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# *Study on the Application of Unmanned Ships in Water Security Management—Taking the Sichuan Section of the Yangtze River as an Example*

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***Keywords:*** Unmanned Ship; Application Prospect; Intelligent Police

***Abstract:*** The application of unmanned boats in the police field is becoming increasingly widespread, involving various police applications such as investigation and evidence collection, emergency rescue, target search, and large-scale surveillance patrols. At the same time, the coordinated operations between unmanned boats and other intelligent unmanned devices like drones can effectively combat all kinds of water-related criminal activities, strongly maintaining the overall stability of political security in water areas, and fully serving to support the high-quality development of the Yangtze River Economic Belt. Currently, the Sichuan section of the Yangtze River faces major challenges including frequent water-related incidents, increasing security tasks year by year, and frequent changes in public security elements. Unmanned boats, with their ease of operation, long endurance, and flexible mobility, can significantly enhance police presence in the water area management of the Sichuan section of the Yangtze River, strengthen emergency response and rescue efforts, and improve smart policing construction, fully leveraging the advantages of unmanned boat applications in water areas.

## 1. Introduction

As the reform and opening-up policy advances, the international situation has become increasingly complex, and the construction of China's development path has entered a new era. The leadership collective centered around the General Secretary has formed a comprehensive state security concept. This comprehensive state security concept is a significant strategic idea proposed by the central leadership with the General Secretary at its core, based on China's actual security conditions and an accurate understanding of global security trends. It is an essential guideline that must be adhered to in the long term for maintaining state security and social stability in the new era. It also vividly demonstrates our commitment to serving the people wholeheartedly, marking that our capabilities in conducting state security work have become increasingly mature. Guided by the General Secretary's ecological civilization thought, public security organs' efforts to safeguard state security are the primary task for social harmony, stability, and long-term peace. In the face of numerous challenges and difficulties in maintaining public order along the Sichuan section of the Yangtze River, unmanned boats, as a new type of police equipment, significantly reduce manpower and equipment costs. Leveraging their inherent performance advantages, they greatly enhance

patrol efficiency and safety control effectiveness, providing strong support for promoting high-quality development in the Yangtze River Economic Belt and maintaining state security and stability.

## 2. Basic concepts and characteristics of unmanned ships

Unmanned ship (Unmanned Surface Vessel), also known as unmanned ship (USV), is a kind of fully automatic surface robot that can be remotely controlled, has autonomous planning and navigation ability, and can navigate on the water surface according to preset tasks with the help of accurate satellite positioning and its own sensing [1].

Currently, there are mainly three types of unmanned vessels: remotely operated, semi-autonomous, and fully autonomous. Remotely operated unmanned vessels are controlled from a distance and are commonly used for simple rescue operations and short-distance patrols. They have a length of about 2 meters and are classified as small unmanned vessels. Semi-autonomous unmanned vessels can navigate and perform tasks according to preset algorithms and routes. Their length ranges from 5 to 7 meters, making them medium-sized unmanned vessels. They are often used for law enforcement patrols, reconnaissance, and underwater monitoring. Fully autonomous unmanned vessels are entirely controlled by machine language and are typically used for communication relaying, logistics support, and resupplying [2]. It is worth noting that fully autonomous vessels represent the primary direction of future development in unmanned vessel technology. The advancement and development of unmanned vessels will increasingly meet the typical needs of intelligent policing, such as integrated intelligence, high sharing, and deep application, and will also drive the steady progress of social security prevention and control systems.

### 2.1 Easy to control

The unmanned ship relies on artificial intelligence technology to remotely control, and can realize autonomous navigation without manned control. It can run its own algorithm through preset programs, perform various tasks and adapt to different operating systems according to different models of unmanned ships. Especially for small unmanned ships, it only needs to operate remotely with a simple operator, which is very convenient.

### 2.2 Long battery life

Unmanned vessels use power management systems to monitor the status of their power sources in real time and promptly replenish electrical energy through solar technology or wired transmission. When fully charged, unmanned vessels can complete 5-10 hours of navigation with the assistance of solar power. This capability enables long-distance and extended-duration operations, especially in practical water security management tasks such as patrols, surveillance, evidence collection, target search, and major event security. The extended operational time of unmanned vessels provides strong technical support for public security operations, fully demonstrating their application value.

