TACKLING THE TURTLES - THE DEVELOPMENT OF SURVEILLANCE AND CONTROL TOOLS FOR RED-EARED SLIDER TURTLES

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ABSTRACT

Red eared slider turtles (REST, *Trachemys scripta* elegans) are listed in the top 100 invasive species of the world. One of the reasons they made this list is because they are adaptable, tough, and highly elusive. This makes surveillance and control very challenging.

Queensland has been tackling red-eared slider turtles since they first detected a naturalised population in Southeast Queensland (SE QLD) in 2004. Over this time, surveillance and control tools have been steadily improved through innovation and the application of new technologies. Control tools have included barrier fencing, seine netting, trapping using a variety of trap types and designs, pitfall traps, dam draining, and fishing.

Control techniques have combined with extensive surveillance undertaken to confirm the presence or absence of red-eared slider turtles across Queensland. In the beginning, surveillance consisted of a netting survey of every waterbody within the original detection zone. This was followed by property inspections, which led to the detection of a person who was keeping, breeding, and distributing REST and the successful prosecution by the Department. These findings initiated an intensive control program to remove over 150 individual turtles.

Surveillance techniques were revolutionised in 2014 by utilising basking platforms that take advantage of a turtle's natural behaviour to bask in the sun. Surveillance platforms are fitted with monitoring cameras and most recently with aluminium strips where eDNA is collected. Each surveillance and control technique has undergone incremental improvements through trial, and collaboration to increase their effectiveness. There have been successes and failures, with some limitations remaining problematic.

There is an ongoing threat of red-eared slider turtles becoming established in Queensland due to the illegal trade, and subsequent releases of exotic reptiles. As such, REST surveillance and control is essential to protect Queensland and has been on a journey of accomplishments and downfalls encountered during the development of tools.

Keywords: Red-eared slider turtles, exotic turtles, turtle surveillance, turtle control, *Trachemys scripta elegans*

INTRODUCTION

Red-eared slider turtles (REST, *Trachemys scripta elegans*) have been illegally introduced into Australia by exotic reptile collectors as part of the illegal pet trade (Ernst & Lovich 2009; Csurhes & Hankamer 2012). Red-eared slider turtles are striking in appearance with vivid green, red and yellow patterns. This makes them highly attractive to reptile collectors when compared to our native turtles which are very dull in comparison. Not only are red-eared slider turtles unique in their appearance, they are extremely robust and hard to control once established (García-Díaz et al. 2017). Isn't that the ultimate pet, attractive and robust? Because of their ability to adapt to a range of water conditions, their elusiveness, capability of reproducing where females can hold viable sperm for years and their aggressiveness

towards native turtles (e.g., Cadi & Joly 2003a; Polo-Cavia et al. 2010; Polo-Cavia et al. 2011; Pearson et al. 2015; Lambert et al. 2019), it makes them extremely difficult to monitor and control; if this project had been about eradicating native turtles we would have had success many years ago. This is the challenge we are up against in eradicating red-eared slider turtles in Queensland.

There are currently only two locations in Queensland where red-eared slider turtles (REST) are known to be found in the wild:

The first is within the Moreton Bay Region which was first detected in 2004. An extensive eradication project was successful in Mango Hill which was then the Pine Rivers Shire pre amalgamation (now City of Moreton Bay), followed by later detections in the Caboolture Shire (now City of Moreton Bay). In Burpengary, a naturalised population was detected again in 2018. A study was conducted on the population genetics of REST in Australia by Jack Castles Savage (Savage 2022). Jack found the genetic relatedness of the Burpengary population before and after eradication was the same, which suggests that eradication was not a complete success and a breeding population was able to persist.

The second known location is in Robina within the City of Gold Coast. A male REST was caught on a fishing line during the annual Tilapia Busters Day in November 2022. A mature female REST was later trapped at the same location. A necropsy was conducted by Duncan Limpus from the Department of Environment and Science and the results showed she was an older age adult female that was in preparation for laying eggs later in the summer and had bred in previous breeding seasons.

In total, 50 REST have been detected and seized in Queensland since 2007, associated either with illegal keeping or detected at large at numerous locations throughout SE QLD, from the Gold Coast to Bundaberg.

It is essential Biosecurity Queensland makes every attempt to eradicate REST in QLD to protect our environment and stop other exotic pests from becoming established.

MATERIALS AND METHODS

Surveillance

Monitoring is conducted to determine the presence or absence of REST in a waterbody. It is very difficult to determine the population size unless long term surveillance is carried out and each individual REST can be identified. Dr Malcolm Kennedy Senior Scientist with the Pest Animal Research Centre was able to calculate the population and identify each individual REST in his research project at Burpengary in 2022.

