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DIVISION of FISHERIES and OCEANOGRAPHY

Report No. 58

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R. G. Chittleborough

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by R.G. Chittleborough

INTRODUCTION

A fishery upon *P. ornatus* has developed in Torres Strait since 1969. Although relatively small in comparison with major rock lobster fisheries elsewhere, the catches represent an important source of income to the islanders of this region. Some concern has been felt that reefs may be overfished if the rock lobster fishery continues to expand. For these reasons, the Department of Aboriginal Affairs asked the Division of Fisheries and Oceanography, CSIRO, for advice on the resource and its management.

As it has not been possible to mount a large-scale survey, the following should be regarded as an assessment of the problem, with suggestions for immediate management and also for useful lines of further study of this resource.

THE FISHERY

During the past three years, the annual production of rock lobster tails from Torres Strait has been in the range of 150,000 - 200,000 lb. This represents approximately 395,000 - 250,000 lb live weight of catch. Practically the entire catch is *P. ornatus*. Some 10-12 vessels (32-55 ft in length) equipped with freezers are engaged in rock lobster fishing. The larger of these are converted pearling luggers. Several dinghies operate from each vessel, rock lobsters being taken from coral outcrops by shallow diving (mainly 1-3 m) and spearing. Tails are removed and the rock lobster heads left around the reef. When dinghies return to the vessel, each man's catch is counted and weighed, the tails are washed, the digestive tract removed and the tails placed in plastic bags and frozen.

Most of the catch is returned to Thursday Island where there are three processing and freezing plants. The current price paid by processors is $1-30 to $1-40 per lb of tails. The Queensland Department of Aboriginal and Island Affairs has ruled that a minimum of $0-75 per lb be paid to those employed in diving. Processors have imposed a minimum tail weight of 4 oz.

Less is known of the segment of the fishery which is based at Daru. It is understood that one of the three processors there exported 41,169 lb of *P. ornatus* tails in the ten months from July 1970 to April 1971. The three rock lobster operators based at Daru employ an unknown number of divers and canoes which spread over some of the same reefs fished by those from Thursday Island.

THE RESOURCE

P. ornatus favours moderately turbid water (Pyne 1970) and is practically the only species of rock lobster on the shallow reefs of Torres Strait. Further to the east of Torres Strait and Cape York, as the clearer waters of the Barrier Reef are approached, *P. ornatus* is replaced by *P. versicolor* and an occasional *P. longipes femoristriga*.

Because *P. ornatus* does not enter baited traps, methods applied in assessing western rock lobster resources, e.g. the catch per pot-night as an index of abundance (Bowen and Chittleborough 1966), or mark-recapture estimates of population density (Chittleborough 1970) cannot be applied directly to the rock lobster population of Torres Strait. Some measure of fishing effort (however crude) is required in order to check whether there have been any trends in the catch per unit effort during the brief history of this fishery.

Upon examining records kept of the operations of several fishing vessels, it was possible to determine the weight of rock lobster tails taken per man per day's fishing during successive cruises (Tables 1-3). This affords an index of abundance of rock lobsters on the shallow reefs, bearing in mind that the crew on a vessel may change in time (varying skill) and that weather conditions have considerable influence on the effectiveness of the fishing effort.

Although the catch rates shown in Tables 1-3 are highly variable, there is a general pattern of higher catches per man per day from April or May through to September and lower values from October to March. For vessel "M", the peak catch rates were lower in the most recent season, mainly due to replacement of part of the crew with less experienced divers, and perhaps also to more fishing on the eastern side of Cape York than in the centre of Torres Strait.

Both vessels "E" and "Y" obtained highest catch rates during the most recent season, having located good concentrations of rock lobsters on reefs near Mobiag Island, an area fished consistently in previous years without spectacular results. An experienced rock lobster fisherman commented that the reefs near Mobiag Island afford plenty of cover but in previous years held only moderate numbers of rock lobsters, most of which were relatively small, yet this season the sizes have improved as well as the numbers.

TABLE 1

CATCHES OF *P. ORNATUS* BY VESSEL "M" IN RECENT YEARS

(Trips of approx. 2 weeks cycling round Mobiag, Warrior Reef, East Coast of Cape York in turn. Mainly east coast during past 12 months.)

