Research and Management Techniques for the Conservation of Sea Turtles
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Factors to Consider in the Tagging of Sea Turtles

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Introduction

Sea turtles are tagged to achieve the recognition of individuals or cohorts for research purposes. Tagging is most often conducted to obtain information on reproductive biology, movements, strandings, residency and growth rates. This chapter will cover the use of external and internal tags, exclusive of remote sensing techniques (sonic and radio transmitters; see S. Eckert, this volume), naturally occurring genetic markers (see FitzSimmons *et al.*, this volume), data logging devices that require the electronic down-loading of stored information (see S. Eckert, this volume), and the injection of tetracycline or other substances to mark skeletal components.

Tagging of sea turtles as defined for this chapter includes: the external attachment, usually to the flippers, of a metal or plastic tag inscribed with numbers and words; the insertion into the body of a wire tag or microprocessor that can be detected with a electronic device; the marking of the carapace or other body part with paint, or by engraving or minor surgery to remove or alter tissue to form a recognizable external mark.

Historically, tagging has been the single-most valuable activity in advancing our understanding of sea turtles and their conservation needs in relation to complex life cycles, reproductive migrations, slow growth rates (for some species), and delayed sexual maturation. In many cases, a commitment to years of systematic tagging may be necessary to achieve certain objectives. However, in some instances the tagging of even a few turtles, particularly at nesting beaches where tagging has never been conducted, can yield valuable insight into migrations and the locations of resident foraging areas.

Unfortunately, current technologies and techniques for effectively tagging sea turtles are less than perfect. The degree of success from tagging, in terms of tag retention and maintaining recognition of a turtle, can be highly variable due to multiple factors that can include the following: the type of tag used and where and how it is applied to the turtle; the species of turtle and size class tagged; the geographical location and character of the marine environment; the skill of the person doing the tagging; the condition of the tagging gear; and the number of tags applied to each turtle.

Few of these elements have been carefully studied and quantified. Consequently, the researcher initiating a tagging program must make decisions based on uncertain and often confusing information, realizing that the outcome may not be apparent for years or even decades. An important objective of this chapter is to provide the reader with a basic understanding of what factors must be considered, and what options are available, to optimize the success of a tagging program in terms of the objectives that need to be accomplished.

The length of time the tag is expected to stay on the turtle to achieve the program's objectives is a fundamental consideration. The longer the desired time, the more uncertain the outcome. Hence, the first goal of a tagging program must be to minimize tag loss to ensure that recognition is retained, while not causing any lasting harm to the turtle from the tagging process. The second critical goal is to measure the extent of tag loss in order to correctly interpret resulting data and to adjust tagging techniques accordingly.

A realization of the above factors and limitations is essential to a new tagging program or improving an existing one. A methodology that may be successful at one location, under a certain set of circumstances, may be inadequate elsewhere. In short, tagging sea turtles at present can be considered partly

science, partly art and partly guesswork. Having provided this warning, there are nevertheless an array of guidelines and options that can be set forth to help conduct an effective and productive tagging program.

Externally Applied Tags

The most commonly used tags on sea turtles are made of metal or plastic that attach to the posterior edges of the flippers. Some workers have constructed tags that attach through the edge of the carapace, but detailed information on their level of success is not yet available.

Plastic Flipper Tags

Plastic tags most often used on sea turtles consist of two pieces that require a special applicator to snap the sides together. Once in place they can not be taken apart without destroying the tag. An additional tool, such as a leather punch or pointed object, is usually needed to pierce a hole in the flipper prior to using the tag applicator. The resulting locked tag consists of two rotating parallel plates joined at the end where the tag passes through the flipper.

Plastic tags, such as the Jumbo Tag (45 x 17 x 10 mm) made by Dalton Supplies Ltd., England (fax 441-491-419-001) can be ordered in different colors with numbers and lettering embossed on both the internal and external surfaces of the tag's plates.

