NSW GOVERNMENT
Department of Primary Industries

NSW Recreational Fishing

Catch and Release

Handbook

Recreational Fishing Trusts

www.dpi.nsw.gov.au

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INTRODUCTION

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The NSW Department of Primary Industries (NSW DPI) promotes responsible fishing. This guide summarises the current best practice catch and release methods for inshore and freshwater recreational species. It should be used in combination with the fisheries regulations detailed in the NSW Recreational Saltwater and Freshwater Fishing Guides, which can be found at www.dpi.nsw.gov.au/fisheries.

Following the practices outlined in this guide will help you to maximise the survival of released fish and invertebrates, minimise impacts to aquatic resources and promote the sustainability of recreational fishing into the future.

GENERAL RESPONSIBLE FISHING GUIDELINES

- Only keep sufficient catch for your needs, and follow the current NSW DPI regulations.
- Quickly release all illegal or unwanted catches, except those classified as noxious species, following the best practice catch and release methods outlined on pages 10–13. Remember that all native species are important to ecosystems.
- Quickly and humanely kill your retained catch and noxious species using the methods outlined on pages 14–15. To avoid wastage, always immediately chill your retained catch.
- Dispose of all litter, discarded fishing tackle and fish waste responsibly. Return unused live baits to areas where they were collected.
- Wherever possible, use environmentally friendly fishing tackle such as non-lead sinkers, biodegradable line and non-stainless hooks. To minimise pollution, maintain boat engines.
- Reduce injuries to wildlife by always attending your lines, regularly checking any set traps and hoop nets, and avoiding known feeding and breeding areas of birds, turtles or platypus. Take care when boating and anchoring to avoid damaging habitat.
- If you hook a bird, stay calm. Gently reel it in. Even pelicans can be slowly retrieved and are generally placid. Place a towel or shirt over the bird's head and eyes and carefully remove the hook or line. Do not cut the line or release the bird if the hook has been swallowed or embedded too deeply to remove easily. Instead, contact the Australian Seabird Rescue: north 0428 862 852, central 0438 862 676 or south 0431 282 238; or alternatively call WIRES 1800 641188.
- Do not interfere with commercial fishing and keep clear of boating channels. Obtain permission from landholders before accessing private property and only drive on established roads.
- Fish safely and do not take any undue risks, particularly when rock fishing or boating. Always check weather forecasts and swell conditions before you go fishing. Refer to www.safefishing.com.au for more information.
- If you suspect illegal fishing activity, contact your local NSW DPI Fisheries Officer or the Fishers Watch Phoneline 1800 043 536.
- For more information on responsible fishing, refer to the *National Code of Practice for Recreational and Sport Fishing* available from the Department of Agriculture, Fisheries and Forestry www.daff.gov.au/publications/fisheries or visit www.dpi.nsw.gov.au/fisheries.

WHY CATCH AND RELEASE?

Every recreational fisher should know how to catch and handle fish and aquatic invertebrates to ensure released individuals have the best chance of survival. Bag and size limits, closed seasons and locations and protected species, all require certain individuals to be released, so you need to be prepared. Catch and release is also popular as a voluntary conservation measure, and has been adopted by many fishing competitions.

The good news is that Australian and international research shows that most inshore and freshwater fish and crustaceans survive after release, and that catch and release fishing is effective for managing and conserving stocks. While these results are very positive, it is also clear that for many species, survival can be improved and adverse effects to the health of individuals reduced if appropriate catch and release practices are chosen.

Catch and release research in NSW

Since 2001, the NSW DPI Fisheries Conservation Technology Unit, with funding from recreational licence fees, has been investigating the survival and health of key inshore and freshwater fish and crustaceans after catch and release. Most of this work has involved volunteer recreational fishers targeting key species with their conventional methods and then releasing their catches into field-based cages or tanks for monitoring, typically over less than five days.

Other more regulated experiments in ponds or aquaria have been used to investigate specific factors of interest (e.g. barotrauma or deep-hook shedding) or when only aquaculture fish were available (e.g. Mulloway and Silver Perch). Tag and release experiments were also completed to investigate the longer-term fate of some angled fish. The results from these other experiments have not been included in survival estimates tables, but are summarised on the appropriate individual species pages.

This guide combines all of the relevant research results from NSW, with some similar studies from other Australian states and overseas, to outline best practice catch and release methods.

Some of the findings are relevant to many species and form the basis of general guidelines summarised in this front section, which is followed by more specific information about individual species that were studied in greater detail.

The suitability of each species for catch and release was also rated. This rating was based on the likely survival of individuals after experiencing one or more known harmful factors during conventional fishing:

- fair, if severely affected
- good, if moderately affected
- excellent, if minimally affected.

While considerable progress has been made to identify best practice catch and release procedures, there are still more than 50 important species in NSW and other fishing scenarios that need to be investigated. In particular, very little work has been done with oceanic fish, especially those that are angled and released from deep water, freshwater crustaceans, cephalopods or bycatch species.

Such research is clearly an ongoing priority, and the results will be included in future updates of this guide. In the meantime, we encourage fishers to closely follow the broad recommendations outlined here. Doing so will minimise unwanted impacts to some of our most valuable aquatic resources.

WHY DO RELEASED FISH AND AQUATIC INVERTEBRATES DIE?

Most deaths after catch and release usually occur within one day and are often associated with extreme physical injuries, stress, suffocation, temperature shock or toxicity. But other individuals that appear healthy when released can also die later, sometimes many weeks after the fishing event. These delayed mortalities often are directly caused by disease or starvation, or indirectly by the predation of weakened individuals.

Being aware of and understanding why released fish and aquatic invertebrates die can help you to reassess and adjust your catch and release methods to maximise their survival.

Physical injury

Many physical injuries in fish and aquatic invertebrates are caused by contact with the fishing gear. For example, hooks can puncture vital organs in fish and cause excessive bleeding, while traps and nets can entangle and damage both crustaceans and fish.

Death can result directly from the injuries or their effect on the individual's ability to function, including evading predators and acquiring food.

Other injuries can result from:

- poor handling, including being dropped onto the deck or ground, which can cause appendage, scale or mucus loss and/or fin or gill damage
- barotrauma induced by a change in depth and pressure, which can compress or evert organs, over-inflate or rupture the swim bladder, bulge eyes or result in internal or external bleeding.

Such injuries can predispose individuals to later infection or compromised function.

Stress

Fish and aquatic invertebrates undergo similar internal physiological responses to stressors as we do, including increased circulation of stress hormones. These responses divert energy away from normal bodily functions. Catch and release fishing is known to cause at least some physiological stress in most species, but generally individuals fully recover within three to five days.

If stress is prolonged or too extreme, energy reserves may become totally depleted and normal bodily functions cease. In particular, long fight times or excessive handling may fatigue or totally exhaust individuals to a point that they are unable to recover. Confinement in a live well, keeper net or trap may also increase or prolong stress, particularly if overcrowded or during warm temperatures or poor water quality. When combined, stressors that are individually tolerable can have cumulative, overwhelming effects.

Suffocation—through air exposure

Just as we need oxygen to breathe and survive, so do aquatic organisms. But unlike us, fish and aquatic invertebrates extract dissolved oxygen from water and can only breathe effectively when their fragile gill filaments are submerged and unrestricted, except for some crustaceans that can respire out of water for many days.

During air exposure (e.g. while being removed from fishing gears or when photographs are taken), most aquatic animals are effectively holding their breath. Thus, prolonged air exposure can cause additional stress and eventually suffocation. The time until suffocation varies between species, but is generally shorter for fish than crustaceans.

Fish and aquatic invertebrates may also suffocate in water (e.g. while held in live wells, keeper nets, or entangled in meshes), if dissolved oxygen concentrations are not maintained through regular water exchange or aeration, or if their gills are obstructed (e.g. by meshes).

Temperature shock

Most fish and aquatic invertebrates are unable to independently maintain their body temperature. Large and rapid changes (e.g. by 5°C during retrieval from deep to surface water) can cause shock and even death. Water or air temperatures beyond the normal tolerance ranges of species can also increase stress or exacerbate the effects of other factors, like air exposure. Many harmful bacteria tend to flourish in warmer temperatures, which can increase the risk or extent of infection.

Toxicity

During exercise and stress, fish excrete considerably more ammonia than when they are resting. If fish are held in live wells without adequate water exchange, ammonia concentrations can rapidly increase to lethal levels and cause mortality.

Fish health and welfare

The stress experienced by an animal during capture and handling can also cause other sublethal effects that could diminish their long-term welfare. For example, fish with retained deep hooks (in the gills, throat or gut), crustaceans that lose appendages, or any individuals that are overly stressed or fatigued could feed, grow or even reproduce less than normal after release.

BEFORE YOU GO—WHERE, WHEN AND HOW WILL YOU FISH?

Before you go fishing, there are various things you should consider to ensure the maximum survival of any released individuals.

Where

If you can, fish in water shallower than 10 m, or be prepared to deal with fish that have barotrauma (see page 12). Likewise, try to avoid areas where threatened or protected species or undersized individuals are common (e.g. nursery grounds). Also consider whether you can easily land your catch without dragging it across rough ground or up a steep incline (e.g. a high jetty).

