Electronic Monitoring on Transshipment Vessels Operating in the Western and Central Pacific Ocean Longline Tuna Fishery

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Executive Summary

To better understand the role that electronic monitoring (EM) can play in increasing transparency of transshipment activities, and as part of the Pacific Ocean Tuna Longline Fishery Improvement Project (FIP)[1], Tunago Fishing Company, Key Traceability, the Thai Union Group, and the Nature Conservancy (TNC) partnered to install and operate on June 4, 2018, the first ever EM system onboard a frozen longline tuna transshipment vessel, the F/V *Shin Ho Chun 102* (SHC102), owned and operated by Tunago Shipping Company and licensed and flagged by Panama.

This report summarizes initial results, lessons learned including vessel owner feedback, and potential next steps on the path towards scaling EM on transshipment vessels as an accepted and authorized Monitoring, Control, and Surveillance (MCS) tool to combat of Illegal, Unreported, and Unregulated (IUU) fishing activities.

This project has enabled a first of its kind look into 24 hours a day/7 days a week automated transshipment monitoring without a vessel returning to port for extended periods of time. As of June 20, 2020, the EM system onboard the SHC102 has been operational for 729 days since installation with a 100% fully operational (all cameras recording) status for 696 of those days and was successful in performing many of the monitoring and compliance functions typically done by a human observer.

In general, the EM system on the SHC102 was effective at capturing an accurate record, including name, date, Latitude/Longitude position, International Maritime Organization (IMO) number, and call sign, of all the longline vessels transshipping tuna and non-tuna product and receiving bait and other re-provisioning supplies. The camera angles and high-definition resolution provided EM analysts clear evidence of all transshipment activities, but they were not able to provide species-level identifications primarily due to condensation (white frost) that forms on the surface of the fish. The EM analysts provided estimates of total catch transferred based on nominal counting of net loads of fish being winched onboard and applying a weight proxy (qualitatively estimating 1 net=1mt of product) to the total count. This rudimentary weight estimate protocol resulted in an approximately 30% underestimate of the transshipped catch compared to the cannery receipts for the transshipment under analysis (F/V *Tunago 51*) by the Satlink affiliate company Digital Observer Services (DOS)[2].

In order to gather more accurate weight data from the individual transshipments, the use of an onboard motion-compensated scale should be tested with the subsequent EM derived estimates compared with associated estimates from the onboard observer, the captain's logbook, the engineer's receipts, and the cannery or fish processor final size and species weight invoices. A Forum Fisheries Agency (FFA) consultancy was recently undertaken on the topic of design and use of motion-compensated scales in the

1 https://fisheryprogress.org/fip-profile/pacific-tuna-longline
2 http://digitalobserver.org/en/

WCPO PS transshipment operations[3]. The authors have offered to share the equipment from that study and their expertise in helping to design comparative trials.

The Pacific Community (SPC) Oceanic Fisheries Program staff noted during their preliminary review of this report that monitoring the actual number of fish being transshipped by vessel would be a key metric to record given the utility of using that information for logbook validation and associated port sampling efforts. Although a numerical count was not conducted as part of this phase 1 trial, DOS staff have confirmed that the EM video files provide enough resolution and angle coverage to provide a numerical count as suggested.

If funding and interests align, it is envisioned that a phase 2 EM Project would entail the following core objectives (additional objectives provided in Potential Next Steps, page 11): 1) continue funding the operation of the SHC102 EM system (Thai Union currently covering the costs) to ensure that all vessels that are transshipping are authorized to do so by Tunago and are in good standing on the FFA Vessel Register; 2) include an estimate of the number of fish being loaded and transshipped by vessel, along with a crew-sampling protocol for estimating species composition, as part of the data deliverables; 3) install an EM system on a second Tunago transshipment carrier vessel with the addition of a motion-compensated scale to conduct the comparative research trial noted above (or alternatively, install the scale on the SHC102); and 4) compose a draft set of EM Transshipment Performance and Data Standards, in collaboration with relevant stakeholders, to help guide the adoption and scaling up of EM on other transshipment carrier vessels operating in the WCPO. FFA and SPC are currently discussing a dedicated meeting of the regional Data Coordinating Committee (DCC) to consider what data could be collected by EM LL transshipment monitoring activities with a view to establishing minimum data fields. In addition, a PEW funded report proposing a set of potential data standards from an on-board observer perspective was completed in January 2020[4].