### 2.3 Flexible operation

Unmanned vessels are characterized by their small size and mobility. By following preset navigation routes and mission tasks, they can autonomously navigate to perform missions or be remotely controlled via a remote system for real-time navigation and task execution. In China, the

most advanced unmanned vessels can achieve a maximum speed of 40 knots, with hull lengths ranging from 1 to 7.5 meters, demonstrating strong maneuverability and autonomy.

### 2.4 Diversified modules can be carried

Unmanned ships have the advantage of modular design, capable of carrying various mission modules such as water patrols, reconnaissance and evidence collection, public announcements, video surveillance, and data collection. They can switch module options in real-time according to operational needs, completing multiple tasks in a single voyage. Additionally, due to their highly compatible system, they can carry modules for receiving and transmitting data different from that of intelligent devices, converting data of different formats, and enabling real-time communication between both parties, thus achieving coordinated operations.

## 3. Main challenges of public security control in Sichuan section of the Yangtze River

### 3.1 There are many accidents involving water, and the pressure of maintaining stability is great

In recent years, school bullying has become increasingly common in primary and secondary schools. Adolescents have weaker stress resistance and lack proper guidance, leading to frequent incidents of jumping into rivers or attempting suicide. Meanwhile, due to the impact of the pandemic, the overall economic environment remains sluggish, and employment pressure and emotional conflicts have become significant challenges for special groups. Many people have resorted to jumping into rivers or attempting suicide out of momentary emotional agitation. On the other hand, as people's interests and hobbies grow richer, many enjoy swimming with their families by the river. Some swimming enthusiasts are particularly fond of wild swimming and rafting on the Yangtze River. Accidents such as drowning can easily lead to concentrated disturbances and demands for compensation, which may further escalate into issues involving unidentified bodies, often drawing attention to the police.

### 3.2 The security tasks in waters are increasing year by year, and the pressure of prevention and control is great

As the strategic importance of the Yangtze River Basin grows, major events and security missions often take place in key waters and locations along the river, bringing positive influence to local governments while also increasing the pressure of prevention and control during these missions. With continuous technological advancements and the evolving times, criminals' methods are constantly emerging, presenting new challenges to units within jurisdictions and public security personnel. However, due to relatively backward construction of key water safety prevention sites, insufficient investment in safety facilities and equipment, inadequate public education and awareness, and insufficient emphasis on these issues, key oil pipelines, ports, ferry terminals, and hazardous chemical vessels are prone to become targets for terrorist attacks. This makes it difficult to fully meet the changing demands of public security risk management, hindering the continuous improvement of public security prevention work. On the other hand, some units have poor interconnectivity and compatibility among internal technical preventive measures, leading to high daily maintenance and usage costs, which also have a negative impact on security, protection, and counter-terrorism efforts.

### 3.3 Water security problems are prominent and the pressure of remediation is great

In recent years, thanks to the Yangtze River protection efforts and the "ten-year fishing ban" in the Yangtze River, the overall public security along the Sichuan section of the Yangtze River has continued to improve steadily. Both water-related incidents and crime rates have shown a steady downward trend. However, criminal activities cannot be overlooked. Some lawbreakers, driven by profit, still choose to take risks, especially in cases of illegal fishing and sand mining, which continue to occur from time to time. At the same time, some people seek thrills, leading to an increasing number of participants in water activities such as rafting, rowing, and surfing, bringing about increasingly prominent public security and safety issues. This poses challenges and impacts on water area public security management. Although the police have done a lot of work, due to jurisdictional limitations, they have no authority to handle these issues. When citizens report incidents, they can only persuade them to leave.

### 3.4 The elements of water security change frequently, and the management is difficult

As the Yangtze River's illegal docks, sand and gravel stockpiles are being rectified, along with environmental pollution control, the relocation, transfer, and dismantling of bulk cargo terminals and water facilities have led to a decline in dock operations. This has resulted in a large number of vessels retaining their crew members, leading to a sharp reduction in the workforce and increased turnover among seafarers. The upstream logistics channels of the Yangtze River have changed, with local vessels frequently sailing outside their home waters, making it difficult to maintain control. The increase in ship transactions and frequent changes in ownership of shipping companies have also made it more challenging to fully understand the situation regarding ships and personnel. To support the high-quality development of the Yangtze River Economic Belt, local governments are actively promoting water engineering projects, which bring economic benefits but also pose security risks. Most contractors and construction teams are cross-provincial migrants, leading to high mobility. With the growing number of water projects, water facilities, and water-related occupations, the dynamics of water area governance elements are rapidly evolving under new requirements. Although self-built surveillance cameras along the river have expanded the scope of monitoring, they still fall short of the precision required for data collection.