Date (returned)	No. of men	No. of dinghies	Total catch		Mean wt tails taken per man per day*	Mean tail wt (lb) per rock lobster
			Number	Tail wt (lb)		
Apr. 30, 1971	10	5	3517	2520	21.0	.717
May 25, 1971	9	5	4168	3452	32.0	.828
June 22, 1971	8	4	3328	2658	27.7	.799
July 23, 1971	9	5	4713	3870	35.8	.821
Aug. 11, 1971	9	5		3881	35.9	
Aug. 25, 1971	11	6	2648	2113	16.0	.798
Sept. 20, 1971	12	6	3709	3159	21.9	.852
Oct. 1-10, 1971	11	6	1668	1220	13.9	.731
Oct. 20-Nov. 2, 1971	10	5	1854	1360	11.3	.734
Dec. 10, 1971	9	5	2254	1907	17.7	.846
Dec. 16, 1971) Jan. 20, 1972)	10	5	2011	1632	11.7	.812
Feb. 11, 1972	10	5	3001	2352	19.6	.784
Mar. 10, 1972	10	5		2129	17.7	
Apr. 12, 1972	10	5		800	6.7	
Apr. 28, 1972	10	5	1734	1536	12.8	.886
May 25, 1972	10	5		2544	21.2	
June 26, 1972	8	4		2325	24.2	
July 24, 1972	7	4	2141	1818	21.6	.849
Aug. 18, 1972	7	4	1914	2450	29.2	1.280
Sept. 15, 1972	8	4	2215	3143	32.7	1.419
Sept. 30-Oct. 7, 1972	8	4	635	718	15.0	1.131
Nov. 10, 1972	9	5	874	1116	10.3	1.277
Dec. 19, 1972	8	4	1439	843	8.8	.586
Jan. 29, 1973	7			1160	14.0	
Feb. 28, 1973	5			713	11.9	
Apr. 11, 1973	6+		964	952	13.2	.988
May 4, 1973	5++	3	1239	1324	22.1	1.069
May 19, 1973	4	2	1010	942	19.6	.933
June 13, 1973	5	3	709	619	10.3	.873

* Assuming 12 days fishing each trip unless otherwise recorded

\+ Two men and four boys on this trip

++ Three men and two boys

TABLE 2

CATCHES OF *P. ORNATUS* IN TORRES ST. BY VESSEL "E" IN RECENT YEARS

Period	Days worked	No. of men	Catch tail wt (lb)	Mean wt tails per man per day
Mar. 21-25, 1969	3	7(?)	293	14.0
Oct. 19-28, 1971	8	5	470	11.8
Nov. 1-20, 1971	18	3	941	17.4
Nov. 26-Dec. 13, 1971	16	4	973	15.2
Jan. 30-Feb. 16, 1972	16	2	705	22.0
Mar. 25-Apr. 7, 1972	12	4	991	26.4
Apr. 21-May 9, 1972	17	5	1011	11.9
May 17-June 1, 1972	14	7	1378	14.1
June 7-19, 1972	11	6	1094	16.6
June 24-Jul. 7, 1972	12	6	1393	19.3
July 11-23, 1972	11	7	1353	17.6
Aug. 16-20, 1972	3	6	510	28.3
Aug. 23-Sept. 6, 1972	13	6	810	10.4
Sept. 13-Oct. 1, 1972	17	6	777	7.6
Oct. 8-25, 1972	16	6	1160	12.2
Nov. 1-15, 1972	13	6	787	10.1
Nov. 19-Dec. 9, 1972	19	6	863	7.6
Dec. 13-21, 1972	7	6	431	10.3
Feb. 20-Mar. 2, 1973	9	6	494	9.2
Mar. 7-20, 1973	12	6	1066	14.8
Mar. 24-Apr. 4, 1973	10	6	1301	21.7
Apr. 8-20, 1973	11	6	1363	20.7
Apr. 26-May 4, 1973	7	6	1078	25.7
May 9-20, 1973	10	6	1394	23.2
May 24-31, 1973	6	6	1387	38.5
June 9-15, 1973	5	6	1562	52.1

