



Koh Tao Sea Turtle Head-Starting and Rehabilitation New Heaven Reef Conservation Program

The developments and progress of the NHRCP Sea Turtle Head-starting and Rehabilitation Program and request to extend and continue the program under the supervision of the Royal Thai Navy and the Thai Department of Marine and Coastal Resources.

2016

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Abstract

Since April of 2012, the New Heaven Reef Conservation Program (NHRCP) has been operating a sea turtle head-starting and rehabilitation program in Chalok Ban Kao Bay. Over 60 juvenile sea turtle have been successfully raised and released through this program. Additionally, 8 injured or sick adult sea turtles have been cared for prior to transfer to the DMCR Sea Turtle Center in Chumphon. Our center consists of multi-use tanks which have been specially designed to facilitate the rehabilitation and rearing of juvenile sea turtles, and have incorporated many novel methods to improve the growing condition for the juvenile turtles. Additionally, we also manage a sea turtle sighting database, using photo ID and also RFID tags. The NHRCP has become the main group responsible for the monitoring, research, protection, rescue, and rehabilitation of sea turtles for the island of Koh Tao. As we already have invested a large amount of money, resources, and time into rehabilitating these turtles and developing improved head-starting techniques, we are requesting to continue the project into the future for both Hawksbill and Green Sea turtles. We request a new batch of hatchling or juvenile turtles from the Department of Marine and Coastal Resources, as our partner in this project along with the Royal Thai Navy. Through this partnership and program we hope to help restore local populations of these endangered species in the Gulf of Thailand.

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Introduction

The New Heaven Reef Conservation Program (NHRCP) was started at the New Heaven Dive School to encourage and promote reef research, protection, and restoration. The NHRCP carries out daily projects including monitoring the reefs, maintaining coral nurseries and artificial reefs, installing and maintaining mooring buoys, maintaining a giant clam nursery, program, testing water quality, coral rehabilitation, coral coral larval culturing, and much more. For the last 12-15 years the Royal Thai Navy has been conducting an annual sea turtle release program on the island of Koh Tao, alongside the local community.



Since April of 2012, the New Heaven Reef Conservation Program has been running a sea turtle head-starting and rehabilitation program in Chalok Ban Kao Bay. Over 60 juvenile sea turtle have been successfully raised and released through this program. Additionally, 8 injured or sick adult sea turtles have been cared for prior to transfer to the DMCR Sea Turtle Center in Chumphon. Following several years of success of this program, we are requesting to continue the project into the future for both Hawksbill and Green Sea turtles to work alongside the Department of Marine and Coastal Resources and Department of Fisheries to help restore local populations of these endangered species in the Gulf of Thailand.

Project Goals

- Rear and care for juvenile and hatchling turtles until they reach a weight and size large enough to escape most predators in the area
- Rehabilitate sick and injured juvenile sea turtles before release into the wild
- Act as a local contact and temporary care facility for injured or sick adult sea turtles until they can be transported to the Chumphon Sea Turtle center
- Provide a turtle learning center for visitors and local residents of the island to increase awareness on global threats to sea turtles
- Operate a local sea turtle sighting and recording database to track and monitor local turtle populations and share data with regional groups



A Sea Turtle Release at the annual Save Koh Tao Festival

Project Background

Of the 7 extant species of sea turtles worldwide, all are listed as either “Critically Endangered”, “Endangered”, or “Vulnerable” by the IUCN (Eckert *et al.* 1999). Five species of Sea Turtles can be found in Thai Waters, with only 3 being in the Thai Gulf (the Hawksbill, Olive Ridley, and Green Sea Turtles), all of which are experiencing rapid declines in population abundance and nesting (Settle 1995).

For the last 12-15 years the Royal Thai Navy and the Department of Marine and Coastal Resources have been conducting annual sea turtle release programs on the island of Koh Tao, alongside the local community and the Save Koh Tao Community group. During most of that time, the New Heaven Dive School (specifically Maleephan and Devrim Zahir) have been assisting by caring for the turtles for 2-3 days prior to their release. This has included setting up holding tanks, feeding, caring for wounds or infections, and other tasks to ensure their comfort and survival prior to release at the yearly Save Koh Tao Community Festival.

