Queensland **the Smart State**

A Report on the Queensland Shark Safety Program

March 2006

Queensland Government
Department of Primary Industries and Fisheries

A Report on the Queensland Shark Safety Program

March 2006

Q106042

Table of Contents

1 Executive Summary

The SSP has been in place on Queensland beaches since 1962. It relies on nets, drum lines or a combination of both to remove high risk sharks from a particular location.

In the 44 year history of the program, there has been one fatal attack on a beach with SSP measures in place. That occurred at Amity on 7 January 2006.

A review of that attack has already identified some unique features of the Amity site and made a range of recommendations relevant to the incident.

The current review of the SSP has been undertaken on a statewide basis to ascertain whether the program continues to meet its objectives.

On the basis of an analysis of the SSP data, there is no compelling reason to believe that specific changes are needed anywhere in the program in relation to the gear being used. This situation will however continue to be routinely monitored.

The review did however identify a significant recent decline in tiger shark catches at Point Lookout and on the Sunshine Coast in particular drum line catches.

While the cause is unknown, it has been noted that there has been a change in recent years in drum line baits used at these locations, from mullet to shark, to reduce non target catch.

Trends in shark catch often occur over long periods and are often unrelated to effectiveness of the SSP. It is recognised that many factors could be causing changes in the catch of sharks and non-target species in the SSP. Better mechanisms are needed to determine when a detailed review of program effectiveness is required in a particular location. This report addresses that issue.

This review has highlighted that the community needs to be better educated about sharks and bather safety to ensure bathers make appropriate decisions about when and where to swim.

Specific initiatives considered include: packaging information in a way that is attractive for use in school curricula; further linkages to Surf Life Saving Queensland education activities and to local government and tourism bodies; updating of brochures and posters; advertising and community service announcements especially in newspapers and on radio; and upgrading of the DPI&F website.

While there has been considerable media attention recently about electromagnetic shark barriers, these are still in the experimental stages and even in the future may only have application in sheltered bays rather than on surf beaches. However, longer term applications of the technology will continue to be monitored.

South Africa is recognised as being at the forefront of shark control including applied science research. Whilst links have been maintained with South Africa since 1992, it is an appropriate time for this relationship to be strengthened.

The key role that research can play to both improve bather safety and reduce inadvertent program impacts is recognised.

The SSP has many valid applications for research and development funding including a continuation of research into methods of reducing non-target catch, improving the effectiveness of proven shark catching and deterrent technologies, research into high risk shark populations, water temperature monitoring, improving data management and data validation systems.

In response to local government demand, DPI&F considered the issue of locating shark control equipment into canals but concluded that this is extremely problematic in many respects and cannot provide sufficient assurance that bathers are properly protected. In short any application of SSP gear to canal environments would be ineffective long term and worse give rise to false expectations in relation to bather safety. At the present time, swimming enclosures which are provided by local governments and appropriate education campaigns are considered the most appropriate way to deal with shark threat in canals.

As a part of the review, a thorough assessment was made of the process under which new beaches are added to the program. This report recommends that a more transparent and considered process be adopted before the current program is expanded to any new locations.

Recommendation 1 (p16)

It is recommended that the effectiveness of shark, mullet, and other baits be evaluated in controlled statistical trials.

Recommendation 2 (p16)

it is recommended that a series of formal trigger events be determined that will prompt future reviews of shark and non-target catch in particular locations.

Recommendation 3 (p20)

It is recommended that DPI&F continue to enhance education initiatives to better inform all persons who use beaches and waterways on safer bather swimming practices.

Recommendation 4 (p23)

It is recommended that a formal government to government scoping visit be made to South Africa to strengthen current collaboration and to investigate and report on electronic barrier technology and other developments associated with shark control.

Recommendation 5 (p23)

It is recommended that the current research investment ($500,000 over five years) which is due to end in 2006/07 be extended for a further five years.

Recommendation 6 (p25)

It is recommended that in future DPI&F only considers applications for new SSP locations lodged by local governments and supported by a range of information consistent with a social and environmental assessment report, and in locations which are serviced by SLSQ or other professional lifesavers or lifeguards.

2 Background

On 7 January 2006 Miss Sarah Whiley was fatally attacked at Amity Point, North Stradbroke Island.

This was the first fatal shark attack on a beach with Shark Safety Program (SSP) gear since the program was established in 1962.

As a result, the Queensland Government immediately called for two reports.

The first specifically reviewed the circumstances surrounding the Amity attack. That report '*Fatal Shark Attack at Amity Point, North Stradbroke Island: a Report to the Minister for Primary Industries and Fisheries January 2006*, was released on 15 January 2006.

This is the second report. It involves a broader, Statewide review of the SSP especially to consider whether the program continues to appropriately meet its primary objective, bather safety.

3 Program Description

Queensland established the SSP in 1962 following a number of fatal shark attacks, particularly in south east Queensland waters.

It was decided that for reasons of shark species selectivity and suitability of deployment in particular situations, a mixed strategy of gear types would be far more effective than the exclusive use of either nets or drum lines in reducing local shark populations near major swimming beaches. The program was initially restricted to the Gold and Sunshine Coasts. Requests from local governments, however, led to inclusion in the program of other beaches throughout the state, and minor extensions to the program occurred up to 1996.

Beaches with shark control equipment installed tend to be close to high human population densities where the chance of shark-human interaction is highest. Conversely beaches not patrolled by lifeguards tend to be used by relatively few bathers and hence have a lower probability of such interaction.

The program was designed to reduce the number of potentially dangerous sharks in particular areas rather than creating an impenetrable barrier against shark attack.

Nets (see Appendix 1) manufactured to DPI&F specifications are 186 metres in length. Each net is made up of 3 x 62 metre sections. The nets have a depth of 6 metres and a mesh size of 500 millimetres. They are marked with inflatable buoys and are anchored to the seabed using either Danforth or CQR pattern high-holding anchors.

The nets are set adjacent to and generally parallel to the shoreline according to the prevailing tides and currents. Their distance from shore is determined by topographical and sea conditions/feature of each area. Equipment is usually placed far enough offshore to preclude bather interaction.

For the drum line method, (see Appendix 2) a 14/0 shark hook is suspended from an inflatable buoy using a 5 or 6 millimetre galvanised chain trace two metres long. The depth of the hook is adjusted to suit local conditions. The hook generally is baited every other day with fresh sea mullet, which is a naturally occurring food source for sharks. Each drum line is anchored to the seabed using varying lengths of 12 millimetre polypropylene rope and a Danforth or CQR high-holding anchor. The fresh bait attracts sharks and the float provides high impact resistance to set the hook if the bait is taken.

Equipment is serviced by independent contractors who work under Queensland Boating and Fisheries Patrol (QBFP) supervision. The program operates at 10 Queensland centres and gear is present on 84 beaches. Appendix 3 provides details of specific locations and SSP gear configurations.

Table 1 provides information on SSP expenditure for the past three years. Payments to shark contractors, bait and equipment routinely accounts for 80% of program expenditure.

Table 1: SSP Expenditure

	2002/3 ($K)	**2003/4 ($K)**	**2004/5 ($K)**
Contract Payments	975	1.147	1.193
Bait	73	88	70
Management*	139	225	239
Equipment	60	244	110
Research	102	90	91
TOTAL	**1.349**	**1.794**	**1.703**

* includes the program manager, administrative assistance, training

4 Shark Control Methods Employed In Other Jurisdictions

Programs Similar To Queensland

There are two other shark safety programs worldwide of any scale designed to protect bathers by removing dangerous sharks from localised areas. They are in New South Wales and the Province of Kwa Zulu Natal in South Africa.

In South Africa, nets fish continuously in a manner similar to Queensland. Drum lines are used, but not extensively (only three drum lines in one location). The scale of operations in South Africa is considerably greater than Queensland. The South African system uses some 259 nets, most of which are 214 metres long, 6 metres deep and have a mesh size of 51cms. They are set like those in Queensland, on the surface and are anchored at each end by two 35kg anchors. The Program offers protection to 80 bathing areas over 320 kilometres of coastline. By way of contrast Queensland deploys some 6.5km of nets (each 186m in length, and 6m deep with a mesh size of 500mm) and 344 drum lines.