In a recent call with the Project partners, TNC has agreed to draft a Statement of Work to help guide a decision on undertaking a phase 2 research trial. The SOW will lay out phase 2 goals and objectives based in part from lessons learned during phase 1 and include potential co-funding aspects and a projected timeline to complete the work.

[3] An investigation of options for the use of Hook Type Crane Scales for the standardization of transshipment monitoring in the WCPO Purse Seine fishery. Francisco Blaha, FFA funded, November 2019.

[4] Brogan, Dierdre. January 2020. Standardised Monitoring Procedures for Longline Transhipments in the WCPFC. PEW Charitable Trust.

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Introduction

Since the introduction roughly twenty years ago of the first electronic monitoring (EM) systems onboard fishing vessels, there has been a significant increase in its use and acceptance as an independent, verifiable, and cost-effective tool[5]. TNC and a host of collaborative partners have been instrumental in helping to drive the use, evolution, and acceptance of EM systems in the Western Central Pacific Ocean (WCPO) longline tuna fisheries and other emerging global geographies[6].

One major contributor to the high rates of IUU in tuna longline fisheries is transshipment at sea. Published estimates of lost revenue to the Pacific Island countries due to IUU exceeds USD $500 million[7]. Legal transshipments are generally defined as the authorized transfer of fish from a fishing vessel to a carrier vessel whether in port, at sea in areas under national jurisdiction, or on the high seas. Transshipments from fishing vessel to fishing vessel may be authorized, under specific circumstances. Unauthorized transshipment in jurisdictional EEZs or on the high seas enables illegal operators to avoid port controls and to maximize profits. It creates inaccuracies about the actual number of transshipments taking place and the overall catch being transferred and, as it results in vessels remaining at sea for longer periods, it can result in labor and human rights violations. Illegal transshipment creates major gaps in transparency and impacts for not only fishery stocks but livelihoods.

The challenges due to COVID-19, such as the temporary suspension of observer placements on tuna fishing and transshipment vessels, have exposed the risks to achieving effective MCS and fulfilling key data collection requirements.

Project Materials and Methods

The Tunago Fishing Company owns and operates seven ultra-low temperature tuna longline vessels flagged and licensed by Vanuatu and the Tunago Shipping Company owns two frozen tuna transshipment carrier vessels flagged by Panama. The SHC102 was selected by Tunago owner Shih-Chieh (Stephen) Lo to carry the EM system which was manufactured and installed by the Spanish-based EM Service Provider Satlink LLC. The EM system consists of a 4-camera Seatube Lite unit set to record continuously (24 hours/7 days a week) all relevant transshipment activities (see camera views in Figure 1). The raw video files record at 24 frames per second and the associated meta-data files containing vessel name, date, and position information are time-stamped/watermarked onto the video frames received via an independent VMS antenna. The files are stored onto two (main and backup) 4-terabyte capacity solid state hard drives (SSHD) linked to a Network Video Recorder box located in the wheelhouse. The use of SSHDs for this project was considerably more expensive than Western Digital mechanical hard drives used in previous EM projects but given the poor performance of the mechanical hard drives in several projects and the long durations between port visits, it was viewed as a necessary upgrade to minimize any data loss due to hard drive crash or corruption. The SHC102 EM system included a high-aspect near 360-degree camera to capture transshipment activities from various angles (seen in Figure 2).

[5] https://onlinelibrary.wiley.com/doi/full/10.1111/faf.12425

[6] Catalyzing the Growth of Electronic Monitoring in Fisheries, Building Greater Transparency and Accountability at Sea - Opportunities, Barriers, and Recommendations for Scaling the Technology. September 2018. California Environmental Associates & the Nature Conservancy.

[7] https://www.ffa.int/files/FFA%20Quantifying%20IUU%20Report%20-%20Final.pdf

One of the key objectives of the project was to build capacity and develop infrastructure for in-country review of the transshipment activity. The contractual agreement required hard drives from the SHC102 to be copied and sent to the Digital Observer Services (DOS) Data Review Center (DRC) in Bilbao and a secondary copy to the Vanuatu Fisheries Department DRC in Port Vila, Vanuatu.

