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Declining catch per unit effort of an estuarine-dependent fish, *Rhabdosargus sarba* (Teleostei: Sparidae), in the marine environment following closure of the St Lucia Estuarine System, South Africa

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Monitoring of catch per unit effort of the tropical stumpnose *Rhabdosargus sarba* in the St Lucia Marine Reserve between 2001 and 2005 revealed a significant decline. A similar decline was evident from shore patrol data collected by Ezemvelo KwaZulu-Natal Wildlife staff in the southern areas of the Greater St Lucia Wetland Park. As the distribution of fishing effort has decreased considerably since the promulgation of a beach vehicle ban in January 2002, this decline in the abundance of stumpnose has not been attributed to overfishing but rather to the closure of the mouth of the St Lucia estuary and lake system. The reason for this is because tropical stumpnose make extensive use of St Lucia as a nursery area and, since the mouth closure in June 2002, there has been no recruitment of juvenile fish into, or adult fish out of, the system. This emphasises the importance of estuarine nursery areas and highlights the need for ongoing catch and effort monitoring.

Keywords: catch monitoring, estuarine dependence, marine-protected area, St Lucia Estuarine System

Introduction

An ongoing fish monitoring and tagging study was initiated in the St Lucia Marine Reserve, north of Cape Vidal, in November 2001. The primary purpose of this study was to evaluate the effectiveness of the no-take sanctuary area between Leven Point and Red Cliffs (Figure 1) in protecting shore-angling fish species. Shortly after the start of this study in June 2002, the mouth of the nearby St Lucia Estuary closed, due to an ongoing drought in northern Zululand (Cyrus and Vivier 2006). The mouth of this large estuarine system has remained closed until the present day (June 2006). This situation has provided an opportunity to monitor the response of the local adult marine population of tropical stumpnose *Rhabdosargus sarba*, an estuarine-dependent fish species that makes extensive use of the St Lucia estuarine system as a nursery area (Wallace and van der Elst 1975). In terms of its estuarine dependence, tropical stumpnose — being a euryhaline marine species of which the juveniles are found mainly in estuaries but also at sea — is classified as Category IIb, according to Whitfield (1998).

Tropical stumpnose is an important component of anglers' catches along the northern coast of KwaZulu-Natal (KZN), and is caught both within estuarine systems and along the shore of the marine environment (van der Elst 1988, Brouwer *et al*. 1997, Mann *et al*. 2002). While the biology and population dynamics of this species in southern Africa have received some attention (Wallace 1975a, 1975b, Wallace and van der Elst 1975, Radebe *et al*. 2002, James *et al*. 2004), the purpose of this short communication is to document trends in the adult population over the period 2002–2005, to determine whether the natural closing of the St Lucia estuary has had an impact on recruitment.

Materials and methods

Marine reserve study

Twenty-five sampling trips, one every two months, were undertaken in the St Lucia Marine Reserve north of Cape Vidal between November 2001 and November 2005. During each field trip, eight anglers fished for four consecutive days in four 2km fishing areas, two sites (SA and SB) inside the no-take sanctuary area north of Leven Point and two sites (EA and EB) in the previously-exploited area south of Leven Point (Figure 1). Each 2km fishing area was subdivided with numbered flags at 100m intervals, using a GPS. All fishing was undertaken from the shore, using standardised rock and surf tackle and bait. Barbless hooks were used and fish were landed onto specially-made vinyl stretchers, to reduce injury and capture stress. All fish caught were identified, measured (mm fork length) and immediately released. Fishing catch per unit effort (CPUE) (fish caught per angler per hour) was carefully recorded by each individual angler and recorded in relation to the closest 100m marker flag. For the purposes of this communication, CPUE data for all tropical stumpnose caught from the four 2km fishing areas were pooled and compared on a per-trip basis.

