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Hooking Mortality of Released Silver Perch (*Bidyanus bidyanus*) after Capture by Hook-and-Line Fishing in New South Wales, Australia

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Abstract

Silver perch (*Bidyanus bidyanus* Terapontidae) is a protected species in NSW, and must be released if captured in rivers. However, silver perch are stocked in impoundments in NSW, and a size and bag limit applies. Assessing the suitability of these limits as management tools is dependent on estimates of hook related mortality. The aims of this study were to determine short-term and delayed mortality of fish following catch and release fishing. The experimental design incorporated a comparison of gear types (circle hooks, J-hooks and artificial lures), exposure times in air and hooking location. Experimental fish were caught by hook and line and control fish by net. Hooking location was the principal factor determining hooking mortality. Fish that were shallow hooked had low or zero hooking mortality but fish that were deep hooked experienced high mortality. Cutting the line near the mouth of deep-hooked fish, rather than removing the hook, decreased the hooking mortality of these fish. Use of circle hooks decreased the frequency of deep hooking compared to J-hooks with no difference in the hooking success of fish by circle hooks. Lures resulted in a near zero hooking mortality. Mortality associated with exposure to air for periods of up to 5 min was low with no significant difference between the different treatments. The results suggest that management strategies for this species should focus on encouraging the use of circle hooks and cutting the line for deep-hooked fish.

Introduction

Freshwater fishing licence sales in New South Wales (NSW) indicate that an estimated 205,000 participants (based on 1998/99 sales) fish in impoundments and inland rivers which support substantial recreational fisheries for native fish and trout species. Minimum legal lengths, bag limits, closed seasons and protected species status are current management strategies used in NSW to protect and enhance freshwater fish stocks. However, if large percentages of released fish die, alternative strategies should be adopted to limit total mortality. Catch and release fishing has continued to gain popularity and acceptance in recreational fishing, particularly in NSW freshwater habitats. In recent times many fishing tournaments have voluntarily introduced catch and release regulations, where historically the majority of the catch was retained.

The ability of freshwater fish to survive hooking, handling and release can depend on a variety of factors, including hooking location (Muoneke 1992), hooking duration (Gustaveson et al. 1991), fish size (Meals and Miranda 1994), water quality (Hartley and Moring, 1993) and water temperature (Plumb et al. 1988; Malchoff et al. 2002). Other factors include geographical area, handling methods and fishing tackle used (Muoneke and Childress 1994). More specifically, factors like fight time during capture (Parker et al. 1959), prolonged exposure to air following landing (Muoneke and Childress 1994), physical damage due to hooking and handling (Vincent-Lang et al. 1993) and penetration of vital organs by ingested hooks (Warner and Johnson 1978) have been shown to result in significant immediate and short-term mortalities. This makes the management of particular species and water bodies difficult using broad management regulations (Muoneke and Childress 1994) and the effectiveness of current management restrictions need to be assessed for individual species in particular habitats. Furthermore, fish mortalities arising from hooking may also be addressed by subtle modifications to existing gears, often involving modified hook designs and handling practices.

Silver perch (*Bidyanus bidyanus* Terapontidae) is a valued freshwater recreational species in stocked impoundments in NSW. These fish are usually caught by hook and line using bait or artificial lures. Silver perch populations in NSW rivers have declined since the 1940s, largely as a result of barriers impeding fish passage (impacting on spawning and recruitment) and habitat degradation (Merrick 1996; Harris and Gehrke 1997). To allow recovery of these populations, silver perch have been declared a protected species in NSW under the *Fisheries Management Act 1994*. To this end, catch-and-release is mandatory in rivers and it is illegal to harm silver perch and/or their habitat. Approximately half a million silver perch fry are stocked annually into NSW impoundments to enhance recreational fishing. On these waterways, a size limit of 25 cm and a bag limit of five legal-sized fish per angler per day apply. These regulations, combined with the facts that undersize fish occur in similar habitats as legally-sized fish and existing fishing methods do not select for legally-sized fish, result in large numbers of this and other native freshwater fish species such as golden perch *Macquaria ambigua*, Australian bass *Macquaria novemaculeata*, trout cod *Maccullochella macquariensis* and Murray cod *Maccullochella peelii peelii* being released following capture every year. To achieve the objectives associated with the recovery of silver perch populations, a high proportion of undersized fish that are caught and subsequently released should survive. Studies on hooking mortality of saltwater species (Diggles and Ernst 1997; Broadhurst and Barker 2000) and rainbow trout *Oncorhynchus mykiss* (Pankhurst and Dedual 1994; Dedual 1996) and mortality relating to commercial hauling gear (Broadhurst et al. 1997; 1999) have been done in Australasia. However, no studies are available on the fate of released recreationally-caught silver perch, other terapontids or other native inland fish in Australia.