When

The negative effects of catch and release usually increase during periods of warmer water and hot air temperatures. If you are fishing in summer, try to avoid hot afternoons.

Also, avoid targeting species during their spawning, irrespective of fishery closures. Ripe individuals should be immediately released with care, to minimise damaging or dislodging eggs in berried crustaceans or allowing air to expand further and compress the gonads in fish that have barotrauma. Even if individuals aren't obviously ripe, there is some evidence to suggest that angling fish during their gonadal development could interfere with reproduction after release.

During late autumn and winter, dissolved oxygen profiles in impoundments extend deeper and allow fish to distribute below 10 m. To prevent barotrauma, avoid targeting fish in these deeper habitats at these times.

How

Choose appropriate fishing methods, gears and tackle to avoid catching undersized individuals and unwanted species. For example, larger mesh sizes and 'escape gaps' in crab and lobster traps increase the chances of undersized individuals and/or unwanted fish escaping. Consider using artificial lures only, or circle and/or barbless hooks; these reduce deep hooking or damage during unhooking.

Conventional hooks can be easily modified. For example, the barbs can be filed off or pinched flat.

Alternatively, some research has shown that simply adding 1.5–2 cm of stiff horizontal wire to the hook eye can almost eliminate deep hooking.

Irrespective of the hook shape or size, you should ideally choose one with the narrowest possible wire diameter. For example, choose 0.9 mm or less for fish smaller than 40 cm total length. Thin hooks degrade more readily if lost to the environment or swallowed by fish. Cutting a small notch in the shaft of a thick hook reduces the wire diameter, removes the protective coating and effectively provides a weak point for degradation if swallowed by a fish.

Other important choices include matching rod and line strengths to your target species to minimise retrieval time. Long playing times rapidly exhaust fish and greatly increase their stress, recovery times and chances of mortality.

Ensure you have all equipment needed to quickly and efficiently unhook fish and keep them alive (e.g. knotless landing net, jaw grips, long-nose pliers, gloves, live wells and aerators).

WHILE YOU ARE THERE—BEST PRACTICE METHODS TO MAXIMISE SURVIVAL

Different species, or even sizes, ages and sexes of a particular species, can respond differently to catch and release fishing. Nevertheless, there are some common steps that you can follow that have been shown to maximise the survival of most species studied to date. Some clearly relate to fish and angling only, while others also apply to crustaceans, as indicated below. You should also apply these procedures when releasing unstudied species.

Minimise deep hooking

Deep hooking has been identified as the most common factor that reduces fish survival. Use fishing methods and tackle that minimise deep hooking, such as artificial lures and circle hooks, or rigs with short traces or a sinker on the hook. Pay attention and actively fish lines to set the hook as quickly as possible. Avoid slack lines that allow fish extra time to swallow the bait.

Land catch quickly

To minimise stress and physical damage, ideally unhook fish while they are still in the water. Only remove your catch from the water if it is absolutely necessary.

If landing fish, do so quickly using a knotless fine-mesh or rubber landing net, sling or cradle rather than a knotted large-mesh net to minimise abrasion, scale loss and fin damage. Hoop nets should be checked regularly (at least every three hours) to minimise damage to crabs.

Minimise air exposure

Be prepared, and have the right equipment onboard, to handle fish quickly and minimise their air exposure and the chances of suffocation. Ideally photograph fish in the water or resting on a wet towel or measuring mat, rather than held with minimal body support.

In contrast, some crustaceans can tolerate longer air exposures, so rather than quickly and forcibly removing them from meshes and breaking their appendages, it is better to take your time.

Avoid rough handling

Minimise your handling of fish to reduce their mucus and scale loss, and fin or eye damage. To limit skin damage, only place fish on cool, wet surfaces. Use appropriate equipment (e.g. jaw grips, and wet gloves or towels) to firmly hold fish and avoid dropping them. For particularly fragile species like garfish, avoid touching the body, and instead gently shake individuals off the hook over water.

For crustaceans, ensure all individuals are completely untangled before removing them from traps and nets. In particular, try to avoid breaking their appendages, because any open wounds allow water to enter their body and increase the chances of death. Handle lobsters by the body and avoid contacting and breaking their antennae, which are vital for detecting food and mates.

Remove mouth hooks

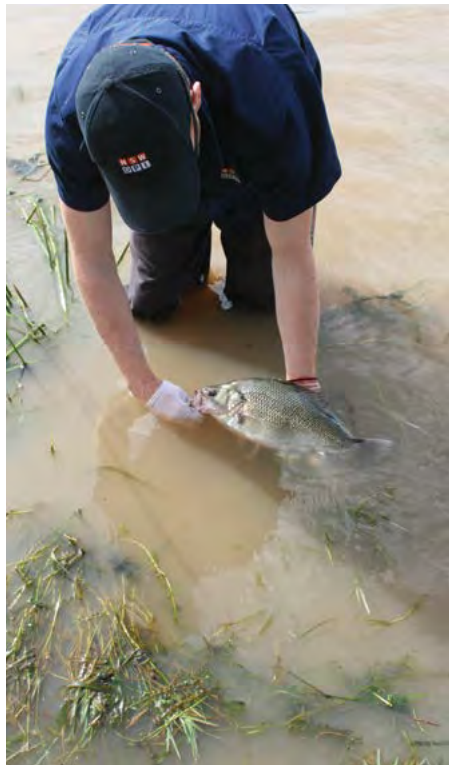
If possible, remove all mouth hooks (in the lips, tongue, floor or roof of the mouth) to reduce the possibility of later ingestion or obstruction to feeding. Do not simply tear hooks out. Have the right equipment (e.g. long-nose pliers) available to firmly grasp the hook and remove.

Cut the line on deep hooks

For all deep hooks (in the gills, throat or gut), simply cut the line close to the mouth and release the fish. Attempting to remove deep hooks can increase injuries, bleeding and handling time, and therefore mortality. Most fish can feed and later shed deeply imbedded hooks.

Carefully release catch

Gently return fish and invertebrates to the water; do not throw them. Revive any fish that appear exhausted or unable to swim away by holding them upright facing into the current or if in still water, gently 'swim' them to increase flow over the gills. For particularly oxygen-starved fish with flared and locked gill covers, placing them in an aerated recovery tank for 30–60 minutes may benefit survival.



SPECIAL CASES THAT REQUIRE EXTRA EFFORT

Barotrauma

Some fish may experience barotrauma, usually when they are caught from water deeper than 10 m. Barotrauma is caused by the rapid expansion of gases in the swim bladder and other tissues as fish are retrieved to the surface.

The expanded gases can block or burst blood vessels causing internal or external bleeding, enlarge, compress or damage organs or cause fish to become excessively buoyant and unable to return to their preferred depth. Other visible effects may include an inflated hard abdomen, bulging eyes or stomach out of the mouth or intestines out of the anus. Be careful not to puncture these organs.

Although usually associated with offshore saltwater species, barotrauma can also occur in freshwater fish caught from deep lakes, dams and rivers. Barotrauma may reduce the survival of fish if they are not released appropriately.

The quicker that fish with barotrauma are returned the water, the better their chances of surviving.

Release weight

Insert the weighted, barbless hook through the lower jaw membrane and send the fish headfirst back into the water. Allow the line to unravel freely and tug it upward when the fish reaches the approximate capture depth. To rapidly release fish, it helps to have the hook on a separate dedicated rope.

Recommended best practices for fish affected by barotrauma include the following.

- If a fish is released immediately and able to submerge, leave it untreated. If the fish is unable to submerge in deep water, return it to the approximate capture depth with a weighted device (see below).
- If a fish is either floating in a live well, unable to submerge in shallow water, or released where there are many predators (e.g. birds or sharks), it may need to be vented (see below). This should only be done by an experienced operator with appropriate equipment. Incorrect venting can injure fish and reduce survival.

If you intend to target fish in deep water, you should have:

- a release weight or cage on a dedicated line
- sterile venting needles
- gloves
- appropriate knowledge and skills to quickly deal with individuals that have barotrauma.

Venting

Only attempt to vent fish if you know the correct technique and the location of the swim bladder, which varies between species, but is usually at the intersection below the forth or fifth dorsal spine and tip of the flattened pectoral fin. Hold the fish firmly and slowly insert a sterile needle under a scale at 45° to the body, until you hear gas escaping. Hold the needle steady until all gas is expelled.

Live wells

If you use a live well even briefly, ensure that it is large enough to accommodate your target species and bag limit. Fish should have sufficient space to avoid touching the sides or each other and be able to turn around.

Fill your live well with water when you catch your first fish, not at the start of the day. If you don't have a flow-through system, exchange half of the water every 15 minutes thereafter.

If you are participating in a delayed-release, live weigh-in tournament, and holding fish for longer than one hour, you should have a constant flow-through system. At the very least, provide aeration from a bubbler or recirculation pump and spray system.

If you are holding fish over the side of a vessel in keeper nets, these should have rigid frames and knotless mesh and allow adequate water exchange and space as above for live wells. Collapsible, knotted-mesh keeper nets restrict the breathing or movement of fish and cause abrasion, scale loss and fin damage, and should be avoided.

Big fish

Everyone loves to catch a big one, but make sure you are prepared. Big fish are often old and rare. Large females also generally produce more eggs and contribute a greater number of offspring to populations.

