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CMAR Code of Practice for Tagging Marine Animals

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1. CODE OF PRACTICE FOR TAGGING MARINE ANIMALS

The Code of Practice (COP) for tagging marine animals consists of a series of Standard Operating Procedures (SOP) detailing the various steps involved when tagging marine animals. Each SOP has an associated date indicating the last time the SOP was revised. Suggestions for revision of any SOP should be directed to the authors. Suggestions will be appended to the COP and incorporated on a schedule as outlined in SOP 9.

Improving the quality of tagging protocols is good practice to ensure that techniques and methods are transferrable between staff, across years and across projects. Improving our protocols is also an important component of meeting our obligations under animal welfare legislation and are in-line with the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes* (NHMRC 2004). The following protocols have been based upon CSIRO's *Fish Tagging Protocol* (Bradford et al. 2007); they are designed to be a living document that will be updated in light of advances in technology and methods.

In the text that follows references made to fish will, in general, encompass both bony and cartilaginous fishes unless specified otherwise.

List of Standard Operating Procedures.

1. Animal Ethics
2. Safety & wellbeing
3. Field trip preparation
4. Training
5. Tag types
6. Selection & handling of animals
7. Tagging procedure
8. Post field trip equipment cleaning & storage
9. Revision of protocols

1.1 Standard Operating Procedure 1: Animal Ethics

(created: June 2009; full revision due June 2011)

CSIRO Marine and Atmospheric Research (CMAR) is licensed under Tasmanian State legislation to carry out research on live animals (fulfilling a legal requirement of section 27 of the *Animal Welfare Act* 1993). The license requires all projects to abide by the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (http://www.nhmrc.gov.au/publications/synopses/eA16syn.htm); it is also CSIRO policy that the Code of Practice be followed by all staff. Under the Code of Practice it is a legal requirement (sections 4(3) and 30(3) of the *Animal Welfare Act* 1993) that all projects conducting research on live animals (all non-human vertebrates and higher order invertebrates) must have approval from an Animal Ethics Committee (AEC) before the research can proceed. Failure to obtain AEC approval for a project compromises not only CMAR's license but the ability of all of CSIRO to conduct research on animals.

Approval for research can be obtained from a local AEC. In Tasmania, CMAR approval is sought from the Tasmanian Department of Primary Industries and Water (http://www.dpiw.tas.gov.au/aec) under a Memorandum of Understanding. Under some circumstances additional Animal Ethics approval may be required if the research is being done in collaboration with other institutions and/or in other states. Appendix A provides further information of permit requirements.

Our obligations under Animal Ethics require that we treat every animal with care to ensure its safety and wellbeing. For tagging studies it is essential that the tagged animal is in good health upon release. However, should there be an unexpected event that impacts or may impact negatively on the wellbeing of an animal in your care, you must report the incident to the relevant AEC as soon as practicable. Adverse incidents include animal escapes, unexpected illness, injury or death, emergency treatment or euthanasia, or accidents to the investigator. The current AEC policy (2009) indicates the following course of action:

> "The AEC Executive Officer must be informed, as soon as is practicable, after the incident occurs, but no longer than **7 days** after the event. A post-mortem must be conducted to investigate the cause of the incident, and a report forwarded to the AEC Executive Officer within a week of reporting the incident.
>
> Failure to report an adverse incident within 7 days is contrary to your Animal Research Approval Certificate. In the absence of notification of adverse incidents, the AEC is unable to fulfil its obligations to DPIW or other licensed institutions, to ensure that all care and use of animals by those institutions is conducted in compliance with the Code.
>
> The Operating Procedures for the DPIW AEC provide that, on receiving an Adverse Incident Report, the AEC Executive Officer circulates the report to the AEC members, who may request additional information.
>
> If they consider it warranted, the AEC may suspend or cancel the project or amend the conditions of the Approval Certificate. The Chief Investigator will be notified of the AEC's decision by the Chair, and the Chair will also provide a report to the Secretary DPIW on the adverse incident."

In the very rare case where communications prevent notification within seven days, the incident must be reported as soon as communications are possible and the researcher must provide a valid reason for being unable to report the incident sooner. Note that the report can be relayed through a supervisor/manager/associate investigator if direct communication to the AEC is likely to be delayed.

All tagging personnel are obliged to read and understand their obligations under Animal Ethics, and must use best practice to ensure the safety and wellbeing of all animals that are being used in their research. The Standard Operating Procedures outlined herein do not replace or override the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes and the legal requirements of the *Animal Welfare Act* 1993.

1.2 Standard Operating Procedure 2: Safety & wellbeing

(created: June 2009; full revision due June 2011)

When discussing safety and wellbeing we tend to focus on the human side of the equation. Of equal importance, however, is the safety and wellbeing of the subject of our research. All species differ in their susceptibility to stress, including capture stress (Monamy & Gott, 2001). It is the researcher's moral and ethical duty to ensure that the effects of capture and handling on wildlife are accounted for and minimised. It is also scientifically sound to ensure that the effects of any intervention are minimal so that they do not adversely affect the analysis and interpretation of data.

When assessing the effects of capture and handling, we must formally consider the humane Principals of replacement, reduction and refinement (Monamy & Gott, 2001). The researcher should consider the possibility of using non-destructive, non-interventionist procedures and the feasibility of replacing the animal with a computer model. In the event that replacement cannot be achieved, the researcher must carefully consider the required number of animals to achieve a statistically robust result. It is also a requirement that the researcher continually refine techniques with an aim to achieving/maintaining the "normal" functioning of physiological and behavioural systems (Heeger & Brom, 2001).

More specific information is contained in SOP 6 (Selection & handling of animals).

Returning our attention back to the human side of safety, some general notes follow on the responsibilities of personnel while in the field. It should be noted, however, that safety is largely a matter of common sense and is maximised through effective prior planning. If it doesn't feel "right", don't do it.

Much of CSIRO's tagging requires time on vessels at sea or in remote locations. Wherever possible the daily decisions on where and how operations are to be conducted are the responsibility of the senior scientist, as is the decision on whether or not the weather conditions are suitable for effective tagging. However, when on a fishing vessel, the vessel skipper has the ultimate veto with respect to navigation, personnel safety considerations and the safety of the vessel.

Before going out into the field it is the *responsibility of the Investigator* to ensure the CSIRO personnel have met the requirements for field-going staff:

- Current workplace level 2 first aid.
- Current sea-going medical (for at-sea based field work).
- Current 'Elements of Shipboard Safety' or Personal Survival Training certificate (for at-sea based field work).
- Have read and signed off on the OHS&E risk assessment.
- Notified CSIRO of having completed the requirements.

"Recent changes to the OHS&E Act have removed the immunity from prosecution for all CSIRO employees. This means that there are now potential fines and penalties associated with breaching the Act. Research Group and Project Leaders bear the responsibility for ensuring that personnel have received the appropriate instruction and training before working on vessels." (Young 2005).

