

MANUAL FOR THE MONITORING OF SEA TURTLES IN THE CAPE VERDE ISLANDS



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1. INTRODUCTION

To actively protect sea turtles on their nesting beaches, it is essential to obtain knowledge about trends in abundance. The way sea turtles live makes it extremely difficult to identify how many individuals there are in a population at any point in time. Due to practical problems, given their entirely marine life with limited visibility and great oceanic dispersal, counting males or juveniles is currently quite difficult and imprecise. Counting females and nests on beaches during the nesting season is the best feasible but still imperfect method, since *only an unknown portion of adult females nest every season*. It is impossible to know the real number of females in the population by merely counting females and nests in a given year. The number of nesting females can vary greatly from year to year and it is therefore advisable to count them incessantly in subsequent years. Variations in nesting females between years can be independent of general population fluctuations and be due to chance or (unknown) environmental factors. Since the work has to be done at night and the majority of individuals must be marked and recaptured in order to be effective, carrying out censuses of females is complex. Yearly *censuses of nests* is suggested as the most effective method and the best way to obtain knowledge about the abundance of individuals in a population, their numerical development over time, the conservation status of the population and the effectiveness of conservation measures. The capture frequency of females and poached nests on beaches also requires counting the numbers involved.

In every island or study area in Cape Verde, a Research Coordinator responsible for activities and databases will be nominated. Furthermore, there will be several technical experts in charge of conservation, censuses and recording information. All technical staff will receive specific training prior to the start of their work. Female and egg management on beaches, identification of turtles and nest tracks and the correct collecting of data will be especially emphasized.

It is advisable to subdivide the coast of each island into sectors and to plan all actions by sector. Each sector must be suitable to be surveyed on a daily basis. In order to choose sectors, the following criteria should be used: inclusion of complete beaches, accessibility, nest abundance and logistical considerations. Furthermore, identification (a unique name) and precise demarcation of all study beaches, with the help of cartography and aerial photography (at least in beaches of more than 50 m in length) are essential. If feasible, the limits will be marked by GPS and/or geographic coordinates at the beginning of the program. The beach will thus become the study unit and for any census or other type of information, the precise reference of the beach and its length will always be known. All censuses will be carried out on a daily basis, covering complete beaches and counting all nests made at complete nights, with a maximum and homogeneous effort along the entire beach. For each piece of information, precise spatial (actual beach or group of beaches) and temporary (exact day or number of days) information must always be provided. Ambiguous or misquoted data are of only limited value and do not allow to rigorously estimate abundance, make comparisons or evaluate trends.

2. OBJECTIVES AND PRIORITIES

Activities on beaches have the following prioritized objectives:

Priority 1 – Essential priorities

- **Protecting breeding females** in order to prevent them from being disturbed or captured.
- **Protecting nests and hatchlings** in order to prevent them from being destroyed or disturbed by natural causes or beach disturbance and/or predation by animals or humans.
- **Carrying out a census of the number of nests on beaches** in order to obtain knowledge about the abundance of turtles and their numerical development, as well as about important nesting areas so as to plan their protection.
- **Carrying out a census of the number of poached females and plundered nests** in order to assess the magnitude and status of the main conservation problems, as well as to identify risk areas and seasons and to assess the effectiveness of protection programs.
- **Saving turtles** found on land which for any reason cannot return to the sea.

Priority 2 – Advisable priorities

- **Marking and identifying individual breeding females** in order to discover connectivity between beaches and islands, as well as to estimate survival rates in females.
- **Monitoring nests *in situ* until the emergence of young** in order to assess hatching and productivity success, important beaches for incubation and sex ratio.
- **Carrying out a census of hatchling emergence** and assessing the success of their entrance into the sea.
- **Transferring threatened nests** to safe places on beaches or controlled incubation in corrals to strengthen the productivity of the population.

Priority 3 – Additional priorities

- **Obtaining basic scientific information**, integrated into research programs about ecology and the biology of sea turtles.
- **Identifying occasional nesting of other species.**
- **Conserving other threatened species.**
- **Training experts** in ecology and conservation along with technicians in vigilance and monitoring.
- **Developing and divulging environmental education programs.**
- **Contributing to sustainable development.**
- **Collaborating with ecotourism activities** as an important element of sustainable development in local communities.

Every participant in the activities must know and follow these objectives, in order to understand the correct procedures in each situation.

3. DIRECT PROTECTION ON BEACHES

3.1. Protection and rescue of females

Direct protection of breeding females on nesting beaches is a priority action carried out during **nocturnal surveillance**. Beaches of higher nesting abundance must be prioritized. The **nesting season** must be taken into account, being mostly from 1 June to 31 October for the loggerhead turtle *Caretta caretta* in Cape Verde. Periods of high poaching pressure, such as the start of the laying season and dates prior to local festivities, must also be taken into consideration.

Frequency and duration of nocturnal surveillances will depend on the number of available night observers, on the length and accessibility of the beach, the predicted number of females that use the beach and, finally, the risk and amount of poaching and other human pressure. Bearing in mind the standardization and planning of the work, nocturnal surveillances are classified as:

- + **constant** – if a given beach has continuous and direct protection, with observers being present each night;
- + **frequent** – if a given beach has direct protection between one and six times a week, with continuous presence of observers on days during which poaching pressure increases;
- + **sporadic** – if a given beach has direct protection less than once a week, on random and unforeseeable nights only.

Surveillance schedules must be planned according to the most active hours of female turtles, usually during neap-tide or new moon phases, and also according to the behavior and habits of poachers. Extreme routine surveillance actions on beaches must be avoided. Carrying out continuous surveillance activity from sunset to dawn must be considered.