The equipment is serviced by staff employees, Monday to Friday, 20 times per month.

New South Wales employs an intermittent seasonal strategy of netting particular beaches during peak swimming seasons using private contractors. Nets are set from September to April and removed during the winter months from May to August.

The dimensions of mesh nets used are 150 metres in length with a depth of approximately 6 metres and mesh size of 50-60 centimetres. Nets are set on the ocean floor, in approximately 10 metres of water, which is generally 500 metres off shore.

Netting is currently undertaken at 49 beach locations along 200 kilometres of coastline between Newcastle and Wollongong.

The New South Wales and South African programs have been in place since 1936 and 1952 respectively. Both programs are considered to have been highly effective in protecting bathers with New South Wales having only one fatality on a protected beach in its 70 year history.

While many in the community question the effectiveness of shark meshing/safety operations, data from South Africa shows that in the period 1990 to 1998 there were seven shark attacks (one fatal) in Kwa Zulu Natal (where meshing occurs) and 46 (five fatal) in South Africa's Eastern and Western Cape provinces where no protective measures are in place.

Comparisons between these programs and the Queensland situation are complicated by a number of factors which preclude the making of valid comparisons with the Queensland experience. Principal among these are significant differences in oceanographic features of sites, specific climatic conditions including water temperature, differing shark species composition and different patterns of beach usage, particularly in Queensland where large number of visitations occur through the entire year.

Consequently, whilst understanding experiences from other programs might be useful in the assessment and reviews of the SSP, in view of the differences mentioned above, it would not be appropriate to assume that strategies successful in other regions would be suitable for the Queensland environment.

Other Jurisdictions

Quite different methods have been adopted in other jurisdictions.

In Western Australia, there is no specific shark catching equipment in place however there is a system of aerial surveillance at selected locations from October to February. This is used to alert authorities to the presence of dangerous sharks near beaches.

South Australia and Victoria have no direct and active anti-shark measures however South Australia conducts overflights of beaches and maintains a data base of shark sightings.

Both South Australia and Western Australia have relatively high fatality rates from shark attack, principally by the white pointer species.

Swimming enclosures are widely used by local governments in Queensland to reduce the threat posed by marine stingers and/or sharks. They are also the predominant method to reduce shark attack in Hong Kong.

Unfortunately however these can only be used in smooth or partially smooth waters (including canals) or where the beach is relatively stable. Enclosures are impracticable to install on surf or exposed beaches. For bathers using enclosures, the level of security offered is greater than that provided by the SSP.

However, the historical experience with enclosures of a substantial nature is that they have high construction and maintenance costs and are subject to damage and erosion in ocean conditions. Experiments in South Africa and New South Wales were abandoned after experiencing the preceding difficulties. In Queensland the safety of enclosures was irreparably compromised following a fatal attack in a Townsville enclosure in 1933.

Enclosures provide no protection to board riders, people using the State's surf beaches, or swimmers utilising sections of beaches outside the enclosure.

SSP gear operates in all but the roughest beach conditions and provides high levels of bather protection over entire beaches.

5 Minimisation of Non-Target Catch

Whilst there is considerable support for the SSP from the community, there is also general concern about the levels of non-target catch.

SSP managers are very aware of the need to reduce the inadvertent impacts of the program and this routinely occurs when it can be achieved without compromising bather safety.

This matter has been the subject of two previous reviews which has resulted in the SSP endeavouring to minimise by-catch with some success. Key initiatives in this regard have included the use of acoustic warning devices, replacement of nets with drum lines in some locations, formation of mammal release teams, the trial of turtle friendly designed hooks, and using different drum line baits.

DPI&F continues to support research into minimising inadvertent impacts of the program. By-catch levels are carefully monitored in conjunction with other agencies. However, unless there are major or unexpected scientific developments, some level of by-catch will continue to occur.

The 1998 review 'Effect of the Shark Control Program on non-target species: whale, dugong, turtle and dolphin' by Gribble *et al* 1998 supports the fact that the program is not a major contributor to any decline in vulnerable or threatened species.

6 Previous Program Reviews

The SSP has been previously reviewed in 1992, 1998, and 2001.

The 1992 review led to a number of significant program amendments including the establishment of a strong working relationship with Surf Life Saving Queensland (SLSQ), availability of basic educational material, procedures to follow when gear is lost at sea, maintenance of linkages with South African shark authorities, and gear changes in the Rockhampton and Townsville areas.

The 1998 and 2001 program reviews were narrow in focus and concentrated primarily on options to reduce non-target catch. Changes to gear were made in some situations but invariably only after local community consultation occurred and support from key stakeholders (especially local government's and SLSQ) was obtained.

A key outcome of the 2001 review was a Government commitment to fund $500,000 in research over 5 years ending 2005/2006. This funding is made available from the DPI&F budget allocation. The majority of the funds have been invested in staff to maintain and enhance the database which underpins the SSP and researching and trialling by-catch mitigation devices and technologies e.g. turtle safe hooks and acoustic warning devices attached to nets. This was the first occasion when a long-term research program had been funded.

7 Results of the Program

Rationale for current SSP fishing strategies

Program Description (Section 3), provides a rationale for the current SSP fishing strategy noting that the program was designed to reduce the number of dangerous sharks in particular areas rather then creating an impenetrable barrier against shark attack. This section provides additional background to regional differences in the SSP concentrating on the nature of the shark catch during the last 14 years.

Examination of shark attacks in Queensland over the last 100 years shows that most attacks occur during the late spring to mid-autumn period (Figure 1). There are many reasons for this including numbers of people in the water, shark movement, feeding patterns, water temperature and availability of bait fish. The SSP maintains gear throughout the year in all SSP areas to ensure bather safety even though the risk of an attack is higher during the warmer months of the year. There are some local variations, such as the removal of nets for six weeks at Cairns during the marine stinger season when most bathing is confined to defined stinger enclosures and these local practices have been assessed as not compromising bather safety.

New South Wales operates a pulse fishing strategy of only fishing periodically during the warmer months. Whilst this strategy has been effective in New South Wales it has not been adopted in Queensland where there are critical differences in climatic conditions, beach visitations, shark numbers and species composition. No new information has become available which would now alter that view. Recent analysis of species composition of shark catches continues to show the majority of sharks caught in Queensland are whalers and tiger sharks while hammerhead sharks are a large part of the New South Wales catch (in the Queensland context Hammerheads are generally considered a lower risk species than the whaler sharks). However in South-East Queensland this species is added to the high risk group of sharks because of its local abundance. Likewise warmer water temperatures in Queensland result in large numbers of beach visitations even during winter. Water temperature is recognised as being a factor in shark feeding activity.

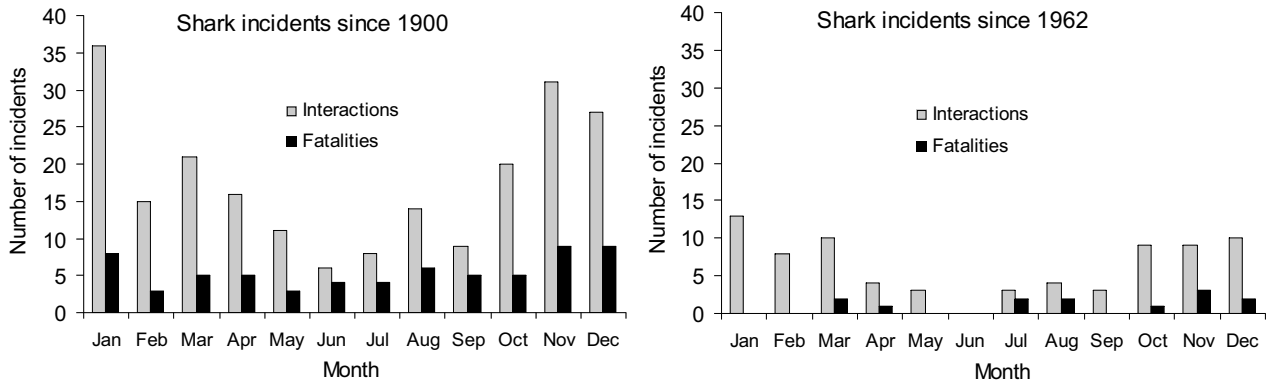


Figure 1: Number of human fatalities and interactions with sharks in Queensland recorded in the 'Australian Shark Attack File' since 1900, and since shark control measures were adopted in 1962. 'Interactions' range from minor shark contact to severe injuries.

