

## Impact of Mini Trawl Fishing on the Population of Alligator Pipefish *Syngnathoides biaculeatus* Bloch (1785) Caught as Bycatch from the Seagrass Meadows of Palk Bay, Southeast Coast of India

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### ABSTRACT

Seagrass meadows are a highly productive ecosystem providing habitat, breeding and feeding ground for various marine species and also support the fisheries. The single species *S. biaculeatus* is the most dominant pipefish among Syngnathoids in Palk Bay. Periodic monitoring and observation of bycatch and discards, of the alligator pipefish *Syngnathoides biaculeatus*, caught in Mini trawl from Devipattinam for one year formed the basis of this communication. The size range of alligator pipefish was recorded between 128 mm to 240 mm and individual weight ranged from 1.42 to 6.60 g. The maximum numbers of Pipefish were recorded during July 2017. There is no significant difference in b values ( $P > 0.05$ ) and K values between male and female. In the present study, popu-

lation of pipefish *S. biaculeatus* have shown negative allometric growth pattern ( $b = 1.92$ ). Fishing by Mini trawl in the inshore region of seagrass meadows has harshly affected the alligator pipefish population and its habitat. Mesh size regulation and its strict implementation will be the required management measures to ensure the sustainability of the pipefish population in the seagrass meadows of the Palk Bay.

**Keywords** Allometric growth, Devipattinam, Discards, Alligator pipefish, Population.

### INTRODUCTION

The Palk Bay is a coastal region which lies between Tamil Nadu (India) and Sri Lanka along the Indian coast which occupy area of nearly 600 sq km and endowed with rich seagrass meadows comprising 14 species existing along the Palk Bay coast (Thangaradjou and Bhatt 2017). Seagrass meadows are highly productive ecosystem providing habitat, breeding and feeding ground for various marine species and also greatly supporting the fisheries. The dominant species like *Cymodocea serrulata*, *C. rotundata*, *Syringodium isoetifolium*, *Halodule uninervis* and *Halophila ovalis* are observed in this region. The seagrass also supports habitat for family Syngnathidae which include 215 species covers 52 genera and comprise mainly seahorse, pipefish. The commonly known alligator pipefish (*Syngnathoides biaculeatus* Bloch 1785) are categorized as Least Concern (LC)

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under the IUCN Red List. The pipefishes are peculiarly long and slender pipe-like body, mostly stick like with head in the line with the body. The body is semi-flexible due to the presence of bony plates and rings. Jaws are fused and the snout is tubular in shape with small mouth. The size of pipefish ranges from a few centimeters to more than 65 cm reported. The single pipefish *S. biaculeatus* has a wide geographic distribution in various seagrass habitats from African water, Red Sea region, Tonga Islands, Philippines, China and Australia (Dawson 1985). The species *S. biaculeatus* is the most dominant among *Syngnathoides* at both Palk Bay and Gulf of Mannar regions in India (Murugan *et al.* 2008). Earlier, this species has been exported for traditional Chinese medicine (TCM) and aquarium keeping (Pogonosik *et al.* 2002). Indiscriminate use of various destructive gear in the seagrass meadows has led to habitat loss which ultimately affects the wild population of *S. biaculeatus*. Like other Syngnathids, the male *S. biaculeatus* is ovigerous and incubate the eggs in the ventral side of the abdomen (Kuitert 2000). It mainly feeds on microcrustaceans like copepods, amphipods and isopods (Dhanya 2008, Kitsos *et al.* 2008). The captive rearing and breeding are also much limited (Kornienko 2001, Silva *et al.* 2006a, Dhanya 2008, Barrows *et al.* 2009, Gurkan *et al.* 2009). The fecun-

dity ranges between 108 to 236 numbers at 28 to 32°C with the gestation period of  $25 \pm 5$  days (Takahashi *et al.* 2003, Dhanya 2008). Length-weight relationship (LWR) is an important parameter in fishery biology and stock assessment of marine species and it helps to estimate its natality and mortality. Fulton's condition factor (K) is an index for assessing feeding intensity, growth rate and age of fish and the status of the marine ecosystem in which they live (Uddin *et al.* 2016). In this paper attempts have been made to study the impact of Mini trawl (*Thallumadi* in local parlance) fishing on the population of alligator pipefish *Syngnathoides biaculeatus* as bycatch in the seagrass beds of southern Palk Bay and also to estimate the basic growth information like length-weight relationship and Fulton's condition factor.

