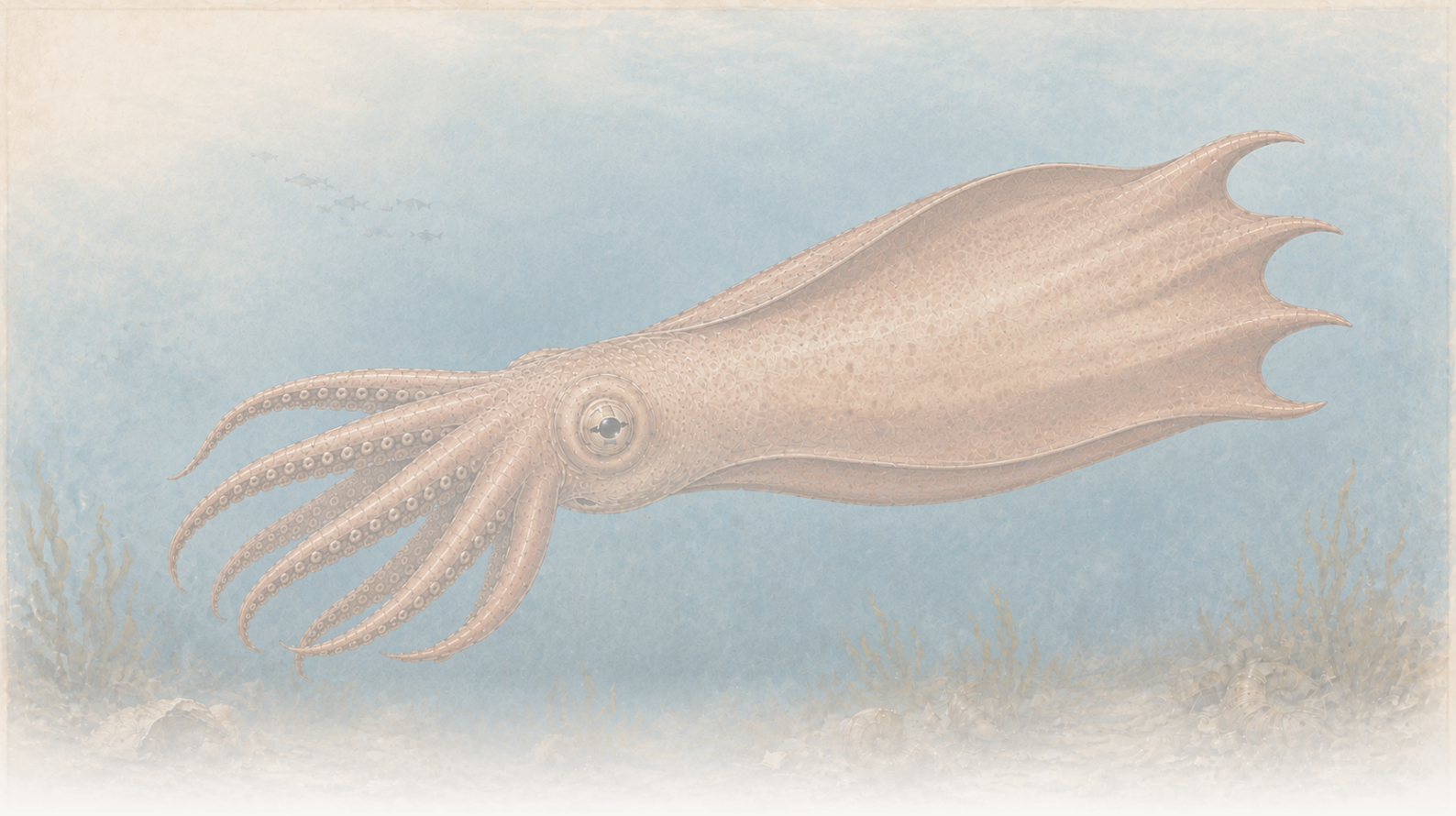




The CLEAN PAPER

WHAT THE PAPER SAYS · WHAT IT DOESN'T · WHY IT MATTERS

Giant Cretaceous octopuses lè ti jé top predators — şùgbón evidence bèrè pèlú jaws, kì í şe sea monsters

