusing on meteorological disasters

frequently affecting the region, such as typhoons, lightning, heavy rainfall, severe convection and high temperature. These analyses provide a solid foundation for scientific and reasonable design of projects and further operational management.

Monitoring and forecasting:

Established collaborative fusion observations. A series of drifting buoys have been deployed along the coast of Guangdong, and real-time monitoring cameras have been set up in various ranch areas. Conventional meteorological automatic stations have been built in the marine ranch areas of Zhanjiang City. Among them, the meteorological station located on “Haiwei No.1” recorded the maximum wind of force 15 during Typhoon Yagi, which became a crucial reference for insurance claims. In collaboration with Guangdong Ocean University, joint typhoon impact marine-atmosphere observation experiments were conducted at "Haiwei No. 1," "Haiwei No. 2," and Suixi Caotan. In pilot marine ranch enterprises, equipment such as ocean current meters, wave tide meters and roadbed stations were installed. On the “Penghu” aquaculture platform in Zhuhai City, atmospheric and marine environmental data were collected by installing water quality monitoring equipment in sea bass aquaculture ponds and South American white shrimp ponds. Additionally, eight monitoring stations were established on offshore platforms in Yangjiang City.

Developed land-sea integrated refined grid forecast technology. According to the needs of marine ranches, intelligent forecast products based on numerical weather prediction have been initially developed. Through optimizing refined grid forecasts, a highly adapted forecast product set has been developed for marine ranch meteorological services. A preliminary land-sea integrated refined grid forecasts were built with a 1×1 km resolution, extending 20 km from land to sea, with hourly updates. Regular marine ranch meteorological disaster risk warning trials were conducted, and special forecast reports were issued. Preliminary algorithm models for wind (typhoon) impacts, wind waves, and disaster impact assessment models based on thresholds were constructed. Satellite, Beidou sounding and other remote sensing products were applied to verify satellite-derived wind fields and Beidou sounding profiles. Research on quantitative precipitation estimation and thunderstorm wind intelligence identification has been carried out based on radar data retrieval and deep learning methods. A three-dimensional weather conceptual model for classifying warm-zone rainstorms has been established, and AI-based objective classification technology for warm-zone rainstorms has been developed. Wind-wave forecast models for user applications have been developed, and a model for meteorological and oceanic element indicators serving different marine ranch production scenarios was preliminarily established based on user feedback.

Launched the “1313” progressive service. On August 26th, the Guangdong meteorological departments launched the “1313” progressive service, which orderly provides early risk warning, full-process rolling warning and emergency preparedness through direct reports, direct services, warning and emergency coordination, and authoritative warning information releases. This progressive service provided sufficient advance notice, refined risk prediction and scientific defense suggestions for the government, departments, enterprises and public organizations. Typhoon

impact notifications can be sent to enterprises nearly two weeks in advance, and the high risk of typhoon impact on marine ranches can be notified 6–7 days in advance. On September 2nd, representatives from marine ranches, offshore wind power enterprises, and member units from Guangxi Province, Hainan Province, and other regions were invited to jointly assess the typhoon impacts. Additionally, daily meteorological disaster risk warnings for marine ranches were issued, and relevant information was released through official channels. On September 3rd, for the first time, a joint release of a typhoon disaster risk warning for marine ranches was made through the National Meteorological Center via the national warning release platform. Besides, multiple-channel typhoon impact forecasts and service materials encourage appropriate preparation. The Marine Ranch Meteorological Service Center has sent more than 20 risk reminder messages and 15 service special reports, and jointly issued 3 risk reminders with the Guangdong Meteorological Observatory for the southern marine ranches.

Early warning release:

