

The Echinoidea Collected by the Royal Society of London Expedition to Southern Chile, 1958-1959

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ABSTRACT: The collection comprises the species *Arbacia dufresnei* (Blainville), *Pseudechinus magellanicus* (Philippi), and *Loxechinus albus* (Molina). Typical temnopleurid epistroma is now known to be present in juveniles of *Pseudechinus magellanicus*, and the disposition of the ocular plates in the apical system in this species is determined by the position of the anal aperture. The shallow water echinoid fauna of southern Chile includes the endemic genera *Loxechinus* and *Tetrapyrgus*, and genera with antarctic (*Tripylus*) and circumpolar (*Pseudechinus*) affinities.

DURING LATE 1958 and early 1959, an expedition sponsored by the Royal Society of London conducted marine and terrestrial investigations in southern Chile. Littoral marine stations were established in three separate areas: (1) Isla Chiloë (approx. 42°S), (2) Puerto Eden to Punta Arenas (approx. 49°–52°S), and (3) Isla Navarino and southern regions (approx. 55°S).

The present paper contains an account of the Echinoidea collected in the intertidal and sublittoral zones by the expedition's marine biologist, Professor G. A. Knox, of Canterbury University, Christchurch, N.Z.

The collection contains 243 specimens which represent three genera and three species. The three species are common in southern Chile and are typical of that area. *Pseudechinus magellanicus* (Philippi) is abundant in the collection. It is a species of a southern genus which apparently originated in Australasia, and has spread to various subantarctic localities with the aid of the west wind drift. *Loxechinus albus* (Molina) is a large urchin with a green test and green spines and is used extensively as food in the areas in which it occurs. The third species, *Arbacia dufresnei* (Blainville), has a characteristic green test and purple spines.

I would like to thank Professor G. A. Knox

and the Royal Society for the opportunity to study this collection.

MATERIAL EXAMINED

Echinoids were collected at the following stations:

Stn. 19. Puerto Eden, Isla Wellington, 49°08'20"S, 74°26'55"W; intertidal granitic gneiss rocks, sheltered; hand collecting, also collection from *Macrocystis* fronds and holdfasts, and sublittoral collection by diving; Nov. 29–30, 1958. *Pseudechinus magellanicus*, 8 specimens.

Stn. 21. Puerto Eden, 49°08'30"S, 74°26'52"W; depth 16–18 m, grey sand; dredge; Dec. 2, 1958. *P. magellanicus*, 5 specimens.

Stn. 22. Puerto Eden, 49°08'48"S, 74°26'48"W; depth 6–8 m, grey sand with small stones; dredge; Dec. 2, 1958. *Arbacia dufresnei*, 1 specimen; *P. magellanicus*, 8 specimens.

Stn. 24. Puerto Eden, 49°08'31"S, 74°26'48"W; depth 10–12 m, grey sand; dredge; Dec. 4, 1958. *P. magellanicus*, 2 specimens.

Stn. 27. Isla Carlos, 49°09'35"S, 74°25'24"W; collection from *Macrocystis* fronds and holdfasts; Dec. 5, 1958. *A. dufresnei*, 1 specimen.

Stn. 29. Isla Carlos, Puerto Eden, 49°08'38"S, 74°25'32"W; intertidal gneiss rocks, semi-exposed; hand collecting; Dec. 6, 1958. *P. magellanicus*, 1 specimen.