Paper kan nínú Science tún şàyèwò huge Cretaceous cephalopod jaws, ó sì jìyan pé Nanaimoteuthis species méjì jé early finned octopuses, pèlú body-size estimates tó dé several meters, bóyá dé 18.6 m. Heavy jaw wear ní daba hard-prey crushing; asymmetric wear lè tóka sí lateralized behavior. Ó jé fossil story tó spectacular, şùgbón clean version kì í şe 'kraken jé gidi': ó jé reconstruction láti jaws, wear patterns, taxonomy àti scaling.

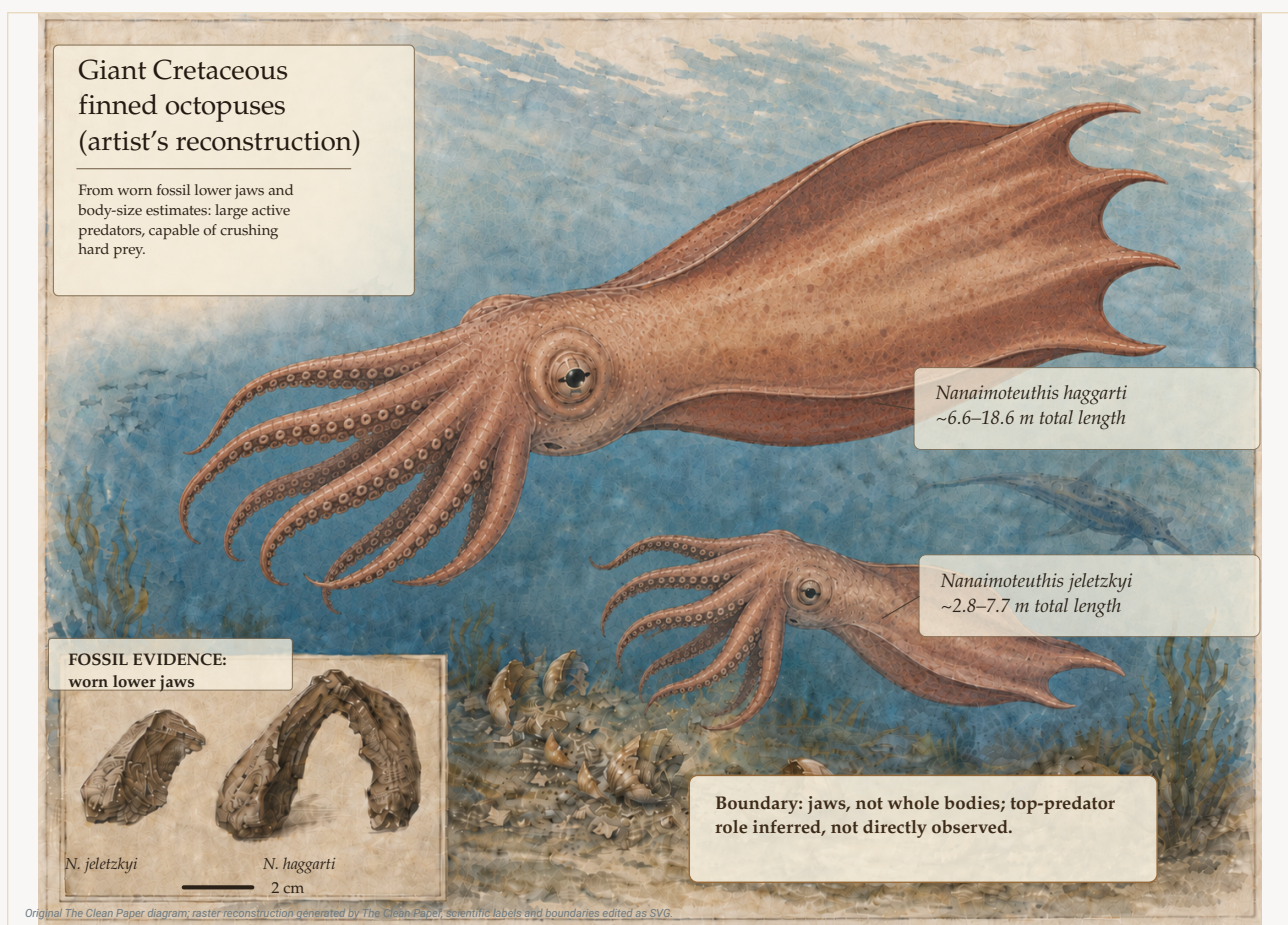
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Paper: *Earliest octopuses were giant top predators in Cretaceous oceans*, Shin Ikegami, Jörg Mutterlose, Kanta Sugiura, Yusuke Takeda, Mehmet Oguz Derin, Aya Kubota, Kazuki Tainaka, Takahiro Harada, Harufumi Nishida, and Yasuhiro Iba, *Science* 392, 406–410 (2026) · DOI: 10.1126/science.aea6285