Every field-based operation has a different suite of safety concerns. Under *Duty of Care*, each person is responsible for their own health and safety, as well as the health and safety of all other personnel working within the same environment. When undertaking field work at sea, ensure you have discussed safety with the skipper of each vessel and are aware of the location of safety equipment. In the case where there are two CSIRO officers/delegates conducting the field work,

one member will have the role of *field/cruise leader*, and as such is deemed responsible for the safety of the other staff. The instructions of the field/cruise leader as regards safety issues must be adhered to.

1.3 Standard Operating Procedure 3: Field trip preparation

(created: June 2009; full revision due June 2011)

In preparation for field-based tagging work, thorough consideration should be given to the equipment required, a detailed inventory documented and a kit of field equipment prepared, including storage/packaging that is suitable for transport. The kit should also contain adequate supplies of 'spare' items and consumables, as well as a basic first aid kit. Personal equipment, such as adequate clothing and footwear, wet weather gear, a personal EPIRB, inflatable life vest, sun protection and sleeping gear for the trip should also be prepared, along with other personal items required for the trip. Copies of all relevant permits should be made and placed in the tagging kit.

Prior to departure, tagging equipment to be used should be inspected to ensure it is in good, serviceable condition following transport, clean and ready for use. For larger items, such as a tagging cradle, it is wise to set up the equipment before setting sail while the benefit of sure-footing exists. This allows a check for correct ropes and attachments, ensuring that the mesh liner is securely laced to the frame and the boom attachment ropes are fixed to the cradle frame. For the tagging cradle used in conventional and archival tagging, ensure the measuring scale is accurate and readable. This time also provides a good opportunity for showing/explaining to the skipper and crew what equipment will be used and how the equipment is to be used. Once set up, the equipment should be stored in an area where it is secure and protected from potential damage or buffeting and out of the way of the crew.

If large animals are to be removed from the water using a cradle and boom, a check should also be performed to ensure that the vessel's boom and winch systems are sufficiently adjustable and manoeuvrable (and even to check they are in good operating condition) to permit the use of a tagging cradle (i.e. to extend the boom laterally such that the winch line can draw the cradle up vertically from the water, clearing the side of the vessel). The crew should be instructed in how the cradle must be deployed and retrieved to ensure the careful and safe landing of the specimen to be tagged, along with an adequate number of hands available for its deployment and retrieval.

1.4 Standard Operating Procedure 4: Training

(created: June 2009; full revision due June 2011)

In the context of SOP 4 we are concentrating on the training requirements for tag application (including gaining a familiarity with the documentation procedures required for each particular operation). For training in selecting and handling an animal for tagging, please see SOP 6.

Training is an essential component of any research program. Different tag types require different levels of training. Below we outline the training requirements for all current tag types from non-surgical conventional tags through to electronic tags requiring surgical implantation. The training program for all tagging operations is overseen by an advisory committee consisting of a veterinarian, tagging instructors and data users.

Advisory Committee Members

(as of September 2009)

Barry Wells (Veterinarian)
Russell Bradford (Electronic Tag Systems Support coordinator/Animal Ethics/Instructor)
Alistair Hobday (Training development/Instructor)
Karen Evans (Animal Ethics/Instructor)
Clive Stanley/Thor Carter (Instructor)
Paige Eveson (Data user representation)

Training for non-surgical conventional tags.

Training for non-surgical conventional tags is a three step process. As the majority of conventional tags deployed are on fish, training is focussed on fish. First all potential taggers are required to observe and practice non-surgical tag application in a “class room” setting using a surrogate fish of synthetic rubber. The surrogate is anatomically similar to a 15 kg southern bluefin tuna. Practice on the surrogate ensures the tagger is proficient in the correct placement of non-surgical tags. Class room training will ideally also involve dead fish that have been obtained through other field studies. The placement of tags can be demonstrated and checked by removing the flesh around the anchor to expose the pterygiophores.

The next step in training is obtained in the field under the supervision of an experienced tagger (minimum level 3, see below). During this step the trainee is introduced to capture methods, animal selection (SOP 6), data collection and tag application. The trainee will observe the experienced trainer, practice technique and tag placement on recently euthanaised fish. Once the trainer is satisfied of the trainee’s technique, the trainee will be allowed to tag live fish under supervision.

The final step in training for non-surgical tags is gaining sufficient experience to be able to perform field work without the supervision of a trainer. Generally this will occur after the trainee has conventionally tagged a minimum of 500 live fish. Released fish are tracked in the CSIRO database and provide a mechanism to monitor a tagger’s proficiency.

Training for non-surgical electronic tags.

Training for non-surgical electronic tags is the same as that for non-surgical conventional tags apart from the following:

- The anchor type used for electronic tags is not compatible with the surrogate fish. However, the Principals of tag placement are the same for both non-surgical tag types.
- During the class room component the trainee is introduced to the various anchor types used with non-surgical electronic tags.
- The trainee is not required to deploy 500 electronic tags under supervision before being declared proficient. Deployment of non-surgical conventional tags is considered equivalent in this instance.

Training for surgically implanted tags.

Surgical implantation requires further training in addition to the requirements for non-surgical tags. Again, as the majority of surgically implanted tags are deployed on fish, the training is focussed on fish. CSIRO has implemented a series of four certification steps aimed at ensuring each tagger is properly trained and that their techniques are effective. The requirements for the four levels are outlined below.

Level 1.

Level 1 training is conducted in the class room setting where the trainee is instructed in the theory of tagging, liaison with crew and skipper of fishing vessels, and surgical techniques associated with the implantation of tags. Animal handling and selection (SOP 6) is also covered at this time. Training is conducted on the surrogate fish as well as on dead fish obtained through other field studies. Daily practice in suturing techniques is encouraged. Level 1 training also includes viewing training videos of surgeries conducted under field conditions.

Level 2.

Level 2 training is conducted in a field setting under the supervision of a minimum level 3 trainer. While in the field the trainee will observe an experienced tagger and practice surgical techniques on recently euthanaised fish. Once the trainer is satisfied of the trainee's technique, the trainee will be allowed to tag live fish under the direct supervision of the trainer.

Level 3.

Level 3 training consists of further tagging in the field, initially under the direct supervision of a trainer. The trainee will be able to perform unsupervised surgical tagging once the trainer is satisfied of the trainee's proficiency. However, to complete level 3 the trainee must perform a minimum of 50 surgeries on fish that are subsequently released in the field. Released fish are tracked in the CSIRO database and provide a mechanism to monitor a tagger's proficiency.

Instructor.

Instructor status is achieved through the development of training protocols and the delivery of training courses at level 1. Level 3 proficiency and qualifications must have been attained to reach this level.

1.5 Standard Operating Procedure 5: Tag types

(created: June 2009; full revision due June 2011)

CSIRO deploys a variety of tag types ranging from simple non-surgical conventional tags through to sophisticated electronic tags that may or may not require surgery to deploy. Conventional tags commonly include both dart and T-bar tags. Electronic tags can include acoustic, archival, pop-up satellite archival (PSAT), and satellite transmitting (SAT) tags. The choice of tag is often based on prior knowledge and use. However, each study should assess the suitability of the particular tag and in particular the implications of tag choice on animal welfare. The application of tags is outlined in SOP 7; below is an introduction to the tag categories commonly used by CSIRO on pelagic animals.

Conventional tags.