Unfortunately, because big fish are generally heavier and more difficult to handle, they typically take longer to land and unhook, which can cause greater stress during catch and release. Use jaw grips, wet gloves and towels or other similar devices (e.g. smooth-sided slings or cradles) to firmly secure fish and allow quick hook removal.

The backbones of large fish are not designed to support their body weights out of water. Therefore, only use jaw grips to secure fish that are supported horizontally and never to lift or suspend them vertically. Holding large fish vertically from their jaws, eyes or gills can injure these structures and permanently stretch their backbones.

Even when held horizontally during photographs, the entire body should be supported. Ideally, use a smooth-sided sling or cradle to hold fish in water over the side of the boat or support their weight if bought onboard.

HUMANE HARVEST METHODS

Despite your best efforts, some animals may be seriously injured during capture and unlikely to survive after release. As with any retained catch or noxious species, these should be swiftly and humanely killed. The only exceptions are undersized individuals or threatened or protected species, which must always be immediately returned to the water, irrespective of their condition.

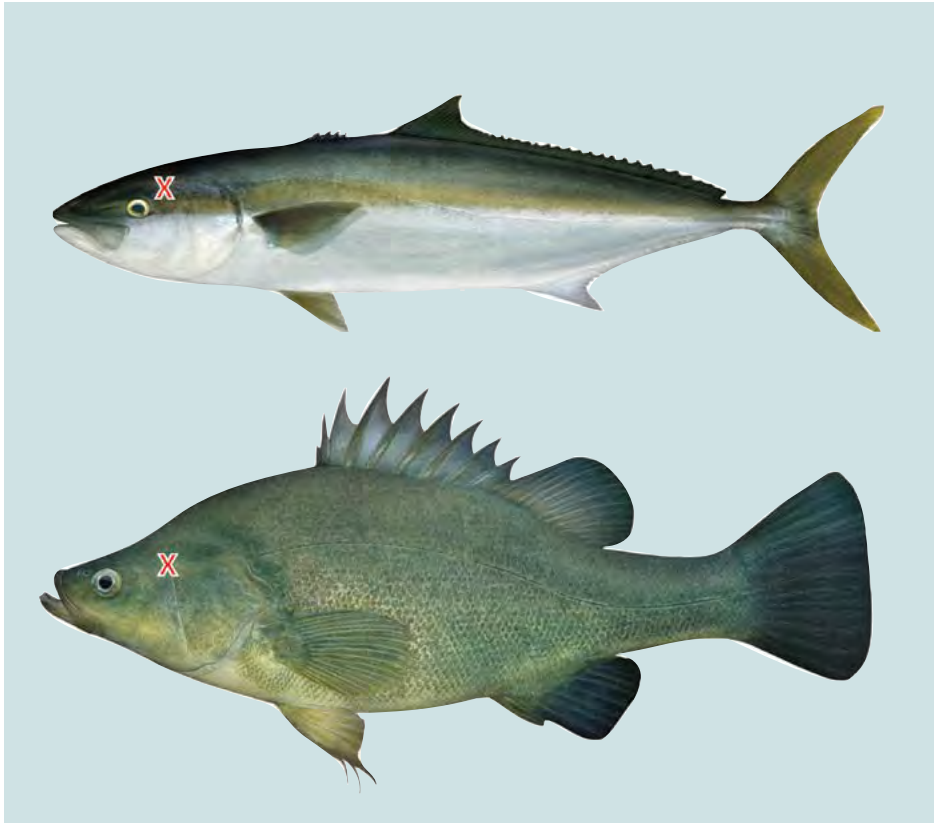
Fish

For fish, percussive stunning should cause immediate unconsciousness if it is delivered swiftly and to the correct area. A sharp blow should be made to the head just behind and slightly above the eyes in the area adjacent to the brain with a heavy blunt tool. Refer to www.ikijime.com for information on the brain location for local fish species.

This should be followed by piercing the brain (called pithing) with a sharp pointed tool at the same location or by cutting the throat and bending the head back to sever the spine. When these methods are applied correctly the gill covers and eyes should cease movement promptly.

Alternatively, small or medium warm-water fish may be immersed for more than 20 minutes in an ice slurry, which has at least a 50% volume of ice. The slurry temperature should ideally be checked with a thermometer and be no warmer than 0°C and minus 4°C for freshwater and saltwater, respectively. Some species may still require pithing or severing of the spine after immersion.

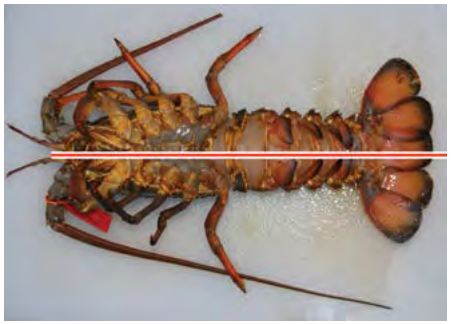
X *Red cross on species images indicates correct point for humane dispatch*



Crustaceans

All crustaceans should be immersed in an ice slurry (as described for fish) for at least 20 minutes, before their central nerves are rapidly destroyed as follows.

Lobsters and crayfish have a chain of nerve centres down their midline from head to tail. These should be destroyed by cutting the animal in half lengthwise along the underside with a large sharp knife. Make two quick cuts from the tail/chest junction, the first towards the head and the second towards the tail; and then rapidly remove the nerve centres in the head and chest area. Do not separate an individual's head and chest from its tail, or cook it without first destroying these nerve centres.

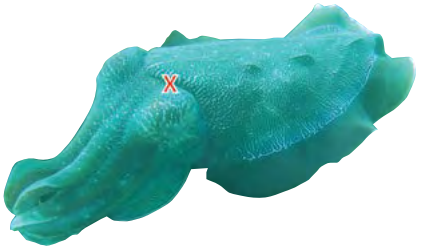


Crabs have two main nerve centres (at the front and rear) that can be pierced through the underside in the soft central area under the abdominal flap with a thick pointed pithing tool or exposed by rapidly removing the top carapace (shell) and then destroyed. Do not section or boil crabs before destroying their nerve centres.

Cephalopods

Cephalopods should also be immersed in an ice slurry (as described for fish) for at least 20 minutes, before their brains are rapidly destroyed as follows.

Cephalopod brains are located in the middle of the head just behind the eyes (see red cross on three illustrations) and are best destroyed by pithing in that location. Alternatively, squid and cuttlefish can be decapitated.



Humane harvesting is a rapidly evolving area of research, particularly for invertebrates. The above guidelines have been developed based on the best information available at the time of publication.

FISHING COMPETITIONS

If you are organising or participating in a catch and release fishing competition, there are additional things to consider. A summary of the main points is provided below, but for more comprehensive information please visit www.dpi.nsw.gov.au/fisheries to obtain a copy of the *Code of Practice for Fishing Events in NSW*.

It is in the best interests of event organisers and participants to promote ethical and responsible fishing practices, minimise impacts to resources and allay the concerns of other users and community groups. This will help to ensure a positive future for fishing competitions in NSW.

Where, when and how

Fishing competitions can attract large numbers of fishers and spectators to a specific area, placing additional pressures on local fish stocks. It is therefore responsible practice for organisers to seriously consider where, when and how the competition will be run to maximise the survival of released fish. Responsible fishing methods include the following.

- Avoid known spawning aggregations or protected species habitats.
- Avoid warm temperatures (e.g. afternoons in summer) and water deeper than 10 m because both can reduce the survival of many released species. If competitions are run under these conditions, ensure participants understand how to best handle afflicted fish using release weights or clean venting needles, with appropriate training, or have adequate live wells or recovery tanks.

Consider introducing competition rules that minimise the total number of individuals caught and released, such as those listed below.

- Limit the number of eligible species.
- Introduce species-based awards rather than aggregated weights.
- Display an up-to-date scoreboard to discourage fishers from presenting ineligible individuals.
- Introduce more conservative species size and bag limits than NSW DPI regulations.
- Restrict entrant numbers.

Best practice methods

Outline minimum standards for competition participation (e.g. mandatory flow-through live wells for live weigh-in events, or lure-only events) that encourage best practice catch and release methods.

Weigh-in procedures

Consider adopting weigh-in procedures at the point of capture, such as photo validation, buddy systems, pre-certified scales or roving marshal boats, particularly for species that survive poorly in live wells (e.g. Golden Perch or Silver Trevally). Most species have better survival after immediate than delayed release. Alternatively, to reduce fish retention times in live wells, consider introducing shorter sessions to include just peak periods when fish are most likely to be on the bite.

Carefully design weigh-in procedures to avoid lengthy air exposure to already stressed fish. Have an adequate number of marshal boats, weigh-in stations or stewards to rapidly process fish. Use fish friendly equipment (e.g. fine-mesh or smooth-material slings or bags rather than rigid, large-mesh baskets) during weigh-in to reduce scale and mucus loss and fin damage.

Releasing fish

During heavy boat traffic, it may be beneficial to rope off an area where fish can be released with less chance of additional injury or stress from engine propellers or stirred-up sediments. Fish exposed to air for long periods during weigh-in or lengthy retention onboard may benefit from a brief period in an aerated/flow-through revival tank before release.

