Review of Grey Nurse Shark Tagging Research
Brisbane, 8–9 September 2003

Executive Summary

- Grey nurse sharks (*Carcharias taurus*) have vulnerable status globally and the east coast population from Australia is listed as critically endangered. A national recovery plan is in place for the species and is supported by population size, and animal movement data gained from a tagging program conducted primarily by New South Wales Fisheries, with supporting research from Queensland Parks and Wildlife Service and CSIRO staff.

- The New South Wales Fisheries program utilises fin tagging with cattle-ear (Roto-) tags that have subsequently shown a tendency to 'foul' with marine organisms, and in severe cases, this fouling causes skin abrasion and ulceration. The skin lesions are unsightly and may offer the opportunity for secondary infection to occur, but the effects on overall animal health are not known.

- Tagging operations that involve removal of the target fish to the surface carry a small but finite possibility of mortality, particularly if the animal is already suffering from a health challenge (for example, fishing-related hook damage).

- A single episode of recapture has shown that it is technically possible to remove Roto-tags from a shark where tag-related fin damage is viewed as problematic.

- It is viewed as unwise to continue the Roto-tagging program.

- Both the New South Wales Fisheries program and acoustic tagging conducted by CSIRO researchers have delivered information essential to the management and recovery of the population.

- In view of this, it is strongly recommended that tagging programs be allowed to continue, with the use of less invasive procedures and low impact tagging technologies.

RECOMMENDATIONS

- **No more grey nurse sharks from the eastern Australian population to be tagged using Rototags.**
- **Capture, restraint and removal of grey nurse sharks to the surface to be avoided wherever possible.**
- **Any incidental mortality of grey nurse sharks to be suitably investigated by veterinary autopsy, with particular reference to tagging- or fishing-related injuries.**
- **A watching brief to be maintained on tagged grey nurse sharks to identify fish showing tag-induced damage or heavy tag fouling. Regulatory authorities to develop a scale of severity of skin lesions and fouling for determining when intervention for tag removal is required.**
- **Investigate and/or take actions for removing tags from grey nurse sharks showing evidence of tagging-related skin lesions.**
- **Subject to suitable constraints (as below) the tagging program should continue.**
- **All future tagging should utilise non-capture and/or restraint, underwater pole-tagging or similar tag application techniques.**
- **Tags must be designed to minimise biofouling, and abrasive contact with the skin, and should ideally have a planned limited life.**
- **Double tagging should be avoided wherever possible.**
- **Tag placement should follow best practice procedures.**
- **It is highly desirable that all contributing regulatory authorities have joint ownership of program approval.**
- **Program activity should be based on a principle of tagging a minimum scientifically feasible number of animals.**

Introduction

Grey nurse shark (*Carcharias taurus* Rafinesque, 1810) numbers in inshore New South Wales waters declined dramatically in the 1960s and 1970s due to a combination of spearfishing, recreational and commercial fishing and beach protection shark meshing. This species has a low intrinsic capacity to recover from population decline, as reproductively active females appear to have only two offspring every other year. In recognition of the plight of the east coast of Australia population of this species, the grey nurse shark was declared a protected species by the New South Wales Government in 1984. Further listings and protection of the east (and west) coast of Australia populations of grey nurse sharks have followed at both State and Commonwealth levels to assist in its conservation.

Current protection status of *Carcharias taurus* in Australia.

- Protected species in Commonwealth waters under the *Environment Protection and Biodiversity Act 1999*: east coast population – 'Critically Endangered' (2002); west coast population – 'Vulnerable' (2001).
- Listed as a 'Vulnerable' species in New South Wales waters under the *Fisheries Management Act, 1994* (since 1999).
- Listed as a 'Vulnerable' species in Victorian waters under the *Fisheries Act, 1995.*
- Protected species in New South Wales waters under the *Fisheries Management Act, 1994* (since 1984).
- Protected species in Tasmanian waters under the *Fisheries Regulations, 1996* (since 1998).
- Protected species in Queensland waters under the *Fisheries Act, 1994 (Fisheries Regulation, 1995)* (since 1997).
- Protected species in Western Australian waters under the *Wildlife Conservation Act, 1950* (since 1999).

The International Union for the Conservation of Nature (IUCN) Red List of Threatened Animals lists this species globally as Vulnerable (A1ab+2d, *2000 Red List Assessment*). A recent update (Australia only) lists the species as Vulnerable (A1abcd+3bc), and the east coast population as Critically Endangered (A2abcd+3bc)(IUCN Shark Specialist Group assessment, March 2003).