The type and quantity of fishing gear used in the SSP areas has evolved since the program was introduced with some areas using a mixed strategy of both nets and drum lines and others using drum lines exclusively. Local oceanographic, tidal, and other conditions preclude the use of certain types of gear at particular locations. For example, nets cannot be effectively utilised in areas of high current or high tidal range. Over the years, changes to the type and configuration of gear used at particular locations were prompted by concerns about non-target catch, changes in local conditions and shark populations as well as input from local community groups. For example, nets

were replaced with drum lines in some areas where dugong capture in nets was a concern. While the gear used at each of the beaches has evolved over the 44 years that the program has been in operation, configurations have not changed dramatically in the last 12 years. Changes to the configuration and quantity of fishing gear prior to the mid 1990s complicates the assessment of long-term changes, as modifications to the amount and type of gear has implications for the overall shark catch. This is because nets and drum lines have different catching abilities for certain species and sizes.

Comparison of species and size of high risk sharks caught in nets and drum lines

In Queensland, the high risk species caught by the SSP are considered to be (in order of risk to bathers): bull whaler sharks, tiger sharks, "other" whaler sharks, great white sharks and hammerhead sharks. The hammerhead species is added to this high risk group, not so much for its proven attack history in the Queensland context, but for its local abundance. Figure 2 details the trends in catch of these high risk shark species from 1992 to 2005 in nets and on drum lines and Table 1 shows the average size of these same species caught by the two fishing methods. It needs to be recognised that differences between numbers caught in nets and drum lines do not reflect absolute differences in catching ability of the two gear types. This is because of differences in the numbers of nets and drum lines at various locations throughout the state and the different effective catching abilities of one net compared with one drum line. They are shown here mainly to indicate overall trends in catches of the two gear types and to indicate relative differences.

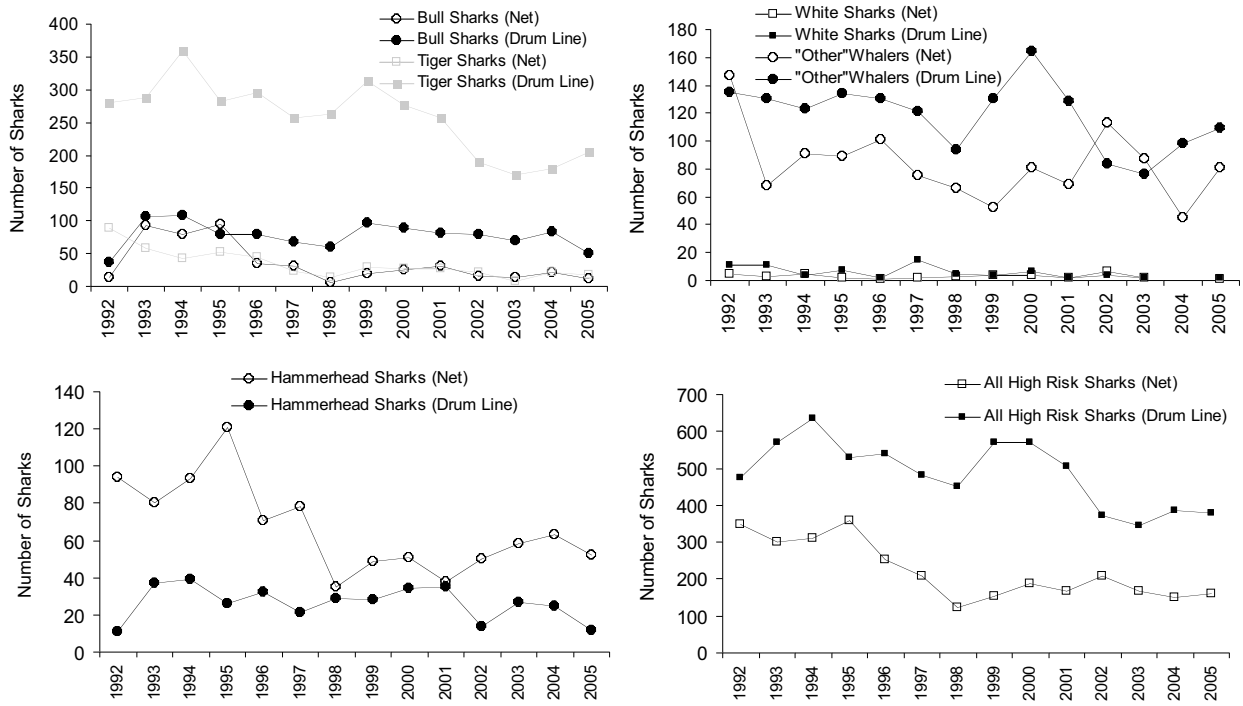


Figure 2: Numbers of high risk sharks caught by SSP nets and drum lines throughout Qld. since1992.

Table 1: Average size of high risk shark species caught in SSP nets and drum lines

Shark Species	Average Shark Length (metres)	
	Drum line	Net
Bull Whalers	1.81m	2.16m
Tiger Sharks	2.39m	2.74m
"Other" Whalers	1.66m	2.11m
White Sharks	2.84m	2.63m
Hammerhead Sharks	2.20m	2.02m

Tiger sharks are the main species taken on drum lines with much lower numbers of this species taken in nets (Figure 2). The "other" whalers is a large group of many different species, some of

which are caught more frequently in one type of gear compared to the other. Figure 2 shows that there were generally more “other” whalers caught on drum lines. Similar numbers of white sharks are caught in both types of gear and nets are more effective than drum lines at catching hammerhead sharks. Overall, there is evidence of a decline in shark catches by both methods.

Both nets and drum lines are capable of catching large specimens of each of the high risk species. There is evidence (Table 1) that drum lines catch: smaller bull sharks, tiger sharks, “other” whalers; larger white sharks and hammerheads. Nets more commonly catch: larger bull sharks, tiger sharks, “other” whalers, smaller white sharks and hammerheads.

Shark catch trends in SSP areas

The trends in shark catch at SSP areas over the past 14 years are shown in Figures 3a to 3e and are summarised below each graph.

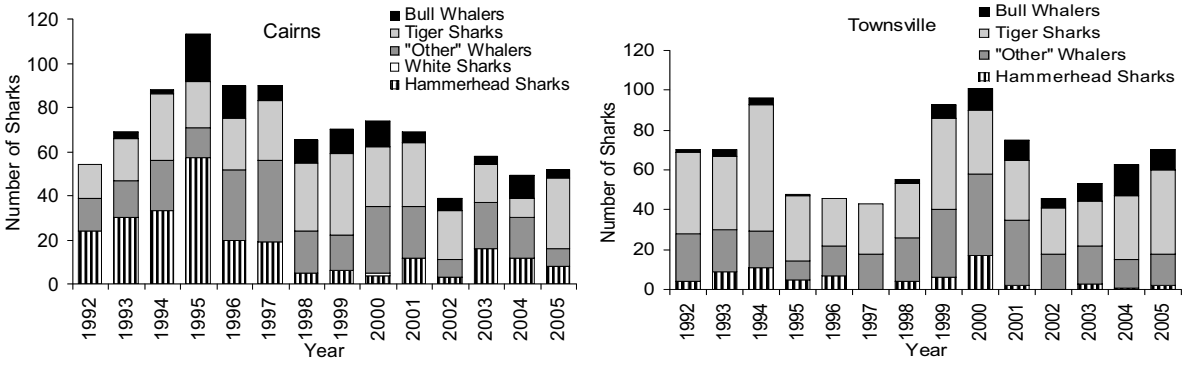


Figure 3a: Change in total numbers of high risk shark species caught since 1992 by SSP fishing gear at Cairns and Townsville.

Cairns — A slight decline in the total catch of sharks since 1995 mainly related to a decline in hammerhead catch. The great white shark recorded in 2000 is probably a misidentified Mako shark as it is unlikely that white sharks would be found in these tropical waters.