The REST eradication project first began in the Moreton region in 2004 when REST were first detected at Mango Hill. Local governments, the former Department of natural resources, the former Department of Environment and Heritage and Protection and the Queensland Museum established a taskforce and worked tirelessly every day for over six months to delimit and eradicate the population. Delimiting for REST in 2004 consisted of netting; workers in wetsuits swept waterbodies, often full of silt or polluted with horse manure, back and forth to determine if REST were present or absent. Every waterbody within 2km of the Mango Hill site, including all creeks and dams were netted. This was a massive operation where thousands of man hours were dedicated to the project.

Monitoring platforms

In March 2014 monitoring for REST was revolutionised by Principal Biosecurity Officer Matthew Ryan when he developed the very first monitoring platform. Matthew thought there must be a way he could utilise monitoring cameras on something floating that could be deployed in the middle of a waterbody. Back in 2014, monitoring cameras were being used in a wide range of situations to monitor for animals, why not REST? He knew REST bask in the sun to maintain their body temperature, so Matthew set out to design a floating monitoring platform. He used materials that were easily sought from a local hardware store and designed a platform to fix a camera to and exploit the basking behaviour of turtles. Matthew also had bait material attached to the platform in a bait box as an attractant to increase the chances of REST using the platform. The first MARK 1 platform was developed (Figure 1).

The MARK 1 platform was constructed out of PVC pipe with two rigid netted ramps on each side for turtles to climb up on to the platform. The platform was covered in bark to provide a natural feature for the turtles and to camouflage the platform to reduce the of risk from theft/vandalism. It had a separate compartment for bait material with holes drilled into the bottom to allow berley, which was used as an attractant to drift out. Expanding foam was used to internally fill the pipe to stop water from entering in the event of any holes or cracks. A galvanised sand anchor was tied with rope attached to the platform so that it would stay in one location and a Scoutguard motion sensor camera was affixed to an upright piece of PVC. The MARK 1 platform was then deployed.

Figure 1. Image of the MARK 1 monitoring platform.

It worked, the camera operated effectively with turtles activating the camera when they used the monitoring platform. It recorded images of sufficient quality to determine species and specific markings of each turtle. Ducks also regularly used the platform and did not deter the turtles from basking. The total cost at the time excluding the camera and labour was $162.00, a fraction of the cost when compared to the labour required for netting. One benefit of the platform was the ability to be able to deploy several in multiple locations at the same time.

During the initial trial a limitation was discovered. Scoutguard cameras hold eight AA batteries which only provided one week of battery life; this needed to be extended. The

external battery option was preferable to extend monitoring time to at least four weeks. A reconfiguration of the platform to house an external battery was made. Expanding foam was not required if the PVC joins were joined with glue and no screw holes were made in the pipe to attach any fixtures. Four MARK II platforms were developed, constructed and deployed.

In 2018 the first REST were detected using the monitoring platforms. Platforms had been deployed in waterbodies in Burpengary where REST were detected in 2004. A small population was found to be naturalised in two separate adjacent waterbodies. A REST response was initiated by Biosecurity Queensland and continues today.

In the past 9 years of working with monitoring platforms a number of improvements, features and mistakes have been made.

First, the bait box was removed. It is thought that because turtles utilise the platform to bask, a food lure is not required to attract them to the platform; this is yet to be examined but is utilised in the United States.

Second, Reconyx cameras were purchased to replace the Scoutguard. Reconyx cameras house 12 AA batteries and their settings can be adjusted to extend the battery life to six weeks. Platforms are always deployed for a minimum of six weeks because of the elusive nature of REST as it takes them several weeks before they will bask on the platform. Reconyx cameras capture a higher quality photo which can be zoomed in to identify turtles in the distance that are basking on natural features within the waterbody. Reconyx are extremely reliable with very few malfunctions and the settings consistently stay the same. Reconyx also seal and maintain watertight integrity when submerged in water, which has happened on several occasions (seals are cleaned between each deployment).

The shape of the platforms has changed over time to reduce the size (Figure 2). This makes them easier to be transported. A singular long arm extends past the basking platform to mount the monitoring camera. The focal distance of the camera was calculated so that the exact distance to the platform could be constructed.

Figure 2. Image of the MARK 10 monitoring platform.

The ramps on either side of the platform were modified so that they could be folded on to the platform. This reduces damage and makes them easier to transport. The ramps were altered to have a frame made of conduit while keeping the mesh ramp.

