# 4 Life as a *Honu*

The turtle lives 'twixt plated decks
Which practically conceal its sex.
I think it clever of the turtle
In such a fix to be so fertile.
—Ogden Nash, "The Turtle"

## The *honu*'s life cycle

When we met Clothahump, her size impressed us. Her shell was easily fifteen inches long and almost as wide. At the time, that seemed huge, since our previous turtle experiences were limited to freshwater turtles.

Then came a dive that was nearly as memorable as our first encounter with Clothahump. It was overcast, creating a gloom fifty feet underwater. We were exploring new territory, when we began to make out a large mound looming in the distance. As we approached and details became apparent, silhouettes formed: four huge turtles!

For one unforgettable moment, we were transported to prehistoric times, glimpsing giant reptiles: enormous shadows, impressive, regal, and shy. We had found the adults.

Our sense of turtle size suddenly required dramatic adjustment. These turtles were easily eight, maybe ten times as large as Clothahump. We began wondering if Clothahump would get that big. How long would it take? Where did Clothahump come from, anyway?

Eventually we found the answers to most of these questions. The life cycle of the *honu* is similar to that of other green turtles, and scientists have a good grasp of what is involved. We learned a lot about the green turtle's life cycle through old-fashioned research. Books, papers, the Internet, and questioning the experts—these are the tools that must stand in for personal experience when learning about *honu* migration, nesting, and hatching.

Usually *honu* make nests and hatchlings emerge only at the remote French Frigate Shoals, or Mokupāpapa as they are called in Hawaiian. Since the shoals are inside the Northwestern Hawaiian Islands National Monument, where access is strictly controlled, we thought we would always be limited to secondhand knowledge of these events. Then a turtle chose to nest on a beach fifteen minutes away from Honokōwai. Before we get to her remarkable story, however, we need a little background.

## Migration and reproduction

*Honu,* like most sea turtles, spend nearly all of their lives in their coastal foraging grounds. When they get old enough — a minimum of twenty to twenty-five years or so — the urge to breed begins. They leave their home reefs and swim for a month or more to the nesting beach.

Sometime between February and April, many mature *honu* stop foraging in their home pastures. They begin the long swim to the French Frigate Shoals in the Northwestern Hawaiian Islands. Once there, many of them end up going to the sandy islet called East, where they originally hatched. Like all sea turtles, their natal area calls them to come and reproduce, one of a lifelong series of migrations.

## Navigation

This presents an interesting puzzle. How do *honu* navigate to that tiny speck in the central North Pacific Ocean, across open water devoid of any kind of markers?

We found two predominant theories concerning the way sea turtles navigate: by scent clues and by detecting the earth's magnetic field. Neither of these ideas rules out the other, and in fact, research indicates that both might play some role.

The idea that they navigate entirely by smell has some weaknesses. Scent trails tend to dissipate and of course couldn't be helpful if the destination was downcurrent, as Mokupāpapa is from the main islands. Also, animals following a scent trail usually change course frequently in order to pick up the smell, but satellite tracking has shown that the turtles maintain a fairly straight course toward their goal. Still, other experiments have shown that when the turtles get close to their target, odors probably do help them reach their destination.

It seems likely that some kind of biological compass helps turtles in long-distance navigation. Like all sea turtles, *honu* have poor vision above water, so scientists suspected that navigating by the stars was al-

most certainly out of the question. Sure enough, satellite tracks show that they are able to keep a straight course during overcast conditions and moonless nights.

Is it possible that they are sensitive to the earth's magnetic field? Indeed, some scientific experiments have shown that the earth's magnetism probably plays a role in sea turtle navigation; however, that doesn't seem to be the whole explanation.

*Honu* are probably using a combination of strategies to help them in their journeys, but no one knows which ones or how they are combined. Exactly how they navigate is still one of the great turtle mysteries.

## Who goes?

Not every *honu* of breeding age makes the migration. Females typically nest every two or three years, although some might wait four or even longer. *Honu* mothers aren't necessarily regular, so a female might migrate after two years, then three years, then two again. A lot depends on how well momma has been able to feed in the meantime.

Males aren't on a fixed cycle either. Some migrate annually, some every second year. Some go annually for a while, then skip a year. At our dive site, we've noticed several males with this sort of irregular attendance.

A good example is Nui, a young *honu* we first met in 1990. We had the privilege of watching Nui mature into a fine male. He was missing for the first time in the summer of 1996. Then in 1997, he was absent until late in the summer, when he finally showed up looking skinny and tired—just what you'd expect after a long journey. We think he was at the French Frigate Shoals both years. He was home all summer in 1998 but gone again in 1999. We've recorded similar absences ever since, as well as some late summer appearances in which he looked gaunt and exhausted.

We can't say for sure where he goes, but this pattern fits with what is known about *honu* males attending at the shoals.

## The tribulations of the male *honu*

When Nui does go to the breeding grounds, he has to compete with other males for the joy and privilege of fertilizing the eggs of one or more of the females. This turns out to be a tremendous challenge.

Once he locates a female that isn't already occupied with another male, he has to mount her. He attempts this by hooking the claws of his front flippers onto the shell of his chosen mate. Then he curls his long tail and hind flippers underneath her to secure his position, hooking his

These white patches are tissue that is healing from the bites of competing males. When Blue, a male we've known since 2000, returned from the French Frigate Shoals in 2005, the edges of his hind flippers looked like this. Notice the missing pieces, bitten away by his competition during courting and mating.

hind claws to the side edges of her carapace. Accomplishing this is hard enough, but a female often becomes unreceptive once she's made her first nest (usually during mid-May). She will attempt to swim away. If that doesn't work, she'll press her hind flippers together tightly and curl up her tail in order to prevent Nui from completing his mission.

To make matters worse, rival males will move in on Nui while he's mounted and attempt to dislodge him. They'll bite at his head, flippers, and tail, often drawing blood and lacerating his skin. As the wounds heal, scabs form that will appear whitish yellow underwater. These provide clues that help you recognize a male newly returned from the nesting grounds.

On males, you'll see most of the wounds at the trailing edges of the flippers, both front and rear. Sometimes females also bear mating scars, but not as many as the males. You might see white scars around the back of a female's neck, where the male sometimes bites while mounted. Such nipping might be a signal to the female to head for the surface. *Honu* mating can last hours, and since the male is holding on with all flippers, she has to bring them both up for air.

Even if successful, Nui might be the daddy of only some of the female's

hatchlings. A female might have multiple mates, each fertilizing some of her eggs. Nui has to work hard to perpetuate his genes.

Nui and the other males, having finished their breeding duties long before the ladies have made their final nests, leave the French Frigate Shoals first. The females begin to follow two or more months later. Scientists think that each *honu* migrates alone. The turtles use their little-understood but marvelous navigational abilities to find their way back to the same foraging and resting grounds they started from months before.