In 2007, The New Heaven Reef Conservation Program (NHRCP) was started to encourage and promote reef research, protection, and restoration. Our program operates independently on a day to day basis, but also collaborates and works with many government and non-government

partners. Regarding sea turtles, the NHRCP runs a head-starting and release program, helps to run a community wide sea turtle database, protects sea turtle breeding/nesting areas, reports sea turtle deaths or entanglements, cares for sick or injured turtles, and coordinates the Save Koh Tao turtle releases.

In 2008, 6 of the turtles brought for release were determined to be too small and unhealthy for release. Preexisting injuries to the turtles included open wounds, bite marks, and partial amputation of rear or front limbs. The reason for the injuries was determined to be biting or fighting amongst the juveniles, especially towards the smaller individuals. As with most reptiles or birds,



Applying Gentiane Violet to wounds and infections on turtles during temporary care (New Heaven, 2007).



Juvenile turtles in the natural enclosure did not display any aggressive behavior towards each other, and were commonly observed foraging on natural food sources. (Ao Leuk, 2008)



Dr. Chansue inspects and puts RFID tags in some of the turtles for release at the SKT Festival in 2012.

this is an instinctual response to resource availability, whereby larger juveniles will kill or consume their smaller siblings to reduce competition for limited resources and increase their own chances of survival. At the time, and it is assumed to be the same at the Sattahip center, the turtles were being kept in a plastic tub with no natural objects or food sources available. Mostly the turtles were fed lettuce and cucumbers, which do not contain high levels of calcium or iodine, essential for sea turtle development (Eckert *et al.* 1999). That year, it was decided to temporarily rear the juvenile sea turtles in a natural enclosure with the consent of the Royal Thai Navy in the vicinity of Ao Leuk Bay, Koh Tao.

Immediately upon placing the juvenile sea turtles into the natural enclosure, their behavior and health changed dramatically. Limbs of injured sea turtles which had been chronically infected or open, healed in days, and in some individuals, regeneration of lost limb tissues was even observed. Individuals ceased to bite or fight over resources, as in the enclosure natural, nutrient rich food was available in high abundance (including macro algae, biofilm, bivalves, and crustaceans.)

Based on our observations, the sea turtles benefitted greatly from being in the natural enclosure instead of being in the plastic or tile tubs. The project however ended abruptly when the wall of the enclosure was destroyed in a storm, and the sea turtles were able to escape to the sea. Following this pilot project, we constructed flow through tanks at the New Heaven Dive school in order to simulate the natural enclosure area but better control the physical and environmental conditions.

Methods

By May of 2012, we had constructed large flow through tanks to allow constant water change over, mechanical and biological filtration to maintain water quality, and a macro-algae pond to both remove nutrients in the water (that contribute to disease and bacterial growth) and provide a natural food source for the juvenile turtles. Thorough research of other head-starting programs was carried out (Caillouet 1993, Okuyama 2010, Eckert *et al.* 1994, and Frazer 1992) and



Dr. Jae administers daily vitamin and antibiotic injections to the sick Hawksbill and Green Sea Turtles, 2012

every effort was made to simulate the natural conditions for the sea turtle's development and health, including:

- Natural substrates such as dead coral and dead giant clam shells were placed into the tanks to allow the turtle's access to natural habitat to rest under and wedge themselves into to sleep. This natural substrate also allowed for the turtles to practice foraging and feeding skills which are essential for their survival in the wild (Eckert *et al.* 1999, and Okuyama 2010).
- Coconut branches cut and dried in the sun float on the surface of the tanks to allow the turtles a place to rest, or to hide from other individuals, as in the wild sea turtles are solitary animals that will often travel through the sea under flotsam and debris (Carr 1987).
- Cleaning shrimp were introduced into the tanks to remove parasites and fouling organisms from the turtles. Within 4 days, the turtles no longer had algae on their shells, nor where they ever observed to have obvious signs of skin or shell parasites.
- Water temperature, pH, and DO levels are maintained by the system, and tend to be very stable due the construction of the flow through and filtration systems, and the daily water changes (20-40% water change per day).
- The turtles are fed a diet consisting of primarily of fresh fish (with bones), supplemented with macro-algae (*Sargassum* sp., *Padina* sp., and *Halimeda* sp.), and probiotic turtle pellets (purchased from an aquarium store) (Eckert *et al.* 1999, Okuyama 2010). Also, when doing net and debris removals from reefs around the island, often many crabs, shrimps, and other crustaceans are brought back with the rubbish, these are also fed to the turtles when available, providing more calcium and keratin to the turtles diet.