The PVC pipe is glued and then silicone is applied to all joins to ensure watertight integrity, although, very occasionally sinkage still occurs. The PVC pipe is painted in camouflage to disguise the platform.

Bark was initially used on the platform to provide a natural landscape and camouflage but was replaced with marine carpet. Although this worked well the platform was no longer rigid. After rainfall and a large number of water birds used the platform, the carpet would sink and resemble a sewerage treatment plant. The marine carpet was replaced with carpet that had a rubber backing to reinstate rigidity.

Water birds are an ongoing problem when monitoring for REST. Water birds see the monitoring platforms as a perfect place to live away from land predators and a place to raise their families. Had this study been about water birds I would be able to provide you with a large amount of data. Bird spikes have been installed, particularly on top of the camera after ongoing issues of bird excrement dribbled down over the camera lens, significantly reducing the image quality. Bird spikes are also installed on the arm that attaches the camera mount to the platform, as birds often sit on the arm blocking the entire view of the camera. While water birds will never be completely deterred from the monitoring platform, water birds and turtles are able to co-exist. Evidence has shown a water bird nest constructed on a platform and a turtle still managing to get some space to bask (there is also speculation that water bird nests provide micro-environments that may encourage juvenile turtle basking, although

this is yet to be examined). When thinking of bird deterrents such as fake owls there needs to be consideration as to what a turtle may also see as a predator. An owl has not been trialled to this date.

While the monitoring platforms are providing excellent results juvenile REST have never been detected. Dr Lana Harriot and Dr Catherine Kelly (Pest Animal Research Centre) currently lead the REST research project on the development of a juvenile REST surveillance pontoon. Juvenile REST reportedly aquatically bask as warmer surface water is enough to stimulate their metabolism due to their small size (Lefevre & Brooks 1995). As such, the aim of this project is to pilot trial a pontoon specifically designed for juvenile REST surveillance taking their basking behaviour into account (Kelly *et al.* 2023). This trial is ongoing, with the next deployment of pontoons planned for later this year.

In far north Queensland freshwater crocodiles cause issues with the basking platforms (Figure 3). Being a reptile, freshwater crocodiles also bask in the sun to raise their body temperature. A basking platform is an ideal place for basking, and the crocodiles do not hesitate to climb aboard. Platforms have had to be modified to prevent a 60kg freshwater crocodile from sinking or tipping them.

Figure 3. Image of a freshwater crocodile basking on a monitoring platform in North Queensland.

Camera settings

As mentioned earlier platforms are deployed for six weeks. The battery life of the monitoring camera and the number of images captured are the two factors that have to be managed. Monitoring cameras have to last six weeks, and it is extremely time consuming if officers have to view tens of thousands of images. Initially, camera settings were set using the factory default which is three images taken when the motion sensor was triggered and a one second interval between triggers. Although this worked well, large numbers of water birds, particularly at night time, triggered the camera repeatedly, subsequently flattening the batteries. The settings have been adjusted to take only one photo when the camera is triggered to increase battery life and reduce the number of images. In terrestrial applications, it is not unheard of getting tens of thousands of images of grass growing. The movement of grass by wind triggers the camera, capturing too many images to be observed and reducing the life of the batteries. When using monitoring cameras on REST platforms, water birds are the equivalent to grass. Tens of thousands of images of birds are captured, especially when it is nesting season. Although some people may enjoy watching birds build

a nest and raise their families, this can get rather exhausting when it repeatedly happens and soon the observer can develop a dislike to water birds. Cameras also have a sensitivity option of low, medium, and high. The sensitivity is generally set to medium, which has had to be reduced to low in situations when platforms were deployed in small waterbodies. In small dams, the movement of the platform and close proximity of the bank and trees triggers the camera repeatedly on windy days, again causing tens of thousands of images to be captured and flattening the batteries. Setting the camera to low sensitivity minimises this. Dr Malcolm Kennedy trialled using time lapse as well as motion sensor. The detection of turtles increased using the time lapse. When platforms are deployed in known bird habitats, they are now only set using time lapse to reduce the number of images captured and extend the battery life. As a large amount of water bird visitation is at night, the newly purchased Reconyx hyperfire 2 cameras are set to only record images during daylight hours to overcome these issues.

The average number of images captured by platforms over six weeks is between 3000 and 4000. This is a manageable amount that can be reviewed in detail. When images are viewed, the entire image is scanned as turtles have been observed near the platform with only the head poking out of the water or are seen in the background basking on a nearby natural landscape feature.