The aims of this study were to determine short-term (3 h) and delayed (36 h) hooking mortality of silver perch following catch and release fishing. Different gear types (circle vs conventional J-hooks vs artificial lures) and release methods were used and compared. Differences in hooking location, effectiveness of gear type and the effects of different exposure times to air were also investigated for silver perch.

Materials and Methods

Approximately 9,000 silver perch were reared in an aquaculture pond (roughly 4,000 m^2) at the Grafton Aquaculture Centre, north-eastern NSW. The fish had a mean length of 24.6 cm (± 4.9 SE) at the time of the study. From 20-22 November 2001 silver perch were captured by rod and reel by three researchers with different degrees of fishing expertise and simulating typical angling practices. Normal recreational angling gear was used which included nylon monofilament main line of 3 kg. Generally, fish were landed as quickly as possible. None of the anglers used gloves or rags during removal of hooks.

Experiment 1: *Capture treatment*

Three gear types and sizes were tested. These were a conventional J-hook, (Mustad, size four, Red Baitholder 92668NPNR), which are commonly used by recreational anglers and a circle hook (VMC, size one 7381BN). The size of the hooks chosen was based on the average size of silver perch in the pond. These hooks were fished using frozen peeled prawn bait. Cast-and-retrieve techniques were also used to fish artificial lures (including celta-type and diving bug and baitfish imitations) with one hook and treble hooks (size four). Fish were landed as quickly as possible onto the bank of the pond with the aid of a 'knotless' landing net. Fish that were hooked in the jaw and mouth were classified as superficially hooked and fish hooked in the pharynx, oesophagus and gills or gill arch were classified as deep hooked. Fish were separated according to deep or superficial hooking and hook type and placed in floating cages in the pond, which were randomly assigned to hook type and hook location. The cages consisted of a square steel frame (1.5 m x 1.5 m x 2 m deep) with plastic one centimetre mesh. All cages had removable lids. Hooks were removed using bent nose pliers commercially designed for dehooking. Fish caught using J-hooks that were deep hooked were split randomly into two groups and placed in separate cages. In one group, the hook was removed and in the other, the hook was left in place and the line cut as close as possible to the mouth of the fish. This procedure was used to test the hypothesis that cutting the line on a critically hooked fish improved its chances of survival. This provided seven hooking treatments. A minimum number of 28 fish were caught for each capture method (i.e. J-hook, circle hook and lure). Anglers switched hook types to reduce bias caused by differential fishing technique.

Short-term mortality for the capture experiment was assessed after 3 h and delayed mortality after 36 h. After a 36 h holding period, the cages were raised and all surviving fish were counted, measured, observed for any skin infections and then released. Fish that were deep hooked using J-hooks and released by cutting the line were inspected after 36 h for mortalities and kept in the cages for a further 6 d and fed daily with commercial pellets. After 6 d, the cage was lifted and all fish measured. Fish that swallowed the hook were subjected to an autopsy to determine location and passage of the hook. All three anglers recorded details of each cast including type of fishing tackle used, hooking location if a fish was caught and whether a fish was successfully hooked or missed.

Experiment 2: *Handling treatment*

Circle hooks (VMC, size 1, 7381BN) were used in this second experiment to minimise other potential mortality effects (such as deep hooking and increased exposure times) arising from hooking capture. Silver perch were caught using the methods described in the capture experiment. Only superficially hooked fish were used in the experiment. Fish were randomly assigned a time period of either 1, 3 or 5 min which was recorded as the moment fish were removed from the water until it was returned to the water in the cage. Anglers alternated randomly between time periods to reduce bias caused by different fishing techniques. After each capture, the hook was carefully removed and the fish were left on the bank for the allocated time period. Once the time period was complete, the fish were transferred to a floating cage. One separate floating cage was assigned to each time period. Fish were monitored for a period of seven days and all cages were checked daily for mortalities to determine short term (3 h) and delayed (7d) mortalities arising from hooking and handling practices and infections. Fish in all the cages were fed daily with commercial pellets. After 7 d, the cages were raised and all surviving fish were counted and measured.