Ìtàn kraken, tí a yọ gbogbo àṣejù kúrò, tó sì kù sí fossil

Fossil jaw kì í ṣe ẹranko. Ó jẹ apá líle tó kù lára ara rírò, fragment kan tí paleontologists gbódò fi tún anatomy, ìhùwàsí àti ecology ṣe láìṣe bí ẹni pé wọn rí ẹranko nàà nígbà tó wà láàyè. Ìdí nìyẹn tí iwé iwádii yí fi ní fa ènìyàn mọra tó, tó sì rọrùn láti oversimplify. àkólé tó ní fà mọni ni: octopus nílá bí kraken ni wọn ní ṣàkóso òkun Cretaceous. ẹ̀dà tó ọ̀ra dára ju: fossil jaws tí preservation wọn dára gan-an ní daba pé diẹ lára àwọn finned octopuses àkókó tí a mò jẹ carnivore nílá, tí wọn máa ní fọ hard prey leraléra, tí wọn sì lè ti wà ní top tier ti Late Cretaceous marine food webs.

Èyí sì spectacular. Ẹ̀gbọn ó yẹ ká ka a gégé bí reconstruction láti jaw, wear àpẹẹrẹ, taxonomy àti body-size scaling — kì í ṣe sea-monster ìtàn.



Artist reconstruction ti species *Nanaimoteuthis* méjì tí iwé iwádii ní jíròrò, pèlú fossil lower jaws gégé bí ẹ̀rí taara lẹ́yìn body-size reconstruction. Image nàà jẹ reconstruction, kì í ṣe fossil photograph: jaws ni ẹ̀rí tí ó preserved, nígbà tí body length àti top-predator role jẹ inference láti scaling, wear àpẹẹrẹ àti ecology.

Original hybrid diagram — The Clean Paper CC BY 4.0

Ohun tí àwọn olùkòwé ẹ

Àwọn olùkòwé tún ẹ àyèwò fossil jaws láti Cretaceous octobrachian cephalopods — ẹgbé tó gbooro tí octopus àti relatives rẹ wà nínú rẹ. Jaws nílá 15 ni a ti ròyìn tẹlẹ láti Japan àti Vancouver Island. ẹgbé nàà tún rí jaw mû 12 nínú carbonate concretions márùn-ún láti Japan pèlú digital fossil-mining.

Method nàà darapò high-resolution, full-color grinding tomography pèlú zero-shot learning AI àwòṣe, ìyẹn àwòṣe tí a kò train specifically lórí fossils wònyí. Wọn grind concretion kọọkan ní **50-micrometer intervals**, wọn sì photograph ojú tuntun kọọkan láti dá sequence color images nílá. Segmentation àwòṣe tí a ní pè ní DEVA dá digital outline, tàbí mask, fún jaw nínú image kọọkan. Àwọn olùwádíí ṣàyèwò outline wònyí pèlú original images, lẹyìn nàà wọn stack, wọn sì join wọn sí minimally smoothed, original-color 3D àwòṣe. Èyí jẹ kí wọn rí jaw tó farapamọ sínú àpáta, kí wọn sì ṣàyèwò chip, scratch àti wear àbùdá tó kékeré lórí ojú. Grinding tomography pa àpáta àpẹrẹ márùn-ún nàà run, ṣùgbọ́n image dátà, masks àti 3D àwòṣe ni wọn archive.

