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# The subtidal gully fish community of the eastern Cape and the role of this habitat as a nursery area

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The fish fauna of rocky subtidal gullies between Chelsea Point and Skoenmakerskop (South Africa) was sampled between October 1985 and September 1986 using rotenone to investigate the species composition and the importance of this habitat as a nursery area for marine linefish species. A total of 59 species belonging to 28 families were collected. The majority of these were cryptic fishes such as Clinidae and Cheilodactylidae. Sparidae and Serranidae were represented by juveniles of inshore species. The findings are discussed in relation to previous studies of intertidal pools in the eastern and western Cape, and it is concluded that shallow rocky inter- and infratidal areas are important nursery areas for numerous inshore fishes, including some species caught by recreational line fishermen. The results from this study suggest that previous intertidal studies have over-emphasized the importance of rock pools as nursery areas.

Tussen Oktober 1985 en Augustus 1986 is monsters geneem van die visfauna in rotsagtige subgety-sloepe tussen Chelseapunt en Skoenmakerskop om spesies-samestelling vas te stel en die belangrikhed van die habitat vir seevisse te bepaal. Altesame 95 spesies behorende aan 28 families is versamel. Die meeste was kriptiese soorte, byvoorbeeld die Clinidae en Cheilodactylidae. Jongvisse van die kusspesies het die Sparidae en Serranidae verteenwoordig. Die bevindings word vergelyk met vorige studies van tussengetypoele in die Oos- en Wes-Kaap en daar word afgelei dat vlak rotsagtige tussen- en infragetygebiede belangrike grootwordgebiede is vir van die hengelvisspesies. Die resultate van hierdie studie dui daarop dat vorige tussengetystudies die belangrikheid van rotspoele as grootwordgebiede oorbeklemtoon.

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Studies of reef fish communities in the Cape have concentrated mainly on those inhabiting intertidal rock pools (Christensen 1978; Marsh, Crow & Siegfried 1978; Christensen & Winterbottom 1981; Bennett, Griffiths & Penrith 1983; Beckley 1985a, b; Bennett 1987). As a result, this fauna is now becoming well known. Less information is available on the fish communities of deeper waters, mainly on account of the greater difficulty in sampling these areas. Preliminary studies of deeper reefs have shown that there are considerable differences between the ichthyofauna of shallow and deeper waters in this region (Buxton & Smale 1984).

Beckley (1985a) has suggested that, compared to other coastal habitats such as estuaries and inshore areas, rock pools are important nurseries for some transient species, particularly two species in the family Sparidae and two in the family Cheilodactylidae. Comparative material from subtidal areas was, however, lacking. In view of the apparently declining catches of line fishes (van der Elst 1976; Smale 1985; Buxton 1987), the present study was initiated to determine the composition of the subtidal ichthyofauna and evaluate the importance of subtidal gullies as nurseries to exploited linefish and other components of the fish fauna.

## Study areas

The study area was a 9-km stretch of rocky coast between Chelsea Point (34°02'S / 25°38'E) and Skoenmakerskop (34°02'S / 25°33'E), which is within the area studied by Beckley (1985a). The gullies chosen were those which had at least one end open to the sea at low tide and which were 2–5 m wide and between 1–2 m deep at the deepest point. They had sides of sandstone and the bottoms were usually covered with sandy sediment and boulders. The sides were covered to a varying degree by macrophytic algae including *Plocamium corallorhiza, Arthrocardia* sp., *Amphiroa ephirea, Plocamium* sp. and *Octocorallia* spp., and a variety of invertebrate fauna. This coast is subjected to heavy swell action and a wide temperature range (12–27°C, $\bar{x}$ = 18,1°C) as a result of both seasonal changes, and short term, aseasonal upwelling and downwelling (Beckley 1983).

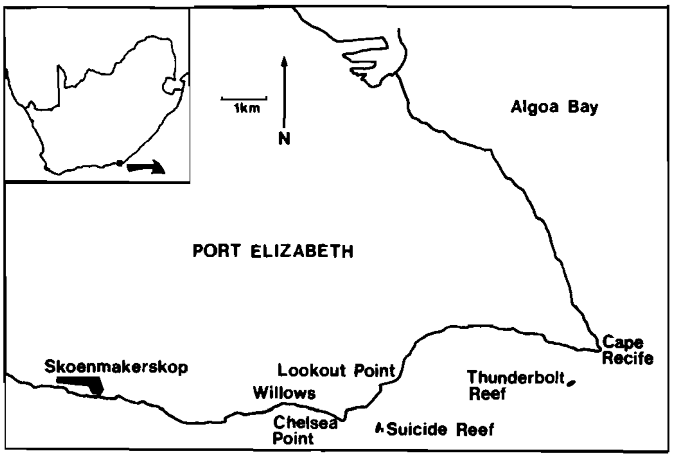


**Figure 1** Map showing places mentioned in the text.

### Methods

Monthly rotenone collections were taken between October 1985 and September 1986. Suitable gullies of similar size were chosen on the basis of the mouth being open at spring low tide and water movement not being excessive (which would otherwise have reduced the effect of rotenone). No gully was poisoned more than once in this study. Subjective assessment of the species composition of the benthic fauna and algae showed gullies to be similar. The fish fauna of different gullies was also similar, although the relative proportions of the dominant species appeared to differ between gullies partly in relation to the degree of protection afforded from wave action by seaward rocks and availability of algal cover and cracks for shelter.