Observers should walk on the sand in groups of 2-4, slowly, quietly and without regular use of artificial lighting. They must wear discretely colored clothes, integrated into the nocturnal landscape, facilitating their camouflage. Beaches must be walked on wet sand, next to the sea, in order to make it easier to observe turtles' trails, without disturbing nesting. When a fresh track is found, the most experienced observer must carefully follow the track to establish if nest site selection and the nesting process are proceeding appropriately. Depending on beach morphology, particularly the presence of dunes and shrub vegetation, it may be advisable for a second group to patrol, walking through dunes and scrubland, paying special attention to lost, turned or disoriented turtles and also to the presence of other people on the beach.

3.2. Nest and hatchling protection

Direct protection of nests and hatchlings is carried out by **night and daytime surveillance** and also by several **complementary activities**, such as the installation of corrals or stations for controlled incubation. Procedures, schedules and intervention periods must be in accordance with logistic requirements and local circumstances. Technicians must always adopt a **proactive attitude** of intervention, determined by a detailed assessment of risks and priorities. The most important threats to nests are:

- + **nest destruction due to natural causes**, such as runoff erosion after torrential rain, excessive clay, flooding by extreme tides;

- + **nest destruction due to mechanical impact**, such as beach compaction by human activities, including vehicular traffic and tourism furniture;
- + **high nest predation** by animals such as crabs and dogs and poaching by humans, as well as artificial nighttime lighting on beaches important for hatchlings.

This assessment will suggest the **minimum** or **effective** option of intervention strategies. If a nest is left *in situ* on the beach, in the same place where it was laid by the female, this is considered a **minimum** proactive intervention strategy. If technicians relocate eggs to controlled incubation corrals, following a set of recognized procedures, this is considered an **effective** proactive intervention strategy.

Direct hatchling protection will depend on two types of risk:

- + **hatchling capture**, during the short period of time between emergence from the nest and entrance into the sea, **by animals** (crabs, dogs, cats, rats, birds) and **humans** (for private possession or sale to tourists as a souvenir);
- + **disorientation caused by artificial light sources**, which attract hatchlings in a direction opposite to the sea, resulting in a high risk of predation and dehydration.

In these cases, technicians may take preventive actions, such as the control of stray dogs and cats frequenting nesting beaches or the control of artificial light sources (time schedule, restricted intensity or direction of light) or other effective actions, such as protecting hatchlings during their final phase of emergence and journey to the sea, keeping away potential predators, or guarding artificially lighted premises near beaches in order to pick up disorientated hatchlings and bring them to the sea.

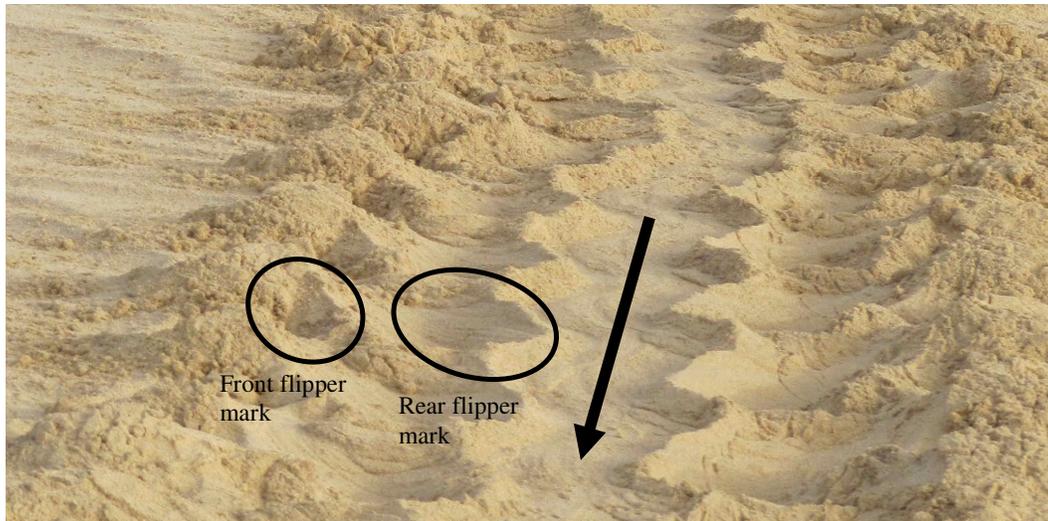
4. NEST AND EMERGENCE CENSUS

4.1. Introduction

Nest censuses are the primary method of obtaining knowledge about the abundance of sea turtles and priority must be given to these over any other kind of data gathering. This should be done by way of morning patrols, which must always census complete beaches. These patrols will also allow for the censusing of emerging hatchlings, poached or predated nests and dead or injured turtles, as well as the rescue of turtles found on the beach which, for different reasons, have not reached the sea before dawn. Censuses are classified as:

- + **intensive** – if a certain beach is subject of a census on more than 90% of days during the nesting season. Such censuses should be carried out on **reference beaches** with a high abundance of nests;
- + **frequent** – if a certain beach is subject of a census one to six times a week;
- + **periodical** – if a certain beach is subject of a census less than once a week.

The aim is to carry out an intensive census on **all** beaches. If resources are limited, intensive censuses should be carried out on beaches with five or more daily nests and frequent censuses should be carried out on beaches with two or more daily nests. Census frequency should always be as high as possible. Daily censuses should begin around 15 June and must continue until 15 October. For **emergence** censuses, work should continue until 15 December.



Orientation of the track: vertical plane of the track located in its original position, caused by the turtle pushing sand backwards as it moves forward (top). Track without nest and one failed nesting attempt (bottom left) and track without nest or failed nesting attempt (bottom right) (photos by Adolfo Marco).

