

**Describing the Competency Queries of the
MarineTLO Ontology,
From Ver 1.0 to Ver 4.0**

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FORTH

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Intro

Motivated by the need and the collected feedback of the iMarine community, we proposed a set of *competency queries* to in order to design the MarineTLO *ontology*. In this document we describe them, from the competency queries related to the version 1.0.0 to the one related to version 4.0.0. It is important to notice that the formalization of such queries is based *only* on the classes and the properties provided by MarineTLO. Moreover, trough the use of the *mappings* and *transformation rules* we are able to access to the *grounds*, that are distributed across different iMarine sources, to provide concrete set of results.

Informal Competence Queries

Competency Queries related to MarineTLO Version 1.0.0

#Query	For a scientific name of a species (e.g. <i>Thunnus Albacares</i>), find
Q ₁	find its target
Q ₂	find its WoRMS classification
Q ₃	find its targeted by
Q ₄	find the WoRMS classification of its prey of
Q ₅	find its references/images/db
Q ₆	find more general terms for it
Q ₇	Its types of identifier and their values (e.g. FLOD codes, ECO codes, WoRMS Id)
Q ₈	its competitors
Q ₉	the codes of the biotic type that are its predators
Q ₁₀	the codes and the WoRMS classific. of the biotic type that are its predators

Competency Queries related to MarineTLO Version 2.0.0

#Query	For a scientific name of a species (e.g. <i>Thunnus Albacares</i>), find
Q ₁	the biotic types that are its predators
Q ₂	its WoRMS classification
Q ₃	the biotic types that are its prey of
Q ₄	the WoRMS classification of the biotic type that are its prey of
Q ₅	its references/images/db
Q ₆	the biotic type that are more general terms for it
Q ₇	Its types of identifier and their values (e.g. FLOD codes, ECO codes, WoRMS Id)

Q ₈	the biotic type that are its competitors
Q ₉	the codes of the biotic type that are its predators
Q ₁₀	the codes and the WoRMS classific. of the biotic type that are its predators
Q ₁₁	Get the list of species provided by the different organizations
Q ₁₂	its scientific name, assignment data and authority

Competency Queries related to MarineTLO Version 3.0.0

#Query	For a scientific name of a species (e.g. <i>Thunnus Albacares</i> or <i>Poromitra Crassiceps</i>), find/give me
Q ₁	the biological environments (e.g. ecosystems) in which the species has been introduced and more general descriptive information of it (such as the country)
Q ₂	its common names and their complementary info (e.g. languages and countries where they are used)
Q ₃	the water areas and their FAO codes in which the species is native
Q ₄	the countries in which the species lives
Q ₅	the water areas and the associated FAO portioning related to a country
Q ₆	the presentation w.r.t Country, Ecosystem, Water Area and Exclusive Economical Zone (of the water area)
Q ₇	the projection w.r.t. Ecosystem and Competitor, providing for each competitor the identification information (e.g. several codes provided by different organizations)
Q ₈	a map w.r.t. Country and Predator, providing for each predator both the identification information and the biological classification
Q ₉	who discover it, in which year, the biological classification, the identification information, the common names - providing for each common name the language, the countries where it is used in.

Competency Queries related to MarineTLO Version 4.0.0

#Query	For a scientific name of a species (e.g. <i>Thunnus Albacares</i> or <i>Poromitra Crassiceps</i>), find/give me
Q ₁	the biological parameters (e.g. <i>size, weight, longevity</i> , etc) of it and the related publications where they are documented
Q ₂	the fishing related activities happened in a specific water area in a given year
Q ₃	the fishing related activities with respect to water area and the type of equipment used for
Q ₄	the fishing related activities happened in a specific water area , for each

	activity provides the other type of biotic element that have been caught with as target species (Target Catch and Non Target Catch), if any. <i>(In other words, when thunnus albacares has been caught in a specific area, we would like to know what are the others species that has been caught as well as.)</i>
Q ₅	the fishing related activities happened in a specific water area , for each activity provides the other type of biotic element that have been caught and discarded (Target ByCatch and Non Target ByCatch), if any.
Q ₆	the fishing related activities (world wide) that involved the given species
Q ₇	the reference resources and their types associated with it related to a specific year and author
Q ₈	the input , the method and the output produced
Q ₉	who hold the right of the software used to calculate the given indicator
Q ₁₀	the software that has been used and the server used for the execution .