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- Stn. 33. Puerto Eden, 49°09'28"S, 74°26'06"W; depth 11–12 m, sandy mud with *Mytilus* shell; dredge; Dec. 8, 1958. *P. magellanicus*, 17 specimens.
- Stn. 37. Caletta Lackawana, 49°10'32"S, 74°25'52"W; depth 18 m, sand rock, shell; dredge; Dec. 9, 1958. *P. magellanicus*, 1 specimen.
- Stn. 39. Puerto Eden, west side of Canal Sur, 49°09'52"S, 74°26'08"W; intertidal boulder beach of granitic gneiss; hand collecting and collection from *Macrocystis* fronds and holdfasts; Dec. 9–11, 1958. *A. dufresnei*, 6 specimens; *P. magellanicus*, 9 specimens; *Loxechinus albus*, 5 specimens.
- Stn. 40. Isla Dulce and Isla Levinson, Puerto Eden, 49°09'02"S, 74°25'10"W; intertidal and sublittoral granitic gneiss rocks; hand collecting; Dec. 12–13, 1958. *P. magellanicus*, 5 specimens.
- Stn. 44. Puerto Eden, 49°08'16"S, 74°25'34"W; depth 3–5 m sand; Dec. 18, 1958. *P. magellanicus*, 7 specimens.
- Stn. 49. Bahía Muñoz Gomera, 59°20'S, 73°32'W; intertidal basaltic rock; hand collecting and collection from *Macrocystis* holdfasts; Dec. 26, 1958. *P. magellanicus*, 1 specimen.
- Stn. 50. Puerto Williams, Isla Navarino, 54°55'40"S, 67°39'W; intertidal boulder beach; hand collecting; Jan. 7, 1959. *P. magellanicus*, 1 specimen.
- Stn. 51. Puerto Williams, Isla Navarino, 54°55'30"S, 67°34'30"W; intertidal argillite rocks; hand collecting and collection from *Macrocystis* fronds and holdfasts; Jan. 8, 24, 31, 1959. *P. magellanicus*, 6 specimens; *L. albus*, 2 specimens.
- Stn. 52. Puerto Robalo, Isla Navarino, 54°55'50"S, 67°41'40"W; intertidal argillite rock; hand collecting and collection from *Macrocystis* fronds and holdfasts; Jan. 10, 16, 23, 30, 1959. *A. dufresnei*, 3 specimens; *P. magellanicus*, 17 specimens.
- Stn. 57. Isla Hermite, Caleta San Martín, 55°51'S, 67°32'W; intertidal granitic rock; hand collecting; Jan. 13, 1959. *L. albus*, 1 specimen.
- Stn. 66. Puerto Williams, Isla Navarino, 54°55'35"S, 67°36'50"W; depth 2–4 m, grey mud with boulders; dredge; Jan. 22, 1959. *P. magellanicus*, 7 specimens.
- Stn. 68. Puerto Williams, Isla Navarino, 54°55'40"S, 67°36'50"W; depth 0–5 m; collection by diving; Jan. 29, 1959. *P. magellanicus*, 34 specimens.
- Stn. 70. Isla Bertrand, 55°14'30"S, 67°55'40"W; intertidal granitic rock, very exposed; hand collecting; Feb. 3, 1959. *L. albus*, 8 specimens.
- Stn. 73. Seno Grandi, small island opposite Puerto Grandi, 55°15'S, 67°56'W; collection from *Macrocystis* fronds and holdfasts; Feb. 5, 1959. *P. magellanicus*, 12 specimens.
- Stn. 74. Seno Grandi, peninsula on Isla Navarino opposite Puerto Grandi, 55°11'20"S, 67°56'W; collection from *Macrocystis* fronds and holdfasts; Feb. 5, 1959. *P. magellanicus*, 5 specimens.
- Stn. 75. Seno Grandi, point on Isla Navarino east of Rio Grande, 55°11'20"S, 67°52'30"W; intertidal volcanic rocks, sheltered; hand collecting; Feb. 5, 1959. *P. magellanicus*, 1 specimen.
- Stn. 77. Puerto Grandi, Isla Bertrand, to the west of the wharf, 55°12'S, 67°55'30"W; intertidal granitic rocks and boulder beach, semisheltered; hand collecting; 7/2/1959; collection by diving among *Macrocystis*; Feb. 8, 1959. *P. magellanicus*, 2 specimens.

ECHINOIDEA

Family ARBACIIDAE Gray, 1855

Arbacia Gray, 1835TYPE SPECIES: *Arbacia lixula* (Linnaeus).

REMARKS: This well-defined genus contains seven species, of which *A. dufresnei* (Blainville) and *A. spatuligera* (Valenciennes) are known from southern Chile. Unfortunately the latter species is not represented in the present collection.