### 3.5 Weak police infrastructure and low level of informatization

The water conditions of the Sichuan section of the Yangtze River are complex, with narrow and shallow channels that are prone to danger. There are many tributary rivers involved, and there is a lack of front-end sensing equipment along the river, which is mostly deployed on land. The key areas and sections along the river have harsh environments, making it difficult to set up video surveillance, leading to some regions being unmonitored. The main channel of the Sichuan River stretches for 220.8 kilometers, and the police force allocation cannot meet daily policing needs. In routine water policing work, issues such as long patrol lines, insufficient manpower, technical deficiencies, and outdated equipment often arise. Traditional boats have limitations in speed, turning radius, and flexibility, posing a severe challenge to water area security management.

### 3.6 The expression of demands is networked, and it is difficult to control the public opinion position

The Internet has become a significant tool for hostile forces and elements to infiltrate our country, with its impact and harm becoming increasingly evident. They view the web as an "unsealable,

unstoppable, and unbreakable" channel against China. Using various means such as spreading rumors, fabricating stories, and taking things out of context, they maliciously attack our socialist path, political system, and central leadership, attempting to create negative effects on us in the international community, aiming to disrupt the people, society. The Sichuan section of the Yangtze River, serving as the first gateway for southwestern regions to reach the sea and exit the country, frequently sees illegal dissemination of religious beliefs by residents along the river and vessels involved in water activities. Unstable public opinions related to military affairs, terrorism, education, and other issues can easily spread through social media when enterprises, institutions, and individuals involved in water-related activities express their concerns, gather, or engage in activities.

## 4. Advantages of unmanned ships in the public security management of the Sichuan section of the Yangtze River

The waters of the Sichuan section of the Yangtze River belong to mountainous rivers, with winding and narrow channels, numerous shoals, and swift currents, leading to chaotic water conditions. If traditional conventional police activities are adopted, they often face issues such as low efficiency and poor accuracy. It is imperative to enhance water management through artificial intelligence technology. The author believes that unmanned boats, as intelligent water equipment, can achieve comprehensive patrols, multi-terminal coordination, and smart reconnaissance in the security control of the Sichuan section of the Yangtze River, achieving goals such as cost reduction, rapid response, and timely rescue. This can effectively safeguard political, ecological, and public safety in the water area.

### 4.1 More effective emergency rescue

The purpose of water emergency rescue is to ensure that sudden incidents on the water can be handled as quickly and efficiently as possible, increasing the likelihood of successful rescue. Due to their high speed and compact hulls, unmanned boats can adapt well to rivers with varying currents. They can respond swiftly to emergencies such as drowning or fuel leaks, effectively improving response efficiency and reducing personal safety risks. These vessels are suitable for emergency rescue in the Sichuan River area and serve as a valuable supplement to traditional water patrols. For example, the M75 "Guardian" Yunzhou intelligent professional search and rescue boat, the "Dolphin 1" small surface life-saving robot, and the "Water Fly" mobile rescue stretcher [3], these intelligent search and rescue equipment built around the field of emergency rescue have been widely applied in many places.

### 4.2 The police presence rate has increased significantly

Unmanned boats, as a powerful supplement to police equipment, can reduce tasks such as boat scheduling, rental, and personnel maintenance. They can quickly reach specific waters that traditional boats cannot access, allowing for the initial handling of sudden incidents in these areas, effectively addressing the shortage of police forces. For example, micro-unmanned boats, which are remotely operated, can transmit high-definition video footage in real-time from the scene. Equipped with optical devices, warning lights, and communication devices, they can remotely warn or alert individuals who violate regulations, or drive them away when necessary. These boats are suitable for simple, short-distance missions and can be used in conjunction with manned traditional boats, drones, and police vehicles for patrols, achieving comprehensive coverage of water, land, and air patrols. This forms a strong deterrent against criminal activities involving rivers.