Coconut branches provide shelter and allow the turtles to feel isolated in the tanks.



One of the cleaner shrimp (this one with eggs) from the turtle pond



NHRCP Studnets measure and weigh the turtles as part of the daily observations

- The turtles are observed daily for general health, feeding, behavior, swimming ability, and diving. The turtles are also measured and weighed weekly to monitor growth and calculate the amount of food to be given each day (2-5% of body weight as per Okuyama *et al.* 2010 and Eckert *et al.* 1999).

After reaching a shell length of about 24 cm, the turtles are released by boat in a sheltered area with over the coral reef (depth of sea below release site ranged from 3-14 meters). In some cases, released turtles had been observed a week later to still be in the same area, surviving well and displaying natural behaviors (foraging, diving, predator and human avoidance, etc.)

Design of the flow through tanks

The flow-through tanks at the New Heaven Dive School are multi-use tanks which have been specially designed to facilitate the rehabilitation and rearing of juvenile sea turtles. Using a stand-pipe system, the water in the tanks flows continuously 24 hours a day to maintain a high level of water quality. Water flow to each tank can be controlled independently, to facilitate the quarantining of sick turtles and to provide any tank to be used as a feeding tank. The basic design of the system can be seen in the illustration below.



The tanks are constructed out of concrete, which have been rendered to be water proof. PVC and a sump pump are used for the water system, and air stones have been added to each tank. Before introducing the turtles, the system was run for 2 weeks, with 1 bottle of vinegar added per day to neutralize pH. After pH was stable for 24 hours without adding any vinegar than the system was assumed to be stable, and the turtles were placed in the tanks. After flowing out of



the individual tanks, the water is passed through a coarse and fine mechanical filter, before flowing through a biological filter creating using bio-balls, ceramic rings, and broken clay tiles. After the filtration, the water is circulated through the sump, which is also exposed to the sun to allow for the growth of macro-algae to remove dissolved nutrients from the water and provide food for the turtles. Marine probiotics are added to the system weekly (purchased from an aquarium store) to maintain water quality, reduce harmful bacteria, and increase the effectiveness of the biological filter.

Results

2012-2013 Rehabilitation and Head-Starting Project (Hawksbill Turtles)

Upon arrival in April of 2012, there were 24 turtles; 21 small hawksbills, about 2 months old, and two larger Green Sea Turtles, about 9 months old. All of the 24 turtles were sick, weak, and the two green turtles were covered in open wounds and infected sores. All received a score between 1-2 in all health categories for the first month of care. Hope for survival of all the 23 turtles was low. By April 30th, one of the larger green turtles had died despite daily injections of vitamins, antibiotics, and IV Saline (for rehydration). By June 2012, nine of the smaller hawksbill turtles had succumbed to their illness.

By July, one Green Sea Turtle and 10 Hawksbills remained, with 9 of the 10 receiving a score of 5 for all health categories (the last one scored a 1 in all categories, and then died on the 8th, of July. For the rest of the year, all of the turtles scored between 4 and 5 on all health categories and all survived until released.

The average starting weight of the Hawksbill turtles was 48 grams (range from 42-52 g). By December of 2012, the average weight of the turtles had increased to 805 g (range 603-1,000 g) (see Appendix A). The surviving Green Sea Turtle weighed 380 g in April, and had reached a weight of 1,130 g by July 25th. The green sea turtle was released in a very healthy state from a boat on August 12th, 2012 in the vicinity of Ao Leuk Bay.