There are ongoing issues that have yet to be resolved. For example, turtles bask on natural landscape features, for example logs, rocks, or even just the bank. Why would a turtle all of a sudden change its routine and bask on a monitoring platform instead? This is a limitation to the platforms as many don't, so when you are monitoring for REST you need to observe the natural landscape around and within the waterbody. Even though platforms are positioned to get the maximum number of direct sunlight hours, turtles may still not use the platform. If there is a natural island or fallen down tree within the waterbody, you can almost guarantee that the turtles will bask on it instead. Deploying monitoring cameras in locations where these natural features are maximises the chances of you capturing images of basking turtles. At West Lake in Robina, there are two man-made floating islands for bird habitats; turtles gravitate to these islands to bask on. We installed monitoring platforms on both of the islands to take advantage of the turtles natural habit of basking on them. This has been hugely successful, although we have had to set these cameras to time lapse only due to the large number of birds also using the islands.

eDNA Surveillance

<u>eDNA water testing</u>

eDNA testing aims to detect the DNA of the REST within a water sample taken from a potentially infested waterbody. eDNA water testing would be the perfect way to prove the presence or absence of REST within a waterbody. There are a few limitations with eDNA water testing. Only a limited number of water samples can be processed at any one time as the filtering process in the laboratory is time consuming, particularly if the water contains a lot of particles (is murky). Water samples have to be filtered and tested within 24 hours of the sample taken before the DNA deteriorated, which is another reason only a limited number could be collected at one time. To manage this, a maximum of 15 samples (5 one litre samples from 3 separate waterbodies) were taken at a time. Initially the eDNA testing was processed in the Biosecurity Queensland Laboratories by Jane Oakey (Genetic Scientist) at Coopers Plains.

In 2019, positive results were obtained from the known detection locations which were processed by Jane Oakey. Two samples were inconclusive, the other two samples were

negative. Obtaining positive detections in both of the known infested waterbodies gave us confidence this method of surveillance was a useful surveillance tool, and further eDNA surveillance was conducted. eDNA water sampling continued to be conducted throughout 2020 with results continuing to be inconclusive or negative. The consistent inconclusive results put doubt over the ability to detect minute amounts of REST DNA in waterbodies.

In 2021, Dr Malcolm Kennedy commenced working with Dr Jack Rojahan from the University of Canberra, who was conducting research into detecting REST eDNA. Jack was also working with NSW DPI who have more locations and a higher population of REST than QLD. Jack was finding the use of eDNA testing for REST via water samples was not reliable at detecting REST due to inconsistent shedding of DNA by the species. Biosecurity QLD was determined to pursue the eDNA testing of water samples and is committed to assisting with improving the accuracy of this method.

In 2022, another eDNA water sampling activity was developed by Jack Rojahan to test the detection rate of REST eDNA in water. Biosecurity officers took samples from six dams in total, two dams where REST are/have been present and four dams in the immediate area where REST were located historically. The water samples were filtered by Biosecurity Officers in the lab using a pump provided by University of Canberra. The filters contained a preservative so the samples could be stored until they could be tested by the university. It was hoped that eDNA testing could be improved to the point where it will be the primary method of determining the presence or absence of invasive species, greatly reducing surveillance resource requirements. All of the results returned negative, even in the dam where REST are known to be present. This information showed inconsistent shedding of DNA by the species and low density of REST in waterbodies and that there is not enough eDNA from REST to be detected through water samples.

Water sampling for REST eDNA is still hoped to be the preferred way to conduct REST surveillance. How easy would it be if you could just take water samples to confirm presence or absence of REST? However, there are challenges to eDNA-based approaches (i.e., physiological traits) and because the population of REST is quite low in most instances, water sampling may not be that feasible.

The University of Canberra lent Biosecurity Queensland an eDNA Citizen Science Sampler which is a portable vacuum pump for sampling eDNA in water. Water is filtered through a filter that contains a preservative to preserve the DNA and eliminate the immediate need for refrigeration. The Citizen Science Sampler saved a lot of time. Historically, water samples were collected, refrigerated immediately and were required to be filtered in a laboratory within 24 hours. Filtering the water can be an extremely slow process depending on the quality of the water (particles).

The eDNA Citizen Science Sampler was tested at West Lake Robina in March 2023. Two water samples were taken from ten locations within West Lake. A boat was used to collect each of the samples, and a GPS location and the quantity of water filtered was recorded. While the sampler worked really well, there were variations in the amount of water that was able to be filtered at each site; the smallest quantity filtered was 500ml and the largest amount was 1700ml. The aim was to achieve a minimum of 1000ml for each sample.