Formal Competence Queries

Competency Queries related to MarineTLO Version 1.0.0

#Query	
Q ₁	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?preys WHERE { <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> tloCore:LT5_usually_is_predator_of ?preys } </pre>
Q ₂	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT ?genus ?family ?order ?class ?phylum ?kingdom WHERE { <http://www.marinespecies.org/entity#WoRMS:127027/Thunnus_albacares> tloCore:LT8_usually_belongs_to ?genus . ?genus tloCore:LT8_usually_belongs_to ?family . ?family tloCore:LT8_usually_belongs_to ?order . ?order tloCore:LT8_usually_belongs_to ?class . ?class tloCore:LT8_usually_belongs_to ?phylum . ?phylum tloCore:LT8_usually_belongs_to ?kingdom } </pre>
Q ₃	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT ?prey WHERE { ?prey tloCore:LT5_usually_is_preay_of <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> } </pre>
Q ₄	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> </pre>

	<pre> SELECT DISTINCT ?prey ?genus ?family ?order ?class ?phylum ?kingdom WHERE { ?prey tloCore:LT5_usually_is_preay_of <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> . ?prey tloCore:LT8_usually_belongs_to ?genus . ?genus tloCore:LT8_usually_belongs_to ?family . ?family tloCore:LT8_usually_belongs_to ?order . ?order tloCore:LT8_usually_belongs_to ?class . ?class tloCore:LT8_usually_belongs_to ?phylum . ?phylum tloCore:LT8_usually_belongs_to ?kingdom } </pre>
Q5	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?references WHERE { <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> tloCore:LX2_is_about_type ?references } </pre>
Q6	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> SELECT ?moreGeneralTerms WHERE { <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> rdf:type ?moreGeneralTerms } </pre>
Q7	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/> prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?code ?codeType WHERE { ecol:thunnus_albacares tloCore:LX1_is_identified_by ?code . ?code tloimarine:LX_has_code_type ?codeType . } </pre>
Q8	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/> SELECT DISTINCT ?x WHERE { { ecol:thunnus_albacares tloimarine:LT5_usually_is_competitor_of ?x }UNION{ ?x tloimarine:LT5_usually_is_competitor_of ecol:thunnus_albacares } } </pre>
Q9	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?predators ?code ?codeType WHERE{ <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> tloCore:LT5_usually_is_predator_of ?predators . ?predators tloCore:LX1_is_identified_by ?code . ?code tloimarine:LX_has_code_type ?codeType . } </pre>
Q10	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT ?prey ?code ?codeType ?genus ?family ?order ?class ?phylum ?kingdom WHERE { ?prey tloCore:LT5_usually_is_preay_of <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> . } </pre>

```

?prey tloCore:LX1_is_identified_by ?code .
?code tloimarine:LX_has_code_type ?codeType .
?prey tloCore:LT8_usually_belongs_to ?genus .
?genus tloCore:LT8_usually_belongs_to ?family .
?family tloCore:LT8_usually_belongs_to ?order .
?order tloCore:LT8_usually_belongs_to ?class .
?class tloCore:LT8_usually_belongs_to ?phylum .
?phylum tloCore:LT8_usually_belongs_to ?kingdom
}

==alt==

define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?prey ?code ?codeType ?genus ?family ?order ?class ?phylum ?kingdom WHERE {
  <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares>
    tloCore:LT5_usually_is_predator_of ?prey .
  ?prey tloCore:LX1_is_identified_by ?code .
  ?code tloimarine:LX_has_code_type ?codeType .
  ?prey tloCore:LT8_usually_belongs_to ?genus .
  ?genus tloCore:LT8_usually_belongs_to ?family .
  ?family tloCore:LT8_usually_belongs_to ?order .
  ?order tloCore:LT8_usually_belongs_to ?class .
  ?class tloCore:LT8_usually_belongs_to ?phylum .
  ?phylum tloCore:LT8_usually_belongs_to ?kingdom
}