A national recovery plan for this species in Australia was adopted for implementation in June 2002. The overall conservation objective is to manage an increase in grey nurse shark numbers that will lead to the species being removed from the list of threatened species under the EPBC Act.

A conservation-related research program by New South Wales Fisheries, with funding from the Australian Government's Natural Heritage Trust, was set up to provide essential information for population assessment and management of this species. The resulting tagging study, employing standard tags, has delivered important baseline data on animal movement and population size. The outcomes from the study have provided a scientific foundation for management of this critically endangered population and have been instrumental in the development of measures to further protect the species.

Over recent years the Australian Government's Department of the Environment and Heritage has been contributing to research on grey nurse sharks, undertaken by CSIRO, New South Wales Fisheries, Queensland Parks and Wildlife Service and Western Australian Fisheries. This has included using a variety of tags for the identification and tracking of individual sharks. Fin tags ('cattle-ear' type tags) have been used on grey nurse sharks in a New South Wales Fisheries led program since 2001. This program has provided valuable information on individual movements and forms the basis for population estimates using standard mark-recapture (or resighting) procedures. Recent observations suggest that fin-tagging of grey nurse sharks can result in abrasion wounds. The fouling of these tags with algae and barnacles may also be negating one of their original intended purposes, that is, allowing individual identification by divers.

The Department of the Environment and Heritage has expressed concern about the unexpected impacts that fin tags seem to be having on the welfare of the tagged individuals, resulting in the commissioning of the current review. Further tagging using this technique has been suspended in Commonwealth waters off Queensland and New South Wales and Queensland and New South Wales waters until the recommendations of this review are finalised and all other tagging work has been suspended in Commonwealth waters off New South Wales and Queensland also pending finalisation of this review.

Information on movement patterns and the ability to monitor population status is viewed as critical to conserving grey nurse sharks, but ensuring that this information is collected without impacting the sharks is of highest priority. Due to the urgency in resolving these matters with respect to current tagging projects, the independent review panel is charged with examination of the issue of management of the currently tagged animals, and offering advice on the issue of future tagging research.

Review findings

Stage I

1. Assessment of the tagging technique and impacts of fin tags ('cattle-ear' type tags) on grey nurse sharks on the east coast of Australia:

Preamble

Tags

Grey nurse sharks in the tagging program were all double-tagged, with no Rototag loss demonstrated to date.

A number of independent sources have reported that divers are experiencing difficulties in reading the tag numbers on grey nurse sharks. There is a suggestion that this is a common problem produced by biofouling of the Rototags. The precise nature of biofouling is insufficiently known, but is reported to range from 'slight fouling' by filamentous algae to 'heavy fouling' that may involve algae and various sessile invertebrates, particularly barnacles. Heavy fouling of tags, especially with barnacles, can be associated with abrasion and/or ulceration of tissues close to the site of tag attachment.

Biofouling appears to be patchy on a temporal scale. Some tags appear to remain essentially unfouled for many months, whereas others can foul in less than one month. The tags provide a substrate for attachment and there appears to be a succession of settlement, growth and loss of organisms, resulting in a dynamic community of encrusting plants and animals. The settlement of barnacle nauplii on tags may be related to the relative sedentary nature of the sharks and their occupancy of habitats (for example, rocky gutters) where barnacles are naturally prevalent. The implication is that tag fouling and possible abrasion related injuries would be ongoing.

Tag fouling, skin abrasion and ulceration are unsightly. Ulceration provides a potential site for secondary infection although the long-term health effects of this are not known. While the biofouling is potentially problematic for individual sharks, it also limits the utility of the tagging program. Sightings of sharks with fouled tags (where the number is unreadable) can still provide useful information for population estimation, but are of limited or no value in the study of animal movements.

Tagging Process

Capture of individual grey nurse sharks by lasso (head noose) or barbless, baited hook and removal to the surface for tagging and measuring has proven to be practical. These methods are probably a suitable compromise between animal handling effects and diver/surface support personnel safety *if* surface handling is required.

The process of capture and handling will be stressful to sharks, although the impact is probably transitory *unless* sharks are compromised by other, pre-existing, injury or insult. Of the 22 grey nurse sharks tagged in the current program there has been a single recorded case of mortality and there is a finite possibility that this mortality was a result of the tagging procedure. An autopsy report on the dead animal identified the mortality to be associated with an underlying

pathology due to prior hooking damage and septicaemia. Observational evidence suggests that a substantial proportion of the east coast population of grey nurse sharks carry fishing-related injuries or have fishing gear attached.