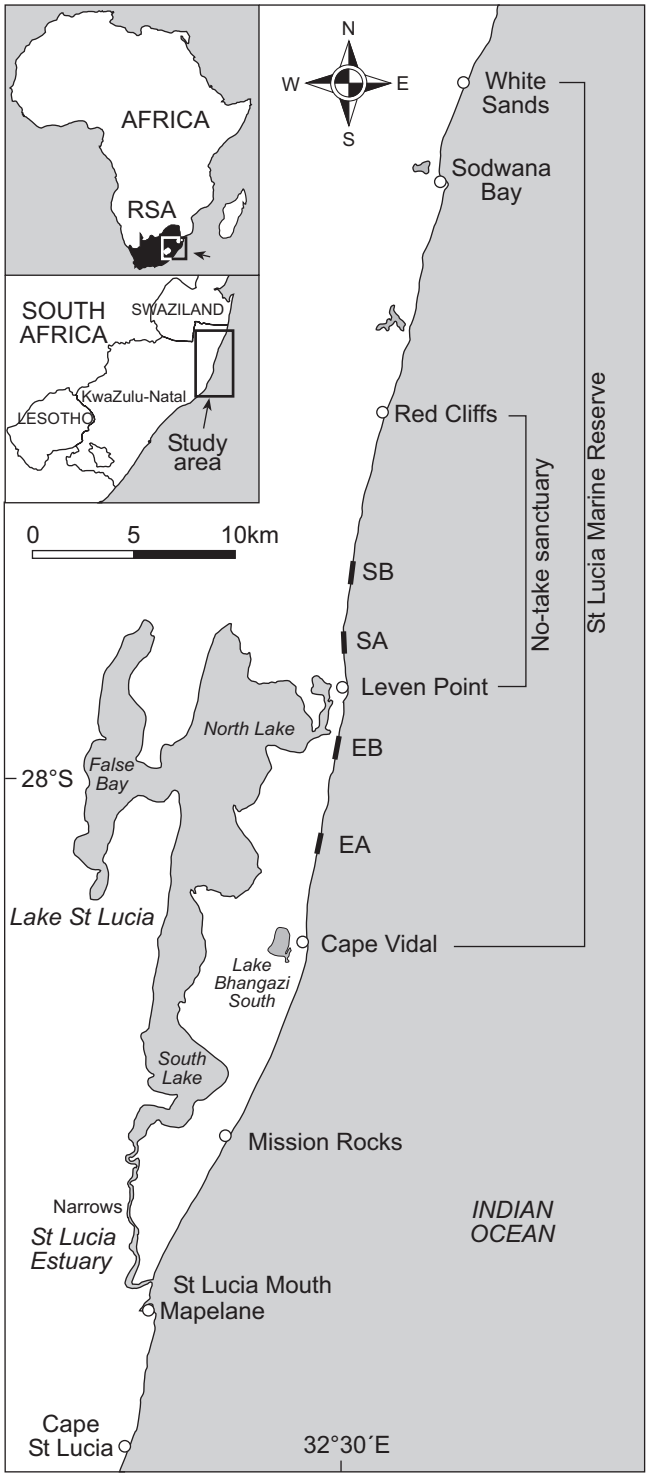

Figure 1: Map of the St Lucia Marine Reserve and the St Lucia estuarine system. The four 2km experimental fishing areas north of Cape Vidal are depicted as EA and EB (in previously exploited area) and SA and SB (in no-take sanctuary area). The EKZNW patrol zones extend from Red Cliffs to Mission Rocks (Cape Vidal zone), Mission Rocks to St Lucia Mouth (St Lucia zone) and St Lucia Mouth to Cape St Lucia (Mapelane zone)

Shore patrol study

In order to ascertain if similar trends were apparent from other data sources, shore patrol data collected by Ezemvelo KwaZulu-Natal Wildlife (EKZNW) and captured onto the National Marine Linefish System (NMLS) were interrogated. Shore patrols are conducted in a similar fashion to roving creel surveys, but are often biased in that they concentrate patrol effort in heavily-fished areas because they double as law enforcement patrols (Brouwer *et al*. 1997). The data from the three marine shore patrol zones adjacent to the St Lucia Estuary mouth, namely St Lucia, Cape Vidal and Mapelane (Figure 1), were used for this analysis. EKZNW shore patrols were initiated in 1985 (van der Elst and Penney 1995) and catch rate data (number of fish caught per angler checked) for tropical stumpnose for the period 1996–2005 were analysed.

Results

The total numbers of fish caught during this project are shown in Table 1, and very few other estuarine-dependent species were captured. Analysis of results from the shore fish monitoring and tagging project conducted in the St Lucia Marine Reserve showed that there was a gradual but significant ($p < 0.05$) decline in the CPUE of tropical stumpnose between November 2001 and November 2005 (Figure 2). This was the only species for which a decline was observed, whereas the CPUE for other important species caught, such as the Large-spotted Pompano, *Trachinotus botla*, and the Speckled Snapper, *Lutjanus rivulatus*, either fluctuated seasonally or even increased (Figure 2).

Analysis of annual length frequency data for tropical stumpnose showed that between 2002 and 2005, larger adult fish (>300mm FL) made up a progressively larger proportion of the catch (Figure 3).