```

Competency Queries related to MarineTLO Version 2.0.0

Q1	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?preys WHERE { <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> tloCore:LT5_usually_is_predator_of ?preys } </pre>
Q2	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT ?genus ?family ?order ?class ?phylum ?kingdom WHERE { <http://www.marinespecies.org/entity#WoRMS:127027/Thunnus_albacares> tloCore:LT8_usually_belongs_to ?genus . ?genus tloCore:LT8_usually_belongs_to ?family . ?family tloCore:LT8_usually_belongs_to ?order . ?order tloCore:LT8_usually_belongs_to ?class . ?class tloCore:LT8_usually_belongs_to ?phylum . ?phylum tloCore:LT8_usually_belongs_to ?kingdom } </pre>
Q3	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT ?prey WHERE { ?prey tloCore:LT5_usually_is_preay_of <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> } </pre>
Q4	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> </pre>

	<pre> SELECT DISTINCT ?prey ?genus ?family ?order ?class ?phylum ?kingdom WHERE { ?prey tloCore:LT5_usually_is_predator_of <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> . ?prey tloCore:LT8_usually_belongs_to ?genus . ?genus tloCore:LT8_usually_belongs_to ?family . ?family tloCore:LT8_usually_belongs_to ?order . ?order tloCore:LT8_usually_belongs_to ?class . ?class tloCore:LT8_usually_belongs_to ?phylum . ?phylum tloCore:LT8_usually_belongs_to ?kingdom } </pre>
Q5	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?pics WHERE { <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> tloCore:LX2_is_about_type ?z. ?z dc:identifier ?pics . FILTER (regex(?pics, 'jpg') regex(?pics, 'jpeg')) } </pre>
Q6	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> SELECT ?moreGeneralTerms WHERE { <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> rdf:type ?moreGeneralTerms } </pre>
Q7	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/> prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?code ?codeType WHERE { ecol:thunnus_albacares tloCore:LX1_is_identified_by ?bncode . ?bncode tloimarine:LX_has_code_type ?codeType . ?bncode tloimarine:assignedCode ?code } </pre>
Q8	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> SELECT DISTINCT ?x ?y WHERE { ?x tloimarine:LT5_usually_is_competitor_of ?y } </pre>
Q9	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?predators ?code ?codeType WHERE { <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> tloCore:LT5_usually_is_predator_of ?predators . ?predators tloCore:LX1_is_identified_by ?bncode . ?bncode tloimarine:LX_has_code_type ?codeType . ?bncode tloimarine:assignedCode ?code } </pre>
Q10	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT ?prey ?code ?codeType ?genus ?family ?order ?class ?phylum ?kingdom WHERE { ?prey tloCore:LT5_usually_is_preoy_of <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares> . ?prey tloCore:LX1_is_identified_by ?bncode . ?bncode tloimarine:LX_has_code_type ?codeType . ?bncode tloimarine:assignedCode ?code . ?prey tloCore:LT8_usually_belongs_to ?genus . } </pre>


```

?genus tloCore:LT8_usually_belongs_to ?family .
?family tloCore:LT8_usually_belongs_to ?order .
?order tloCore:LT8_usually_belongs_to ?class .
?class tloCore:LT8_usually_belongs_to ?phylum .
?phylum tloCore:LT8_usually_belongs_to ?kingdom
}

==alt==

define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?prey ?code ?codeType ?genus ?family ?order ?class ?phylum ?kingdom WHERE {
  <http://www.ecoscope.org/ontologies/ecosystems/thunnus_albacares>
    tloCore:LT5_usually_is_predator_of ?prey .
  ?prey tloCore:LX1_is_identified_by ?bncode .
  ?bncode tloimarine:LX_has_code_type ?codeType .
  ?bncode tloimarine:assignedCode ?code .
  ?prey tloCore:LT8_usually_belongs_to ?genus .
  ?genus tloCore:LT8_usually_belongs_to ?family .
  ?family tloCore:LT8_usually_belongs_to ?order .
  ?order tloCore:LT8_usually_belongs_to ?class .
  ?class tloCore:LT8_usually_belongs_to ?phylum .
  ?phylum tloCore:LT8_usually_belongs_to ?kingdom
}

```

```

Q11 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?s WHERE {
  ?s rdf:type tloCore:BT27_Species
}