As with all tags applied to sea turtles, researchers in different areas have reported varying levels of success using plastic tags. Plastic may be liable to increased wear, brittleness and breakage depending upon the type of plastic, the behavior of the turtle, and the characteristics of the marine habitat where the tagging will occur. Also, unlike the completely closed design of metal tags after application, the open-ended shape of most plastic tags makes them liable to entanglement in gill nets. This in turn can result in an increased risk of mortality to the turtle from forced submergence and/or greater tag loss from tearing.

Some manufacturers of plastic tags have made claims as to the superior nature of their product for use on sea turtles. Before purchasing any tag, it is recommended that a researcher supplement the company's information with independent inquiries in order to obtain a balanced viewpoint.

Metal Flipper Tags

Metal tags commonly used on sea turtles are made of pure titanium (Stockbrands Company, Mt. Hawthorn, Australia, fax 619-444-0619) or blends of metals known as alloys that have enhanced physical characteristics. Monel 400 and Inconel 625, trademarks of International Nickel Company, are two alloys used to make tags for sea turtles by the National Band and Tag Company (NBTC) of Newport, Kentucky, USA (fax 001-606-261-8247).

Metal tags require a special applicator for proper attachment. However, except for the tough front flippers of leatherbacks, pre-punching is usually not needed due to the self-piercing design of the tag. When the applicator is squeezed, the sharp point of the tag pierces through the flipper and passes into a hole in the opposite end of the tag, where it bends over and locks into place. The resulting shape of the tag is rectangular or oval with no parts that can easily entangle in a net. This simplified locking mechanism exists on NBTC tag style 681C (25 x 8 x 9 mm) and style 1005-1 (8 x 2.5 x 2.5 mm). Style 1005-1 tags are small enough to be used on hatchlings, but are only available in Monel. The style 681C tag is produced in Inconel or (as style 1005-681) Monel. NBTC also offers a style 1005-49 tag (40 x 10 x 11 mm) in Monel only, but the locking mechanism is more complex involving an internal bridge that the point bends around. In some cases this lock has been the site of accelerated corrosion when the tags have been used on sea turtles.

Stockbrands' titanium tags (40 x 11 x 10 mm and 17.5 x 6 x 4-6 mm tapered) also have the simplified point-through-the-hole locking design. [Note that the latter measurement of each tag dimension listed is the gap within the tag after application.]

Difficulties in applying metal tags are sometimes experienced that involve incomplete sealing of the tag's point or the point prematurely bending over before passing through the hole. Some researchers using titanium tags have found it necessary to scrutinize and slightly bend each tag prior to application to make sure the point aligns with the hole. Similar malfunctions with Inconel and Monel tags often seem to be related to the manner in which the tag is snapped into the applicator by the researcher. NBTC has recently updated its instructional literature in an effort to lessen this problem.

Malfunctions when applying metal tags can also result from the use of applicators that are rusted, clogged with sand or other debris, or are worn from heavy use. All tag applicators must be inspected and cleaned on a routine basis and discarded when they cease to function properly. The timely replacement of worn applicators is an essential part of any tagging program. Stainless steel applicators available from

Stockbrands for titanium tags are more resistant to the wear that contributes to malfunction.

Malfunctions of Inconel and Monel tags can also result from slight differences in the manufacturing process. A company should be asked to test each applicator purchased with an order of tags to ensure they will seal properly. Additionally, applicators that function well with one batch of tags may not always do so with tags ordered at a later time. Testing and re-testing of applicators and tags prior to use in the field is an absolute necessity.

All metals corrode in sea water, but it is their rate of corrosion that must be of concern to sea turtle researchers. Prior to the availability in the late 1970's of tags made of Inconel and titanium, Monel tags were commonly used on sea turtles dating back to the early 1960's. Monel tags have exhibited highly variable rates of corrosion, both between geographical locations and on different turtles tagged at the same study site. For example, Monel tags applied to green turtles in the Hawaiian Islands and recovered 2-4 years later were found pitted and deteriorating from corrosion. Tag loss from this factor alone was estimated to be at least 90%. In sharp contrast, a few of the Monel tags used in Hawaii have been recovered in excellent condition 20 or more years later. Unpredictable variations in the quality of the Monel used to produce different orders of tags may also be a factor in their rate of corrosion.