TABLE 3

CATCHES OF *P. ORNATUS* IN TORRES ST. BY VESSEL "Y" IN RECENT YEARS

Period	Days worked	No. of men	Catch tail wt (lb)	Mean wt tails per man per day
Mar. 21-26, 1969	4	9	442	12.3
June 7-22, 1972	14	10	1671	11.9
June 26-Jul. 9, 1972	12	9	1700	15.7
Jul. 12-31, 1972	18	7	1698	13.5
Aug. 2-8, 1972	5	6	390	13.0
Aug. 15-27, 1972	11	7	893	11.6
Aug. 30-Sept. 14, 1972	14	8	623	5.6
Sept. 16-21, 1972	4	8	116	3.6
Oct. 24-Nov. 8, 1972	14	9	916	7.3
-Dec. 20, 1972	?	8	82	?
Feb. 10-16, 1973	5	7	450	12.8
Feb. 21-Mar. 4, 1973	10	9	1563	17.4
Mar. 8-12, 1973	9	9	1563	19.3
Mar. 24-Apr. 1, 1973	7	10	1737	24.8
Apr. 8-16, 1973	7	8	1539	27.5
Apr. 21-May 2, 1973	10	8	1237	15.5
May 5-14, 1973	8	9	2023	28.1
May 19-30, 1973	10	8	2472	30.9
June 3-10, 1973	6	13	2212	28.4

One fishing vessel (Table 1) recorded the total number of rock lobsters taken as well as the total weight of tails so the mean tail weight per animal gives an index of the average size of rock lobster for each trip. The increase in mean weight for most of the catches in the last year may be due in part to this boat operating more often on the eastern side of Cape York.

The seasonal cycle in abundance on the reefs in Torres Strait is the opposite of that recorded by Pyne (1970) for Yule Island where *P. ornatus* is taken during the N.W. monsoon season (November-April). This may reflect different methods of fishing in the two areas rather than differences in behaviour patterns of the rock lobsters.

With the aim of comparing the relative abundance and size composition of rock lobster populations on reefs having different histories of exploitation, the fishing vessel *Manahiki* was chartered for two weeks in September, 1973. The main reefs chosen were Dungeness Reef which has been well fished for at least five years, and Wapa Reef which has had less fishing because of high turbidity and strong tidal flow. The five fishermen were encouraged to operate in their usual way except that rock lobsters were brought intact to the *Manahiki* where the CSIRO observer (H. Kirkman) measured and examined each before processing took place. The total time each dinghy was away fishing was recorded, giving a much more precise measure of fishing effort than available previously.

Table 4 shows the catch per unit effort each day, both as the number of rock lobsters taken per man hour and also as tail weight per man hour. Although the data are insufficient for adequate statistical comparison, catch rates on the less fished reef (Wapa Reef) were similar to those on more regularly fished reefs (Dungeness and Warrior Reefs). Fluctuations in turbidity and tidal stream from day to day and from one reef to another made it impossible to compare the relative abundance of rock lobsters on the different reefs. It should be noted that another vessel from Thursday Island and four canoes from Daru were fishing Wapa Reef at that time.

While variability in skills of individual divers is not important when comparing catch rates of the whole group moving from one reef to another, the former is important when comparing operations of different boats or long term changes in catch rate on one boat. Table 4B shows that two of the fishermen on *Manahiki* had much greater skill and experience than the other three.

The sex ratio of catches taken in September 1973 consistently favoured males (Table 4), similar to that recorded by V. Wells in the same area in December 1959 (33 per cent females). The mean tail weight per rock lobster did not vary significantly from one reef to another and was similar to that of catches in the same area more than two years earlier (compare Tables 4 and 1). This indicates that there has not been a decline in size composition as a result of fishing operations.