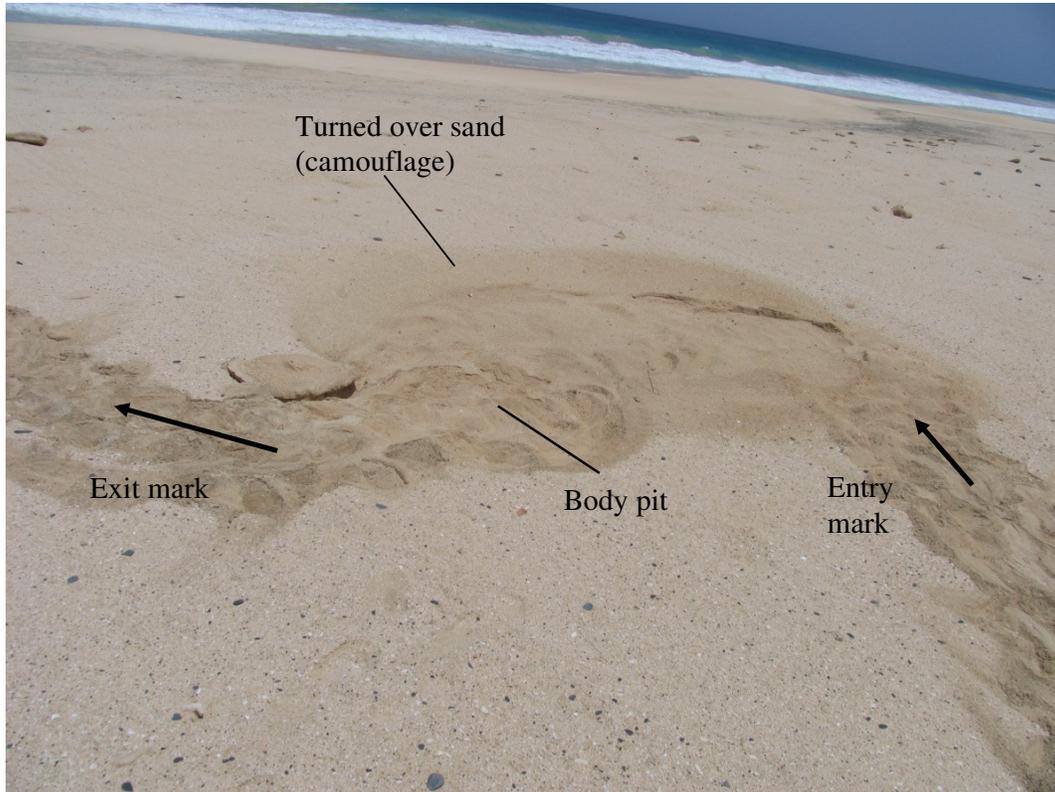
4.2. Nest census

Morning patrols for nest censuses must start at dawn. Sun, wind or rain can erase turtle trails of the previous night within a few hours. Technicians must walk perpendicular to the shoreline, so as to census the whole beach width. Complete beaches, from one end to the other, must be included in the census and **all unmarked trails must be incorporated**, i.e. those made since the previous census, without double counts. The whole mark is considered as a single trail, from its way out of the sea to its return to the sea or its ending in another part of the beach. If the previous census was not carried out the previous morning, a distinction must be made between nests from the night immediately before and those from previous nights.

In periodical censuses (i.e. after more than four days from the previous census), all unmarked nests and false crawls on the beach must be counted and marked during the evening and a census of fresh nests and false crawls made during the night must be carried out the next morning. A distinction must be made between old nests (evening census) and fresh nests (morning census). All trails must be interpreted and assigned to one of the following categories:

- + **nest** – complete trail of entry and exit, with evidence of nest;
- + **false crawl** – complete trail of entry and exit, without nest;

- + **doubtful crawl** – complete trail, but with doubts about the existence of a nest. Efforts should be made to minimize this category to a reasonable minimum (< 5%), improving training of observers and checking for the presence of eggs on tracks;
- + **capture** – incomplete trail, with a slaughtered female present or other signals of poaching;
- + **disorientation** – incomplete trail, with the female lost or disoriented at the land end of the track;
- + **accident** – incomplete trail, with the female hurt or blocked at the land end of the track.



Indicators of nest location (photo by Adolfo Marco).

After having decided upon the type of track, it must be clearly marked with a sequence of crosses, S's, zigzags, etc., made by foot or with a stick in the vicinity of the nest and placed in a conspicuous position. This will help avoiding double counts. Walking on or marking the nest itself (i.e. the turned-over sand area) must be avoided.

The number of nests for each beach and day must always be estimated, taking **nest** number as minimum value and **nest** plus **doubtful trail** number as maximum value. These values must be divided by the total number of complete trails to estimate nesting success on each beach. If censusing is not daily, values of nest per beach and the precise number of days between censuses must be given. As trails disappear with time, if the previous census was four days before, error through erased trail is considered high and if it was seven days before, it is considered too large an error. For periodical censuses, a specific methodology must be used.

4.3. Nest location

Whenever possible, the geographical position of the nest must be recorded by GPS. This information will allow mapping the distribution of nests, evaluating important areas, assessing variation in seasonal and annual abundance and laying site selection. The error of *ca.* 3 m in GPS positions does not allow locating a nest for exhumation after the trail has disappeared.

4.4. Emergence census

Tracks of hatchlings on beaches can be found from mid-August onwards. The place of emergence can be identified by following the tracks and hatchlings must be counted individually. Qualitative nest success must be registered as the proportion of tracks reaching the sea being high (>80%), average (20-80%), low (1-20%) or none (0%). The place of emergence should be marked if GPS is available.



Tracks of hatchlings after emergence (photos by Adolfo Marco).

4.5. Census card

Circumstances, such as rain, incomplete sampling, loss of marks, etc., or any other important details of events, **must be noted in the margins of the data form**. If GPS location is used, the number of the GPS location must be indicated instead of “/”. Numbers separated by commas indicate hatchlings, such that each number represents an emerged nest and the number corresponds with the number of different hatchling marks (X). If the place of emergence is recorded, the number of hatchling marks must be stated first, followed by the GPS location (L), separated by a hyphen. Two numbers must be used for the total number of hatchlings: the number of emerged nests (R) and the total number of observed tracks (X). General success (high, average, low, none) of hatchlings reaching the sea must be recorded.