Titanium and Inconel are equivalent in their superior resistance to corrosion in sea water. Tags for sea turtles made of these metals are recommended, unless one can be absolutely certain that Monel will not corrode at a rate unacceptable for the purpose of the research at the site where the work will occur. For example, Inconel tags have shown no visible signs of corrosion after being attached for 21 years to adult green turtles in captivity at Sea Life Park Hawaii.

Tag Sizes

Both plastic and metal tags are available in different sizes. The size of the tag selected for use on a particular size-class of sea turtle rests with the judgement of the researcher. No data exist to offer clear guidance.

The size of the tag used should seem appropriate for the size of the turtle, keeping in mind that tags on immature turtles must provide sufficient space during the growth process. However, this issue is complicated by the fact that the position of a tag on a flipper can alter over time as the turtle grows. This change may result in the tag's piercing site ending up too close to the posterior edge of the flipper, hence making it more liable to tearing and loss. Or, if the piercing site ends up at a more anterior location (farther away from the posterior edge), the tag can become overgrown or the gap within the tag can become crowded with tissue. The latter problem is of less concern with plastic tags that have one end open and two plates that rotate freely.

The ideal, of course, when tagging immature turtles is to have the piercing site and the tag remain in the same relative position on the flipper as growth takes place to an adult size. However, achieving this goal is difficult.

Tag Numbers and Message

Externally applied metal and plastic tags can be inscribed by the manufacturer with an address or other visible message, as well as identification numbers and letters. The size of the tag used will dictate the length of these two components. Some companies are able to imprint very small characters that allow more information to be included. The manufacturer's literature may not always show this option, so it is always wise to make personal contact with a company representative to discuss specific needs.

On metal tags the letters and numbers are formed by a high pressure stamping process. The manufacturer should be instructed not to stamp close to or directly on parts of the tag where the metal must bend when applied to the turtle. These areas can be weakened by stamping and, for certain alloys like Monel, can cause increased corrosion and tag loss. On titanium tags fissures and breakage may be more likely due to the brittle nature of this metal.

Careful thought must be given to the message that will be used on the tag. It is highly desirable that a concise mailing address, or other positive and practical means of notification, be used that will remain valid indefinitely or at least for the life of the project. For messages written in English the inclusion of words like "notify" or "write to" may be helpful to a lay person in determining what action should be taken when encountering a tagged turtle. In contrast, the use of words such as "return to" or "send" may result in a tag being removed from a live turtle and mailed to the specified address.

A decision will also have to be made whether or not to offer a reward for reporting the recovery of a tag, and if such wording should appear on the tag as an incentive for reporting. If a monetary reward is offered, the future availability of the funds must be

assured or at least considered. Some researchers feel that offering and advertising a reward will motivate fishermen to take turtles that are already endangered due to over-hunting and other reasons. Other researchers feel that this factor is of minor concern and that the benefits of increased tag reporting are worth the risk. If a reward is deemed necessary, then compensations such as t-shirts, caps or posters with turtle designs can be given as an alternative to money.

Careful attention must be given to the identification numbers ordered from manufacturers of external tags. The use of the same number series by a company can occur when filling orders from different researchers (or even from the same researcher). A company can not be depended upon to monitor and notify a researcher when tags are being ordered with a number series that has previously been produced. A new tagging program has the responsibility to find out what identification numbers have been and are currently being used in the region in order to lessen the chances of duplication. The duplication of a number series is not a problem when ordering passive integrated transponder (PIT) tags. It is not possible to order a specific number series for PIT tags, since a 10-element alphanumeric unique identification is coded into each tag without duplication between manufacturers.