## Nesting

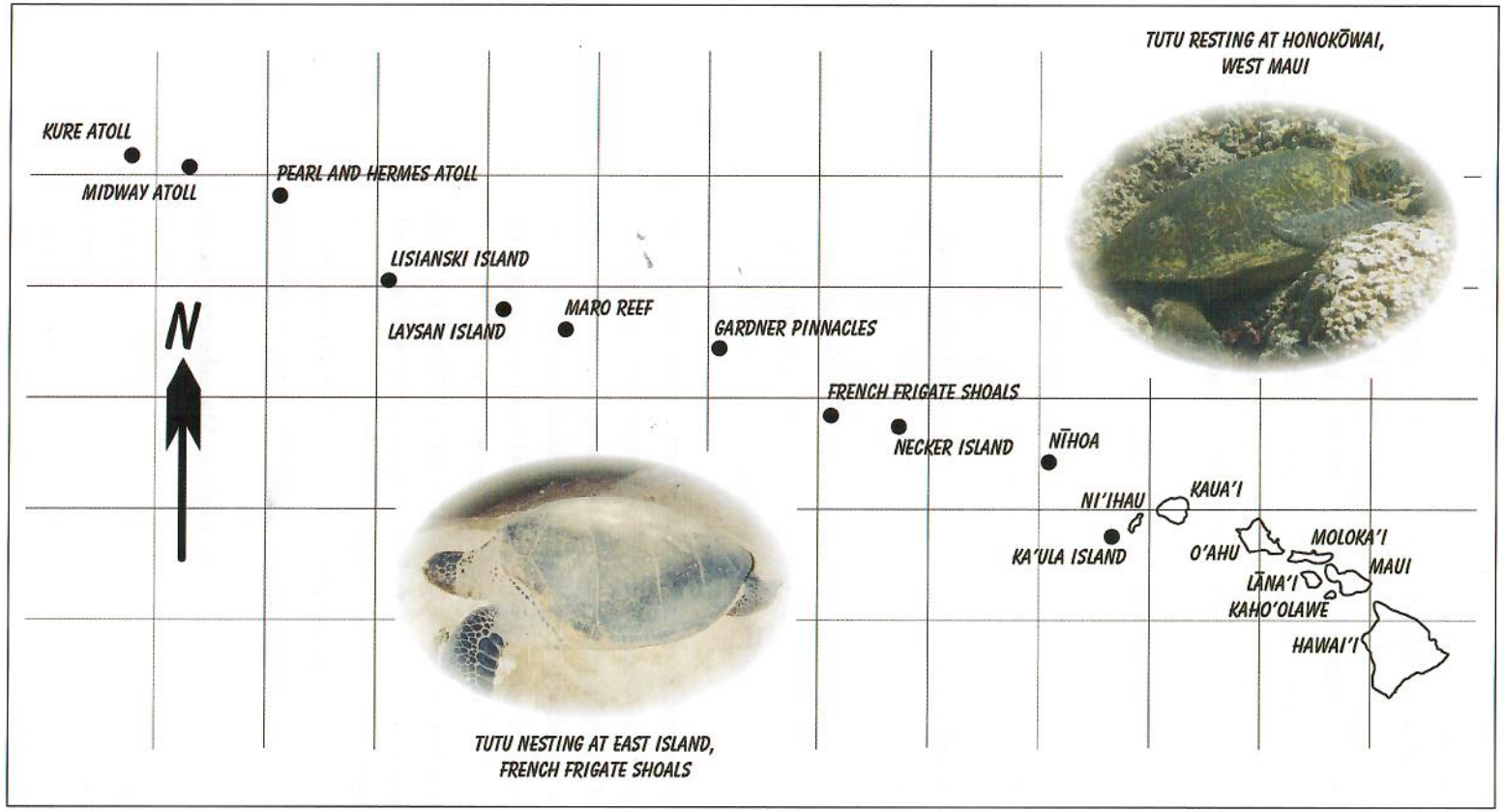
At the nesting grounds, when a female *honu* is not mating she spends most of her time resting nearby. At intervals ranging from twelve to sixteen days, she crawls ashore. She waits patiently until sunset, then slowly and ponderously drags herself up the beach until she is above the high-water mark. There she begins the grueling task of making a nest—or maybe not.

Sometimes, she turns and crawls back into the ocean. She might be partway up the beach, or she might have actually started to dig. Then, something happens and she abandons the attempt. This is what is called a *false crawl*.

In some parts of the world, such as Florida, a turtle might make a false crawl because a light from shore or some movement, perhaps human, disturbs her. At the French Frigate Shoals, these disruptions are unlikely, but *honu* make false crawls anyway. Perhaps the sand is too dry or wet when she starts to excavate, or the temperature isn't right, or her eggs really aren't ready after all. Only the turtle really knows why.

Because the French Frigate Shoals are remote and require permission to visit, we never expected to be in the close company of a nesting *honu*. Then, in 2000, a special turtle began making nests on one of the main Hawaiian Islands. The turtle had an unusual history, but she was absolutely typical when it came to nesting—except for her choice of a nesting beach.

She first attracted attention because one night in May, she crawled up onto a Maui beach and dug a nest. Mary Jane Grady, who loves *honu* as so many do these days, eventually managed to read and record the number from a metal tag spotted on her flipper. Although she later came to be called names such as Maui Girl, her official name is her tag number: "5690."




The Hawaiian chain extends from the Big Island northwest to Kure Atoll. Most *honu* migrate to the French Frigate Shoals (FFS) to reproduce. Tutu certainly does. Tutu was first recorded nesting at East Island in the FFS in 1988. We first sighted her at Honokōwai, West Maui, in 1990. By 2005, Tutu had migrated and nested at East Island six more times. Every time she returned to her home at Honokōwai. According to George Balazs, Tutu holds the Hawaiian record for the most migrations with both end destinations documented.

She began life in 1980 at the French Frigate Shoals as one of 174 hatchlings that George Balazs brought back as part of a study. Sea Life Park on O'ahu raised her and the other hatchlings for a year. Then in 1981, George released her off the coast of the Big Island near Hilo. Weighing just seven pounds, she was rather small to be tagged, but George decided to try anyway. He gave her a single tag, which he couldn't attach as well as he'd like. He thought that it probably would be lost, but nothing ventured, nothing gained. He really didn't expect to see her again.

When she reached twenty—just about the youngest a *honu* momma can be—5690 was ready to breed. As a hatchling she'd never crawled down the beach at East Island, so it wasn't particularly surprising that she didn't head for the French Frigate Shoals with the other *honu* nesters. Her choice of nesting site still surprised everyone, however.

It wasn't a quiet, secluded stretch of sand in some remote part of the Big Island. Rather, it was next to a big hotel in Lahaina, Maui. In the daytime, this is probably Lahaina's busiest beach, and even at night there's plenty of activity. Inevitably, she was spotted. George got a phone call from Mary Jane—and just like that, 5690 was a part of his life again.