A 50 mm stretch mesh monofilament gill net was deployed across the mouth of the gully to prevent the escape of mobile individuals. It was not practical to deploy a finer net to trap smaller fishes because the surf action would have removed it from the gully. Approximately 3 kg of rotenone powder, dissolved in isopropylalcohol and water, was dispersed about halfway along the gully, in areas with the least water movement at spring low tide. Particular care was taken to force it into overhangs and caves, using plastic squeeze bottles. The fish were recovered by at least three snorkel divers and a surface attendant, using hand nets. The operation was continued until all the moribund fish had been recovered, after which the gill net was retrieved. Specimens were immediately placed in iced water and taken to the laboratory where they were sorted, identified and measured to the nearest mm (total length) and weighed to the nearest 0,1 g. Otoliths were removed from a subsample and placed in the permanent collections of the Port Elizabeth Museum. The fish specimens were lodged in the collection of the JLB Smith Institute of Ichthyology. The names used in the text are after Smith & Heemstra (1986).

**Table 1** Species of fish collected by rotenone from subtidal gullies between Chelsea Point and Skoenmakerskop between October 1985 and September 1986. The number, length and mass range, means and one standard deviation are shown. S = schooling, C = cryptic.

| Species | | No. | Length range (mm) | Mean length | *S.D.* | Mass range (g) | Mean mass | *S.D.* |
|---|---|---|---|---|---|---|---|---|
| Scyliorhinidae | | | | | | | | |
| *Haploblepharus* sp. | C | 1 | 87 | – | – | 3,0 | – | – |
| Congridae | | | | | | | | |
| *Conger cinereus* | C | 1 | 986 | – | – | 1420 | – | – |
| *C. wilsoni* | C | 17 | 78–855 | 418,9 | 304,9 | 0,5–1150 | 286,8 | 379,3 |
| Ophichthidae | | | | | | | | |
| *Muraenichthys gymnotus* | C | 2 | 140–237 | 188,5 | 68,6 | 1–5,6 | 3,3 | 3,3 |
| Ariidae | | | | | | | | |
| *Galeichthys ater* | C | 464 | 50–276 | 86,1 | 25,0 | 1,4–293 | 11,4 | 24,7 |
| Plotosidae | | | | | | | | |
| *Plotosus nkunga* | C | 6 | 352–510 | 419,8 | 68,1 | 351–1160 | 677,1 | 354,5 |
| Gadidae | | | | | | | | |
| *Gaidropsarus capensis* | C | 1 | 61 | – | – | 1,5 | – | – |
| Batrachoididae | | | | | | | | |
| *Batrichthys apiatus* | C | 3 | 57–71 | 63,0 | 7,2 | 2,1–3,6 | 2,6 | 0,8 |
| Bythitidae | | | | | | | | |
| *Bidenichthys capensis* | C | 1 | 66 | – | – | 3,0 | – | – |
| Gobiesocidae | | | | | | | | |
| *Chorisochismus dentex* | C | 267 | 20–235 | 98,3 | 37,2 | 0,1–230 | 31,5 | 40,6 |
| *Diplecogaster megalops* | C | 3 | 23–28 | 25,3 | 2,5 | 0,1–0,3 | 0,2 | 0,1 |
| Atherinidae | | | | | | | | |
| *Atherina breviceps* | S | 4 | 67–79 | 74,3 | 5,1 | 2,1–3,7 | 3,0 | 0,7 |
| Syngnathidae | | | | | | | | |
| *Syngnathus acus* | C | 11 | 180–235 | 206,6 | 19,7 | 1,6–5,3 | 3,7 | 1,3 |
| Tetrarogidae | | | | | | | | |
| *Coccotropsis gymnoderma* | C | 1 | 24 | – | – | 0,3 | – | – |
| Serranidae | | | | | | | | |
| *Acanthistius sebastoides* | C | 45 | 66–277 | 172,9 | 172,9 | 5,2–497 | 144,5 | 109,6 |
| *Epinephelus guaza* | C | 22 | 86–357 | 231,4 | 63,9 | 12,2–830 | 257,3 | 194,8 |
| *E. rivulatus* | C | 3 | 201–296 | 239,0 | 50,3 | 140–540 | 295,3 | 214,4 |
| Haemulidae | | | | | | | | |
| *Pomadasys olivaceum* | S | 2 | 56–91 | 73,5 | 24,7 | 2,7–11,9 | 7,3 | 6,5 |