## MATERIALS AND METHODS

Devipattinam is the coastal village in southern Palk Bay (Fig. 1) located in Tamil Nadu has the maximum intertidal zone with a large extent of Seagrass meadows. Periodic monitoring and observation of bycatch and discards, of the alligator pipefish *Syngnathoides biaculeatus* Bloch (1785) were carried out in Mini trawl operated in Devipattinam (9°28'38.435"N: 78°53'55.042"E, 9°28'52.385"N: 78°53'53.714"E,

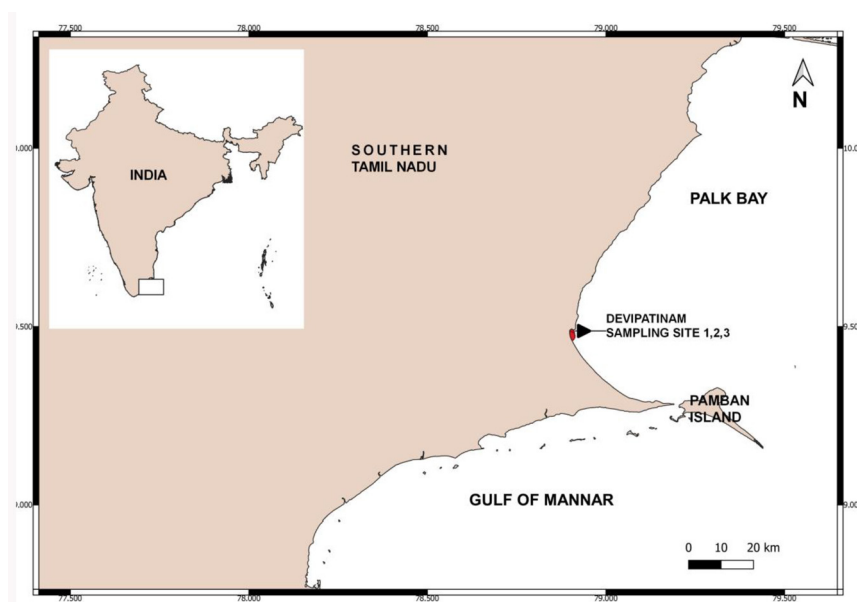


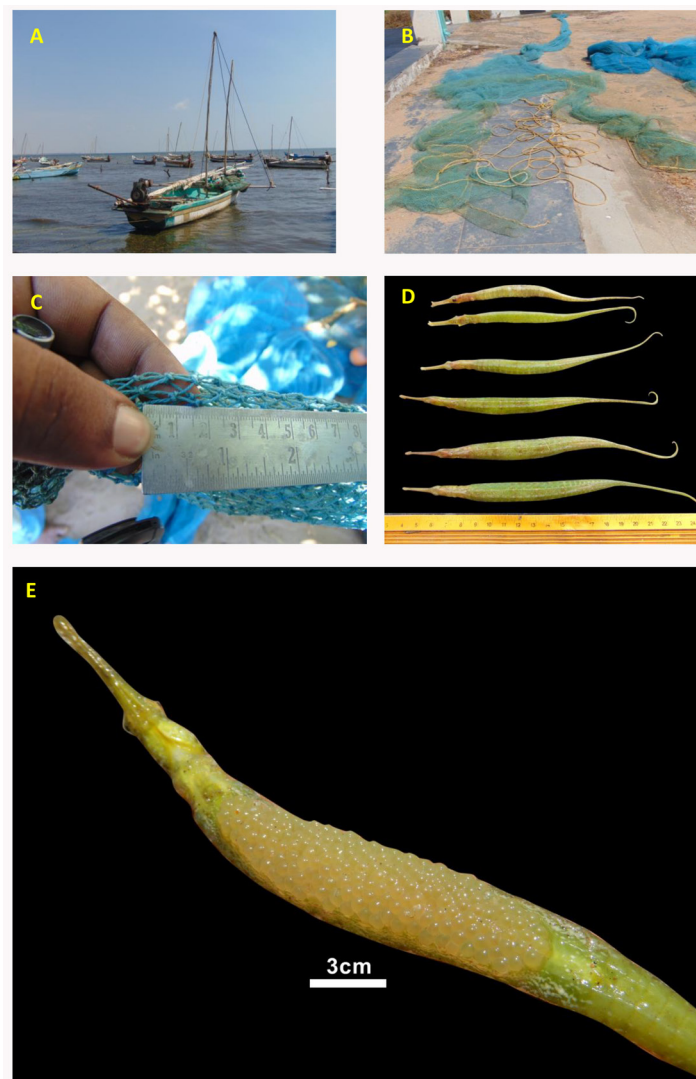
Fig. 1. Sampling location of pipefish *Syngnathoides biaculeatus* at Devipattinam, Palk Bay.