CSIRO typically uses two variations of conventional tag: dart and T-bar (Figure 1). Both tag types are made of plastic on which an identification number and a “return to” message have been printed. Both tag types are applied using a stainless steel needle, by hand for dart tags and using an applicator gun for T-bar tags.

Conventional tags are inexpensive (~ $1), quick and simple to apply and are traditionally used where large numbers of tags are to be deployed. They can provide high resolution data on tag release and recapture position (although recapture positions tend to be reported at a lower resolution than release position). At release, data on fish condition, sex, size and weight may be collected. If on recapture similar data are collected, growth rates can be calculated. Rates of tag return can be used to estimate fishing and natural mortality parameters. These data can then be used in fishery models to assess population parameters and exploitation rates.

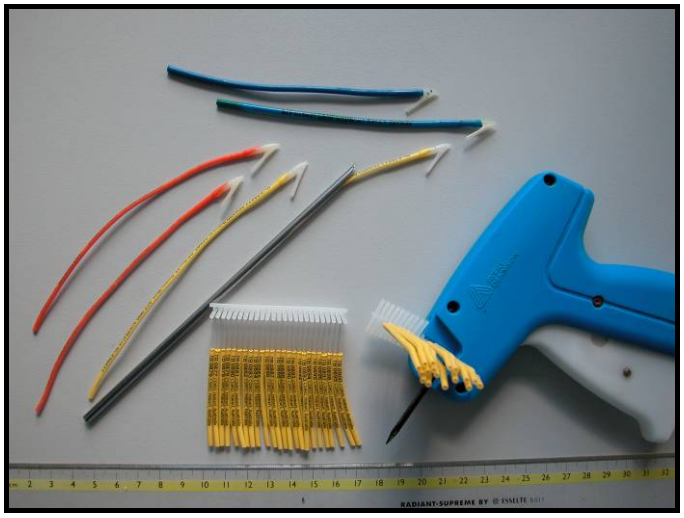

Figure 1. Range of conventional tags used by CMAR: dart and T-Bar tags.

Acoustic tags.

Acoustic tags come in a variety of shapes and sizes (Figure 2) that can be tailored to the study at hand. Acoustic tags emit an ultrasonic signal on a random basis that encodes a tag number. When within the detection range of an acoustic receiver, the signal is detected and logged by the

receiver. Some acoustic tags also incorporate sensors that can measure depth and temperature of the tag. The same ultrasonic signal encodes the data from the sensor.

Current battery technology and power management systems can allow life spans of acoustic tags of up to 10 years. Long life tags allow the researcher to follow ontogenetic changes in the distribution of species. Although acoustic tags can be deployed either externally or internally, in the case of fish internal deployment is preferred. Surgically implanting tags in fish eliminates the potential for biofouling communities to grow on the tag and irritate the tagged animal (Figure 3). However, there are specific cases where surgically implanting acoustic tags in fish is not feasible and the tag needs to be attached externally to the animal. In these cases the tether attaching the tag to the fish should incorporate a mechanism to allow timely release of the tag.

Figure 2. A range of acoustic tags commonly used in CMAR research projects.

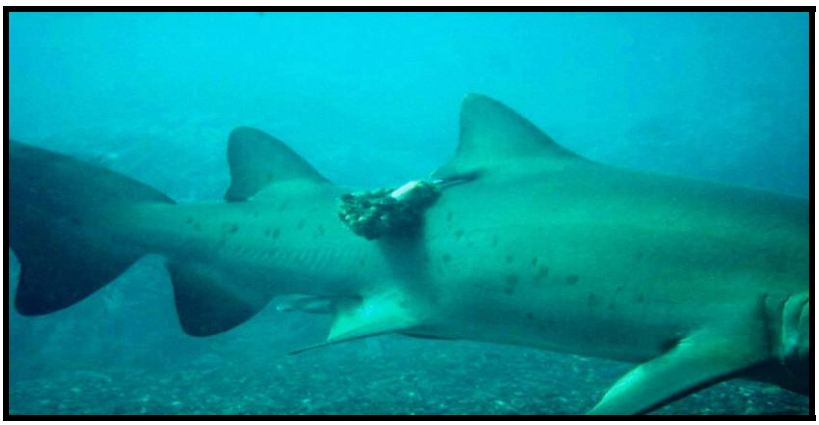

Figure 3. Example of tag fouling on an externally attached acoustic tag.

Acoustic tags are moderately expensive (several hundred dollars) and are used where the researcher needs to collect data on specific, known individuals (ID encoded in the ultrasonic signal). **Continuous** acoustic tags that emit their signal on a high repetition rate (typically every second) are used to manually track individuals. Continuous acoustic tracking tags allow for fish to be followed from a tracking vessel (fitted with a hydrophone) and monitor their swimming depth over the duration of the tracking operation. Manual tracking is generally of short duration

(days to weeks). **Coded** acoustic tags that emit their signal on a low repetition rate (~1 – 10 minutes) are commonly used where the researcher wishes to examine the presence/absence of individuals at particular sites over longer time frames, or to examine long range movement patterns of individuals.

Archival tags.

Archival tags are user programmable tags capable of storing data on internal and external environmental parameters (Figure 4), typically water and body temperature, depth and ambient light levels. Archival tags can be either attached externally or surgically implanted. External attachment is the most common method for air-breathing marine animals and for large fish or those fish that are susceptible to high levels of capture stress. However, for most fish the standard practice is for archival tags to be surgically implanted. Sensors can be programmed to collect data on a time scale from every second to several minutes. The rate of data collection affects the life span of the tag through constraints imposed by its memory chip and battery life. Astronomical algorithms applied to the collected light level data provide medium resolution position estimates (which can be improved through further post processing and using additional sensor data).

Archival tags are relatively expensive (AUS $1000+) and used where the researcher requires high resolution data to be collected over medium to long time frames (maximum ~ 3 years). The archived data is only accessible on recapture of the animal and return of the tag. Archival tags, therefore, are often used in conjunction with other tag types where high resolution data from a few individuals may be applied to a larger population.

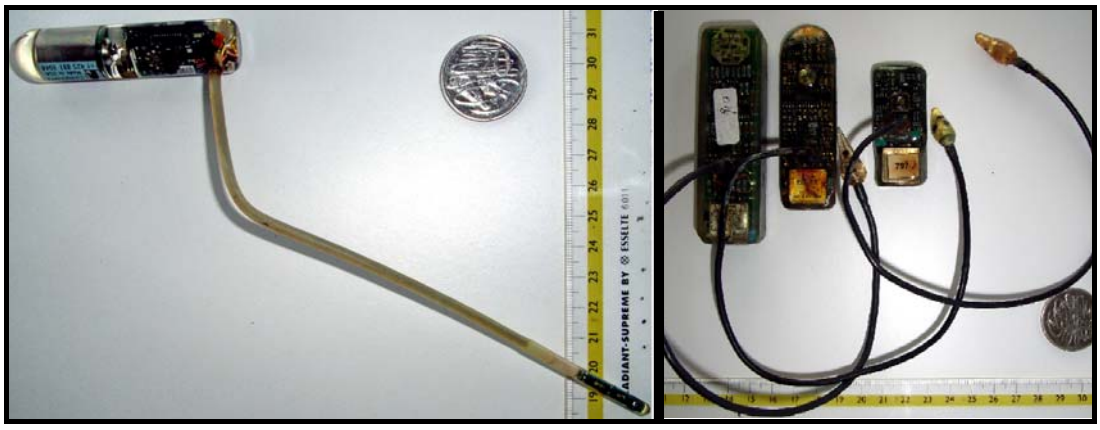

Figure 4. Examples of archival tags used by CMAR. Current generation Wildlife Computers mk10 archival tag (left); earlier versions of archival tags (right).