Lẹyìn nàà wọn ẹ ohun méréin tó so mó ara wọn.

Àkókó, wọn revise taxonomy. Fossil jaws tí a ti pin sí species márùn-ún ni wọn tún ṣètò sí species méjì: **Nanaimoteuthis jeletzkyi** àti **Nanaimoteuthis haggarti**. Genus nàà, tí a ti ka sí relative vampire squid tẹlẹ, ni ìwé ìwádíí yí fi sínú **Cirrata**, finned octopuses.

Èlẹ̀kẹ̀jì, wọn fa timeline nàà sí èyìn. Material tuntun nàà mú **N. jeletzkyi** dé earliest Cenomanian, ní ayíká **100 million years ago**, ó sì fa àkọ̀sílẹ̀ tí a mò fún finned octopuses sí èyìn ní tó 15 million years, àti octopuses ní gbogbogbo ní tó 5 million years.

Èlẹ̀kẹ̀ta, wọn ìṣíró àfojúsùn body ìwòṇ láti jaw ìwòṇ. Pèlú allometric relationships láti modern long-bodied finned octopuses, wọn ìṣíró àfojúsùn mantle length, lẹyìn nàà total length. Estimate wọn gbooro: **N. jeletzkyi** lè dé tó **2.8 sí 7.7 meters** total length, **N. haggarti** sì tó **6.6 sí 18.6 meters**. Upper ààlà yí ni ibi tí “kraken” èdè ti wá.

Supplementary ọ̀nà fi scaling chain nàà hàn gbangba. Níbi tó yẹ, wọn reconstruct worn tàbí weathered jaw outline, lẹyìn nàà wọn lo **12 species-specific relationships** láàárín lower-jaw hood length àti mantle length. Wọn ẹ account fún average **39% fixation shrinkage** nínú relevant modern specimens, wọn sì yí mantle length padà sí total length pèlú ratio **4.2** tí wọn rí láti long-bodied living finned octopuses. Yíyàn wònyí ní fún ààlà, kì í ẹ taara measurement ti fossil body.

Èlẹ̀kẹ̀rín, wọn ṣàyèwò wear. Àwọn jaw tó tóbi jù jẹ blunt àti rounded ní ibi tí juvenile máa ní sharper jaw elements. Wọn ní chips, scratches, polished ojú, cracks àti asymmetric loss ní jaw edges. Àwọn olùkòwé tùmò èyí gégé bí ẹ́rì ti repeated hard-prey crushing, àti bóyá lateralized ìhùwàsí.

Ohun tí wọn rí

Ó ẹẹ ẹ gan-an pé wọn jẹ **early finned octopuses**, kì í ẹ **vampire squids**. Supplementary taxonomy yà step méjì tó so mó ara wọn. Bridge kọọkan jẹ strip jaw ohun èlò tó so hood mó lateral wall. Nínú **Nanaimoteuthis**, bridge wònyí farapamọ patapata lábẹ inner àti outer jaw plates, àpẹrẹ kan tó ẹ àtílẹyìn fún placement genus nàà nínú Cirrata. Broad jaw wings rẹ tún ẹ àtílẹyìn fún assignment sí long-bodied ẹgbé ti finned octopuses. Èyí ẹ pàtàkì nítorí ìwé ìwádíí kì í kan sọ “large cephalopod”; ó ní yí ibi tí fossil wònyí wà nínú octopus history padà.

Wọn ti pé gan-an. New specimens nàà fi finned octopuses sí ayíká **100 million years ago**, ní Late Cretaceous. Èyí mú wọn jẹ diẹ lára octopus-line animals àkókò tí a mò.