Numbers are usually stamped on metal and plastic tags in a consecutive manner. The ordering of duplicate numbers on two or more tags, so that all tags attached to a turtle will bear the same number, is not recommended as being practical or necessary. Duplicate tag numbers also increase the potential for different turtles to be accidentally tagged with the same tag number.

Tagging Sites

External tags used on the front flippers should always be attached at a proximal location, where the swimming strokes will cause minimal up-and-down movement of the tag. Figure 1 illustrates the preferred proximal front flipper tagging site used by many researchers. Tags have also been applied with success to the hind flippers of both immature turtles and nesting females (especially nesting leatherbacks) at the location shown in Figure 2.

Some workers use additional or alternate tagging sites that are between the large scales along the posterior edges of the front flippers, or directly through one of the scales. Care must always be taken to ensure that the gap within the tag is wider than the thickness of the flipper where tagging will occur.

Metal tags with their closed design should never be attached too far onto the flipper in a manner that inhibits the full range of free movement of the tissue within the tag; *e.g.*, the movement that takes place when both front flippers stretch forward when dig-

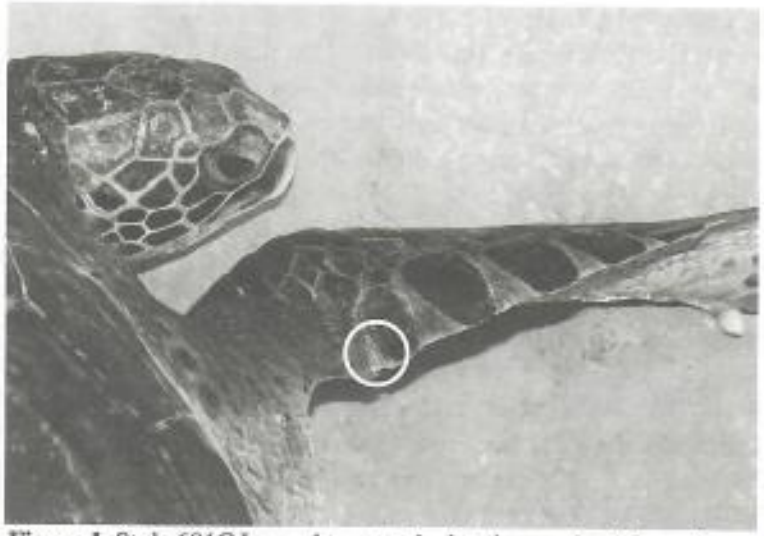

Figure 1. Style 681C Inconel tag attached to the proximal front flipper tagging location used by many researchers. The tag's piercing site is proximal of and adjacent to the first large scale on the posterior edge of the flipper.

Figure 2. Style 681C Inconel tag attached to the hind flipper of a juvenile green turtle. The tag's piercing site is proximal of and adjacent to the first large scale. This tagging location seems to work well on nesting females. Discomfort to the turtle from applying the tag here is much less than when applied to a front flipper.

ging a body pit and during the nest covering process. To reduce injury from tag abrasion, metal tags used on the front flippers of leatherbacks should be applied so that the point that locks the tag ends up on the dorsal surface of the flipper.

Fouling of Tags

Barnacles, algae and other fouling organisms can grow on metal and plastic tags attached to turtles living in certain marine environments. Algae is harmless except for needing to be scraped off in order to read the tag inscription. However, if barnacles become excessive they will produce drag and tearing that contributes to tag loss. The tag "scar" that results from this sort of loss will often be a healed slit or v-notch. However, there is no certainty that a scar will be formed and remain detectable following the loss of a tag from any cause.