By the time 2000 was over, 5690 had made four nests, but we hadn't been lucky enough to see her make any of them. In 2002, however, she returned. This time we were privileged to witness the whole nesting process, with the added thrill of seeing (and helping) George outfit her with a satellite tag. That summer, she made seven nests.

The satellite tracking data revealed that 5690 lived just a few miles northwest of Lahaina, in the Nāpili-Kapalua area, where the *limu* is lush and many other *honu* live—and perhaps significantly, where she was exposed to people, hotels, and lights without any adverse effects.

Returning to Lahaina in 2004, again 5690 made seven nests. She is truly an unusual *honu,* because the average *honu* momma lays only four clutches.

The first time we got the chance to watch 5690, she teased us with a couple of false crawls, but then she decided to get down to business. Like all *honu* mothers, she began by making a *body pit*—a depression about six feet in diameter and about eighteen inches deep. She accomplished this with much determined and vigorous flailing of flippers and slinging of sand, sometimes resembling a mini-sandstorm. Nesting *honu* bulldoze their body pits with power and enthusiasm.

She continued to thrash, her front flippers making loud "thwap" sounds as each stroke finished by slapping against her shell. As she dug

Here 5690 lays eggs at Lahaina, Maui, during her sixth nesting in the summer of 2004. You can see the protective dimple in one of the shells.

deeper, her movements became more and more precise, until she reached damp sand and formed the body pit to her liking. Then she switched to digging purposefully with her feet.

Alternating, 5690 shaped each hind flipper into a huge spoon. Over and over, she scraped a flipper-cup of sand up from the bottom and put it in a little pile next to the hole. At the same time, she flicked her opposite flipper, spraying forward the pile of sand from her previous scoop so that it couldn't slide back.

She was carving out the *egg chamber* — a flask-shaped hole in the sand that widened somewhat as it got deeper and had a rounded bottom. Eventually, she began rocking slightly backward each time she scooped so that she could get the maximum reach from each hind flipper. She was nearly done. By the time she finished, 5690's hind flippers had dug down another eighteen inches.

When she felt that the chamber was just right, she began to lay her eggs. Each egg weighed about an ounce and a half and was a bit larger than a golf ball. The shells weren't hard like chicken eggs. They were

tough and rubbery, with a small dimple in each, indicating that the egg wasn't quite full so that it would not burst when it dropped. (Eggs that develop normally gradually absorb moisture, and the dimple disappears after a few days.)

Like all nesting sea turtles, once 5690 began to lay — two or three eggs at a time — almost nothing could deter her. Sea turtle researchers refer to this as the "egg-laying trance." At the French Frigate Shoals, nesting monitors take the opportunity to approach the *honu* to check for tags, take measurements, conduct a health examination, and mark her shell with an etching tool and paint, all without harm to the turtle. The *honu* ignores all this, concentrating only on dropping her clutch.

In 5690's case, however, none of this went on. We watched quietly from a respectful distance. We couldn't count her eggs as they dropped, but when researchers excavated 5690's nests in 2002 and 2004, they discovered that she usually laid about 75–90. This is smaller than the typical *honu* nest of 100–110 eggs, but 5690 compensated for the small clutch size by making more nests.

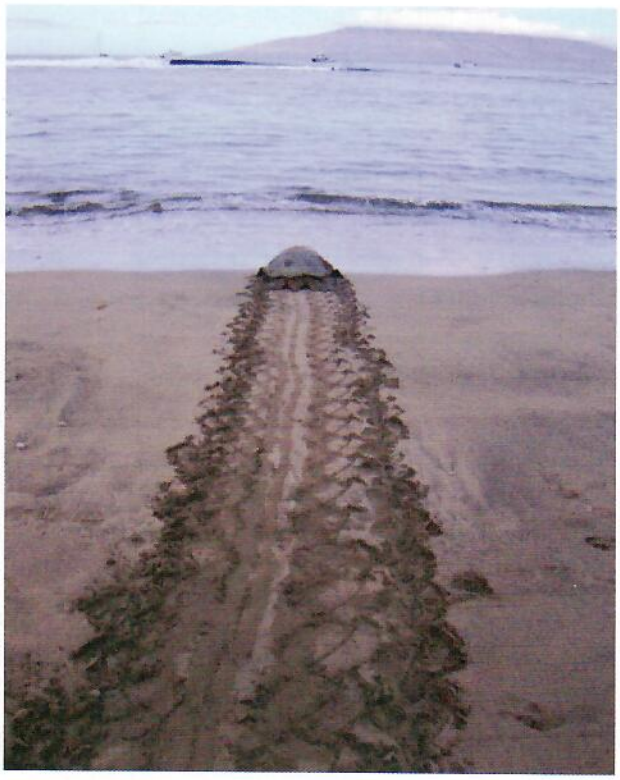
Since she doesn't lay great numbers, 5690 tends to be quick depositing her eggs. From the time when the rocking stopped (indicating the egg chamber was finished) until she resumed movement (signaling that she was covering up), 5690 took only fifteen minutes or so. Other turtles can take up to forty-five minutes.

After all the eggs had been deposited, she began the laborious process of covering the nest. First, 5690 used her feet to push sand into the egg chamber, kneading and packing it carefully. Next the front flippers got going, tossing sand back over the nest. As she did this, 5690 gradually inched forward, obscuring the location of the egg chamber and, of course, the eggs themselves.

Like every nesting sea turtle, concealing the nest was the last motherly act 5690 did for her offspring. It also took the most time. It was an agonizingly slow process that took over two hours and left her drained. Her breathing was labored and audible throughout the ordeal. She took frequent rests, becoming completely immobile until recovering enough energy to continue.

Dawn had long broken before 5690 finished. She took one last extended rest and then began the long crawl back into the ocean, her work done. The buoyancy of the water surely gave her welcome relief. In the way of turtles, her eggs hatched untended, and her offspring had to dig out entirely on their own — something they are well adapted to accomplish.

Above: The egg-laying trance provides an opportunity for identification photos such as this one, taken as 5690 made her fourth nest of 2004. The whitish patch on her back is what remains of the harmless adhesive used to attach the satellite transmitter she carried in 2002. After the batteries ran out of power, George Balazs removed the transmitter during a nesting in 2004, and by 2006 the mark had almost disappeared.



Right: It's not unusual for 5690 to keep us up past dawn, her fourth nest of 2006 being one example. It was 5:37 in the morning before she finished, making this track as she left.

## Hatchlings

Because 5690 nests a few minutes away from where we stay on Maui, she has bestowed another *honu* blessing upon us. We have been privileged to see *honu* hatchlings scurry down the beach. Like most things *honu*, this required a lot of patience and persistence on our part.