**Table 1** Continued

| Species | | No. | Length range (mm) | Mean length | *S.D.* | Mass range (g) | Mean mass | *S.D.* |
|---|---|---|---|---|---|---|---|---|
| Sparidae | | | | | | | | |
| *Boopsoidea inornata* | S | 1 | 59 | – | – | 2,1 | – | – |
| *Diplodus cervinus hottentotus* | S | 68 | 58–194 | 120,2 | 33,1 | 3,2–129,8 | 35,6 | 25,3 |
| *D. sargus capensis* | S | 455 | 25–200 | 66,2 | 23,4 | 0,1–141 | 6,6 | 10,1 |
| *Gymnocrotaphus curvidens* | S | 4 | 140–145 | 142,8 | 2,1 | 50,9–69,3 | 57,8 | 9,0 |
| *Lithognathus lithognathus* | S | 1 | 170 | – | – | 57 | – | – |
| *Rhabdosargus holubi* | S | 46 | 71–172 | 128,5 | 22,47 | 5,7–75 | 34,7 | 16,7 |
| *Sarpa salpa* | S | 866 | 51–202 | 76,7 | 14,5 | 1,5–123 | 6,5 | 14,5 |
| *Sparodon durbanensis* | S | 49 | 60–200 | 119,4 | 40,0 | 3,3–135,5 | 33,5 | 31,3 |
| Mullidae | | | | | | | | |
| *Parupeneus rubescens* | S | 7 | 79–113 | 101,3 | 10,9 | 6,8–21,4 | 15,3 | 4,7 |
| Sciaenidae | | | | | | | | |
| *Argyrosomus hololepidotus* | S | 1 | 226 | – | – | 118 | – | – |
| Chaetodontidae | | | | | | | | |
| *Chaetodon marleyi* | S | 5 | 28–112 | 83,4 | 33,4 | 0,5–41,5 | 23,3 | 17,3 |
| Cheilodactylidae | | | | | | | | |
| *Cheilodactylus fasciatus* | C | 504 | 67–215 | 124,0 | 33,4 | 3,6–137 | 31,1 | 24,0 |
| *Chirodactylus brachydactylus* | C | 902 | 42–261 | 123,6 | 48,0 | 1,1–271 | 37,4 | 38,8 |
| Labridae | | | | | | | | |
| *Stethojulis interrupta* | S | 39 | 36–100 | 75,0 | 17,21 | 0,6–2,5 | 5,5 | 3,1 |
| Mugilidae | | | | | | | | |
| *Liza richardsoni* | S | 76 | 57–313 | 200,7 | 86,1 | 2,1–296 | 116,3 | 98,2 |
| *L. tricuspidens* | S | 29 | 45–268 | 156,6 | 61,9 | 0,7–180 | 47,7 | 46,7 |
| Congrogadidae | | | | | | | | |
| *Halidesmus scapularis* | C | 377 | 38–168 | 104,3 | 26,7 | 0,1–8,3 | 2,6 | 1,6 |
| Blenniidae | | | | | | | | |
| *Parablennius cornutus* | C | 16 | 30–93 | 72,1 | 19,2 | 0,3–10,7 | 5,6 | 3,1 |
| *P. pilicornis* | C | 1 | 113 | – | – | 14,0 | – | – |
| Tripterygiidae | | | | | | | | |
| *Cremnochorites capensis* | C | 7 | 53–72 | 68,6 | 7,5 | 2,3–5,6 | 3,6 | 1,3 |
| Clinidae | | | | | | | | |
| *Blennioclinus brachycephalus* | C | 134 | 26–105 | 73,8 | 19,9 | 0,1–18,6 | 4,9 | 3,5 |
| *B. stella* | C | 3 | 25–44 | 37,0 | 10,4 | 0,1–0,8 | 0,5 | 0,4 |
| *Blennophis anguillaris* | C | 2 | 70–118 | 94,0 | 33,9 | 2,4–11,2 | 6,8 | 6,2 |
| *B. striatus* | C | 13 | 89–159 | 122,4 | 21,4 | 4,9–38 | 15,5 | 9,1 |
| *Cirrhibarbis capensis* | C | 171 | 27–240 | 113,7 | 44,1 | 0,13–158 | 20,3 | 27,8 |
| *Climacoporus navalis* | C | 86 | 23–79 | 52,9 | 12,1 | 0,1–3,9 | 1,4 | 0,8 |
| *Clinus berrisfordi* | C | 19 | 39–154 | 75,9 | 26,5 | 0,6–51 | 7,4 | 11,2 |
| *C. cottoides* | C | 450 | 20–120 | 68,1 | 22,2 | 0,05–17,7 | 4,5 | 3,8 |
| *C. robustus* | C | 3 | 150–332 | 230,7 | 92,7 | 34,6–382,7 | 171,2 | 185,7 |
| *C. superciliosus* | C | 186 | 32–190 | 104,0 | 31,5 | 0,3–90,4 | 17,8 | 15,7 |
| *C.* sp. (brevi B) | C | 27 | 39–154 | 90,7 | 33,0 | 0,6–51 | 13,8 | 14,2 |
| *C. taurus* | C | 30 | 51–162 | 106,1 | 28,0 | 1,7–70,6 | 20,7 | 15,7 |
| *C. venustris* | C | 65 | 57–96 | 81,2 | 10,6 | 1,8–11,1 | 6,7 | 2,5 |
| *Fucomimus mus* | C | 10 | 30–81 | 59,5 | 15,3 | 0,2–6,1 | 2,7 | 2,0 |
| *Muraenoclinus dorsalis* | C | 5 | 20–49 | 30,2 | 11,8 | 0,1–0,8 | 0,3 | 0,3 |
| *Pavoclinus gramminus* | C | 223 | 18–129 | 87,5 | 23,5 | 0,1–23,5 | 8,8 | 5,8 |
| *P. pavo* | C | 59 | 16–89 | 59,2 | 15,5 | 0,1–7,3 | 2,2 | 1,6 |
| Gobiidae | | | | | | | | |
| *Caffrogobius caffer* | C | 2 | 95–103 | 99,0 | 5,7 | 13,5–16 | 14,8 | 1,8 |
| *C. saldanha* | C | 535 | 18–104 | 68,3 | 14,6 | 0,07–12,7 | 4,6 | 2,6 |
| Soleidae | | | | | | | | |
| *Heteromycteris capensis* | C | 1 | 68 | – | – | 2,6 | – | – |
| Tetraodontidae | | | | | | | | |
| *Amblyrhynchotes honckenii* | C | 4 | 108–128 | 120,3 | 8,8 | 28,2–68,1 | 48,1 | 16,4 |

The following diversity indices were calculated according to Odum (1971) for comparisons to previous studies:

(i) Margalef species richness index $d = (S-1)/\log_e N$
(ii) Shannon index $\bar{H} = -\Sigma\ (ni/N) \log_e (ni/N)$
(iii) Pielou evenness index $e = \bar{H}/\log_e S$
where $N$ = total number of individuals; $ni$ = number of individuals of each species; $S$ = number of species.