Townsville — Tiger sharks and ‘other’ whalers make up the majority of the catch in Townsville and there are no trends in the catch of any of the major high risk species, apart from a small increase in the bull whaler catch since 1999.

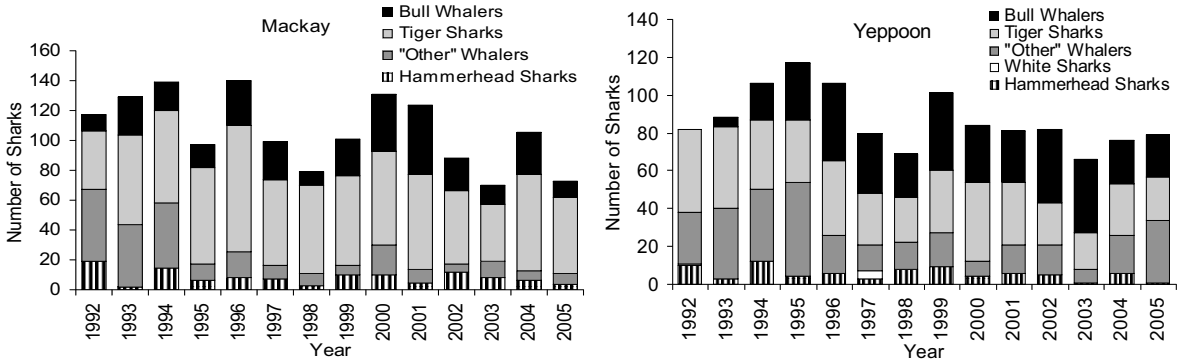


Figure 3b: Change in total numbers of high risk shark species caught since 1992 by SSP fishing gear at Mackay and Yeppoon.

Mackay — Tiger sharks are the most commonly caught species at Mackay. Bull whalers are also a major component of the catch. There are no strong trends in the catch of any shark species.

Yeppoon Bull whalers are the most commonly caught shark in this area which has the highest proportion of bull whalers compared with other SSP areas. There are no strong trends of increasing or decreasing catch of any high risk species.

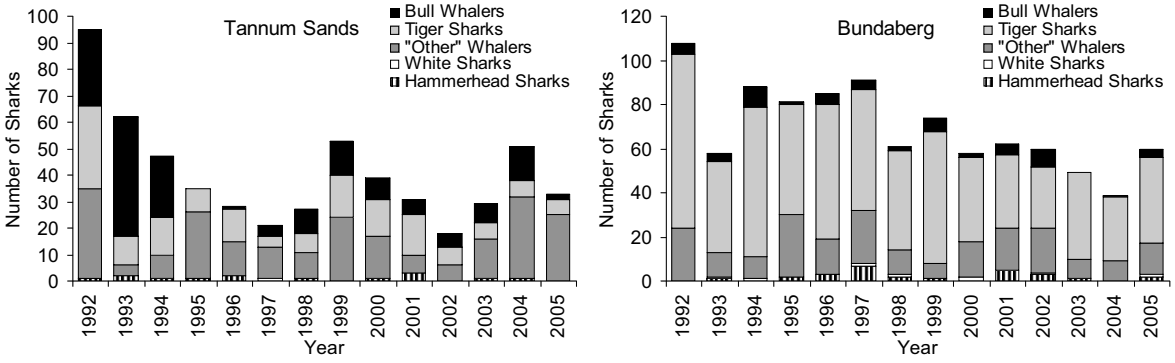


Figure 3c: Change in total numbers of high risk shark species caught since 1992 by SSP fishing gear at Tannum Sands and Bundaberg.

Tannum Sands Apart from an unusually high catch of sharks during 1992 there are no major trends in the shark catch in this area. All high risk sharks are represented in the catch but numbers of hammerhead sharks are low due to the exclusive use of drum lines in this area. A large catch of bull whalers was recorded during 1992/93.

Bundaberg This area has the highest proportion of tiger sharks caught in the SSP and there is some evidence of a recent decline in tiger shark catch.

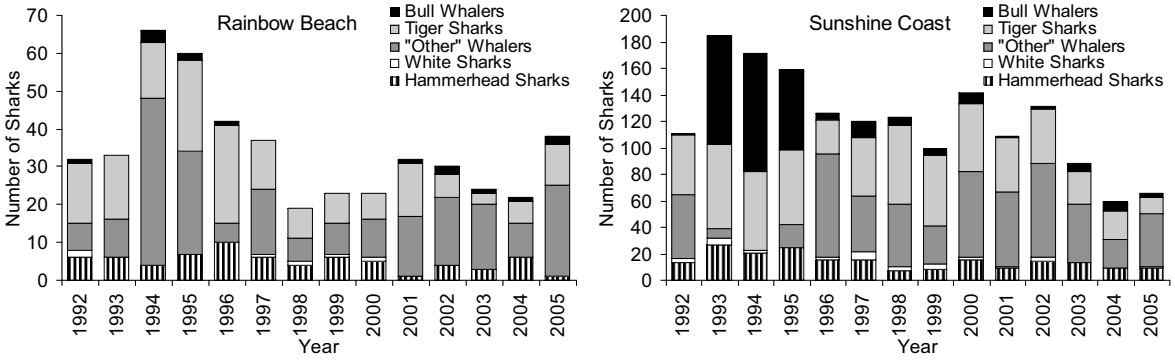


Figure 3d: Change in total numbers of high risk shark species caught since 1992 by SSP fishing gear at Rainbow Beach and the Sunshine Coast.

Rainbow Beach Apart from an unusually high catch of "other" whaler sharks during 1994 and 1995 there are no trends in shark catch. Bull whalers are only a minor component of the catch at Rainbow Beach, while in recent years 'other' whalers predominate in the catch.

Sunshine Coast There is some evidence of a declining shark catch trend largely related to a recent reduction in tiger shark catch. Large catches of bull whalers were recorded during 1993–1995. Lower shark catches overall were recorded in 2004 and 2005.

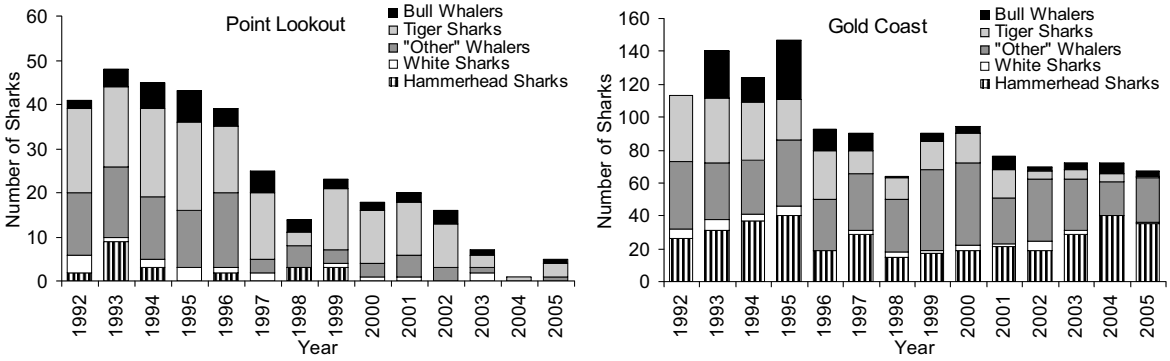


Figure 3e: Change in total numbers of high risk shark species caught since 1992 by SSP fishing gear at Point Lookout and the Gold Coast.

Point Lookout — Traditionally this is a low shark catch area, however it is the site of a number of shark attacks. There is a significant decline in total shark catch since 1996. Tiger sharks and "other" whalers have been the main species caught here but these have declined in recent years. There has been a low shark catch in the past three years in particular.

Gold Coast — There is a reasonably stable total catch of sharks after a drop in catch during the mid 1990s including higher bull whaler catches during 1993 to 1995. However there is evidence of a decline in tiger shark catch.

Many of the different patterns in bull whaler and "other" whaler catches up to 1995 may be caused by misidentification of the whaler species which are difficult to distinguish and were not accurately identified prior to training of contractors in species identification during the early 1990s.

Reasons for patterns in shark catch

The most significant catch trend in the SSP is the recent decline in tiger shark catch in the southern part of the State and in particular the declining shark catch at Point Lookout (drum lines only) and the Sunshine Coast (nets and drum lines).