5. CENSUS OF CAPTURED OR INJURED FEMALES AND PLUNDERED NESTS

5.1. Females not returning to the sea

All trails coming in from the shore but not returning to the sea must be tracked to assess if the female is alive, absent or dead. If the female is dead, it will be included in the census and will be inspected for possible microchip (PIT) identification and flipper tags, the code of which, if found, must be noted on the census form, together with the GPS location. A distinction must be made between being quartered, killed or captured by poachers, killed by accident or having died a natural death. Carcasses will be marked (with paint, encoded marking of the shell, nailing the shell, etc.) to avoid double counts in consecutive censuses. If the trail is interrupted and the female is not found, it must be interpreted as being removed and signs of dragging or loading trails to a vehicle, donkey or boat must be looked for. It must be included in the census and the trail erased. Collecting humeri of dead turtles can be useful in order to establish their age. Details must be noted on the back of the census form. In order to estimate the **percentage of poached females** on each beach or beach sector in a laying season, the total number of poached females must be divided by the number of different females that have used that beach. This number will be estimated by counting the total number of nests laid on these beaches during 15 consecutive days (approximately from the second half of July onwards), plus the number of poached females from the beginning of the season to the middle of that period of 15 days, i.e. 23 July.

If females are still alive, a distinction must be made between three categories: 1) disoriented or lost; 2) stuck among rocks or turned by falling; 3) turned by poachers. If a female has apparently turned over accidentally and without evidence of poachers being present, it must be identified as injured on the census form. If a female is turned without apparent natural cause or if there are tracks of poachers around, it must be identified as turned on the census form.

5.2. Sea turtle rescue

If an exit trail does not return to the sea, observers must look for females on land and, if found alive, these must be rescued by leading them back to the sea. The same applies to lost hatchlings, making a note on the back of the census form describing the event. Turtles may be trapped between stones, in cavities or in debris on the beach or they may have turned over, thus being unable to return to the sea. Occasionally a female may lose its sense of direction, wandering around erratically and being unable to return to the sea. Furthermore, turn over or capture attempts by poachers are incidents which may require a more complex procedure. Nonviolent actions using common sense, a pedagogical attitude and some determination are always recommended.

When confronted with any of these situations, technicians must immediately release the turtle, placing it in its normal position and moisturize its body with sea water. It should be checked for the presence of tags on its flippers or a microchip, noting down the code on the card. If no tags or microchips are present, this should also be noted on the card and the technician should proceed with measuring the animal and taking note of any supplementary observations. After this, the turtle must be allowed to head for the sea and helped if needed. If it must be transported by technicians, it must be moisturized and its head must be covered using a damp cloth. Technicians must be

aware that such turtles will probably be stressed and can bite or beat. For that reason, some basic safety precautions must be taken, such as keeping away from the turtle's mouth and flippers. Technicians must also be aware that turtles can be in an extreme stress condition, both physically (exhaustion and dehydration) and mentally. Therefore, needlessly extending the process, aggressive and abrupt movements, artificial lighting and unnecessary noises must be avoided.

5.3. Nest threat assesment

It is advisable to familiarize oneself with the most important risks for nest incubation, as well as with beach sectors of high risk, when planning the protection and management of sea turtles. During morning censuses, any evidence of alteration or risk of important damage to nests must be identified, no matter whether nests are marked or not. This includes poaching by humans, predation by domestic animals or crabs, erosion by the tide or other causes and the presence of vehicle tracks in nesting areas.

The emergence season should also be used for assessing important risks for hatchlings on beaches. Relevant signs of predation by domestic animals must be noted, as well as hatchlings being stuck or killed in vehicle tracks, the presence of beach furniture or other kinds of artificial obstacles, disorientation by artificial lighting, etc. All relevant information must be taken note of by assessing its importance on the back of the census cards. Date, beach and name of the observer must always be given.

6. IDENTIFYING AND MARKING TURTLES

6.1. Identification of turtle species

Nowadays, sea turtles laying eggs on the beaches of Cape Verde are almost exclusively loggerhead turtles *Caretta caretta*. Sporadically, other species may be found, including green sea turtle *Chelonia mydas*, hawksbill *Eretmochelys imbricata*, olive ridley or Pacific ridley *Lepidochelys olivacea* and leatherback turtle *Dermochelys coriacea*. If in doubt about an animal's specific identity, technicians must consult the identification key and take photographs of the carapace and head of the animal.

6.2. Individual identification of females

For individual **identification of females**, double tagging with two complementary systems is recommended: external markings (tags on flippers) and internal markings (microchip or PIT). The first step for individual identification is to verify if the animal is already marked or if there are signs that it has been in the past. Each individual can have both (external and internal) types of markings, one of these or none. If no evidence of markings is found, it will be identified as a new turtle and tagging can take place.

Identification of external tags is simple, since marks are large and fixed to the front flippers and only rarely to the rear ones. All information of the mark must be noted. Marks are frequently lost, leaving fissures or holes on the flippers, which heal but remain visible for many years. These turtles are considered as recaptures and can be remarked, but the loss of the previous mark must be registered. If a tagged turtle is in

bad condition or inflicting injuries are found, the tag should be removed, noting down the mark code.

Microchip identification requires the use of an electronic reader or scanner. It is essential to know the rules of use and battery charge and its proper functioning must always be checked before starting the census. To read the microchip, the reader must be brought as close as possible to the flippers and neck, repeatedly and for some seconds, and then to all other external soft tissue. All numbers given by the reader must be noted down on the census card.

6.3. Flipper tagging

The use of metal tags (INCONEL) is recommended.