By January of 2013, the remaining Hawksbills had all exceeded a weight of 1,000 grams, with an average weight



One of the small hawksbills received in April 2012 (number 16) Swimming free after being released in Chalok Ban Kao in February of 2012.

of 1,137g. Shell length of the hawksbills had increased from an average of 6 cm in April 2010, to 22 cm in January 2013 (range of 6.2-7, and 21-23.2, respectively).

Dr. Jae Intaraksa inserted RFID tags into the turtles on January 29th, 2013, and a complete list of the RFID numbers can be found in Appendix B. Subsequent to tagging, the Hawksbill turtles have been slowly released as they reach a shell length of about 22.5 cm. The first two were released by boat in the vicinity of Chalok Ban Kao on February 10th. The turtle was observed to exhibit natural behaviors in the first 30 minutes post-release, diving and exploring the reef, and wedging under corals to rest. One of the turtles was observed surfacing for air about 6 days later, approximately 20 meters from the site of release, indicating that the turtle was surviving well. Two more turtles were released in the same location on February 28th, and were observed for the first hour post-release. Again the turtles exhibited natural behavior and survival instincts and had strong swimming and diving skills.

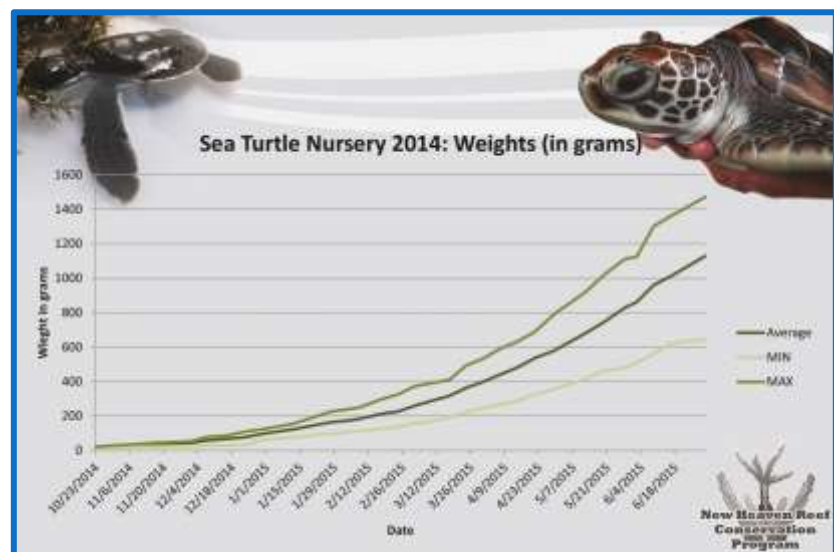
2013-2014 Rehabilitation and Head-Starting Project (Green Sea Turtles)

In 2013, 27 Green Sea Turtles arrived on June 17th, delivered by the Department of Marine and Coastal Resources from the breeding center at Sattahip. Upon arrival, 26 of the 27 turtles were coded as ‘unhealthy’ due to obvious infections and injuries. The turtles were given a regime of antibiotics and nutrients under the supervision of Dr. Jae Intaraksa. All of the turtles survived until release, for a 100% survival rate in the nurseries. All of the sea turtles were also tagged with RFID tags supplied by the Koh Tao NOISTAR Animal Clinic (see Appendix B).

Upon arrival, the turtles had an average weight of 222 g (range 106 – 305 grams), and an average shell length of 11.1 cm (range 6.8 – 10.5 cm). The first 3 sea turtles released were on October 15th, 2013, which had grown to a shell length of 17, 17.8, and 16.8 cm and a weight of 656, 672, 598 g (turtle numbers 17, 26, and 27, respectively). The last turtles released were on the 28th of February, 2014. Five turtles were released, which had an average shell length of 24.3 cm and an average weight of 1.5 kgs. All of the turtles head-started during the 2013-2014 project were healthy upon release, with most swimming quickly away from the boat or diving down to the sea bed (depth 4-12 meters).