Analysis of NMLS shore patrol data, pooled for the three marine patrol zones adjacent to the St Lucia Estuary, showed that between 2000 and 2005 there appeared to be a similar trend in decreasing abundance of tropical stumpnose caught per angler interviewed (Figure 4). A similar decline in catches of Spotted Grunter *Pomadasys commersonnii*, another important angling species also dependent on estuaries, was also observed between 2001 and 2005.

Discussion

These results suggest that the adult population of tropical stumpnose, which is primarily found in the marine environment (Wallace 1975a), has declined in abundance in northern KZN over the period 2002–2005. In the case of the data from the St Lucia Marine Reserve project (Figure 2), this decline in abundance cannot be ascribed to overfishing because, since the promulgation of the beach driving limitation in January 2002, shore fishing (with the exception of catch-and-release research fishing) of more than ~5km (i.e. walking distance) north of Cape Vidal has ceased. It is therefore possible that the decline is due to the closure of the mouth of St Lucia, thus preventing the recruitment of fry and small juveniles into the estuarine nursery area (Harris and Cyrus 1995, 1996) and the subsequent recruitment of

Table 1: List of all species caught in the St Lucia Marine Reserve shore fish monitoring project between November 2001 and November 2005. Species are shown in phylogenetic order, according to Smith and Heemstra (1986). Species shown with an asterisk are those regarded by Whitfield (1998) as having some dependence (Categories I and IIa and b) on estuarine nursery areas

Family	Species	Common name	No. caught	%
Elopidae	*Elops machnata**	Ladyfish	1	0.02
Albulidae	*Albula vulpes*	Bonefish	128	2.42
Muraenidae	*Echidna nebulosa*	Floral moray	1	0.02
Muraenidae	*Gymnothorax undulatus*	Leopard moray	44	0.83
Muraenidae	*Uropterygius tigrinus*	Tiger reef-eel	2	0.04
Plotosidae	*Plotosus nkunga*	Eel-catfish	7	0.13
Carcharhinidae	*Carcharhinus limbatus*	Blacktip shark	7	0.13
Odontaspididae	*Carcharias taurus*	Spotted ragged-tooth	1	0.02
Rhinobatidae	*Rhinobatos annulatus*	Lesser guitarfish	6	0.11
Rhinobatidae	*Rhinobatos leucospilus*	Greyspot guitarfish	3	0.06
Rhinobatidae	*Rhynchobatus djiddensis*	Giant guitarfish	36	0.68
Dasyatidae	*Himantura gerrardi*	Sharpnose stingray	23	0.44
Dasyatidae	*Himantura uarnak*	Honeycomb stingray	12	0.23
Dasyatidae	*Himantura* sp	Roundnose stingray	4	0.08
Belonidae	*Strongylura leiura*	Yellowfin needlefish	2	0.04