- + Placement of the tag must be carried out after the spawning process has been finished and the female starts to return to the sea. If a female with no intention of spawning is found, the tag can be placed when it is clear that it is returning to the sea.
- + Technicians must always have an ethical attitude with full respect for the turtle, avoiding prolonged periods of immobilization, avoiding direct artificial lighting on the eyes or towards the shore, using excessive force on the animal, etc.
- + To avoid infections, tags and its applicator must be clean and properly lubricated, so as to open and close easily and quickly.



Tagging of the front flippers of a loggerhead turtle (photos by Adolfo Marco).

- + two tags must be attached on each female, one on each front flipper to reduce the risk of loss. The insertion must be made in the existing membrane between the second and third big scales or directly in the middle of these scales, in the rear part of the flipper. Applying some drops of povidone-iodine on the injury is recommended.
- + The identifier code of the tag must face upward in order to facilitate reading.
- + It must be verified that the tag is firmly closed but with some clearance, to reduce the probability of loss and without strangulating tissue. If it is not properly closed, efforts should be made to correct the defect with the applicator. When this cannot be achieved, the tag must be removed and properly placed anew.
- + After placing both tags and before releasing the turtle, the codes and place of the tags must be noted on the record card.

6.4. PIT tagging

In Cape Verde, turtles must be marked with a coded microchip (PIT) according to ISO 3 FDX-B4. The standardized use of *AVID Friendchip* is advisable.

- + PIT placement must be carried out after the spawning process has finished and the female heads for the sea. If the female is found on the beach but with no intention of laying eggs, the PIT can be placed when it is clear that it is returning to the sea.
- + Technicians must always have an ethical attitude with full respect for the turtle, avoiding prolonged periods of immobilization, direct artificial lighting on the eyes or towards the shore, excessive use of force on the animal, etc.
- + The applicator syringe, together with the PIT, must be taken from its sterilized package immediately before placement.
- + Only one PIT should be placed on each female, on the right front flipper, on the rear part above the large second and third marginal scales. In order to avoid accidental contact with bone, the needle must be injected at an angle of 15 degrees.
- + After placing the PIT, its insertion must be confirmed with the reader, noting down the complete code on the record card or by applying the PIT's sticker.
- + Applying some drops of povidone-iodine on the injury is recommended.
- + After PIT tagging and before releasing the turtle, the rest of the required data must be included on the individual female record card.



PIT placement on a loggerhead turtle and reading the chip's code (photos by Adolfo Marco).

6.5. Basic biometrics of females

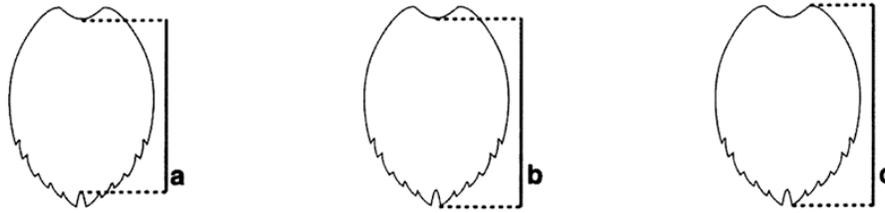
The most important measurement in female turtle size is the length of the dorsal carapace. There are two methods for its determination:

- + **straight length**, measured with a caliper of at least 130 cm;
- + **curved length**, recommended and measured with a tape measure.

There are three methods of measuring the length of the central vertebral area of the carapace, each of which gives different results:

- + **minimum length** of the carapace, measured between the front central end of the nuchal plate and the external point of contact of both supra-caudal shields (**a**);
- + **nape-tail length** of the carapace, measured between the front central end of the nuchal plate and the line which joins the rear ends of both supra-caudal shields (**b**);

+ **total length** of the carapace, measured between the front end of the carapace and the line which joins the back ends of both supracaudal shields (**c**).



Minimum curve length (a) (MCL) is the most often used and recommended reference value for basic biometrics of turtles. The chosen type of measurement must always be indicated (using regression for conversion). Distortion due to epibionts or defects in the vertebral line of the carapace must be avoided when taking measurements. Values must be registered in centimetres.

6.6. Supplementary observations on females

Supplementary observations on female turtles should concentrate on three aspects: birth or acquired defects, recent damages or injuries and epibionts. The alteration in the typical number and layout of the main scales of the carapace or the absence of part of the carapace or a limb, not caused by injury, are considered to be due to a birth defect. Most common acquired defects are amputation of limbs parts caused by predators or amputations, fractures or permanent injuries caused by collisions with boats, engine propellers, friction or net strangulation, etc. Any nets and hooks found on the animal must be removed.

A frequent and striking disease is *fibropapilloma*, easily identified by external visual observation. Papillomas are tumors caused by a virus, which develops in the epidermis, in soft parts of the body such as eyes, mouth, neck or limbs. It is shaped irregularly, slightly spherical, and may acquire quite significant dimensions of several centimetres.

Epibionts are frequent in loggerhead turtles. In the case of large (number of) adherents, seemingly affecting the health of the turtle, the most significant groups must be indicated: seaweed, barnacles, goose barnacles, crabs, remoras, worms, etc. If possible, females must be photographed, both the complete animal and details of the defects, disease or epibionts. When the female suffers from noticeable or extreme loss of weight this must be registered. Samples of epibionts can be extracted and stored in tubes filled with alcohol (>70%).