A group of control fish for Experiment 1 and 2 were not subjected to angling capture and were carefully netted from the pond and transferred to a holding cage. All control fish appeared in excellent condition and were held for the duration of both experimental treatments.

Data analysis

Experiment 1: *Capture treatments*

Short term and delayed mortalities for each treatment were expressed as percentages of the total catch. Relationships between capture treatment, fish size and total mortality were analysed using one way ANOVA. The post-hoc Tukeys (HSD) test was used to discriminate among means.

Experiment 2: *Handling treatment*

A chi-squared test was used to determine if mortality rates were significantly different between handling treatments in Experiment 2 (see Table 1).

Hook-up rates *(Experiment 1 and 2)*

Hook-up rates (fish caught versus fish missed) for all 3 anglers were calculated and the mean percentage of hook-ups for J- and circle hooks determined. Similarly, hooking location for each angler using the different hook types was expressed as a mean percentage of the total fish captured. A Students t-test using square transformed individual percentages of hook-ups and hooking location was used to determine any significant differences in hook-up and hooking location frequencies.

Results

Fish

A total of 271 silver perch were caught by hook and line and 30 fish were netted for the control component. The size of silver perch caught averaged 248.5 (±

1.26 SE) mm and ranged from 164 mm to 321 mm fork length (Table 1). There was a significant difference in the mean lengths of experimental silver perch caught using J-hooks, circle hooks and artificial lures and control netted fish ($F = 5.9$, $P < 0.05$) (Table 1). A post-hoc comparison using Tukey's HSD ($P < 0.05$) indicated that silver perch caught using artificial lures were significantly larger than the control fish and fish caught using J- and circle hooks.

Table 1: Number and fork length of silver perch caught for each of the capture and hook type treatments in November 2001 at the Grafton Aquaculture Centre, NSW.

Experiment No.	Treatment		Number caught	Mean fork length (mm) (SE)
	Hook type	Details		
Experiment 1:				
Capture	Circle hook	Superficial	29	249 (2.5)
Capture	Circle hook	Deep	30	256 (2)
Capture	J-hook	Superficial	37	243 (4.5)
Capture	J-hook	Deep	31	248 (3.4)
Capture	J-hook	Deep (line cut)	28	244 (4.2)
Capture	Artificial lure	Superficial	29	269 (3)
Capture	Artificial lure	Deep	1	288 (-)
Experiment 2:				
Handling	Circle hook	1 min air exposure	31	246 (3.6)
Handling	Circle hook	3 min air exposure	25	242 (4.4)
Handling	Circle hook	5 air min exposure	30	241 (3.5)
Control	Net	-	30	246 (4.9)

***Experiment 1**: Capture treatments*

Total silver perch mortalities were significantly different between capture treatments and the control (Tukey (HSD) $p < 0.05$). Deep hooked capture treatments had significantly higher total mortality than any of the mouth hooked treatments, however mortalities recorded from the J-hooked deep treatment with the line cut were significantly less than either of the other deep hooked treatments (Tukey (HSD) $p < 0.05$).

More detailed examination of short term and delayed mortalities (Figure 1) indicated that percent mortality was high for deep hooked fish caught with circle and J-hooks (> 70%) with most fish dying within three hours of capture. However, silver perch that were deep hooked and released by cutting the line had an initial low short-term mortality of 10.7% and a delayed mortality of 17.9%. Of the 24 fish that had swallowed the hook, autopsies showed that none had shed the hook, 12 had the hook embedded in the oesophagus, none had the hook lodged in the gill arches, nine had the hook in the stomach and three had the hook embedded in the buccal cavity.

None of the released fish died immediately and even badly wounded, bleeding fish swam to the bottom of the cage. One fish that had a deep-hooked J-hook removed was moribund and had a damaged, infected lower jaw. All survivors appeared robust, and otherwise physically unharmed by the angling, handling and caging to which they were exposed.