Also consider the movement patterns of the target species. Is it likely to swim away from the area after release? Is it a nesting, aggregating or territorial species like Freshwater Catfish, Dusky Flathead or Murray Cod? If so, it may be more appropriate to have immediate release or weigh-in procedures at the capture location.

Reward good practices

Consider offering incentives to encourage anglers to adopt best practices through prizes for the quality rather than just the quantity of fish caught.

SUMMARY OF RESEARCH RESULTS

Percentage survival and main factors

Most of the results summarised below for key NSW inshore and freshwater fish species were obtained from field-based events that monitored survival after conventional fishing and release in water mostly shallower than 10 m. Other results from more regulated experiments in ponds or aquaria or from tag-and-release studies are only included on the individual species pages, except for species where no other data were available. These are indicated by an asterisk* in the tables.

Saltwater fish			
Species	**% survival**	**Main factors for reduced survival**	**Page**
Bream, Black 	*	Deep hooking and removal, and associated damage and bleeding.	23
Bream, Yellowfin 	72–92	Deep hooking and removal, and associated damage and bleeding.	23
Eastern Sea Garfish 	46	Deep hooking, excessive scale loss and extended air exposure.	28
Flathead, Dusky 	91–97	Deep hooking and associated bleeding, and poor live-well water quality.	26
Flathead, Southern Sand 	*	Deep hooking and associated bleeding.	26
Luderick 	99	None identified.	29

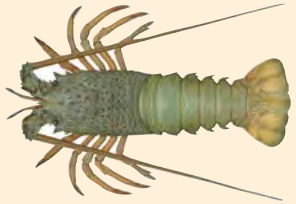
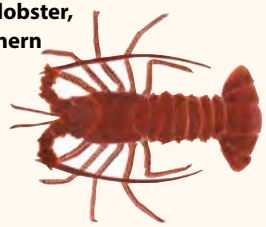
Saltwater fish			
Species	**% survival**	**Main factors for reduced survival**	**Page**
Mulloway 	*	Deep hooking and removal.	30
Sand Mullet 	96	Bleeding from hook wounds, and long traces.	32
Sand Whiting 	97	None identified.	33
Silver Trevally 	63–98	Extended time in live wells.	35
Snapper 	67–92	Deep hooking and removal, and associated damage and bleeding.	36
Tailor 	92	Deep hooking and removal, and associated damage and bleeding.	38
Yellowtail Kingfish 	85	Deep hooking and associated damage and bleeding, which were worse when held in a landing net rather than restrained.	40

Freshwater fish			
Species	**% survival**	**Main factors for reduced survival**	**Page**
Australian Bass 	94–100	Deep hooking typically with natural baits, small fish sizes and warm termperatures.	42
Freshwater Catfish 	97	Deep hooking.	45
Golden Perch 	57–100	Deep hooking with natural baits, large fish sizes and time of capture (warm temperatures).	46
Murray Cod 	80–85	Restraining fish with bare hands.	48
Silver Perch 	*	Deep hooking and hook removal.	50

* refer to text on page 18.

Saltwater crustaceans

The survival of crustaceans was estimated from regulated experiments that involved the most common NSW fishing methods and gears. Where appropriate, estimates were divided into those occurring during confinement in traps, and then after release into cages for monitoring over up to 90 days. Because most crustaceans survived, the main factors listed are those that caused harm rather than death. The results from other related experiments are also summarised in the table below, and on the individual species pages.

Saltwater crustaceans				
Species	**% survival in traps**	**% survival after release**	**Main factors causing harm**	**Page**
Blue Swimmer Crab 	100	99	Limb loss during removal from traps and hoop nets, rough handling on soft-shelled crabs and bleeding wounds.	52
Giant Mud Crab 	100	100	Limb loss caused by netted traps, particularly hoop nets.	56
Rocklobster, Eastern 	97	100	Predation in traps and limb loss during hand collection when diving.	54
Rocklobster, Southern 	–	–	Predation in traps and limb loss during hand collection when diving.	54

RESEARCH RESULTS FOR INDIVIDUAL SPECIES

Recreational catch and release data included on the following individual species pages were extracted from:

Henry G.W. and Lyle J.M. (2003). The national recreational and indigenous fishing survey. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia.
Rowling K., Hegarty A.-M. and Ives M. (Eds) (2010). Status of fisheries resources in NSW 2008–09. Industry & Investment NSW, Cronulla, NSW, Australia.

Other general reading relevant to multiple species includes:

Hall K.C., Broadhurst M.K. and Butcher P. (2009). Barotrauma in fish angled from deep water. Go Fishing 25, pp. 86–87.
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Other relevant literature is listed at the end of each individual species page.

Black Bream *Acanthopagrus butcheri*

Yellowfin Bream *Acanthopagrus australis*

Similar species
Snapper *Pagrus auratus*
Tarwhine *Rhabdosargus sarba*

Recreational catch data
820–1070 tonnes of Yellowfin Bream retained in NSW, and more than 63% released of the total number of all breams and Tarwhine caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
Yellowfin Bream: 92% when held in live wells and 72% when immediately released over 10 days, after one conventional angling event in NSW.

Main factors that reduced survival
Deep hooking and removal, and associated damage and bleeding.

Other research results (Bream cont…)

- Yellowfin Bream: 95% survival over five days, after one angling event in NSW that used specific J-hooks and handling methods.
- Deep hooking was most frequent in Yellowfin Bream caught with conventional J-hooks, soft baits (e.g. squid and gut) and slack lines, particularly those with single hooks and long traces.
- Up to 76% of deep-hooked Yellowfin Bream shed their hooks within 105 days.
- Larger Yellowfin Bream more readily shed their deep hooks.
- Black Bream: 74–95% survival over three days, during eight angling events in Victoria that used specific terminal rigs, hooks and baits.
- Deep hooking was least frequent in small Black Bream that were caught with actively fished large hooks.
- Cutting the line on both species when they were deep hooked increased their survival from 12–58% to 81–100%.
- A long-term tagging study in Queensland showed no detrimental effects of cutting the line on deep-hooked fish.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Use lures or actively fish circle hooks with hard baits (e.g. crustaceans) to promote mouth hooking.
- Use carbon-steel hooks with wire diameters narrower than 0.9 mm and minimal protective coating to maximise degradation.

Further reading

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Wilde G.R. and Sawynok W. (2009). Effect of hook removal on recapture rates of 27 species of angler-caught fish in Australia. Transactions of the American Fisheries Society 138: 692–697.

Dusky Flathead *Platycephalus fuscus*

Southern Sand Flathead *Platycephalus bassensis*

Similar species
Northern Sand Flathead *Platycephalus endrachtensis*
Bluespotted *Flathead Platycephalus caeruleopunctatus*
Tiger Flathead *Platycephalus richardsoni*
Bartail Flathead *Platycephalus indicus*
Mud Flathead *Ambiserrula jugosa*

Recreational catch data
570–830 tonnes of Dusky Flathead retained in NSW, and more than 45% released of the total number of all flatheads caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
Dusky Flathead: 91–97% over four days, after two conventional angling events in NSW.

Main factors that reduced survival
Deep hooking and associated bleeding, and poor live-well water quality.

Other research results

- Dusky Flathead: 93% survival over four days, after one angling event in Queensland that used specific hooks and baits.
- Southern Sand Flathead: 92% survival over four days, after one angling event in Tasmania that used specific hooks and baits.
- Knotted large-mesh landing nets caused greater fin damage in Dusky Flathead than knotless nets or no net.
- Cutting the line, rather than removing deep hooks, improved the survival of Southern Sand Flathead from 60% to 81%.
- Both species swallowed lures and circle hooks less frequently than J-hooks.
- Although few fish of either species were deep hooked, when this occurred it usually involved natural baits, rather than lures.
- A long-term tagging study in Queensland indicated greater recapture among deep-hooked Dusky Flathead that had their lines cut, than those with deep hooks removed.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Use lures or actively fish circle hooks with natural baits to promote mouth hooking.
- Use a fine-mesh, knotless landing net to minimise fin and scale damage.
- Use an adequately sized live well with flow-through water and aeration.

Further reading

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Eastern Sea Garfish *Hyporhamphus australis*

Similar species
River Garfish *Hyporhamphus regularis ardelio*
Snubnose Garfish *Arrhamphus sclerolepis*
Longfin Garfish *Euleptorhamphus viridis*
Slender Garfish *Hyporhamphus dussumieri*

Recreational catch data
Less than 10 tonnes of Eastern Sea Garfish retained in NSW, and more than 12% released of the total number of all garfishes caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Fair.

Survival
51% over one day, after one conventional angling event in NSW.

Main factors that reduced survival
Deep hooking, excessive scale loss and extended air exposure.

Other research results
- Only 4% of angled Eastern Sea Garfish were deep hooked.
- Fish lost more scales when they were held with dry, rather than wet hands or not handled at all; dropped on the ground instead of being held; or exposed to air or confined in live wells the longest.

Best practices for catch and release
- Remove mouth hooks, and cut the line for deep-hooked fish.
- Gently shake the fish off the hook without touching it using a pair of pliers either in water or just above the surface to minimise scale loss and air exposure.
- Release fish immediately and avoid holding them in live wells to minimise damage.