Serranidae	*Epinephelus andersoni*	Catface rockcod	285	5.40
Serranidae	*Epinephelus macrospilos*	Bigspot rockcod	7	0.13
Serranidae	*Epinephelus marginatus*	Yellowbelly rockcod	82	1.55
Serranidae	*Epinephelus malabaricus*	Malabar rockcod	2	0.04
Serranidae	*Epinephelus tukula*	Potato bass	92	1.74
Teraponidae	*Terapon jarbua**	Thornfish	2	0.04
Pomatomidae	*Pomatomus saltatrix*	Elf/shad	94	1.78
Haemulidae	*Plectorhinchus chubbi*	Dusky rubberlip	1	0.02
Haemulidae	*Plectorhinchus flavomaculatus*	Lemonfish	29	0.55
Haemulidae	*Plectorhinchus gibbosus*	Harry hotlips	6	0.11
Haemulidae	*Plectorhinchus playfairi*	Whitebarred rubberlip	18	0.34
Haemulidae	*Plectorhinchus sordidus*	Redlip rubberlip	2	0.04
Haemulidae	*Pomadasys commersonnii**	Spotted grunter	1	0.02
Haemulidae	*Pomadasys furcatum*	Grey grunter	1 031	19.53
Haemulidae	*Pomadasys kaakan*	Javelin grunter	1	0.02
Haemulidae	*Pomadasys multimaculatum*	Cock grunter	4	0.08
Haemulidae	*Pomadasys olivaceum*	Pinky/Olive grunt	2	0.04
Dinopercidae	*Dinoperca petersi*	Cavebass	212	4.02
Lutjanidae	*Lutjanus argentimaculatus*	River snapper	5	0.09
Lutjanidae	*Lutjanus fulviflamma*	Dory snapper	1	0.02
Lutjanidae	*Lutjanus rivulatus*	Speckled snapper	851	16.12
Lutjanidae	*Lutjanus russellii*	Russell's snapper	66	1.25
Sparidae	*Diplodus cervinus hottentotus*	Zebra	19	0.36
Sparidae	*Diplodus sargus capensis*	Blacktail	270	5.11
Sparidae	*Lithognathus mormyrus*	Sand steenbras	5	0.09
Sparidae	*Rhabdosargus sarba**	Tropical stumpnose	324	6.14
Sparidae	*Rhabdosargus thorpei**	Big-eye stumpnose	166	3.14
Coracinidae	*Dichistius multifasciatus*	Banded galjoen	9	0.17
Kyphosidae	*Kyphosus bigibbus*	Grey chub	1	0.02
Scorpididae	*Neoscorpis lithophilus*	Stonebream	72	1.36
Ephippidae	*Tripterodon orbis*	Spadefish	1	0.02
Gerreidae	*Gerres methueni**	Even-fin pursemouth	1	0.02
Drepanidae	*Drepane longimanus*	Concertina fish	2	0.04
Mullidae	*Parupeneus indicus*	Indian goatfish	9	0.17
Sciaenidae	*Argyrosomus japonicus**	Dusky kob	14	0.27
Sciaenidae	*Umbrina robinsoni*	Baardman	5	0.09
Carangidae	*Carangoides armatus*	Longfin kingfish	3	0.06
Carangidae	*Carangoides ferdau*	Blue kingfish	2	0.04
Carangidae	*Carangoides fulvoguttatus*	Yellow-spotted kingfish	3	0.06
Carangidae	*Caranx ignobilis**	Giant kingfish	37	0.70
Carangidae	*Caranx melampygus*	Bluefin kingfish	8	0.15
Carangidae	*Caranx papuensis*	Brassy kingfish	18	0.34
Carangidae	*Caranx sem*	Blacktip kingfish	119	2.25
Carangidae	*Gnathanodon speciosus*	Golden kingfish	2	0.04
Carangidae	*Scomberoides commersonnianus*	Talang queenfish	1	0.02