2014- 2015 Head-Starting Project (Green sea turtles)

In July 2014, Haad Kwat Resort and the Municipal Government on Koh Phangan contacted the NHRCP to inform us of 3 clutches of eggs that had been laid on a nearby beach. The resort owner, after informing the



local government along with members of the community constructed cages and later runs to help protect the nests and eggs and direct the new hatchlings to the sea.

On the 21st of October, 15 hatchlings made their way to the sea, 7 of the hatchlings swam to the lights of a nearby fisherman who collected them and brought them back to land and informed the local municipality. It was then decided that the remaining hatchlings should be collected once they emerged.

On the 22nd of October, four more hatchlings emerged and were collected ready for arrival the following day by the NHRCP. Upon checking the hatch rate of the nest, a smaller, deformed turtle was found buried within the sand bringing the total number up to 12. Upon arrival to the head start program the turtles had an average weight of 25g (range 16 - 28 g), and an average shell length of 4.9 cm (range 4 - 5.3 cm). The deformed turtle which was found under the sand showed little appetite or growth and by late December had died.

All of the other 11 sea turtles survived and were released to the sea healthy and strong. The first of these turtles were released on the 24th June, 2015 with shell lengths of 22 cm and weighing between 1,130 and 1,150 grams. The last of the turtles was released on 5th December, 2015 with a shell length of 25 cm and a weight of 1,300 grams.

2015-2016 Rehabilitation and Head-starting Project (Green sea turtles)

In 2015, 10 green sea turtles born on the 30th December 2014 arrived on June 17th to our program from the Department of Marine and Coastal Resources. Upon arrival, all of the turtles were coded as unhealthy due to infections and injuries that could be clearly seen. Due to their health problems, the turtles received antibiotics and vitamin injections for 2 weeks under the supervision of Dr. Jae Intaraksa.

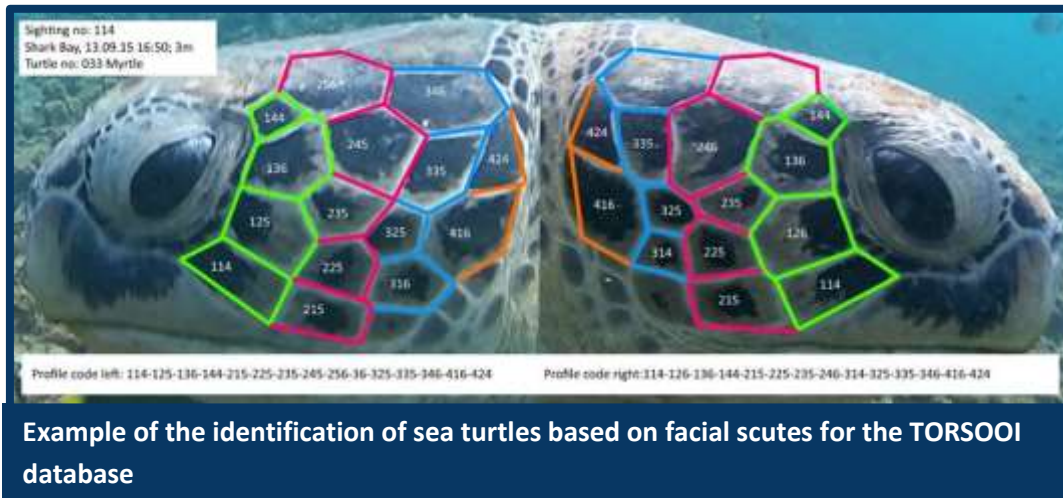


Upon arrival, the turtles had an average weight of 309 g (range 240 - 383 grams) and an average shell length of 13.4 cm (range 12.6 - 14.8 cm). The first turtle to be released was on 5th December 2015 with a shell length of 23cm and a weight of 1,200 grams. The last turtle was released on 21st June 2016 with a shell length of 23cm and a weight of 1,450 grams. All of the turtles survived the rearing period, and were healthy upon release and all exhibited diving behavior within seconds of being in the water.