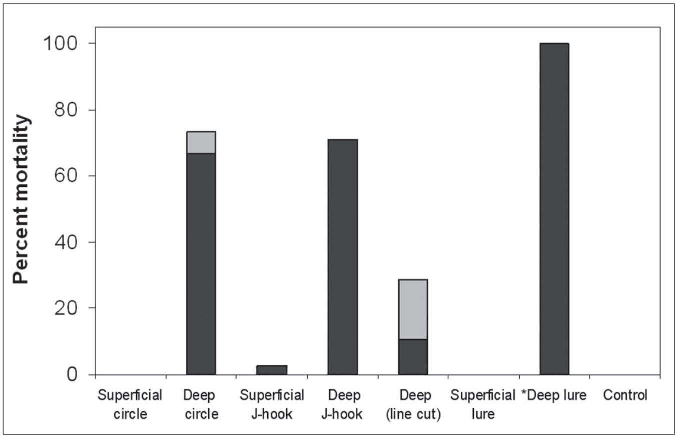

Fig. 1: Short-term (black) and delayed mortalities (grey) for silver perch caught in November 2001 at the Grafton Aquaculture Centre, NSW. *Note: The Deep lure treatment had a sample size of 1 fish only.

Experiment 2: *Handling treatment*

Short-term mortality associated with exposure to air for superficially hooked fish using circle hooks was zero for all treatments but the 3 min and 5 min treatments had delayed mortalities (7 days) of 8.0 and 3.3%, respectively (Fig. 2). There was no significant difference in mortality between the different treatments ($P < 0.05$). None of these fish had infections resulting from the treatment. No control (i.e. netted) fish died during the study.

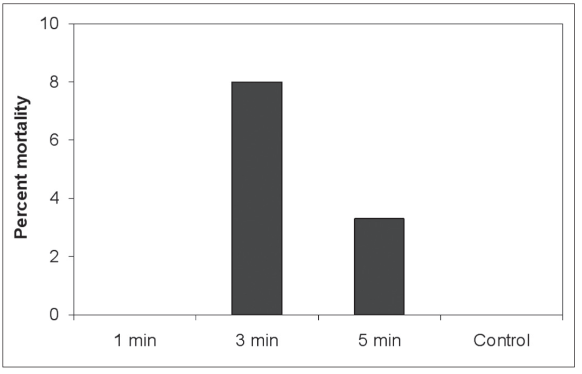

Fig. 2: Delayed (i.e. 7 d) mortalities of silver perch caught in November 2001 at the Grafton Aquaculture Centre, NSW after being exposed to air for stated periods.

Hooking efficiency and hooking location frequency

The mean hooking rates for all three anglers in Experiment 1 and 2 using J-hooks was 67.6% compared to 55.8% using circle hooks (Table 2). There was no significant difference in the hooking efficiency of the two hook types (t = 1.29, $P < 0.05$). However, the mean percentage of deep-hooked fish using J-hooks was significantly higher than deep-hooked fish using circle hooks (t = 4.89, $P < 0.05$).

Table 2: Mean hooking location and hook-up rates (fish caught versus fish missed) for all casts from three anglers in November 2001 at the Grafton Aquaculture Centre, NSW.

Hook type	Number of fish caught	Mean percentage of deep hooked fish (SE)	Mean percentage of hook-ups (SE)
J-hooks	96	47.6 (0.1)	67.6 (0.12)
circle hooks	145	20.4 (0.09)	55.8 (0.03)

Discussion

This study has shown that hooking location appears to be the principal determining factor for hooking mortality in silver perch in this study. Similar findings were made by Cooke et al. (2003a) for largemouth bass *Micropterus salmoides*, by Vincent-Lang et al. (1993) for coho salmon *Oncorhynchus kisutch* and Nuhfer and Alexander (1992) for brown trout *Salmo trutta*. The low or zero hooking mortalities for shallow hooked silver perch using J- and circle hooks that were caught and released suggests a high survival rate for these fish after capture. However, mortality rates of deep hooked fish using both hook types were high (>70 %). Similar findings have been observed by Taylor and White (1992), Diodati and Richards (1996) and Schisler and Bergersen (1996). Although most hooking mortality occurred within the first three hours, the measure of short term and delayed mortality provides a more complete estimate of mortality.