### 4.3 More accurate task execution

The special nature of water patrol and security tasks determines the complexity and intricacy of related work. Facing vast waters, if full coverage is not achieved, any accident could have extremely serious consequences. As an efficient and mobile professional device, unmanned boats have frequently appeared at large summits, forums, exhibitions, and festival celebrations both domestically and internationally, assisting in water area public security management. For example, during the 2021 Zhuhai Airshow, the Yunzhou L30 "Outlook" patrol boat helped the Zhuhai Public Security Bureau carry out water security tasks, conducting 24-hour uninterrupted patrols in the Jinwan waters near Zhuhai Airport. This eliminated water safety hazards, prevented various types of water accidents, reduced police force deployment, and effectively improved the efficiency of water patrol and security work.

### 4.4 More effective crackdown and treatment

Typically, the most crucial aspect of effectively combating criminal activities involving rivers is securing evidence at the crime scene. Without relevant physical evidence from the crime, subsequent interrogations can be challenging. When carrying out tasks such as combating illegal fishing, mining, and pollution, unmanned boats can accurately patrol and track suspects, transmitting and recording video images and other information in real-time. This significantly reduces the difficulty of comprehensive surveillance and investigation. Medium to large unmanned boats are capable of autonomous navigation, automatic obstacle avoidance, self-defense, fixed-point monitoring, and round-the-clock operations, making them suitable for covert investigations and patrol control among other missions.[4]

### 4.5 Public security management has been strengthened

Unmanned boats leverage their flexibility and long endurance to set key water routes based on the actual [5] of the water area. They dynamically update and cover security elements in key waters, critical areas, and important locations, maintaining a dynamic grasp of basic water data. For example, when an unmanned boat passes under a Yangtze River bridge under construction, it can provide real-time positioning of the water project, take live photos (to monitor construction progress), and collect basic information about personnel involved in the construction, forming a systematic and dynamic management system for water security elements. On the other hand, the diverse module systems carried by unmanned boats can secretly gather intelligence during routine patrols. Through cloud transmission and analysis, they help analysts understand the ideological trends of key groups and individuals, assisting in early warning and analysis.

### 4.6 Smart police reform is further deepened

Currently, with the development of society, people's living standards are gradually improving. To better adapt to the new requirements of public security science and technology, and to meet the needs of police work in the new era, it is essential to effectively maintain water safety and stability. Leveraging technology for police force and information for combat effectiveness has become a major trend in police reform. Unmanned boats, as advanced specialized equipment for water areas, not only have specific active sensing and detection functions, providing strong support for intelligence analysis and judgment [6], but also can be equipped with police lights, sirens, and loudspeakers—key components of police work—to assist officers in their duties. Additionally, they can carry customized equipment such as automated retrieval systems, water sample extraction

devices, and life-saving device deployment tools, meeting the needs of handling unidentified bodies, investigation and evidence collection, and emergency rescue tasks in daily police work.

## 5. Conclusion

Water area public security management is complex, dynamic, and dangerous. It requires targeted measures, addressing specific targets, waters, areas, periods, and characteristics from multiple angles to tackle issues effectively. If traditional conventional methods are used, they often face problems such as low efficiency and low precision. Unmanned boats, as surface robots that can autonomously navigate and perform one or more tasks without human control, will become an indispensable part of water area public security prevention in the future.

## References

*[1] Peng Qiwei, Wen Linshen, Qian Jinlin. Analysis on the Application of Unmanned Boat Patrol in River Chief System [J]. Journal of Zhejiang University of Water Resources and Electric Power, 2022,34(03):4-8+78.*
*[2] Yu Lianlian, Yin Qiliang. Analysis of the Development of Unmanned Ship Patent in China [J]. Chinese Invention and Patent, 2020,17 (S1):64-69+93.*
*[3] Luo Minghui. Application and Prospect of Unmanned Ships in the Market of Water Safety Prevention and Control [J]. China Security, 2022, (08):50-53.*
*[4] Zhang Jian. Research on the Application of Unmanned Ship Technology for Police [J]. Legal Expo, 2017, (34):237-238.*
*[5] Chen Jingtong. Unmanned boats in the application of "smart water management" [J]. Modern Information Technology, 2020,4 (15):137-139.*
*[6] Chang Jian, Li Li, Jin Changwei, Luo Congcong. Research on Police Emergency Response Robots and Key Technologies [J]. China Security Prevention Technology and Application, 2018, (05):64-68.*