Wọn lè ti tóbi gan-an. Body-size ìsírò àfojúsùn kì í ẹ single measurement láti preserved body; wọn jẹ calculations láti jaws. Sùgbón nòmbà nàà nílá paapaa nígbà tá a bá sọ ó pèlú ìṣọra. Species kékeré, *N. jeletzkyi*, ni a ìsírò àfojúsùn sí several meters total length. Species tó tóbi, *N. haggarti*, lè dé upper ìsírò àfojúsùn tó **18.6 meters**, tó jọ scale ti marine predators tó tóbi jù ní àkókò nàà àti largest living cephalopods.

Jaws nàà ní wear púpò. Nínú specimens tó tóbi jù, jaw ohun èlò tó sọ̀nù dé tó **10% ti total jaw length**. ìwé ìwádíí jìyan pé wear yíì kì í ẹ preparation damage tàbí transport abrasion: specimens wá láti low-energy outer-shelf deposits, chips àti scratches preserved lónà tó bá lò mu, co-occurring fossil squid jaws kò sì fi àpẹrẹ kan nàà hàn. Àwọn olùkòwé fi wear nàà wé modern durophagous cephalopods — ẹranko tó n jẹ hard prey.

Wear nàà jẹ asymmetric. Right jaw edge ní wear púpò ju left lọ nínú species méjèjè. Àwọn olùkòwé tùmò èyí sí ẹ ẹ ẹ behavioral lateralization: preference láti lo side kan ju ekeji lọ. Nítorí lateralized ìhùwàsí n ní association pèlú complex nervous ètò nínú modern animals, wọn daba pé octopuses àtijọ wònyí lè ti ní advanced intelligence.

Ohun tí èyí ẹ ẹ tùmò sí

Ecological interpretation tó lágbára jù ni pé finned octopuses ní Late Cretaceous kì í ẹ gbogbo wọn ni small abẹlẹ animals nínú ecosystem tí large vertebrates n dominate. Top-predator ọ̀ràn àwọn olùkòwé darapọ̀ àwàrí méjì: gigantic estimated body ìwọn àti durophagous carnivory — repeated processing of hard animal prey — tí a infer láti jaw wear. Papọ̀, àwàrí wònyí ẹ àtìlẹ̀yìn fún possibility pé invertebrate lineage kan wọ top tier food web tí a sàbà so mó mosasaurs, plesiosaurs, large fish àti sharks.

Evolutionary ìtàn nàà tún wunì. Vertebrate marine predators àti octopus-line cephalopods gba route tó yàtò sí ara wọn sí predation. Vertebrates ní jaws, streamlined bodies, wọn sì sàbà dín external armor kù. Octopus relatives dín shell kù tàbí internalize rẹ, wọn di soft-bodied àti mobile, sùgbón wọn pa powerful jaws àti flexible arms mó. ìwé ìwádíí nàà frame èyí gégé bí convergent path sí large, intelligent marine predators.

Apá ìhùwàsí ni speculative jù. Extensive wear ẹ àtìlẹ̀yìn fún hard-prey feeding. Large ìwọn ẹ àtìlẹ̀yìn fún ecological importance. Asymmetric wear ẹ àtìlẹ̀yìn fún ẹ ẹ lateralized ìhùwàsí. Sùgbón “advanced intelligence” jẹ inference, kì í ẹ fossil measurement taara. Ó ẹ ẹ gbà nínú context biology octopus, sùgbón a kò gbọdọ mú un lágbára ju ẹrì lọ.

Ohun tí èyí kò fi ẹrì múlẹ̀

- Kò preserve whole body ti giant octopus. Reconstruction dá lórí jaws ní pàtàkì, body ìwọn sì jẹ inference láti modern finned-octopus scaling.
- Kò fi stomach contents tàbí taara prey remains hàn. Hard-prey feeding jẹ inference láti jaw wear, kì í ẹ fossilized meal.
- **Authored research article** nàà kò propose pé wọn jẹ mosasaurs, plesiosaurs tàbí large marine reptiles mû. Research text rẹ lo àwọn ẹranko wònyí gégé bí ifiwéra ti body ìwọn àti ecological position nìkan.