TABLE 4A

SUMMARY OF CATCH AND EFFORT BY *MANAHIKI* OPERATING ON *P. ORNATUS* IN TORRES ST. DURING SEPTEMBER 1973

Date		Reef	Effort		Catch		Catch per unit effort		Mean tail wt (lb)	♀ %
			No. men*	Total hrs +	No.	Tail wt (lb)	No. per man hour	Tail wt per man hour		
Sept. 9	p.m.	Dungeness R.	5	21½	219	154	10.2	7.2	.703	41.1
10	a.m.	Dungeness R.	5	23½	116	85	4.9	3.6	.733	32.2
	p.m.	"	5	21	140	104	6.7	5.0	.743	38.3
11	a.m.	Dungeness R.	5	20	117	97	5.9	4.9	.829)	32.1
	p.m.	"	5	16-3/4	130	97	7.8	5.8	.746)	
12	a.m.	Dungeness R.	5	19	76	62	4.0	3.3	.816)	32.1
	p.m.	"	5	14	115	91	8.2	6.5	.791)	
Sept. 13		Wapa R.	5	31¼	198	164	6.3	5.3	.828	43.6
14	a.m.	Wapa R.	5	7½	80	55	10.7	7.3	.688)	39.6
	p.m.	"	5	32½	266	210	8.2	6.5	.789)	
Sept. 15	a.m.	Warrior R.	5	20	41	31	2.1	1.6	.756)	35.6
	p.m.	"	5	15	62	49	4.1	3.3	.790)	
16	a.m.	3m N. Makai	5	7½	46	32	6.1	4.3	.696	34.8
	p.m.	Warrior R. (S)	5	20	151	119	7.6	6.0	.788	39.2
17	a.m.	Warrior Is.	5	10	93	72	9.3	7.2	.774	38.0
	p.m.	1½m S. Dungeness Is.	5	11-3/4	20	16	1.7	1.4	.800	
18		Dungeness R.	5.	25	147	111	5.9	4.4	.755	26.1
					2017	1549			.768	

* Not including CSIRO observer

\+ Includes travel to and from *Manahiki*

TABLE 4B

SUMMARY OF THE 10 DAYS FISHING BY INDIVIDUALS ON *MANAHIKI*, SEPT. 1973

Fisherman	No. rock lobsters per hr		Total tail wt per day	
	Range	Mean	Range	Mean
A	6.6 - 16.0	11.4	27 - 71	53.5
S	2.6 - 25.1	10.7	13 - 93	48.3
M	2.0 - 5.8	3.7	9 - 31	16.1
H	1.6 - 4.0	3.0	8 - 37	14.7
B+	1.6 - 6.1	3.5	5 - 36	16.8

+ Including some taken by CSIRO observer.

TABLE 5

SIZE COMPOSITION OF *P. ORNATUS* TAKEN FROM TORRES ST. REEFS IN SEPTEMBER 1973 *(MANAHIKI)*

Carapace length (mm)	Dungeness R.		Dungeness R.*		Wapa R.		Warrior R. *et al.*	
	♂	♀	♂	♀	♂	♀	♂	♀
<62	1	1	0	0	0	0	0	0
63	0	0	2	0	0	0	0	0
64	0	0	0	0	0	0	0	0
65	4	2	0	0	0	0	0	0
66	0	1	0	1	1	0	0	0
67	1	0	1	0	0	0	0	0
68	1	0	0	1	0	0	0	1
69	2	2	0	0	1	0	0	0
70	3	2	0	2	1	2	1	1
71	1	2	0	0	1	1	2	0
72	5	1	0	0	1	1	1	1
73	3	2	1	3	3	4	0	0
74	3	3	1	0	3	3	1	1
75	2	5	1	0	2	0	2	1
76	4	8	1	1	3	3	1	2
77	9	5	3	1	1	2	2	4
78	4	4	1	0	2	3	0	0
79	10	7	1	1	8	3	5	3
80	14	8	1	1	5	5	5	2
81	7	8	3	1	4	6	4	4
82	6	7	3	0	8	9	7	3
83	15	6	1	1	3	4	6	4
84	16	16	5	2	7	6	8	2
85	15	6	3	2	3	5	7	6
86	8	4	2	0	7	9	2	4
87	6	6	1	2	8	9	11	8
88	3	2	1	0	7	4	3	5
89	14	2	1	0	8	8	10	4
90	16	11	7	1	15	8	10	5
91	11	3	1	1	8	5	8	9
92	8	3	5	0	6	7	9	6
93	9	5	4	1	11	5	9	4
94	4	1	3	0	9	8	5	3
95	10	3	4	0	9	6	9	3
96	7	2	2	2	3	3	5	5
97	6	3	2	0	12	4	6	2
98	2	1	4	1	12	4	2	1
99	6	1	1	0	6	3	3	3
100	11	6	0	0	7	3	4	2
101	3	1	1	0	2	2	4	2
102	4	2	3	0	6	3	4	3
103	4	2	0	0	5	2	2	0
104	8	3	1	0	3	4	5	2
105	4	3	0	1	1	1	4	0
106	5	6	0	0	5	2	1	1
107	4	4	0	0	4	7	1	4
108	2	4	0	0	2	4	3	0
109	6	2	0	0	1	3	1	2
110	8	8	2	0	4	4	4	5
111	7	6	1	0	4	4	3	0
112	8	6	2	3	3	3	5	2
113	8	4	5	0	5	3	4	3
114	8	3	3	1	1	5	3	2
115	5	2	2	0	1	0	0	0
116	10	3	3	2	0	5	2	1
117	8	3	1	0	5	3	5	3
118	9	4	2	0	8	4	0	2
119	4	1	2	1	2	0	0	0
120	10	3	4	1	3	3	2	1
121	4	2	0	1	6	2	1	3
122	7	0	1	1	4	3	4	1
123	8	0	2	0	6	4	4	2
124	9	0	0	0	3	3	3	1
125	3	2	0	0	2	0	0	0
126	9	3	2	2	5	2	4	2
127	5	2	2	1	2	2	1	0
128	6	0	0	0	4	0	4	1
129	0	1	1	0	4	0	1	0
130	7	0	0	0	3	0	2	0
131	3	1	0	0	4	0	0	1
132	3	0	0	0	5	1	6	0
133	4	1	1	0	3		0	2
134	0		0	0	1		0	0
135	2		1	0	0		0	0
136	0		1	0	0		1	1
137	2		1	0	0		0	0
138+	19		3	1	18		10	
Total	463	231	113	40	320	223	242	146