Arbacia dufresnei (Blainville)

Fig. 1

Arbacia dufresnei Mortensen, 1935:579 (complete list of references); 1936: 215; 1952: 8; Bernasconi, 1935:12, pl. V, pl. VI, figs. 8-10, pl. VII, fig. 4, pl. VIII, figs. 7-11.

DIAGNOSIS: Denuded test green, radioles purple.

MATERIAL EXAMINED: 11 specimens, from Stn. 22 (1); Stn. 27 (1); Stn. 39 (6); Stn. 52 (3).

REMARKS: These are typical representatives of this well known and attractive species. The largest specimen has a horizontal diameter of 42 mm, and a height of 23 mm, while the smallest is 16 mm and 7 mm, respectively. Two specimens (both from station 52) carry reproductive products on the aboral side of the test. In one the products are eggs, and in the other, sperms. The presence of eggs and sperms on the test of *A. dufresnei* has also been observed by Studer (1880) and Mortensen (1936). A specimen from station 39 is unusual in possessing seven anal valves (Fig. 1), while members of the family Arbaciidae characteristically have four or five. This single variant is apparently normal in all other respects. Jackson (1927) has reported considerable variation in the anal valves in *Arbacia punctulata*, at least 10% of the 10,000 specimens he examined having more or less than four anal valves. It is possible that a similar degree of variation exists in *A. dufresnei*.

The characteristic green colour of the test is darker in smaller specimens.

DISTRIBUTION: *A. dufresnei* is known from the southern part of South America, from Rio de la Plata in the east to Puerto Montt in the west, Antarctica (Booth Wandel Island), and the Falkland Islands, in depths ranging from the intertidal zone to 315 m.

Family TEMNOLEURIDAE Agassiz, 1872

Pseudechinus Mortensen, 1903

TYPE SPECIES: *Pseudechinus albocinctus* (Hutton).

REMARKS: Genus *Pseudechinus* contains twelve species, all of which have a southern distribution. Six of the species are apparently restricted to the New Zealand region.

Fell (1958, 1962) has discussed the systematic position of this genus, consequent upon his discovery of weakly developed epistroma in three of the New Zealand species, *P. flemingi* Fell, *P. albocinctus* (Hutton), and *P. novaezealandiae* (Mortensen). As the presence of epistroma is an important temnopleurid character, there is strong evidence for the retention of the genus in the Family Temnopleuridae. Mortensen (1943) had supplied some independent evidence in favour of this systematic position. No larval stages are yet known for this genus, but they should prove to be of the characteristic temnopleurid type.

Pseudechinus magellanicus (Philippi)