Sea turtle ID project (launched June 2015)

Since June 2015 the NHRCP, alongside one of its former interns, Lena Schenke, launched a website and Facebook page where members of the public could report sightings of sea turtles around Koh Tao. These sightings are then entered into the Database of Marine Turtles of the South West Indian Ocean run by TORSOOI. The Photo ID software enables the identification of

individual sea turtles based on the facial scutes, and allows individual turtles to be tracked over time. Within 5 months of launching the project the NHRCP had collected over 1,600 photographs from more than 200 sea turtle sightings, of those 35 could be positively identified and had corresponding date and location information.



The database allows us to better understand the population dynamics and movements of our local sea turtles, and also provides a way to learn more about where threats are occurring. For example, in December of 2015 a dead Hawksbill sea turtle was found floating on the water in the vicinity of Koh Nang Yuan. The turtle had no RFID Tag, but when the facial scutes were analyzed it was found that the turtle had been sighted at least 13 times over 3 years, moving between Hin Wong Pinnacle, Laem Tien, and Mango Bay. Over time, as more of this type of data is collected we will be able to identify the important nesting or feeding areas, migration routes, and locations where illegal fishing or other activities are endangering the animals.

Sea Turtle Rescues and Reporting

The NHRCP also acts as a contact for locals and divers who find injured or dead marine life, including sea turtles. Between May of 2015 and July of 2016 there have been 4 turtles incidents reported to the NHRCP of sick/injured or dead turtles. The first, a turtle named 'Maya' was found on Sairee beach on Monday 25th May during a night of heavy wave action. After efforts made to return her to sea did not work she was brought to New Heaven due to our history of keeping and working with sea turtles. On arrival her breathing was labored and she was quickly put into the turtle recovery position to try and rid her of any excess fluid. Due to the amount of water she expelled the decision was made to monitor her breathing throughout the night and to continue to put her into the recovery position periodically during this



time. For the next 3 days and 2 nights her breathing was monitored under the supervision of Dr. Jae Intaraksa and from the second day Dr. Watchara Sakornwimon from the DMCR center in Chumphon. Upon further investigation she was found to have damage to one shoulder and shadowing on her lungs, a possible indication that due to the injury on her shoulder she was unable to support her head and it could account for the consumption of water and therefore shadowing on her lungs. Her weight was 69 kilos, her length was 49 cm and she was estimated to be at least 30 years old. In other instances, when dead sea turtle have been found, the NHRCP has helped to contact and arrange transfer to the DMCR.



Discussion

Results from the 2012-2016 projects show that even under professional care, many of the sick or injured turtles arriving for release are unable to recover. It is the author's opinion that if released directly most of these turtles would not survive, and there are many benefits to the rehabilitation and head-starting program. Although all 24 turtles arriving in the 2012-2013 project were severely ill, 14 of those were able to be rehabilitated and release to the sea healthy and strong. In the 2013-2014 project 26 of the 27 turtles arrived sick or injured, and all 27 were eventually released in a high state of health. All of the 11 sea turtles from 2014 and the 10 turtle from the 2015 projects survived and were released large and healthy.

Additionally, having the sea turtles on land has allowed us to increase the awareness and teach the local community about the threats facing sea turtles locally and globally. We host regular events with local and foreign school children to allow them to see the endangered sea



Kids from the local 'Playskool' come down to see and learn more about the sea turtles.

turtles up close, and in some instances assist in the feeding, care, or monitoring of the turtles. Local boat captains have also taken notice of the program we are running, and have been watching for threats to sea turtles and reporting to us when they have seen turtles or problems such as illegal fishing, lost nets and marine debris, or mis-behavior by visitors or tour guides.

The New Heaven Reef Conservation Program has become the main group responsible for the monitoring, research, protection, rescue, and rehabilitation of sea turtles for the island of Koh Tao. As we already have invested a large amount of money, resources, and time into rehabilitating these turtles and developing improved head-starting techniques, we are requesting to continue the project into the future for both

Hawksbill and Green Sea turtles to work alongside the Department of Marine and Coastal Resources and the Royal Thai Navy to help restore local populations of these endangered species in the Gulf of Thailand.