The last 10 years have seen increased usage of shark as bait on drum lines when previously mullet was almost exclusively used as bait. Shark is known to be effective shark bait and has also been used on drum lines in some areas as a means of reducing by-catch (particularly turtles) and also for maintaining the effectiveness of the gear. It prevents scavenging of baits by dolphins which are generally less inclined to remove shark from hooks. Scavenging of mullet baits by dolphins is a significant problem in some areas because dolphins can quickly remove mullet baits thereby rendering the gear ineffective for catching sharks. Turtles are also less inclined to remove shark from hooks as compared to mullet and are less likely to be caught on hooks baited with shark. While differences in the shark catching ability of the two baits (mullet and shark) has not been statistically assessed by the SSP, areas such as Bundaberg where mullet is used exclusively have still shown declining catches of tiger sharks in recent years suggesting that shark baits are not solely responsible for declining shark catches. The SSP is currently investigating the efficacy of different drum line baits as part of ongoing research into by-catch reduction and shark catch.

Recommendation 1

It is recommended that: the effectiveness of shark, mullet and other baits be evaluated in controlled statistical trials.

There are many likely factors affecting local shark populations including: reduction in food due to declining fish stocks; increased boat traffic; water quality and climatic conditions (most notably the drought); the effectiveness of the SSP in local areas; and overall pressures on shark populations from legal and illegal fishing. It is extremely unlikely that the declines in catch rate of some species (particularly tiger sharks), most notable in the southern part of the State, are solely related to a change in effectiveness of the SSP in these areas. It should be appreciated that trends in catch, of shark or by-catch, manifest over long timeframes. Accordingly to endeavour to establish cause or causes of trends, it will be necessary to determine a series of trigger events e.g. peak catch, low catch which automatically prompt a detailed review of the operation of the SSP in a particular area.

Recommendation 2

While it is recognised that many factors could be causing changes in the catch of sharks and non-target species in the SSP, it is recommended that a series of formal trigger events be determined that will prompt future reviews of shark and non-target catch in particular locations.

Future modifications to the SSP

The structure of the program and the mix of fishing equipment used is regularly reviewed at specific locations, usually as a result of concerns expressed by conservation groups, focus groups, shark contractors and scientists. This review process is ongoing and over the years the SSP has been responsive to calls to improve the program, while always being mindful of the need not to compromise bather safety. The process of regular review of fishing gear and conditions operating in particular areas will continue to form an important part of the operations of the SSP and the introduction of formal trigger points will further enhance this process.

The recent fatality at Amity has prompted suggestions for increasing the efficiency of the SSP, including the use of bottom set nets, “less flexible” buoying systems on drum line gear and electronic barriers. Bottom set nets were trialled in the 1960s but were abandoned because of the extremely high level of non-target catch (particularly rays) and the logistical difficulties of checking and servicing bottom set as opposed to surface gill nets. The suggestion to use different buoying systems to improve “hooking rates” on drum lines will be evaluated in the near future by the SSP.

Large scale electronic barriers remain unproven despite decades of research and development. The technology has many logistical difficulties to overcome before it can be implemented for anything other than individual protection (See also Section 9 - Research). Other local and international developments in shark deterrent technology and non-target catch reduction are regularly reviewed by the SSP and regular contact is maintained with key researchers and managers in these fields to ensure that the latest technology is implemented within the SSP.

Conclusions

Drum lines and nets remain effective methods of reducing shark numbers in localised areas thereby providing protection to bathers. Both methods have particular characteristics that result in different catching abilities for the various high risk shark species but both still catch all species of large sharks. There is evidence of declining shark catches (in particular tiger sharks) in the southern part of the state. Reasons for this decline are not precisely known.

Recommendations to enhance the program include the formalisation of review trigger points and a continuation of research into improvements to fishing gear, and in particular a statistical trial to determine the comparative shark catching abilities of mullet and shark baits to evaluate other baits.

8 Education

Education has been a component of the SSP since 1988 when the first shark safety brochure was produced and distributed to the general community through public displays. This brochure identified dangerous sharks and gave advice on safe swimming practices.

Since 1988, DPI&F has implemented a range of communication/education measures to highlight the risk of shark attack when swimming in the ocean, as well as in canals and estuaries. The campaign has generally peaked each year in the lead up to the summer months when sharks become more active. The campaign is regularly reviewed and modified depending on specific areas of need.

DPI&F has used a broad range of communication tools to highlight safe swimming practices including Statewide media releases, community education activities, radio and print advertising, direct mail outs, and other educational materials.

Educational materials

- Since 1988, SSP brochures have been updated regularly to reflect current issues such as the dangers of swimming in canals. These brochures were distributed throughout the State via local governments, Surf Life Saving Queensland (SLSQ), public displays and events. Following the Amity attack, the brochures were again updated and distributed throughout North Stradbroke Island and the Redland Shire to outlets including ferry services, tourism information centres, Council customer service centres, and the local school.

- In 1996, a video featuring SSP information and safety messages was produced. This video was used for public education about the program. The video is currently out of date.

- A static display for use at public events featuring the SSP has been used by QBFP officers at events throughout the State since 1996. This display needs to be updated.

- An educational workbook targeted at primary school students has been widely distributed throughout the state during the past seven years. Hard and electronic copies of this book are currently available from DPI&F by either downloading the booklet from the website or contacting the DPI&F Call Centre for hard copies.

- In 2002, a publication titled ‘Common Large Sharks of Queensland’ was produced and is still in circulation. This book features detailed information about Queensland shark species and had a limited distribution to schools when first published. This book is still available from DPI&F.

- In 1999, posters featuring common large sharks in Queensland waters which were aimed at primary and secondary school students were distributed to teachers throughout the state.

- Following the Gold Coast canal shark fatalities in 2003/2004, DPI&F produced 250,000 SSP brochures which were distributed with Gold Coast City Council rates notices.

Website

- Bather safety messages have been highlighted on the DPI&F Fisheries website since 2004 and have frequently featured on the DPI&F home page. The SSP web pages include information on:
  - shark safety tips for swimmers
  - bull sharks and other dangerous species
  - how the program works to help protect swimmers
  - by-catch issues
  - research and development.

Media

- DPI&F works closely with media outlets to periodically disseminate bather safety messages. For example, following the Gold Coast canal fatalities, DPI&F worked with Gold Coast radio stations to assist with messages warning of the dangers of swimming in canals.

- Each year, in the lead-up to the warmer, wetter months when sharks are more active, DPI&F releases a number of media statements focussing on bather safety advice. These releases receive good coverage in media throughout Queensland.

Advertising

- DPI&F has capitalised on opportunities to flag swimmer safety issues as part of its broader advertising campaigns. For example, bather safety messages have featured regularly on *Brownie's Coastwatch* - radio and television - as part of the general Fisheries summer promotion.

- DPI&F has run paid advertisements - radio, television and newspapers – in localised areas during peak holiday periods highlighting the bather safety message.

- Following the Gold Coast canal fatalities, community service announcements were run on the Gold Coast's Prime television and regional television networks throughout the holiday period warning people about the dangers of swimming in canals.

- Following the Amity attack, advertising featuring bather safety messages were placed in local Redland Shire publications and on some Brisbane-wide radio stations.

Community relations

- Over the years, DPI&F has developed an excellent working relationship with SLSQ. Since 1993, DPI&F has entered into numerous financial sponsorship agreements with SLSQ in return for assistance in publicising swimmer safety messages with regard to sharks. The most recent sponsorship agreement was entered into in 2005. SLSQ have assisted in promoting the SSP and swimmer safety message with regard to sharks through their educational materials and school education program.

- Following the Gold Coast canal fatalities, DPI&F worked closely with Neighborhood Watch groups to spread the swimmer safety message in suburbs with canal access.

- The QBFP continues to play an active role throughout summer conducting regular patrols of Gold Coast canals to help dissuade people from swimming in these waterways and educating the public about the dangers.