## Results

A total of 6 336 fishes were collected during this study,

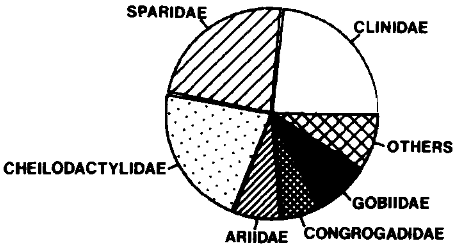


**Figure 2** Composition by number of fish families collected in subtidal gullies.

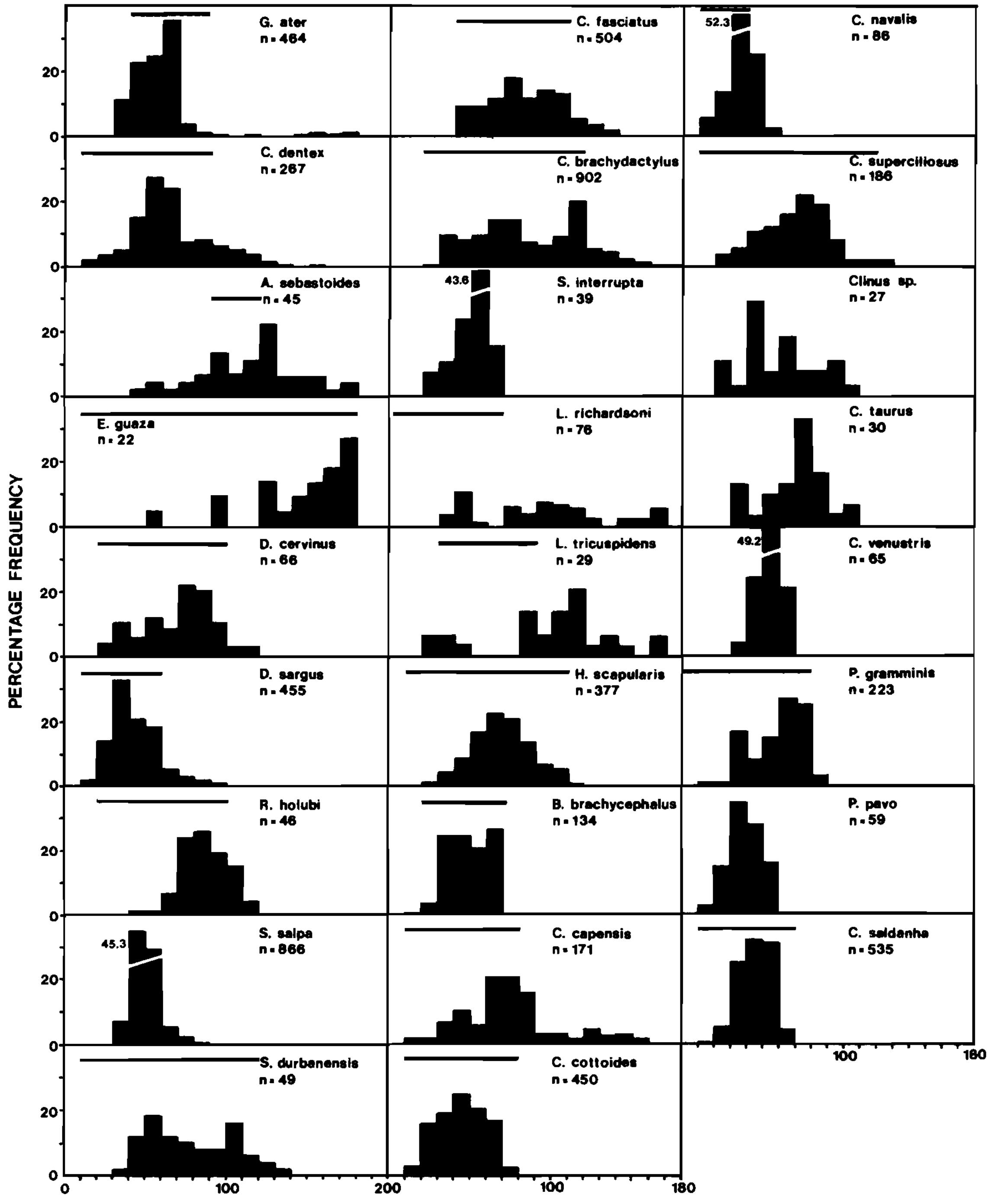


**Figure 3** Length frequency histogram of 26 species of fishes collected from subtidal gullies. The length range recorded by Beckley (1985a) is illustrated as a bar.

comprising 59 species belonging to 28 families (Table 1). Three families made up 69% of the number sampled. These were Sparidae (8 spp.), Clinidae (17 spp.) and Cheilodactylidae (2 spp.). Gobiidae (2 spp.) and Ariidae (1 sp.) were less numerous (Figure 2). The sample was dominated by 43 cryptic species (72%), while 16 schooling species (27%) made up the balance.

The sample comprised individuals ranging from 16–986 mm, although the majority were smaller than 150 mm (Figure 3). Gibson (1982) described rock pool fishes as resident or transient, and this definition applies equally to subtidal fishes. Adults and juveniles of resident species such as Clinidae, Gobiesocidae and Gobiidae were collected from the subtidal gullies. Adults and juveniles of some of the transient species, such as Mugilidae, Ariidae and Congridae were also recorded. Members of the families Sparidae, Sciaenidae, Cheilodactylidae and the rockcod *Epinephelus guaza*, were caught only as small and apparently juvenile individuals, which showed no macroscopic evidence of reproductive activity.