Over 47% of silver perch caught in this study were deep-hooked using J-hooks. Using a mortality rate of 71% for deep-hooked fish measured in this study, over 35% of fish caught using J-hooks would be expected to die after being released. Acceptable hooking mortality rates vary among fisheries but mortalities above 20% are generally considered "high" and deserving of management attention (Muoneke and Childress 1994). The majority of fish caught in this study using J- and circle hooks were under the minimum legal length of 25 cm. Therefore this mortality estimate would be directly applicable to undersize fish caught and released in impoundments and fish caught in rivers, all of which are required to be released. The results of the study indicate that this management restriction is effective for shallow hooked fish that are released. However, over 70% of deeply hooked fish, irrespective of whether J- or circle hooks are used, died after release.

J-hooks and similar varieties have been traditionally used by recreational freshwater anglers in Australia and are the most common hook type available (D. Joyner, Australian Fishing Tackle Association, personal communication). A national recreational fishing survey in Australia indicated that the release rate for the total harvest of fresh and saltwater angling fish was more than 40% (Henry and Lyle 2003). Silver perch are a schooling fish and are often caught in large numbers when moving upstream to spawn and in summer, often congregating in large numbers below rapids, barrages and weirs. Immature fish have also been observed to move upstream after small rises in river level (Merrick 1996). Large silver perch can also be caught incidentally using lures aimed at larger fish.

A lower percentage of fish (20.4%) were deep hooked when circle hooks were used, thereby decreasing the mortality of released fish. This decrease in deep-hooking incidence has also been observed for chinook salmon *Oncorhynchus tshawytscha* (Grover et al. 2002), rock bass *Ambloplites rupestris* (Cooke et al. 2003b), striped bass *Morone saxatilis* (Lukacovic and Uphoff, 2002) and in pelagic fisheries (Skomal et al. 1999). There was also no significant difference in the hooking efficiency of circle hooks compared with J-hooks in this study. However, a meta-analysis of the literature (Cooke and Suski 2004) found that circle hooks were considered to have a lower capture efficiency than J- style hooks but there was a large variation between species. In some cases, there was no difference in mortality between hook types (Malchoff et al. 2002; Cooke et al. 2003a). Therefore, the results of the present study are not universal and appear to only pertain to silver perch. To gain acceptance by anglers, Cooke and Suski (2004) suggest that recommended hook performance should match conventional hooks.

When the line was cut near the mouth of deep-hooked fish using J-hooks, hooking mortality was significantly reduced in this and other studies (Mason and Hunt 1967; Warner and Johnson 1978; Schisler and Bergersen 1996). Autopsies of these fish supported the hypothesis that when a fish is critically hooked and the hook is not removed, the fish is likely to shed the hook on its own. Similar treatment of shallow-water reef fish indicated that deeply hooked fish regurgitated the hook within 48 h (Diggles and Ernst 1997) while Mason and Hunt (1967) found that nearly 60 % of rainbow trout that had the line cut, shed their hooks within four weeks.

Lurefishing with treble hooks resulted in a near zero hooking mortality, as found in other studies (Clapp and Clark 1989; Diggles and Ernst 1997). This is attributable to a low incidence of critical hooking as the hooking injuries associated with this fishing method were mostly superficial. Only one lure-caught fish was deep hooked and subsequently died. Lure-caught fish were significantly larger than bait-caught fish and therefore it appears that lure fishing may have been selective for larger fish only. Natural baits are often swallowed more deeply than artificial lures resulting in higher mortalities (Muoneke and Childress 1994). However, Warner (1979) found similar mortality rates for Atlantic salmon *Salmo salar* caught with flies, lures and baits, which emphasises the need for species-specific studies.

The ability of silver perch to survive long periods out of the water (up to five minutes) with low mortality confirms the robust and hardy nature of the species. Similarly, hooking mortality of lake trout kept out of the water for up to nine minutes was unrelated with the degree of handling (Loftus et al. 1988). Silver perch can therefore be expected to survive the procedure of an angler unhooking a fish (providing the fish is not deep hooked) and its' subsequent release, assuming short playing times and appropriate handling methods are used.

Because of the high frequency of deep hooking using J-hooks and the associated high hooking mortality, management strategies for silver perch in NSW should focus on fishing practices of anglers. Cutting the line for the release of deep-hooked fish and the use of circle hooks, which are more effective in ensuring lower incidence of deep-hooking should be encouraged. This is particularly important for competitive fishing in NSW, which has developed a catch and release ethic as opposed to retaining angler catches. Historically, fishing competitions have been regarded as low impact. However, with an observed increase in competitive sport fishing in the United States (Schramm et al. 1991) and in NSW, mortalities as high as those recorded in this study may be detrimental to fish populations.