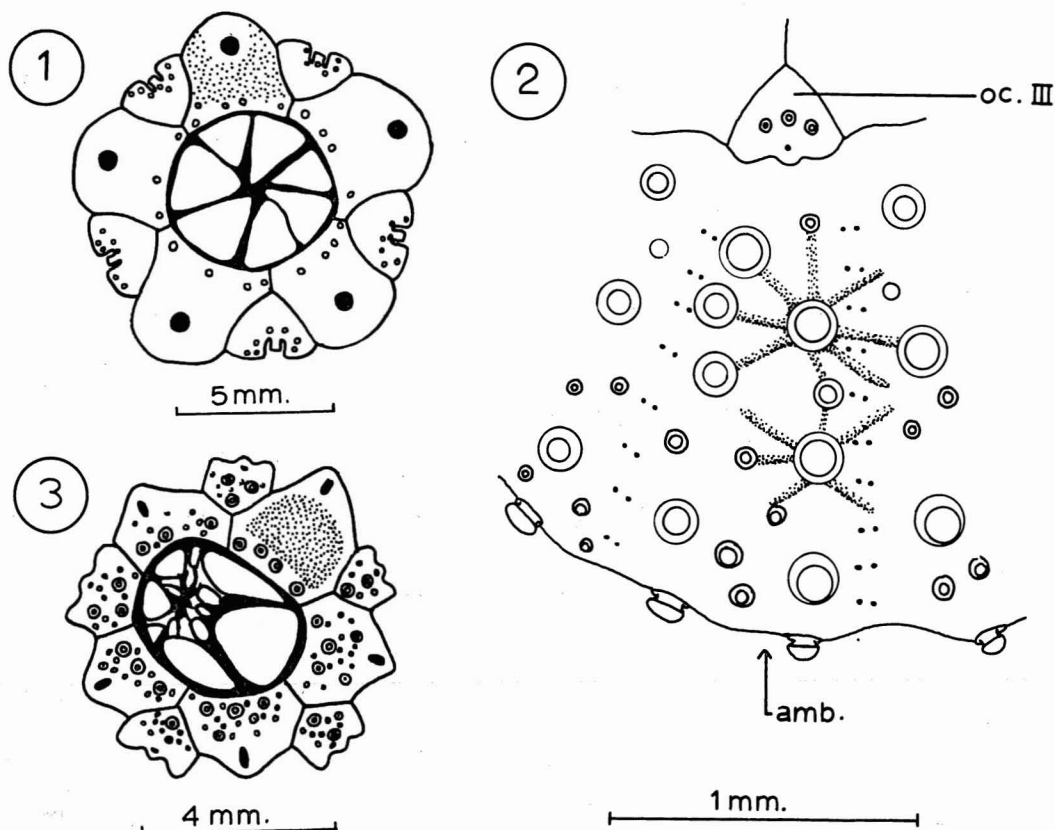
Figs. 2, 3

Pseudechinus magellanicus Mortensen, 1943: 232, figs. 125, 126a (complete list of references); 1952:9; Bernasconi, 1953:17, pl. VII, figs. 2-3, pl. VIII, figs. 1-6, pl. XVIII, figs. 3-4.

DIAGNOSIS: Denuded test faintly red, radioles light red. Tubercles finely crenulate. Valves of globiferous pedicellariae each with one or two lateral teeth. Apical system with ocular I insert. Suranal plate large, naked.

MATERIAL EXAMINED: 216 specimens, from Stn. 19 (8); Stn. 21 (5); Stn. 22 (8); Stn. 24 (2); Stn. 27 (67); Stn. 29 (1); Stn. 33 (17); Stn. 37 (1); Stn. 39 (9); Stn. 40 (5); Stn. 44 (7); Stn. 49 (1); Stn. 50 (1); Stn. 51 (6); Stn. 52 (17); Stn. 66 (7); Stn. 68 (34); Stn. 73 (12); Stn. 74 (5); Stn. 75 (1); Stn. 77 (2).

REMARKS: The smallest specimen has a horizontal diameter of 4 mm, while that of the largest is 29 mm. Two distinct size groups are represented, the first comprising those specimens with a diameter of 17-29 mm, and the second, those with a diameter of 4-10 mm. These probably represent two year-groups. Mortensen (1952) reported two size groups in a collection examined by him, but the groups comprised juveniles 2-5 mm in diameter and



FIGS. 1-3. *Arbacia dufrresnei* and *Pseudechinus magellanicus*. 1, *A. dufrresnei*, abnormal apical system with seven anal valves. 2, *P. magellanicus* juvenile, showing radiating epistomal ridges in an ambulacrum. 3, *P. magellanicus*, abnormal apical system with ocular IV insert. Abbreviations: amb., ambulacrum; oc. III, ocular III.

adults 12-15 mm in diameter. His material was collected in July, while the present specimens were collected between November and February.

The apical systems of 50 specimens were examined. A specimen 6 mm in diameter has two large suranal plates instead of the usual one, and these plates almost fill the periproctal space. In almost all cases, the anterior ocular plate (oc. III) is strongly exsert and oc. I is insert, while the anus tends to occupy a position posterior in the periproct, near oc. I. Some specimens show other ocular plates near the posterior end of the apical system to be almost insert (oc. II and V), while in a specimen of 27 mm h.d. oc. I and II are broadly insert and oc. V is almost insert. The fact that oc. III remains the most strongly exsert of all the ocular plates agrees with the observations made by Fell (1963) on

the tendency for the anus to migrate posteriorly, and the effects of this tendency on the plates of the apical system. Another specimen 23 mm in diameter has an unusual apical system (Fig. 3) in which only oc. IV is insert, and while the anus is as usual excentric, it does not lie in its normal posterior position, but nearest oc. IV. Oculars I, II, III, and V are here strongly exsert.