On February 19, 2019, DOS conducted a comprehensive five-day EM Analysts data review, analysis and interpretation training at Port Vila, Vanuatu, using the DOS reviewing software platform (Satlink View Manager (SVM)). At the conclusion of the training, a certification exam was given to all participants to assess and confirm minimum qualification levels. The DOS trainer/technician remained on-site at the Port Vila DRC after the training to help set up the SVM workstations and provide mentoring and support in use of the SVM software. As a result of the training, four Vanuatu Fisheries Department staff received SVM EM Analyst certificates needed to competently review images and annotate data using the DOS system.

The contract included a provision for DOS to conduct a remote audit every 6 months after training concluded to assess the performance of the EM Analysts and to provide refresher training on any new DOS system capabilities and upgrades.

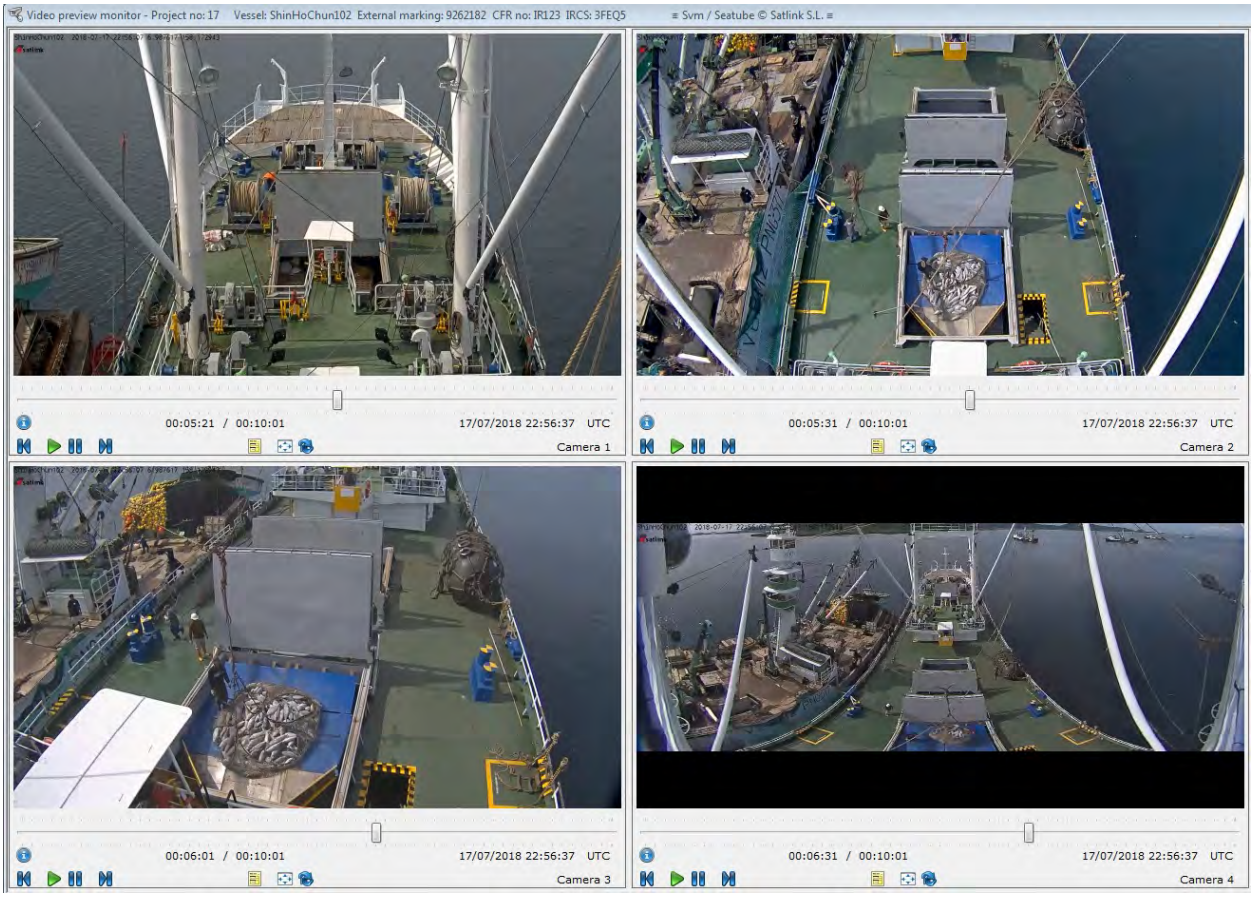

Figure 1. Views of the 4-camera Satlink Seatube Lite EM System installed on the SHC102.