It is important to note that this study showed that the use of circle hooks did not significantly affect hooking efficiency. If a significant reduction in mortality could be attributed to the correct handling of fish and slight modifications in tackle, it is anticipated that anglers in Australia could be educated to adopt such methods that enhance survival of released fish. Some regulatory agencies have implemented the mandatory use of circle hooks in some fisheries, but there have been difficulties as there is no clear definition of a circle hook and no industry standard (Cooke and Suski 2004). In their comprehensive review of circle hook studies, Cooke and Suski (2004) emphasise that because of differences in hook size, fishing method, fish feeding mode and mouth morphology between species and fisheries, management agencies should only recommend circle hooks where appropriate scientific data exists. This paper has presented data for silver perch and the recommendations should not be extrapolated to other species or fisheries without further research. Furthermore, many other factors not assessed in this study can affect survival of hooked fish (Muoneke and Childress 1994; Cooke and Suski 2004) and should be examined before any major variation to management methods for the species is made.

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References

Broadhurst, M.K. and D.T. Barker. 2000. Effects of capture by hook and line on plasma cortisol, scale loss and survival in juvenile mulloway, *Argyrosomus hololepidotus*. Archive of Fishery and Marine Research 48:1-10.

Broadhurst, M.K., S.J. Kennelly and D.T. Barker. 1997. Simulated escape of juvenile sand whiting (*Sillago ciliata*, Cuvier) through square-meshes: Effects on scale-loss and survival. Fisheries Research 32:51-60.

Broadhurst, M.K., D.T. Barker and S.J. Kennelly. 1999. Scale-loss and survival of juvenile bream (*Acanthopagrus australis*) after simulated escape from a Nordmore-grid guiding panel and release from capture by hook and line. Bulletin of Marine Science 64:255-268.

Clapp, D.F. and R.D. Clarke Jr. 1989. Hooking mortality of smallmouth bass caught on live minnows and artificial spinners. North American Journal of Fisheries Management 9:81-85.

Cooke, S.J., B.L. Barthel and C.D. Suski. 2003b. Effects of hook type on injury and capture efficiency of rock bass, *Ambloplites rupestris*, angled in southeastern Ontario. Fisheries Management and Ecology 10(4):269-271.

Cooke, S.J., C.D. Suski, M.J. Siepker and K.J. Ostrand. 2003a. Injury rates, hooking efficiency and mortality potential of largemouth bass (*Micropterus salmoides*) captured on circle hooks and octopus hooks. Fisheries Research 61:135-144.

Cooke, S.J. and C.D. Suski. 2004. Are circle hooks effective tools for conserving freshwater and marine recreational catch-and-release fisheries? Aquatic Conservation: Marine and Freshwater Ecosystems 14 (3): 299-326.

Dedual, M. 1996. Observed mortality of rainbow trout caught by different angling techniques in Lake Taupo, New Zealand. North American Journal of Fisheries Management 16:357-363.

Diggles, B.K. and I. Ernst. 1997. Hooking mortality of two species of shallow-water reef fish caught by recreational angling methods. Marine and Freshwater Research 48:479-483.

Diodati, P.J. and R.A. Richards. 1996. Mortality of striped bass hooked and released in saltwater. Transactions of the American Fisheries Society 125:300-307.

Grover, A.M., M.L. Palmer-Zwahlen and M.S. Mohr. 2002. Hook-and-release mortality of Chinook salmon from drift mooching with circle hooks: management implications for California's ocean sport fishery. American Fisheries Society Symposium 30:39-56.

Gustaveson, A.W., R.S. Wydoski and G.A. Wedemeyer. 1991. Physiological response of largemouth bass to angling stress. Transactions of the American Fisheries Society 120:629-636.

Harris, J.H. and P.C. Gehrke (editors). 1997. Fish and rivers in stress. The NSW Rivers Survey. NSW Fisheries Office of Conservation and the Cooperative Research Centre for Freshwater Ecology, Sydney, NSW. 298pp.