Table 1: (cont.)

Family	Species	Common name	No. caught	%
Carangidae	*Scomberoides lysan**	Double-spotted queenfish	2	0.04
Carangidae	*Trachinotus africanus*	Southern pompano	3	0.06
Carangidae	*Trachinotus baillonii*	Small-spotted pompano	2	0.04
Carangidae	*Trachinotus botla*	Large-spotted pompano	1 057	20.02
Rachycentridae	*Rachycentron canadum*	Prodigal son	1	0.02
Echeneidae	*Echeneis naucrates*	Shark remora	4	0.08
Pomacentridae	*Abudefduf sordidus*	Spot damsel	40	0.76
Labridae	*Thalassoma purpureum*	Surge wrasse	1	0.02
Polynemidae	*Polydactylus plebeius*	Striped threadfin	5	0.09
Scombridae	*Scomberomorus commerson*	King mackerel	2	0.04
Diodontidae	*Diodon hystrix*	Porcupinefish	1	0.02
Total	**71 species**		**5 280**	**100**

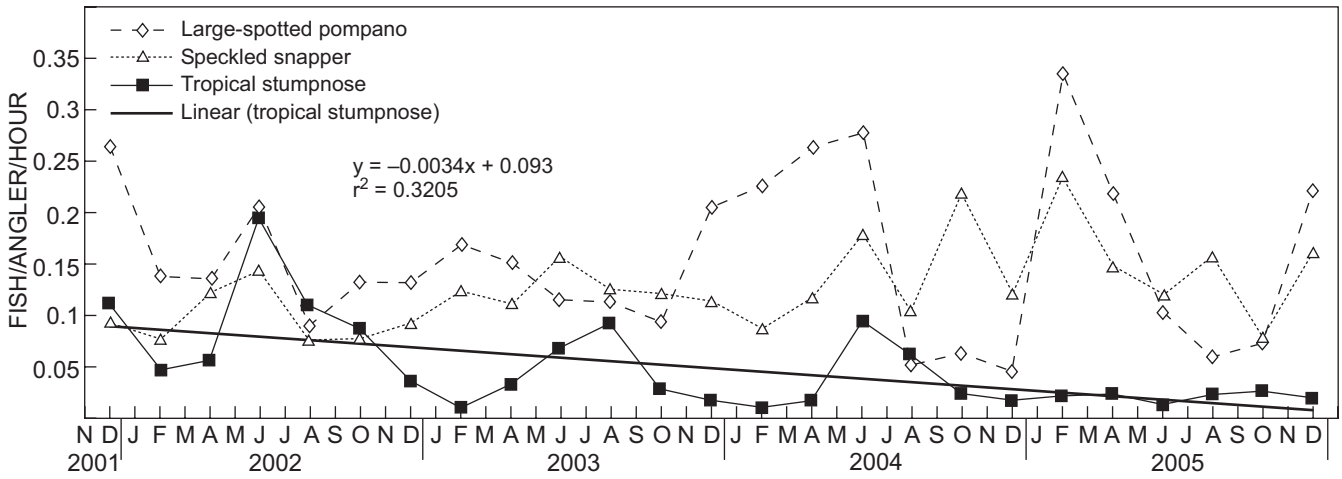

Figure 2: The trend in CPUE of tropical stumpnose caught in four experimental fishing areas in the St Lucia Marine Reserve and Sanctuary between November 2001 and November 2005. Trends in CPUE of two other important angling fish are also shown for comparison

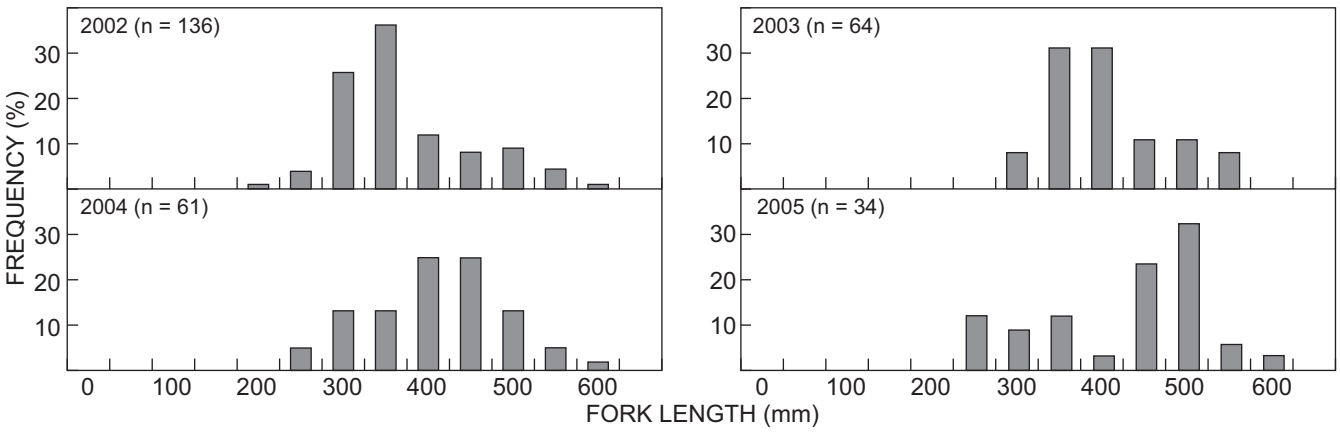

Figure 3: Changes in modal size class of tropical stumpnose caught and measured in four research fishing areas in the St Lucia Marine Reserve between 2002 and 2005

sub-adults back into the marine environment to join the adult population (Wallace 1975a, 1975b). This is further supported by the fact that the size structure of tropical stumpnose caught in the St Lucia Marine Reserve north of Cape Vidal has comprised progressively fewer, larger individuals (Figure 3) and, although there is evidence of some smaller fish joining the adult population, there are very few new recruits. While this observed trend in size structure