Figure 2. Image of a Tunago company tuna longline vessel transshipping to the SHC102

Results and Discussion

The SHC102's EM system has provided independent, tamper-evident data on the movement of the transshipment vessel and a verifiable record of every longline tuna transshipment that has taken place including the name of the vessel, call sign and other identifying vessel information (see Appendix).

The EM system onboard the SHC102 has been operational to date for 729 days since installation with a 100% fully operational status (all cameras recording) for 696 of those days. The 33 days of partial operational status comprised of a single camera issue that was resolved when the vessel returned to port and did not impact the operability of the remaining system cameras. The system has had no discernable issues with the solid-state hard drives, nor has it experienced any loss of data.

Of the 729 days since install, 408 days were spent transshipping or transiting and 321 days were spent in port offloading and re-provisioning. A total of 25 port visits had been completed with an average port visit of 13 days (range 1-60 days, the latter Covid-19 influenced). The longest continuous 'at sea' time was 65 days from November 25, 2018 to January 28, 2019.

To date, DOS has received five hard drives from SHC102 (see Table 2). Video footage recorded on these hard drives allowed the DOS Bilbao DRC to collect data on the names and vessel register numbers for longline vessels transshipping at-sea to the SHC102.

Date Received (D/M/Y)	Carrier Ship	First date recorded (D/M/Y)	Last date recorded (D/M/Y)	Cloned for Vanuatu DRC
14/09/2018	SHC 102	04/06/2018	30/08/2018	Yes
08/01/2019	SHC 102	30/08/2018	30/10/2018	Yes
09/04/2019	SHC 102	30/10/2018	04/03/2019	Yes
30/10/2019	SHC 102	01/08/2019	16/10/2019	No[8]
02/06/2020	SHC 102	16/10/2019	12/05/2020	No

Table 2. Status of SHC102 hard drives received at DOS Bilbao DRC.

Estimates were made of transshipment deliveries/events that occurred during two distinct time periods, the first analysis during a 65-day time span from November 25, 2018, when the ship departed Bangkok, to January 29, 2019[9], when the ship called to port in Suva, Fiji.

A total of 30 vessel encounters were detected. The transshipment operations during this period averaged 1.5 boats per event with a maximum of 4 different boats offloading during a single transshipment event. All the vessels documented to have transshipped to the SHC102 during this period were in good standing on the FFA Vessel Register and received advanced permission to transship from Tunago Fishing Company (see Appendix).

The second analysis was during a 48-day period from September 2, 2018 to October 30, 2018 with the vessel departing from and arriving to Kaohsiung, Chinese Taipei. The analysis included review of a 2-day transshipment time span from October 5, 2018 to October 6, 2018, which lasted approximately 30 hours during which time the F/V Tunago 51 conducted 162 exchanges offloading fish to, and picked up supplies from, the SHC102.

As with the first analysis, 30 vessel encounters were noted and all the vessels that transshipped were in good standing on the FFA Vessel Register and had received Tunago authorization to transship (vessel name and details available upon request). DOS analyzed EM footage from the transshipments of the F/V Tunago 51 estimating that each transshipment net weighed approximately 1 metric ton (mt). This led to DOS' total transshipment weight estimate of 103mt which was lower than the 131mt (including 108mt of albacore, 3mt of skipjack) reported by the Thailand cannery receiving the transshipped product. A

[8] The Project partners made the decision to suspend sending hard drives to the Port Vila DRC given the lack of progress and inactivity.

[9] The hard drives for both events were removed by Satlink's agent YDG while the ship was in port at Kaohsiung, Chinese Taipei.

total of 8.5mt of sharks and 11mt of other non-tuna product were sold and shipped to a trader in Kaohsiung, Chinese Taipei (Tunago owner Stephen Lo, pers.comm.).

The DOS EM analyst noted that the majority of fish offloaded were medium to large sized tuna (most likely albacore) with a small number of billfish in the mix (noted by trunk length). The EM analyst was unable, however, to identify specific tuna species given the white frost covering that envelops the fish when pulled from the ULT wells and exposed to warmer ambient air. The analysis noted approximately 59 non-fish transfer events taking place between the SHC 102 and Tunago 51. These events included 45 bait containers holding ~37mt of frozen bait, 12 sealed wooden crates, and 2 large sacks containing bags of rice (S. Lo, pers.comm.).