```

```

Q12 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?sname ?aname ?date WHERE {
  ecol:thunnus_albacares tloCore:LX6_type_was_attributed_by ?sbn .
  ?sbn rdf:type tloimarine:BC46_1_Scientific_Name_Assignment .
  ?sbn tloimarine:assignedName ?sname .
  ?sbn tloCore:LC13_is_carried_out_by ?sbn2 .
  ?sbn2 rdf:type tloCore:BC8_Actor .
  ?sbn2 tloimarine:name ?aname .
  ?sbn tloimarine:assignedDate ?date .
}

```

Competency Queries related to MarineTLO Version 3.0.0

```

Q1 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>
prefix fishbase: <http://www.fishbase.org/entity#>

SELECT DISTINCT ?ecosystem ?ecosystemType ?country WHERE {
  ?species tloimarine:LX14_is_introduced_at ?ecosystem.
  ?ecosystem rdf:type tloCore:BC14_Ecosystem_Environment.
  ?ecosystem tloCore:LX3_has_type ?ecosystemType .
  ?ecosystem fishbase:isAssociatedWith ?country .
}

```

```

Q2 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?commonName ?commonNameLanguage ?country WHERE {
  ecol:thunnus_albacares tloCore:LX4_has_appellation ?x .
  ?x rdf:type tloimarine:CommonName .
  ?x tloimarine:name ?commonName .
  ?x tloimarine:hasLanguage ?commonNameLanguage .
  ?x tloimarine:is_used_in ?country
}

Q3 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?waterarea ?waterareacode WHERE {
  ecol:thunnus_albacares tloimarine:LX13_is_native_at ?waterarea.
  ?waterarea rdf:type tloCore:BC15_Water_Area .
  ?waterarea tloCore:LC1_is_identified_by ?x .
  ?x tloimarine:assignedCode ?waterareacode .
}

Q4 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>

SELECT DISTINCT ?country WHERE {
  ecol:thunnus_albacares tloimarine:LX10_is_biotically_related_to ?country .
  ?country rdf:type tloimarine:BC4_2_Country
}

Q5 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?country ?waterarea ?subarea ?division ?subdivision WHERE {
  ?country tloimarine:is_associated_with ?waterarea.
  OPTIONAL {
    ?waterarea tloCore:LC27_has_section ?subarea .}
  OPTIONAL {
    ?subarea tloCore:LC27_has_section ?division .}
  OPTIONAL {
    ?division tloCore:LC27_has_section ?subdivision .}
  ?country a tloimarine:BC4_2_Country
}

==alt==

define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?waterarea ?area_id ?subarea ?subarea_id ?division ?division_id ?subdivision ?subdivision_id
WHERE {
  ?waterarea rdf:type tloCore:BC15_Water_Area .
  ?waterarea tloCore:LC1_is_identified_by ?x.
  ?x tloimarine:assignedCode ?area_id .
  OPTIONAL {
    ?waterarea tloCore:LC27_has_section ?subarea .
    ?subarea tloCore:LC1_is_identified_by ?y.
    ?y tloimarine:assignedCode ?subarea_id .
  }
}

```

```

}
OPTIONAL {
  ?subarea tloCore:LC27_has_section ?division .
  ?division tloCore:LC1_is_identified_by ?z.
  ?z tloimarine:assignedCode ?division_id .
}
OPTIONAL {
  ?division tloCore:LC27_has_section ?subdivision .
  ?subdivision tloCore:LC1_is_identified_by ?w.
  ?w tloimarine:assignedCode ?subdivision_id .
}
}

```

Q6 **define** input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

```

SELECT ?ecosystem ?country ?waterarea ?eez WHERE {
  <http://www.fishbase.org/entity#selar_boops> tloimarine:LX10_is_biotically_related_to
  ?waterarea.
  ?waterarea rdf:type tloCore:BC15_Water_Area.
  ?waterarea tloimarine:is_associated_with ?eez .
  ?eez rdf:type tloimarine:BC4_1_Exclusive_Economic_Zone .
  ?country tloimarine:is_associated_with ?waterarea .
  ?country rdf:type tloimarine:BC4_2_Country .
  ?ecosystem tloimarine:is_associated_with ?country .
  ?ecosystem rdf:type tloCore:BC14_Ecosystem_Environment
}