9°28'22.584"N; 78°53'58.549"E). The country craft (FRP or wooden) commonly called Mini trawl and locally called Thallu madi or Thallu valai operated by traditional fishermen.

### Craft and gear

In Devipattinam 540 outboard motorized FRP boats are being operated of which more than 320 boats were particularly operated for mini trawl fishery every day. The FRP craft overall length (OAL) of 10-12 m and

width of 1.8-2.5m with the outboard diesel engine of 9-10 HP (Fig. 2A) with sail will have a crew comprising 3-5 fishermen engaged in fishing operation. The wind-driven country trawl (Mini trawl) fishing units are actively operated every day in a distance ranging from 2-7 Nautical mile within the inshore water at a depth of 1.8 - 4m. The engine was operated only to reach the fishing ground whereas the gear was operated by wind energy using the sail. The gear is made of high-density nylon filament with a stretched mesh with an overall length of 20 m (Fig. 2B). The gear



**Fig. 2A.** Craft used for Mini trawl operation, **B.** View of the Mini trawl, **C.** Measurement of the Cod end (18mm), **D.** Size range of Pipefish in bycatch, **E.** View of the ovigerous male *Syngnathoides biaculeatus*.

is divided into three portions, the first portion (wing and square) having 7-8 m length with mesh size of 25mm and a second portion (body/ belly) having 5-6 m length with mesh size of 20 mm. The remaining catch accumulation part of Mini trawl (cod-end) has a mesh size of 18 mm (Fig. 2C). The width/ mouth opening of the gear is 7-7.5 m.

The data were collected fortnightly for a period of one year from September 2016 - August 2017. The secondary data have also been collected through interview with local fishers and from the literature. Simple random sampling method has been followed. The number of pipefish present in the catch were recorded by selecting ten units of fishing gears operated in the sampling area. The total numbers of pipefish in the individual units were raised to the total number of units operated on that particular day that landed in the fish landing center (Hilborn and Walters 1992, King 1995). After measurements were taken with the utmost care from the gears the live bycatch animals were immediately released back into the sea. Females were identified by the occurrence of white colored zigzag pattern on its ventral side of the abdomen and having 15-20 blue dots and red patches (Barrows *et al.* 2009).

The regression line was subtracted by the simple least-squares regression analysis method using Microsoft Office Excel 2019. The significant difference in regression coefficient  $r^2$ , intercept (a) and regression slope (b) between male and female specimens

collected from the Palk Bay was confirmed based on covariance analysis (ANCOVA). The LWR analysis of juveniles were estimated as pooled analysis due to the small sample size. The level of significance was done at 5%, represented as  $P < 0.05$ . The Fulton's condition factor (K) was calculated (Ricker 1975, Cakic *et al.* 2002) by the formula,  $K = 1000 * W / TL^3$ , where TL is the total length of fish (cm) and W is the weight of fish (g).

## RESULTS AND DISCUSSION

The large number of alligator pipefish were caught as bycatch in mini trawl which is operated in the inshore region, along with many commercially important fin-fish and shellfish. The major catch was comprised of green tiger shrimp and blue swimming crabs especially juveniles. The size range of alligator pipefish was found (Total length) between 128 mm to 240 mm (Fig. 2D) and individual weight ranged from 1.42 to 6.6 g. On an average 350-940 numbers /day of pipefish are being caught as bycatch and are discarded in the beach while landing or sea. Brood males were also recorded in bycatch and discards. The survival rate of discarded pipefish is very low and observed that the dead pipefish were washed ashore along with dead seagrass biomass. An increasing trend was observed in the number of alligator pipefish caught as bycatch from March to July (Fig. 3). The maximum and minimum numbers of pipefish caught from the seagrass meadows were recorded during July 2017 (21800 nos) and February 2017 (13060 nos) respectively. The