Further reading
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Butcher P.A., Broadhurst M.K., Hall K.C., Cullis B.R. and Nicoll R.G. (2010). Scale loss and mortality in angled-and-released eastern sea garfish (*Hyporhamphus australis*). ICES Journal of Marine Science 67: 522–529.

Luderick *Girella tricuspidata*

Similar species
Blue Drummer *Girella cyanea*
Rock Blackfish *Girella elevata*

Recreational catch data
270–550 tonnes of Luderick retained in NSW, and more than 33% released of the total number caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
99% over four days, after one conventional angling event in NSW.

Main factor that caused harm
Stress and damage caused by confinement in keeper nets with other Luderick.

Other research result
- The stress of fish increased during their confinement in keeper nets, but returned to normal within four days after release.

Best practice for catch and release
- Release fish immediately to minimise stress and damage.

Further reading
Butcher P., Broadhurst M., Hall K. and McGrath S. (2009). Post-release survival of angled tailor and luderick. Go Fishing 23, pp. 74–78.
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Mulloway *Argyrosomus japonicus*

Similar species
Teraglin *Atractoscion aequidens*

Recreational catch data
100–500 tonnes of Mulloway retained in NSW, and more than 46% released of the total number of all Mulloway, teraglins and jewfishes caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
27–96% over five days for deep-hooked and mouth-hooked fish that had their hooks removed, during three aquaria experiments in NSW; 100% over 25 days for mouth-hooked fish during one aquaria experiment in NSW; and 65% over 61 days for deep-hooked fish that had their lines cut during one aquaria experiment in NSW. These data are based on three regulated aquaria experiments with aquaculture fish.

Main factors that reduced survival
Deep hooking and removal.

Other research results
- Most deaths occurred within one day of release.
- Cutting the line on deep-hooked fish increased survival from 27% to 84%. Survival was further increased to 90% when lines were cut in water and fish were not exposed to air or handled.
- Survival of mouth-hooked fish was 93–100%, but some eventually swallowed unremoved hooks.
- 5–30% of deep hooks were shed over 61 days.
- Ingested nickel-plated carbon-steel hooks degraded 10 times faster, and were shed more readily, than red-lacquer carbon- or stainless-steel hooks.

Best practices for catch and release
- Release fish immediately in water without air exposure or handling if possible.
- Remove mouth hooks, and cut the line on deep-hooked fish.
- Use lures or actively fish circle hooks with natural baits to promote mouth hooking.
- Use carbon-steel hooks with wire diameters narrower than 0.9 mm and minimal protective coating to maximise degradation.

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McGrath S.P., Broadhurst M.K., Butcher P.A. and Cairns S.C. (2011). Fate of three Australian teleosts after ingesting conventional and modified stainless- and carbon-steel hooks. ICES Journal of Marine Science 68: 1–9.

Sand Mullet *Myxus elongatus*

Similar species
Sea Mullet *Mugil cephalus*
Yelloweye *Mullet Aldrichetta forsteri*
Pinkeye Mullet (Freshwater Mullet) *Trachystoma petardi*
Goldspot Mullet *Liza argentea*

Recreational catch data
Less than 10 tonnes of Sand Mullet retained in NSW, and more than 23% released of the total number of all mullets caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
96% over four days, after one conventional angling event in NSW.

Main factors that reduced survival
Bleeding from removed hooks, and long traces (greater than 50 cm) between the hook and float.

Other research results

- Only 2% of Sand Mullet were deep hooked.
- All deaths occurred within three to four days after release.

Best practices for catch and release

- Use short traces and actively fish natural baits to promote mouth hooking.

Further reading

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Sand Whiting *Sillago ciliata*

Similar species
Eastern School Whiting *Sillago flindersi*
Trumpeter Whiting *Sillago maculata*
Stout Whiting *Sillago robusta*
King George Whiting *Sillagniodes punctata*

Recreational catch data
230–460 tonnes of Sand Whiting retained in NSW, and more than 32% released of the total number of all whitings excluding King George caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
97% over 10 days, after one conventional angling event in NSW.

Main factors that reduced survival
None identified during the above event.

Other research results

- 94% of Sand Whiting survived over seven days, after one angling event in NSW that used a specific long-shank J-hook. Factors that reduced survival were deep hooking with beach worm baits.
- Fish angled from low salinities (e.g. during flooding) were more stressed than those caught from salt water.
- Deep-hooked fish resumed feeding within five days after release into tanks, and 25% shed their embedded J-hook within 21 days.
- A long-term tagging study in Queensland showed no detrimental effects of cutting the line on deep-hooked fish.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Use lures or actively fish natural baits, especially when using worms, to promote mouth hooking.

Further reading (Sand Whiting cont…)

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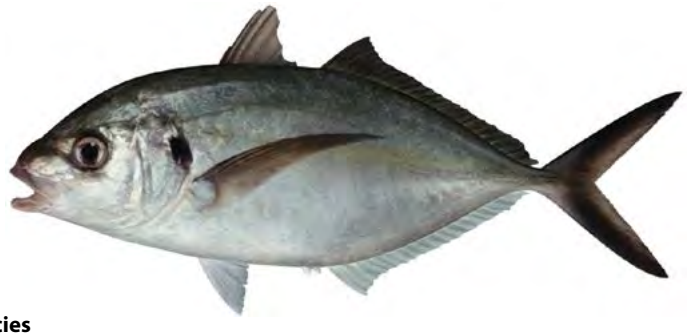
Silver Trevally *Pseudocaranx dentex*



Similar species
Bluefin Trevally *Caranx melampygus*
Bigeye Trevally *Caranx Sexfasciatus*
Giant Trevally *Caranx ignobilis*
Golden Trevally *Gnathanodon speciosus*

Recreational catch data
100–210 tonnes of Silver Trevally retained in NSW, and more than 39% released of the total number of all trevallies caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
63% when held in live wells and 98% when immediately released, over 10 days, after one conventional angling event in NSW.

Main factor that reduced survival
Extended time (of more than 45 minutes) in live wells.

Other research results

- Only 3% of fish were deep hooked.
- Most deaths of individuals held in live wells occurred within one to four days after release into monitoring cages.

Best practices for catch and release

- Release fish immediately and avoid holding them in live wells to minimise stress.
- If using a live well, minimise retention time and maintain water quality (ensure it is adequately sized with flow-through water and aeration).

Further reading

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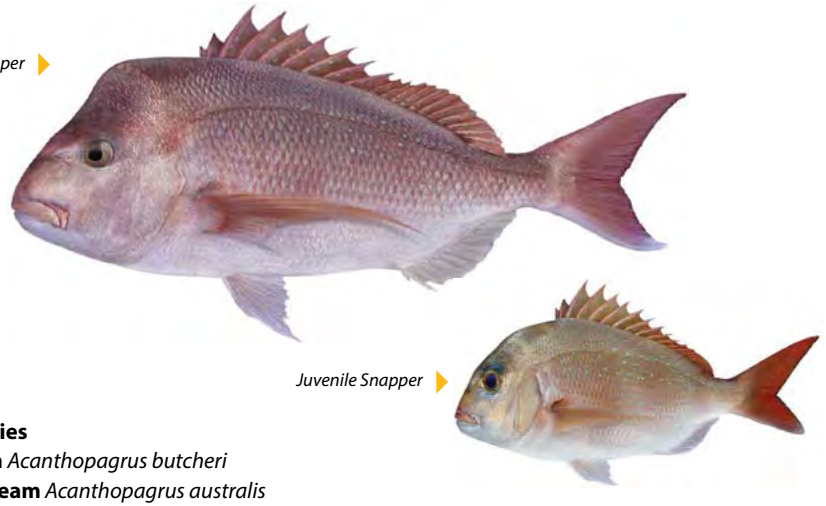
Snapper *Pagrus auratus*



Similar species
Black Bream *Acanthopagrus butcheri*
Yellowfin Bream *Acanthopagrus australis*
Tarwhine *Rhabdosargus sarba*

Recreational catch data
180–250 tonnes of Snapper retained in NSW, and more than 66% released of the total number caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
67–92% over less than 10 days, after two conventional angling events in NSW.

Main factors that reduced survival
Deep hooking and removal, and associated damage and bleeding.

Other research results
- 48–97% survival over three days, after five angling events in Victoria that used specific hooks and baits.
- Cutting the line on deep-hooked fish increased survival from 0–42% to 44–45%.
- Bleeding and damage to the throat and gills were more evident after deep hooks were removed than when lines were cut.
- 13–77% of deep hooks were shed over three to 61 days.
- Nickel-plated carbon-steel hooks modified with small notches degraded faster and were shed more readily than unmodified designs, or those made from stainless or red-lacquer carbon steel.
- Angled fish held in live wells for 60 minutes became stressed after 30 minutes.
- In NSW, fish caught from water deeper than 10 m often had barotrauma, and the symptoms remained similar among individuals caught from down to 120 m. Fish retrieved from 20 m had barotrauma, but all survived over three days after release.
- In another study in Western Australia, survival decreased from 97% at depths of 5, 15 and 30 m to 31% at 45 and 65 m over one to four days after release.
- A long-term tagging study in Queensland showed no detrimental effects of cutting the line on deep-hooked fish.