As of the date of this report, there have been no reports from the Port Vila DRC on progress made in analyzing the cloned hard drives received from DOS. Communications from the Port Vila DRC have been infrequent and Project partners are continuing to work to understand what data has been annotated to date at the Port Vila DRC and how that data compares to DOS' analysis.

Feedback from the Vessel Owner

Tunago Fishing and Shipping company owner, Mr. Stephen Lo, was asked to share his views on the Project and challenges faced to date. He stated that the main issues are: 1) taking care of another electrical system onboard as an additional element he and his captain and engineer have to deal with; 2) arranging and participating in the communications and logistics for replacing the hard drives; and 3) making port of call destination decisions based in part on need for EM system maintenance. He also felt that with current policy of 100% human observers mandatory on all WCPO tuna longline transhipment vessels, having an EM system onboard is redundant. He hopes that WCPFC would authorize using either human observer or an EM system to meet the monitoring mandates so he and other vessel owners can pick the most cost effective and safe option. He felt that many owners would choose an EM system monitoring option if they have the choice given recent COVID-19 related events and concerns with the health, safety and liability of hosting an observer on the vessel for extended periods of time.

Lessons Learned

The EM system installed on the SHC102 proved to be durable and has the capacity to record high resolution video and associated meta-data 24/7 for extended periods of time without any significant maintenance or remote servicing needs. The camera array and placement were adequate to record the vessel names and identifying information and to cover the transshipment operations both day and night. The EM system provided accurate watermarked positions and dates/times on all video frames using an integrated and independent GPS/VMS system.

The condensation that forms on the frozen tuna during transfer between vessel wells made it difficult to distinguish between species so estimating the amount and species of catch transshipped was not possible. This led to inaccurate overall weight estimates when compared to offloading estimates at the final destination.

The ability to adequately handle remote servicing diagnostics and repairs was hampered by the language barrier between the Spanish Satlink/DOS technicians and the Chinese captain and engineer. Additional attention to dock side training in the operation of the installed EM system, including anticipated at-sea maintenance/repairs, would help improve this dynamic.

In regard to the project objective of building capacity and developing infrastructure with the Vanuatu Fisheries Department and the Port Vila DRC, the in-country logistical support was insufficient to overcome the challenges encountered and it was decided to suspend that aspect of the Project until adequate support is put in place.

Potential Next Steps

Thai Union is now covering the costs of operating the EM system on the SHC102, and any analytical work done by DOS, per agreement after the initial contract period and funding ended. It is anticipated that Thai Union will continue this financial support into the near future given the objectives of the Project to support transparency and verifiable on-the-water progress as part of the ongoing Pacific Ocean Tuna Longline FIP.

Per request from Project partners, Tom Evans of Key Traceability has discussed with Tunago owner Stephen Lo if he would be interested in adding an EM system to the second of his two transshipment carrier vessels. Mr. Lo is open to further discussions on adding a second EM system but would want to see an explanation of the benefits to him and his company for doing so. He has referenced the need for a WCPFC Conservation and Management Measure that would allow vessel owners to choose between a human observer or an EM system to meet tuna longline transshipment monitoring obligations.

TNC has agreed to draft a Statement of Work to share with Project partners to help guide a decision on undertaking a phase 2 research trial. The SOW would include potential co-funding aspects and a projected timeline to complete the work.

Below are several potential options to consider for advancing a phase 2 component of the Project.

- From a science-based perspective, consider installation of hydraulic sensors to eliminate recording of non-transshipment activities which would free up hard drive space and reduce EM analyst review times. This would not provide the necessary 24/7 coverage, however, needed for compliance verification.
- Consider development and use of Machine Learning/Artificial Intelligence algorithms to automate selected elements of the video review to reduce review times and efficiencies.
- Consider having a crew member(s) on the SHC102 carry out a random sampling of the species composition from a sub-sample of fish being delivered to the vessel.
- Investigate satellite transmission of compressed video and/or text to transmit key real time information of interest and advance data transmissions options beyond current industry standard of physical hard drive removal.
- Investigate the authorization and use of a single-integrated VMS antenna (for existing FFA and EM system requirements) to increase efficiency and drive down costs[10].
- Consider paying EM Vendor(s) for delivery of actionable data (e.g., data/metrics per tuna longline transshipment operation) versus buying and having to maintain the EM systems outright.
- Consider adding a motion-balanced digital scale to the winch hook/sling so the EM system can record actual weights of fish being transshipped.