Pop up Satellite Archival (PSAT) tags.

The PSAT group of tags (Figure 5) includes both simple light-based positioning and light-based positioning GPS position acquiring tags. PSAT tags are user programmable tags capable of storing data on external environmental parameters, typically water temperature, depth and ambient light levels. PSAT tags are attached externally and incorporate a mechanism to ensure tag release (at a user programmed time). Upon release, the tag floats to the surface and begins to transmit a summary of the archived data to the Service Argos satellite constellation. Astronomical algorithms applied to the collected light level data provide medium resolution

position estimates (which can be improved through further post processing and using additional sensor data). Tags incorporating GPS positions provide very high resolution position data in addition to light-based estimates.

PSAT tags are expensive (~AUS $4,000 – $6,000) and are typically used in shorter term studies (up to 1 year of data collection) where the return of tags is either unlikely or there is a need for data collection independent of tag returns. PSAT tags are programmable to release from their host on a time scale from hours to years. However, methods of attachment generally restrict deployment length to less than 12 months. The full PSAT archived dataset can be accessed should the tag be found and returned.

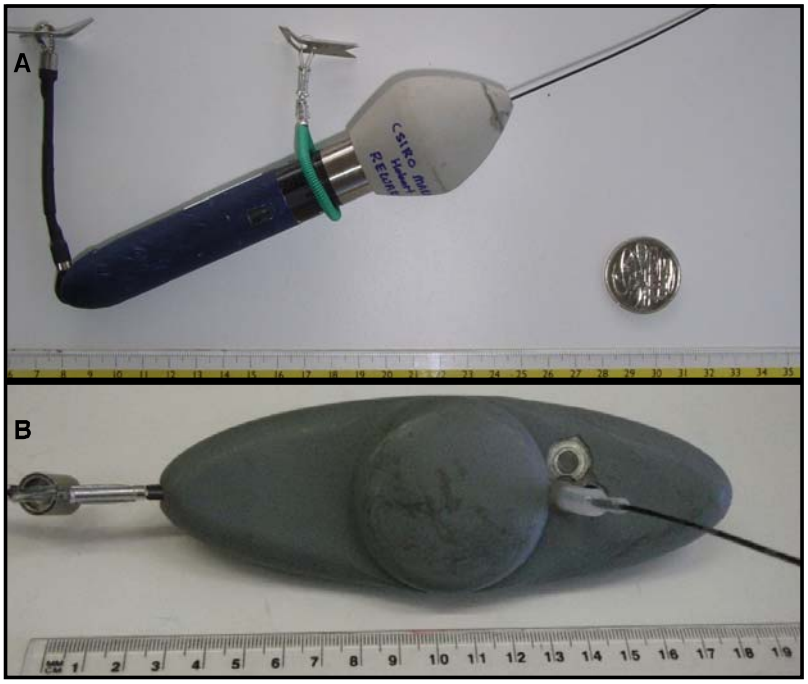

Figure 5. Pop-up Satellite Archival Tag (PSAT) group of tags. A: standard mk10 PSAT tag rigged for deployment on shark species; B: GPS Position Acquiring Tag.

Satellite Transmitting (SAT) tags.

The SAT group of tags (Figure 6) includes those tags that transmit to the Service Argos satellite constellation whenever the tag is exposed to air. They can include tags that derive positions from the Service Argos system as well as GPS position acquiring tags. Some SAT tags are capable of storing data on external environmental parameters, typically water temperature, depth and ambient light levels, with some also capable of acquiring GPS position. SAT tags are attached externally and transmit a summary of the data collected whenever the tag is exposed to air. The Argos system applies a Doppler algorithm to transmissions to provide medium to high resolution position data. For periods between transmissions, location position can be estimated using the data collected on light levels (for those tags that collect light data) in the same fashion as for archival and PSAT tags or in the case of GPS acquiring tags from those GPS positions collected by the tag.

SAT tags are expensive (~AUS $1,000 – $4,000) and are used where the researcher requires high resolution habitat data coupled with relatively high resolution position data. SAT tags do not have a self-release mechanism; this must be taken into consideration in study design. The full SAT archived dataset can be accessed should the tag be retrieved. For some SAT tags that do not transmit to the satellite, but acquire GPS position from satellite (e.g. Wildlife Computers Mk10-AF), the data is retrieved only if the tag is recaptured.

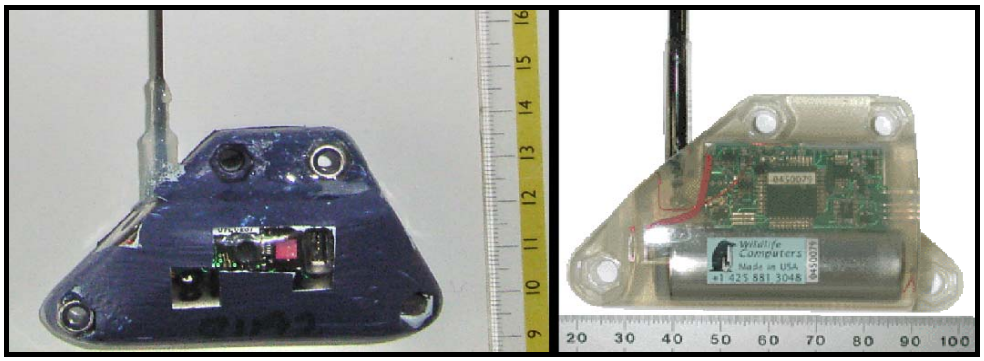

Figure 6. Examples of Wildlife Computers SAT tags currently in use by CMAR. SPLASH tag coated in antifouling paint (left); SPOT tag (right, courtesy of Wildlife Computers).

1.6 Standard Operating Procedure 6: Selection & handling of animals

(created: June 2009; full revision due June 2011)

In general, the aim of any tagging program is to release tagged animals in good condition so that they may return to their environment with 'normal' physiological and behavioural functioning. Exceptions to this may be in studies where post-release survival (for example in the case of by-catch in a commercial fishery or sport fish caught by recreational fishers) may be the focus of the study. Even then, the aim is that CSIRO's tagging procedure, itself, does not alter physiological and behavioural functioning. When handling animals, there are a number of "Rule's of Thumb" to assist in ensuring best practice in tagging and releasing animals.