```

Q7 **define** input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

```

SELECT ?ecosystem ?competitors ?code ?codeType WHERE {
  ecol:thunnus_albacares tloimarine:LX10_is_biotically_related_to ?ecosystem.
  ?ecosystem rdf:type tloCore:BC14_Ecosystem_Environment .
  ecol:thunnus_albacares tloimarine:LT5_usually_is_competitor_of ?competitors .
  ?competitors tloimarine:LX10_is_biotically_related_to ?ecosystem.
  ?competitors tloCore:LX1_is_identified_by ?bncode .
  ?bncode tloimarine:LX_has_code_type ?codeType .
  ?bncode tloimarine:assignedCode ?code
}

```

Q8 **define** input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

```

SELECT ?country ?preys ?code ?codeType ?genus ?family ?order ?class ?phylum ?kingdom WHERE {
  ecol:thunnus_albacares tloimarine:LX10_is_biotically_related_to ?country.
  ?country rdf:type tloimarine:BC4_2_Country .
  ecol:thunnus_albacares tloCore:LT5_usually_is_predator_of ?preys .
  ?preys tloCore:LX1_is_identified_by ?bncode .
  ?bncode tloimarine:LX_has_code_type ?codeType .
  ?bncode tloimarine:assignedCode ?code .
  ?preys tloCore:LT8_usually_belongs_to ?genus .
  ?genus tloCore:LT8_usually_belongs_to ?family .
  ?family tloCore:LT8_usually_belongs_to ?order .
  ?order tloCore:LT8_usually_belongs_to ?class .
  ?class tloCore:LT8_usually_belongs_to ?phylum .
  ?phylum tloCore:LT8_usually_belongs_to ?kingdom
}

```

Q9 **define** input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

```

prefix ecol: <http://www.ecoscope.org/ontologies/ecosystems/>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?sname ?aname ?date ?cname ?uc ?lang ?code ?codeType WHERE {
  ecol:thunnus_albacares tloCore:LX6_type_was_attributed_by ?sbn .
  ?sbn rdf:type tloimarine:BC46_1_Scientific_Name_Assignment .
  ?sbn tloimarine:assignedName ?sname .
  ?sbn tloCore:LC13_is_carried_out_by ?sbn2 .
  ?sbn2 rdf:type tloCore:BC8_Actor .
  ?sbn2 tloimarine:name ?aname .
  ?sbn tloimarine:assignedDate ?date .

  ecol:thunnus_albacares tloCore:LX4_has_appellation ?cn .
  ?cn rdf:type tloimarine:CommonName .
  ?cn tloimarine:name ?cname .
  ?cn tloimarine:hasLanguage ?lang .
  ?cn tloimarine:is_used_in ?uc .

  ecol:thunnus_albacares tloCore:LX1_is_identified_by ?bncode .
  ?bncode tloimarine:LX_has_code_type ?codeType .
  ?bncode tloimarine:assignedCode ?code .

  ecol:thunnus_albacares tloCore:LT8_usually_belongs_to ?genus .
  ?genus tloCore:LT8_usually_belongs_to ?family .
  ?family tloCore:LT8_usually_belongs_to ?order .
  ?order tloCore:LT8_usually_belongs_to ?class .
  ?class tloCore:LT8_usually_belongs_to ?phylum .
  ?phylum tloCore:LT8_usually_belongs_to ?kingdom
}

```

Competency Queries related to MarineTLO Version 4.0.0

```

Q1 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT ?bio_param ?value WHERE{
  ?bn rdf:type tloCore:BC44_Attribute_Assignment .
  ?bn tloCore:LX6_assigned_attribute_to_type ?species .
  ?bn tloCore:LC9_assigned ?bn2 .
  ?bn2 rdf:type tloCore:BC62_Statistic_Indicator .
  ?bn2 tloCore:LC19_has_dimension ?bio_param .
  ?bn2 tloCore:LC20_has_value ?value .
}

Q7 define input:inference 'http://www.ics.forth.gr/isl/Schema'
define input:same-as 'yes'
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/>
prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/>

SELECT
DISTINCT ?species ?resource ?aname ?title ?date ?insource ?typeOf ?language ?keywords ?remarks
WHERE{
  ?resource rdf:type tloimarine:BibliographyResource .
  ?resource tloCore:LX2_is_about_type ?species .
  ?species rdf:type tloCore:BT27_Species .
  ?resource tloimarine:authorName ?aname.
  ?resource tloimarine:inSource ?insource .
  ?resource tloimarine:title ?title .
  ?resource tloimarine:date ?date .
  ?resource tloimarine:isTypeOf ?typeOf .
  ?resource tloimarine:hasLanguage ?language.
  ?resource tloimarine:keyWords ?keywords.
  ?resource tloimarine:remark ?remarks.
}