Best practices for catch and release
- Remove mouth hooks, and cut the line for deep-hooked fish.
- Use lures or actively fish circle hooks with natural baits to promote mouth hooking.
- Choose appropriate hook sizes to minimise catches of undersize fish.
- Release fish immediately and avoid holding them in live wells to minimise stress.
- Fish with barotrauma (as indicated by a swollen red anus, stomach everted out of the mouth or bloated abdomen), usually caught from water deeper than 10 m, should be left untreated and immediately released if possible. Alternatively they should be returned to depth with a release weight if they remain floating on the surface, and only vented by an experienced operator if they return to the surface or predators are present.

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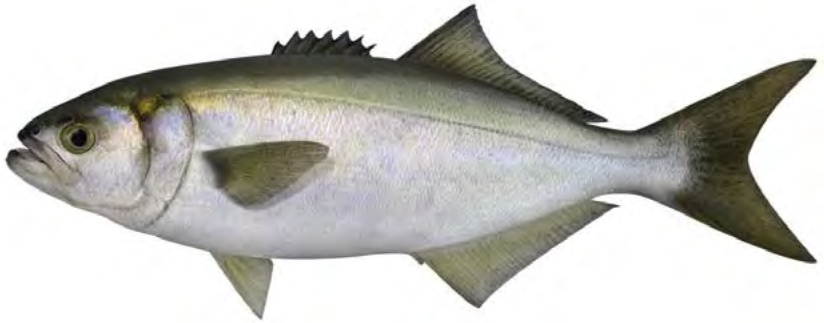
Tailor *Pomatomus saltatrix*



Similar species
None.

Recreational catch data
150–300 tonnes of Tailor retained in NSW, and more than 38% released of the total number caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
92% over 10 days, after one conventional angling event in NSW.

Main factors that reduced survival
Deep hooking and removal, and associated damage and bleeding.

Other research results

- 97% survival over two hours, during one angling event in Western Australia that used specific hook types; and 61% over 21 days, during one event in the USA in which fish were angled from deep water using specific terminal rigs and procedures.
- Many angled fish had damaged mouths and fins, and lost scales.
- Compared with treble hooks, single and ganged hooks caused more gill and jaw damage, respectively.
- In NSW, fish held in live wells had increased stress levels.
- In the USA, survival was less among larger (and older) fish that were bleeding.
- A long-term tagging study in Queensland showed no detrimental effects of cutting the line on deep-hooked Tailor.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Use lures or actively fish circle hooks with natural baits to promote mouth hooking.
- Release fish immediately and avoid holding them in live wells to minimise stress.

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Yellowtail Kingfish *Seriola lalandi*

Similar species
Amberjack *Seriola dumerili*
Samsonfish *Seriola hippos*
Highfin Amberjack *Seriola rivoliana*

Recreational catch data
120–340 tonnes of Yellowtail Kingfish retained in NSW, and more than 55% released of the total number of all Yellowtail Kingfish, Samsonfish and amberjacks caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
85% over seven days, after one conventional angling event in NSW.

Main factors that reduced survival
Deep hooking and associated damage and bleeding; which were worse when held in landing net rather than securely restrained.

Other research results
- Cutting the line on deep-hooked fish increased survival from 33% to 66%.
- Angled fish resumed feeding within one day after release into monitoring cages.
- Few angled fish lost scales or had damaged fins after handling.
- Of 10 gill-hooked fish that had their lines cut and were released with transmitting tags, two were dead within 10 minutes of release, while the remaining eight were detected for up to 49 days.

Best practices for catch and release
- Use strong fishing line to minimise retrieval time.
- Use lures or actively fish circle hooks with large baits to promote mouth hooking.
- Use a landing net to remove fish from the water, but then immediately restrain them (especially deep-hooked individuals) with a wet towel or gloved hands to minimise further hook damage and bleeding.

Further reading
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Australian Bass *Percolates novemaculeata*

Similar species
Estuary Perch *Percolates colonorum*

Recreational catch data
47 tonnes retained in NSW, and more than 76% released of the total number caught throughout Australia. Estimates are for Australian Bass combined with many other freshwater perch and cod species, including Estuary Perch, Silver Perch, Macquarie Perch and Trout Cod, for 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
94–100% over two to five days, after three conventional angling events in NSW.

Main factors that reduced survival
Deep hooking typically with natural baits, small fish sizes (of less than 25 cm total length) and warm temperatures, with greater mortality during summer.

Other research results

- Deep-hooked fish were unable to feed properly or shed hooks, and 31% eventually died over one month.
- Fish weighed in during tournaments often had damaged fins or were held in live wells with poor water quality.
- Fish caught from water deeper than 10 m often had barotrauma, but all immediately released untreated fish survived. Injuries caused by incorrect venting reduced survival to 87%.
- Angling early in the spawning season during gonadal development affected the reproductive potential of some females.
- Ripe females with barotrauma had compressed ovaries and expelled eggs from their vents (anus).
- A long-term tagging study in Queensland showed no detrimental effects of cutting the line on deep-hooked Australian Bass.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Use lures or actively fish natural baits to promote mouth hooking.
- Choose appropriate hook sizes to minimise catches of undersize fish.
- Fish when temperatures are cool and avoid hot afternoons in summer.
- Avoid targeting riverine fish during their spawning season between June and September.
- Fish with barotrauma (as indicated by a swollen red anus, stomach everted out of the mouth or bloated abdomen), usually caught from water deeper than 10 m, should be left untreated and immediately released if possible. Alternatively they should be returned to depth with a release weight if they remain floating on the surface, and only vented by an experienced operator if they return to the surface or predators are present.

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Hall K.C., Broadhurst M.K., Butcher P.A. and Rowland S.J. (2009). Effects of angling on post-release mortality, gonadal development and somatic condition of Australian bass *Macquaria novemaculeata*. Journal of Fish Biology 75: 2737–2755.
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Freshwater Catfish *Tandanus tandanus*

Similar species
Estuary Cobbler *Cnidoglanis macrocephalus*
Blue Catfish (Fork-tailed Catfish) *Arius graeffei*
Striped Catfish *Plotosus lineatus*
Hyrtl's Catfish *Neosilurus hyrtlii*

Recreational catch data
94 tonnes retained in NSW, and more than 75% released of the total number caught throughout Australia. Estimates are for all marine and freshwater catfishes combined for 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
97% over three days, after one conventional angling event in NSW.

Main factor that potentially reduced survival
Deep hooking.

Other research result

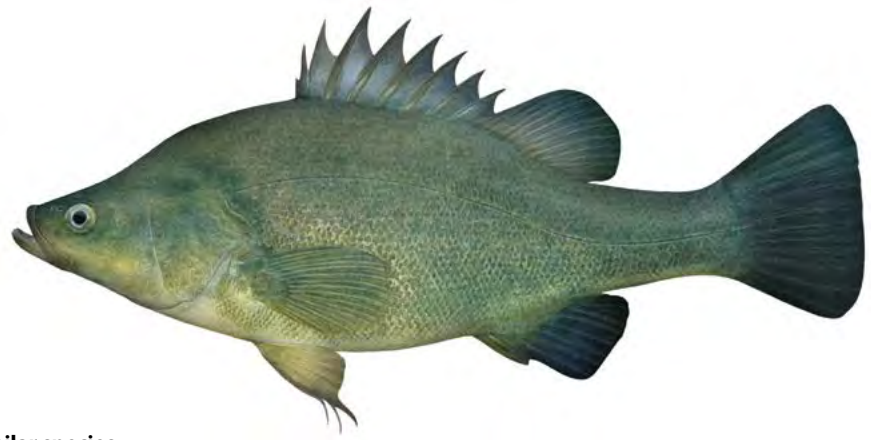
- Most fish caught on natural baits with actively fished lines were mouth hooked.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Actively fish natural baits to promote mouth hooking.
- Restrain fish with a wet towel or gloved hands to avoid stings and minimise rough handling.

Further reading
Broadhurst M., Hall K., Brand C. and Cullis B. (2012). Cool for cats. Freshwater Fishing Australia 116, pp. 88–89.

Golden Perch *Macquaria ambigua*



Similar species
Silver Perch *Bidyanus bidyanus*
Macquarie Perch *Macquaria australasica*

Recreational catch data
325 tonnes of Golden Perch retained in NSW, and more than 44% released of the total number caught throughout Australia. Estimates are for 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
57–100% over four days, after four conventional angling events in NSW.

Main factors that reduced survival
Deep hooking with natural baits, large fish sizes (greater than 40 cm total length) and time of capture (summer afternoons, with warm temperatures).

Other research results

- Compared with lure-only events, using natural baits increased the percentage of deep-hooked fish (up to 50%).
- Fish with barotrauma (caught from water deeper than 10 m) that were held in a live well (for 15 minutes) had more severe symptoms and poorer survival than immediately released individuals. Injuries from incorrect venting, bulging eyes or haemorrhaging into the swim bladder also reduced survival.
- Angling during late gonadal development (ready to spawn) affected the reproductive potential of some females.
- Ripe females with barotrauma had compressed and haemorrhaged ovaries.
- A long-term tagging study in Queensland showed no detrimental effects of cutting the line on deep-hooked fish.