The University of Canberra (UC) (National eDNA reference centre) received the 20 water filter samples for testing of environmental DNA (eDNA) testing. The samples were collected using water filter papers (Smith Root eDNA 1.2um and 5um PES) which were provided by

UC. There was no detection of REST eDNA. The UC report stated that all positive and negative controls produced expected results.

eDNA swab sampling

Dr Malcolm Kennedy assisted Jack Rojahan from UC with the development of using eDNA approaches to detect REST by swabbing monitoring platforms. This sampling technique uses a raised aluminium strip attached to basking platforms (Figure 4). As REST move across the raised strip to bask, they leave trace amounts of DNA on the strip which is later retrieved via swabbing. If there is camera failure, which occasionally occurs, the eDNA swabs act as a back-up. When there are no REST detected on camera and the eDNA swabbing results are negative, this improves the confidence that there are no REST present. This technique has been very successful at detecting REST presence/absence, complementing the monitoring camera and has become a permanent fixture on all monitoring platforms since 2022. The only downside is REST must use the monitoring platform.

Figure 4. Image of collecting an eDNA swab sample from the aluminium strip mounted on the monitoring platform.

Visual observations

The old fashioned “chucking” a bit of bread to feed the birds also works with turtles. Turtles that are regularly fed by the public are easily identified by this method; turtles come flocking when a bit of bread is tossed in the water. This simple technique works really well for identifying turtles which are accustomed to getting fed this way and where there is good water clarity. We are yet to detect any REST this way in Queensland.

If you are quick enough or sneaky enough turtles can easily be observed with binoculars or a spotting scope in areas where they normally bask. Not a lot of time is spent doing this, it

is an opportunistic monitoring technique that is labour intensive. The observer would occasionally hide in the bushes (due to the elusive nature of REST) for hours with a set of binoculars waiting for a turtle to bask or a head to pop up, REST were distinguished from native turtles by their vibrant markings. It is most likely that observational fatigue impacts detection; imagine sitting in the same place for hours on end staring at the same thing, you will eventually become complacent if you haven't fallen asleep already.

Control

As discussed earlier, REST are very illusive and an absolute challenge to control. Any presence of a disturbance and REST go in to hiding. Since 2019, we have captured thousands and thousands of native turtles and only six REST. Although this number may sound low it is due to Queensland having a low population of REST. Presently, we only have one known male REST remaining at the Burpengary site, and an unknown population at the Robina site.

REST hate disturbance. Repeated activity around any waterbody where REST are present sends them in to hiding which is a challenge when trapping. Traps have to be checked daily for animal welfare, but this hinders the chance of success for REST. In Robina, traps have to be checked twice daily due to the large number of native turtles being captured, which certainly deters the elusive REST.

Since 2019 we have tried every control option we can think of available to us, this includes the following.

<u>Netting</u>
Historically seine netting was one of the main types of control used to capture REST in Mango Hill and Burpengary. Dams and creeks were netted several times in attempts to eradicate and determine the presence or absence of REST. Netting required teams of people in the water dragging the net through systematically.

In 2020, Moreton Bay Regional Council joined forces with Biosecurity Queensland to drag a 50 x 5 meter seine net through the dam at Burpengary to try to capture REST. Unfortunately, there was a large amount of silt on the bottom of the dam and nearly two tonnes of mud was trapped in the net which had to be manually removed. Six native turtles and 20 tilapia were caught; no REST were captured. REST are known to dive and dig into the mud when disturbed, so this was not unexpected. The native turtles were relocated to the neighbouring dam and the tilapia euthanised.

<u>Set net</u>
The use of a set net was trialled at the Burpengary site in August 2019, with expectations that REST would swim into the net and get captured. A set net 40 x 3 meters was borrowed from QLD fisheries. The net was set across the dam and left in place for several hours while Biosecurity officers were on site waiting for a slight movement from the floats indicating that something was caught in the net. Disappointingly, nothing swam into the net and no REST were captured.

<u>Fyke net</u>
A fyke net is a type of fish trap (Figure 5). It consists of long cylindrical netting bag with several netting cones fitted inside to make entry easy and exit difficult. This net is then mounted on rigid rings and fixed in place with stakes. It also has wings or leaders to help guide the fish towards the entrance of the bag. They are commonly used in estuaries or

shallow inshore waters and work particularly well in flowing water. A fyke net was trialled in 2020 for the first time in Burpengary over a five-day period. It was not successful; only fingerlings were captured.

Figure 5. Image of the fyke net trialled.