6.7. Recording individual females

The date on the card must correspond to the day on which the census began and the start and end time must be recorded in the '**observações**' section. The geographical coordinates registered by GPS must indicate the position of the nest or, alternatively, the place where the female was caught. The '**tags**' section must be marked **C** if it has none (capture), **R** if it has one (recapture) and **V** if there are signs that it had tags in the past. In 'position' (P), indicate with **1** if the tag is on the second large scale, with **2** if it is on the third large scale and **M** if it is in between these. In the '**PIT**' section, **C** means new (capture), **R** means old (recapture). In 'position', **D** indicates PIT on the right

flipper and **E** on the left flipper. If the PIT has a self-adhesive sticker, this must be applied on the record card. In the '**postura**' (nest) section, **C** indicates a nest and **N** no nest, 'ovos' refers to the number of eggs, 'tentativas' to the number of false nesting attempts, 'marca' to the external mark of the nest and 'transfer' indicates whether the nest was relocated on the beach or moved to a corral. Details referring to the various observations should be registered under '**observação complementar**'. Malformations or epibionts must be noted in '**ocorrências particulares/observações**', with a drawing indicating the position on the animal's body.

7. STUDY AND MONITORING OF NESTS *IN SITU*

7.1. Study and marking of nests for tracking

Marking and monitoring a number of nests is essential to obtain knowledge about the number of eggs laid, incubation time, sex ratio and hatching success. In each island, a minimum of 30 nests must be chosen annually and, in case of high spatial heterogeneity, nests must be proportionally selected from all the different types of beach identified. Only nests in which the number of eggs has been counted during spawning should be tracked, otherwise the number of eggs that have disappeared due to predation (often > 20%) cannot be known.

Nests should be chosen when a female is found before having finished nest excavation. It is essential to proceed counting the eggs. In order to do this, the observer must lay on the sand, behind the turtle, in silence and using a faint light, not affecting the head of the animal. The egg count is done visually, without coming into physical contact with the eggs. It is important to pay full attention, since the eggs may come out individually or in groups of two or three. For a precise count, it is advisable to place a hand (with a latex glove) in the trajectory of the eggs. During this process, an automatic incubation temperature recorder can be placed in the middle of the nest to obtain information relevant to the ensuing sex ratio. After spawning, a stick with a sign facilitating subsequent tracing and individual identification of the nest during future visits must be placed. If GPS is available, the position of the nest must be registered.

7.2. Tracking of nests marked during incubation

Incubation of turtle eggs lasts between 48 and 65 days. During this time, marked nests must be periodically monitored in order to check the external conditions, as well as to identify relevant circumstances, such as nest flooding, predation or erosion. From day 45 of incubation onwards, nests should be monitored on a daily basis, searching for hatchling tracks to identify emergences. After 4-5 days of the emergence or from day 65 of incubation, the nest must be exhumed.

7.3. Nest exhumation after emergence

Exhumation should be carried out in order to establish the number of hatched eggs, dead eggs, alive and dead hatchlings and the presence and estimated age of dead embryos. The age of an embryo must be given on a scale from 0 to 4, where 0 is without appreciable embryo, 1 is no pigmented embryo, 2 is a pigmented embryo but smaller than 1 cm, 3 is an embryo between 1 and 3 cm, and 4 is a fully developed

embryo which completely fills the space of the egg. Hatching success should only be estimated if the initial number of eggs immediately after spawning is known.

8. TRANSLOCATION OF THREATENED NESTS

8.1. Nests in risk areas

Nest relocation in areas of increased risk can greatly improve hatching success (>75% of average success in corrals) and increase turtle production as long as a series of precautions are taken into account. Relocation is especially important in islands with very few nests (less than 500 per season) or on beaches with many nests and a high average mortality.

Nests suitable for relocation are those that carry any of the following risks in an evident way: clearly floodable area due to tides, clayish area or with many plant roots at the base of dunes which can bury the nest, next to a slope which can erode the nest, high abundance of ghost crabs or dogs, a lot of artificial nocturnal lighting, industrial sand extraction, lots of road traffic on the beach or large presence of tourists, including furniture on the beach.

On beaches which have quality areas for incubation but nests in risk areas, beach relocation can be considered. On beaches with poor general conditions for incubation, it is advisable to create incubation corrals (hatcheries) and concentrate relocated nests. Corrals must therefore be located near a beach with many nests but poor circumstances and it must have all conservation and quality conditions required for significantly improving the success of the original beach where the eggs were laid. An improper relocation is a waste of time, effort and motivation and it does not help conservation. In case of doubt, the best choice is not to relocate.

8.2. Nest relocation

When a nesting female is observed or when fresh nests of the previous night (or six nights ago at most) are observed during the morning census and it is certain that the nest is located in a high risk location (defined above), relocation should take place. First, it has to be decided, before extracting the eggs, if it is to be relocated to a safe nearby location on the same beach (non-floodable area, without clay, with few or without stones, away from plant roots, away from transit areas, beach free of plundering), to a corral if this is built nearby or if there is a vehicle available for rapid transfer (total duration of relocation must be less than one hour).

During spawning, eggs should be directly extracted from the female or from the nesting pit. If the mother has already covered the nest, the location must be marked and, after the female has returned to the sea, the eggs can be extracted. Eggs must be put in clean plastic bags. Eggs must be transported to the corral or the new location as fast as possible. Turning or shaking must be minimized during transport. If more than six hours have passed since spawning, careful digging must take place at the most likely position (often in the middle of a bulging area with loose sand, down to 40 cm depth, rarely deeper) to extract the eggs. Eggs should be extracted carefully, without turning them, and must be put in a box or wrapped in clothes or another material preventing them from turning or rolling. Turning or rolling the eggs may kill the embryo when more than six hours have passed since spawning. Exposure to the sun should be avoided at all times (e.g. by casting a shadow over the eggs or by covering them with

clothes) and they must never be put in contact with dry or hot sand. They can be placed on wet sand extracted from the nest or its surroundings.