Once 5690 makes her first nest of the season, we know that twelve to sixteen nights later, she'll make the next one. Hatchlings are not as obliging. Beginning at day fifty-two, we have to check the area around the nest daily because it's difficult to predict when they'll emerge. The primary reason for this is warmth — or lack thereof.

### Warm or cool?

Temperature is the earliest influence on a *honu* hatchling. Heat profoundly affects egg development in all cold-blooded animals, including *honu*. Temperature has much to do with how successful 5690's clutch will be: how fast the eggs develop, the amount of activity after hatching, and when the hatchlings emerge from the nest. Eggs developing in warm sand hatch in seven to eight weeks, while those in cool sand take longer.

There's even more riding on temperature: the very sex of a *honu*. Whether the embryo develops into a male or female depends on the sand temperature that prevails during incubation of the eggs. At a point called the *pivotal temperature*, an equal number of males and females are produced. Eggs turn out to be mostly females when they develop in sand warmer than the pivotal temperature. Cooler temperatures result in clutches that are mostly males.

Scientists haven't established the pivotal temperature for *honu* yet, but if we assume that it is similar to that of other green turtles, it's around 84 degrees Fahrenheit.

A lot can therefore depend on whether 5690 makes her nest out in the open or near shade, how deep she digs her nest, or what the weather is like that season. Taken further, a breeding summer of unusually warm, sunny days or one of cool, cloudy days could produce an entire season of hatchlings largely favoring one sex.

### The developing *honu*

Whether male or female, a quiet transformation occurs inside each successful egg. A *honu* is happening. Heart, eyes, shell, and flippers form, as do the facial scales and markings that make each creature unique. Yet

for all the individuality of the incubation process, to break free from the sand demands the persistent efforts of all.

The temperature of the nest isn't entirely uniform. Eggs around the edges of the nest are influenced more by external environmental conditions than the eggs at the center, which are warmed by the natural heat of their incubating embryotic neighbors. This not only affects the male-female ratio, it also means that some eggs hatch sooner than others.

These "early birds" don't just crawl up through the sand to the surface and make a run for it. If you've ever allowed yourself to be covered in sand, you know that it often isn't possible to free yourself. Sand is deceptively heavy, and sand that has covered an undisturbed egg chamber for two months is not just heavy. In completing her nest, 5690 has packed it down to some degree. Water from rain or waves can compact it further.

At East Island, the relatively small nesting area for *honu* results in a reasonable chance that other turtles have crawled over the nest, compressing the sand even more. But 5690's hatchlings face a different problem: They're buried under a busy beach that thousands and thousands of feet trample during their incubation. Fortunately, when 5690 makes a nest someone ropes off the area almost immediately. The guardian is often a state or federal official, but it's just as likely to be a regular at the beach, such as a surfing instructor or a local resident.

Her hatchlings need all the help they can get, because getting to the surface is no small feat.

## Group action

The struggle to the top isn't just about fighting your way *up*. It's also about sifting the sand *down* from above to raise the floor. Creating this sand "elevator" begins as a barely perceptible process, a few grains at a time.

Hatching itself—simply breaking out of the egg—loosens some of the sand in the egg chamber. The eggshell collapses. Since the volume of the unhatched egg is greater than that of the hatchling and the broken shell, this makes room for sand to trickle down. The first little turtles to hatch wriggle about and loosen the sand even more.

Like children forced to share the same small bed, the movement of one youngster stimulates the others. Many hatchlings, squirming around together, move more and more sand. The top and sides of the nest collapse. The sand sifts down to create a new floor. Together, 5690's clutch slowly rises toward freedom.

All of this work doesn't happen quickly. The little turtles take several days to struggle up and out of their nest. The process of raising the bottom of the nest is slow and takes place in fits and starts, with long rests in between.

This group effort maximizes the number of hatchlings that will eventually make the mad dash down the beach. Like all sea turtle hatchlings, *honu* use mass emergence as a survival strategy.

At the French Frigate Shoals, the predators know when the turtle nests begin to hatch, and they're waiting. Being part of a crowd reduces any single individual hatchling's chances of being eaten. Though 5690's hatchlings don't have to face a gauntlet of birds and crabs, they don't know that. Instinct prevails, and they still act together.

When the top turtles are within an inch or so of the surface, temperature comes into play one last time. If the top layer of sand is hot, it means that it is likely daytime and the sun is beating down. The hatchlings stop moving, waiting for the sand to lose its heat. Cool sand means that it is probably night. The hatchlings instinctively know that night is the best time to emerge. After dark, they avoid the potentially deadly heat of the sun, and it's harder for predators to see them.