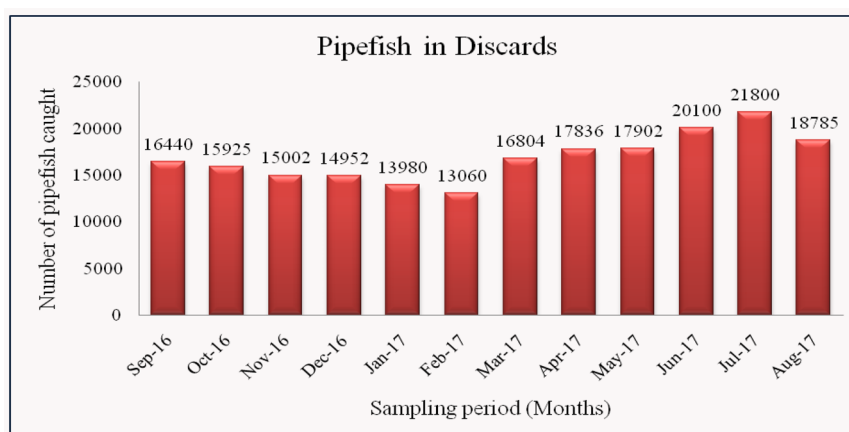


Fig. 3. Number of pipefish *Syngnathoides biaculeatus* caught as bycatch in Mini trawl.

**Table 1.** Length-weight relationship parameters and descriptive statistics on the population of alligator pipefish *Syngnathoides biaculeatus* from Palk Bay. N-Sample size, a- Intercept of the regression, b-Regression coefficient (slope),  $r^2$ -Coefficient of determination, K-Fulton's condition factor.

Gender	N	Total length (min-max)	Weight (min-max)	A	B	$r^2$	K	LW relationship
Male	30	13.9-23.4	1.7-6.2	0.013167	1.984495	0.850253	0.679012	$y = 0.013x^{1.984}$
Female	39	12.8-24.0	1.42-6.6	0.008597	2.148496	0.889416	0.686307	$y = 0.008x^{2.148}$
Pooled	69	12.8-24.0	1.42-6.6	0.016958	1.920831	0.875682	0.711165	$y = 0.016x^{1.920}$

length-weight relationship parameters of the pipefish caught as bycatch estimated and the descriptive statistics were given in Fig. 4 and Tables 1 - 2.

The estimated regressions of LWR relationships for both male and female fish were significant ( $r^2 > 0.95$ ). There were no any significant differences in b values between male and female ( $P > 0.05$ ) and the K values of male and female fishes ( $P > 0.05$ ). The population of pipefish *S. biaculeatus* in the present study exhibited as negative allometric growth pattern ( $b = 1.92$ ).

In the present study, the bycatch quantity of alligator pipefish in the mini trawl recorded was 90%, whereas, from other gears like bottom set gillnets, trammel nets, seine net only 10% were encountered. The availability of food and prey items decided the distribution, growth, reproduction, migration of fish species (Pfeiler *et al.* 2000). The pipefish individual of 25-30 numbers caught as bycatch in wind-driven country craft in Palk Bay, Tamil Nadu were reported (Sanaye 2017) in different landing centers (Murugan *et al.* 2008). In this study, the maximum number of alligator pipefishes were recorded during July month around 12-15 %. Dhanya (2008) recorded relatively high b values (males, females and juveniles of 3.17,