At the new location, the new nest must be similar in depth (*ca.* 50 cm) and shape to a typical turtle nest. Eggs must be carefully placed in the new nest, always on wet sand. They must be kept in the same position in which they were extracted. If eggs have white patches on the shell, this patch must always be kept upwards when relocating it. If monitoring activities are carried out for assessing nest success, the number of eggs must be counted during their placement into the new nest. Dead eggs can be discarded and if a white patch on the shell is noticed, the opportunity can be taken to estimate the percentage of embryonated eggs. After having placed all eggs in the new location, the nest must be covered with wet sand until it covers the entire pit and sand must be thrown over it, simulating a true female covering. Human footprints near the new nest must be removed.

8.3. Controlled incubation in corrals

Corrals must be situated in places with loose and deep sand, without clay or plant roots, without risk of flooding by heavy rain or tides, without any kind of pollution and away from artificial lighting. If such a beach is not available, an area with these characteristics can be refurbished. It must be fenced to prevent access by animals, including crabs, and must be permanently guarded. Nests must be placed at a minimum distance of 60 cm from each other. It is advisable to arrange the nests in lines for ease of surveillance and to avoid overlap of nests. The new nest must be about 45 cm deep, replicating a genuine turtle nest, and should be processed similarly to nests relocated on the beach. Nests should not be touched or disturbed until hatching takes place. Incubation time (50-58 days to effectuate an appropriate sex ratio) must be monitored. Nests must be marked with an identification number and the laying date and after 45 days they must be surrounded with a closed mesh to prevent hatchlings from dispersing, thus ensuring a correct count. They must be released into the sea on the night of emergence. During nocturnal release, hatchlings should be released on different parts of the beach to avoid a gathering of predators near the corral.

8.4. Counting, weighing and basic measurements of hatchlings

Both in nests on the beach and in corrals, it is advisable to count the number of hatchlings naturally emerging and to divide this by the number of eggs at the beginning of incubation in order to estimate the nest's success. Basic biometrics include straight dorsal carapace length (SCL – 0.1 mm) and weight (0.1 g) of 10 randomly selected hatchlings of each nest.

MATERIAL

Each team must have copies of the four data sheets (census, female, nest and nest monitoring), a rigid briefcase, a species card and a backpack with the following tools:

- Pencils and indelible pen
- Flipper tags
- Applicator plies
- PIT
- PIT reader with the battery charged
- Extra batteries
- Three poles
- Tape measure
- Knife or scissors
- Latex gloves
- Headlamp or flashlight (red light)
- Ballpoints
- Bottle of water and basic first aid kit

It is advisable to also include:

- Turtle brake
- GPS with battery charged
- Digital camera
- Sample containers

LITERATURE CONSULTED

Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois & M. Donnelly (eds.), 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4 (available at <http://mtsg.files.wordpress.com/2010/11/techniques-manual-full-en.pdf>). 235 pp.

Marco, A., E. Abella-Pérez, C. Monzón-Argüello, S. Martins, S. Araujo, L.F. López-Jurado, 2011. The international importance of the archipelago of Cape Verde for marine turtles, in particular the loggerhead turtle *Caretta caretta*. *Zoologia Caboverdiana* 2: 1-11.

Marco A., E. Abella, A. Liria-Loza, S. Martins, O. López, S. Jiménez-Bordón, M. Medina, C. Oujo, P. Gaona, B.J. Godley, L.F. López-Jurado, 2012. Cape Verde hosts the world's third largest nesting population of the loggerhead sea turtle (*Caretta caretta*) despite sustained high levels of adult female mortality. *Animal Conservation*: in press.

Varo-Cruz, N., A. Liria-Loza, Ó. López-López & L.F. López-Jurado, 2006. Manual para Trabajos Prácticos con Tortugas Marinas Nidificantes en Cabo Verde. Imprenta Pérez Galdós, Las Palmas de Gran Canaria. 81 pp.

FICHA DE CENSOS

Día: _____ Praia: _____ GPS: _____ Observadores: _____			
			Total
Rastro completo	Ninho	//////////	X
	Não	//////////	X
	Dúvida	//////////	X
Fêmeas mortas	Natural	//////////	X
	Capturada	//////////	X
	Trasladada	//////////	X
Fêmeas vivas	Perdidas	//////////	X
	Acidentadas	//////////	X
	Voltadas	//////////	X
Recém-nascidos		X-L, x, x, x, x,	R-X



FICHA INDIVIDUAL DA FÊMEA REPRODUTORA

DATA ____/____/____ ESPÉCIE _____

ILHA _____ PRAIA _____

LATITUDE _____ LONGITUDE _____ UTM _____
 ____° ____' ____" ____° ____' ____"

Flipper tag ESQ _____ C R V P 1 M 2

Flipper tag DTO _____ C R V P 1 M 2

PIT tag _____ C R A P E D T E

BIOMETRIA ELEM. CCL_{min} _____ SCL_{min} _____ PESO _____

OBSERVAÇÃO COMPLEMENTAR

DEFEITOS DOENÇAS FERIMENTOS EPIBIONTES

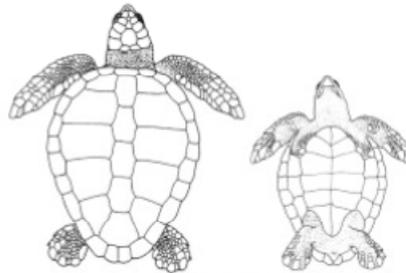
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POSTURA Nº OVOS TENTATIVAS MARCA TRANSFER.