General rules of thumb

- **Be trained:** never attempt to tag an animal without prior adequate training.
- **Be prepared:** have all of your equipment set-up, ready to use, and at hand before any animals are captured.
- **Be clean:** all equipment must be cleaned between the tagging of each animal and dipped in antiseptic to avoid transfer of zoonoses, disease and viruses; if using a cloth to cover the eyes or head of an animal, use a fresh cloth on each animal.
- **Be careful and quick:** aim for all handling and tagging operations to take the minimum amount of time without compromising the care taken in handling the animal.
- **Be gentle:** use the minimum amount of force required when handling animals, always wear gloves and in the case of fish ensure your gloves are damp.
- **Be focused:** capture and tagging of animals often involves moving and noisy platforms, multiple people and elevated levels of adrenalin. Remain calm, take extra care and remain totally focused.
- **Know your role:** if you are part of a team of people required for the capture and tagging of an animal know your role and stick to it unless directed otherwise.

In addition to the general Rule's of Thumb, the wellbeing and viability of the animal will be enhanced by following common sense. Never lift or carry an animal without supporting its weight across the entire body. Never, ever, carry a fish by the caudal peduncle (the region between the trunk and tail). When carrying an animal, always carry it 'right way up'; carrying a fish upside down may result in paralysis and death and it is likely to increase stress in other animals. Finally, some fish (e.g. sharks) require oxygenated seawater to be passed through the buccal cavity and over the gills.

Fish

When selecting a fish for tagging first make a quick check of the fish's condition. Check for signs of stress by looking for blood coming from behind the gill plate, bloody eye (indicative of being hooked in the eye), excessive skin abrasion, torn jaw, or excessive flapping (may be indicate a fish in cardiac arrest). In the case of operations occurring on a charter vessel, fish showing signs of minor stress should immediately be returned to the water and fish showing signs of extreme stress should immediately be euthanaised. If operating on a commercial fishing vessel, fish that are not in good condition should be passed to the skipper and crew of the vessel for normal processing as part of their commercial operations.

Fish which are considered to be of good condition and suitable to tag should be handled carefully and quickly. In the case of non-surgical conventional tags, a fish should not be

exposed for more than about 20 seconds. Where archival tags are to be surgically implanted or PSAT tags externally attached, the fish should not be exposed for more than three minutes. SAT tags require more time to attach, but in all cases the time the animal is exposed or restrained should not exceed six minutes.

A competent, well trained tagger should be able to apply the required tag(s) well within the suggested time frames provided above. However, no matter how well prepared or experienced a tagger may be, occasionally a problem may be encountered that will extend the time the animal is handled. Under this circumstance the tagger must assess the viability of the fish and decide whether to halt the procedure and either euthanaise the fish or pass it over to the vessel for inclusion in its commercial catch. **If in doubt, don't release the tagged fish.**

Fish which are to be euthanaised must be handled humanely. The preferred method of euthanaising a fish < 150 cm TL is by pithing – the insertion of a metal skewer into the brain cavity. For swordfish and fish other than tunas > 150 cm TL the preferred method of euthanaising is to quickly and cleanly remove the head. Where possible, biological samples should be collected from all fish which have been euthanaised.

All adverse incidents must be reported to the relevant Animal Ethics Committee immediately. A post mortem must be performed and a report forwarded to the Animal Ethics Committee as soon as practical after the event, but no longer than seven days after the adverse incident (see SOP 1 for further detail).

1.7 Standard Operating Procedure 7: Tagging procedure

(created: June 2009; full revision due June 2011)

Standard procedures follow. Some adjustments will be required depending on the species being tagged. Adjustments will be outlined in the Animal Ethics application and tuition provided by the PI prior to any tagging activity. All adjustments will be examined on a regular basis to assess if they should formally be included in the standard procedures.

Conventional tags.

For conventional tags to be effective they must be retained by the animal. It is good practice to apply two conventional tags to each animal to increase the likelihood of identifying a tagged individual should a tag be shed.

Fish

Although there may be slight differences in the equipment used to apply different types of conventional tags (for example stainless steel needle applicators for dart tags, an applicator gun for T-bar tags), the underlying technique is the same. The tag head, or anchor, is inserted into the dorsal musculature such that the anchor locks into the pterygiophores of the dorsal fin of the fish (Figure 7).

The first (or primary) tag is the easiest to insert and is placed on the side of the fish facing the tagger when it is lying in the tagging position. Care must be taken when inserting the second (or companion) tag to ensure the applicator does not cut through the primary tag. For this reason the companion tag is inserted slightly further back towards the tail of the fish.

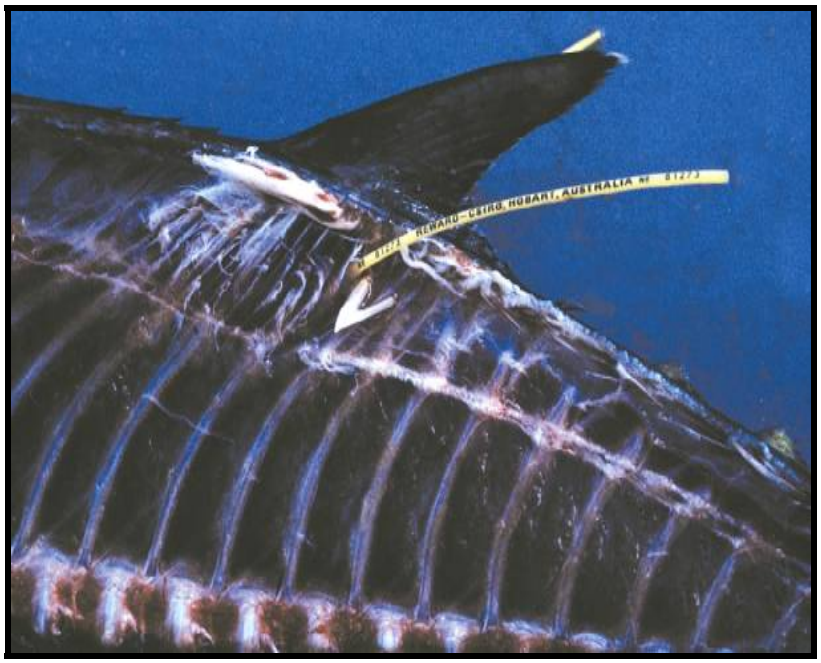

Figure 7. Dissection of a southern bluefin tuna showing the correct tag insertion technique.

Conventional tags are inserted into the fish to the rear of the origin of the second dorsal fin at an angle approaching 45° to the body and with the anchor pointing towards the head of the fish.

The insertion point should be close to the base of the dorsal fin where it disappears into the body. Tagging large fish may require some force, but extra care should be taken with smaller fish to ensure the tag does not pass through the fish. Application effectiveness should be checked on a regular basis by tugging on the tag to ensure it does not pull out. When tags are correctly inserted they will lie in a semi-streamlined position (Figure 8), with the dart head anchored in and around the pterygiophores of the fin rays.

Figure 8. Tagged southern bluefin tuna about to be released showing the semi-streamlined conventional tags.

Acoustic tags.

Acoustic tags may be surgically implanted into the body cavity or deployed externally depending on the animal. In fish, surgically implanting tags is preferred where possible; however, for large animals or those which do not handle capture stress well, external application may be the safest means of deployment.