Ways to Reduce Problems

The following additional suggestions can help to minimize difficulties when using metal tags:

1. Mark one jaw of the applicator with colored paint as a reminder of the correct way to insert the tag.
2. Use durable tape to keep the tags from falling off the cardboard or plastic strip that they are loosely attached to when delivered from the factory. Groups of tags can also be strung together in a secure consecutive fashion with monofilament fishing line for convenient use in the field and to prevent loss.
3. Gain experience in tagging by applying tags to a piece of cardboard. Several tags from each new order should always be tested in this manner with each applicator. It should be noted that metal tags are designed to pierce something in order to work properly. Don't seal a tag for testing purposes without attaching it to cardboard or other similar material that mimics the flipper.
4. Tags that fail to lock when applied to a turtle are difficult, frustrating and sometimes impossible to properly correct, even when using additional tools. A tag that malfunctions should be removed, recorded as being destroyed and replaced with a new tag.
5. There are two distinct motions involved in applying metal tags. The first step is to squeeze the applicator so the tag point pierces the flipper. The second step a moment later involves applying substantially greater force to drive the point through the hole and make it bend over completely. The handles of the applicator should always be gripped as far back as possible to gain maximum leverage. Some taggers may find it helpful to use both hands to complete the second step.
6. After attachment, feel the tag with your finger and visually inspect to make sure the point has bent over into a fully locked position. Metal tags can pop open and be lost if not securely sealed.

Tissue Grafts and Other External Marks

Contrasting pigmented marks can be created by the surgical exchange (or autografting) of small pieces of tissue between the carapace and plastron. These marks, sometimes called "living tags," are retained and increase in size as a hatchling or young turtle grows to an adult. By doing the grafts on different scutes, the marks can be used to distinguish year-classes. The marks will appear in older turtles as spots or streaks, depending upon the site selected for the graft. An awareness by researchers and the public that turtles have been marked in this manner is essential for recognition and reporting to occur. The grafting procedure requires some skill, patience and practice but once mastered it can be carried out on hatchlings quite rapidly.

The notching of a marginal scute or combination of scutes by minor surgery can also be used to identify year-classes of hatchlings. However, these marks may become confused with natural injuries as a turtle grows larger. Small holes drilled in various combinations through the marginal scutes of juvenile to adult turtles appear to be retained for many years and can also be used for marking purposes.

Any marking procedure that involves cutting tissue, as described above, should involve consultation with a veterinarian and the exercising of proper precautions to prevent the transmission of disease.

Paint and other substances, including two-part resins, can be used to form identifying characters on the carapace. These marks are often short-lasting due to abrasion and the natural process of cellular shedding and regrowth. Numbers or other marks can be created on adult females that will stay readable throughout a nesting season. This can be accomplished by the shallow engraving of a scute using a portable Dremel Mototool with a No. 131 cutting bit and then applying paint to the grooves.

Internal Tags

Wire Tags

Small 2 mm wire tags made by Northwest Marine Technology (Shaw Island, Washington USA, fax 001-360-468-3844) can be inserted into the flipper of hatchlings or larger turtles to identify year-classes. Tags may be magnetized by passing a magnet over them either before or after implantation, if a magnetometer is used for detection. X-ray equipment can be used to detect the tags in either their magnetized or unmagnetized state. Portable magnetometers are available for field use. However, the possibility has been raised by some researchers that a turtle's navigational ability might be harmed by using magnetized tags.

Wire tags are sold with notch-coding that permits numerous year-classes to be identified. However, a coded tag must be removed from a sea turtle in order to decode it.

PIT Tags

Passive integrated transponder or PIT tags are small inert microprocessors sealed in glass that can transmit a unique identification number to a hand-held reader when the reader briefly activates the tag with a low frequency radio signal at close range. PIT tags used on sea turtles range in size from 11.5 x 2.1 mm to 20.0 x 3.2 mm. Even larger ones are manufactured that have been used on domestic livestock. Larger PIT tags can be read from greater distances than smaller PIT tags.