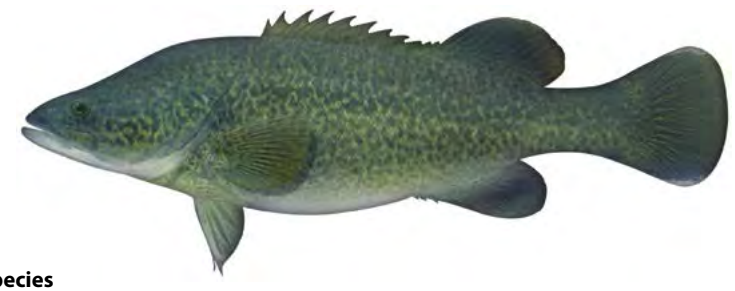
Best practices for catch and release

- Remove mouth hooks, and cut the line for all deep-hooked fish.
- Use lures or actively fish natural baits to promote mouth hooking.
- Fish when temperatures are cool (avoid hot afternoons in summer).
- Avoid targeting riverine fish, and impounded fish from water deeper than 10 m depth, during their spawning season (October to January).
- Release fish immediately and avoid holding them in live wells to reduce stress.
- Fish with barotrauma (as indicated by a swollen red anus, stomach everted out of the mouth or bloated abdomen), usually caught from water deeper than 10 m, should be left untreated and immediately released if possible. Alternatively they should be returned to depth with a release weight if they remain floating on the surface, and only vented by an experienced operator if they return to the surface or predators are present.

Further reading

Hall K., Broadhurst M. and Brand C. (2010). Tight lines may save lives. Freshwater Fishing Australia 108, pp. 44–45.
Hall K., Broadhurst M., Butcher P. and Brand C. (2010). Caught a tagged bass? NSW Fishing Monthly, August 2010, p. 65.
Hall K., Broadhurst M., Butcher P., Brand C. and McGrath S. (2008). Golden perch survival in winter. NSW Fishing Monthly, September 2008, pp. 56–57.
Hall K., Broadhurst M., Butcher P., Brand C. and McGrath S. (2008). Survival of freshwater fish after catch and release angling. Freshwater Fishing Australia 90, pp. 59–61.
Hall K.C., Broadhurst M.K. and Butcher P.A. (2012). Post-release mortality of angled golden perch *Macquaria ambigua* and Murray cod *Maccullochella peelii peelii*. Fisheries Management and Ecology 19: 10–21.
Hall K.C., Broadhurst M.K. and Butcher P.A. (2013). Clinical signs of barotrauma in golden perch, *Macquaria ambigua* (Richardson), and associated effects on post-release mortality and health. Journal of Fish Diseases, in press.
Wilde G.R. and Sawynok W. (2009). Effect of hook removal on recapture rates of 27 species of angler-caught fish in Australia. Transactions of the American Fisheries Society 138: 692–697.

Murray Cod *Maccullochella peelii*



Similar species
Clarence River Cod *Maccullochella ikei*
Trout Cod *Maccullochella macquariensis*

Recreational catch data
94 tonnes of Murray Cod retained in NSW, and more than 78% released of the total number caught throughout Australia. Estimates are for 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
80–85% over four days, after two delayed-release events in NSW; and 98% over five days, after one immediate-release event in Victoria.

Main factor that reduced survival
Restraint with bare hands.

Other research result

- Survival was improved by holding fish in aerated recovery tanks for 30 to 60 minutes after tournament weigh-in.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Release fish immediately in water without air exposure or handling if possible.
- If fish are brought onboard, keep them horizontal at all times with full body support, ideally in a smooth-sided sling or cradle.
- Securely restrain fish with jaw grips, a wet towel or gloved hands, and use long-nose pliers to aid hook removal.
- To prevent spinal damage, do not hold fish vertically from their jaws, gills or eyes.
- If fish are transported onboard, use an adequately sized live well with flow-through water and aeration.
- Revive any fish with locked, flared gill covers in an aerated recovery tank, live well or over the side of the boat, ideally in a sling or cradle. Hold fish upright, close the gill covers with your hand and gently 'swim' fish in a side-to-side motion.

Further reading

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Gould A. and Grace B.S. (2009). Injuries to barramundi *Lates calcarifer* resulting from lip-gripping devices in the laboratory. North American Journal of Fisheries Management 29: 1418–1424.

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Hall K.C., Broadhurst M.K. and Butcher P.A. (2012). Post-release mortality of angled golden perch *Macquaria ambigua* and Murray cod *Maccullochella peelii peelii*. Fisheries Management and Ecology 19: 10–21.

Silver Perch *Bidyanus bidyanus*

Similar species
Golden Perch *Macquaria ambigua*
Macquarie Perch *Macquaria australasica*

Recreational catch data
47 tonnes retained in NSW, and more than 75% released of the total number caught throughout Australia. Estimates are for Silver Perch combined with various freshwater perches and cods, including Australian Bass, Estuary Perch, Macquarie Perch and Trout Cod, for 12 months in 2000–01.

Suitability for catch and release
Good.

Survival
Less than 30% for deep-hooked fish caught with natural baits and hooks removed, and 100% for mouth-hooked fish monitored for 36 hours. Data are based on two regulated aquaria experiments with aquaculture fish in NSW.

Main factors that reduced survival
Deep hooking and removal.

Other research results

- Cutting the line improved the survival of deep-hooked fish from less than 30% to more than 82%.
- Increased air exposure from one minute to three or five minutes reduced survival from 100% to 92% and 97% after seven days.
- No deep-hooked fish shed their hooks after 36 hours.
- Deep hooking was less frequent with circle (20%) than J-hooks (48%).
- A long-term tagging study in Queensland showed no detrimental effects of cutting the line on deep-hooked fish.

Best practices for catch and release

- Remove mouth hooks, and cut the line for deep-hooked fish.
- Use lures or actively fish circle hooks with natural baits to promote mouth hooking.
- Release fish immediately in water to minimise air exposure.

Further reading

Van der Walt B., Faragher R.A. and Lowry M.B. (2005). Hooking mortality of released silver perch (*Bidyanus bidyanus*) after capture by hook-and-line fishing in New South Wales, Australia. Asian Fisheries Science 18: 205–216.

Wilde G.R. and Sawynok W. (2009). Effect of hook removal on recapture rates of 27 species of angler-caught fish in Australia. Transactions of the American Fisheries Society 138: 692–697.

Blue Swimmer Crab *Portunus pelagicus*

Similar species
Sand Crab *Ovalipes australiensis*

Recreational catch data
150–310 tonnes of Blue Swimmer Crab retained in NSW, and more than 41% released of the total number caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
99% over three days, after one experiment using four common traps deployed for three soak times in NSW.

Main factors that caused harm
Limb loss during removal from traps, rough handling to soft-shelled crabs and bleeding wounds.

Other research results

- Collapsible-netted round traps caught more crabs that were legal and undersize and bycatch, than hoop nets and rigid-wire and collapsible-netted rectangular traps.
- Only 5% of crabs were damaged during capture and handling.
- Crabs were easier to remove from wire and netted traps than from hoop nets.
- Hoop nets were often damaged if left for more than three hours, and especially for 24 hours.
- Crabs with bleeding wounds were more stressed than those that were either not wounded, or had sealed wounds after deliberately dropping their limbs.
- Hoop nets were easily damaged and lost meshes, causing marine pollution.

Best practices for catch and release

- Set hoop nets for less than three hours to limit damage to crabs.
- Use large netted (75 mm or larger) or wire (50 x 50 mm) mesh in traps to minimise bycatch.
- Be patient and carefully remove crabs, especially those that have limbs entangled or are soft shelled.
- Do not put any pressure (e.g. with your foot) on the shell of soft crabs because they can be easily damaged.

Further reading

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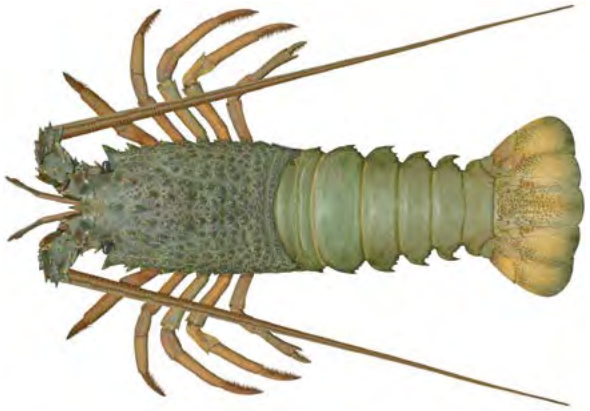
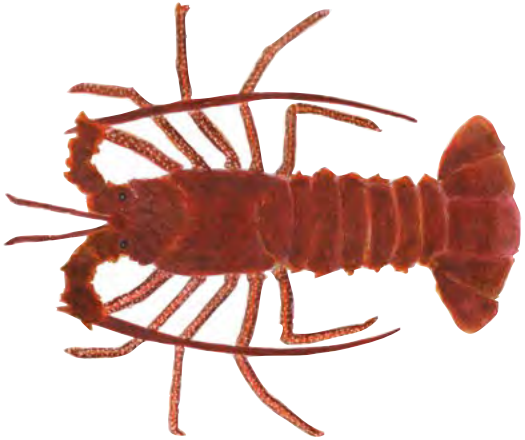
Eastern Rocklobster *Sagmariasus verreauxi*



Southern Rocklobster *Jasus edwardsii*



Similar species
Tropical Rocklobsters *Panulirus* spp.