```

Queries that can be expressed using MarineTLO ver4 but they are not tested as we do not have real data.

Q1	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?fish_act_capture WHERE { ?species tloimarine:LX_has_been_caught ?fish_act_capture. ?fish_act_capture tloCore:LC47_took_place_at "givenArea" . ?fish_act_capture tloCore:LC5_has_time_span "givenYear" . } </pre>
Q2	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?species ?fish_act_capture ?equipmentType WHERE { ?species tloimarine:LX_has_been_caught ?fish_act_capture. ?fish_act_capture tloCore:LC47_took_place_at "givenArea" . ?fish_act_capture tloimarine:LX_used_object_of_type ?equipmentType. } </pre>
Q3	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> SELECT DISTINCT ?fish_act_capture ?bioticElemType WHERE { ?species tloimarine:LX_has_been_caught ?fish_act_capture . ?fish_act_capture rdf:type tloCore:BC61_Capture_Activity . ?fish_act_capture tloimarine:LX_caught ?w . ?w rdf:type ?bioticElemType } </pre>
Q4	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> SELECT DISTINCT ?fish_act_capture ?bioticElemType ?disc_reason WHERE { ?fish_act_capture rdf:type tloCore:BC61_Capture_Activity . ?fish_act_capture tloimarine:LX_caught ?w . ?w rdf:type ?bioticElemType . ?w tloimarine:LX_is_discarded_by ?disc_reason } </pre>
Q5	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?species ?value ?unit WHERE { ?z rdf:type tloCore:BC44_Attribute_Assignment . ?z tloCore:LX6_assigned_attribute_to_type ?species . ?z tloCore:LC9_assigned ?stat_ind . ?stat_ind rdf:type tloCore:BC62_Statistic_Indicator . ?stat_ind tloCore:LC19_has_dimension tloimarine:global_statistic_landing . tloimarine:global_statistic_landing tloCore:LC20_has_value ?value . tloimarine:global_statistic_landing tloCore:LC21_has_unit ?unit } </pre>
Q6	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?stat_ind ?input ?method ?output WHERE { ?stat_ind rdf:type tloCore:BC62_Statistic_Indicator . ?stat_ind tloCore:LC37_was_measured_by ?meas_event . ?meas_event rdf:type tloCore:BC56_Digital_Measurement_Event . ?meas_event tloimarine:LC31_used_software ?method . ?meas_event tloCore:LC29_had_output ?output . } </pre>

	<pre> ?meas_event tloCore:LC30_had_input ?input } </pre>
Q7	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> prefix tloimarine: <http://www.ics.forth.gr/isl/ontology/iMarineTLO/> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?person WHERE { ?stat_ind rdf:type tloCore:BC62_Statistic_Indicator . ?stat_ind tloCore:LC37_was_measured_by ?meas_event . ?meas_event rdf:type tloCore:BC56_Digital_Measurement_Event . ?meas_event tloCore:LC31_used_software ?software . ?software tloimarine:LC_right_held_by ?person. } </pre>
Q8	<pre> define input:inference 'http://www.ics.forth.gr/isl/Schema' define input:same-as 'yes' prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> prefix tloCore: <http://www.ics.forth.gr/isl/ontology/MarineTLO/> SELECT DISTINCT ?software ?server WHERE { ?stat_ind rdf:type tloCore:BC62_Statistic_Indicator . ?stat_ind tloCore:LC37_was_measured_by ?meas_event . ?meas_event rdf:type tloCore:BC56_Digital_Measurement_Event . ?meas_event tloCore:LC31_used_software ?software . ?meas_event tloCore:LC32_happened_on_device ?server . } </pre>