PIT tags have been inserted into the shoulder muscle of sea turtles or under the scales or between the digits of a front or hind flipper. PIT tags are a relatively new innovation in sea turtle research. The disadvantages of PIT tags include their higher cost, the cost of the readers, and the inability of someone without a reader to detect that a turtle has been tagged. In addition, PIT tags can sometimes migrate within body tissue making it necessary to carefully scan the entire area where implantation occurred. PIT tags have the advantage of being encased in glass and positioned inside the turtle where loss or damage over time from abrasion, breakage, corrosion or tearing should be virtually non-existent. PIT tags therefore offer the promise for reliably retaining the identification of individual sea turtles for decades, something that is not considered possible with externally applied tags. PIT tags may prove especially valuable for tagging leatherbacks due to the high loss of external tags applied to this species.

Until long term PIT tag retention is proven, it is always advisable whenever possible to apply two or more external tags to each turtle, as well as one or more PIT tags. Multiple tagging in this manner will help to reduce the chance of losing a turtle's identity. The use of two or more tags on each turtle also provides the basis to compute the probability of tag loss in a tagging program.

PIT tags are available from several companies including Avid (Norco, California, USA, fax 001-909-737-8967), Destron-Fearing (South St. Paul, Minnesota, USA, fax 001-303-444-1460), and Trovan Ltd. (Koln, Germany, fax 49-221-395-893).

PIT tags are made in two different transmitting frequencies (125 and 400 khz), but the readers that can readily detect 400 khz are being phased out. Also, the readers made by one company may not always be capable of reading tags produced by another company. Efforts toward better industry standardization and compatibility are underway.

Other Important Considerations

When to Tag

The decision of when to tag relates mainly to nesting females. To the extent possible, turtles emerging to nest should be allowed to lay their eggs before tagging takes place. Some researchers feel the best time to tag is immediately after egg deposition when backfilling of the egg chamber starts with the hind flippers. If tagging must occur prior to this time, some turtles will prematurely return to the sea but will usually emerge again to successfully nest on a subsequent night.

Cost of Tags

The cost of buying tags and applicators and shipping them to the study site is an important consideration. Again, the goals and finances of the tagging program will be guiding factors to the researcher. Tags that under some conditions may be more liable to loss are less expensive than ones that may have a longer retention time. For example Monel tags, which have been known to corrode rapidly in some cases, cost about US$300 per 1000, while tags made of Inconel and titanium cost US$750 and $2200 per 1000, respectively. Plastic tags cost US$400 per 1000. The applicators for metal and plastic tags range from US$15-70 each. PIT tags cost US$4-10 each. The more expensive ones are sterilized and include a disposable injector. Lower per unit prices may be avail-

able when metal, plastic or PIT tags are ordered in large quantities. PIT tag readers cost US$300-1250. The more expensive readers have greater sensitivity in their ability to detect tags. Readers that use easily obtained disposable batteries are recommended over ones that have a built-in rechargeable battery.

For many projects the cost of tags, even the more expensive ones, may end up being only a small percentage of the overall budget when taking into account personnel salaries, travel, living expenses at the study site, and post-fieldwork data analysis, report writing and publication. In view of the great importance of the tag to most work with sea turtles, it is recommended that funds for tags be budgeted first and foremost, rather than last, in order to obtain the "best" tag in ample quantity for the project to be conducted.

Storage of Tagging Data

Inherent in conducting a sea turtle tagging program is the need to accurately record and store for future retrieval the tag numbers, return address, tag type, tag size, date and place of tagging, and all data collected for the tagging event. The principal value of tagging results from the recovery and recognition of a turtle at some later date. The archiving of all tagging information should occur, with duplicate copies stored separately as a safeguard against catastrophic loss.

Regional data bases are sometimes established to provide a centralized location for storage of tagging and tag recovery data collected by multiple researchers. Regional data bases offer several advantages if they are operated properly with long term funding support. These advantages include accurate archiving of data, protection against loss, timely retrieval of tag information, and the capacity to analyze data on a regional basis to facilitate regional management of sea turtles. Regional data bases sometimes supply standardized tags and tagging gear at no cost. Individual tagging projects may come and go, but the regional repository will ideally remain intact.