Recruitment patterns were apparent for some of the

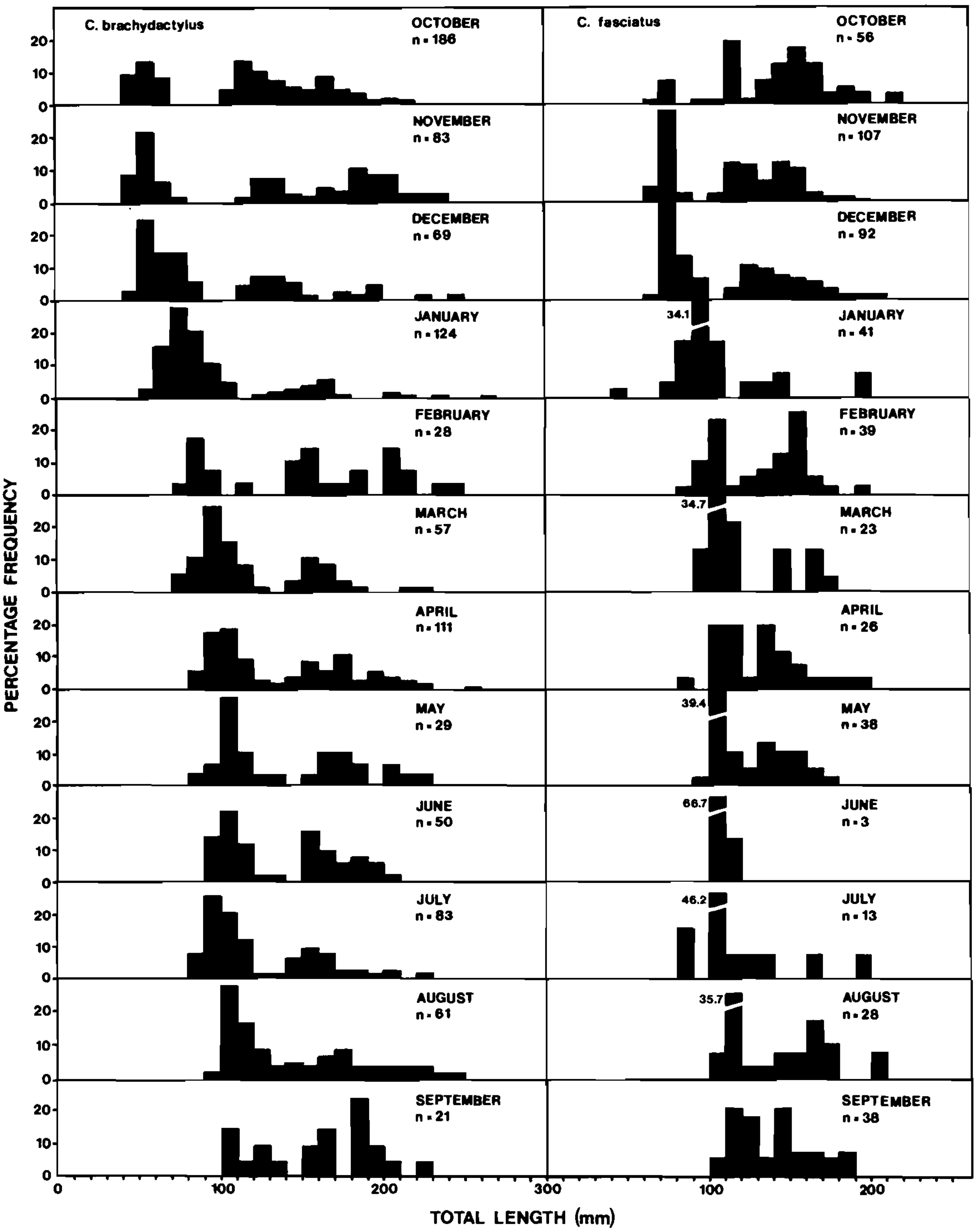


**Figure 4** Monthly length frequency distribution of *Chirodactylus brachydactylus* and *Cheilodactylus fasciatus* collected from subtidal gullies.

species recorded in these collections. *Chirodactylus brachydactylus* recruited in October to December and monthly cohort progression suggests that they may attain about 100–120 mm one year after recruiting to the gullies (Figure 4). The regularity of the trimodal length frequencies suggests that three year classes are represented in the samples, after which they probably leave the gullies and move into deeper water.