- Kò fún precise body length. Estimates jẹ ààlà, claim tó tóbi jù jẹ upper ìsírò àfojúsùn.
- Kò measure intelligence taara. Lateralized jaw wear ni a túmò sí ẹẹ́ ẹẹ́ behavioral lateralization, tó lè daba complex ìhùwàsí; ìyẹn ẹ́ ní inferential steps púpò kí a tó mọ ohun tí ẹranko lè ẹ.
- Kò túmò sí pé gbogbo early octopuses jẹ giant. Claim jẹ fún *Nanaimoteuthis* species wònyí, pàápàá N. haggarti, kì í ẹ gbogbo early octopus lineage.

Báwo ni ẹrí ẹ lágbara tó?

Fún existence ti very large Cretaceous octopus-line jaws, ẹrí lágbara: ìwé ìwádíí ní described specimens, digital àwòṣe, stratigraphic context àti ìfiwéra pẹ̀lú modern àti fossil cephalopod jaws.

Fún hard-prey feeding, ẹrí tún reasonably lágbara. Wear àpẹẹrẹ detailed — chips, scratches, polish, cracks, asymmetric loss — àwọn olùkòwé sì ẹ effort láti exclude preparation damage àti transport abrasion. ìfiwéra pẹ̀lú modern durophagous cephalopods jẹ bridge tó ẹẹ́ gbà.

Fún exact body ìwọn àti top-predator status, ìgbẹ̀kẹ̀lé yẹ kí ó jẹ moderate. Size ìsírò àfojúsùn dá lórí allometric scaling láti living long-bodied finned octopuses. Ecological role jẹ inference láti combination estimated ìwọn àti durophagous carnivory, kì í ẹ taara observation. Argument náà coherent, ẹ̀gbọ̀n ó jẹ ecological reconstruction, kì í ẹ taara census ti food web.

Kí nìdí tí ó fi ẹ pàtàkì?

ìwé ìwádíí yí jẹ example tó dára ti bí paleontology ẹ lè ẹ lágbara claims láti partial ẹrí láìsí magic. Jaw ni object. Wear ni behavioral trace. Scaling curve ni bridge láti hard fossil sí soft body. Step kọ̀ọkan ní fi power kún un, step kọ̀ọkan sì ní fi uncertainty kún un. Lesson yẹn ni ó yẹ ká pa mọ.

Ó tún correct familiar picture. A sáà foju inú Cretaceous oceans gégé bí ayé large vertebrate predators àti smaller shelled prey. Fossils wònyí ní daba pé diẹ lára soft-bodied invertebrates kò kan ní farapamọ ní abẹ́ food web náà. Ó ẹẹ́ ẹ kí wọn máa compete ní upper ìpele rẹ.

èsi náà visual gan-an, ẹ̀gbọ̀n clean ìtàn kì í ẹ “kraken jẹ gidi.” Ó jẹ pé large, early finned octopuses fi jaws sílẹ, láti inú wọn ni àwọn olùwádíí ẹ reconstruct gigantic bodies àti repeated hard-prey feeding — combination tó ní fún serious, ẹ̀gbọ̀n inferential, ọ̀ràn pé invertebrate top predators wà ní age of marine reptiles.

Àkótán kedere

Àwọn olùwádíí tún ẹ̀yẹ̀wò Cretaceous fossil cephalopod jaws láti Japan àti Vancouver Island, wọn sì lo full-color grinding tomography pẹ̀lú zero-shot AI segmentation láti digitally reconstruct hidden jaws gégé bí detailed 3D specimens láti Japanese àpáta. Wọn tún organize fossil taxa sí species ***Nanaimoteuthis*** méjì, tí wọn túmò sí early finned octopuses. Fossils náà fa àkọ̀sílẹ́ finned octopuses sí tó **100 million years ago**. Láti jaw-size scaling,

àwọn olùkòwé ìsírò àfójúsùn total lengths tó **2.8–7.7 m** fún **N. jeletzkyi** àti **6.6–18.6 m** fún **N. haggarti**. Heavy jaw wear — chips, scratches, polish, cracks àti asymmetric edge loss — ní daba repeated hard-prey crushing àti bóyá lateralized ìhùwàsí. Gigantic estimated ìwọn pèlú durophagous carnivory ẹ̀ àtìlẹ̀yìn fún interpretation pé octopuses wònyí lè ti wà ní top tier marine food webs. ẹ̀rí kò ní whole bodies, exact lengths, identified prey tàbí taara measurements of intelligence. Authored research article kò propose predation lórí large marine reptiles.