Education program - summer 2005/2006 (pre-Amity attack)

Media releases

The media program for summer 2005/2006 included releases focussing on:

- Increased shark activity in Queensland – Queensland-wide release with specific figures provided for regional areas.
- Summer safety campaign launched in conjunction with SLSQ – Queensland-wide release.
- Summer warning about swimming in canals – Queensland-wide with a particular focus on the Gold Coast.
- Shark safety book for kids now online – Queensland-wide release.

School education program

- In 2005, DPI&F entered into a sponsorship agreement with SLSQ to fund a surf safety brochure which was to be used as part of the SLSQ primary school student education program. The program was officially launched with a media event featuring the Westpac lifesaving helicopter, lifesavers and DPI&F officers in early December at Graceville State School.

- The brochure featured shark safety information which DPI&F provided to SLSQ. Surf safety presentations, at which these brochures were handed out, were conducted at 40 schools reaching 12,000 students before the start of the summer school holiday in late November/early December 2005.

- QBFP officers were invited to participate in these presentations to talk specifically to the students about shark safety and the equipment used to help protect swimmers. Patrol officers participated in a number of these presentations throughout the state.

- In 2006, SLSQ's school education program will be rolled out throughout the school year across Queensland and is expected to reach in excess of 50,000 students. DPI&F is planning to participate in these presentations where possible.

Shark safety book online

- In late December 2005, the DPI&F's children's shark safety educational booklet, which was developed a number of years ago, was posted online. Posting an electronic version of this booklet online made this information more accessible to the general public. The online publishing of this book was promoted through media releases and in a letter to all surf life saving clubs throughout Queensland encouraging junior lifesaving activity coordinators to access and use the information in training.

Mail out to surf lifesaving clubs

- In December 2005, DPI&F updated its shark safety stickers and magnets featuring the shark hotline number. This number is used by the public and key groups such as surf lifesaving to notify DPI&F of any issues related to shark Safety equipment. In conjunction with SLSQ, these materials were mailed out to all surf life saving clubs in the State with a letter explaining when to call the hotline. The letter also flagged the children's shark safety book on the DPI&F website which could be used for junior lifesaving education.

"Fish" (DPI&F publication)

- DPI&F's publication, *Fish*, which is distributed to more than 3000 stakeholders throughout Queensland featured shark safety information in its Spring 2005 edition.

Website

- Shark safety information has featured on the DPI&F home page (www.dpi.qld.gov.au) and the Fisheries (www.dpi.qld.gov.au/fishweb) home page regularly since December 2005. The tips for safe swimming have been the major focus of these pages. At the time of the Amity attack, there was a feature on bather safety on DPI&F's home page.

- All web material related to the shark Safety program is constantly reviewed and updated particularly in the lead up to school holiday periods.

Other SSP communication issues

Signage

Local governments currently have responsibilities for beach and aquatic management signage.

While DPI&F believes that signage relating to sharks has a place in any education program, this should be integrated where practical into the full range of bather advisory signs already in place.

DPI&F will therefore continue to work in an advisory capacity with local governments and SLSQ to promote appropriate aquatic signage throughout the State.

There are a number of potential themes for signage: advice that sharks inhabit a particular area, advising fishers not to clean fish or berley in areas adjacent to bathers.

Conclusion

Despite current DPI&F efforts to modify behaviour to minimise the risk of shark attack, bather behaviour indicates they choose to ignore a number of basic safety principles.

Recommendation 3

It is recommended that DPI&F continue to enhance education initiatives to better inform all persons who use beaches and waterways on safer bather swimming practices.

Specific initiatives that will be considered include:

- The exploration of options to further develop links with SLSQ to educate the public. Surf safety messages disseminated by SLSQ are aimed at a similar target audience as SSP messages. In particular, DPI&F will be looking to further its participation and assistance with SLSQ's surf safety school education program.

- Update school education materials and other SSP information with the aim of packaging the information in a way that is attractive for teachers to include in their work programs, by tailoring it to a range of key learning areas under the Queensland School Curriculum and existing education modules. Apart form tailoring the information to the years 1 to 10 syllabus, additional fact sheets on the SSP aimed at secondary schools audiences will also be posted on line. An active distribution campaign will be undertaken to promote the information to schools and teachers, including contacting schools directly through a mail out and establishing links to the information on Education Queensland's (EQ) Bulletin Boards, the EQ "Education Views" and the Queensland Studies Authority website.

- Building closer links with local governments and community groups such as tourism bodies, particularly in coastal areas, to increase the opportunities for communicating bather safety messages to the general public.

- The review and updating of a range of educational materials related to the SSP such as brochures, posters, and the static display. A review of distribution to key regions and organisations throughout the State will also be undertaken.

- An advertising campaign featuring print, radio and television community service announcements will be run throughout the State during summer and Easter school holiday periods.

- A review and updating of SSP information on the DPI&F website will continue, with the primary focus of the information being swimmer safety advice. Stakeholder groups will be approached to link their websites to this information and to promote the DPI&F website in their promotional materials.

- Media campaign materials will continue to be issued, particularly in the lead up to summer and school holidays. Two groups will be targeted:
    - Bathers – warned about the risk of shark attack when swimming on Queensland beaches and in other waterways.
    - Fishers – warned about the dangers of berleying and cleaning fish near swimming areas.

- DPI&F will continue to advise and liaise with local governments and SLSQ in the development of appropriate signage both for beaches and other waterways.

9 Research

The SSP has maintained an active involvement in research particularly following the 1992 review of the program. In 2002 $500,000 was committed over five years to support research initiatives, mainly related to reducing the catch of non-target species.

Recent initiatives within the SSP have included: developing better acoustic 'pingers' and deterrents for reducing whale and dolphin entanglements; changing net and drum line configuration and construction to minimize the impact of the SSP on non-target catch species and using alternative drum line baits to reduce by-catch. In addition, the SSP maintains regular collaborative contact with scientists and managers involved in shark safety, acoustic and by-catch reduction research in South Africa, the United States of America and elsewhere.

Specific research initiatives have included:

- Advances in acoustic alarm/pinger technology for reducing entanglement of marine mammals have been made by SSP scientists and new devices are soon to be trialled.
- The introduction of "hook guards" has been effective at reducing turtle catches on drumlines in southern Queensland while not affecting shark catches.
- Introduction of temperature data loggers on Gold Coast nets to correlate shark and by-catch activity with sea temperature is providing insights into the seasonal activity of sharks and by-catch species.
- Tag and release program was established in 2004 for harmless species caught and released from SSP gear to help understand their behavior upon release.
- Preliminary results for two hook drum line rigs versus single hook rigs indicate that there is little difference in the catching ability of either rig for most species but such rig may be more effective for bull whalers.

In addition, a number of alternative baits, drum line rigs and net modifications have been assessed but considered unacceptable for use in the program.

On the basis of current knowledge, ongoing research may continue to reduce the probability of an inadvertent entanglement or capture of by-catch, but a total solution to by-catch is unlikely in the short term unless there is a dramatic breakthrough. Likewise, the use of nets and drum lines to reduce local populations of sharks will continue to reduce the probability of attack but will not totally guarantee bather safety.

The preceding assessment is provided in light of ongoing research, exhaustive discussions with numerous fishing technology experts, animal behaviouralists, scientists, fishers and contractors on the issues of by-catch minimisation and shark capture.

While there has been considerable media coverage about using electronic barriers to deter sharks and ensure bather safety, this concept is not new and has been widely discussed and researched since the technology was first developed in South Africa in the 1980s. It is the basis of commercially available personal devices that are used, predominantly by recreational and commercial divers in high risk areas, to reduce the risk of shark attack. The use of the technology on a broader scale to protect larger areas is still considered to be in the very early experimental stage today. The technology appears to have a range of engineering and logistical issues which need to be addressed before it can be used for anything other than for personal protection.

If logistical difficulties associated with the deployment and maintenance can be overcome and the technology can eventually be proven to be effective on a large scale then it may have application

in some sheltered bays in Queensland at some time in the future. However, on the basis of advice to DPI&F by the developers of the technology it would appear that it would not have any application in open ocean surf conditions in its present form. Despite concerns about the ability of the technology to deliver broad-scale protection, the SSP has an ongoing collaborative association with the developers of the technology and closely monitors developments in this area. It should be noted that the developers of the technology have invested many millions of dollars into this technology without its application being developed for other than personal use.