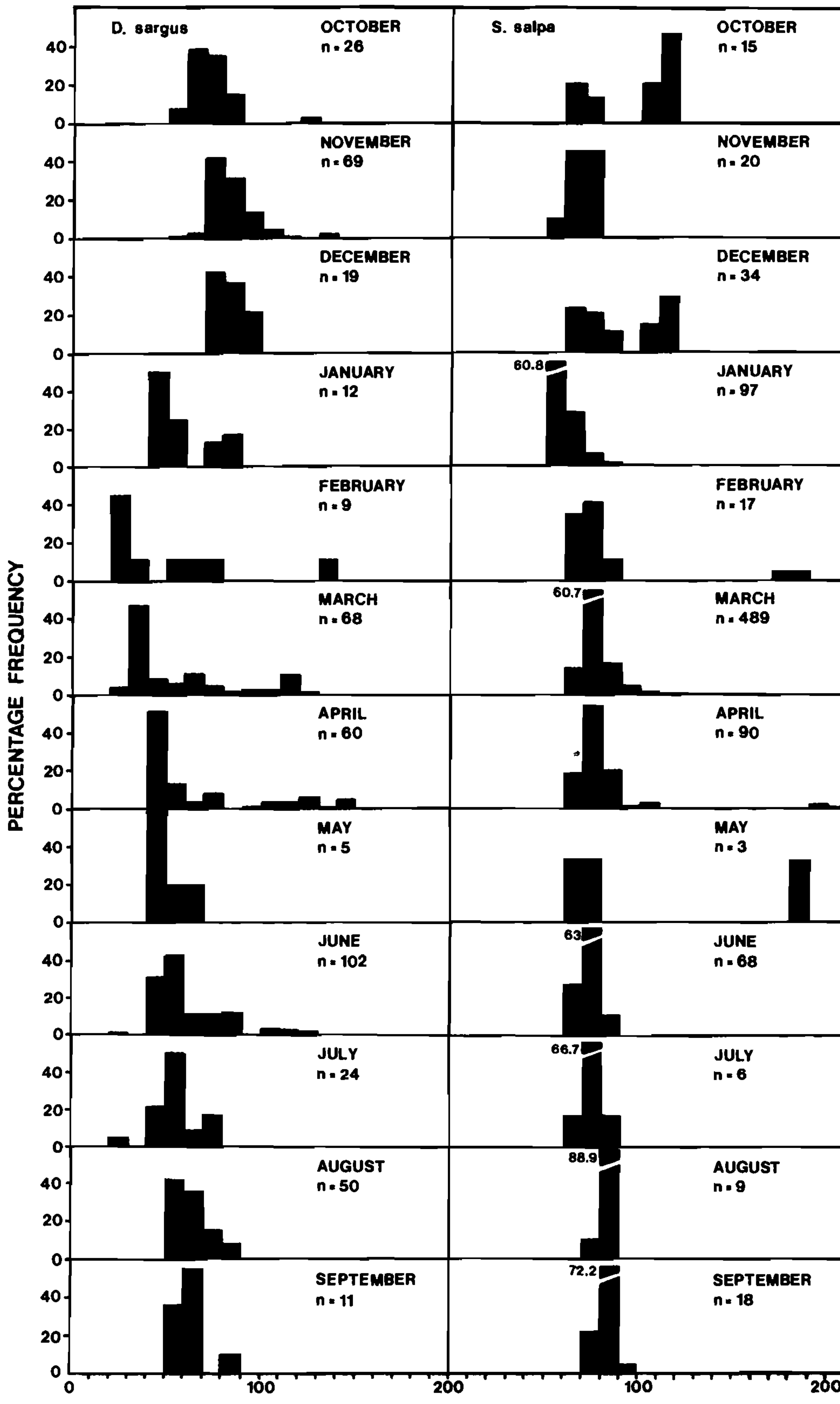


**Figure 5** Monthly length frequency distributions of *Diplodus sargus* and *Sarpa salpa* collected from subtidal gullies.

*Cheilodactylus fasciatus* recruited to the gullies between October and January, but mainly in November and December. They also appear to attain about 100–140 mm in a year and, from the bimodal shape of the histograms, appear to remain there for two years before moving into deeper waters.

*Diplodus sargus* recruited later in the year, mainly in February and March, and attained 100–120 mm in one year (Figure 5). Larger fishes either move into deeper water or were more easily disturbed and escaped from the gully. Recruitment of *Sarpa salpa* occurs over several months from November–July but appears highest in January. Modal progression suggests that they too may attain 80–120 mm after one year. Large *S. salpa* were rarely taken in these samples.