* Special day of non-selective fishing

The size composition of catches taken from various reefs during September 1973 (Table 5) show that males grow to a larger size than females. In both sexes, the size composition tended to be bimodal for each reef, indicating that at least two age groups were being fished. In each sex, each modal size tended to be higher for rock lobsters from Wapa Reef than from Dungeness Reef, probably reflecting better growth rate on Wapa Reef. There was no evidence to support a hypothesis that heavier fishing on one reef had reduced the proportion of larger (older) individuals.

Deeper holes (6-10 m) towards the eastern side of some reefs appear to hold some large rock lobsters but are less accessible because of exposure to prevailing winds and tidal currents.

On the last day of fishing (September 18), the fishermen were instructed to take every rock lobster regardless of size (some selectivity is generally applied as the processors do not want tails of less than 4 oz). However, despite some attempt to locate small rock lobsters, the size composition of the catch on that day (Table 5) was virtually the same as than previously taken on the same reef. The few small individuals seen were too small for the spears being used. The paucity of very small rock lobsters could indicate widely fluctuating year classes or that young juveniles occupy a different habitat. Pyne (1970) observed that in Papua, small juveniles of *P. ornatus* usually occupy very turbid inshore waters of less than one metre depth. Two fishermen reported that they have seen groups of post-larvae in shallow water on Torres Strait reefs in January and February.

None of the female rock lobsters examined during September 1973 carried eggs or sperm masses and the ovaries were pale and undeveloped. Fishermen report that egg bearing *P. ornatus* are very rarely seen on reefs in Torres Strait. Frozen tails of female rock lobsters examined by the author at Thursday Island in June had setose endopodites on the pleopods but as whole specimens were not available, it could not be determined whether these setae carried the previous crop of eggs or were in preparation for the next spawning.

One fisherman reported that in August and September, the larger females taken on the shallow reefs have large orange coloured ovaries but that these rock lobsters disappear in October and November at the same time that adults move out to deeper water seasonally for breeding. Seasonal breeding would be consistent with the observation of a fresh crop of post-larvae appearing at the beginning of each year.

CONCLUSIONS

The very limited data available on the rock lobster resources of Torres Strait do not indicate that the larger reefs which have been fished commercially for several years are overfished. However, fishing intensity is already quite high. Recent catches of over 800 lb (live weight) per day by some vessels are quite comparable with vessels

operating in the western rock lobster fishery. There is no management plan for the Torres Strait fishery and insufficient is known of the resource to suggest a sustainable yield. But the fishery is of sufficient local importance to warrant interim management measures while carrying out further studies.