Recommendation 4

It is recommended that a formal government to government scoping visit be made to South Africa to strengthen current collaboration and to investigate and report on electronic barrier technology and other developments associated with shark control.

In this regard, South Africa given its history and scope of operations is at the forefront of shark control research and application. Queensland has had both formal and informal links with South Africa since 1992. It would be timely to have a formal visit to South Africa of some duration to update SSP management of the considerable shark research and applied technology research undertaken by shark control authorities in that country.

Recommendation 5

It is recommended that the current research investment ($500,000 over five years) which is due to end in 2006/07 be extended for a further five years.

There are a multitude of valid applications for research funding including a continuation of research into methods of reducing non-target catch, improving the effectiveness of proven shark catching and deterrent technologies, research into high risk shark populations, water temperature monitoring, improving data management, and data validation systems.

10 Other Issues

Extension of SSP into Canals and Estuarine Environments

In recent years there have been numerous reports about the presence of dangerous sharks (principally bull whalers) in canals and estuarine environments,

The two fatal shark attacks in the Gold Coast canal system in 2002 and 2003 highlighted the risk to bathers.

As a result, there have been periodic requests for DPI&F to extend the SSP into canals and estuaries.

DPI&F assessment of these proposals indicate that:

- There are more than 120 kilometres of canals on the Gold Coast alone. When coupled with canal estates in other locations and numerous river systems, the area to be potentially protected is significant.

- There are frequent sightings of dolphins and turtles in some of these areas. This means that there would be an inadvertent impact on these animals some of which have a high conservation status.

- Many canals, rivers and lakes are quite narrow. This means that shark safety gear would become a hazard to swimmers, vessels or to other recreational users of the waterways.

- Bull sharks are known to move frequently from these environments to the sea and return and in doing so cover significant distances. This would make it difficult to easily reduce shark numbers in a localised area because new sharks would quickly re-inhabit a location.

- Shark behaviour in canal environments is not well understood.

- Costs of providing even a low level of protection would be high.

DPI&F's conclusion is that extension of the program to these areas is extremely problematic without any assurance that bathers can be properly protected by SSP measures in these environments.

At the present time, local governments such as the Gold Coast City Council have responded to the shark threat by constructing swimming enclosures. These and educational programs are considered the best option to aid bather safety in these areas.

Aerial Surveillance

Historically aerial surveillance has not been a formal part of the SSP. It is used in some jurisdictions as the primary mechanism to detect sharks and then respond accordingly.

In some Queensland locations aerial patrols occur in conjunction with other bather safety services provided by local governments or SLSQ, and in these situations, if sharks are sighted, lifesavers are normally informed.

Aerial surveillance has severe limitations including its high cost, the difficulty in detecting sharks in certain weather conditions, the potential for sharks to move into the bathing area between over flights, and on some occasions, the inability of agencies on the ground to respond quickly to shark sightings.

Therefore while aerial surveillance potentially has a role to play, especially in jurisdictions without SSP gear in place, it is believed that SSP resources can be more cost effectively used in other areas (for example education and research) in the Queensland context.

Policy for Determining the Deployment of New SSP Equipment

Historically, SSP gear has been deployed at specific sites following requests from local governments, SLSQ or community groups to provide protection from sharks.

The request is normally assessed by DPI&F staff who consider anecdotal evidence of local shark threat, beach usage, and practicality of installing and servicing gear.

While there have been few requests in recent years for gear to be placed at new locations, invariably there is a higher degree of interest following media reports of shark attacks.

The review of the fatal shark attack at Amity raised concerns about the choice of that location as a SSP site. Specific concerns were: a large population of transient sharks in the area that would not be fished down; an abundance of alternative food sources which outclassed SSP baits; the unsuitability of the location (oceanographic features, probable high levels of by-catch) for SSP nets; and an absence of any local lifeguard service.

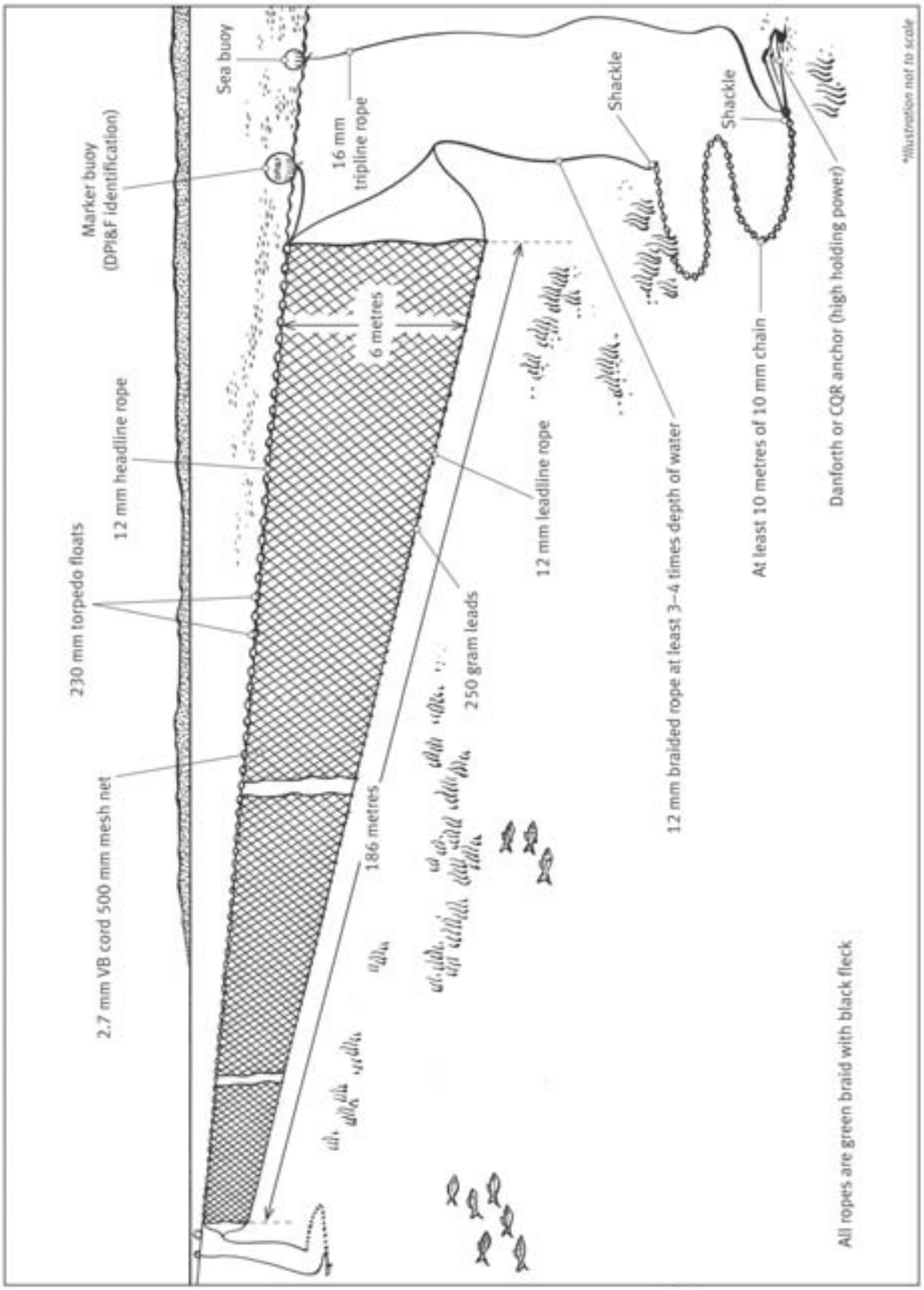
It is therefore clear that a more formal and considered assessment process needs to be adopted to ensure that both the merits and risks are fully considered before new sites are considered.

Information which would need to be considered in the application would include:
- an evaluation of the shark threat
- environmental consequences of the proposal, including the impact on non-target animals
- stakeholder expectations
- beach usage/visitation
- potential tourism/local business impacts
- community views
- servicing of the location by SLSQ or other similar professional group.