3.00 and 2.48 respectively) from LWR study of *S. biaculeatus* (Population size of males, females and juveniles of 400, 347 and 234 respectively) at the Palk Bay and high b value from Papua New Guinea (Barrows *et al.* 2009). The probable reason for high b value as reported due to the existence of pregnant males in the LWR analysis and favorable environmental circumstances predominant at the sampling time. The estimated b value ( $b = 1.92$ ) in *S. biaculeatus* exposed that strong negative allometric relationship indicated the weight increment at a slower rate than the body length. The reason may be due to the unique morphology of pipefish *S. biaculeatus*. The continuous degrade of seagrass habitats by fishing pressure like shrimp trawling/bottom trawling, wind-driven mini trawl. Along the Palk Bay might influence the growth pattern in *S. biaculeatus*. The syngnathids species of *Cosmocampus albirostris*, *Syngnathus* sp. and *Micrognathus* sp. were heavily exploited by ornamental fish traders in Brazil and leads to alarming wild populations (Martin-Smith *et al.* 2003). In Australia, *Vanacampus vercoi* are categorized as vulnerable due to heavy habitat loss (Pogonoski *et al.* 2002). The local extinction of pipefish *Doryichthys cuncalus* recorded in India (Chhappgar and Pande 1986) and freshwater pipefish *Syngnathus watermeyer* in South Africa (Whitfield and Whitfield 1996). The pipefish

**Table 2.** Comparison of length weight relationship between sexes.

Source	df	ssx	ssy	spxy	Reg.coef	Deviations from regression				
						df	SS	MS	F	Prob
Within										
Males	29	0.609515	2.823162	1.209578809	1.98449523	28	0.422759	0.015099		
Females	38	1.164132	5.9187	2.475521415	2.126495899	37	0.654514	0.01769		
Pooled W	67	1.773646	8.741862	3.685100224	2.077697287	65	1.077272	0.016573		
			Difference between slopes			1	0.008067	0.008067	0.490545	0.486146241
Between B										
W+B	68	1.773678	8.744785	3.685403731		67	1.087137			
			Between adjusted means			1	0.001798	0.001798	0.109333	0.741951645

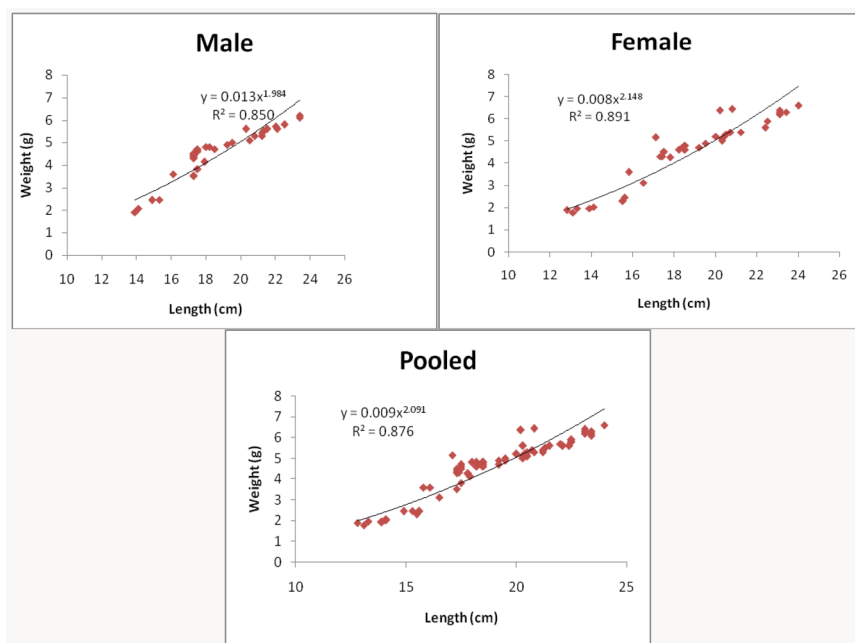


Fig. 4. Length-weight relationship of the alligator pipefish *Syngnathoides biaculeatus* caught as bycatch from Devipattinam.

*S. biaculeatus* could be a flagship species to evaluate seagrass ecosystem. During 2001, the dry weight of 12,173 kg of pipefish and pipehorse were exported to Hong Kong from India (Martin-Smith *et al.* 2003). The Ministry of Environment, Forests and Climate change, Government of India banned the export of all syngnathids from 11<sup>th</sup> July 2001 and covered under Schedule I of the Indian Wildlife Protection Act, 1972. Because of this ban, there has been a considerable decline in syngnathids fishing, but they are being exported through clandestine means. In India, the capture and trade of all syngnathids are prevented and all varieties of pipefishes are listed under Schedule I (Part IIA) of the WPA, 1972. The fishing by mini trawl gear in the inshore region of seagrass meadows will cruelly affect the alligator pipefish population and its habitat. So suitable mesh size regulation has to be taken for restoring this population. The information provided in this study may use to improve *S. biaculeatus* population inhabiting critical habitats.