Àyèwò láìsí àṣejù

Ohun tí iwé iwádíí fi hàn: Large Cretaceous octopus-line jaws, tí a revise sí Nanaimoteuthis species méjì, tí a sì fi sínú finned octopuses; àkọsílẹ̀ Cirrata tó ti pé sí i; body-size ìsírò àfójúsùn tó dé several meters, bóyá dé 18.6 m; extensive adult jaw wear tó bá hard-prey feeding mu; asymmetric wear tó bá ẹ́ẹ̀ ẹ́ẹ̀ lateralized ìhùwàsí mu.

Ohun tó ẹ́ẹ̀ gbà ṣùgbọ̀n tí a kò fi ẹ̀rí múlẹ̀: Pé N. haggarti jẹ ọkan lára invertebrates tó tóbi jù lọ tí a ti mò; pé àwọn ẹranko yíi jẹ true top predators; pé asymmetric wear ní fi behavioral lateralization àti advanced cognition hàn.

Ohun tí kò fi hàn: Whole-body fossils; taara prey tàbí stomach contents; exact body lengths; predation lórí large marine reptiles; ẹ̀rí taara of intelligence; pé gbogbo early octopuses jẹ giants.

Main limitations: Body ìwọn jẹ inference pèlú multi-step jaw-to-mantle-to-total-length scaling àwòṣe; top-predator status jẹ inference láti estimated ìwọn + durophagous carnivory; ìhùwàsí jẹ inference láti asymmetric wear; fossils preserve jaws, kì í ẹ́ ẹ́ whole animals tàbí taara prey.

Confidence wo ni gbogbogbò reader yẹ kí ó ní? Gíga pé fossils wònyí ní very large early finned-octopus jaws pèlú lágbára wear ẹ̀rí. Medium pé largest animals dé upper end 6.6–18.6 m ìsírò àfójúsùn. Medium pé wọn jẹ true top predators dípò large hard-prey carnivores nìkan. Kéré pé a lè sọ ohun kan specific nípa intelligence wọn. Ìpò tó yẹ: fossil ìtàn tó spectacular, ṣùgbọ̀n tí a kò láti jaws àti inference, kì í ẹ́ ẹ́ complete sea monster.

Àwọn àtúnṣe lẹ́yìn itẹ́jádẹ

- **Àtúnṣe · 2026-07-26**

Lẹ́yìn feedback láti corresponding author Yasuhiro Iba, a sọ ní kedere pé authored research article lo large marine reptiles gégé bí comparison, kì í ẹ́ ẹ́ prey, a sì ṣàlàyé ìyàtọ̀ láàárín authored research article àti separate Editor's Summary ti Science nípa prey attribution. A tún gbooro digital fossil-mining method àti top-predator evidence, a sì ṣàyèwò complete supplementary package.

Àwọn orísun

Science 392, 406–410 (2026)

<https://doi.org/10.1126/science.aea6285>

Supplementary methods, text, figures S1–S6, and references

https://www.science.org/doi/suppl/10.1126/science.aea6285/suppl_file/science.aea6285_sm.pdf

Supplementary tables S1–S6

https://www.science.org/doi/suppl/10.1126/science.aea6285/suppl_file/science.aea6285_tables_s1_to_s6.zip

MDAR reproducibility checklist

https://www.science.org/doi/suppl/10.1126/science.aea6285/suppl_file/science.aea6285_mdar_reproducibility_checklist.pdf

Fossil lower jaws dataset — Figshare

<https://doi.org/10.6084/m9.figshare.27933759>

Tomographic animations — Figshare

<https://doi.org/10.6084/m9.figshare.27935904>

CPU-enabled AI segmentation code — Zenodo

<https://doi.org/10.5281/zenodo.15176344>