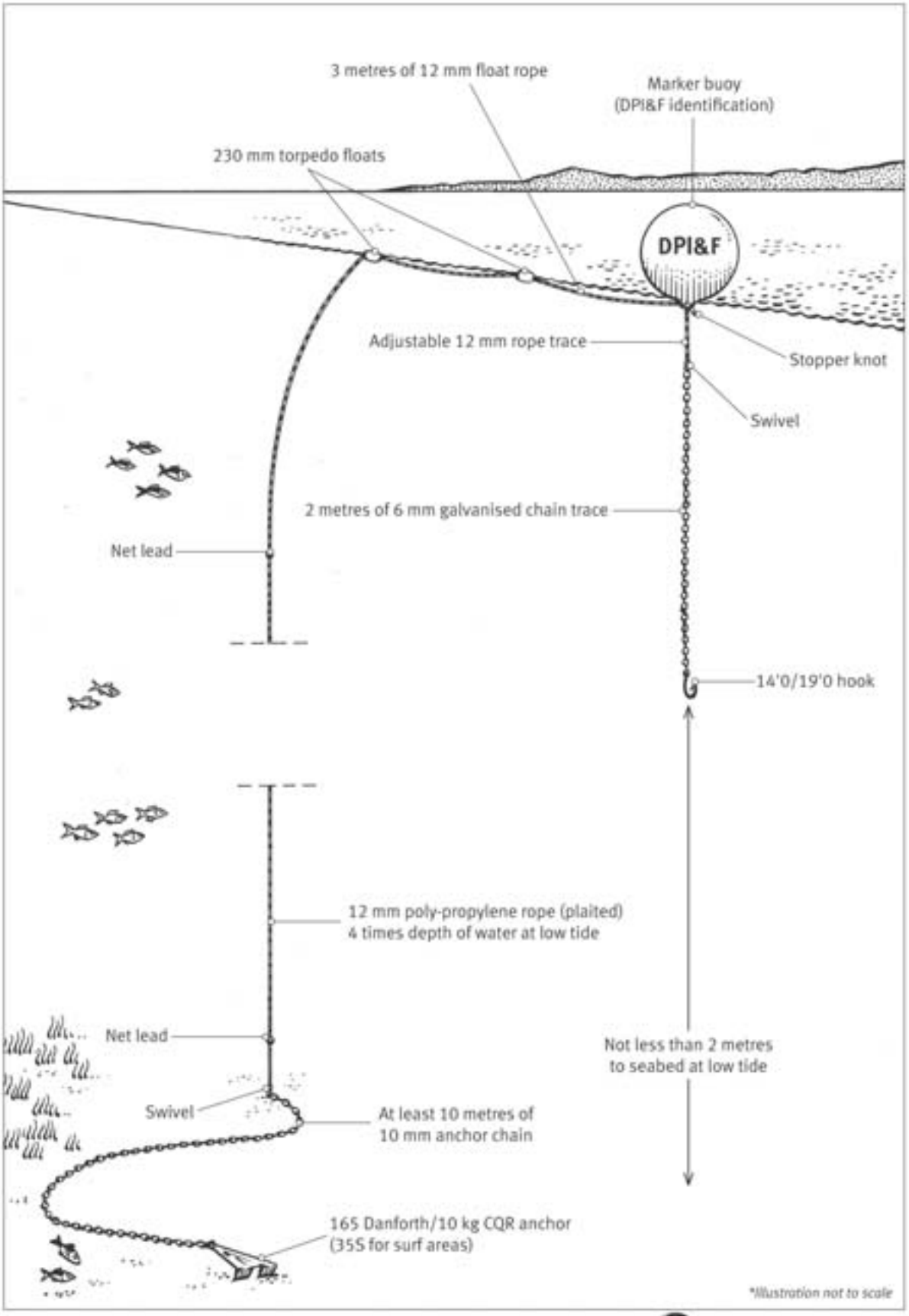
Recommendation 6

It is recommended DPI&F only consider applications for new SSP locations lodged by local governments and supported by a range of information consistent with a social and environmental assessment report, and in relation to locations which are serviced by SLSQ or other professional lifesavers or lifeguards.

Appendix 1 SSP Net



Appendix 2 SSP Drum line



Drumline arrangement

Queensland Government
Department of Primary Industries and Fisheries

Appendix 3 Current Gear Distribution

Cairns:	Ellis Beach	1 Net
		5 drum lines
	Buchans Beach	2 drum lines
	Palm Cove	1 net
		7 drum lines
	Clifton Beach	1 net
		2 drum lines
	Trinity Beach	1 net
		3 drum lines
	Yorkeys Knob	1 net
		2 drum lines
	Holloways Beach	3 drum lines
	Total	5 nets
		24 drum lines
Townsville	Picnic Bay	5 drum lines
	Nelly Bay	9 drum lines
	Alma Bay	6 drum lines
		3 drum lines
	Florence Bay	5 drum lines
	Radical Bay	5 drum lines
	Horseshoe Bay	12 drum lines
	Palarenda Beach	3 drum lines
	Kissing Point	6 drum lines
	Total	54 drum lines
Mackay	Harbour Beach	2 nets
		9 drum lines
	Lamberts Beach	6 drum lines
	Blacks Beach	6 drum lines
	Eimeo Beach	1 net
	(Net rotated for 6 drum lines in turtle season September to March each year)	
	Bucasia Beach	2 nets
		6 drum lines
	Total	5 nets
		27 drum lines
Rockhampton	Emu Park	6 drum lines
	Fisherman's Beach	6 drum lines
	Tanby Beach	5 drum lines
	Mullambin Beach	5 drum lines
	Kemp Beach	6 drum lines
	Lammermoor Beach	10 drum lines
	Cooee Bay	6 drum lines
	Yeppoon Beach	5 drum lines
	Farnborough Beach	5 drum lines
	Total	54 drum lines

Tannum Sands	Tannum Sands	12 drum lines
	Total	12 drum lines
Bundaberg	Oak Beach	2 drum lines
	Neilson Park	6 drum lines
	Bargara Beach	3 drum lines
	Kelleys Beach	9 drum lines
	Total	20 drum lines
Rainbow Beach	Rainbow Beach	3 nets
		12 drum lines
	Total	3 nets
		12 drum lines
Sunshine Coast	Noosa	2 nets
		3 drum lines
	Sunshine Beach	3 drum lines
	Sunrise Beach	3 drum lines
	North Peregian Beach	3 drum lines
	Glen Eden Beach	3 drum lines
	Peregian Beach	3 drum lines
	Coolum Beach	1 net
	Yaroomba Beach	4 drum lines
	Hyatt Resort	4 drum lines
	Marcoola Beach	1 net
	Surfair Resort	4 drum lines
	Mudjimba Beach	4 drum lines
	Twin Waters Resort	4 drum lines
	Maroochydore	2 net
	Alexandra Hdl	2 nets
	Mooloolaba	1 net
	Point Cartwright	3 drum lines
	Buddina Beach	6 drum lines
	Wurtulla Beach	1 net
	Currimundi Beach	4 drum lines
	Moffat Beach	3 drum lines
	Caloundra Beach	1 net
		6 drum lines
	Bribie Island (Woorim)	18 drum lines
	Total	11 nets
		78 drum lines
Point Lookout	Amity Point	4 drum lines
	Cylinder Beach	12 drum line
	Ocean Beach	12 drum lines
	Total	28 drum lines
Gold Coast	Sheraton Mirage	5 drum lines
	Main Beach	1 net
	Narrowneck	2 drum lines
	Staghorn Avenue	2 drum lines
	Elkhorn Avenue	2 drum lines
	Surfers Paradise	1 net

Northcliffe	3 drum lines
Broadbeach	2 drum lines
Kurrawa Beach	1 net
Mermaid Beach	1 net
Nobby's Beach	2 drum lines
Miami Beach	1 net
North Burleigh	2 drum lines
Burleigh Beach	1 net
Tallebudgera Beach	1 net
Palm Beach	2 drum lines
Currumbin Beach	1 net
Tugun Beach	3 drum lines
Bilinga Beach	1 net
Kirra Beach	2 drum lines
	1 net
Coolangatta Beach	1 net
Greenmount	2 drum lines
Rainbow Bay	6 drum lines
Total	11 nets
	35 drum lines
Grand Total	35 nets
	344 drum lines