Fish

External deployment. External deployments are used for **continuous** acoustic tracking tags (where the aim is to have the tag release shortly after the tracking event – i.e. within several days to about a week of the tagging event) and for **coded** acoustic tag deployments on large sharks.

Continuous acoustic tracking tags are cylindrical, approximately 100 mm in length and 12 mm in diameter. A corrodible release is used to detach the transmitter from the animal after the tracking period (Figure 9). The acoustic tracking tag is attached to a float. The float serves two purposes: first it allows the tag to float free of the animal's body reducing the chances of irritation. Second the float allows the tag to rise to the surface on release and provides for an opportunity for recovery of the tag.

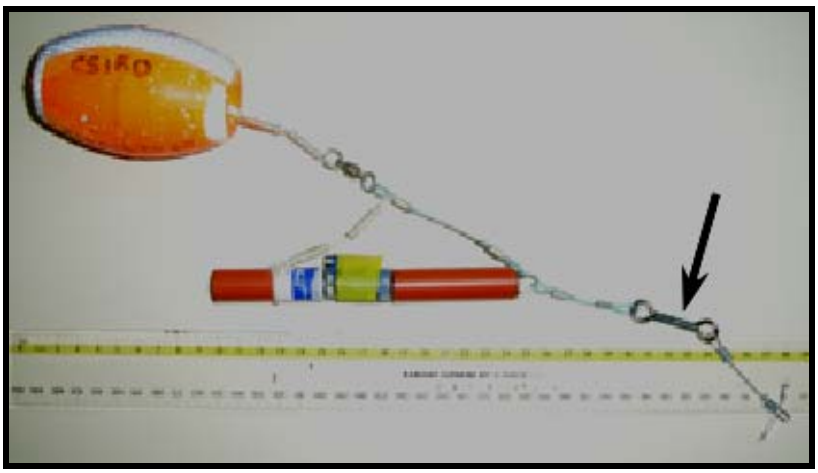

Figure 9. A typical continuous acoustic tag set-up showing the location of the corrodible release (arrow).

Externally applied coded acoustic tags are cylindrical, approximately 94 mm in length and 16 mm in diameter. Coded acoustic tags are attached using a nylon or 316 stainless steel tether attached to a dart or Domeier anchor (Figure 10). To date, the tether design has limited the lifespan of the tags to about two years, after which the coded acoustic tag detaches from the animal. In general, coded acoustic tags are embedded in a small high-density float that is coated in antifouling paint. The float minimises the chances of the coded acoustic tag making contact with the animal's body and causing irritation; the antifouling greatly reduces the amount of marine growth which may cause abrasions. The float has the added function of improving the hydrodynamic shape of the tag.

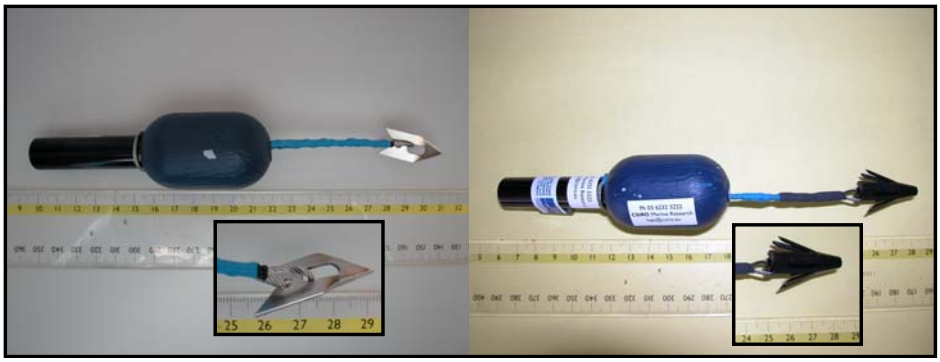

Figure 10. A typical coded acoustic tag set-up for external application. Inset shows detail of dart (left) and Dormeier (right) anchors.

Both continuous and coded acoustic tags are attached to the animal using a hand pole to dart the tag into the dorsal musculature of free-swimming animals. Care must be taken in the orientation of the tag anchor. The point of the anchor must be towards the head of the animal with the tail angle pointing to the opposite side of the animal. This will ensure that the anchor will lay flat

and present the greatest surface area to the angle of highest stress. External tags are attached close to the base of the dorsal fin (Figure 11).

Some hand pole applicator heads collect a tissue sample at the same time as applying the tag (Figure 12). If this type of applicator is used the tissue sample should be removed immediately after the tagging event, placed in a suitable vial and labeled with the acoustic tag number, date, and species. Tissue should be placed in a suitable preservative that does not degrade the DNA such as ethanol or DMSO (Dimethyl sulfoxide) or frozen immediately. Note that ethanol is a restricted substance on aircraft.

Figure 11. Externally attached acoustic tag on a juvenile white shark.

Internal deployment. Coded acoustic tags for internal deployment come in a range of sizes from 18 mm in length and 7 mm in diameter to 96 mm in length and 16 mm in diameter (Figure 2). The surgical technique is the same for all fish with some small adjustments in the location depending on the size of the fish. For most fish the location of the surgery is on the ventral surface approximately midway between the pelvic and anal fins (Figure 13). For sharks, the surgery is conducted more towards the anal fin where the skin and musculature are thinner and more pliable (Figure 13).

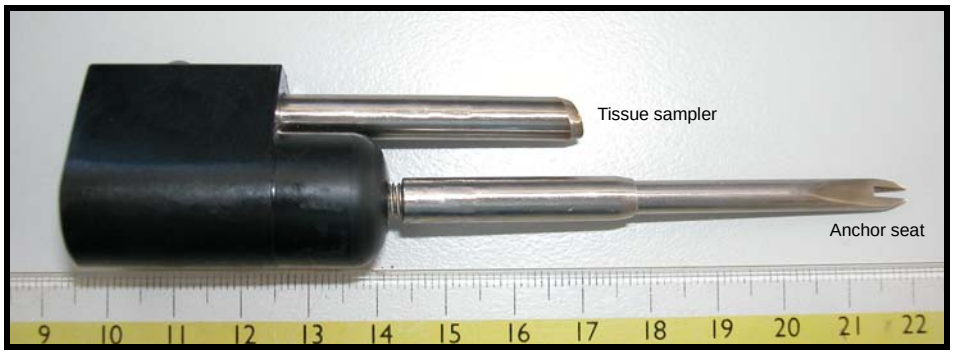

Figure 12. Applicator head for dart tags showing the addition of a tissue sampler.

Once the location of the surgery has been decided, use a sharp knife to cut a small slit of about 4 cm length through the skin, fat and muscle, taking care to leave the peritoneum intact. This may require several passes with the knife depending on the condition of the animal. Use your finger to gently break through the peritoneum. Next, insert the tag so that it lies lengthwise inside the body cavity. Suture the slit closed, normally with a cross stitch, and cut the thread about 5 mm

above the knot (Figure 14). Apply one or two external conventional tag(s) (orange dart tag to denote an internally tagged fish). For most fish, two external orange dart tags will be applied. The orange external dart tag indicates that this animal has a surgically implanted tag. It helps to differentiate the animal and avoid a second capture. It also helps fishers and the public to recognise that the animal has an internal tag should the animal be caught.