New South Wales Fisheries evidence is that existing tagged sharks, plus natural 'tags' (unique identifying features of individuals) are sufficient to maintain population estimate research for now.

STAGE I (1): RECOMMENDATIONS

- **No more grey nurse sharks from the eastern Australian population to be tagged using Rototags.**
- **Capture, restraint and removal of grey nurse sharks to the surface to be avoided wherever possible.**
- **Any incidental mortality of grey nurse sharks to be suitably investigated by veterinary autopsy, with particular reference to tagging- or fishing-related injuries.**

2. Advice on options to deal with the 25 sharks currently tagged

Preamble

Twenty-five grey nurse sharks have been tagged using Rototags, including three sharks tagged and released by Sea World. One shark is known to have died (see above), and of the remaining 24 fish, 20 have been resighted. The four sharks that are unaccounted for may have fouled (= unreadable) tags, and as noted above, this is likely to continue to be an issue. Sharks affected by tag-abrasion might be lost from the population as a worst-case scenario.

The current perception of the program by members of the public and those in the dive industry is mixed. Views include:

- strong support for the research program, in recognition of the benefits for managing the species; and
- ambivalence about the value of the program compared to the potential for damage to the sharks.

The high level of publicity activity by New South Wales Fisheries and Queensland Parks and Wildlife Service is acknowledged, however, the lack of awareness of the program in some areas, including diver groups, indicates that further effort is probably required.

A single recapture episode of a grey nurse shark showing tag fouling and some tissue damage has demonstrated that it is technically possible to retrieve tagged fish and remove the tags. The prognosis for this shark is currently not known.

If sharks are to be recaptured for tag removal for animal health issues, then fish should probably not be retagged. Alternatively, if the tag removal is necessitated by tag fouling but without evidence of skin lesions, it may be useful to consider maximising the capture opportunity to implant alternative tags. Evidence to date suggests that the procedure of shark recapture for tag removal (the panel is not aware of any way of safely removing Rototags without recapturing sharks) is quicker and less stressful than the initial tagging procedure.

The expert panel considers the valuable information resulting from currently tagged grey nurse sharks and the small, but finite, risks of mortality associated with recapture as reasons for not attempting broad-scale removal of Rototags from this population.

STAGE I (2): RECOMMENDATIONS

- **Watching brief to be maintained on tagged grey nurse sharks to identify fish showing tag-induced damage or heavy tag fouling. Regulatory authorities to develop a scale of severity of skin lesions and fouling for determining when intervention for tag removal is required.**

- **Investigate and/or take options for removing tags from grey nurse sharks showing evidence of tagging-related skin lesions.**

Stage II
3. Advice on all invasive tagging techniques

Preamble

The Roto-tagging program is delivering information on population size and grey nurse shark movements that is essential to management and recovery of the east coast population. Acoustic and archival tagging is delivering essential information on activity space and the consequent requirements for protection of critical habitats.

The panel has the strong view that tagging activities need to continue in some form.

While supporting the necessity for ongoing data collection from tagging programs, the panel emphasizes that all activities should be designed with a view to minimal impact on tagged animals, and should involve as small a proportion of the population as possible to meet the scientific objectives for effective population management. It is the view of the panel that it will be necessary to:

- conduct any further tagging of grey nurse sharks underwater without shark capture or restraint;
- utilise tags that are designed to incorporate antifouling technologies;
- place tags to minimise the potential for creating skin abrasion; and
- incorporate removal or drop-off mechanisms in tags, and ensure that they leave minimal residual signatures following removal or drop-off.

The absence of tag loss in the current double-tagged sharks indicates that double tagging is probably not required. Within this tagged population there is considerable variability in the placement of tags and there is some evidence to suggest that inappropriate tag placement can exacerbate abrasion effects.

Expert opinion suggests that tag placement high in the dorsal musculature, posterior to the leading edge (and preferably posterior to the trailing edge) of the first dorsal fin is optimal.

STAGE II (3): RECOMMENDATIONS

- **Subject to suitable constraints (as below) the tagging program should continue.**
- **All future tagging should utilise non-capture and/or restraint, underwater pole-tagging or similar tag application techniques.**
- **Tags must be designed to minimise biofouling, and abrasive contact with the skin, and should ideally have a planned limited life.**
- **Double tagging should be avoided wherever possible.**
- **Tag placement should follow best practice procedures.**
- **It is highly desirable that all contributing regulatory authorities have joint ownership of program approval.**
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