Electrofishing

Queensland Fisheries use electrofishing to sample fish communities. Electrofishing involves passing an electrical current through water, stunning fish so that they can be netted and processed. Imagine zapping the water and all the turtles float to the surface which can then be scooped up. Is this not the ultimate type of turtle hunting? Electro fishing has never been used for turtles however, only fish. It is believed the electric charge required to stun turtles would kill the fish, so approval to trial this technique has not been obtained.

Shooting

At the Burpengary site REST were basking on the basking platforms daily, eluding the traps. Shooting the REST when they basked on the platform seemed like an easy solution of control, especially if you are a precise shooter. The problem; ricocheting and houses. Projectiles are known to ricochet on water and Burpengary is a peri-urban environment with several houses in the firing line. Research into projectiles with a low ricochet potential were investigated. Unfortunately, this was not a safe option and approval was not obtained.

Dam draining

Draining a dam (waterbody) has been the only successful method in eradicating REST, particularly when the dam is filled in. In the initial REST eradication program in 2004 several dams were drained; large portable pumps were hired after permits were obtained to drain the dams. This was a large operation as barrier fences had to be erected (see section below), the dam drained which took approximately two days, machinery coordinated to remove the silt back to a clay lining, then the silt sieved to retrieve the REST. When landowners would provide consent, the dam was filled in. At all of the sites where this occurred eradication was achieved.

In 2020, one of the Burpengary waterbodies was deemed suitable for conducting draining. Planning, risk assessments and equipment were prepared. Prior to the operation, the last known remaining REST breached the barrier fence and moved into the neighbouring waterbody. Proceeding with draining was no longer feasible and the operation was cancelled.

Barrier fencing (containment)

Barrier fencing has been used in conjunction to dam draining as a means to contain a known REST population. In the 2004 eradication project, barrier fences were constructed after finding that when a waterbody is drained, REST would leave overnight; once a waterbody reaches a certain water level, REST seek another waterbody. As draining a waterbody takes approximately two days, officers found when they returned on the second day all the REST had moved to another waterbody. To overcome this barrier fences were constructed prior to draining and remained in place for five years.

The barrier fence consists of a one-metre high section of rigid plastic that is dug 100mm into the ground, supported by steel pickets every 10 metres. Netting is used on inflow and overflow areas of the dam to allow for natural water flow and prevent localised flooding. A barrier fence was constructed at one of the Burpengary sites to contain the REST population. The barrier fence is currently still in place and regularly maintained. Cameras are positioned on the inside and outside of the fence to monitor REST movement. One REST was detected trying to find a way out from the inside of the barrier fence by a camera installed on the fence. Two other REST that were individually identified from the monitoring platform cameras were detected in both dams, indicating that they moved across the barrier fence. How they breached the barrier fence still remains a mystery to this day.

Pitfall traps

A pitfall trap is a container dug into the ground at ground level. It works by relying on REST to fall into it. The pitfall traps are used when a barrier fence is constructed and are positioned on the inside and outside of the fencing. Pitfall traps have been successful when dam draining programs were conducted. They were installed at the Burpengary site where the barrier fence was constructed but were removed at the landowners request.

Fishing

During the Tilapia Busters fishing competition at Robina in November 2022 a REST was captured on a fishing line using African night crawlers (worms). It is not uncommon for anglers to hook the occasional turtle when fishing in fresh water. Biosecurity Officers rigged up fishing lines using African night crawlers in an attempt of capturing more REST at Robina. To date, this has been unsuccessful.

Detection dog

“Angus” the black Labrador detection dog was an asset to the original response in 2004. Angus was trained to detect residue from REST, REST eggs and REST urine. Angus was used to patrol the edges of water bodies where REST had been detected, he followed the scent trails of animals leaving the water to lay eggs (O’Keefe 2009). Several REST nests were located by Angus which made a valuable contribution to the project. Unfortunately, Angus was not replaced after retirement.

Texan basking trap

Two aluminium basking traps with tilting floors were purchased to trial for REST eradication (Figure 6). The traps were modelled from the Texan basking trap. The aluminium trap has a tilting floor that drops the turtle into the trap when it basks. Modifications were made to the trap to try to increase its effectiveness, these included:

- Installation of mesh sides so that turtles cannot jump off the trap when the floor tilts
- Installation of weights to increase the sensitivity of the floor
- Installation of floats to increase the buoyancy of the trap.

Figure 6. Image of the aluminium basking trap before modifications.

To date, there has been no success using aluminium drop floor basking traps.