Small specimens were examined for traces of a temnopleurid epistroma, which has already been found in some other members of the genus *Pseudechinus* (see above). Epistroma is definitely present in *P. magellanicus*, at least in juvenile specimens. The smallest specimen in the collection (4 mm h.d.) shows weakly developed ridges radiating from the areoles of primary and secondary tubercles, especially in the ambulacra, near the apical system (Fig. 2).

The remainder of the area is sculptured, so that in this aboral region the median sutures of the ambulacral plates cannot be seen. Slightly larger specimens show faint traces of an epistroma, but these soon disappear as the animal grows. This parallels the situation in *P. novaezealandiae* and *P. albocinctus*, where the epistroma disappears before maturity is reached (Fell, 1958:36).

The stomach contents of several specimens consisted almost entirely of fragments of a brown alga, probably *Macrocystis*. This species appears to be predominantly a vegetarian browser.

DISTRIBUTION: *P. magellanicus* is well known from the southern part of South America. To the east the northern limit of its range is about 35°S (Rio de la Plata), and to the west the northern limit is about 41°S (Puerto Montt). The species also occurs at Tristan da Cunha. It is extremely common in some areas, and appears to favour life in the *Macrocystis* zone, where it may be found in large numbers on the fronds of *Macrocystis*.

Family STRONGYLOCENTROTIDAE Gregory,
1900

Loxechinus Desor, 1856

TYPE SPECIES: *Loxechinus albus* (Molina).

REMARKS: This genus is monotypic.

Loxechinus albus (Molina)

Loxechinus albus Mortensen, 1943:172 (complete list of references), pl. LVII, figs. 18-19; 1952:10; Bernasconi, 1953:23, pl. VII, fig. 1, pl. XI, pl. XII, figs. 1-9.

MATERIAL EXAMINED: 16 specimens, from Stn. 39 (5); Stn. 51 (2); Stn. 57 (1); Stn. 70 (8).

REMARKS: The largest specimen has a horizontal diameter of 82 mm and a height of 40 mm, and the smallest 23 mm and 13 mm, respectively. In all specimens the radioles are green, and the denuded test is faintly purple admedially in the ambulacra and interambulacra, green elsewhere.

DISTRIBUTION: This species is known to oc-

cur on the west coast of southern South America, as far north as Callao, Peru. While its depth range is 0-340 m, it is most commonly found in the littoral zone, where it may be extremely abundant.

DISCUSSION

In area 1 (Isla Chiloe, Stns. 1-19), no echinoids were collected, although Professor Knox (personal communication) noted the presence of a common sea urchin (probably *L. albus*) on the rocky coasts.

The three species in the collection were taken from the other two areas, Puerto Eden to Punta Arenas (Stns. 19-49) and Isla Navarino (Stns. 50-78), where they are all represented in the rocky infralittoral zone.

Species not represented in the collection, but known to occur in southern Chile, include the arbaciid *Tetrapygyus niger* (Molina) and the schizasterids *Tripylus excavatus* Philippi and *Tripylaster philippi* (Gray).

The known echinoid fauna of this region is related to the faunas of other subantarctic or cold temperate localities at the generic level. *Pseudechinus* is a southern genus, with species on many subantarctic islands. *Arbacia* appears to have the west coast of South America as its centre of distribution, whence species have spread to the east coast, and to the Atlantic coast of Africa (Mortensen, 1935). The genera *Loxechinus* and *Tetrapygyus* are monotypic, and their species are known only from the southwestern coast of South America. *Tripylus* has three species in the Antarctic seas, and a single species is known from the southern tip of South America. Tropical genera are not conspicuous in the shallow water fauna.

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