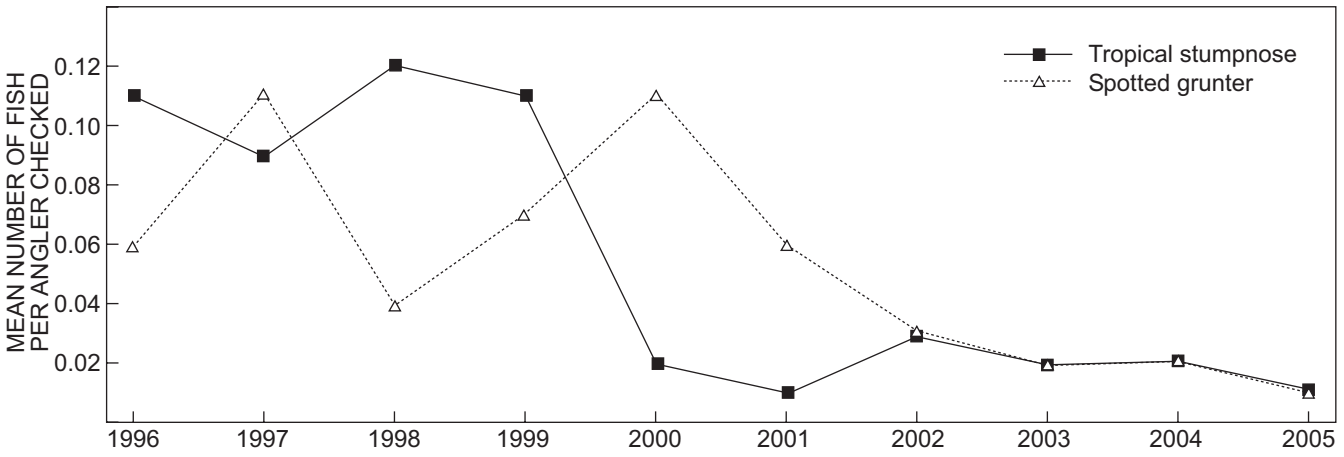

Figure 4: Trends in catch rate of tropical stumpnose and spotted grunter recorded in anglers' catches during routine shore patrols conducted by EKZNW staff (data from Cape Vidal, St Lucia and Mapelane zones are pooled)

may be due to the movement of a strong cohort through time, this would not explain the overall decline in CPUE. Furthermore, the selectivity of the fishing gear used, with hook sizes ranging from <1/0–>7/0, was such that the capture of smaller fish was not precluded.

There are other large estuarine systems in northern KwaZulu-Natal, such as Kosi Bay and Richards Bay, which continue to function as important nursery areas for juvenile tropical stumpnose. But the St Lucia Estuary and lake system is extremely large, comprising 80% of the estuarine surface area in KZN (Begg 1978). For this reason, it is likely to contribute a substantial percentage of the estuarine-dependent fish species found in the nearshore marine environment in northern KZN.

A fish survey undertaken in the St Lucia Estuary and lake system in December 2004 during the period of mouth closure (Cyrus and Vivier 2006) collected very few tropical stumpnose. Despite the use of both gill-nets and seine nets and sampling at various localities throughout the system, only six tropical stumpnose were caught, with lengths of between 210–220mm FL: all were caught at two localities in South Lake where the salinity was 27–28ppt. This suggests that little or no recruitment of tropical stumpnose had taken place into the system since closure of the mouth in June 2002 and that no breeding of this species had taken place within the system. Nevertheless, a small number of recruits may have entered the system when water from the adjacent Mfolozi Estuary entered the St Lucia Narrows (Figure 1) in January 2004, after a flood (Cyrus and Vivier 2006).

Analysis of NMLS shore patrol data collected between Leven Point and Cape St Lucia showed a similar decline in the abundance of tropical stumpnose in the region since 2000. This decline was also reflected in catches of Spotted Grunter, another estuarine-dependent species. Various biases in this database, as discussed by Mann-Lang (1996), compromise its use in detecting finer-scale fluctuations in abundance of important angling species. Nevertheless, these data, in conjunction with the more comprehensive research fishing project data collected in the St Lucia Marine Reserve, provide strong evidence of the impact that the closure of the St Lucia mouth has had on the adult population of this and other estuarine-dependent marine species. Despite this impact, the decision by the relevant authorities to leave the St Lucia mouth closed, and not to breach it artificially during the period 2002–2005, is believed to have been the correct one. This is because if the system had been breached during low levels of freshwater input, it would have become hypersaline through the influx and evaporation of seawater, leading to a considerably greater impact on the overall biota (Taylor *et al*. 1994).

Tropical stumpnose are known to reach ages in excess of 16 years (Radebe *et al*. 2002) and therefore adult fish will continue to survive and spawn in the marine environment for many years. However, once the drought is broken and the St Lucia mouth re-opens, it is likely that recruitment of fry into the estuary will resume (Wallace 1975a, 1975b, Wallace and van der Elst 1975). After approximately two to three years, those (then adult) fish will leave the estuary, assuming that the mouth stays open, to spawn and, after reaching a size greater than 35cm SL, will permanently join the adult marine population (Wallace 1975a). It would thus be interesting to continue the current catch-and-effort monitoring programmes to see whether such a recovery does indeed take place once the St Lucia mouth re-opens.

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