Heated basking trap

NSW DPI loaned Biosecurity Queensland a heated basking trap that was in its early trial stages (Figure 7). Ian Turnball (Invasive Species Officer, Department of Primary Industries) came to Queensland to demonstrate how to assemble and use the trap, which was a first of its kind. It was fitted with solar-powered heating elements to encourage REST to bask and LED lights to extend pre-dawn.

The trap was deployed for the first time in 2021. Unfortunately, it sank, and modifications were made to resolve the issue. Modifications made to the trap included:

- Installation of a camera facing downward to capture turtle interactions.
- Bird spikes to deter birds.
- Extra flotation devices to increase its buoyancy.

Figure 7. Image of the heated basking trap deployed at Burpengary.

The trap was redeployed days later and sank again. The reason for the trap sinking was determined to be a result of the components being screwed into the PVC pipe used for floatation, which compromised its integrity. The concept has merit, and redesigned floatation is being considered.

Basking trap

Historically, basking traps were used in the QLD 2004 program and are used by NSW DPI with success. Basking traps use the same principle as the surveillance platforms, except the centre of the trap is open with a net underneath. The trap is very simple, consisting of a PVC pipe frame and a basket suspended underneath. It has two approach ramps on the outside that allow turtles to climb up and bask on the frame. The trap relies on the turtles returning to the water in the centre of the frame, from where they are unable to escape due to the basket and shape of the PVC frame.

In Burpengary lids for the traps were constructed so that REST got use to the traps and used them to bask on. Monitoring cameras were placed on the bank to monitor the traps. Once REST were observed basking on the trap, the lids were removed. The idea was this would increase the chance of capture when the traps were set. Lids were also handy so that traps could be left in place over the weekends and animals could not be captured. Only one REST has been captured since 2019 using a basking trap. We have tried baiting the trap to attract the REST but this has not made any difference. A basking trap was deployed in the initial response at Robina with no success. Basking traps are rarely used presently.

Minnow traps

Chad Rubke, Turtles Project Coordinator from the Arizona Game and Fish Department uses minnow traps to successfully trap juvenile REST. Chad provided BQ with information on how to use the traps. Minnow traps are small fish traps that typically consist of two funnel-shaped entrances at either end of a mesh box or cylinder. When trapping for REST, a buoyancy float is installed so that REST are able to access the surface to breathe when trapped. The traps are also baited. Minnow traps were deployed on the edge of the bank for the first time at Robina in 2023 and are yet to have any success but will be trialled again in the future.

Cathedral trap

Cathedral trapping is commonly used for capture of freshwater turtle species with good success. The cathedral trap is constructed of a crab pot at the base of the trap with a two-meter netted column (Figure 8). The trap has floats to provide sufficient buoyancy at the surface to allow for trapped turtles to access air when captured. A lure is placed in the bottom section of the trap to entice REST to enter. Cathedral traps are not anchored so some movement can occur in large waterbodies. All except one of the REST captured since the 2018 eradication project were trapped with a cathedral trap. In small waterbodies cathedral traps are tethered to the bank so they can be dragged in then redeployed by kayak.

Figure 9. Image of a cathedral trap before it is deployed in Burpengary.

The downside to Cathedral traps is the large quantities of off-target species captured, mostly eels and native turtles. Other off-target species included tilapia, native bream, yabbies, and bullrouts. Native turtle species captured included Eastern Long-necked Turtle (*Chelodina longicollis*), saw-shelled (*Wollumbinia latisternum*) and Krefft's River turtle (*Emydura macquarii*). To date the largest capture of native turtles by biosecurity officers was 57 in one trap at Robina. This put enormous pressure on the trap which was unable to be lifted into the boat. There were similar instances when large numbers of eels were captured.

Mullet had been used as the primary bait type for cathedral trapping in Burpengary with success as all REST captured to date have been trapped using mullet. During the Robina response, large numbers of eels were being captured and this was identified as a serious problem. The large catches were damaging the equipment due to the weight of the eels and creating work health and safety risks (the large eels were approximately 10 kilograms each). The occasional eel was aggressive and attempted to bite officers. Eels would also escape the traps when the traps were lifted into the boat and become loose, slithering around the boat which initiated a fight or flight response amongst the officers on board.

<u>Bait trial</u>

A bait trial was established to determine the most appropriate bait type to maintain the turtle catch and decrease the eel catch. The red-eared slider is an opportunist, omnivorous species feeding on aquatic vegetation, invertebrate and vertebrate species (Balzani et al. 2016).