C N I

Ocorrências particulares / Observações

Responsável pelo preenchimento desta Ficha



Fonte: Research and Management Techniques for the Conservation of Sea Turtles, 1999

NOTAS PARA PREENCHIMENTO CORRECTO

PRAIA: ver *Cartografia Base do Atlas de Tartarugas Marinhas em Cabo Verde* **DATA:** sempre a data do início da noite

Flipper tag: preencher o código e pintar as letras correctas

C: primeira captura R: recaptura V: vestígios de marcas anteriores, mas já não presentes
 P: posição proximal, antes da primeira grande escama 1: perfurando a primeira grande escama
 M: tecido mole, entre a primeira e a segunda grandes escamas 2: perfurando a segunda grande escama

PIT tag: preencher o código de 15 dígitos ou colar a etiqueta do *AVID FriendChip™* e pintar as letras correctas

C: primeira captura R: recaptura A: membro anterior P: membro posterior
 E: membro esquerdo D: membro direito T: inserção no tripicete E: inserção sob a segunda grande escama

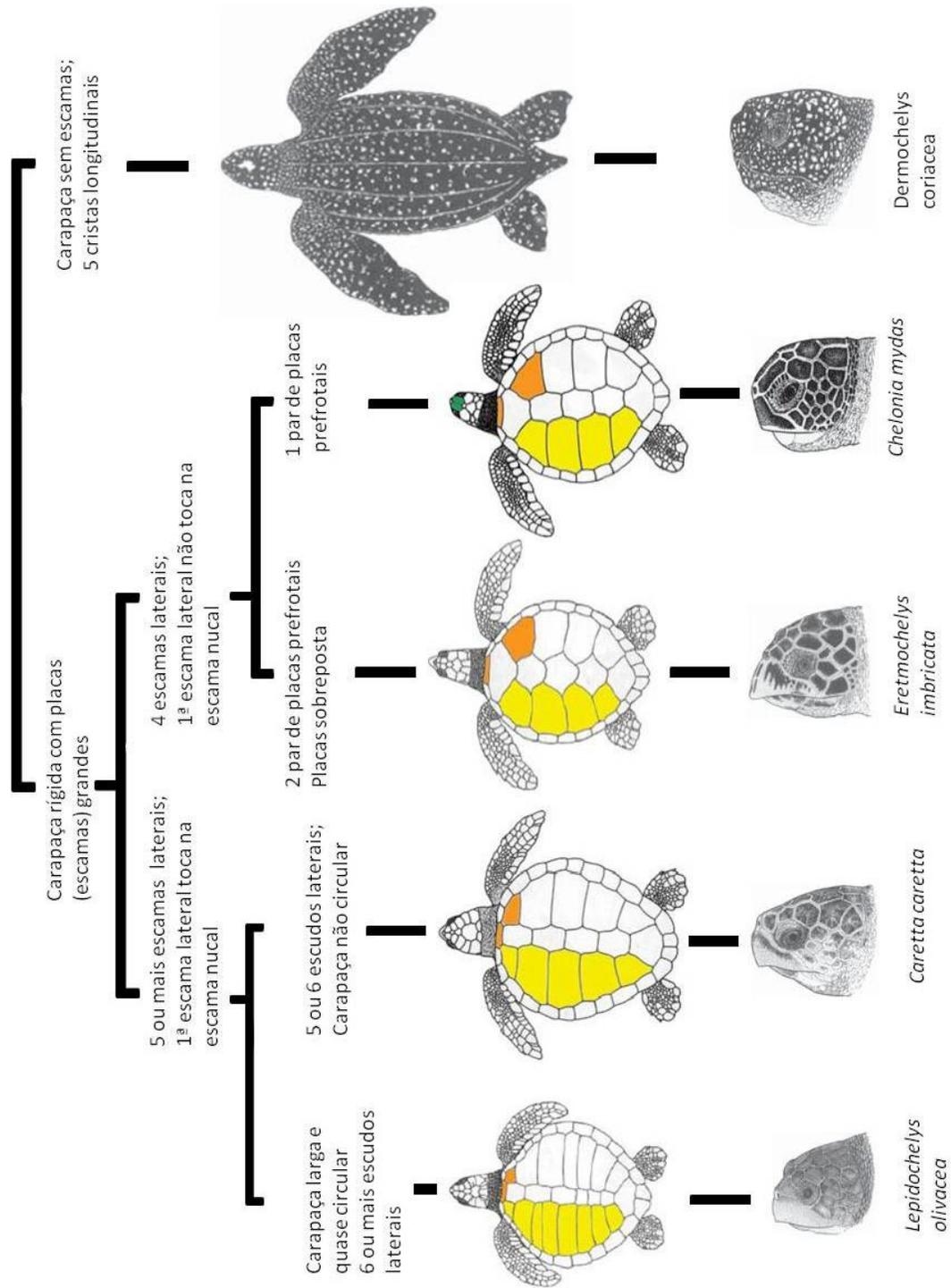
<i>Data/ Hora</i>	<i>Nº VIVOS/ MUERTOS</i>	<i>Emergências</i>				
D H Observac:	V	LRC				
		Peso				
	M	LRC				
		Peso				
D H Observac:	V	LRC				
		Peso				
	M	LRC				
		Peso				
D H	V	LRC				
	M	Peso				

Causa – Resultado de exumação			
<input type="checkbox"/> Marca perdida	<input type="checkbox"/> Marca tirada	<input type="checkbox"/> Marca arrancada	<input type="checkbox"/> Confusão fichas
<input type="checkbox"/> Aberto e trucidado	<input type="checkbox"/> Dois ninhos juntos	<input type="checkbox"/> Material	<input type="checkbox"/> Outros

Ovos não eclosionados		Cascas		Crias	
E: 0		Inteiras		Dentro do ninho	
E: 1		Metades		Vivas	Mortas
E: 2				Eclacionado	
E: 3					
E: 4					

Observações
* explicar anomalia (gêmeos, siameses, albinos, deformados...)

Identification key for sea turtles in the Cape Verde Islands



Source: P.C.H. Pritchard & J.A. Mortimer, 1999. Taxonomy, External Morphology, and Species Identification. Pp. 21-38 in: K.L. Eckert, K.A. Bjorndal, F.A. Abreu-Grobois & M. Donnelly (eds.), 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4 (available at <http://mtsg.files.wordpress.com/2010/11/techniques-manual-full-en.pdf>). Illustrations by Tom McFarland.