A regional tagging data base should never be started without the assurance of longevity. Before contributing data to a regional entity, the researcher should determine and find acceptable the conditions for future ownership of the data, agreements for publication and any other aspects, including restrictions and obligations that may exist now and possibly in the future. All agreements and conditions should be confirmed in writing with the authority in charge.

Tag Recovery

Except for certain kinds of short term census work, a turtle that is tagged, and then never seen again, will not yield its full potential for research. Recovery is therefore a vital factor. The three means of recapturing a tagged turtle include intentional capture efforts by researchers, accidental or intentional capture by fishermen, and the chance encounter by the public such as finding a tagged turtle stranded ashore. Directed efforts can be carefully planned to increase the possibility of recovering tagged turtles. Other means are mostly a matter of luck and the willingness of persons to report the tag.

Old tags present on recaptured turtles that are unreadable due to corrosion or being imbedded with tissue should be removed and replaced with a new tag. If a turtle with a tag from a different program is re-tagged, the original tagger should be informed of the change.

Disease Precautions

Precautions need to be taken to prevent the spread of infectious diseases during tagging. Tag applicators and piercing equipment, such as used for plastic tags, must be disinfected after coming into contact with blood or other body fluids. Two complete sets of tagging gear are recommended; one kit for turtles that are diseased and the other kit for apparently healthy turtles. Used tagging gear should never be transferred between projects in different regions. Pre-sterilized PIT tags with disposable injectors should be used in areas where disease may be an issue. The used PIT tag injector needles should be placed into proper disposal containers.

Some researchers apply Betadine, 70-90% alcohol, antibiotic ointment, or other agents on the flipper where the skin will be pierced by the tag. Metal tags in particular must be cleaned prior to use to remove lubricating oil or other reside resulting from the manufacturing process. Soaking the tags in alcohol or other agent as a final step may also be advisable.

Discomfort to the Turtle

The application of external or internal tags will produce some level of pain to the turtle. The discomfort displayed is usually short and highly variable between individuals. Most turtles barely seem to notice, while a few others exhibit a marked response. Topical anesthetics, such as ones sold over-the-counter

for human sunburn, can be applied prior to tagging. This may help to demonstrate compassion on the part of the researcher where the public routinely views tagging activities.

In some instances the jaws of the tag applicator may pinch the turtle and cause as much discomfort as the actual tag-piercing process. In such cases it may be possible to alleviate the problem by grinding off certain unnecessary portions of the jaws.

The small wound-site resulting from a tag properly applied to the flipper should heal completely in a short time, similar to what happens when a person's ear is pierced for an earring. However, healing may not occur if a tag is applied too tightly, or the tag corrodes and releases copper and nickel oxides, as can sometimes happen with Monel tags.

The issue of possible adverse effects from tagging, especially when tagging females on a nesting beach, has been raised in the past and must be briefly addressed here. There is no basis to believe that the tagging experience or presence of tags will cause lasting harm or alter a turtle's long term behavior. When females were first tagged decades ago some researchers were concerned that this might cause the turtles to nest elsewhere, since none returned to nest the year after initially being tagged. This misunderstanding was eventually dispelled with the knowledge that most sea turtles have multiple-year nesting cycles.

Hazards to the Researcher

There is an element of risk to the researcher when tagging large turtles on a nesting beach. Powerful, fast and unexpected swings of the front flippers can inflict painful blows. Tag applicators not gripped firmly may be turned into hazardous projectiles as the result of violent flipper movements. Sand on a nesting beach can be flung by the flippers with incredible force creating a danger to the researcher's eyes if caution is not exercised. Durable shoes are advisable to protect against foot injury from a nesting turtle that suddenly decides to crawl while being tagged. Some turtles attempt to bite when handled during underwater capture efforts and when brought out of the water to be tagged.

The sharp point of a metal tag and the injector needle of a PIT tag are also hazardous and can easily puncture a finger or other body part if care is not taken. Repetitive motion injury can occur to a researcher's hand and forearm from squeezing a tag applicator multiple times when tagging turtles over months or years.