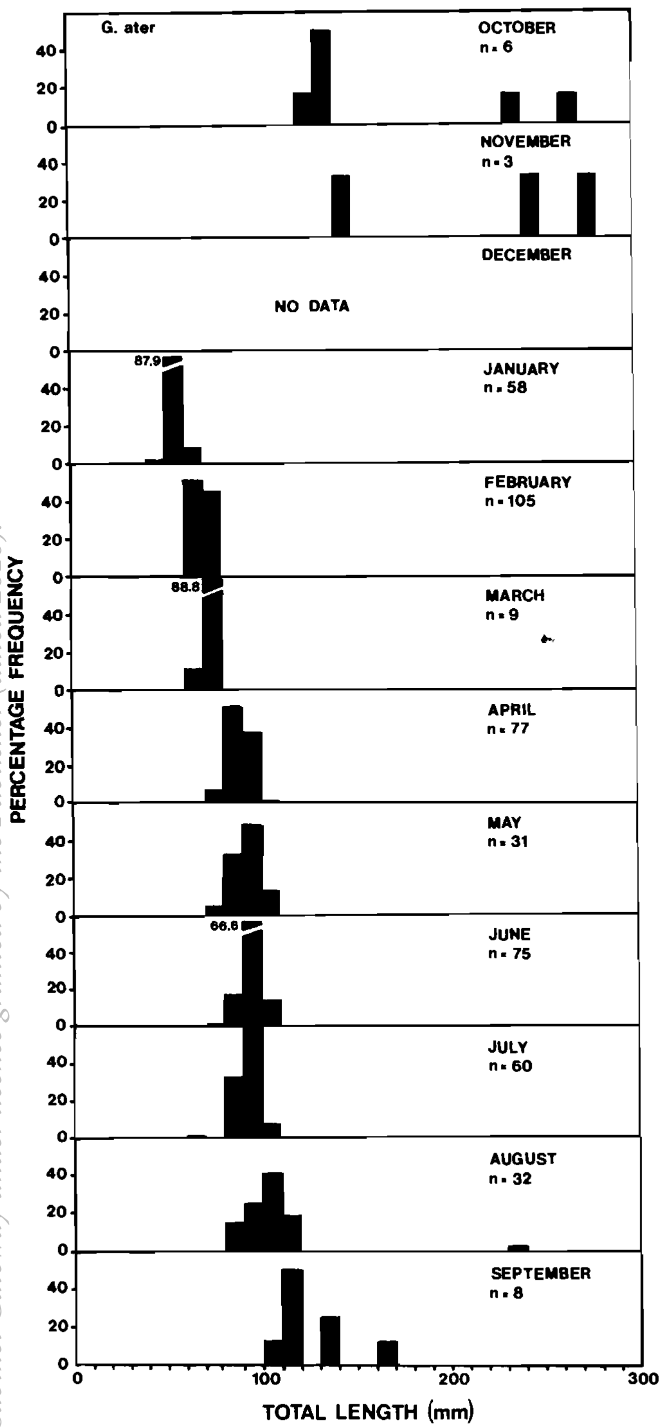


**Figure 6** Monthly length frequency distributions of *Galeichthys ater* collected from subtidal gullies.

*Galeichthys ater* were captured in various months of the year as adults and juveniles (Figure 6). Adult males of 239 and 270 mm were recorded mouth-brooding 15 and 18 eggs, respectively, in October. Juveniles were recruited from January onwards and the histograms suggest that they grow to about 110–150 mm in a year. Most individuals appear to move into deeper water at this size although they visit gullies occasionally thereafter.

Evidence of juvenile recruitment to these shallow water nurseries by other species was recorded as follows: The smallest *Epinephelus guaza* (86 mm) was taken in May. Juvenile *Rhabdosargus holubi* of 61–67, and 60 mm were taken in November and August, respectively. *Sparodon durbanensis* of 61–69, 75 and 90 mm were taken in November, April and September, respectively. The smallest *Diplodus cervinus* of 54–57, and 53 mm were collected in June and July. *Liza richardsonii* of 58–62 and 63 mm were collected in November and February. *Liza tricuspidens* of 45 and 49–55 mm were taken in January and March.

## Discussion

The problems associated with collecting fish using rotenone in the open sea have been discussed by numerous authors (Smith & Tyler 1972; Smith 1973; Christensen & Winterbottom 1981). They include: Varying susceptibility of different species to the effects of rotenone, dilution of the poison by sea currents, escape of affected fish from the station before they could be collected, and consumption of the dead fish by predators. Because all these factors were encountered in this study, the samples were not considered a quantitative estimate of biomass in the gullies.

The use of the gill net at the entrance of the gully retained some of the larger fishes and excluded large fish predators which may have been attracted from deeper waters (e.g. *Pomatomus saltatrix*). Some small specimens were seen escaping through the net and some fishes were collected from the outside areas. The predators which attacked dying fish on the surface of the water were seagulls *(Larus dominicanus)*, but their effect was minor as fish were usually collected by the divers before the birds could attack. Anemones, starfish and octopods also scavenged moribund fish. Nevertheless, the samples were believed to be generally representative of the habitat and the method was considered the most effective available in the habitat under study. An alternative method, the use of underwater transects, was not attempted as the mobile component would have been disturbed and scared out of the gullies which were open to the sea. This problem was not encountered in studies of enclosed rock pools (Christensen & Winterbottom 1981; Beckley 1985a), which were also more suitable for quantitative rotenone collections.

The present study provides new information on the distribution of fishes in the Cape. More species and a wider size range of individuals were found in the present study, compared to those recorded from rock pools (Beckley 1985a). Of the 59 species recorded in the present gully collections, 29 were absent from rock pools in the same area, while 6 species were found intertidally but not subtidally (Beckley 1985a*). [*One species, *Clinus navalis* was omitted from Beckley (1985a). The data were: $n = 9$; length range = 26–60 mm, $x = 41,4$, $SD = 9,9$; mass range = 0,40–1,34 g, $x = 0,60$ g, $SD = 0,38$ (L.E. Beckley, U.C.T. pers.comm.] There were 30 species common to both studies. The above data suggest that rock pools are relatively poor in temperate fishes typical of the region, although they may support more tropical species which are approaching the limits of their normal distribution, but are able to live in the shallow solar warmed pools (Day 1969; Bennett 1987). The Clinidae are thought to be strongly influenced by temperature (Penrith 1970) and this partly explains differences in their depth- and geographic distribution.

With exception of those described below, all the species recorded in this study were within their previously recorded geographical ranges (Smith & Heemstra 1986). Some of the species, e.g. *Clinus navalis, C. venustris* and *C. taurus* appear to be more common than previously documented (Penrith 1970), which was a result of subtidal waters being poorly sampled. Limited subtidal collecting may also explain the finding of an apparently undescribed species (listed as *Clinus* sp.) during this study.

*Clinus berrisfordi* was recorded in this study at Chelsea Point, about 5 km east of the previous eastward record (Smith 1986). We also recorded a large sample of 16 at one site in Skoenmakerskop clearly indicating that it is locally abundant. It has been collected further west at Koppie Alleen (Bennett 1987), Hermanus (Penrith 1970) and in False Bay (Bennett & Griffiths 1984; Smith 1986). *Stethojulis interrupta* was taken at Skoenmakerskop, 15 km west of Algoa Bay, its previous south-westernmost locality in southern Africa (Randall 1986). *Epinephelus rivulatus*, too was recorded at Skoenmakerskop, west of its previous locality range (Heemstra & Randall 1986).

The *Boopsoidea inornata* and *Gymnocrotaphus curvidens* sampled appear to be the shallowest records to date, although they are common on subtidal reefs of > 5 m (Buxton & Smale 1984). There was a change in dominance of two Gobiidae in rock pools compared to gullies. *Caffrogobius saldanha* is clearly more associated with deeper water than is *C. caffer*, which appears to be a resident adapted to intertidal pools. Christensen & Winterbottom (1981) noted that *C. caffer* is most abundant in pools higher up the littoral zone and that its preferred habitat is not deep pools. This was supported by Bennett, Griffiths & Penrith (1983) and Bennett & Griffiths (1984).