Figure 13. Location of incision for surgically implanted tags in bony fish (left) and shark (right). Note that gloves are not being used in the image on the right. Current requirements are that gloves be used at all times.

Archival tags.

Fish

Although archival tags may be deployed internally or externally in fish, the vast majority are surgically implanted. The tagger should adhere to the same precautions and care as for acoustic tags. Internally deployed archival tags have a trailing light stalk that is designed to protrude outside of the body cavity once the tag is in place. In order to ensure comfortable placement of the light sensor stalk the archival tag should be prepared by gently heating the light stalk in warm water and then bending it such that the trailing end lies in a streamlined position when in place (Figure 14).

Figure 14. Southern bluefin tuna with light stalk from a surgically implanted archival tag extending beyond the body wall. Note the bend in the light stalk to present a streamlined profile and suture behind the stalk to prevent the tag moving backwards. The incision is approximately 3 cm in length.

To surgically implant an archival tag follow the same procedure outlined above for acoustic tags. After inserting the archival tag into the body cavity, push the tag forward so that the trailing (external) light stalk is near the anterior end of the incision. The wound should be sutured immediately posterior to the light stalk to keep it from slipping back and extending the incision and/or irritating the anal fin.

Pop up Satellite Archival (PSAT) tags.

Fish

PSAT tags are deployed on a variety of larger fish including southern bluefin tuna, yellowfin tuna, broadbill swordfish, and various shark species. PSAT tags are applied externally, anchoring the tag tether either through the pterygiophores of the dorsal fin or into the dorsal musculature. To place the anchor through the pterygiophores the animal must generally be brought aboard the vessel; securing the anchor into the dorsal musculature can be done on free-swimming animals or animals restrained in the water alongside the vessel. Both operations require considerable coordination of crew members on the vessel so it is important that all people involved know the details of the operation and any role they may have in handling the fish and attaching the tag(s).

In water attachment. Attaching the PSAT tag to fish which are not brought on board is done using a customized tagging pole similar to that described in Chaprales et al. (1998) and is done by one person. If a second person is available they can provide a support role passing tagging equipment to the tagger as required and recording tagging details. Prior to any fish being caught assemble the tagging pole as instructed during the training period. Lock the anchor into the tagging pole tip and stabilise the tag using rubber bands (Figure 15). The rubber bands prevent the tag from being knocked about and/or falling off the tagging pole prior to attachment. Place the tagging pole in an area with the rest of the tagging equipment where they are readily accessible, out of the way of the crew and protected from potential damage or buffeting.

Figure 15. PSAT tag, rigged for deployment on white shark, ready for deployment. A: overview; B: detail showing rubber band placement.

As with all tagging operations ensure the selected fish is in good condition and showing little sign of stress. Guide the fish close to the vessel where tagging can occur safely (e.g. sea door or transom) – this in general will require two people to ensure that the fish is held as still as possible and that the fish is orientated so that the dorsal surface of the fish is exposed. Using the tagging pole insert the tag anchor into the dorsal musculature just below and posterior to the first dorsal fin using a stabbing motion (Figure 16). Try to ensure that the anchor is firmly lodged into the musculature of the animal – the rubber stop on the tagging tip will prevent the anchor from being inserted too deeply into the animal and that the anchor point is retained in the muscle only. Once the anchor is secure, the tag should slide out of the rubber bands as you pull the tagging pole away from the animal. Make a mental note of the position and assessment of the quality of the attachment, to be transferred to the release notes as soon as possible.

Once the tag is attached the line can either be cut or, if possible, the hook removed. Where ever possible the hook should be removed, but if this is not possible the line should be cut as close to the hook as possible.

Figure 16. PSAT tag with secondary anchor (to left) secured into the dorsal musculature and in-line with the primary anchor just behind the dorsal fin.

On board attachment. Attaching the PSAT tag to fish which are brought on board is done using a hand applicator and is done by one person. If a second person is available they can provide a support role passing tagging equipment to the tagger as required and recording tagging details. In order to bring the fish on board a tagging cradle or sling is used. The tagging cradle/sling should be assembled at the start of the trip before any fishing operations take place. Once fishing operations begin, the tagger should ensure all the equipment required to apply the tag is set-up and ready.

Once a fish suitable for tagging has been identified the tagging cradle or sling is deployed into the water to a submerged position which will make it suitable for swimming the fish into (Figure 17). Two people, one at either end of the cradle are required to ensure that the cradle is held in place while the fish is brought to the surface and guide the cradle onto the deck. The aim is to swim the fish into the cradle so that it is clear of the mesh (thereby avoiding scraping of the scales and skin on the mesh), and then bring the mesh up from underneath the fish, providing even support along the length of the fish. Once at the surface, the fish is quickly, but gently, guided head first into the submerged tagging cradle and once completely supported by the cradle, lifted onboard the vessel. Guiding the fish into the cradle in general will require two people to ensure that the fish is orientated correctly and any buffeting against the sides of the cradle is minimised. As soon as the cradle is lowered to the deck a moist cloth is placed over the eye of the fish to aid in calming the animal, the hook is removed, and the fish measured. A new cloth is used on each animal to reduce the chance of transfer of infections between individuals. Using the tag applicator, insert the tag's anchor into the dorsal musculature at the posterior base of the dorsal fin. This will require some considerable force as you will have to 'punch' through the skin. It is sometimes useful, particularly if you are trying to insert the anchor from an awkward angle, to nick the skin with a small knife and use this as your entry point for the tag anchor. If the tag has a secondary anchor, insert the secondary anchor into the dorsal musculature posterior to and in line with the primary anchor so that the tag sits in a line along the dorsal surface of the fish (Figure 16). Try to leave a little bit of slack in the anchor leads (i.e. do not stretch them taut) as this will prevent the leads from chafing and cutting into the animal.

Figure 17. Lifting cradle with a southern bluefin tuna onboard a longline fishing vessel.

After attachment of the PSAT tag the fish and cradle are lowered back into the water. Never tip the fish out of the cradle, instead swim the fish along in the cradle as the vessel slowly steams forwards. This allows the gills to be flushed with water, re-oxygenating the fish and allowing it to revive in its own time. Once the fish is capable of swimming on its own it will swim out of the cradle. The fish is then monitored until it swims out of view and its behaviour noted on the release documentation.

At the end of each tagging period clean all tag applicators, knives and tags thoroughly under running water and then dip them in antiseptic (e.g. Betadine) or alcohol to help avoid transfer of infections between animals. Place them back into the tagging kit tool box ready for the next deployment.

Satellite Transmitting (SAT) tags.

Fish

The following method is specific to sharks – in general SAT tags are not applied to fish due to the requirement of the tag to be clear of the ocean surface to transmit and a position obtained. SAT tags are either attached directly to the first dorsal fin, or tethered to the dorsal fin using a pin and plate system. The tethered system is only used on whale sharks and requires specific training and protocols which are not covered in this Code of Practice. Specific training on tagging of whale sharks will be provided by the Principal Investigator involved in the project.