Costs

The initial construction of the Sea turtle rearing ponds was about 170,000 Thai Baht. Maintenance, food, and materials cost an additional 54,000 baht in 2012, and 9,000 Thai Baht for the first month of 2013. Monthly costs for 2013-2016 project were about 7,000-9,000 Thai Baht per month. These costs have been covered by the NHRCP through the sale of marine conservation courses, and have required no additional outside funding.

Future Needs and Requests

Based on the success and achievements of our first few years of the program we are requesting that the Department of Marine and Coastal Resources allows us to continue our program with the donation of new juvenile turtles. Having new turtles will not only help us to raise environmental awareness amongst local community members and visitors to Koh Tao, but also allow us to assist the DMCR in protecting and increasing the populations of endangered sea turtles in Thai waters.

Additionally we invite the DMCR and other researchers to work with us to publish papers and reports on the developments of the program to spread awareness to other Thai communities and to help track the populations of both natural and head-started sea turtles around Thailand.

Acknowledgments

Thank you to the Department of Marine and Coastal Resources, Royal Thai Navy, and Marine Fisheries Department for permissions and advising, their assistance to our efforts in invaluable. We would also like to thank Dr Jae Intaraksa for all of her time and efforts in caring for the turtles when they were sick, and advising our team members on the proper care for these marine reptiles. We would also like to thank Dr. Nantarika Chansue of the Veterinary Medical Aquatic Animal Research Center at King Chulalongkorn University.



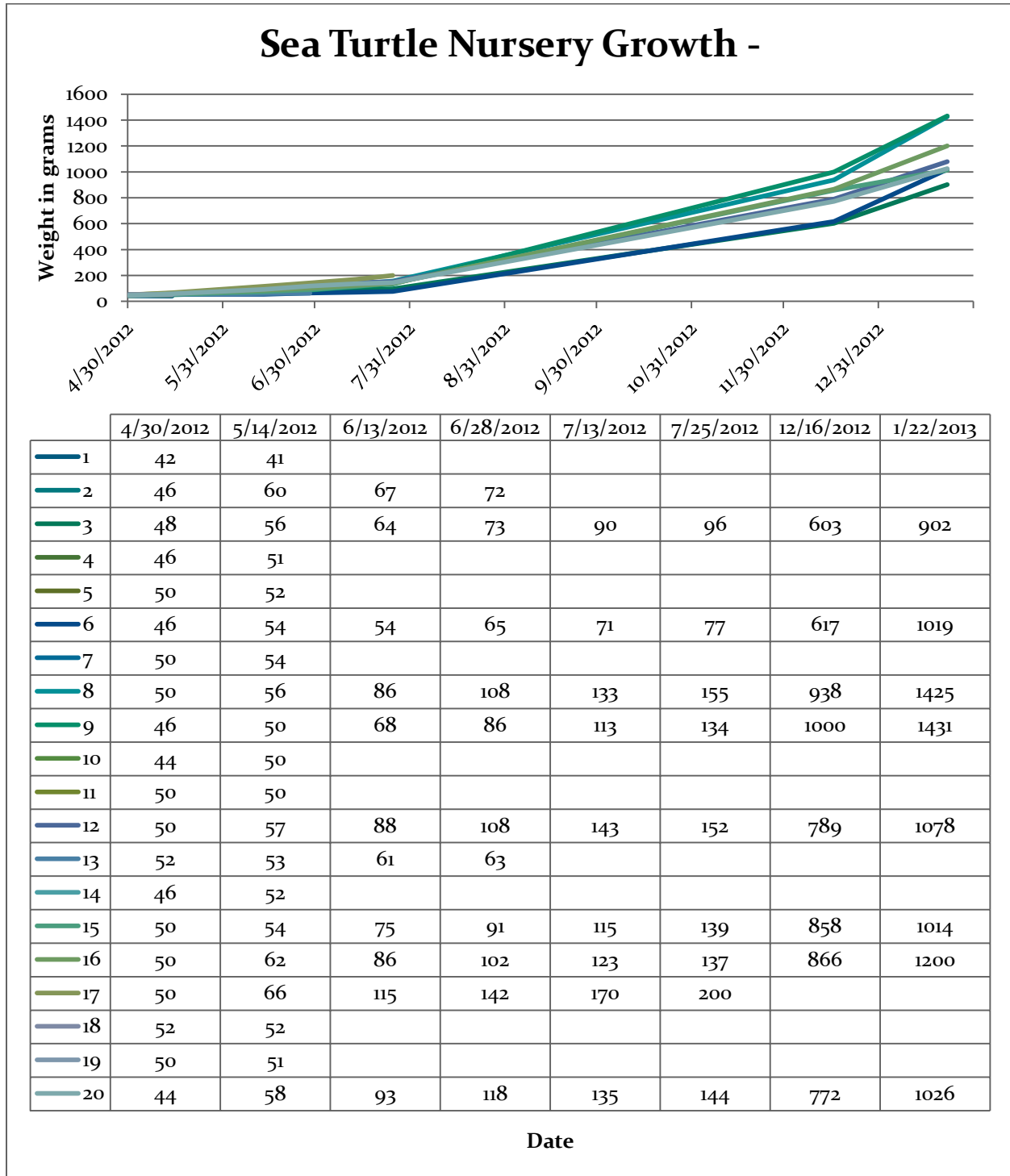
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Appendix A