[10] TNC is helping to foster discussion with FFA and several EM vendors on the challenges and next steps to achieve an integrated VMS option.

- Consider having crew place a color-coded tag on each fish to denote species (yellow YFT, red BET, green ALB, etc.) given current inability to do so due to condensation issues.
- Consider keeping spare EM parts onboard and provide basic system part replacement procedural training to the engineer or other designee to service LL vessels in the fleet. i.e., antenna, camera, HDD's etc.

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Appendix

List of tuna longline vessels that have transshipped with the SHC 102 for the time period of November 25, 2018 to January 29, 2019.

Fishing Vessel	Flag	IMO	Authorized to Transship on HS
Chang Yi 368	Chinese Taipei	8748804	Yes
Chang Yi 868	Chinese Taipei	8748799	Yes
Ching Cheng Fu 66	Chinese Taipei	8795479	Yes
Chi Hong 899	Chinese Taipei	8667311	Yes
Chi Hsiang 889	Chinese Taipei	9700108	Yes
Chi Tsai 988	Chinese Taipei	8777300	Yes
Chi Win 1688	Chinese Taipei	9807621	Yes
Chia Chi Hsing 10	Chinese Taipei	8530855	Yes
Ching Cheng Fu 66	Chinese Taipei	8795479	Yes
Chu Huai 368	Chinese Taipei	8777312	Yes
Chu Huai 628	Chinese Taipei	8782886	Yes
Chu Huai 668	Chinese Taipei	8777324	Yes
Chu Huai 888	Chinese Taipei	8777350	Yes
Fortuna 1	Vanuatu	8946846	Yes
Fortuna 11	Vanuatu	8961767	Yes
Fortuna 12	Vanuatu	8961779	Yes
Grand East	Vanuatu	8821072	Yes
Hai Xing 615	China	9727780	Yes
Hai Xing 817	China	9702936	Yes
Jin Chang 17	Chinese Taipei	8748737	Yes
Li Cheng 28	Chinese Taipei	8782915	Yes
Li Hung 666	Chinese Taipei	8792659	Yes
Longbow 1	Vanuatu	8996114	Yes
Longbow 7	Vanuatu	8956683	Yes

Man Fu Tsai 1	Chinese Taipei	8791887	Yes
Man Fu Tsai 11	Chinese Taipei	8791928	Yes
Man Fu Tsai 168	Chinese Taipei	8791875	Yes
Man Fu Tsai 5	Chinese Taipei	8791899	Yes
Man Fu Tsai 88	Chinese Taipei	8791851	Yes
Man Fu Tsai 9	Chinese Taipei	8791863	Yes
Ming Maan Shyang 86	Chinese Taipei	8777805	Yes
Rong Da Yang 18	China	9679658	Yes
Rong Da Yang 19	China	9679684	Yes
Rong Da Yang 28	China	9679696	Yes
Rong Da Yang 29	China	9679701	Yes
Sea Hawk 2	Chinese Taipei	8791447	Yes
Shin Jaan 66	Chinese Taipei	8792984	Yes
Shin Jaan Shin	Chinese Taipei	8790819	Yes
Shin Jaan Shin 66	Chinese Taipei	8792984	Yes
Tunago 51	Vanuatu	9230608	Yes
Tunago 62	Vanuatu	9260225	Yes
Xin Long 66	China	9741621	Yes
Xin Long 67	China	9741633	Yes
Xin Long 68	China	9741645	Yes
Xin Long 69	China	9741657	Yes
Xin Shi Ji 202	China	9663582	Yes
Xin Shi Ji 203	China	9663594	Yes
Xin Shi Ji 215	China	9727481	Yes
Yi Rong 18	Chinese Taipei	8525654	Yes
Yu Long	Chinese Taipei	8778421	Yes
Yu Long 10	Chinese Taipei	8778433	Yes
Yu Long 12	Chinese Taipei	8778445	Yes
Yu Long 18	Chinese Taipei	8778457	Yes
Zhong Yang 22	China	9804368	Yes
Zhong Yang 23	China	9804370	Yes

Zhou Yuan Yu 2601	China	9861392	Yes
Zhou Yuan Yu 2605	China	9861421	Yes
Zhou Yuan Yu 2607	China	9861445	Yes