Figure 18. Juvenile white shark restrained by in-water stretcher next to vessel with oxygen feed in mouth (left); sub-adult white shark restrained by in-water stretcher attached to transom of vessel (right). Note that gloves are not being used in these images. Current requirements are that gloves be used at all times.

Current CSIRO practice is for a shark to be restrained while the SAT tag is attached to the dorsal fin; this, in general, requires a team of four people for larger sharks. Capture and handling of a shark involves ropes and wire trace so gloves should be worn at all times. In general sharks are either caught via burleying and use of a baited line or via longlining and are tagged alongside the vessel in a water stretcher. Sharks caught via burleying and use of a baited line are initially coaxed close to the vessel using a teaser line (baited line without a hook) to assess the suitability of the shark for capture. If suitable, a baited line with a hook is put out. The aim is to hook the shark in the left-hand side of the jaw. This will make it easier to guide the shark into the in-water stretcher, with its head to starboard. Once hooked, the shark is allowed to tire against the pull of a Styrofoam float attached to the rope just behind the trace (additional floats may be required depending on the size of the shark), taking care to not excessively tire the shark. As soon as the shark is restrained (Figure 18), oxygen is bubbled through a seawater stream and used to irrigate the mouth of the shark. Providing oxygen in this way helps to ensure adequate oxygen irrigation of the gills as well as providing a mild sedative effect.

Two people are tasked with attaching the SAT tag, one (the tagger) to put the tag on, the second to be a support person to pass tag components as required. A third person may be used to aid in holding the shark in the correct orientation. The fourth team member ensures the oxygen is maintained and generally monitors the procedure. The entire tagging procedure should not exceed six minutes from the time the shark is restrained to the time it is released.

With the tagger positioned beside the dorsal fin the support person passes over a template used to locate the position of the bolt holes. The aerial of the SAT tag must be exposed when the dorsal fin breaks the water's surface. The template should be positioned in the upper 1/3rd of the dorsal fin to achieve this. Supporting the back of the fin with a cutting board, the tagger drills through the fin using the template as a guide. Next, the support person passes over the backing plate for the SAT tag and a bolt; this is fitted to the fin. The SAT tag is then passed over and secured using the bolt. A second bolt is then fitted to secure the SAT tag snugly and prevent it from rotating (Figure 19). If time permits, other tags may be attached to the shark once the SAT tag has been attached. The shark is then immediately guided out of the restraint head first, or if brought onboard for tagging, immediately returned to the water head first. The release person must make a mental note of the shark's condition on release and this transferred to the release documentation as soon as possible.

Figure 19. A SAT tag correctly attached to the dorsal fin of a juvenile white shark (image courtesy of George Trinkler).

1.8 Standard Operating Procedure 8: Post field trip equipment cleaning & storage

(created: June 2009; full revision due June 2011)

At the end of each tagging period clean all tag applicators, knives and tags thoroughly under running water and then dip them in antiseptic (e.g. Betadine) or alcohol to help avoid transfer of infections between animals. Place them back into the tagging kit tool box ready for the next deployment. At the end of each tagging trip ensure that all equipment is thoroughly cleaned in fresh water and air dried. Knives should be sharpened and any moving parts on equipment sprayed with WD40 or similar rust prevention. Note the use of any of the consumables in the kit for replacement before the next tagging trip. If any additional samples have been collected as part of tagging operations, these should be packaged appropriately for transport and relevant transport arranged (including any quarantine permits).

1.9 Standard Operating Procedure 9: Revision of Code of Practice and SOPs

(created: June 2009; full revision due June 2011)

The Code of Practice and standard operating procedures outlined above form the basis of a living document. The Code of Practice and procedures are informally reviewed following each tagging trip. Suggestions and alterations will be collected and appended to the current document. These will be reviewed on an annual basis and where appropriate formally included ensuring the relevant SOP reflects current practice.

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APPENDIX A – PERMITS

In addition to approval from an Animal Ethics Committee, research may require further permits. Details for some common permits required for CMAR research can be found on the CMAR intranet site (www.csiro.au/intranet/sms/permits.htm) and are outlined below. Note that some permit applications incur a fee.

A1.1 Environment Protection and Biodiversity Act (EPBC Act)

(http://www.environment.gov.au/epbc/index.html)

The EPBC Act provides a legal framework for the protection and management of matters of national environmental significance (NES). Under the EPBC Act any actions that have, or are likely to have, a significant impact on a matter of NES require approval from the Australian Government Minister for the Environment, Water, Heritage and the Arts.

There are seven matters of NES that are protected under the EPBC Act, these are:

- World Heritage properties
- National Heritage places
- wetlands of international importance
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- nuclear actions (including uranium mines)

Other matters protected under the EPBC Act are:

- The environment, where actions proposed are on, or will affect Commonwealth land and the environment.
- The environment, where Commonwealth agencies are proposing to take an action.

Relevant documentation regarding the requirement for EPBC approvals and the relevant permit application forms can be found on the Department of Environment, Water, Heritage and the Arts website (www.environment.gov.au/epbc/approval).

A1.2 Australian Fisheries Management Authority (AFMA)

(http://www.afma.gov.au/)

Scientific research in a specified area of the Australian Fishing Zone or in a specified fishery may require a permit from AFMA before it can proceed. Note that scientific permits are not transferrable and are granted for a maximum duration of six months. For further details consult the relevant AFMA web site:

Permits: www.afma.gov.au/industry/licensing/permits/default.htm

Forms: www.afma.gov.au/information/publications/forms/licensing/default.htm

A1.3 Australian State Authorities

- **Tasmania:** Department of Primary Industries and Water (DPIW)
  www.dpiw.tas.gov.au
- **Victoria:** Department of Primary Industries, Fisheries Victoria (PIRVic)
  new.dpi.vic.gov.au/fisheries
- **NSW:** Department of Primary Industries (NSW-DPI)
  www.dpi.nsw.gov.au/fisheries
- **Queensland:** Department of Primary Industries and Fisheries (Qld-DPI)
  www.dpi.qld.gov.au/
- **Northern Territory:** Northern territory Government
  www.nt.gov.au/d/Fisheries
- **Western Australia:** Department of Fisheries Western Australia (WAFish)
  www.fish.wa.gov.au/
- **South Australia:** Primary Industries and Resources South Australia (PIRSA)
  www.pir.sa.gov.au/fisheries

A1.4 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

(www.cites.org/ **and** www.environment.gov.au/biodiversity/trade-use/cites)

Australia is one of 175 parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora. As a party to the Convention, import, export and re-export of any live animal or plant of a species listed in the CITES Appendices (or of any part or derivative of such animal or plant) requires a permit or certificate. There are currently around 25,000 plant and 5,000 animal species covered by the provisions of the Convention. To find out whether a species is listed in the Appendices, you can check in the CITES-listed species database of this website, using either the scientific name or the common name of the species.

CMAR is registered on the Registration of Scientific Organisations for Exchange of Scientific Specimens which enables us to export and/or import CITES and native specimens to like-registered institutions elsewhere in the world.

CITES Appendices: www.cites.org/eng/app/appendices.shtml

CITES Species Database: www.cites.org/eng/resources/species.html

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