Recreational catch data
Less than 30 tonnes of Eastern Rocklobster retained in NSW, and more than 49% released of the total number of all marine lobsters caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
Eastern Rocklobster: 97% survival in traps and 100% post-release survival of trapped and hand-collected individuals over 90 days after one experiment in NSW.

Main factors that caused harm
Predation by octopus in traps and limb loss during hand collection while diving for both species.

Other research results

- Damage occurred to approximately 50% of hand-collected Eastern Rocklobster, but only a few trapped individuals.
- Most Eastern Rocklobster regenerated any missing appendages during their next moult, but were smaller and lighter than undamaged individuals.
- All Eastern Rocklobster were stressed immediately after capture, but most recovered after one day.
- Many hand-collected Eastern and Southern Rocklobsters were soft shelled, and more susceptible to being damaged than those with hard bodies.
- Hand-collected Southern Rocklobster lost more limbs than those that were snared with a steel hand-held tube with a loop of wire in New Zealand.
- Octopus preyed on Eastern and Southern Rocklobster during trapping.
- In South Australia, compared to conventional one-chambered traps, those with two chambers reduced the octopus predation of Southern Rocklobster by up to 48%.
- Mandatory escape gaps of 58 x 280 mm in commercial traps reduced catches of undersized Southern Rocklobster and fish bycatch by more than 60% and 50%, respectively.

Best practices for catch and release

- Avoid handling undersized individuals.
- Handle soft-shelled lobsters carefully by the body because they can be easily damaged.
- Use escape gaps or large mesh sizes, of 50 x 75 mm, in traps to minimise the capture of undersized lobsters or fish.
- Set traps no longer than overnight and release hand-collected individuals at their capture location to reduce predation.

Further reading

Brock D.J., Saunders T.M., Ward T.M. and Linnane A.J. (2006). Effectiveness of a two-chambered trap in reducing within-trap predation by octopus on southern spiny rock lobster. Fisheries Research 77: 348–355.

Harrington J.J., Semmens J.M., Gardner C. and Frusher S.D. (2006). Predation of trap-caught southern rock lobsters, *Jasus edwardsii* (Hutton, 1875), in Tasmanian waters by the Maori octopus, *Octopus maorum* (Hutton, 1880): spatial and temporal trends. Fisheries Research 77: 10–16.

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Giant Mud Crab *Scylla serrata*

Similar species
None in NSW.

Recreational catch data
30–60 tonnes of mud crab retained in NSW, and more than 68% released of the total number of all mud crabs caught throughout Australia over 12 months in 2000–01.

Suitability for catch and release
Excellent.

Survival
100% over three days, after one experiment using four common gears deployed for three soak times in NSW.

Main factors that caused harm
Limb loss caused by netted traps, and hoop nets.

Other research results

- Collapsible netted round traps caught more crabs than hoop nets and rigid-wire and collapsible-netted rectangular traps.
- All trapped crabs lost limbs, but this occurred more frequently in hoop nets and collapsible-netted rectangular traps.
- Crabs lost more limbs when they were forcibly, rather than gently, removed, especially those that were tangled in hoop nets and netted traps.
- Collapsible-netted round traps caught more fish and undersize crabs than hoop nets, rigid-wire or collapsible-netted rectangular traps.
- Hoop nets were often damaged if left unchecked for more than three hours and many were totally unusable after 24 hours.
- Hoop nets were easily damaged and lost meshes, causing marine pollution.

Best practices for catch and release

- Set hoop nets for less than three hours to minimise their pollution and also damage to crabs.
- Use large netted (75 mm or larger) or wire (50 x 75 mm) mesh and escape gaps in traps to minimise catch of undersized crabs and bycatch.
- Be patient and carefully remove crabs, especially those that have entangled limbs or are soft shelled.
- Untangle crabs from hoop nets or shake them out of traps from a low height. Hold the trap near the ground or over water if crabs are undersize to minimise damage.
- Release unwanted crabs immediately after capture to reduce stress.

Further reading

Butcher P.A., Leland J.C., Broadhurst M.K., Paterson B.D. and Mayer D.G. (2012). Giant mud crab (*Scylla serrata*): relative efficiencies of common bait traps and impacts to discards. ICES Journal of Marine Science, 69: 1511–1522.

Leland J., Butcher P. and Broadhurst M. (2011). Patience makes a difference. Go Fishing 32, pp. 75–78.

Poole S., Mayze J., Exley P. and Paulo C. (2008). Maximising revenue within the NT mud crab fishery by enhancing post-harvest survival of mud crabs. FRDC Final Report (Project No. 2003/240). Queensland Department of Primary Industries and Fisheries, Hamilton, Queensland, Australia.

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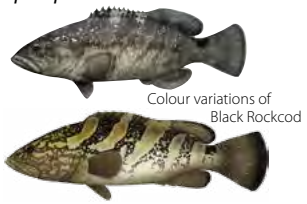
THREATENED OR PROTECTED SPECIES

All threatened and protected species must be released immediately. Because of their low abundances, few have been studied for the effects of catch and release on their survival, but it is imperative that you do your utmost to release them in good health by following the best practice methods.

Saltwater fish

Ballina Angelfish
Chaetodontoplus ballinae

Black Rockcod
Epinephelus daemelii

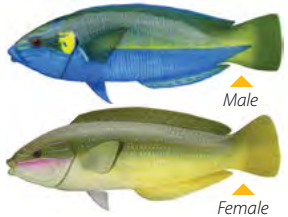


Blue Drummer
Girella cyanea

Also refer to Luderick (p. 29).

Eastern Blue Devil
Paraplesiops bleekeri

Elegant Wrasse
Anampses elegans



Queensland Groper
Epinephelus lanceolatus

Goldspotted Rockcod (Estuary Cod)
Epinephelus coioides

Great Hammerhead
Sphyrna mokarran

Green Sawfish
Pristis zijsron

Greynurse Shark

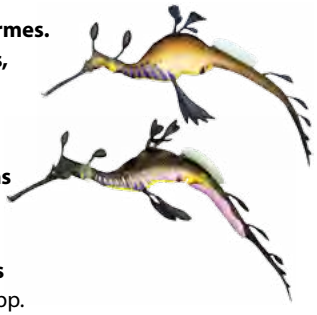
Sandtiger Shark (Herbst's Nurse Shark)
Odontaspis ferox

Scalloped Hammerhead
Sphyrna lewini

Saltwater fish—with photos of the species listed

Southern Bluefin Tuna
Thunnus maccoyii

Syngnathiformes. All seahorses, pipefish, pipehorses, seadragons and seamoths



White Shark
Carcharodon carcharias

Wobbegongs
Orectolobus spp.

Freshwater species

Australian Grayling
Prototroctes maraena

Clarence River Cod
Maccullochell ikei

Freshwater Catfish
Tandanus tandanus

Also refer to p. 45. Protected in all western rivers and some dams.

Macquarie Perch
Macquaria australasica

Also refer to Golden Perch (pp. 46–47) and Australian Bass (pp. 42–43).

Murray Crayfish
Euastacus armatus

Limited recreational fishing allowed during open season: 1 June to 31 August.

River Blackfish
Gadopsis marmoratus

Several small native freshwater fish are also listed as threatened in NSW, but you are unlikely to encounter them during normal fishing, except when targeting bait. These threatened species include: **Oxylean Pygmy Perch** *Nannoperca oxleyana,* **Murray Hardyhead** *Craterocephalus fluviatilis,* **Southern Pygmy Perch** *Nannoperca australis,* **Olive Perchlet** *Ambassis agassizii* and **Purple Spotted Gudgeon** *Mogurnda adspers.*

Silver Perch
Bidyanus bidyanus

Also refer to pp. 50–51. Protected in all rivers.

Trout Cod
Maccullochella macquariensis

Also refer to Murray Cod (pp. 48–49).

ACKNOWLEDGEMENTS

The authors would like to acknowledge funding and support from the NSW Recreational Fishing Trusts and NSW DPI; ethics approval from the NSW DPI Animal Care and Ethics Committee (REF 03/12 and 05/02); and the invaluable contribution of many anglers, tournament organisers, postgraduate students and other researchers, including Anne Leak, Bev Orchard, Brett Louden, Brian Cullis, Brian Paterson, Bryan Van der Walt, Charles Gray, Charles Misfud, Chris Dowling, Craig Brand, Cristiana Damiano, Damien Young, Darren Reynolds, David Barker, David Meyer, Dennis Reid, Jesse Leland, Justin Roach, Lachlan Roberts, Leo Cameron, Les Rava, Margret Rolfe, Mark Porter, Megan Ellis, Michael Wooden, Nick Otway, Owen McTavish, Robert Nicoll, Russell Millar, Shane McGrath, Shane Raidal, Steve Kennelly, Steven Cooke, Stuart Cairns, Stuart Rowland, and Trevor Baillie.

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