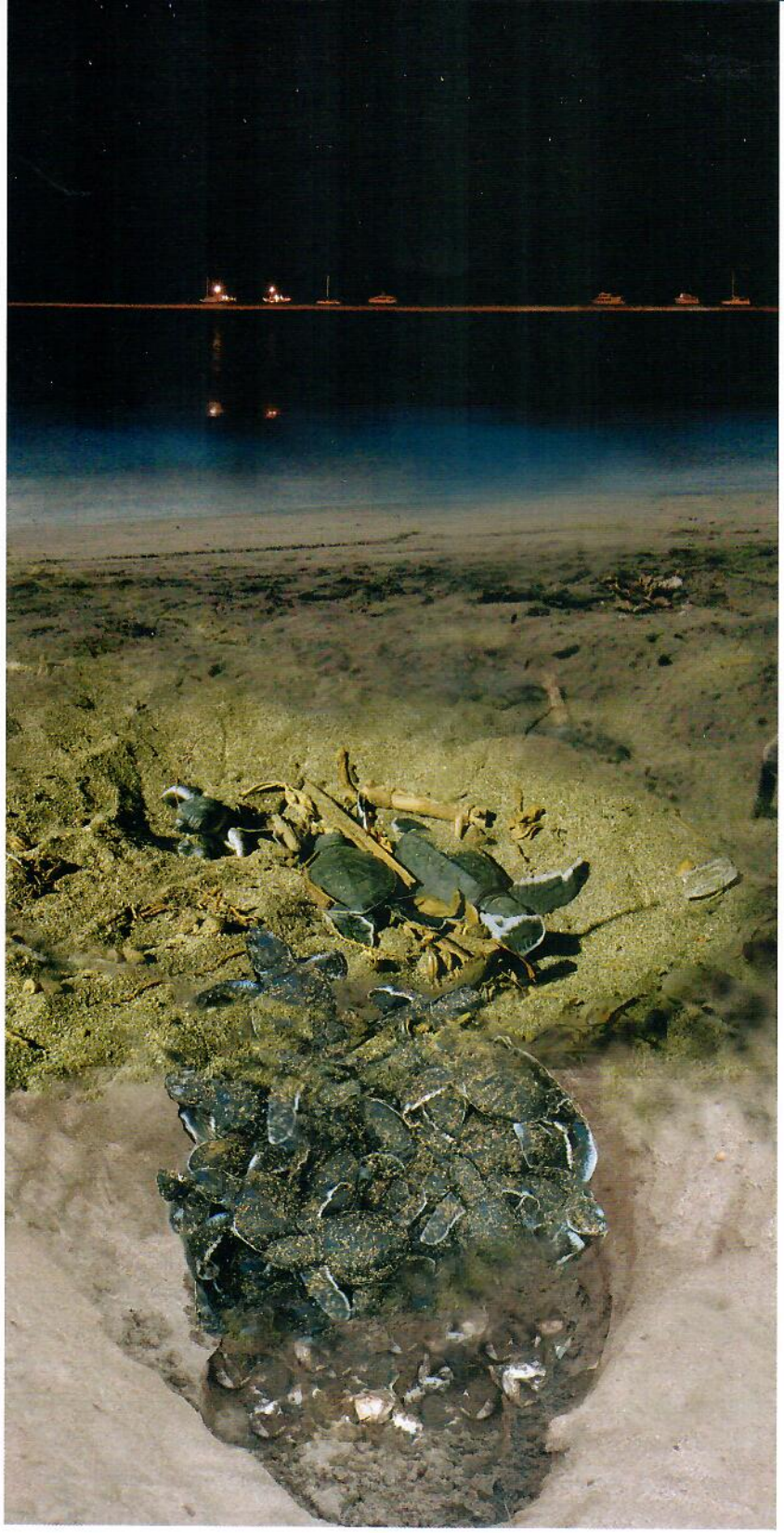
## The great escape

This point in the process gives nest watchers like us the first clue that hatchlings are almost ready to emerge. At the surface, the sand collapses into a shallow funnel shape. Sometimes we can see little *honu* beaks or perhaps the tip of a flipper protruding from the sand.

The first time we saw parts of hatchlings poking out, we got excited. We thought that at any second, 5690's hatchlings would wriggle out and run for the water. We waited. We waited some more. We waited a long, long time — over three hours. The tiny turtles remained completely stationary, with eyes closed. By then, we were wondering whether they were really alive.

They were. This turns out to be a normal behavior, frustrating though it might be to human observers. They were waiting for some signal — just what, we don't know — before the mad dash began. Perhaps they were gathering energy, or perhaps this suspension is necessary for imprinting. Who knows — maybe they just wanted to snooze together for one last time.

*Imprinting* is the term describing the instant and irrevocable conditioning that happens at a particular stage of life, most often shortly after



Composite of several digital photos with hand-drawn fine detail enhancements. This image represents the experience of 5690's hatchlings on the night they leave the nest. The constellation known to Hawaiians as "Maui's Fishhook" (the tail of Scorpius) greets them from above.

birth. The most widely known example is the way certain bird types bond with an object soon after hatching. This is usually a parent, but it can be an inanimate object or even a human.

When *honu* break out of their eggshells, there is no mother to care for them, but scientists believe that the tiny hatchlings undergo an imprinting process every bit as powerful and permanent as those of baby birds to their mother. Instead of connecting with a caretaker figure, however, sea turtles imprint on a location: their natal beach. In the 1990s, DNA studies finally confirmed the widely held belief that female sea turtles returned to nest on the beach where they hatched. For more than 90 percent of *honu*, this means the islets of Mokupāpapa, and most likely East Island.

Yet almost all *honu* hatchlings, once they erupt from the nest and rush into the ocean, never see or feel East Island until they make their first breeding migration decades later. The intriguing question, therefore, is how do they recognize their natal beach?

Dr. Archie Carr, the father of sea turtle research, hypothesized that hatchlings imprint the smells of the nesting beach during their crawl from nest to ocean. Other scientists have speculated that they might imprint other chemical cues, such as tastes, from the beach or the ocean or both. For this reason, when turtle nests are excavated and hatchlings rescued, they are set down and encouraged to scramble to the water on their own.

Studies of sea turtle navigation suggest another possible form of imprinting: The developing brain could be stamped with a sense of location based on the earth's magnetic field.

No one knows for sure how imprinting works in sea turtles, but it is clear that something tells them where they started life. Imprinting doesn't mean that sea turtles *must* nest on their natal beaches, however. If a nesting beach is destroyed or made unusable, or if imprinting is imperfect, the turtles do nest somewhere else.

Whether 5690's hatchlings were imprinting or not, one instant they were all motionless and the next they were all astir. First the two or three at the surface awoke. Then more and more black bodies struggled free from the sand. For a few moments the horde milled about, then as if by signal, off they charged.

Little *honu* dashed toward the waves. The frantic motions of their tiny flippers revealed an instinctive urgency, compelling them to get off the beach and away from shallow coastal waters quickly, for that's where they're at most risk from predators.

A hatchling, one of 5690's offspring, reaches the ocean. This one was a straggler, rescued during excavation from certain death at the bottom of the nest. If this is a female and her good luck holds, she will return to this beach sometime around 2020 to make her own nests.

No one is certain how newly hatched turtles know which way the ocean lies, but experiments have shown that they seem to take their cue from the brightest and lowest horizon. The ocean surface reflects more light than land, and beaches normally slope toward the water.

This intuition can be the death of a hatchling, because visual clues (bright light) tend to be more important than slope clues. In some parts of the world, this means that they head inland toward buildings and streets. Most *honu*, however, are lucky. There are no lighted structures or streetlights to confuse them in the remote, isolated French Frigate Shoals.

Because she makes nests on a beach with numerous lights in sight, 5690 is a special case. Her hatchlings are at greater risk, but they have offsetting luck. Her nests are known, marked, and monitored. Her offspring have a good chance of getting help should they head in the wrong direction.

There was no need to redirect the little ones we saw emerging. Two or

three of them headed off at a bit of an angle, but all of them knew which way to go. We watched in wonder as the tiny turtles scurried through the surf and into the ocean. Within minutes, the surf swept up the last miniature *honu,* and then there was just an occasional black blob on the surface as one of them popped up for air. For us, it was over.

For 5690's hatchlings, it had just begun. Waves close to shore move directly toward the beach, so they instinctively swam straight into the swell. This took them out to sea. Her hatchlings — each unique one — had left the sand for the uncertain life of the open ocean.

## The "Lost Years"

Once in the water, their little flippers worked madly in a "swimming frenzy." This is a period of continuous swimming that lasts from twenty-four to forty-eight hours. It's nature's way of getting them far away from the birds, crabs, and reef fish that prey on them and out into the *honu*'s nursery: the currents and gyres of the North Pacific.

Where were they headed? Aside from the answer, "Out to sea," nobody really knows. Once they've left the beach upon which they hatched, *honu* begin the oceanic stage of their lives: their "Lost Years."

Dr. Archie Carr coined the term "the Lost Year" to describe the pelagic stage — the mysterious period between the time hatchlings scamper down the beach and when they show up later (and much bigger) at their foraging grounds.