The greatest immediate problem for those operating fishing vessels is to find sufficient local men willing and skilled at diving for rock lobsters. This deficiency acts as the only limitation at present on the overall effective fishing effort, preventing over-exploitation of the resource. This situation could change if more boats and fishermen move in from the south and west (as has begun to occur during 1973).

RECOMMENDATIONS

1. Interim management measures

(a) That vessels fishing for rock lobsters be licensed as such (excepting dinghies at or under 14 ft length). These vessels to be owned and operated only by those who have been resident in Torres Strait for at least two years (or even five years).

(b) That there be no further increase in the number of rock lobster fishing vessels, pending an appraisal of the rock lobster resources of Torres Strait.

(c) That the skipper of each rock lobster fishing vessel be required to supply details of catch and fishing effort for each trip. These data are necessary to assess the condition of the stock. Some skippers already record most of these data.

(d) That deliberate destruction of reef habitat by any means (e.g. crowbars, explosives, etc.) be prohibited.

(e) That poisoning by derris root, or any other plant derivative, or the use of any toxic chemicals, be prohibited.

(f) That the period from November 1 to February 28 be closed to rock lobster fishing (failing this, the closed period should be December 1 to February 28).

(g) That the minimum tail weight of 4 oz presently used by Thursday Island processors, be applied throughout this fishery, pending a review of the resource.

(h) That rock lobster heads should not be discarded on or adjacent to reefs.

The first five of these measures are considered to be most essential. The closed season would prevent any disturbance of the very young rock lobsters present on shallow reefs in December, January and

February. As well as aiding the recovery of the stock after each fishing season, it would also give fishermen a clear period in which to plan for maintenance and refitting. At present, they tend to persist in fishing while they see their colleagues pressing on.

At present there is no indication that the practice of "heading" rock lobsters on the reefs has had an effect upon the distribution of the stock in Torres Strait. As fishermen suggest, predators and scavengers may quickly remove the rock lobster heads. However, both *Jasus lalandii* in South Africa and *Panulirus longipes cygnus* in Western Australia have been shown to be repelled by the dead bodies of their species, and the practice of heading on the fishing grounds has been banned in South Africa. Similar action is advisable in Torres Strait pending further study of the behaviour of *P. ornatus*.

2. Applied research recommended at once

(a) Examination of catch per unit effort data being collected from the fishery, to check for possible trends or differences (1) with time during a year, (2) from one reef to another, (3) in long-term trends resulting from fishing.

(b) Investigation of effects of varying environmental conditions on catch per unit effort. The most important environmental factor in this case may be turbidity, possibly affecting both (1) and (2) above. It will be necessary to measure turbidity regularly at selected site(s).

(c) Examine the composition of catches (especially in length frequency distribution) from one reef regularly throughout a year. Appearance and disappearance of particular modal size groups may indicate immigration or emigraiton of particular age groups, while a shift in a mode will give an indication of growth rate.

(d) Apply a high level of fishing pressure on one reef and maintain through successive months, checking for a decline in catch per unit effort by a known fishing effort. Charter of a fishing vessel and team would be required (possibly in close association with other fishing vessel(s) in the initial stages). It is important that the fishing effort be documented in detail. Check for subsequent recovery in following year(s).

(e) Investigate alternative methods for capturing *P. ornatus* alive. This is necessary for the fishery if aiming to meet export requirements. It is also needed as a pre-requisite for certain biological studies (measurement of population density, growth rate, migration, etc.). Tangle nets (set along the path of the tidal current) or shelters (used with some success on *P. argus* in Cuba) might warrant trials.

(f) If live capture has been resolved, tag a significant proportion of a population on selected reef in order to (1) measure population density by mark-recapture, at a period when little migration is occurring,

(2) measure growth rate (important to know whether recruitment into the fishery is at 2 yr or 5 yr of age). (3) follow migration.

(g) Trawl deeper waters in Torres Strait (charter vessel) at selected times and places to resolve annual migration (linked with tagging (f) (3) above).

(h) Maintain collectors (Phillips 1972) for puerulus larvae at selected site(s), checking monthly for the relative strength of larval settlement. This will give an index of variability of year class strength which may be expected.

(i) Check experimentally whether dead bodies repulse living *P. ornatus*.

VI REFERENCES

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