Sea Turtle Growth by Weight (in grams) from April 2012-January 2013, in the rehabilitation and head-starting program at the New Heaven Reef Conservation Program in Chalok Ban Kao, Koh Tao, Thailand.



Appendix 2

RFID Tag codes

Location Code	Date Code	Turtle Number	RFID Tag Preface	RFID Tag Number
KT	2012	3	95600000	2338868
KT	2012	6	95600000	2335528
KT	2012	8	95600000	2336227
KT	2012	9	95600000	2337678
KT	2012	12	95600000	2338336
KT	2012	15	95600000	2332113
KT	2012	16	95600000	2341652
KT	2012	20	95600000	2333476
KT	2013	1	95600000	2338751
KT	2013	2	95600000	2334552
KT	2013	3	95600000	2331614
KT	2013	4	95600000	2334151
KT	2013	5	95600000	233057
KT	2013	6	95600000	2345764
KT	2013	7	95600000	2330822
KT	2013	8	95600000	2349418
KT	2013	9	95600000	2331199
KT	2013	10	95600000	2339161
KT	2013	11	95600000	2329088
KT	2013	12	95600000	2330267
KT	2013	13	95600000	2344949
KT	2013	14	95600000	2337679
KT	2013	15	95600000	2317608
KT	2013	16	95600000	2338872
KT	2013	17	95600000	2334823
KT	2013	18	95600000	2344277
KT	2013	19	95600000	2349420
KT	2013	20	95600000	2349992
KT	2013	21	95600000	2345360
KT	2013	22	95600000	2331187

Location Code	Date Code	Turtle Number	RFID Tag Preface	RFID Tag Number
KT	2013	23	95600000	2339946
KT	2013	24	95600000	2338052
KT	2013	25	95600000	2328382
KT	2013	26	95600000	2344678
KT	2013	27	95600000	2331076
KT	2014	1	1227	19372A
KT	2014	2	1227	46713A
KT	2014	3	1227	57685A
KT	2014	4	1227	62355A
KT	2014	5	1227	51565A
KT	2014	6	1227	09221A
KT	2014	7	1227	49622A
KT	2014	8	1227	64660A
KT	2014	9	1227	12577A
KT	2014	10	1227	19240A
KT	2014	11	1227	22620A
KT	2015	1	1227	21311A
KT	2015	2	1227	16470A
KT	2015	3	1227	15526A
KT	2015	4	1227	12385A
KT	2015	5	1227	13167A
KT	2015	6	1227	45394A