At first, it was the Lost Year because scientists thought that was how long the pelagic stage lasted, but we know today that it lasts multiple years — how many, no one can say. It could vary from species to species or even from turtle to turtle.

What happens during the Lost Years? All we know for sure is that they "go and grow." At this stage in their lives, *honu* are opportunistic feeders. Obviously, at sea they can't get the bottom-growing seaweeds they'll eat later in life. Hatchlings are therefore omnivores, eating macroplankton and anything else they can find in the open ocean. Whatever they eat, they find enough of it to grow from the tiny hatchlings we see disappearing into the ocean to the dinner plate–sized juveniles that show up in nearshore waters.

For *honu,* the latest studies indicate that this period probably lasts from four to six years. Exactly how long, where, and how far they travel remain elusive mysteries. Until someone invents a transmitter tiny enough to attach to a hatchling, this part of the *honu*'s life is completely "lost."

"Lost Years" is an excellent term when you think about it. These tiny turtles are lost to scientists and conservationists in the vastness and vagaries of the ocean. Out there, scientists can't study them and conservationists can't protect them. It is easier to find a specific grain of sand on Waikīkī Beach than a palm-sized hatchling in the central North Pacific. Baby *honu* might as well be on the moon! Fortunately, Mother Nature has a way of looking after her own.

## New arrivals

Scientists refer to the smallest and youngest sea turtles that you will see on the reef as "recruits." The term refers to the fact that these youngsters are recent arrivals that are just beginning to settle into their new homes, where they can finally touch the bottom. They're "recruited" into the local coastal population from the open ocean.

It probably won't take long for a little *honu* that has decided to stay in a particular underwater area to come to the attention of humans. People who don't venture into the water at all might see a tiny head popping up in the shallows as the youngster comes up to breathe. Snorkelers and divers might spot the little *honu* tucked under a ledge or actively swimming about.

You'll find it easy to recognize recruits. The shell is roughly the diameter of a large pizza — about fourteen inches — but more heart shaped than round. The scutes along the edges are scalloped rather than smooth. The plastron is still pure white. Their shells and skin are remarkably free of the green fuzzy algae and barnacles that eventually collect on the carapace, plastron, and even the head of older, larger *honu*. Put another way, the shell is like a precious stone, with a sunburst pattern of brilliant gold and yellow highlights streaked through a lustrous, warm brown.

As beautiful as recruits are on the outside, they're every bit a gem on the inside too. That's because they have brains that can learn — tiny brains to be sure, but brains that are also curious and can benefit from experience. *Honu* recruits are all promise, so if you encounter one, remember that they are impressionable and still learning. How you behave might have a significant effect on the little *honu*'s future attitude toward humans.

Recruits are surprisingly varied in temperament. When they meet up with a human, the response can range from confident approach to all-out flight, although most youngsters are caught up in a delicate dance between curiosity and caution.

When you think of recruits, think adaptation. This is the time in a *honu*'s life when dramatic changes occur. Their habitat changes from pelagic (the open ocean) to benthic (the ocean bottom). For *honu*, this means waters close to shore. Their diet changes from omnivorous (anything edible) to herbivorous (seaweed, or as *honu* would call it, *limu*). The threats change, too.

Out on the high seas, while they are tiny, the threats are almost entirely of two kinds: large fish that might eat them and, much less likely, garbage that might seem edible but actually can kill them.

Inshore, there are still sharks that can devour them, but recruits have grown enough to be safe from the other big fish they might encounter, such as jacks or barracuda. Now humans or human activities become threats: fishing lines and nets, boats, and of course, pollution from agricultural runoff and sewage.

To humans, recruits are just about the cutest things in the ocean, so it is hard to resist the urge to touch. The turtles can easily avoid contact in most cases, however. The danger to the little *honu* might be minor, but touching and grabbing does teach turtles that humans are not to be trusted and are best avoided, so please resist the urge: Don't touch.

If you are lucky enough to see a recruit, keep your distance and watch. The little *honu* might approach you if you're quiet and nonthreatening. If you're really lucky, you might get to see the youngster at play.

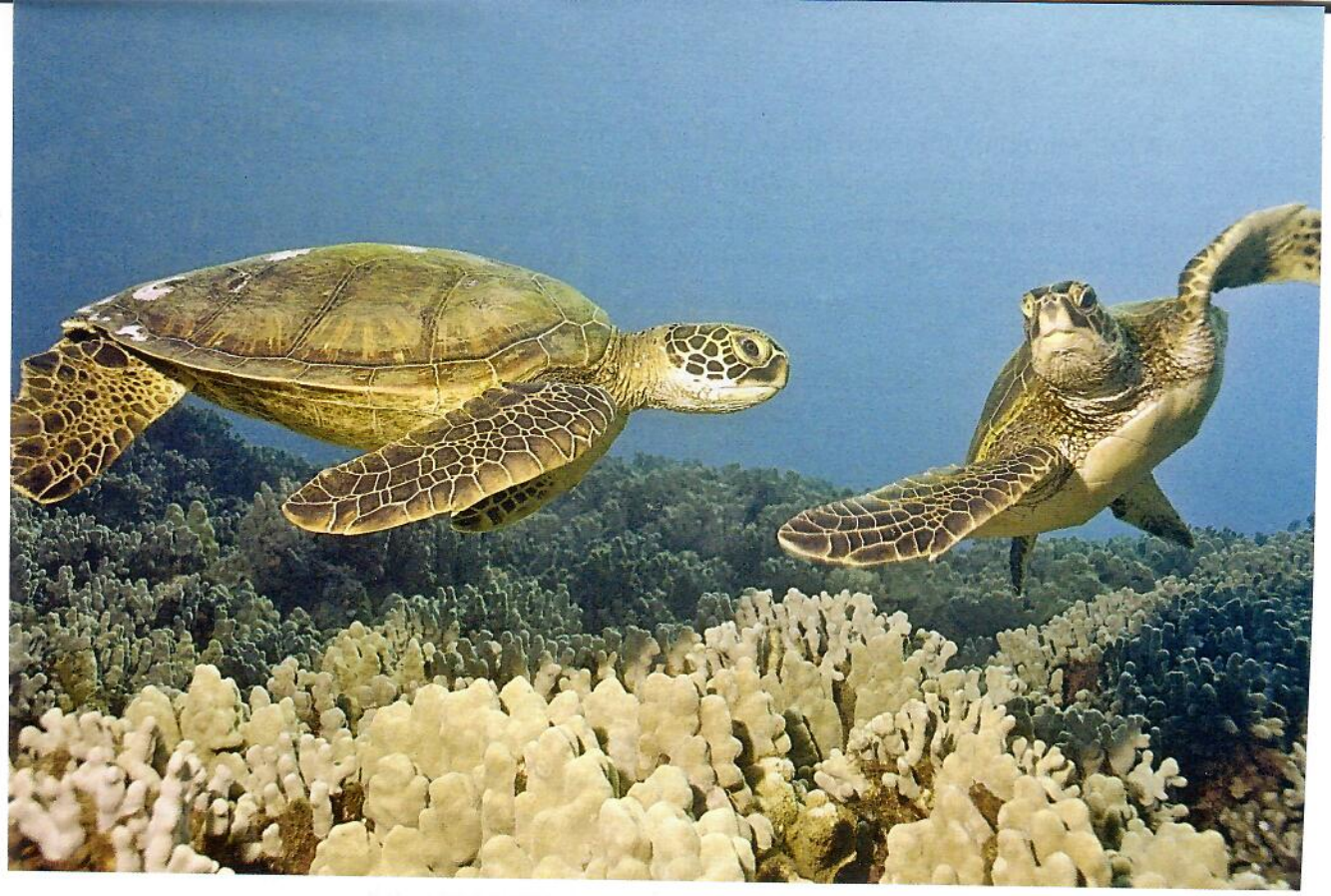
Like kiddies everywhere, young *honu* engage in what we can only interpret as play. We've been delighted to observe this behavior on a number of occasions.