Hartley, R.A. and J.R. Moring. 1993. Observations of black bass (Centrarchidae) confined during angling tournaments: a cautionary note concerning dissolved oxygen. Aquaculture and Fisheries Management 24:575-579.

Henry, G.W. and J.M. Lyle (editors). 2003. The National Recreational and Indigenous Survey. FRDC Project No. 99/158, NSW Fisheries Final Report Series No. 48. 188pp.

Loftus, A.J., W.W. Taylor and M. Keller. 1988. An evaluation of lake trout (*Salvelinus namaycush*) hooking mortality in the upper Great Lakes. Canadian Journal of Fisheries and Aquatic

Sciences 45:1473-1479.
Lukacovic, R. and J.H. Uphoff. 2002. Hook location, fish size, and season as factors influencing catch and-release mortality of striped bass caught with bait in Chesapeake Bay. American Fisheries Society Symposium 30:97-100.
Malchoff, M. H., J. Gearhart, J. Lucy and P.J. Sullivan. 2002. The influence of hook type, hook wound location, and other variables associated with post catch-and-release mortality in the U.S. summer flounder recreational fishery. American Fisheries Society Symposium 30:101-105.
Mason, J.W. and R.L. Hunt. 1967. Mortality rates of deeply hooked trout. The Progressive Fish Culturist 29:87-91.
Meals, K.O. and L.E. Miranda. 1994. Size-related mortality of tournament caught-caught largemouth bass. North American Journal of Fisheries Management 14:460-463.
Merrick, J.R. 1996. Family Terapontidae – freshwater grunters or perches. In: Freshwater Fishes of South-Eastern Australia, second edition. (ed. R.M. McDowall), pp. 164-167. Reed, Sydney.
Muoneke, M.I. 1992. Hooking mortality of white crappie, *Pomoxis annularis* Rafinesque and spotted bass, Micropterus punctulatus (Rafinesque), in Texas Reservoirs. Aquaculture in Fisheries Management 23:87-93.
Muoneke, M.I. and W.M. Childress. 1994. Hooking mortality: A review for recreational fisheries. Reviews in Fisheries Science 2:123-156.
Nuhfer, A. J. and G.R. Alexander. 1992. Hooking mortality of trophy-sized wild brook trout caught on artificial lures. North American Journal of Fisheries Management 12:634-644.
Pankhurst, N.W. and M. Dedual. 1994. Effects of capture and recovery on plasma levels of cortisol, lactate and gonadal steroids in a natural population of rainbow trout. Journal of Fish Biology 45:1013-1025.
Parker, R.R., E.C. Black and P.A. Larkin. 1959. Fatigue and mortality in troll-caught pacific salmon (Oncorhynchus). Journal of Fisheries Research Board of Canada 16:429-448.
Plumb, J. A., Grizle, J.M. and W.A. Rogers. 1988. Survival of caught and released largemouth bass after containment in live wells. North American Journal of Fisheries Management 8:325-328.
Schisler, G.J. and E.P. Bergersen. 1996. Postrelease hooking mortality of rainbow trout caught on scented artificial baits. North American Journal of Fisheries Management 16:570-578.
Schramm, H.L. Jr., M.L. Armstrong, N.A. Funicelli, D.M. Green, D.P. Lee, R. E. Manns Jr., B.D. Taubert and S.J. Waters. (1991). The status of competitive sport fishing in North America. Fisheries 16:5-12.
Siewert, H.F. and Cave, J.B. 1990. Survival of released bluegill, *Lepomis macrochirus*, caught on artificial flies, worms, and spinner lures. Journal of Freshwater Ecology 5:407-411.
Taylor, J.T. and K.R. White. 1992. A meta-analysis of hooking mortality in nonanadromous trout. North American Journal of Fisheries Management 12:760-767.
Vincent-Lang, D., M. Alexandersdottir and D. McBride. 1993. Mortality of coho salmon caught and released using sport tackle in the Little Susitna River, Alaska. Fisheries Research 15:339-356.
Warner, K. and P.R. Johnson. 1978. Mortality of landlocked salmon (*Salmo salar*) hooked on flies and worms in a river nursery area. Transactions of American Fisheries Society 107:772-775.
Warner, K. 1979. Mortality of landlocked Atlantic salmon on four types of fishing gear at the hatchery. The Progressive Fish-Culturist 41:99-102.