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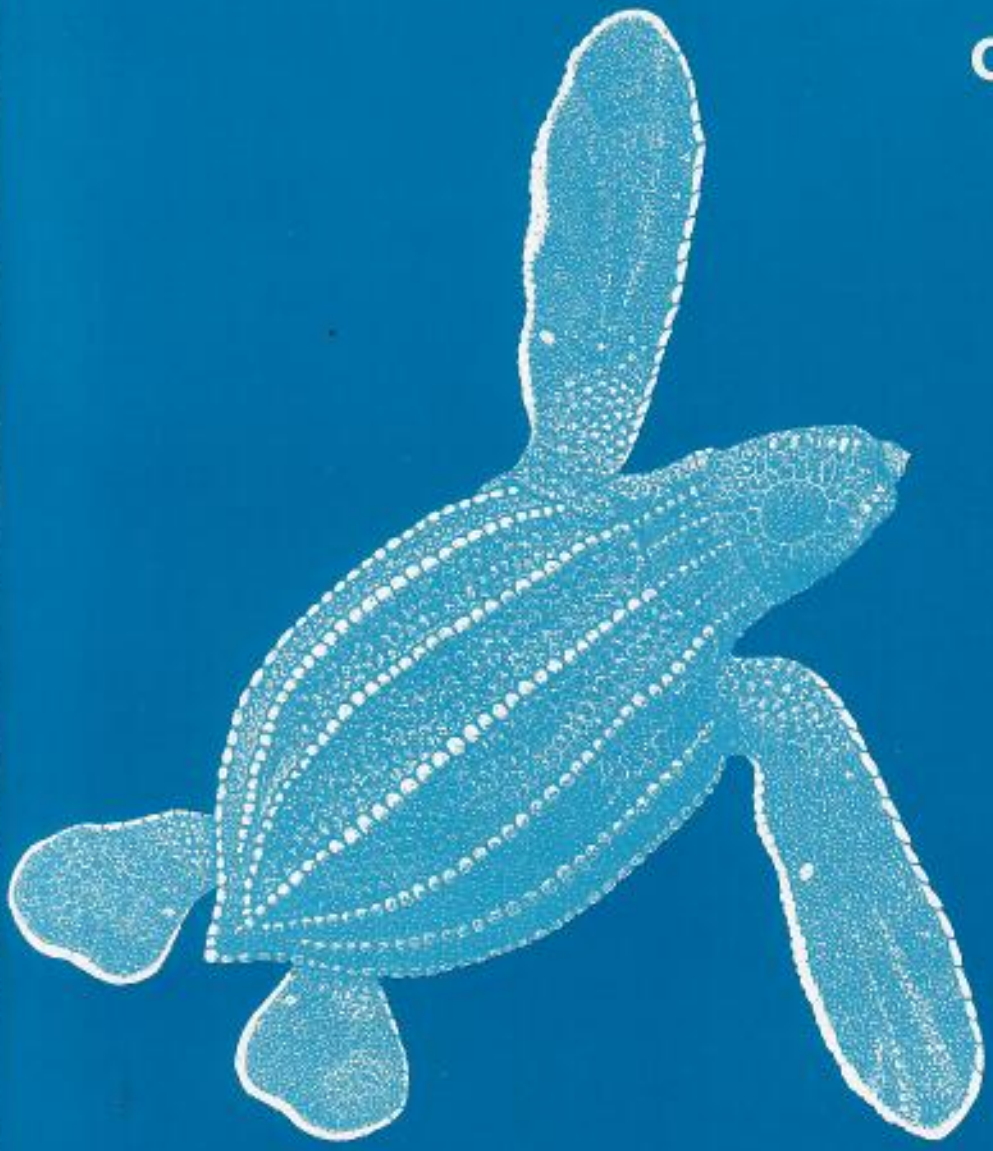
MTSG

Research and Management Techniques for the Conservation of Sea Turtles



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