Issued Rolling risk warnings. On September 2nd, the official Weibo and WeChat accounts of "Guangdong Weather" released updates related to Typhoon Yagi. From September 3rd, a joint effort was made with the Department of Emergency Management of Guangdong Province, the Department of Natural Resources of Guangdong Province, the Department of Culture and Tourism of Guangdong Province, the Department of Agriculture and Rural Affairs of Guangdong Province, and the Guangdong Maritime Safety Administration to issue three rounds of network-wide SMS messages, covering approximately 580 million people across the province. Local authorities began to issue typhoon warning signals and progressively upgraded the levels of warning signals. Across Guangdong, a total of 775 warnings were issued, including typhoon, heavy rain, and thunderstorm and gale warning signals. Among them, there were 10 red typhoon warnings, 21 orange typhoon warnings, 5 red rainstorm warnings and 2 red thunderstorm and gale warnings. The official Weibo accounts of meteorological departments at all levels in Guangdong released a total of 7,313 meteorological service messages for typhoon risk, covering over 14.3 million people. The traffic volume of the refined meteorological service engine through various channels such as Colorful Micro Weather, Class Suspension Bell and Guangdong Provincial Affairs reached 37.1235 million. "Guangdong Weather", the official Weibo account, released a total of 330 posts and hosted 4 topics, amassing 37.05 million views. A single video issued by "Guangdong Weather" on Douyin (TikTok) reached over 500,000 views. The WeChat messages pushed on September 2nd and 3rd had reading volumes of 87,000 and 85,000, respectively. Social media outlets widely disseminated the latest forecasts and popular science knowledge, with 110 articles published in major national and provincial media such as People's Daily Online, China News Service, CCTV, Guangdong TV and Southern Daily. A "chasing typhoon" service was launched and broadcast live side by side with CCTV's comprehensive and news channels, with multiple live broadcasts on "Morning News" and "News Live Room". A total of 4,810 display screens and 8,360 rural loudspeakers in Guangdong released 1,514 pieces of information, and the Emergency Weather

Channel aired 225 times of the promotional videos on weather warning signals.

Disaster preparation and response:

Pilot sectoral emergency coordination of early warning. At 07:30 on September 3rd, the Guangdong Meteorological Service issued a typhoon level-IV warning. At 08:00 on September 5th, the warning was upgraded to level I and lasted for 49 hours. A total of 8,972 decision-making messages were sent to a total of 13.6788 million people. A total of 40 townships received telephone alerts of red heavy rain warnings. A total of 4,026 warning messages were issued to party and government departments at all levels across the province. Three cities—Yangjiang, Maoming, and Zhanjiang—activated the level I wind defense emergency response. Zhanjiang, Maoming, Yangjiang, Jiangmen and Zhuhai implemented the "five suspensions". The meteorological department increased the consultations with relevant sectors such as agriculture, emergency management, marine and water resources, in order to closely monitor key defense areas and high-disaster-risk objects in agriculture and fisheries, and to timely release impact forecasts and risk warning products. The Departments of Agriculture and Rural Affairs organized provincial-wide disaster prevention and mitigation efforts for agriculture and fisheries. From September 3rd to 5th, 11,317 fishing workers (10,084 fishery staff and 1,233 modern marine ranch staff) were successfully evacuated in order from east to west. All 80,270 fishing vessels were safely docked in port.

Defense effectiveness:

Typhoon Yagi was characterized by super-strength and slow-moving speed, and swept through the Liusha Harbor at close range, causing serious losses to related enterprises. These losses include the tilting of the truss-style aquaculture platform "Haiwei No.1", damage to 20% of gravity-based deep-water net cages, and partial tearing of netting in some cages. At 12:00 on September 4, all the operators of marine ranch enterprises, as well as breeding fishing vessels and workboats, successfully returned to the harbor for shelter, and there were no casualties.

Marine ranch enterprises carried out typhoon prevention measures in accordance with typhoon risk warnings, inspecting, reinforcing, and replacing net cage frames, anchoring systems and netting to ensure the stability of the cages during the typhoon, and preventing damage to net cages and escape of aquaculture organisms. For the truss-style aquaculture platforms, efforts were made to lower them as much as possible to reduce the impact of sea surface winds and waves. Ocean farms located slightly farther from the typhoon's center successfully avoided damage to equipment and cultured organisms after implementing appropriate defense measures. Xu Xiangdong, the chairman of Huifu Co., Ltd, said: "Thanks to the scientific monitoring, careful deployment and proper defense of the municipal meteorological department, we had enough time to reinforce the deep-water gravity cages. This allowed us to prepare adequately for disaster defense, and we experienced virtually no losses. This year, we are expecting a bumper harvest of pomfret". Yang Feng, head of the Department of Marine Strategic Planning and Economics of Zhanjiang Ocean and Fisheries Bureau, said: "Although Super Typhoon Yagi caused losses of 750 million yuan to the aquaculture economy of Zhanjiang marine ranches, precise meteorological

monitoring and accurate forecasts and warnings by the Zhanjiang Meteorological Bureau helped to minimize the damage, and no personnel were injured."