The species of Ariidae described in this article is *Galeichthys ater*, which apparently was included in *Tachysurus feliceps* by Smith (1965) (Taylor 1986). It was therefore often confused with *G. feliceps* in faunal studies (e.g. Christensen & Winterbottom 1981; Buxton *et al.* 1984; Beckley 1985a & b; Bennett & Griffiths 1984). Re-examination of juveniles taken in trawls on the shallow soft substrates of Algoa Bay (Buxton *et al.* 1984) has shown that the samples were exclusively *G. feliceps*, suggesting that marine habitats with soft substrates are preferred by *G. feliceps*, although they also occur in estuaries (Wallace *et al.* 1984). All specimens obtained from reefs or tide pools have been found to be *G. ater*, suggesting marked differences in habitat choice. This is further supported by observations made during SCUBA dives on the eastern Cape coast which have shown that the seacatfish found either swimming around subtidal reefs, or sheltering in shallow cracks and caves are *G. ater*.

A comparison of diversity indices calculated in this study with those from South African rock pool studies revealed some interesting differences (Table 2). There is a trend of decreasing species richness of rock pool fishes from east to west along the Cape coast. The Shannon indices show a similar trend but the evenness pattern is less clear. The data collected from subtidal gullies in this study do not fit this trend very well, as they show the greatest species richness and diversity as well as a high evenness value. The reason for the high richness and diversity is explained by the fact that both subtidal and intertidal fishes were sampled in subtidal gullies. This is consistent with other work that has shown greater species richness lower in the shore line (Newell 1979; Bennett & Griffiths 1984). In comparison, the Shannon value calculated in a seagrass community at Botany Bay, New South Wales, was between 2,2 and 2,8 during most of the year (Middleton *et al.* 1984). Smith & Tyler (1972) recorded a value of 3,32 in a coral reef study, which is

**Table 2** Diversity indices of fish communities in rock pools at Port Alfred (PA: Christensen & Winterbottom 1981), Port Elizabeth (PE: Beckley 1985a), Koppie Alleen (KA: Bennett 1988), False Bay and Western Cape (FB, WC: Bennett & Griffiths 1984) and subtidal gullies (SG) in this study.

| | East | | | | | West |
|---|---|---|---|---|---|---|
| Diversity index | PA | SG | PE | KA | FB | WC |
| Margalef (species richness) | 5,20 | 6,63 | 4,48 | 2,67 | 2,40 | 1,73 |
| Shannon | 2,19 | 2,88 | 2,74 | 1,50 | 1,87 | 1,96 |
| Pielou (evenness) | 0,61 | 0,71 | 0,75 | 0,49 | 0,67 | 0,76 |

higher than any of the values calculated for the present study in a warm temperate area, and is consistant with greater species diversity on tropical reefs (Odum 1971).

Examination of the length ranges of fish taken in this study compared to those taken by Beckley (1985a) (Figure 2), indicates that there is generally broad overlap within species, although more large fish were taken in gullies. The species common to both studies which had juveniles markedly smaller (more than 20 mm difference in size in the shallower sites were: *Atherina breviceps, Epinephelus guaza, Diplodus cervinus, Rhabdosargus holubi, Sparodon durbanensis* and *Liza richardsoni*. In many cases the smallest juveniles were approximately the same size at both depths, or were smaller subtidally (e.g. *Conger wilsoni, Galeichthys ater, Acanthistius sebastoides, Diplodus sargus, Chaetodon marlei, Cheilodactylus fasciatus, Chirodactylus brachydactylus* and *Liza tricuspidens*).

The collections made in subtidal gullies provided specimens of several species which have not been collected in rock pools, such as *Argyrosomus hololepidotus, Gymnocrotaphus curvidens* and *Boopsoidea inornata*. These species are generally found in deeper waters over sandy or rocky areas (Smale 1984; Buxton & Smale 1984) and may be regarded as occasional visitors in gullies.

The importance of tide pools as nursery areas forjuvenile fishes was addressed by Beckley (1985a) who concluded that four species (*S. durbanensis, D. cervinus, Cheilodactylus fasciatus* and *Chirodactylus brachydactylus*) may rely heavily or exclusively on tidal pools. All four species were collected in this study of subtidal gullies although the *Sparodon durbanensis* were slightly larger than those recorded in rock pools. In view of the dynamic nature of the semi-diurnal tidal cycle causing drowning and exposure of the sea shore, and the excursions of rock pool fishes at high tide (Gibson 1982; Butler 1980; Bennett *et al.* 1983), it appears that the role of pools as nurseries for transient species may have been overstated by Beckley (1985a). Intertidal rock pools appear to function together with subtidal areas as shallow-water nurseries for several transient fishes, some of which are recreationally important inshore line fish. Tidal pools do provide suitable refuges for small fishes either from storm seas or stranding at low tide when some individuals may not retreat as quickly as the ebbing tide. These fish are, however, not dependent on pools *per se* as nurseries. Additional work on subtidal reefs will undoubtedly reveal that these are also part of inshore nursery areas (Berry *et al.* 1982; Clarke 1987).

Collectively these studies show that relatively few marine linefish species use either rocky intertidal areas or shallow subtidal rocky gullies exclusively as their nursery areas. Deeper reefs (> 5 m) or areas of soft substrates are probably more important as nurseries for most linefish (Joubert 1981; Lasiak 1981, 1983; Smale 1984; Smale & Buxton 1985; Buxton *et al.* 1984; Buxton 1987; Buxton & Clarke 1986; Clarke 1987). These habitats are, however, likely to be critically important to some cryptic resident and endemic groups, such as several species in the families Clinidae, Gobiidae and Cheilodactylidae.

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