In 1998, we met a little recruit with a shell so spectacular and beautiful that we named the youngster Makana, which is Hawaiian for "gift."

In 1999, we started spotting the tiniest recruit that we'd ever seen — so small that we couldn't help bestowing the name Akebono, after the huge Hawaiian-born sumo wrestler.

One afternoon we watched Makana purposely swim up to a resting Akebono and nudge the smaller *honu* into what certainly looked like a game of tag-and-chase. For several minutes, they circled round each other, occasionally making contact but mostly just chasing each other's tails. They certainly appeared to be enjoying themselves.

We've also seen young *honu* rise up from resting on the bottom and face into a strong current, then swim at just the right speed to hover: *honu* surfing! Why? Perhaps the turtle enjoys it and gets some exercise without having to go anywhere.



Juvenile turtles seem to enjoy play. This is one of our most delightful and memorable observations. In 1999, Honokōwai was blessed with two young turtles, Makana (left) and Akebono (right). It was terrific to watch them play—and funny too. The game never involved chasing each other over large areas of reef but rather a compact circular chase, a dance of round-and-round where one would try to nip the tail of the other. If the chasing turtle got close, the youngster being chased would squirt out of the way at the last second, often tilting the shell. It eventually occurred to us that this game had a serious side when we saw Makana use the same "ballet" on a blacktip reef shark following Makana round-and-round. Watching Makana draw ever-tighter circles, we realized that even *honu* fun could have a practical application.

In some ways, the recruit stage resembles a children's kindergarten. There are lots of lessons but with time off to have a little fun. "Recruit" isn't a precisely defined term, so it isn't easy to say how long this period lasts—but it's short, especially in terms of the potential lifespan of a *honu*. Once the gloss is off the shell, the algae is on the skin, the plastron begins to yellow, and the diet has become predominantly *limu*, the little turtle graduates from kindergarten and joins the big kids in the first grade: the juveniles.

## Younger and older *honu*

Turtle biologists in Hawai'i divide *honu* into life stages using the terms "juvenile," "subadult," and "adult," yet they rarely know how old they are. Instead they apply the rough principle that older is bigger. Scientists call *honu* "juveniles" until their straight carapace length reaches sixty-five centimeters, or roughly twenty-five inches. At that stage, *honu* are known as "subadults" until they grow to minimum breeding size, at which point they are called "adults." For *honu*, that's greater than eighty-two centimeters, or just over thirty-two inches.

As turtle watchers, we don't need to be that precise about the divisions. Just think of them as youngsters and oldsters. In fact, the only reason we make the distinction at all is to point out a few differences in behavior.

The young ones are more active. They are more likely to forage during the day, and they seek food more often. Because younger turtles are still developing lung capacity and efficiency, they need to stay closer to the surface and breathe more frequently. As they get older, their lungs develop and the time they can stay beneath the surface gradually increases.

Active turtles need to breathe more often, just like active humans. For example, during feeding *honu* pop their heads up for a quick breath every five or ten minutes. When they are resting on the reef, however, they usually stay down for thirty to forty-five minutes, and sometimes longer. A resting adult *honu* would have little trouble staying under for a couple of hours.

This might explain why younger *honu* usually settle fairly close to shore in a *puka* (Hawaiian for "hole") or under a ledge. The water is shallow, so it's easier to go up to breathe, and they're close to food. Besides, inshore they get more protection from sharks, which tend to remain in deeper water.

Some places are called "developmental habitats" because they attract almost exclusively small, young turtles. The characteristics are ideal for small *honu*, but as the turtles get bigger they outgrow the area. They begin to find that water is too shallow, and they can no longer fit in a *puka*. As *honu* youngsters gradually become oldsters, they start spending the day in deeper water, lying around on the corals most of the time. That's why we call the deeper reefs "resting habitat."

The bulk of their daily activity consists of occasional trips to the surface for air. In our dive area, bigger *honu* don't forage much during the day, usually eating in the late afternoon and early evening or around dawn.

Facing page: We see males attempting to mount other *honu* occasionally, but the turtle on the bottom is almost never female. This was one of the rare exceptions. It wasn't a successful mating, since the incident lasted only a couple of minutes before the pair went to the surface and separated. If the male had achieved his goal, the couple would have stayed together for hours.

Of course, the biggest distinction between youngsters and oldsters is the one that determines the true adults: Mature *honu* migrate to breed.

There is one more behavior that older turtles exhibit. You just might see mounting—a male grabbing another turtle from behind and holding on.

Perhaps you noticed that we haven't mentioned the sex of the mounted turtle. This is because males—at least the ones we've observed—don't discriminate. The *honu* on the bottom *could* be a mature female, but in our experience that probably isn't the case, since most of the mounted pairs we've seen turned out to be males mounting other males. Fortunately for the victim, these episodes are invariably short.

There are also stories told about male turtles attempting to mount divers. We didn't take these seriously until it happened to us. The male turtle approached from behind and tried to grab hold. Why do they do this? We don't know. Perhaps it is a dominance behavior.

There is another interesting aspect to the mounting that we've seen: Other males in the vicinity rush to the scene of the action. How they know something's up, we can't say, but the dash to get there is one of the times when we've seen a *honu* at full speed—and that's impressive. It's much like the way kids rush into the school cafeteria after someone shouts, "Food fight!"

Aside from these few points, you won't notice much difference between the young and old. Dividing them up is useful when scientists want to study them, but for turtle watching it's not necessary. On the other hand, it is useful information if you're reporting a sighting.

## Sorting out the sexes

Without the minor surgical procedure of a fiberoptic internal examination and the drawing of blood for analysis, you can't tell the sex of a young *honu*. You have a better chance as they grow older because of the adult male's tail, but it's still hard to tell females from the larger adolescent males. There are hints, but we've been fooled time and again, so we use them with caution.