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#### REFERENCES

- Barrows APW, Martin-Smith KM, Baine MSP (2009) Population variables and life-history characteristics of the alligator pipefish *Syngnathoides biaculeatus* in Papua New Guinea. *J Fish Biol* 74: 806-819.
- Cakic P, Lenhardt M, Mickovic D, Sekulic N, Budaleov LJ (2002) Biometric analysis of *Syngnathus abaster* populations. *J Fish Biol* 60: 1562-1569.
- Chhapparg BF, Pande JN (1986) Pise Dam: An ecological disaster for the freshwater pipefish *Doryichthys cunocalus* (Ham.-Buch.). *J Bom Nat Hist Soc* 83(1): 232-235.
- Dhanya S (2008) Biology and culture of the alligator pipefish, *Syngnathoides biaculeatus* (Bloch 1785) from Palk Bay, PhD thesis. Annamalai University, Chidambaram, pp 224.
- Gurkan S, Taskavak E, Hossucu B (2009) The reproductive biology of the great pipefish *Syngnathus acus* (Family: Syngnathidae) in the Aegean Sea. *Nor-West J Zool* 5: 179-190.



- Hilborn R, Walters CJ (1992) Quantitative Fisheries Stock Assessment: Choice, Dynamics and Uncertainty, Chapman and Hall, London, pp 570.
- King M (1995) Fisheries Biology, Assessment and Management, Blackwell Science Ltd, Oxford, pp 341.
- Kitsos MS, Tzomos TH, Anagnostopoulou L, Koukouras A (2008) Diet composition of the seahorses, *Hippocampus guttulatus* (Cuvier 1829) and *Hippocampus hippocampus* (L., 1758) (Teleostei, Syngnathidae) in the Aegean Sea. *J Fish Biol* 72: 1259-1267.
- Kornienko KS (2001) Reproduction and development in some genera of pipefish and seahorse of the family syngnathidae. *Russ J Mar Biol* 27: 15-26.
- Kuiter RH (2000) Seahorses, Pipefishes and their relatives: A comprehensive guide to Syngnathiformes, TMC publishing, UK, pp 240.
- Martin-Smith KM, Lam TF, Lee SK (2003) Trade in pipehorses *Solegnathus* spp. for traditional medicine in Hong Kong. *Traffic Bull* 19(3): 139-148.
- Murugan A, Dhanya S, Rajagopal S, Balasubramanian T (2008) Seahorses and pipefishes of the Tamil Nadu coast. *Curr Sci* 95: 253-260.
- Pfeiler E, Padron D, Crabtree RE (2000) Growth rate, age and size of bony fish from the Gulf of California. *J Fish Biol* 56: 448-453.
- Pogonosik JJ, Pollard DA, Paxton JR (2002) Conservation overview and action plan for Australian threatened and potentially threatened marine and estuarine fishes. Environment Australia, Canberra, Australia, pp 375.
- Ricker WE (1975) Computation and interpretation of biological statistics of fish populations. *Bull Fish Res Bd Can* 191: 1-382.
- Sanaye SV (2017) Studies on eco-biology, captive breeding and rearing of alligator pipefish, *Syngnathoides biaculeatus* (Bloch 1785). PhD thesis. Goa University, Taleigao Plateau, Goa, pp 187.
- Silva K, Monterio NM, Almeida VC, Vieira MN (2006a) Reproductive behavior of the black striped pipefish, *Syngnathus abaster* (Pisces: Syngnathidae). *J Fish Biol* 69: 1860-1869.
- Thangaradjou T, Bhatt JR (2017) Status of seagrass ecosystems in India. *Ocean Coast Manag* 159: 7-15.
- Uddin SKN, Ghosh S, Maity J (2016) Length-weight relationship and condition factor of *Penaeus monodon* (Fabricus 1798) from Digha coast, West Bengal, India. *Int J Fish Aquat Stud* 4: 168-172.
- Whitfield AK, Bruton MN (1996) Extinction of the river pipefish *Syngnathus watermeyeri* in the Eastern Cape Province, South Africa. *South Afr J Zool* 92: 59-61.