A variety of bait types were trialled, and the trapping data analysed (Figure 9). Bait types trialled included fruit and vegetables, sheep and ox hearts, burley, and dog food, amongst many other things. An analysis of nearly 900 baits used in the traps showed ox heart performed best. The use of ox hearts resulted in a similar turtle catch rate, but a four-fold

decrease in eel catches. Bread, chicken, and worms performed the worst, with no animals trapped on these bait types. A total of 2492 eels, 2027 native turtles and 425 tilapia were trapped during the Robina response, along with a single REST; note that the REST was trapped on mullet before the bait trail commenced. Ox heart had a relatively high catch rate per trap for turtles (2.509 vs 2.702 for mullet), while minimising the eel catch (1.155 vs. 5.487 for mullet).

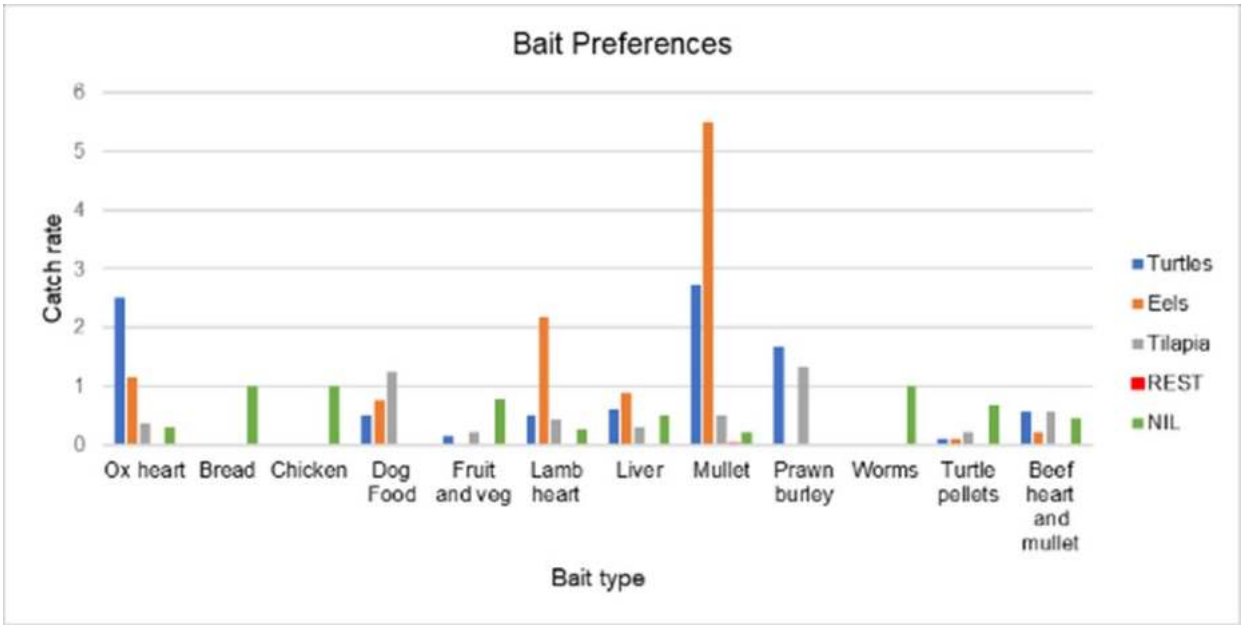

Figure 9. Table with the bait type and catch rates of different species.

RESULTS

Monitoring platforms have proven to be the most successful way to conduct surveillance for REST and exotic turtles, and are currently used throughout Queensland. As new technology becomes available, we will continue to improve our capabilities in surveillance and control of REST. As with the control of any species, there is no doubt that we will face new challenges that need to be addressed in the future. Being able to collect water samples and test them for REST eDNA seems like the ultimate way to conduct REST surveillance. Biosecurity Queensland is committed to providing support in developing this process.

DISCUSSION

The only way to have complete confidence of the eradication of REST in a waterbody is to construct a barrier fence, completely drain the dam, sieve through the silt then ultimately fill in the dam. Unfortunately, this is rarely possible, and we must rely on the tools that we have in an attempt to eradicate any known populations.

Being able to construct a barrier fence is not possible in large waterbodies. The waterbody at Robina is a lake, impossible to contain, it also feeds into another waterbody. One of the waterbodies at Burpengary is part of a creek system, again impossible to contain. This will continue to be an issue into the future.

An important part when trying to achieve eradication is passive surveillance, relying on reports from the public. Educating people on the awareness and identification of REST

increases our chance of early detection and eradication. We continue to provide education through social media, media, and attend public events to increase the awareness of REST and promote reporting.

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