Male-male mounting turns out to be so common where we dive that when we see two positioned turtles, we assume it's a male-male mount rather than male-female mating. In this picture, the long tails identify all three *honu* as males. The *honu* doing the mounting hangs on with his flippers and claws. The mounted turtle isn't happy and is rolling to dislodge his "friend." Typical of these incidents, a third male has arrived and is doing his best to intrude.

One clue is that females, top to bottom, are thicker than males. Most mature females have a carapace length of at least thirty-five inches, so that's a second indication. If a *honu* is clearly bigger than that *and* looks a bit rotund *and* still has a small tail, we cautiously assume we are dealing with a female.

Another clue is a small tail on a turtle that has been absent for a summer —the sign of a possible nesting migration. Even then, we can't be sure she's female unless we know that the *honu* has been confirmed nesting.

Until 1997, this meant that she would return from the nesting grounds sporting shiny new tags on her flippers. Because *honu* are generally tolerant, we'd eventually have an opportunity to read the tags without dis-

These pictures show the identifying number 278 that was harmlessly etched on Tutu's shell when she nested in 2004. Engravings like this make the *honu* readily identifiable from a distance both above and below water.

turbance, report the numbers to George Balazs, and get a confirmation that she'd nested.

Then the monitoring team at the French Frigate Shoals abandoned external tags and switched to small internal passive integrated transponder (PIT) tags, which require a special reader. These tags are actually microchips, safely inserted with little discomfort just under the skin of each hind flipper. While they are great for scientists, this means they no longer attach the visible tags that tell us the turtle is probably a female.

The field team also adds an additional marking that helps us, but it isn't permanent. They use a tool to make a small shallow "etched" number about an inch and a half high on the nester's shell, which is then painted white. This is harmless to the turtle, somewhat like clipping your fingernails. For about a year afterward, this marking is visible on her carapace. If you see a *honu* with fresh white letters or numbers on her shell, it is most likely that she nested that summer.

Unfortunately for turtle watchers, eventually the markings fade from view. How quickly this happens depends on several factors, including how much and what type of algae collects on the shell and, of course, since they are like fingernails, the growth rate of the scutes.

# THE BOOK OF HONU

## Enjoying and Learning about Hawai'i's Sea Turtles

PETER BENNETT AND URSULA KEUPER-BENNETT

# HONU

Enjoying and
Learning about
Hawai'i's
Sea Turtles

# To Clothahump

Clothahump, the first sea turtle we ever met, known at our dive site from 1988 to 1993. Sketch in watercolor pencil on illustration board, 10" x 15". Ursula Keuper-Bennett, winter 2003.


Printed in the United States of America

14 13 6 5 4 3 2

**Library of Congress Cataloging-in-Publication Data**
Bennett, Peter, 1947-
The book of honu : enjoying and learning about Hawai'i's sea turtles / Peter Bennett and Ursula Keuper-Bennett.
p. cm.
"A Latitude 20 Book."
Includes bibliographical references.
ISBN 978-0-8248-3127-1 (pbk. : alk. paper)
1. Green turtle — Hawaii. I. Keuper-Bennett, Ursula, 1949– II. Title.
QL666.C536B46 2008
597.92'809969 — dc22

2008008660

University of Hawai'i Press books are printed on acid-free paper and meet the guidelines for permanence and durability of the Council on Library Resources.

Designed by April Leidig-Higgins

Printed by Sheridan Books, Inc.

# Contents

# Acknowledgments

This book would not exist without the help and encouragement of numerous people. First among these is our mentor and good friend George H. Balazs, who taught us not only about turtles but also how to approach a subject (not just turtles, but any subject) in a thoughtful, rigorous, and scientific manner.

We are equally indebted to Jose Danobeitia, one of the original founders of MVS Solutions Inc. and president since its inception. His support for our efforts has never flagged, and without it our turtle experiences simply would not have been possible.

We also must thank (in no particular order) Eve Clute, Skippy Hau, Glynnis Nakai, Tim West, Randy Miller, Mickey McAfee, John Gorman, Kalei Tsuha, all the owners of Captain Nemo's/Pacific Dive over the years, the numerous beach people of Kamehameha Iki Park (who have helped protect 5690's nests and hatchlings), and especially Blue Robinson of the Nohonani and its resident managers, George Kragca and Pete Macdonald (both deceased), Pat Cerretani, and Bill Lentz. Special thanks to Wayne and Margot. Thanks to our editors Keith Leber and Lee S. Motteler, and to the University of Hawai'i Press for taking on this project.

Finally, thanks to everyone who cares about the turtles. They need all the friends they can get.

UNIVERSITY OF HAWAI'I PRESS

Honolulu, Hawai'i 96822-1888

Cover Photos: U. Keuper-Bennett/P. Bennett

Cover Design: April Leidig-Higgins

ISBN 978-0-8248-3127-1

www.uhpress.hawaii.edu

HAWAI'I NATURAL HISTORY

This is the first guide to finding and observing Hawaiian green turtles, or *honu*. It describes an exciting journey of discovery undertaken by two avid sports divers, Peter Bennett and Ursula Keuper-Bennett, who encountered their first *honu* twenty years ago while diving off Honokōwai, Maui. The Bennetts soon realized that many *honu* (and green turtles worldwide) were afflicted with debilitating and potentially deadly tumors. They began to document the disease using photographs and videotape and in the process educated themselves about the daily lives of *honu*. To their surprise, they discovered they were the first to make prolonged observations of a marine turtle population in its natural habitat.

Drawing on their extensive experience, the Bennetts explain how to find and watch *honu* from shore and while snorkeling, kayaking, and especially diving. They describe the behaviors they have documented over the years and what they might mean. Their rich collection of photographs will introduce readers to *honu* not only as a species, but also as individual animals whose histories they have closely followed and recorded. This special group of *honu* includes Clothahump, the one who started it all; Tutu, who has made the 500-mile migration to her nesting grounds at least six times and shown amazing fidelity by returning to the same spot on the reef after each migration; 5690, who vanished for twenty years until she decided to make her nest on the busiest beach in Lahaina, Maui; Nui, a youngster suffering from tumors who went on to beat the disease and mature into a handsome adult male; and George, the survivor of a particularly vicious shark attack.

Thanks to a highly successful conservation and research program and protection granted by the U.S. Endangered Species Act, encounters between sea turtles and humans in Hawai'i have become common. Accessibly written and extensively illustrated, *The Book of* Honu will alert turtle enthusiasts and others on what to expect when they come across these gentle creatures and how to observe them respectfully.

Since 1988 Peter Bennett and Ursula Keuper-Bennett have journeyed every summer from their home in Ontario to West Maui to dive with and learn from *honu*. They pioneered the use of underwater photography and videotaping in the study of *honu* and in 1995 developed Turtle Trax, the first web site devoted to sea turtles.